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The Labor Market Return in Earnings to Community College Credits and Credentials in California

by

Peter Riley Bahr*
Center for the Study of Higher and Postsecondary Education
University of Michigan

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*Please contact the author for the latest revision of this paper. Correspondence may be directed to the author at the Center for the Study of Higher and Postsecondary Education, University of Michigan, School of Education, Room 2108, 610 E. University Avenue, Ann Arbor, MI 48109-1259; phone: (734) 647-1652; fax: (734) 764-2510; email: prbahr@umich.edu. The author gratefully acknowledges feedback on this work from a number of colleagues, including Christopher Baldwin, Kathy Booth, Ryan Fuller, Brian Jacob, Brian McCall, Jeff Strohl, Jessa Lewis Valentine, and Alice van Ommeren.

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ABSTRACT

In this study, I draw on data from California to estimate the labor market return in earnings to a community college education, including the returns to credentials in 23 fields of study and the returns to course credits in 181 subfields. I find that the return to credits in many career and technical education (CTE) subfields is significant, positive, and oftentimes strong, while the reverse is true of credits in many non-CTE subfields. Furthermore, I find that much of the return to community college credentials is a result of the underlying coursework completed by students, as opposed to the credential itself. Thus, the return to students who are not awarded credentials can be as large as, or larger than, the return to students who are awarded credentials, depending upon the coursework that students complete. Given that the majority of community college students do not complete a postsecondary credential, the results of this study demonstrate the importance of accounting for the human capital acquired by "non-completing" students as we seek a thorough understanding of the economic benefits of a community college education. This finding may be contrasted with contemporary discourse on community colleges, which, framed by the "college completion agenda", focuses primarily on the value of credentials and minimizes the value of non-completing pathways. Moreover, the results provide sound reasons to question the assumption that community college students who do not complete a credential or transfer to a four-year institution must have "dropped out" of college, insofar as many non-completing pathways in many CTE subfields appear to be a rational means of securing meaningful labor market gains.

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BACKGROUND

The Completion Agenda

Without question, the "college completion agenda" is the dominant reformist paradigm through which community colleges in the U.S. are viewed today (e.g., McPhail, 2011; National Center for Education Statistics, 2011). Founded on the assumption that the optimal expression of college completion for most, if not all, students is the receipt of a postsecondary credential, the college completion agenda is focused on substantially increasing the rate at which U.S. citizens complete postsecondary credentials (Lumina Foundation, 2012), particularly segments of the citizenry that historically have been underrepresented in higher education (Lumina Foundation, 2013). Following from this focus and the underlying premise, the relatively low rate of credential attainment among community college students, which is a little more than half that of students who begin at public four-year institutions (Radford, Berkner, Wheeless & Sheherd, 2010), is characterized as symptomatic of the need for major reforms in these institutions.

The completion agenda has been expressed in a variety of forms and arenas, perhaps most notably in President Obama's 2009 address before a joint session of the U.S. Congress, which called for the U.S., by the year 2020, to once again take the international lead in the proportion of citizens who hold college degrees (Kanter, 2011; White House, 2009). Prior to this address, however, several major foundations, including the Bill & Melinda Gates Foundation and the Lumina Foundation, had set national goals and associated funding priorities concerning substantial increases in the number of U.S. citizens who complete postsecondary credentials (Russell, 2011). Subsequent to the President's address, a number of national organizations, such as the American Association of Community Colleges and the National Governors Association, issued calls to action concerning increasing college graduation rates among their constituencies (McPhail, 2011; National Governors Association, 2010).

More recently, in the face of dire financial circumstances for community colleges and excess demand for access to these institutions, the completion agenda has begun to be expressed in state policies that curtail access to the community college among individuals who are pursuing goals that do not terminate in a credential (either a two- or four-year credential) or one of a small selection of other objectives deemed by the state to be high priorities, as were implemented in California (Bahr, Gross, Slay & Christensen, 2014) and advocated in Nevada (Nevada System of Higher Education, 2011). To the extent that states have continuing need to make difficult choices about funding priorities as it pertains to community colleges, it seems likely that student success will be an overriding concern, albeit narrowly defined in terms of graduation and a few other educational outcomes.

Institutional Accountability

The completion agenda paradigm is inextricably linked to, and reinforced by, two other threads of ideas. The first revolves around longstanding policy efforts to develop and implement widely accepted standards of institutional accountability, especially expressions of accountability that link institutional performance to funding (Walters, 2012). These efforts have focused largely on institutions' responsibilities with respect to student success as opposed to student enrollment or other facets of institutional functioning (Dougherty & Hong, 2006).

The central challenge of these efforts is identifying measures that capture the full range of activities of community colleges, including preparing students to transfer to four-year institutions, workforce development, and community education (Bahr, 2013). In the face of this challenge, policymakers often have defaulted to readily measureable outcomes that capture only a portion of the community college mission, of which the most common measure is graduation rate (Bautsch & Williams, 2010; Dowd & Tong, 2007). Not surprisingly, then, anecdotal evidence suggests that community colleges that are grappling with the challenges of excess demand, declining resources, and increasing scrutiny of their graduation rates are electing to reduce or eliminate programs of study in part based on program-specific rates of credential completion (e.g., Puente, 2013; Grubb, 2002a). Such cuts tend to fall disproportionately on career and technical education programs (Bohn, Reyes & Johnson, 2013), which typically have lower rates of graduation than do liberal arts programs (Jenkins & Cho, 2012).

Of course, efforts to develop frameworks for institutional accountability are not the original source of attention to community college graduation rates. A wide range of stakeholders have been concerned with graduation rates for some time, perhaps best exemplified in the "Student Right-to-Know Act" of 1990 (Public Law 101-542), which required postsecondary institutions that receive Title IV funds (federal student financial aid) to disclose their graduation rates. However, the direct linkage between institutional performance and institutional funding evident in many accountability frameworks has increased the consequences to institutions of being judged "low performers" on one-dimensional metrics like graduation rate (Bahr, 2013).

Labor Market Returns

Against this paradigmatic and policy backdrop, a third reinforcing thread has developed in the past several years. Specifically, education researchers increasingly have focused their attention on measuring the labor market returns to the various types of postsecondary credentials offered by community colleges (e.g., Dadgar & Weiss, 2012; de Alva & Schneider, 2013; Jepsen, Troske & Coomes, 2009), such as associate degrees and certificates. Under the completion agenda paradigm, this attention makes sense: if the chief goal of community colleges is providing educational pathways that lead to postsecondary credentials, then certainly the labor market value of those credentials is an important matter to investigate.

In some respects, though, the narrow focus of researchers on the labor market returns to credentials *alone* reinforces the arguably inaccurate perspective that the only worthwhile outcome for community college students is a postsecondary credential. In fact, two decades ago, Kane and Rouse's (1995) foundational study of the returns to a community college education demonstrated that the return in annual earnings to an associate's degree did not differ significantly from the return to an equivalent number of course credits without an associate's degree. Drawing on this finding, the authors argued that, "studies that focus solely on the returns to an associate's degree present an incomplete picture of the returns to a community college education" (p. 602). Although the growth since that time in the number of certificates awarded by community colleges (Bailey & Belfield, 2011; Bosworth, 2010; Carnevale, Rose & Hanson, n.d.) might lead one to substitute the phrase "community college credential" for "associate's degree," nevertheless Kane and Rouse's claim is clear: a community college education takes many economically beneficial forms, and only some of these forms result in a postsecondary credential.

Work by Grubb (1995), conducted around the same time, verified Kane and Rouse's findings and extended this line of inquiry, demonstrating a significant return in hourly wages and annual earnings to vocational course credits for male community college students who did not complete a postsecondary credential, and a significant return to academic course credits for female community college students who did not complete a postsecondary credential. Likewise, Leigh and Gill (1997) found that community college students who did not complete a credential experienced a significant return in wages and earnings. Ten years later, Marcotte, Bailey, Borkoski, and Keinzl (2005) provided further evidence to support Kane and Rouse's claim in their finding of a significant return to years of community college education among students who did not earn a certificate or associate's degree. Even stronger evidence was provided by Jacobson, LaLonde, and Sullivan's (2005) finding among displaced workers of a sizeable, positive return to completed credits in a broad category of community college coursework that included health fields, technically-oriented vocational fields, and academic math and science fields. In sum, the evidence indicates that even students who do not complete postsecondary credentials typically experience a positive labor market return to their community college education (Kane & Rouse, 1999), though how this return varies across the diverse terrain of the curriculum remains to be determined.

Non-Completing Students

Recent work has begun to shed light on the large fraction of students in community colleges who do not complete credentials or transfer to a four-year institution — the so-called "non-completing" students (Bahr, 2010, 2011; Bahr & Booth, 2012; Crosta, 2013). Most notably, Bahr's (2010) analysis of students' course-taking patterns indicated that a large segment (almost one-third) of first-time students in community colleges enroll in just a few courses over a short period of time, succeed in these courses at an exceptionally high rate, and then depart from the institution, typically without completing a postsecondary credential or transferring to a four-year institution. Bahr initially labeled these students *drop-ins* (Bahr 2010, 2011) but subsequently renamed them *skills-builders* (Bahr & Booth, 2012) when further analyses demonstrated that students in this category tend to concentrate their course-taking in a fairly narrow range of fields and, from one semester to the next, to continue in coursework in the same field of study in which they began (Booth & Bahr, 2013). In other words, skills-builder students, the majority of whom enroll in coursework in CTE fields (Booth & Bahr, 2013), appear to be strategic about their course-taking, pursuing seemingly coherent non-completing pathways through the community college. Hence, in contradiction to the premise of the college completion paradigm, community college students who do not complete credentials are not necessarily "drop outs" or students who failed to achieve their goals (Leigh & Gill, 1997).

Yet, despite the evidence of coherent non-completing pathways in community colleges, most of the recent research efforts to quantify the labor market returns to a community college education (e.g., Dadgar & Weiss, 2012, Jepsen, et al., 2009), which are among the most methodologically sophisticated to date, have focused almost exclusively on the returns to credentials, measuring the labor market value of these credentials against the unquantified value acquired by community college students who did not complete a credential, who are presumed incorrectly to be a relatively homogenous group (Grubb, 2002b). In other words, students who completed "some community college" were the ambiguous comparison group against which the returns to a given community college credential were assessed, much as "some college" often is treated as an intrinsically meaningful category of educational attainment in reports of various levels of educational attainment both above and below that offered by community colleges (e.g., Baum, Ma & Payea, 2013). Had the nature and labor market value of "some community college" been quantified in these recent studies, we would be moving in the direction of a complete picture of the returns to a community college education. Absent this quantification, however, one is left to assume that the value of a community college education that does not result in a credential is inconsequentially small. In turn, this assumption further reinforces the premise of the completion agenda that the only worthwhile outcome of a community college education is a postsecondary credential.

As a result of the treatment of non-completing students as a homogenous comparison group in recent studies, we still have only the barest information about the labor market returns to educational pathways in community colleges that do not result in a credential (Grubb, 2002b). Older studies that offered accounts of non-completing community college students tended to consolidate course credits into an undifferentiated mass (e.g., Kane & Rouse, 1995) — an approach that has continued in some of the most recent work (e.g., Belfield, Liu & Trimble, 2014) — or into broad categories of limited utility (e.g., Grubb, 1995). For example, Jacobson, et al. (2005) collapsed students' credits into just two categories, the first of which included math, science, health, and technical trades and professions, while the second included all other subjects. Likewise, studies that have demonstrated returns to years of community college education (e.g., Marcotte, et al., 2005) are comparable for the most part to studies that consolidated credits into an undifferentiated mass. Yet, it is clear that students complete coursework in specific fields and subfields, and one would expect that the return to course credits would vary greatly by the field or subfield in which they are completed, just as does the return to credentials (e.g., Belfield, et al., 2014; Dadgar & Weiss, 2012). Hence, a comprehensive understanding of the returns to a community college education requires the same careful attention to the coursework completed by students that has been applied in recent studies to the credentials awarded to students.

This Study

In this study, I seek to extend recent work on the returns to a community college education (e.g., Booth & Bahr, 2013; Dadgar & Weiss, 2012, Jepsen, et al., 2009), using a comparable student-level fixed effects method and panel data from California to analyze the return in earnings to the course credits completed by students independent of the return to the credentials awarded to students. In doing so, I draw on two key theoretical concepts, namely human capital and the signaling value of credentials (Weiss, 1995). Human capital theory argues that education and training are investments in workers that result in greater productivity and, hence, greater earnings. That is, education and training are investments in human capital. Here, I operationalize the accumulation of human capital in terms of completed course credits in each of 181 potential subfields of study. For a discussion of the rationale for using course credits as a proxy for human capital accumulation, see Garriga and Keightley (2007).

The theory of the signaling value of credentials draws our attention to the fact that a portion of the labor market return to postsecondary credentials is independent of the accumulated human capital that these credentials represent (Weiss, 1995). This is a result of information asymmetry in the relationship between employer and prospective employee: prospective employees know more about their own skills and potential productivity than do employers. Given this asymmetry, a prospective employee's postsecondary credential can serve as a signal to employers about his/her likely productivity, reducing an employer's risk in the hiring decision. For the same reason, employers may set minimum educational thresholds for certain jobs, screening prospective employees on whether or not they possess a postsecondary credential. Though not unequivocal, evidence generally supports this perspective, indicating that postsecondary credentials have a labor market return that, on average, is somewhat greater than an equivalent number of years of education without a credential (e.g., Arkes, 1999; Grubb, 2002b; Jaeger & Page, 1996). Consequently, I do not expect that an analytical account of all credits completed by students will explain *fully* the return that these students receive from any awarded credentials.

Drawing on these two concepts, I seek to answer the following three questions:

1. How do the labor market returns to community college credentials in California differ from those observed in Dadgar and Weiss's (2012) recent study in Washington when, consistent with their study and with other recent studies, no distinction is made between human capital accumulation and the signaling value of credentials?
2. To what extent can the labor market returns to community college credentials be accounted for by human capital accumulation, as measured by completed course credits in the numerous subfields of study offered in the California Community College (CCC) system?
3. How do the labor market returns to course credits, independent of the returns to awarded credentials, vary across subfields of study in the CCC system?

Underlying these questions is my supposition that, if the labor market returns to community college credentials are primarily a result of the human capital acquired in coursework, then the returns that students experience should correspond to the coursework that they complete. Consequently, the returns to students who do *not* complete credentials could rival or exceed that of students who complete credentials, depending on their particular course-taking pathways.

DATA AND METHODS

Data

The data for this study were drawn from three sources. The first is the system database maintained by the Chancellor's Office of California Community Colleges, which addresses all students who enrolled in the CCC system from the early-1990s to nearly present day. These data include detailed transcripts, demographics, the award of credentials, application for and receipt of financial aid, receipt of advising services, participation in various special programs, and the like. In addition, I drew on two other sources of data that were made available by the Chancellor's Office: [1] data that address enrollment by CCC students in postsecondary institutions outside of the CCC system, which were derived from matches with the enrollments records of the California State University (CSU) system, the University of California (UC) system, and the National Student Clearinghouse (NSC; Dynarski, Hemelt & Hyman, 2013; Schoenecker & Reeves, 2008), and [2] quarterly unemployment insurance (UI) earnings data (Aspen Institution, 2013; Feldbaum & Harmon, 2012) collected by the California Employment Development Department (EDD).

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 2006 (a period of four years).[1] The course-taking behavior and academic outcomes of each of these students were observed across the CCC system (i.e., regardless of transfer between institutions within the system; Bahr, 2009, 2012) through the Fall term of 2012. Enrollments in postsecondary institutions outside the CCC system were observed from six years prior to entry to the CCC system through December of 2012. Quarterly earnings were observed from 10 quarters prior to entering the CCC system through the fourth quarter of 2012.

As operationalized here, a *first-time student* is one who had not previously enrolled in the CCC system, was not dual-enrolled in high school and college at entry to the CCC system, did not transfer college credits into the CCC system at entry, did not report having achieved a college degree prior to entry, and did not appear on the enrollment records of any postsecondary institutions in the six years prior to entering the CCC system. Using this definition, a total of 1,222,256 first-time students who reported valid social security numbers entered the semester-

[1] In the Fall 2002, the CCC system included 105 semester-system community colleges and three quarter-system community colleges. By Summer 2006, there were 107 semester-system colleges and three quarter-system colleges.

based colleges of the CCC system in the specified terms, which represents approximately two-thirds (64%) 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 these analyses, the sample was restricted to the 86% of these first-time students who were between the ages of 18 and 50 years at college entry. I then further restricted the sample to the 72% 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.[2] The final analytical sample included 759,489 students, or approximately three-fifths (62%) of the larger body of first-time students. Distributions of selected characteristics of both this sample and the larger body of first-time students are provided in Table 1.

[insert Table 1 about here]

Structure

The data for this analysis were assembled in a *person-period* structure, which includes multiple records for each student, each of which addresses a specific period of time. In this case, the unit of time is an annual quarter. Assembling the data in this manner required that I reconcile information recorded in semester units of time with the desired quarter units of time. In that regard, I focused on when a 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.

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[2] Dropping from the analysis 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 enrollment in the CCC system resulted in a modestly disproportionate loss of the youngest and oldest students. For example, at the extreme ends of the age continuum, 30% of 18-year-olds were dropped, as were 32% of 50-year-olds. In contrast, 25% of students between the ages of 19 and 24 years were dropped.

To illustrate, earnings were observed beginning 10 quarters prior to entry to the CCC system, as noted earlier. Determining when the 10 pre-college quarters began required that I translate a student's first semester of enrollment into an annual quarter. The students of interest in this study entered college from Fall 2002 through Summer 2006, which I translated into 2002Q4 and 2006Q3, respectively. Therefore, the first quarter in which earnings were observed fell between 2000Q2 and 2004Q1, depending on when a student entered the CCC system. Given that the last quarter in which earnings were observed was 2012Q4, the total length of time in which earnings were observed in this study was between 36 and 51 quarters, again depending on when a student entered the CCC system.

There were five exceptions to this approach to reconciling academic terms with annual quarters. These exceptions addressed: (1) the number of course credits attempted by a student in the CCC system in a given quarter, (2) the amount of grant and scholarship aid received by a student in the CCC system in a given quarter, (3) the amount of loan received by a student in the CCC system in a given quarter, (4) whether a student was enrolled in a four-year institution in a given quarter, and (5) whether a student was enrolled in a less-than-four-year institution other than a college in the CCC system in a given quarter. I discuss the reconciliation of these term-based variables with quarter units of time in the section on variable operationalization.

Method of Analysis

I employed an individual fixed effects linear regression model with robust (clustered) standard errors to analyze these data.[3] I confined the analysis to quarters in which students had non-zero, non-missing earnings. This is an important point because incorporating into the analysis records of zero earnings and missing records (which often indicate zero earnings but

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[3] The model was estimated with Stata's *xtreg, fe vce(cluster)* command, clustering on a unique student identifier.

also can be indicative of earnings from an employment sector that is not covered by UI data collection, which I discuss later) confounds earnings with employment: two distinct outcomes, though clearly related to one another. Because the analytical goal here was to understand the relationship between course credits and credentials and subsequent employment earnings, it was necessary to drop from the analysis all quarters in which students received zero earnings or had no record of earnings.

Confining the analysis in this manner did not change the number of students who were included in the analytical sample (N = 759,489) because students who had no earnings records already had been excluded, as mentioned earlier. However, it reduced the number of student-quarters (person-periods) included in the analysis by 34%, from 33,660,590 to 22,215,020. On average, the analysis included 29.2 quarterly earnings records per student.

The preferred statistical model in this study (Equation 1) was specified in a manner that is similar, though not identical, to that used in several recent studies of community college students' earnings (e.g., Dadgar & Weiss, 2012; Jepsen, et al., 2009). The dependent variable in this model, represented by $\ln(Earnings_{it})$, is the inflation-adjusted natural log of quarterly earnings for individual i in quarter t, conditional on being employed in quarter t.[4]

Equation 1: Preferred fixed effects regression model of earnings on selected variables

$$\ln(Earnings_{it}) = \alpha + \beta_k(CumulativeCredits_{ik(t-1)}) + \gamma_k(CumulativeCredits_{ik(t-1)}^2) + \delta_j(CreditAward_{ij(t-1)}) + \zeta_j(ShortCert_{ij(t-1)}) + \eta_j(LongCert_{ij(t-1)}) + \theta_j(AssocDeg_{ij(t-1)}) + \lambda(CreditLoad_{it}) + \mu(CreditLoad_{it}^2) + \nu(EnrollFourYear_{it}) + \xi(EnrollOther_{it}) + o(GrantAid_{it}) + \pi(LoanAid_{it}) + \varsigma(Time_{it}^m) + \upsilon(TransferFourYear_i * Time_{it}^m) + \varphi(StudentCharacteristics_i * Time_{it}^m) + \psi(FirstQuarter_i * Time_{it}^m) + \rho_i + \varepsilon_{it}$$

[4] Earnings were adjusted for inflation using the CPI-U (as reported by the Bureau of Labor Statistics) and set to 2011Q4-equivalent dollars.

As noted earlier, there are two theoretical constructs of primary interest in this study, namely human capital accumulation and the signaling value of credentials. Human capital accumulation is represented in Equation 1 by $CumulativeCredits_{ik(t\text{-}1)}$, which addresses the cumulative number of course credits completed by individual *i* in each of *k* subfields of study described in the CCC Taxonomy of Programs (TOP; Chancellor's Office, 2009) as of the end of the prior quarter ($t - 1$) in any of the semester-based colleges of the CCC system.[5] Both the identity and the square of cumulative completed credits in each of the subfields were included in the model to accommodate the possibility of nonlinear relationships between credits and earnings (e.g., diminishing returns to credits), as found by Jacobson, et al. (2005) and Belfield, et al. (2014). Note that, for a student who never completed credits in a given subfield, the variables representing that subfield were assigned a value of zero in all quarters. Note also that treating completed credits as a leading indicator of earnings invokes the assumption that a change in a student's cumulative number of credits in a given subfield affects the student's earnings in the subsequent quarter, rather than the current quarter in which the credits were completed.

The signaling value of credentials is represented by $CreditAward_{ij(t\text{-}1)}$, $ShortCert_{ij(t\text{-}1)}$, $LongCert_{ij(t\text{-}1)}$, and $AssocDeg_{ij(t\text{-}1)}$, which address the award of various levels of credentials, including low-credit awards (< 6 credits), short-term certificates (6 to 29 credits), long-term certificates (> 29 credits), and associate degrees, to individual *i* in each of *j* fields of study described in the TOP as of the end of the prior quarter ($t - 1$) by any of the semester-based colleges of the CCC system. These variables were treated as dichotomous and were assigned a

[5] The Taxonomy of Programs (Chancellor's Office, 2009) 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 numerical coding scheme draws on a six-digit number in which the first two digits capture 23 broad fields, the second two digits capture a widely varying number of subfields within each field, and the last two digits capture a branch of a subfield when a finer level of granularity is necessary. My primary focus in this analysis is fields and subfields.

value of zero in all quarters prior to the quarter of first receipt of the credential, and then assigned a value of one thereafter. For students who never received a credential of a particular level in a given field, the variable representing that combination of level and field always was coded with a value of zero. Like cumulative credits, treating credential receipt as a leading indicator of earnings assumes that the award of a credential affects a student's earnings in the subsequent quarter, rather than the current quarter in which the award was received.

As a point of clarification, the value in distinguishing between short- and long-term certificates lies primarily in the fact that the distributions of subfields of study often (but not always) differ between the two. For example, in the field of education, 53% of the *short-term* certificates that were awarded to students in the CCC system between Fall 2002 and Fall 2012 were in the subfield of physical education, while 14% were in the subfield of sign language. In contrast, only 9% of the *long-term* certificates in the field of education were in the subfield of physical education, while 67% were in sign language. Hence, short- and long-term certificates in the same field often are markedly different credentials, over and above the difference in the number of course credits that they require.

To account for variation in the opportunity cost of attending college at differing levels of intensity, I included a control for the number of course credits attempted in the CCC system by individual i in quarter t. Both the identity ($CreditLoad_{it}$) and the square ($CreditLoad_{it}^2$) were included to accommodate a nonlinear relationship between intensity of college attendance in a given quarter and earnings in that quarter. In addition, I included separate dichotomous indicators of enrollment in the present quarter in a four-year postsecondary institution ($EnrollFourYear_{it}$) and a less-than-four-year postsecondary institution other than a college in the CCC system ($EnrollOther_{it}$).

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 all grants and scholarships received ($GrantAid_{it}$), as well as the total dollar value of all loans received ($LoanAid_{it}$), by individual *i* in quarter *t* while enrolled in the CCC system. Information about financial aid while enrolled in postsecondary institutions outside of the CCC system was not available.

Equation 1 includes a series of variables to represent time ($Time_{it}^{m}$) in order to capture the underlying trend in earnings. The identity ($Time_{it}^{1}$) is a naturally ordered enumeration of quarters from 10 quarters prior to college entry through the fourth quarter of 2012.[6] I also included the square ($Time_{it}^{2}$) and the cube ($Time_{it}^{3}$) to accommodate multiple points of inflection in the relationship between time and earnings.[7] Each of these variables — identity, square, and cube — was interacted with selected time-invariant student characteristics ($StudentCharacteristics_{i}$, including sex, race/ethnicity, age at college entry, citizenship status, and academic goal at college entry), a dummy variable indicating whether a student ever transferred to a four-year institution ($TransferFourYear_{i}$), and the absolute (not relative) quarter in which a student first entered the CCC system ($FirstQuarter_{i}$). In effect, these interactions allow for a different earnings trend for each demographic group, for students who reported each of the possible goals, for students who were in a position to earn a baccalaureate degree by virtue of transferring to a four-year institution, and for each quarter of college entry.

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[6] For example, for any given student, the quarter that fell 10 quarters prior to the student's entry to the CCC system was assigned a value one, the quarter that fell nine quarters prior to the student's entry was assigned a value of two, etc.

[7] I tested a model that included the fourth power of the time variable as well ($Time_{it}^{4}$), in addition to the identity, square, and cube, but the differences between the models were minimal. As a result, I selected the more parsimonious model specification.

The individual fixed effects nature of the model implies a statistical control (ρ_i) for every individual in the analytical sample, though the implementation of the model involved "demeaning" (differencing) the included variables rather than adding a dummy variable for each individual. This statistical control captures unobserved, time-invariant differences between individuals that potentially are correlated with course-taking behavior, credential awards, and earnings. The result is more accurate estimates of the measured relationships between the independent variables and earnings, owing to reduced omitted variable bias. Finally, α is the intercept, and ε_{it} represents the error term for individual i in quarter t.

Variable Operationalization

As discussed previously, one set of independent variables in this analysis addressed the cumulative number of credits completed by students in each subfield of study delineated in the TOP. However, participation in some subfields was too low to produce estimates of labor market returns to credits that would warrant confidence. To address this issue, subfields in which fewer than 1,000 credits were completed by the analytical sample generally were collapsed into a preexisting "miscellaneous" subfield within the same field.[8] In a small number of cases, the miscellaneous subfield itself had low participation, sometimes even after collapsing other low-participation subfields into it. In all but one of these cases, the low-participation

[8] To illustrate, in the field of foreign languages, student participation was low in the subfields of Latin, Greek, Hebrew, African Languages, and Portuguese. Completed credits in these subfields were collapsed into the "other foreign languages" subfield, which addresses courses offered by the colleges in specific languages other than 14 languages denoted in the TOP.

miscellaneous subfields were collapsed into the broadest subfield within the same field.[9]

Collapsing low-participation subfields in the manner described here reduced the number of subfields considered in this analysis from 219 to 181 and resulted in 13,687 credits (0.06% of the 21,834,535 credits completed by the students in the sample) being reassigned from the narrow subfield in which they actually were taken into a broader subfield. Importantly, however, this smaller set of 181 subfields still accounted for all credits completed by students during their time in the CCC system, though the subfield in which each credit was completed was measured with slightly less precision than it would have been if all 219 subfields had been used. In Table 2, I present the number of credits completed by the sample in each of the 181 subfields and the corresponding percentage of all completed credits that is represented by each subfield.

[insert Table 2 about here]

A similar problem arose with credentials insofar as some of the 23 fields of study had too few credentials of a given level to produce reliable estimates of the labor market returns to that level of credential in that field (see Table 3). This problem has been noted by other researchers as well (e.g., Dadgar & Weiss, 2012) and, in this study, was particularly common for low-credit awards (< 6 credits), which were concentrated in a select number of fields. To address this issue, credentials of a given level and field that were awarded to fewer than 20 students during the observation period were collapsed into an "other fields" category for that level of credential.

[insert Table 3 about here]

[9] One example is the field of law, which includes three subfields: general law, paralegal, and other law, the last of which is the miscellaneous subfield. In this case, "other law" did not have sufficient student participation to stand alone in the analysis. Consequently, credits in "other law" were collapsed into the "general law" subfield. The one exception to this approach is the miscellaneous subfield of the public & protective services field ("other public & protective services"). The public & protective services field does not have a general subfield into which this low-participation, miscellaneous subfield could be collapsed. Thus, "other public & protective services" was retained in the analysis despite low student participation.

In my discussion of findings regarding the labor market returns to course credits and credentials, I frequently distinguish between fields and subfields that are primarily oriented toward CTE and those that are not (Bailey & Belfield, 2011). The CTE orientation of *subfields* is indicated in the TOP, but the CTE orientation of *fields* is not. Although one might expect that the distinction between CTE and non-CTE fields would be intuitively obvious, the devil is in the details: most fields of study include a mix of CTE-oriented and non-CTE-oriented subfields and branches of subfields. To categorize fields in terms of CTE orientation, I examined all of the credentials awarded in the CCC system from Fall 2002 through Fall 2012 and calculated the percentage of awards (without regard to the level of the award) within each field that were in CTE subfields or CTE branches of non-CTE subfields, as denoted in the TOP. Fields in which at least half of the awards were in CTE subfields or branches were deemed CTE-oriented fields. In most cases, this criterion illuminated a clear distinction that was consistent with intuition. However, there were two marginal cases, specifically the fields of education and fine & applied arts in which awards in non-CTE subfields or branches accounted for just 51% and 53%, respectively, of all awards in those fields.

As mentioned earlier, five independent variables required special consideration in translating units of time from academic terms to annual quarters. Three of these were the intensity of enrollment in the CCC system, the amount of grant and scholarship aid received in a given semester in the CCC system, and the amount of loan aid received in a given semester in the CCC system. 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% 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% of the credits attempted in the Fall semester. Attempted credits in the second quarter were set equal to 75% of the credits attempted in the Spring semester plus 25% of the credits attempted in the Summer semester. Attempted credits in the third quarter were set equal to 75% of the credits attempted in the Summer semester plus 25% of the credits attempted in the Fall semester. The amount of grant and scholarship aid and the amount of loan aid received were translated using this same method of proportional allocation. Though this operationalization strategy does not match perfectly 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 two variables concerned the opportunity costs of enrolling in postsecondary institutions outside of the CCC system, which I describe as "external institutions". The measures that I constructed to address enrollment in external institutions were based on data that include the date of the reported enrollment in the external institution, the name of the institution, the state in which the institution is located, whether the institution is a four-year institution or not, and a variety of other information. However, the data did not include information about the intensity of enrollment or when a given external institution's term ended.

To construct the requisite variables, one might simply convert the dates of enrollment into quarters, creating a time-variant dichotomous indicator of enrollment in external institutions. 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 often would indicate enrollment into or through the month May, 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 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 spanning two quarters except enrollment dates in October, November, and December, which were treated as occurring in the fourth quarter only. For example, a January date of enrollment in a given year was presumed to indicate enrollment in the external institution in the first *and* second quarters of that year, while an August enrollment date was presumed to indicate enrollment in the third *and* fourth quarters. Furthermore, 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. Each of these dummy variables was assigned a value of one when a student was enrolled in an external institution of a given type and a value of zero otherwise.

The remaining variables that were included in the analysis were sex, race/ethnicity, age at college entry, citizenship status, academic goal at college entry, whether or not a student ever transferred to a four-year institution, and the quarter in which a student first entered the CCC system, all of which were time-invariant and, therefore, did not require translation to quarter units of time. Each of these variables was interacted with the three variables that represent time, but main effects were not included in the model because the main effects are time-invariant and, consequently, already accounted for by the individual fixed effects. Sex and citizenship were coded as 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. Academic goal at college entry included five 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), other goal, and "not reported".[10] Finally, the quarter of college entry included 12 values: 2002Q4, 2003Q2, 2003Q3, 2003Q4, 2004Q2, 2004Q3, 2004Q4, 2005Q2, 2005Q3, 2005Q4, 2006Q2, and 2006Q3.

Distinctions from Prior Work

There are a number of distinctions to note between the analysis implemented here and that of the most recent prior work on the labor market returns to a community college education (e.g., Belfield, et al., 2014; Dadgar & Weiss, 2012; Jacobson, et al., 2005; Jepsen, et al., 2009). The most significant of these is the inclusion in this analysis of 181 variables (plus the square of each of these variables) to capture students' cumulative course credits completed in each subfield of study. Without exception, this is the most comprehensive representation to date of students' course-taking behavior as it pertains to estimating the returns to a community college education. In fact, the relationship between course-taking behavior and earnings largely has been ignored or minimized in recent prior work, and the few studies that have considered course-taking behavior have used unrealistically simple categorizations of completed credits (e.g., Belfield, et al., 2014;

[10] About three-fifths (59%) of the students assigned to the "other goal" category reported being undecided about their goal at college entry, and about one-quarter (27%) reported personal discovery or personal development goals.

Jacobson, et al., 2005).

Second, the level of credentials and the field of study in which credentials were awarded were measured with greater precision in this analysis than in prior work. Specifically, I distinguished between 23 different fields of study in which credentials were awarded, while the most comprehensive prior studies considered 13 fields of study (Belfield, et al., 2014; Dadgar & Weiss, 2012). Moreover, I distinguished between credentials requiring very few credits (< 6 credits) and short-term certificates (6-29 credits), which is not a distinction that was made in prior work (e.g., Belfield, et al., 2014; Dadgar & Weiss, 2012; Jepsen, et al., 2009).

Third, this study employed a larger and more diverse analytical sample than any used in recent prior work. In particular, this study drew on a sample of 759,489 students, which is more than 31 times as many students as addressed by Dadgar and Weiss (2012), more than 20 times as many as addressed by Jepsen, et al. (2009), and nearly 10 times as many as addressed by Belfield, et al. (2014).[11] In excess of three-fifths (62%) of the students in this study's sample were of a non-White racial/ethnic background (see Table 1), compared with about one-quarter in the samples used by Dadgar and Weiss (2012) and Jepsen, et al. (2009), and one-third in the sample used by Belfield, et al. (2014).

Furthermore, most of prior studies placed restrictions on the analytical samples that limited the generalizability of the findings. For example, Dadgar and Weiss (2012) limited their sample to students who reported that they were pursuing transfer to a four-year institution or a

[11] It is difficult to make a direct comparison with the work of Jacobson, et al. (2005) in this regard because their study included approximately 16,000 community college students *and* a comparison group of approximately 81,000 non-students. However, of the recent prior work on the labor market returns to a community college education, their study is the least similar to the study executed here insofar as it focused exclusively on displaced workers, excluded students who transferred to a four-year institution, and did not seek to measure the returns to community college credentials.

terminal credential program, while Jepsen and his colleagues (2009) limited their sample to students who were pursuing a community college credential and who did *not* transfer to a four-year institution during the period of observation. Jacobson, et al. (2005) focused specifically on displaced workers. This study incorporated none of these restrictions, ensuring the broadest possible external validity.

Fourth, students' earnings were observed in this study for 9.00 to 12.75 years, depending upon when a student entered the CCC system, which is as much as 4.50 years longer than the most recent prior studies (e.g., Belfield, et al., 2014; Dadgar and Weiss, 2012; Jacobson, et al., 2005; Jepsen, et al., 2009).[12] This longer period of observation would seem to be especially important for examining labor market returns in the early post-college period, when earnings tend to change rapidly (Grubb, 2002a, 2002b). Additionally, the period of time in which earnings were observed in this study ended in the fourth quarter of 2012, bridging the dramatic economic recession of 2007-2009 (Bureau of Labor Statistics, 2012) and providing a unique view of the returns to a community college education before, during, and after a period of decidedly unfavorable labor market conditions, which can have an exceptionally strong impact on returns to a community college education (Grubb, 2002b). Of the recent studies, only Belfield, et al. (2014) included earnings data in the post-recession period, but their study was markedly different from this one, focusing primarily on "snapshots" of earnings at various points in time after students left college.

Fifth, this study included a more complex representation of the relationship between time

[12] The maximum number of quarters observed in this study was 51. The maximum number of quarters observed in Dadgar and Weiss's (2012) study was 33, while the maximum observed by Jepsen, et al. (2009) and Jacobson, et al. (2005) was 35 and 36 quarters, respectively. The primary focus of the study by Belfield, et al. (2014) was students' earnings nine years (approximately 36 quarters) after initial enrollment.

and earnings than was used in prior work. I included the cube of the time trend, as well as the identity and the square that were used in recent prior studies (Dadgar & Weiss, 2012; Jepsen, et al., 2009), which allowed the model to capture more accurately the evolution of students' earnings over time. Furthermore, the variables that represented time were interacted with a more precisely measured set of student characteristics than were used in prior work, allowing a more thorough partitioning of variation in earnings over time, which is important because time dependence is not captured by the student-level fixed effects. For instance, Dadgar and Weiss's (2012) measure of race/ethnicity was dichotomous, while the measure used here included eight separate categories.

Finally, this study focused on students in California, in contrast to prior research on community college students in Washington (Dadgar & Weiss, 2012; Jacobson, et al., 2005), Kentucky (Jepsen, et al., 2009), and North Carolina (Belfield, et al., 2014). Hence, it adds to the literature an important and very different economic and sociopolitical context in which the returns to a community college education are observed and analyzed.

Limitations

This study also has a number of 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 or subfield of study is associated strongly with employment in one of these sectors, the estimated returns to coursework and credentials in that field or subfield likely are inaccurate.

To illustrate this problem, Hipple (2010) observed that the beauty, construction, and real estate industries, among others, have comparatively high rates of self-employment. Among students in this study's analytical sample, the subfield of cosmetology & barbering accounted for the majority of credits completed (93%) and credentials awarded (88%) in the field of commercial services. The subfield of construction crafts technology accounted for one-quarter (25%) of credits completed and more than one in seven (15%) credentials awarded in the field of engineering & industrial technologies. The subfield of real estate accounted for about one in eleven (9%) credits completed and one in thirty-two (3%) credentials awarded in the field of business & management. Because earnings from self-employment are not observed in the UI data, the returns to credits in these subfields likely are underestimated in this study, and the returns to credentials in the broader fields in which these subfields are located likely are underestimated to the extent that these subfields account for the credentials awarded in their parent fields.

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., knitting together earnings from multiple part-time jobs versus holding one full-time job), or employment-related fringe benefits like employer-funded healthcare or retirement programs, all of which are important aspects of the overall labor market returns to a community college education (Belfield & Bailey, 2011; Grubb, 2002b). 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, and the like (Baum, 2014).

Third, though this study addresses directly the effect on earnings of multiple credentials of different levels in the same field, as well as the effect of multiple credentials of the same level in different fields, 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. In other words, 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 offers no account of how the relationship between earnings and multiple credentials of the same level and field may differ from the relationship between earnings and a single credential of that level and field.

To understand the scope of this limitation, a useful metric is the average number of credentials of a given level and field awarded to students who received at least one credential of that level in that field, which I present in Table 4. One observes here that the award of multiple credentials of the same level and field to a single student was more common for short-term certificates and low-credit awards than it was for associate degrees and long-term certificates. The highest rate is observed with low-credit awards in public & protective services, in which the average number of awards received by students who received at least one such award in that field was 2.29. More specifically, 878 students (see Table 3) were awarded a total of 2,012 low-credit awards in public & protective services.

[insert Table 4 about here]

Fourth, Equation 1 allows a great deal of flexibility in the shape of a student's earnings trajectory, permitting it to vary by sex, citizenship, race/ethnicity, age, academic goal, whether the student transferred to a four-year institution, and the quarter of the student's entry into college. However, the effects on a student's earnings trajectory of completing coursework in a given subfield, or of being awarded a credential of a given level in a given field, are assumed to be constant over time. For example, Equation 1 allows the effect on earnings of an associate's degree in nursing to be of a different magnitude than the effect of an associate's degree in public & protective services, but it does not allow the earnings trajectory of students who received an associate's degree in nursing to take a different shape from that of students who received an associate's degree in public & protective services, except insofar as the shapes of the earnings trajectory of the two groups are adjusted for average differences in sex, citizenship, race/ethnicity, age, academic goal, transfer to a four-year institution, and quarter of entry to the CCC system. Thus, the estimated returns to credits and credentials in this study represent the average returns over time, as opposed to the specific returns at a particular point in time. This limitation, while important, is consistent with recent prior work (e.g., Dadgar & Weiss, 2012, Jepsen, et al., 2009). Further investigation in future research is warranted.

Fifth, unlike much of the prior work on the returns to a community college education (e.g., Belfield, et al., 2014; Dadgar & Weiss, 2012; Jepsen, et al., 2009; Kane & Rouse, 1995; Marcotte, et al., 2005), this study does not differentiate between the returns of men and women except insofar as the model specification accounts for differences by sex in earnings trajectories. This is a less problematic issue than it may appear because the limited evidence to date suggests the much of the sex differential in earnings associated with a community college education is a result of differences in field of study (e.g., Carnevale, Rose & Hanson, n.d.), and field of study is measured more precisely in this analysis than it was in prior work.

Sixth, with respect to the relationship between earnings and completed credits in the various subfields, this study does not differentiate between credits that were earned with a high level of mastery of course content and those earned with a low level of mastery. In particular, a course grade of "D" or above typically results in the award of credits. Clearly, though, credits earned with an "A" or a "B" demonstrate a greater level of mastery of course content than do credits earned with a "C" or a "D". Given the focus of this study on course credits as a proxy for human capital, an interesting approach to addressing this issue in future research would be to multiply credits completed in each course by the numeric rank of the grade achieved in each course, and then sum course grade points in each subfield of study in each term to generate cumulative course grade points (as a substitute for cumulative course credits). This approach may allow one to draw finer distinctions between levels of human capital accumulation in each subfield.

Finally, as with recent prior work (e.g., Belfield, et al., 2014; Dadgar & Weiss, 2012, Jepsen, et al., 2009), the comparison group in this study against which the labor market returns of credits and credentials were measured was composed of community college students, as opposed to students who did not attend college at all. However, the fact that this analysis accounts for credit accumulation in each of 181 subfields of study allows the comparison group to be much more precisely defined as the hypothetical body of students who earned zero credits but who were otherwise comparable to students who completed credits in a given subfield or were awarded a credential in a given field. Later in this paper, I discuss the results of various sensitivity analyses that address how changes in the parameters that define the analytical sample influenced the findings, including one alternative model in which I excluded students who completed zero credits.

FINDINGS

Returns to Credentials Alone

In Table 5, I present estimated coefficients from two naïve models of the return in earnings to a community college education. My preferred model (Equation 1) is presented as Model 3 in Table 6, discussed later in this paper. The first of the naïve models (Model 1) is identical to the preferred model save that (1) it replaces the measures of the receipt of a credential of a given level and field with a simple set of measures that distinguish the level of credentials *but not the field* in which they were awarded, and (2) it excludes the set of variables that represent cumulative completed credits in each subfield. The second naïve model (Model 2) is identical to the preferred model except that it excludes only the set of variables that represent cumulative completed credits in each subfield. Models 1 and 2 are similar to Dadgar and Weiss's (2012) analysis of earnings in Washington insofar as these models offer no account of course-taking and, consequently, do not differentiate between human capital accumulation and the signaling value of credentials. Their analysis is a useful point of comparison because it is the most comprehensive of the recent prior analyses of the returns to a community college education and the most similar to the analysis executed here.[13]

[insert Table 5 about here]

In Model 1, significant and positive earnings gains are observed for all four levels of community college credentials, including associate degrees (7%), long-term certificates (17%), short-term certificates (13%), and low-credit awards (11%). Dadgar and Weiss (2012) estimated

[13] The work by Jepsen, et al. (2009) also is sophisticated and interesting, but it differs from this study and from the study conducted by Dadgar and Weiss (2012) in that Jepsen and his colleagues included in their analysis records of zero earnings. As discussed earlier in this paper, this is a fundamentally important methodological distinction, and the difference in this regard makes it difficult to compare the results for Kentucky presented by Jepsen and his colleagues with the results from California presented in this study and the results from Washington presented by Dadgar and Weiss. Likewise, the main analyses in the study by Belfield, et al. (2014) draw upon a linear regression model with fixed effects at the college-level, as opposed to the student-level, and focus on earnings nine years after initial enrollment, as opposed to the trend in earnings before, during, and after college attendance. These differences again make it difficult to compare their results from North Carolina with the results of other studies.

returns to credentials separately for males and females and found that the average return to an associate degree was 9% for females and 4% for males, the average return to a long-term certificate was 15% for females and 5% for males, and the average return to a short-term certificate was -3% (a net decrease in earnings) for females and zero for males. Thus, the findings of this study differ from those of Dadgar and Weiss in two ways. First, the average return estimated here to each level of credential below the level of an associate's degree is larger than the largest corresponding return observed by Dadgar and Weiss. Second, and more importantly, the returns to credentials that require the fewest number of course credits (short-term certificates and low-credit awards) are stronger than the returns to associate degrees, in contrast to Dadgar and Weiss's findings of no return or a negative return to the credentials that require the fewest credits.

However, despite the public and political appetite for simple claims about the return to a given level of credential (e.g., Baron, 2013), such claims can be misleading. Labor market returns vary substantially by field of study (Belfield & Bailey, 2011; Carnevale, Strohl & Melton, n.d.; Grubb, 2002b; Klor de Alva & Schneider, 2013; Staklis & Skomsvold, 2014), and, as observed in Table 3, the field of study in which credentials are awarded likewise varies substantially across the four levels of credentials. For example, 68% of the students who were awarded a low-credit award received this credential in either the field of health or the field of public & protective services. In contrast, only 13% of the students who were awarded an associate's degree received this credential in one of these two fields. Hence, in Model 2, I replace the simple measures of the level of a credential award with a set of measures that uniquely identify the level of a credential *and* the field of study in which the credential was awarded.

One observes in Model 2 that earnings gains for associate degrees are significant and positive in eight of the thirteen CTE fields, including agriculture & natural resources (16%), business & management (6%), information technology (12%), engineering & industrial technologies (12%), health (106%), family & consumer sciences (3%), law (12%), and public & protective services (11%). Two CTE fields have negative returns to associate degrees, specifically media & communications (-8%) and commercial services (-14%). These findings generally are consistent with Dadgar and Weiss's (2012) findings, which indicated that returns to associate degrees in many CTE fields are significant and positive, though the earnings gains observed here tend to be stronger than those observed by Dadgar and Weiss, possibly due to finer distinctions in this analysis between fields of study.

In contrast, returns to associate degrees in the 10 non-CTE fields either are negative or are not statistically significant. The fields in which negative returns are observed constitute much of the core of liberal arts education, including biological sciences (-10%), fine & applied arts (-10%), foreign languages (-14%), humanities (-5%), physical sciences (-13%), social sciences (-5%), and interdisciplinary studies (-1%). These findings are *inconsistent* with the significant, positive returns to Dadgar and Weiss's (2012) two broad categories of associate degrees in humanities & social sciences and science & mathematics, respectively.

One possible explanation for this discrepancy is that, in addition to accounting for the opportunity cost of enrolling in a four-year or less-than-four-year external postsecondary institution in a given quarter, the model implemented here allowed a different earnings trajectory for students who transferred to a four-year institution relative to those who did not. Dadgar and Weiss's (2012) model accounted for the former but not the latter.

To elaborate, one would expect that students who transfer to a four-year institution would experience a longer lag in any earnings gains associated with their community college education than would other students, but that their earnings would rise more sharply after they complete their four-year education. Presumably, the award of certain community college credentials is associated more strongly with transfer to a four-year institution than is the award of other credentials. For example, an analysis of the data used here indicated that students who completed associate degrees in non-CTE fields experienced a particularly strong likelihood of transferring to a four-year institution (75%), compared with students who completed associate degrees in CTE fields (37%), students who completed two or more associate degrees in both CTE and non-CTE fields (57%), and students who did not complete associate degrees (17%).

In this study, the presumed earnings gains that follow from attending a four-year institution would be captured, at least in part, by the control for the differential earnings trajectory associated with transferring to a four-year institution. In contrast, the absence of such a control in Dadgar and Weiss's study likely resulted in these gains being subsumed into their estimates of the returns to associate degrees. Hence, compared with prior work, the models presented here provide a more accurate picture of the returns to community college credentials, independent of the returns to attending a four-year institution.

However, a test of this supposition (not shown) in which Model 2 was re-estimated *without* the control for the differential earnings trajectory associated with attending a four-year institution did not fully resolve the discrepancy between the findings of this study and the findings of Dadgar and Weiss. Returns to associate degrees in most non-CTE fields remained either negative or statistically insignificant, though the magnitude of each coefficient shrank, and one non-CTE field (interdisciplinary studies) was found to have a small positive return to an associate degree.

Of the eleven CTE fields in which a sufficient numbers of long-term certificates were awarded to estimate the return in earnings, Model 2 indicates that five of these fields have significant and positive returns, including engineering & industrial technologies (11%), health (39%), family & consumer sciences (6%), law (14%), and public & protective services (27%). In contrast, returns to long-term certificates are negative in one CTE field and one non-CTE field, specifically commercial services (-16%) and interdisciplinary studies (-10%). In large part, these findings are at odds with those of Dadgar and Weiss (2012), who found that long-term certificates in most fields other than health and transportation produced no return or, in a few instances (e.g., business & marketing, education & childcare), a negative return.

Like long-term certificates, Model 2 indicates that short-term certificates in a number of fields are associated with significant earnings gains as well, including seven of the twelve CTE fields in which there were a sufficient number of awards to estimate returns. These fields are business & management (9%), information technology (9%), engineering & industrial technologies (11%), health (11%), family & consumer sciences (9%), library science (27%), and public & protective services (32%). A significant and positive return to short-term certificates in the field of biological sciences (34%) also is observed. Negative returns to short-term certificates are observed in one CTE field — commercial services (-6%) — and in three non-CTE fields, namely education (-13%), fine & applied arts (-13%), and interdisciplinary studies (-13%).

Again, these findings differ from those of Dadgar and Weiss, who found that the majority of short-term certificates produced no returns or negative returns, save those in protective services, construction, education & childcare, and transportation. One should note, however, that the fields in which they found positive returns to short-term certificates are similar in some respects to several of the fields in which positive returns are observed in this study. Their protective services, construction, and education & childcare fields parallel to some extent the fields of public & protective services, engineering & industrial technologies, and family & consumer sciences in this analysis.

Finally, though only nine fields had a sufficient number of low-credit awards to estimate returns, eight of which were CTE fields, Model 2 indicates that low-credit awards in three of these fields are associated with earnings gains, including business & management (12%), health (8%), and public & protective services (13%). No field has a negative return to low-credit awards.

Viewed globally, two fields of study, both of which are CTE fields, have significant and positive returns across all levels of credentials: health and public & protective services. A slightly lower level of consistency in earnings gains is observed in five fields, all of which are CTE fields: business & management, information technology, engineering & industrial technologies, family & consumer sciences, and law. Three fields have consistent or fairly consistent negative returns: commercial services (a CTE field), fine & applied arts (a non-CTE field), and interdisciplinary studies (a non-CTE field).

Returns to Course Credits and Credentials

The primary weakness of the analysis presented in Model 2 and the two most recent prior studies of the labor market returns to credentials (Dadgar & Weiss, 2012; Jepsen, et al., 2009) is that the returns to credentials are measured relative to the unquantified returns of attending a community college but not completing a credential. These analyses fold into a single estimate the labor market value of the human capital accumulated in achieving a given credential and the signaling value of that credential. Simultaneously, they ignore the return to the human capital accumulated by students who do *not* complete credentials, except insofar as the average return to "non-completers" serves as an unspecified baseline against which the labor market value of the credential is estimated.

Students who do not complete credentials constitute the majority of community college students (National Center for Education Statistics, 2011; Shapiro, et al., 2013), and the members of this group are far from homogenous with respect to the ways that they use the community college, as exemplified in differing course-taking behaviors and enrollment patterns (Bahr, 2010, 2011; Crosta, 2013). In all probability, the labor market returns to differing patterns of credit accumulation among "non-completers" vary greatly, yet the treatment of this group in Model 2 and in recent prior work imposes an interpretive framework that implies little, if any, return. Hence, a complete understanding of the labor market returns to a community college education requires an account of the returns to course credits in addition to, but independent of, the returns to credentials.

Much like estimates of the returns to credentials that do not distinguish the field in which the credentials were earned, an estimate of the average return to a credit, while satisfying in its simplicity, cannot describe accurately the returns to credits in each of the many fields and subfields in which students take courses (Grubb, 1995). Hence, in Model 3 (Table 6), I provide the estimated returns to cumulative completed credits by *subfield* and credentials by *field* from the preferred model (Equation 1).

[insert Table 6 about here]

Once the identity and square of cumulative completed credits in each subfield are controlled in Model 3, most community college credentials are not associated with a significant change in earnings, and most of those that retain a significant association relative to Model 2 (prior to controlling for cumulative completed credits) have returns that are smaller in magnitude than were observed in Model 2. In other words, most of the effects of credentials on earnings appear to be a product of the underlying coursework, which is a proxy for human capital accumulation, as opposed to a product of the credentials themselves.

The few credentials that are associated with significant earnings gains in Model 3 are primarily in CTE fields, including associate degrees in agriculture & natural resources (11%), short-term certificates and low-credit awards in business & management (5% and 10%, respectively), associate degrees in engineering & industrial technologies (7%), all levels of credentials in health (with returns ranging from 99% for associate degrees to 6% for low-credit awards), short-term certificates in family & consumer sciences (5%), long- and short-term certificates in public & protective services (10% and 13%, respectively), and short-term certificates in commercial services (9%), the latter of which is a reversal of direction relative to Model 2. Earnings gains also are observed for credentials in two non-CTE fields, namely short-term certificates in biological sciences (26%) and associate degrees in interdisciplinary studies (2%), the latter of which is again a reversal of direction from Model 2. Negative returns are observed for short-term certificates in education (-14%), associate degrees in social sciences (-3%), and long-term certificates in interdisciplinary studies (-7%).

In contrast, many subfields of study exhibit significant associations between course credits and earnings, though one that varies in both magnitude and direction across subfields. Interpreting the return to credits in each subfield is difficult, however, due to the accommodation of the model for nonlinear relationships between credits and earnings. Therefore, I present in Table 7 the percentage change in earnings at six, twelve, and eighteen completed credits for the 53 largest CTE subfields, which collectively account for 95% of the 5,805,438 course credits completed by the analytical sample in CTE subfields. Similarly, I present in Table 8 the percentage change in earnings for the 33 largest non-CTE subfields, which account for 95% of the 16,029,097 credits completed in non-CTE subfields.

[insert Table 7 about here]

[insert Table 8 about here]

Reviewing Table 7, several fields stand out for the high level of consistency of positive returns to credits and for the strength of these returns. Among these are the fields of information technology and engineering & industrial technologies in each of which three-quarters of the subfields have significant, positive, and generally strong returns to credits. For example, the average increase in earnings associated with completing 12 credits in general information technology is 5%, while the return to 12 credits in the more specialized subfields of computer software development and computer infrastructure & support is 8% and 9%, respectively. In engineering & industrial technologies, the return to 12 credits in the nine subfields that have consistently positive returns ranges from 3% in automotive technology to 162% in chemical technology. Likewise, two of the three subfields of public & protective services have significant, positive, strong returns to credits, including for example an average 14% increase in earnings for 12 credits in administration of justice. Collectively, the fourteen subfields of engineering & industrial technologies, information technology, and public & protective services in which consistently positive returns are observed account for about one-third (31%) of the 5.8 million CTE credits completed by the analytical sample.

Returns to credits in the field of business & management are mixed. The subfields of accounting and office technology have positive and strong or reasonably strong returns to credits. These two subfields are noteworthy for the fact that they are the two largest subfields of business

& management, accounting for more than 9% of the 5.8 million CTE credits completed by the sample. The return to credits in the subfield of general business & commerce also is positive over the range of credits considered here, but the return is small and tends toward zero as the number of completed credits increases. In contrast, the return to credits in the subfield of real estate is strongly negative (-9% for 12 credits), and the returns to the subfields of business administration and business management are negative above six credits. The return to the one remaining subfield, marketing & distribution, is not statistically significant.

The return to credits in the field of health also is mixed. Two subfields of health — health information technology and psychiatric technician — have strong, positive returns to credits, but these subfields are relatively small, together accounting for just 1% of the 5.8 million CTE credits. The subfield of emergency medical services is larger in terms of student participation, but the return to credits in this subfield is small, and it is positive only above six credits. The return to credits in the remaining seven subfields of health either are statistically insignificant or negative over the range of credits considered here, including nursing, which is the largest subfield of health (accounting for nearly 6% of the 5.8 million CTE credits) and which has a modestly negative association between credits and earnings (-4% for 12 credits).

Most subfields of the remaining fields either do not have statistically significant associations with earnings or have significant negative associations. Among those with strong negative associations are horticulture (a subfield of agriculture & natural resources), cosmetology & barbering (a subfield of commercial services), commercial music (a subfield of fine & applied arts), and applied photography (another subfield of fine & applied arts). One exception should be noted, though. Early childhood education, which is a subfield of family & consumer sciences, has a modestly positive association between completed credits and earnings

(3% for 12 credits). This is important, in part, because it is the largest of all of the CTE subfields, accounting for 10% of the 5.8 million CTE credits completed by the sample.

Across the fields addressed in Table 7, two-thirds of subfields (66%, or 35 of 53) have significant associations between course credits and earnings, and three-fifths of these (60%, or 21 of 35) are *consistently positive* over the range of credits considered in this analysis or, in one case, positive above six credits. The subfields with significant and consistently positive returns to credits account for 56% of the 5.8 million CTE credits completed by the sample and have returns to 12 completed credits that range from 0.4% (emergency medical services) to 162% (chemical technology), with a median return of 8%. The 11 subfields with significant and *consistently negative* returns to credits account for 20% of all CTE credits completed by the sample and have returns to 12 completed credits that range from -2% (nutrition, foods & culinary arts) to -15% (radiologic technology), with a median return of -8%.

Table 8, which addresses returns to course credits in non-CTE subfields, presents a picture that is nearly the mirror image of that observed in Table 7. Almost three-quarters of the subfields (73%, or 24 of 33) have significant associations between credits and earnings, but three-quarters (75%, or 18 of 24) of these have associations between credits and earnings that are *consistently negative* or, in a few cases, negative above six credits.

Returns to credits in half or more of the subfields of biological sciences, fine & applied arts, foreign languages, and physical sciences are consistently negative, while the returns to the remaining subfields of these four fields are statistically insignificant. Likewise, the one subfield of media & communications and the one subfield of mathematics both have negative associations between credits and earnings. Of note, mathematics is the single largest subfield of all non-CTE subfields, accounting for 16% of the 16 million non-CTE credits completed by the analytical sample.

Returns to credits in the social sciences are mixed. None of the subfields has a consistently positive return to credits over the range of credits considered here, and both anthropology and political science have consistently negative returns. Similarly, the return to the one subfield of psychology varies in that it is negative above 12 credits.

Returns to credits in the humanities and in education are similarly mixed. Of the four subfields of the humanities, philosophy has a strong and consistently negative return to credits, and English, which is the second largest non-CTE subfield (accounting for 15% of the 16 million non-CTE credits), has a return to credits that is negative above 12 credits. Only the subfield of speech communication has a consistently positive return, though this return is very small. In the field of education, the subfield of physical education has modest, positive return to credits, the subfield of health education has a return that is negative above six credits, and the subfield of sign language does not have a statistically significant association with earnings.

The one remaining non-CTE field in Table 8 is interdisciplinary studies, and the one subfield of this field — general studies — is the third largest non-CTE subfield, accounting for 5% of the 16 million non-CTE credits. It has a weak positive association between credits and earnings.

Overall, the 18 (of 33) non-CTE subfields in Table 8 that have significant and *consistently negative* relationships between course credits and earnings over the range of credits considered here, or relationships that are negative above six credits, account for 50% of all non-CTE credits completed by the sample. The estimated returns to 12 credits in these subfields range from -0.3% (economics) to -20% (astronomy), with a median return of -6%. The three non-CTE subfields that have *consistently positive* relationships between credits and earnings account for 15% of all non-CTE credits completed by the sample, and these subfields have returns that range from 2% (speech communication and general studies) to 4% (physical education), with a median return of 2%.

SENSITIVITY

To test the sensitivity of the results to differing specifications of the model and the analytical sample, I used an abridged version of Equation 1 (Model 3, Table 6), replacing the measures of cumulative completed credits in each *subfield* with measures of cumulative completed credits in each *field*. This simplified model, labeled Model 4A in Table 9, was chosen to aid in the comparisons of results across different specifications. I then replicated this model under five different specifications, labeling these alternatives Model 4B, 4C, 4D, 4E, and 4F, respectively. I also executed a sixth alternative specification (not shown) to test my assumption about the functional form of the relationship between credits and earnings, the results of which I discuss at the end of this section.

[insert Table 9 about here]

One way in which the model specification in this study differs from recent prior research is the manner in which change over time in the exogenous labor market conditions is controlled. Equation 1 includes 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 earnings trend to vary uniquely with the quarter of students' entry. As an alternative approach, recent prior research (e.g., Dadgar & Weiss, 2012; Jepsen, et al., 2009) used dummy variables to represent each combination of year and quarter from the first observed quarter through the last. One might ask whether this difference from prior research influenced the results of this study. To address this question, in Model 4B I replace the interactions of time and the quarter of students' entry into the CCC system with dummy variables to identify uniquely each quarter from 10 quarters prior to entering the CCC system through the fourth quarter of 2012.

A second question that may arise about this study concerns the inclusion of students who completed zero credits in the CCC system. As noted earlier, recent prior work treated students who were not awarded community college credentials as a homogenous group against which the returns to community college credentials were measured (e.g., Dadgar & Weiss, 2012; Jepsen, et al., 2009). The study presented here is a significant advancement insofar as it offers a comprehensive account of the labor market return to course credits, independent of the return to credentials. However, it remains that students who do not complete any credits may be (and probably are) very different from students who *do* complete credits, and including in the analysis students who do not any complete credits may bias the estimated return to credits. To explore this prospect, in Model 4C I exclude the 16% of the sample who completed zero credits in the CCC system.[14]

A third question concerns whether the returns to course credits among students who were *not* awarded credentials are different from the returns to credits among students who *were* awarded credentials. One may imagine that bias in the estimates of the returns to credits could arise if common support (Caliendo & Kopeinig, 2005) across completing and non-completing students is weak. More specifically, if the only students who completed a large number of

[14] There is a small discrepancy between the number of students who completed zero credits in Table 1 (N = 116,882) and the number of students who were excluded from Model 4C because they completed zero credits (N = 117,783). The 901 additional students who were excluded from Model 4C completed credits in the Fall 2012 semester only. Because cumulative completed credits is treated as a leading indicator of earnings, and because earnings are measured through the fourth quarter of 2012, information about credits completed in the Fall 2012 semester was not incorporated into the regression models. Credits completed in the Fall 2012 semester would be relevant for students' earnings in the first quarter of 2013, which were unobserved. Hence, students who completed credits only in the Fall 2012 semester were treated as having completed zero credits for the purposes of the regression analysis and were dropped from Model 4C.

credits in a given field were those who earned a credential in that field, then differentiating the return to the credential from the return to the credits becomes problematic, and the return to credits among non-completing students may be inflated by the return experienced by completing students.

A related question that one might raise is whether the positive effect on earnings of completed credits in some fields may be a result of highly-employable students electing to leave college prior to completing a credential, while less-employable students remain in college. The fixed effects analytical approach that was used in this study controls for all differences between students that are invariant over time, but it does not account for unmeasured differences that change over time, such as the discovery by a student while attending college of a special talent for a particular area of study that, in turn, greatly increases the employability and potential earnings of the student even without a credential. If a time-varying phenomenon of this sort were occurring on a significant scale, it would tend to suppress the return to credits because less-employable students remain in college and accumulate more credits. Yet, this particular critique — essentially that employability has an inverse relationship to educational attainment — is not unique to this study and could be levied against virtually any study of the labor market returns to postsecondary education. For example, perhaps the *least* employable individuals at the baccalaureate level are the *most* likely to attend graduate school, resulting in the estimated labor market value of baccalaureate degrees being inflated by an overrepresentation of highly-employable individuals while the value of graduate degrees is suppressed by an overrepresentation of less-employable individuals.

In any case, to explore these possibilities, in Model 4D I exclude the 13% of the sample who earned one or more credentials. If Model 4A and 4D produce similar results with respect to the returns to credits, then one can have greater confidence in the estimates of returns to credits in this study. To be certain, however, later in this paper I explore common support with respect to credits and credentials in these data.

In a similar vein, one could argue that allowing the underlying earnings trend to vary by whether or not a student transferred to a four-year institution as I have done in this study, though an improvement over prior work, cannot capture fully the variation in earnings experienced across the different baccalaureate programs into which students transfer. Thus, despite this statistical control, the estimated returns to credits and credentials in this study may reflect, in part, differences in the propensity to transfer and field-specific returns to a baccalaureate degree. Therefore, in Model 4E, I exclude the 23% of the sample who transferred to a postsecondary institution outside the CCC system at some point, whether to a four-year institution or a less-than-four-year institution.

Finally, one may question whether the pre-college earnings of the youngest students in the sample, many of whom presumably were enrolled in high school during the 10 quarters before entering the CCC system and earning very little, may inflate the estimated returns to course credits and credentials. To explore this possibility, in Model 4F I exclude the 48% of the sample who were less than 20 years of age at entry to the CCC system.

Comparing the results presented in Table 9, one finds that the differences between Models 4A and 4B are minor, indicating that the results are robust to alterations in the method of accounting for change over time in exogenous labor market conditions. Likewise, excluding students who earned zero credits (Model 4C) has very little impact on the results.

Confining the analysis to non-completing students (i.e., excluding students who earned a credential) in Model 4D produces a positive shift in the effects of credits on earnings. Positive returns to credits tend to grow larger in magnitude, while negative returns to credits tend to shrink. For example, in Model 4A, the average return to 18 credits in the field of family & consumer sciences is estimated to be 2%, while the return in Model 4D is estimated to be 4%. The most noteworthy change in this regard concerns the field of health: in Model 4A, the average return to 18 credits in health is -2% (a net negative return), while Model 4D indicates a positive return of 5%. In sum, it appears that pooling completing and non-completing students in a single model suppresses, rather than inflates, the labor market returns to credits. This is an interesting finding and worthy of further investigation in future research.

Excluding students who transferred out of the CCC system (Model 4E) produces meaningful changes in the results. The negative relationships noted in Model 4A between credits and earnings in the fields of architecture & related technologies, environmental sciences & technologies, media & communications, foreign languages, and physical sciences all are statistically insignificant in Model 4E. Likewise, the strong positive relationship between library science credits and earnings in Model 4A also is statistically insignificant in Model 4E, as is the weak positive relationship between credits in agriculture & natural resources and earnings. Minor differences in the relationships between credentials and earnings also are noted. Otherwise, the estimates are fairly similar across the two models.

Making sense of these differences hinges in large part on whether the exceptionally long period of time in which earnings are observed in this study is long enough to capture the labor market return experienced by students who complete baccalaureate degrees in each field of study. To elaborate, one would expect that students who transfer to a four-year institution, who constitute the large majority (86%) of students who transfer out of the CCC system to external institutions, eventually would experience stronger earnings, on average, than their peers who do not transfer through their greater likelihood of completing a baccalaureate degree. Among students in California, completed credits in some fields of study (e.g., architecture & related technologies, biological sciences, education, foreign languages, mathematics, physical sciences, psychology, social sciences) are strongly and positively associated with the likelihood of transferring to a four-year institution. For example, 87% of the students who completed at least 18 credits in the physical sciences transferred to a four-year institution, compared with 18% of students who completed fewer than six credits in the physical sciences. Furthermore, one would expect that, among students who transfer, the more credits a student completes in a given field of study, the more likely is the student to transfer into a major in that field (e.g., more credits in the physical sciences predicts a greater likelihood of transfer and, presumably, a greater likelihood of transferring into a major in the physical sciences or an associated major, such as engineering). Given these expectations, though the model implemented here controls for the average difference in the earnings trends between students who transfer to four-year institutions and those who do not transfer, one reasonably could assume that some of the estimated labor market return to credits in fields in which completed credits strongly predict transfer are mixed with the specific labor market return to a baccalaureate degree *in that field*. The same is true of the returns to credentials in fields in which completing a credential strongly predicts transfer.

However, if the lengthy observation period of this study still is not sufficient to reflect accurately the returns to baccalaureate degrees or, further complicating matters, not sufficient to reflect accurately the returns to baccalaureate degrees in *some* (but not all) fields of study, then excluding transfer students (and, thereby, excluding any field-specific return to baccalaureate degrees) could either increase or decrease the estimated return to credits, depending on the field of study. This is precisely what one observes in comparing Models 4A and 4E. For example, it appears that the strong return to credits in library science in Model 4A is driven in large part by the specific return to a baccalaureate degree in that field because excluding transfer students (Model 4E) reduces this return to insignificance. On the other hand, it is difficult to imagine that a baccalaureate degree in the physical sciences does not produce a strong labor market return, on average. Hence, it seems likely that the net negative effect on earnings of credits in the physical sciences in Model 4A that disappears (statistically speaking) after transfer students are excluded (Model 4E) is indicative of an above average delay in the labor market return to a baccalaureate degree in that field, an above average time to complete a baccalaureate degree in the field, or both.

In sum, though this study incorporates the longest observation period of any of the recent prior work in this area, and though it allows for a distinct earnings trajectory for students who transfer to four-year institutions and, separately, for students who transfer to less-than-four-year institutions, still it appears that the effects on earnings of community college credits and credentials in some fields of study have not been disentangled completely from the effects of students' educational pathways into and through other postsecondary institutions. Further research on this issue is needed. That said, however, the fact that most of the coefficients remain relatively stable from Model 4A to 4E bolsters confidence in the main conclusions of this study.

Meaningful deviations from Model 4A also are observed in Model 4F, which excludes students who were younger than 20 years of age at college entry. Most of these differences are confined to the relationships between credits and earnings, although a few differences are noted with respect to credentials as well. Interpreting the differences between these two models is challenging because it is not clear whether the differences are a result of excluding students whose pre-college earnings records fell during a period in which they were in high school or a result of retaining only those students who entered college for the first time at a "non-traditional" age (i.e., not immediately after high school) who likely have markedly different academic and employment trajectories from "traditional" students. The latter explanation seems the less probable one, given that the models include a separate earnings trend for each age group, and given that the individual fixed effects account for time-invariant differences between students.

Concerning the effects of credits on earnings in Model 4F, three of the smallest CTE fields — architecture, environmental sciences, and library science — no longer have significant associations between credits and earnings, possibly due simply to the loss of statistical power with the much smaller analytical sample. In addition, education (a non-CTE field) also no longer has a significant association between credits and earnings in Model 4F, whereas this relationship was weakly positive in Model 4A. The field of education is dominated by the subfield of physical education, which accounts for 53% of the credits completed in this field. In Model 3, the subfield of physical education has a moderately positive relationship between credits and earnings. Thus, it may be the physical education credits carry less economic value for students who are older than 19 years of age. For example, perhaps students of non-traditional age at college entry are using physical education courses primarily as a means of maintaining personal health and fitness, whereas students of traditional age may be using them as a vehicle to employment in coaching or fitness training.

The other two fields in which differences between Model 4A and Model 4F are worthy of note are family & consumer sciences and health. The positive relationship between credits in family & consumer sciences and earnings is much stronger in Model 4F than in Model 4A. Model 4F indicates a return of 8% to 18 credits, while Model 4A suggests a return of 2%. Nearly two-thirds (63%) of the credits completed by students in family & consumer sciences were in the subfield of early childhood education, which has a positive relationship with earnings in Model 3. One explanation for the difference between Model 4F and 4A is that early childhood education credits are more economically valuable for students who are of non-traditional age at college entry, which suggests that these students may be more likely to be using these credits as a rapid vehicle to employment via a state permit to provide childcare in California (California Administrative Code, Title 5, Division 8, Chapter 1, Article 5, Sections 80105-80115), as opposed to using them in the pursuit of a bachelor's degree in early childhood education or some other goal.

Concerning the field of health, the relationship between credits and earnings in Model 4A is weakly negative over the span of six to 18 credits, while it is weakly positive in Model 4F. Across all 23 fields, the field of health has the greatest number of subfields, and the relationship between credits and earnings varies widely across these subfields (see Model 3). Thus, it may be that students of non-traditional age simply focus their course-taking in a different mix of health subfields than do students of traditional age, resulting in the change of direction of the relationship that is observed in Model 4F. However, in both Model 4A and 4F, the relationship between credits in health and earnings is very small, making the difference in the results between the two models of relatively little consequence from the standpoint of sensitivity to different model specifications.

In addition to the five alternative models discussed here, I executed an sixth alternative specification in which I replaced the square of credits with the square root of credits in order to test my assumption about the shape of the relationship between completed credits and earnings. In the interest of space, I do not display the results of this sixth model in Table 9, but the estimated return to credits over the span of six to 18 credits were very similar to Model 4A with one exception. Specifically, the modestly positive return to credits in the field of education noted in Model 4A was no longer statistically significant under the alternative specification. Again, credits in the field of education are largely (though not exclusively) in the subfield of physical education, and, therefore, it may be that the positive relationship between credits in physical education and earnings is not described well by a quadratic form.

EVALUATION OF COMMON SUPPORT

Although the phrase "common support" is most often found in the context of propensity score matching techniques, it is relevant here as well. In simple terms, common support refers to regions of overlap on the values of the key predictors (Caliendo & Kopeinig, 2005), which are necessary to obtain accurate estimates of the partial relationships between the predictors and the outcome of interest. As it pertains to this analysis specifically, the need for common support refers to the fact that producing meaningful estimates of the return to course credits in a given field, independent of the returns to credentials in that field, depends on having observations in the data that are similar with respect to completed credits but different with respect to awarded credentials. Likewise, estimating the returns to credentials independent of the return to credits depends on having observations in the data that are similar with respect to awarded credentials in a given field but different with respect to completed credits in that field.

To explore this issue as it pertains to these data, I present in Table 10 the 5th and 95th percentiles of the distribution of completed credits in each field of study by the highest credential earned in that field of study, if any. I use the 5th and 95th percentiles, rather than the minimum and maximum, to trim extreme cases from the distributions. One would hope to observe that, within each field of study, the upper bound of the range of completed credits among students who did *not* earn a credential overlaps meaningfully with the lower bounds of completed credits among the four groups of students defined by highest credential earned. In addition, one would hope to observe that, within each group of students whose highest credential was a given level, meaningful variation exists in the number of credits completed in that field.

[insert Table 10 about here]

In Table 10, substantial variation in completed credits is observed within nearly all of the highest-credential groups in each field of study. In addition, one observes in almost all fields some degree of overlap in completed credits between students who did not earn a credential and those who earned each level of highest credential. In some fields, such as engineering & industrial technologies, public & protective services, and commercial services, this overlap is substantial. In a few fields, however, the overlap in completed credits between students who did not earn a credential and those who earned *particular* levels of highest credentials is minimal. For example, in information technology, the upper bound of completed credits for students who did not earn a credential is 12 credits, while the lower bound for students who earned a long-term certificate as their highest credential is 11 credits — an overlap of just one credit. A similarly weak overlap is observed for associate degrees in environmental sciences & technologies, long-term certificates in media & communications, associate degrees in fine & applied arts, short-term certificates and associate degrees in library science, and associate degrees in psychology. The two most problematic cases are long-term certificates in fine & applied arts and law, respectively. In both cases, there is no overlap between the 95th percentile of credits completed for students who did not earn a credential and the 5th percentile of credits completed for students who earned the long-term certificate. That said, of the 65 groups defined by highest credential earned across the 23 fields of study, 80% (52 of 65) exhibit a span of credits that overlaps with the corresponding non-completing group by at least six credits.

Considered globally, the wide variation in completed credits within each of the groups defined by highest credential, combined with the fact that there are relatively few fields of study in which there is no overlap in completed credits between students who did not earn a credential and students in each highest credential group, lends credibility to the results presented here regarding the returns to credits independent of the returns to credentials. However, the minimal overlap of completed credits between students who did not earn a credential and those who earned *particular* levels of credentials in a *few* fields of study suggests a need for caution in interpreting the returns to these credentials specifically, independent of the returns to credits in these fields.

DISCUSSION

In this study, I estimated the labor market return in earnings to community college credentials of four different levels and 23 different fields of study awarded by the California Community College (CCC) system, with and without statistical controls for cumulative completed course credits in each of 181 subfields. The model that *excluded* the controls for cumulative completed credits (Model 2, Table 5) is comparable in many respects to recent prior work on the returns to a community college education (e.g., Dadgar & Weiss, 2012; Jepsen, et al., 2009) insofar as the average returns to credentials were estimated relative to the unquantified returns of students who did not complete credentials, though both my model specification and my findings differed in important ways from those of prior research. The model that *included* cumulative completed course credits (Model 3, Table 6) allowed me to estimate the labor market return to credits in each subfield independent of any credentials awarded as a result of students' coursework. That is, Model 3 allowed me to disentangle human capital accumulation (as measured by completed course credits) and the signaling value of credentials of particular levels and fields (the residual effect of credentials after controlling for completed credits), thereby providing estimates of the labor market returns to community college pathways that do *not* result in a credential.

With respect to the model that is most similar to prior research (Model 2, Table 5), which excluded the controls for completed course credits, the findings of this study largely contradict Dadgar and Weiss's (2012) findings regarding the labor market returns to community college credentials in Washington. Although my findings generally agree with theirs regarding the positive returns to associate degrees in the majority of CTE fields, in contrast to their study I find that the returns to associate degrees in non-CTE fields typically are negative (a net reduction in earnings) or, in a few cases, not significantly different from zero. Furthermore, I find that long-term certificates in about half of CTE fields, and short-term certificates in more than half of CTE fields, produce positive returns that frequently are the equal of, if not greater than, returns to associate degrees in the same fields. Dadgar and Weiss found that, with a few exceptions, long- and short-term certificates in most fields produced either a negative return or a return that did not differ significantly from zero. Finally, unlike prior research, I differentiated in this study between short-term certificates and "low-credit" awards that require very few credits (less than six credits), and I find that even a few of the low-credit CTE awards are associated with significant earnings gains.

In sum, the findings of this study paint a much more favorable picture of the economic benefits of community college credentials in CTE fields than has been provided in recent research. In fact, of the 44 CTE credentials (of all levels) that were analyzed in this study, over half (52%, or 23 of 44) are associated with significant *increases* in earnings. Only four are associated with significant *decreases* in earnings, and three of these are in the field of commercial services, which is dominated by the subfield of cosmetology & barbering, which, in turn, is associated with the heavily self-employed beauty sector (Hipple, 2010). The returns to employment in the beauty sector undoubtedly are sorely underestimated in this study due to the limitations of UI earnings data discussed earlier.

In contrast, the findings regarding credentials in non-CTE fields are dismal. Of the 21 credentials (of all levels) in non-CTE fields, over half (52%, or 11 or 21) are associated with significant *decreases* in earnings. Only one is associated with a significant increase in earnings.

Setting aside the returns to credentials, the unique contribution of this study is the comprehensive analysis of the labor market returns to completed course credits, independent of the returns to credentials. The findings of this analysis (Model 3, Table 6) demonstrate that the returns to community college credentials largely are a product of the returns to the underlying coursework. In other words, most of the statistically significant returns to credentials disappear (statistically speaking) once completed credits in each subfield are entered into the model, and almost all of the credentials that retain a statistically significant association with earnings have a return that is smaller in magnitude.

Concerning the labor market return to credits, I find that the returns to the majority of course credits in CTE subfields are significant, positive, and oftentimes strong. Coursework in many of the subfields of information technology, engineering & industrial technology, and public & protective services is associated with especially strong earnings gains. Earnings gains also were noted in a number of other popular CTE subfields, such as early childhood education, office technology, and accounting. In contrast, returns to the vast majority of credits in non-CTE subfields are negative or, less frequently, not significant.

Considered as a whole, these findings suggest that most of the economic benefit of community college credentials in CTE fields is a result of the human capital acquired in achieving these credentials, rather than the signaling value of the credentials. More importantly, though, it indicates that the labor market return to students who do not complete community college credentials can equal or exceed that of students who complete credentials, depending on the courses taken. This finding challenges the underlying assumption of both recent research (e.g., Dadgar & Weiss, 2012; Jepsen, et al., 2009) and the larger completion agenda paradigm (e.g., Lumina Foundation, 2012, 2013) that the labor market return to non-completing community college students is of little consequence. Claims that "[d]ropping in for a couple of courses at the local campus rarely makes much of difference for long-term student success" (Bosworth, 2010, p. 1) clearly are misleading. Though enrolling in a random mix of community college courses is unlikely to result in earnings gains, a strategic selection of courses in CTE subfields appears to be a potentially rational means of advancing one's earning potential. Thus, there is much to be gained from a community college education, even one that does not result in a credential.

An important exception to this conclusion, however, is the returns to credits and credentials in the field of health. The returns to all four levels of credentials in health remain strongly positive after controlling for credits completed in each subfield. Conversely, the net returns to credits in the various subfields of health, after controlling for awarded credentials, most often are negative or not significantly different from zero. Hence, non-completing pathways in health generally cannot serve as substitutes for completing pathways.

Beyond the novel findings concerning the labor market returns to non-completing community college students, and the implications of these findings for the assumptions that are driving much of the contemporary research and reformists efforts around community colleges, one finding that is exceedingly clear in this study is that the gross categorizations of credits employed in prior work (e.g., Belfield, et al., 2014; Grubb, 1995, 2002b; Kane & Rouse, 1995; Marcotte, et al., 2005; Jacobson, et al., 2005) assume a uniformity of impact on earnings that simply does not align with reality. The labor market return to coursework varies greatly as a function of the subfield in which that coursework is completed.

Moreover, even the precise measurement of subfield in this study likely masks markedly different returns to particular course-taking pathways within those subfields. For example, completed credits in manufacturing & industrial technology (a subfield of engineering & industrial technologies) were found to be strongly and positively associated with earnings, but this subfield includes courses as diverse in subject as computer numerical control (CNC) machining, blueprint reading, firearms manufacturing and repair, hazardous materials safety, iron working, sheet metal working, radiographic examination and testing, welding, and a range of other subjects. Surely, the human capital acquired in some of these courses has greater labor market value than that acquired in other courses. Likewise, even within a particular body of coursework, the human capital acquired in an introductory CNC machining course, for example, probably has considerably less labor market value than that acquired in an advanced course in the programming of the logic controllers that govern the CNC machining process, though such differences in returns are captured to some extent in this study by the fact that greater credit accumulation within a subfield often would indicate a student's advancement into more complex coursework.

In a similar vein, this analysis does not capture what likely are important interactive qualities of community college coursework. For example, six credits of technical mathematics alone have a net negative return. Yet, when taken as part of a program of coursework in the lucrative water & wastewater technology subfield, this coursework likely is of considerable labor market value.

Another clear finding of this study concerns the limitations of UI earnings data for areas of employment that are dominated by a self-employment model. A number of the CTE subfields that typically would lead to employment in these areas, such as real estate, cosmetology & barbering, horticulture, and applied photography, were associated strongly and negatively with earnings, just as one would expect if a greater number of completed credits in these subfields predicts a greater commitment of one's working hours to self-employment in that area. Likewise, the positive returns to credits in such subfields as construction crafts technology and early childhood education likely are underestimated in this study for the same reason. Therefore, the findings of this study concerning the return in earnings to CTE coursework in fact may be understating this return by a large margin due to the limitations of UI earnings data.

As a related matter, the methodological decision to exclude from the analysis student-quarters in which no earnings were reported (which, in most cases, indicates zero earnings), while logical and consistent with recent prior work (e.g., Dadgar & Weiss, 2012), likely further contributes to the underestimation of the returns to credits and credentials in this study. Belfield and Bailey (2011) explain that, "[i]f community college attendance increases the probability of employment (as seems likely if attendance increases productivity), then the earnings gains should be adjusted upward to account for the higher probability of being employed" (p. 49). By excluding records of zero earnings, I ignored the influence of a community college education on students' transitions from unemployed status to employed status, which, by definition, increases earnings. Consequently, the estimated returns to credits and credentials in this study reflect only the returns to *employed students*, further understating the labor market return to a community college education.

IMPLICATIONS FOR POLICY

Perhaps the most important implication of this study for educational policy is derived from what the study does *not* say. This study does *not* indicate that community college credentials have no, or even limited, labor market value. Quite to the contrary, returns to most CTE credentials are positive and frequently strong. However, it remains that, in many CTE subfields, students who complete coursework can achieve similar earnings gains without completing a credential. Said another way, earnings gains can be found at all levels of educational attainment in the community college, including completing credits but not completing a credential.

As a result, although the goal of improving graduation rates in community colleges is unquestionably sound and positive, when this goal is enacted in policies that reduce access for students who are not pursuing credentials or seeking to transfer to a four-year institution (e.g., Bahr, et al., 2014), or in institutional practices that reduce or eliminate programs of study based primarily on graduation rate (e.g., Puente, 2013), unintended negative consequences will result. In particular, the evidence indicates that a meaningful segment of the student population of community colleges is pursuing organized, rational, non-completing pathways in CTE fields (Bahr & Booth, 2012; Booth & Bahr, 2013). This study has demonstrated that many of these pathways can be economically beneficial to students, and, insofar as that is true, they also are beneficial to the state. For example, when students' earnings increase, tax revenues increase and the demand placed on publicly-funded social services shrinks. In other words, improving students' economic position offers the dual benefit to the state of increasing revenues and reducing financial outlays for support programs. In addition, the fact that there are a number of subfields of study that have strong associations between credits (even relatively few credits) and earnings, independent of the credentials awarded to students, is suggestive of areas of employment in which the supply of workers is, at best, just meeting demand. Otherwise, one would expect earnings gains to materialize only at higher thresholds of educational attainment (e.g., greater number of completed credits or at least minimal credentials). Ensuring an adequate supply of workers serves the state's overall economic health and progress, and, thus, policies that reduce the production of these workers by limiting access for students who are not pursuing "completion" goals is not in the best interest of the state.

In addition, although this study demonstrated a net negative return or no return to credentials in most non-CTE fields, and to credits in most non-CTE subfields, this finding does *not* imply that these fields and subfields of coursework should be eliminated. This study considered just one labor market outcome (earnings), and the relationship between non-CTE credits and credentials and other labor market outcomes (e.g., employment; Belfield & Bailey, 2011) remains uncertain at this point. Furthermore, non-CTE course-taking pathways are the primary avenue through which community college students prepare to transfer to four-year institutions, and upward transfer is a core mission of community colleges. For example, as discussed earlier, three-quarters of the students who completed an associate's degree in a non-CTE field transferred to a four-year institution. Hence, the unfavorable returns in earnings to non-CTE coursework and non-CTE credentials is just one small part of a much larger story about the role that non-CTE pathways play in students' educational and workforce attainment.

Finally, in comparing this study with recent efforts in California to provide information about earnings gains associated with community college credentials, such as *Salary Surfer* (http://salarysurfer.cccco.edu/SalarySurfer.aspx), it is important to remember that the results of different approaches to understanding the relationship between education and earnings will be conditioned in different ways and, consequently, may not be directly comparable. For example, the analysis that underlies the figures reported in *Salary Surfer* is based on a relatively narrow group of community college students who completed a credential, were at least 22 years of age at the time the credentials was awarded, departed from the CCC system immediately after completing the credential, and did not transfer to a four-year institution. Salary Surfer reports median earnings two years before the credential was earned, two years after the credential was earned, and five years after the credential was earned. Earnings for a given student in a given year are calculated as the sum of earnings in the four quarters of that year regardless of whether the student was employed in all four quarters or not. *Salary Surfer* does not offer an account of variation in pre-college earnings, baseline earnings trends, or demographic characteristics. While the analytical approach behind *Salary Surfer* is logical given its primary goal of assisting students with selecting a program of study, it is a very different approach from that employed in this study, and, therefore, the results of the two approaches cannot be compared directly.

IMPLICATIONS FOR FUTURE RESEARCH

There are several implications of this study for the direction of future research. First, an explanation for the labor market returns to course credits that was not considered in this study is linkages between community college coursework, state licenses, and professional certifications. Some of the CTE subfields of study that have positive returns to credits are tied closely to licenses or certifications in California that require the completion of particular bodies of coursework or specific numbers of credits in particular subfields. For example, receipt and advancement of a license to operate a wastewater treatment plant in California requires the completion of coursework in wastewater technology, science, or math (California Code of

Regulations, Title 23, Division 3, Chapter 26, Section 3685), in addition to on-the-job experience. Stricter coursework requirements are in place for operators of drinking water treatment plants in California (California Code of Regulations, Title 22, Division 4, Chapter 13, Section 63775). Thus, it is probable that much of the observed return to credits in the specialized water & wastewater technology subfield is associated with the fulfillment of these state licensing requirements, but further research is needed on links of this sort between coursework and licensing or certification requirements.

Although this is an area that would benefit from further investigation, the likelihood that the return to CTE credits is driven in part by licensing and certification requirements does not alter the interpretation of the findings regarding the return to human capital acquired in CTE coursework. As Belfield and Bailey (2011) argue, “if the licensing or certification system is demanded by consumers as a way to guarantee quality of service, then these earnings gains are still real (rather than reflecting a restrictive practice in the labor market)” (p. 54). Nevertheless, much more research is needed on the relationships between community college coursework, state licenses, and professional certifications, particularly with respect to non-completing pathways through the community college (Grubb, 2002a, 2002b).

Second, I did not explore in this study the extent to which earnings gains from coursework in CTE subfields are a result of students’ entry into new occupations or advancement in existing occupations (Grubb, 2002a), nor whether students’ earnings are from an area of employment that is related to their education or not (Grubb, 2002b). None of these possibilities (e.g., new employment versus advancement; in an area of employment related to their education or not) leads to questions about the reality of the observed earnings gains (i.e., the gains are real either way), but these possibilities reflect distinctly different uses of the community college and are worthy of investigation in future research, again with special attention to non-completing pathways.

Third, I did not explore in this study how the labor market return to coursework in each subfield varies geographically. It seems likely that the returns to coursework in some subfields (and presumably the returns to credentials in some fields as well) are highly dependent on local or regional labor market conditions (Grubb, 2002b), specifically the opportunity structure for individuals with particular types of knowledge and training. For example, a large fraction of the credits completed by the analytical sample in chemical technology were completed at just one college (Taft College, in Kern County near the City of Bakersfield), which has strong ties to the local energy production industry (e.g., oil, natural gas). The labor market return to course credits in chemical technology at the few other colleges in the CCC system that offer chemical technology coursework probably is different from the return experienced by students at this one college. Thus, future research would benefit from sensitivity to geographic variability in the returns to the various completing and non-completing pathways through the community college.

Finally, the data used in this study would not support inquiry into any potential disjuncture between students' actual level attainment with respect to credentials and the attainment that they report to prospective employers. One can place a high level of confidence in the accuracy of the data used in this study with respect to students' actual attainment in the community college system, but these data provide no information about what students report to prospective employers about their attainment. The estimates of the labor market returns to course credits and credentials in this study are based on the assumption of no systematic discrepancy between students' actual attainment and the information held by prospective employers about students' attainment. Yet, Attewell and Domina (2011), using data from

National Education Longitudinal Study of 1988 (NELS88), found that students in that survey were especially prone to reporting "fake" associate degrees and certificates. For example, about one-third (35%) of students who reported that they had received an associate's degree in fact had *not* received this degree (Attewell & Domina, 2011, p. 62).

Although reporting a fake degree in the NELS88 survey does not necessarily mean that a student is reporting a fake degree to employers, the magnitude of inaccuracy in students' reporting provides a reason to question the assumption of no systematic error. Encouragingly, though, a majority of students who reported a fake credential in NELS88 had completed nearly enough credits to be awarded the credential. Still, it remains that systematic error in reporting educational attainment to employers could inflate inaccurately the estimated returns to course credits in this study by attributing to the credits the labor market value of the credential. Hence, future research should explore the accuracy of students' job market "claims" regarding educational attainment, and the impact of any discrepancies between claims and reality on the observed returns to a community college education.

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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* = 1,222,256)	Analytical Sample (*N* = 759,489)
Sex		
Male	48.0%	48.9%
Female	51.4%	50.6%
Not Reported	0.6%	0.5%
Race/Ethnicity		
White	37.8%	38.2%
Black	9.4%	8.9%
Hispanic	33.4%	36.1%
Asian	9.1%	7.2%
Pacific Islander	0.9%	0.9%
Filipino	3.3%	3.3%
Native American	1.1%	1.1%
Not Reported	5.0%	4.4%
Age at Entry to CCC System		
< 18	8.0%	----------
18-19	42.0%	48.3%
20-22	10.9%	13.3%
23-25	5.8%	7.0%
26-30	6.3%	7.4%
31-35	5.9%	6.8%
36-40	5.7%	6.5%
41-45	5.3%	6.1%
46-50	4.1%	4.6%
51-60	4.2%	----------
> 60	1.7%	----------
Not Reported	0.2%	----------
Citizenship		
U.S. Citizen	83.9%	84.5%
Not U.S. Citizen	15.1%	14.6%
Not Reported	1.0%	0.9%
Self-Reported Academic Goal		
Transfer with or without a Credential	36.1%	36.1%
Terminal Credential	10.9%	11.6%
Non-Credential Employment-Related Goal	16.4%	18.2%
Other	31.6%	29.8%
Not Reported	4.9%	4.3%
Mean Number of Credits Completed in CCC System	30.4	29.1
Awarded Low-Credit Award in CCC System	0.4%	0.4%
Awarded Short-Term Certificate in CCC System	2.6%	2.6%
Awarded Long-Term Certificate in CCC System	2.1%	2.2%
Awarded Associate's Degree in CCC System	10.1%	9.4%
Transferred to Four-Year Institution	21.7%	19.9%

Table 2: Total number of credits completed by students in the analytical sample during the observation period, by subfield of study

Fields and Subfields	Completed Credits	Percentage of All Completed Credits
Agriculture & Natural Resources†		
Agriculture Technology & Sciences, General†	9,640	0.04%
Animal Science†	28,751	0.13%
Plant Science†	12,287	0.06%
Viticulture, Enology & Wine Business†	3,370	0.02%
Horticulture†	28,157	0.13%
Agriculture Business, Sales & Service†	7,173	0.03%
Forestry†	7,392	0.03%
Natural Resources†	13,166	0.06%
Agricultural Power Equipment Technology†	8,789	0.04%
Architecture & Related Technologies†		
Architecture & Architectural Technology†	42,244	0.19%
Environmental Sciences & Technologies†		
Environmental Science	14,455	0.07%
Environmental Studies	14,374	0.07%
Environmental Technology†	5,839	0.03%
Biological Sciences		
Biology, General	523,632	2.40%
Botany, General	7,391	0.03%
Microbiology	73,129	0.33%
Zoology, General	8,298	0.04%
Natural History	14,199	0.07%
Anatomy & Physiology	230,360	1.06%
Biotechnology & Biomedical Technology†	5,459	0.03%
Other Biological Sciences	5,707	0.03%
Business & Management†		
Business & Commerce, General†	201,267	0.92%
Accounting†	333,340	1.53%
Banking & Finance†	14,609	0.07%
Business Administration†	82,805	0.38%
Business Management†	152,861	0.70%
International Business & Trade†	6,917	0.03%
Marketing & Distribution†	45,476	0.21%
Logistic & Materials Transportation†	1,578	0.01%
Real Estate†	99,216	0.45%
Office Technology†	206,646	0.95%
Labor & Industrial Relations†	3,239	0.01%
Other Business & Management†	5,861	0.03%
Media & Communications†		
Media & Communications, General	29,291	0.13%
Journalism†	38,367	0.18%
Radio & Television†	53,512	0.25%
Technical Communications†	2,064	0.01%
Mass Communications†	9,362	0.04%

Film Studies	100,263	0.46%
Digital Media†	67,058	0.31%
Other Media & Communications†	1,554	0.01%
Information Technology†		
Information Technology, General†	192,133	0.88%
Computer Information Systems†	129,422	0.59%
Computer Science (Transfer)	15,949	0.07%
Computer Software Development†	62,979	0.29%
Computer Infrastructure & Support†	46,395	0.21%
World Wide Web Administration†	5,093	0.02%
Other Information Technology†	3,850	0.02%
Education		
Education, General (Transfer)	16,922	0.08%
Educational Aide (Teacher Assistant) †	10,465	0.05%
Special Education†	10,042	0.05%
Physical Education	600,925	2.75%
Recreation	3,939	0.02%
Health Education†	371,523	1.70%
Sign Language	119,479	0.55%
Educational Technology†	1,129	0.01%
Other Education†	1,812	0.01%
Engineering & Industrial Technologies†		
Engineering, General (Transfer)	18,735	0.09%
Engineering Technology, General†	7,318	0.03%
Electronics & Electric Technology†	80,648	0.37%
Electro-Mechanical Technology†	1,975	0.01%
Printing & Lithography†	5,107	0.02%
Industrial Systems Technology & Maintenance†	5,438	0.02%
Environmental Control Technology (HVAC)†	43,033	0.20%
Diesel Technology†	31,169	0.14%
Automotive Technology†	200,673	0.92%
Automotive Collision Repair†	34,882	0.16%
Aeronautical & Aviation Technology†	34,802	0.16%
Construction Crafts Technology†	236,932	1.09%
Drafting Technology†	57,202	0.26%
Chemical Technology†	19,980	0.09%
Manufacturing & Industrial Technology†	116,020	0.53%
Civil & Construction Management Technology†	36,489	0.17%
Water & Wastewater Technology†	20,148	0.09%
Marine Technology†	2,364	0.01%
Other Engineering & Related Industrial Technologies†	4,482	0.02%
Fine & Applied Arts		
Fine Arts, General	172,386	0.79%
Art	363,890	1.67%
Music	412,973	1.89%
Commercial Music†	28,700	0.13%
Technical Theater†	11,403	0.05%
Dramatic Arts	169,853	0.78%
Dance	69,786	0.32%
Applied Design	8,506	0.04%

Photography	42,498	0.19%
Applied Photography†	51,012	0.23%
Commercial Art†	9,729	0.04%
Graphic Art & Design†	41,342	0.19%
Other Fine & Applied Arts†	8,033	0.04%
Foreign Languages		
Foreign Languages, General	13,919	0.06%
French	58,857	0.27%
German	17,719	0.08%
Italian	28,355	0.13%
Spanish	454,661	2.08%
Russian	4,740	0.02%
Chinese	21,229	0.10%
Japanese	39,604	0.18%
Arabic	4,434	0.02%
Other Asian, South Asian & Pacific Islands	12,388	0.06%
Other Foreign Languages	14,516	0.07%
Health†		
Health Occupations, General†	36,749	0.17%
Medical Laboratory Technology†	3,177	0.01%
Physicians Assistant†	1,708	0.01%
Medical Assisting†	38,451	0.18%
Respiratory Care/Therapy†	23,471	0.11%
Cardiovascular Technician†	3,794	0.02%
Surgical Technician†	1,943	0.01%
Occupational Therapy Technology†	2,501	0.01%
Speech-Language Pathology & Audiology†	3,012	0.01%
Pharmacy Technology†	7,378	0.03%
Physical Therapist Assistant†	2,023	0.01%
Health Information Technology†	15,866	0.07%
Radiologic Technology†	43,828	0.20%
Diagnostic Medical Sonography†	2,440	0.01%
Athletic Training & Sports Medicine†	2,710	0.01%
Nursing†	344,496	1.58%
Psychiatric Technician†	41,012	0.19%
Dental Occupations†	46,416	0.21%
Emergency Medical Services†	87,635	0.40%
Paramedic†	21,883	0.10%
Mortuary Science†	4,231	0.02%
Health Professions, Transfer Core Curriculum	17,040	0.08%
Community Health Care Worker†	1,231	0.01%
Kinesiology†	2,419	0.01%
Other Health Occupations†	9,708	0.04%
Family & Consumer Sciences†		
Family & Consumer Sciences, General†	29,873	0.14%
Interior Design & Merchandising†	26,382	0.12%
Fashion†	47,780	0.22%
Early Childhood Education†	580,807	2.66%
Nutrition, Foods & Culinary Arts†	202,670	0.93%
Hospitality†	28,570	0.13%

Family Studies†	8,283	0.04%
Gerontology†	3,822	0.02%
Law†		
Law, General	7,193	0.03%
Paralegal†	42,749	0.20%
Humanities		
English	2,467,827	11.30%
Comparative Literature	26,014	0.12%
Classics	40,337	0.18%
Speech Communication	681,883	3.12%
Creative Writing	16,571	0.08%
Philosophy	363,783	1.67%
Religious Studies	45,619	0.21%
Other Humanities	75,322	0.34%
Library Science†		
Library Science, General	10,166	0.05%
Library Technician (Aide)†	4,133	0.02%
Mathematics		
Mathematics, General	2,529,015	11.58%
Mathematics Skills	47,200	0.22%
Other Mathematics	5,151	0.02%
Physical Sciences		
Physical Sciences, General	48,765	0.22%
Physics, General	111,481	0.51%
Chemistry, General	358,870	1.64%
Astronomy	141,395	0.65%
Geology	94,328	0.43%
Oceanography	39,908	0.18%
Earth Science	26,923	0.12%
Other Physical Sciences	1,268	0.01%
Psychology		
Psychology, General	890,700	4.08%
Behavioral Science	2,731	0.01%
Other Psychology	4,641	0.02%
Public & Protective Services†		
Public Administration†	1,556	0.01%
Human Services†	80,663	0.37%
Administration of Justice†	514,448	2.36%
Fire Technology†	206,671	0.95%
Legal & Community Interpretation†	2,095	0.01%
Other Public & Protective Services†	466	0.00%
Social Sciences		
Social Sciences, General	68,665	0.31%
Anthropology	304,579	1.39%
Ethnic Studies	130,032	0.60%
Economics	284,148	1.30%
History	837,584	3.84%
Geography	183,905	0.84%
Political Science	450,568	2.06%
Sociology	476,425	2.18%

Other Social Sciences	2,443	0.01%
Commercial Services†		
Cosmetology & Barbering†	210,420	0.96%
Travel Services & Tourism†	3,380	0.02%
Aviation & Airport Management/Services†	12,404	0.06%
Interdisciplinary Studies		
General Studies	1,067,136	4.89%
Vocational ESL†	25,169	0.12%
General Work Experience†	45,019	0.21%
Other Interdisciplinary Studies	20,417	0.09%
Total of All Completed Credits	**21,834,535**	**100.00%**

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

Table 3: Number of students in the analytical sample who were awarded a credential, by the level and field of that credential

Field of Study	Low-Credit Award (< 6 Credits)	Short-Term Certificate (6-29 Credits)	Long-Term Certificate (> 29 Credits)	Associate's Degree (> 59 Credits)
Agriculture & Natural Resources†	122	264	143	419
Architecture & Related Technologies†	24	144	53	188
Environmental Sciences & Technologies†	166	7	8	24
Biological Sciences	0	98	6	849
Business & Management†	312	2,721	1,008	6,367
Media & Communications†	8	330	189	529
Information Technology†	14	539	143	541
Education	0	225	85	360
Engineering & Industrial Technologies†	289	3,042	3,094	1,558
Fine & Applied Arts	3	283	306	1,125
Foreign Languages	0	134	1	262
Health†	1,491	3,034	3,772	6,409
Family & Consumer Sciences†	166	4,242	1,368	2,280
Law†	1	153	201	302
Humanities	4	390	2	1,059
Library Science†	2	102	6	23
Mathematics	0	16	4	435
Physical Sciences	0	58	3	349
Psychology	0	15	0	1,110
Public & Protective Services†	878	3,624	1,648	3,943
Social Sciences	0	55	18	5,923
Commercial Services†	15	707	1,911	198
Interdisciplinary Studies	7	97	2,927	46,513

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

Table 4: 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

Field of Study	Low-Credit Award (< 6 Credits)	Short-Term Certificate (6-29 Credits)	Long-Term Certificate (> 29 Credits)	Associate's Degree (> 59 Credits)
Agriculture & Natural Resources†	1.00	1.25	1.61	1.18
Architecture & Related Technologies†	1.17	1.10	1.04	1.09
Environmental Sciences & Technologies†	1.54	1.00	1.00	1.04
Biological Sciences	----------	1.14	1.00	1.01
Business & Management†	1.10	1.34	1.15	1.07
Media & Communications†	1.00	1.23	1.14	1.02
Information Technology†	1.07	1.45	1.07	1.06
Education	----------	1.05	1.02	1.02
Engineering & Industrial Technologies†	1.25	1.55	1.15	1.09
Fine & Applied Arts	1.00	1.36	1.05	1.04
Foreign Languages	----------	1.03	1.00	1.02
Health†	1.28	1.08	1.03	1.03
Family & Consumer Sciences†	1.56	1.42	1.14	1.04
Law†	1.00	1.01	1.01	1.02
Humanities	1.00	1.17	1.00	1.01
Library Science†	1.00	1.01	1.00	1.00
Mathematics	----------	1.50	1.00	1.00
Physical Sciences	----------	1.10	1.00	1.05
Psychology	----------	1.00	----------	1.00
Public & Protective Services†	2.29	1.11	1.06	1.06
Social Sciences	----------	1.05	1.00	1.02
Commercial Services†	1.00	1.05	1.01	1.09
Interdisciplinary Studies	1.00	1.09	1.03	1.11

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

Table 5: Return in quarterly earnings (natural log) to community college credentials, estimated with two naïve models that do not account for cumulative completed credits ($N_{students}$ = 759,489; $N_{student\text{-}quarters}$ = 22,215,020)

	Model 1				**Model 2**			
Field of Study	LC Award	Short Cert	Long Cert	Assoc Deg	LC Award	Short Cert	Long Cert	Assoc Deg
Any Field of Study	0.106***	0.122***	0.153***	0.066***				
Agriculture & Natural Resources†					0.006	0.093	-0.024	0.148***
Architecture & Related Technologies†					-0.062	-0.085	-0.163	-0.078
Environmental Sciences & Technologies†					0.083	----------	----------	-0.084
Biological Sciences					----------	0.296***	----------	-0.106***
Business & Management†					0.109*	0.086***	0.041	0.057***
Media & Communications†					----------	-0.023	0.054	-0.078*
Information Technology†					----------	0.087**	0.056	0.117***
Education					----------	-0.140*	0.060	-0.032
Engineering & Industrial Technologies†					0.005	0.108***	0.106***	0.112***
Fine & Applied Arts					----------	-0.136**	0.007	-0.110***
Foreign Languages					----------	-0.054	----------	-0.149**
Health†					0.077***	0.105***	0.328***	0.720***
Family & Consumer Sciences†					-0.081	0.090***	0.063**	0.034*
Law†					----------	0.112	0.130*	0.115*
Humanities					----------	0.001	----------	-0.052*
Library Science†					----------	0.236***	----------	0.056
Mathematics					----------	----------	----------	-0.059
Physical Sciences					----------	0.054	----------	-0.144**
Psychology					----------	----------	----------	-0.035
Public & Protective Services†					0.120***	0.275***	0.243***	0.105***
Social Sciences					----------	-0.139	----------	-0.050***
Commercial Services†					----------	-0.060*	-0.172***	-0.156*
Interdisciplinary Studies					----------	-0.141*	-0.103***	-0.008*
Other Fields of Study					-0.085	-0.019	0.240	----------

NOTES: *$p \leq 0.05$; **$p \leq 0.01$;***$p \leq 0.001$; † Indicates a field that is oriented primarily toward career and technical education (CTE). Standard errors available upon request.

Table 6: Return in quarterly earnings (natural log) to community college credits by subfield and community college credentials by field ($N_{students}$ = 759,489; $N_{student\text{-}quarters}$ = 22,215,020)

	Model 3 (Preferred Model)					
Fields and Subfields of Study	LC Award	Short Cert	Long Cert	Assoc Deg	Completed Credits (Identity)	Completed Credits (Square)
Agriculture & Natural Resources†	-0.003	0.017	-0.079	0.100*		
Agriculture Technology & Sciences, General†					0.0126*	-0.0000
Animal Science†					-0.0011	0.0001
Plant Science†					-0.0083*	0.0005*
Viticulture, Enology & Wine Business†					0.0002	0.0001
Horticulture†					-0.0079**	0.0002
Agriculture Business, Sales & Service†					0.0193***	-0.0007*
Forestry†					0.0087	-0.0000
Natural Resources†					-0.0193***	0.0003**
Agricultural Power Equipment Technology†					0.0118**	0.0000
Architecture & Related Technologies†	-0.029	-0.047	-0.085	-0.016		
Architecture & Architectural Technology†					-0.0029	-0.0000
Environmental Sciences & Technologies†	-0.096	----------	----------	0.014		
Environmental Science					-0.0090	-0.0007
Environmental Studies					-0.0133**	0.0002
Environmental Technology†					0.0039	-0.0001
Biological Sciences	----------	0.233**	----------	-0.010		
Biology, General					-0.0014	-0.0002**
Botany, General					0.0179	-0.0026
Microbiology					-0.0004	0.0003
Zoology, General					-0.0019	-0.0026
Natural History					0.0031	-0.0016
Anatomy & Physiology					-0.0077***	0.0001
Biotechnology & Biomedical Technology†					0.0129*	-0.0000
Other Biological Sciences					-0.0276	0.0015
Business & Management†	0.093*	0.052***	0.009	0.008		
Business & Commerce, General†					0.0026*	-0.0001
Accounting†					0.0078***	-0.0001*

Banking & Finance†					0.0083	-0.0009
Business Administration†					0.0047*	-0.0004
Business Management†					0.0029*	-0.0003**
International Business & Trade†					0.0033	-0.0004
Marketing & Distribution†					0.0041	-0.0007
Logistics & Materials Transportation†					0.0078	-0.0010
Real Estate†					-0.0109***	0.0003**
Office Technology†					0.0046***	-0.0001**
Labor & Industrial Relations†					0.0027	-0.0000
Other Business & Management†					0.0156**	-0.0007*
Media & Communications†	----------	0.002	0.077	-0.028		
Media & Communications, General					0.0030	-0.0001
Journalism†					0.0025	-0.0003
Radio & Television†					-0.0078***	0.0001
Technical Communications†					-0.0007	0.0000
Mass Communications†					0.0122*	-0.0015***
Film Studies					-0.0040*	0.0001
Digital Media†					-0.0010	0.0000
Other Media & Communications†					0.0227	-0.0033
Information Technology†	----------	0.009	0.002	0.046		
Information Technology, General†					0.0051***	-0.0001
Computer Information Systems†					0.0014	-0.0001
Computer Science (Transfer)					0.0037	0.0007*
Computer Software Development†					0.0081***	-0.0001*
Computer Infrastructure & Support†					0.0079***	-0.0001
World Wide Web Administration†					-0.0011	0.0003
Other Information Technology†					0.0000	0.0004
Education	----------	-0.155*	0.025	-0.013		
Education, General (Transfer)					-0.0143**	0.0016**
Educational Aide (Teacher Assistant) †					0.0022	0.0001
Special Education†					0.0052	-0.0003
Physical Education					0.0030***	0.0000
Recreation					-0.0107	0.0007
Health Education†					0.0085***	-0.0008*
Sign Language					-0.0018	0.0000
Educational Technology†					0.0154	-0.0022

Other Education†					-0.0370*	0.0046
Engineering & Industrial Technologies†	-0.045	0.021	0.010	0.071***		
Engineering, General (Transfer)					0.0116*	-0.0002
Engineering Technology, General†					0.0072	-0.0002
Electronics & Electric Technology†					0.0117***	-0.0001***
Electro-Mechanical Technology†					-0.0208*	0.0004
Printing & Lithography†					-0.0048	0.0002
Industrial Systems Technology & Maintenance†					0.0078	-0.0000
Environmental Control Technology (HVAC)†					0.0078***	-0.0001
Diesel Technology†					0.0113***	-0.0001*
Automotive Technology†					0.0027***	-0.0000
Automotive Collision Repair†					0.0033	-0.0000
Aeronautical & Aviation Technology†					-0.0009	0.0001*
Construction Crafts Technology†					0.0055***	-0.0000*
Drafting Technology†					0.0011	-0.0000
Chemical Technology†					0.1098***	-0.0025***
Manufacturing & Industrial Technology†					0.0094***	-0.0001**
Civil & Construction Management Technology†					0.0059***	-0.0001
Water & Wastewater Technology†					0.0283***	-0.0005***
Marine Technology†					0.0050	-0.0003
Other Engineering & Related Industrial Technologies†					0.0092	-0.0003
Fine & Applied Arts	----------	-0.035	0.103	0.002		
Fine Arts, General					-0.0026	-0.0002
Art					-0.0058***	0.0000
Music					-0.0035***	-0.0000
Commercial Music†					-0.0087***	0.0001***
Technical Theater†					-0.0068	0.0001
Dramatic Arts					-0.0085***	0.0001***
Dance					-0.0057***	0.0001*
Applied Design					-0.0037	-0.0003
Photography					-0.0109***	0.0001
Applied Photography†					-0.0069***	-0.0001
Commercial Art†					-0.0056	0.0001
Graphic Art & Design†					0.0007	0.0000
Other Fine & Applied Arts†					0.0031	-0.0001
Foreign Languages	----------	-0.011	----------	-0.047		

Foreign Languages, General					0.0043	-0.0006
French					-0.0049*	-0.0002
German					-0.0075	-0.0002
Italian					-0.0018	-0.0002
Spanish					-0.0023**	-0.0002*
Russian					0.0178*	-0.0009*
Chinese					0.0030	-0.0011**
Japanese					-0.0110***	0.0002
Arabic					-0.0205**	0.0006
Other Asian, South Asian & Pacific Islands					-0.0092	0.0005
Other Foreign Languages					0.0034	0.0000
Health[†]	0.058**	0.096***	0.228***	0.689***		
Health Occupations, General[†]					-0.0059*	-0.0000
Medical Laboratory Technology[†]					0.0267**	-0.0004
Physicians Assistant[†]					-0.0252*	0.0002*
Medical Assisting[†]					-0.0044	0.0001
Respiratory Care/Therapy[†]					-0.0020	0.0000
Cardiovascular Technician[†]					-0.0001	0.0001
Surgical Technician[†]					0.0111	-0.0001
Occupational Therapy Technology[†]					-0.0223*	0.0006*
Speech-Language Pathology & Audiology[†]					0.0112	-0.0012*
Pharmacy Technology[†]					-0.0055	0.0000
Physical Therapist Assistant[†]					-0.0265**	0.0005
Health Information Technology[†]					0.0114***	-0.0003***
Radiologic Technology[†]					-0.0168***	0.0003***
Diagnostic Medical Sonography[†]					-0.0039	0.0002
Athletic Training & Sports Medicine[†]					0.0016	-0.0005
Nursing[†]					-0.0052***	0.0002***
Psychiatric Technician[†]					0.0053**	0.0000
Dental Occupations[†]					-0.0039**	0.0001**
Emergency Medical Services[†]					-0.0017	0.0002**
Paramedic[†]					0.0039	0.0001
Mortuary Science[†]					-0.0163*	0.0003*
Health Professions, Transfer Core Curriculum					0.0023	0.0001
Community Healthcare Worker[†]					0.0118	-0.0006
Kinesiology[†]					-0.0186	0.0024

Other Health Occupations†					0.0035	0.0001
Family & Consumer Sciences†	-0.090	0.044***	0.037	-0.002		
Family & Consumer Sciences, General†					0.0017	-0.0006
Interior Design & Merchandising†					-0.0023	-0.0000
Fashion†					-0.0017	0.0000
Early Childhood Education†					0.0022***	0.0000*
Nutrition, Foods & Culinary Arts†					-0.0023**	0.0001**
Hospitality†					-0.0047	0.0001
Family Studies†					-0.0074	0.0008
Gerontology†					0.0111	-0.0002
Law†	----------	0.065	0.056	0.060		
Law, General					0.0014	0.0008
Paralegal†					-0.0012	0.0001
Humanities	----------	-0.030	----------	0.011		
English					0.0059***	-0.0004***
Comparative Literature					-0.0018	-0.0005
Classics					-0.0001	-0.0004
Speech Communication					0.0028***	-0.0001
Creative Writing					-0.0103*	-0.0000
Philosophy					0.0014	-0.0006***
Religious Studies					-0.0056	-0.0004
Other Humanities					-0.0016	0.0000
Library Science†	----------	0.100	----------	-0.013		
Library Science, General					-0.0272**	0.0051
Library Technician (Aide)†					0.0187**	-0.0004
Mathematics	----------	----------	----------	0.052		
Mathematics, General					0.0007	-0.0003***
Mathematics Skills					-0.0085*	-0.0004
Other Mathematics					-0.0163	0.0024
Physical Sciences	----------	0.155	----------	-0.021		
Physical Sciences, General					0.0006	-0.0003
Physics, General					-0.0034	0.0002
Chemistry, General					-0.0083***	0.0000
Astronomy					0.0083**	-0.0022**
Geology					-0.0003	-0.0002
Oceanography					0.0093	-0.0019

Earth Science					-0.0064	0.0004
Other Physical Sciences					0.0080	-0.0002
Psychology	----------	----------	----------	-0.001		
Psychology, General					0.0023***	-0.0002***
Behavioral Science					0.0014	-0.0013
Other Psychology					0.0349**	-0.0077*
Public & Protective Services†	0.041	0.122***	0.098***	-0.017		
Public Administration†					0.0279**	-0.0007
Human Services†					0.0008	0.0001
Administration of Justice†					0.0113***	-0.0001***
Fire Technology†					0.0061***	0.0000
Legal & Community Interpretation†					0.0037	-0.0001
Other Public & Protective Services†					0.0164	0.0010
Social Sciences	----------	-0.063	----------	-0.029**		
Social Sciences, General					0.0012	0.0001
Anthropology					-0.0024*	-0.0005***
Ethnic Studies					0.0030	-0.0002
Economics					0.0072***	-0.0006**
History					0.0035***	-0.0006***
Geography					-0.0013	-0.0001
Political Science					0.0023*	-0.0007***
Sociology					0.0038***	-0.0002
Other Social Sciences					-0.0005	-0.0026
Commercial Services†	----------	0.086**	0.033	-0.101		
Cosmetology & Barbering†					-0.0109***	0.0001***
Travel Services & Tourism†					0.0008	-0.0002
Aviation & Airport Management/Services†					-0.0048	-0.0000
Interdisciplinary Studies	----------	-0.124	-0.072***	0.017***		
General Studies					0.0022***	-0.0000***
Vocational ESL†					0.0101***	-0.0002***
General Work Experience†					0.0042	0.0000
Other Interdisciplinary Studies					0.0051	-0.0008
Other Fields of Study	-0.045	0.079	0.242	----------		

NOTE: *$p \le 0.05$; **$p \le 0.01$;***$p \le 0.001$; † Indicates a field that is oriented primarily toward career and technical education (CTE). Standard errors available upon request.

Table 7: Percentage change in earnings at three thresholds of completed credits in selected CTE subfields, calculated based on estimates from Model 3 (Table 6)

Fields & Subfields	% of All CTE Credits	6 (vs. 0) Credits	12 (vs. 0) Credits	18 (vs. 0) Credits
Agriculture & Natural Resources				
Animal Science	0.50%	not significant in identity and square		
Horticulture	0.49%	-4.0%	-6.6%	-8.1%
Architecture & Related Technologies				
Architecture & Architectural Technology	0.73%	not significant in identity and square		
Business & Management				
Business & Commerce, General	3.47%	1.2%	1.5%	1.1%
Accounting	5.74%	4.4%	8.0%	11.0%
Business Administration	1.43%	1.2%	-0.7%	-5.6%
Business Management	2.63%	0.7%	-0.5%	-3.7%
Marketing & Distribution	0.78%	not significant in identity and square		
Real Estate	1.71%	-5.5%	-8.9%	-10.6%
Office Technology	3.56%	2.5%	4.5%	6.0%
Media & Communications				
Journalism	0.66%	not significant in identity and square		
Radio & Television	0.92%	-4.1%	-7.1%	-9.2%
Digital Media	1.16%	not significant in identity and square		
Information Technology				
Information Technology, General	3.31%	2.8%	5.0%	6.6%
Computer Information Systems	2.23%	not significant in identity and square		
Computer Software Development	1.08%	4.6%	8.4%	11.4%
Computer Infrastructure & Support	0.80%	4.6%	9.0%	13.2%
Engineering & Industrial Technologies				
Electronics & Electric Technology	1.39%	6.7%	12.6%	17.5%
Environmental Control Technology (HVAC)	0.74%	4.5%	8.8%	12.8%
Diesel Technology	0.54%	6.6%	12.8%	18.4%
Automotive Technology	3.46%	1.6%	3.2%	4.7%
Automotive Collision Repair	0.60%	not significant in identity and square		
Aeronautical & Aviation Technology	0.60%	-0.3%	-0.3%	0.2%
Construction Crafts Technology	4.08%	3.2%	6.2%	9.0%
Drafting Technology	0.99%	not significant in identity and square		
Chemical Technology	0.34%	76.9%	162.2%	225.5%
Manufacturing & Industrial Technology	2.00%	5.5%	10.7%	15.4%
Civil & Construction Management Technology	0.63%	3.3%	6.2%	8.7%
Water & Wastewater Technology	0.35%	16.5%	30.9%	42.1%
Fine & Applied Arts				
Commercial Music	0.49%	-4.7%	-8.6%	-11.7%
Applied Photography	0.88%	-4.4%	-9.2%	-14.4%
Graphic Art & Design	0.71%	not significant in identity and square		
Health				
Health Occupations, General	0.63%	-3.7%	-7.5%	-11.5%
Medical Assisting	0.66%	not significant in identity and square		
Respiratory Care/Therapy	0.40%	not significant in identity and square		
Health Information Technology	0.27%	5.7%	9.1%	9.8%

Radiologic Technology	0.75%	-8.6%	-14.8%	-18.8%
Nursing	5.93%	-2.5%	-3.9%	-4.1%
Psychiatric Technician	0.71%	3.3%	7.0%	11.0%
Dental Occupations	0.80%	-2.0%	-3.5%	-4.5%
Emergency Medical Services	1.51%	-0.4%	0.4%	2.6%
Paramedic	0.38%	not significant in identity and square		
Family & Consumer Sciences				
Family & Consumer Sciences, General	0.51%	not significant in identity and square		
Interior Design & Merchandising	0.45%	not significant in identity and square		
Fashion	0.82%	not significant in identity and square		
Early Childhood Education	10.00%	1.5%	3.3%	5.5%
Nutrition, Foods & Culinary Arts	3.49%	-1.1%	-1.8%	-1.9%
Hospitality	0.49%	not significant in identity and square		
Law				
Paralegal	0.74%	not significant in identity and square		
Public & Protective Services				
Human Services	1.39%	not significant in identity and square		
Administration of Justice	8.86%	6.8%	13.6%	20.3%
Fire Technology	3.56%	3.8%	7.9%	12.4%
Commercial Services				
Cosmetology & Barbering	3.62%	-5.9%	-10.9%	-14.8%

Table 8: Percentage change in earnings at three thresholds of completed credits in selected non-CTE subfields, calculated based on estimates from Model 3 (Table 6)

Fields & Subfields	% of All Non-CTE Credits	6 (vs. 0) Credits	12 (vs. 0) Credits	18 (vs. 0) Credits
Biological Sciences				
Biology, General	3.27%	-1.5%	-4.3%	-8.2%
Microbiology	0.46%	not significant in identity and square		
Anatomy & Physiology	1.44%	-4.0%	-6.9%	-8.7%
Media & Communications				
Film Studies	0.63%	-1.9%	-3.0%	-3.1%
Education				
Physical Education	3.75%	1.8%	3.7%	5.7%
Health Education	2.32%	2.1%	-1.8%	-11.1%
Sign Language	0.75%	not significant in identity and square		
Fine & Applied Arts				
Fine Arts, General	1.08%	not significant in identity and square		
Art	2.27%	-3.4%	-6.5%	-9.5%
Music	2.58%	-2.2%	-4.5%	-6.8%
Dramatic Arts	1.06%	-4.7%	-8.6%	-11.9%
Dance	0.44%	-3.1%	-5.7%	-7.8%
Foreign Languages				
French	0.37%	-3.6%	-8.3%	-13.9%
Spanish	2.84%	-2.0%	-5.1%	-9.3%
Humanities				
English	15.40%	2.1%	1.4%	-2.1%
Speech Communication	4.25%	1.3%	1.7%	1.3%
Philosophy	2.27%	-1.2%	-6.5%	-15.1%
Other Humanities	0.47%	not significant in identity and square		
Mathematics				
Mathematics, General	15.78%	-0.5%	-2.8%	-6.7%
Physical Sciences				
Physics, General	0.70%	not significant in identity and square		
Chemistry, General	2.24%	-4.7%	-9.1%	-13.0%
Astronomy	0.88%	-3.0%	-20.0%	-43.7%
Geology	0.59%	not significant in identity and square		
Psychology				
Psychology, General	5.56%	0.7%	0.1%	-1.8%
Social Sciences				
Social Sciences, General	0.43%	not significant in identity and square		
Anthropology	1.90%	-3.1%	-9.2%	-17.7%
Ethnic Studies	0.81%	not significant in identity and square		
Economics	1.77%	2.1%	-0.3%	-6.9%
History	5.23%	0.1%	-3.6%	-10.8%
Geography	1.15%	not significant in identity and square		
Political Science	2.81%	-1.0%	-6.7%	-16.3%
Sociology	2.97%	1.5%	1.4%	-0.2%
Interdisciplinary Studies				
General Studies	6.66%	1.1%	2.0%	2.5%

Table 9: Six models to test the sensitivity of the results to alternative specifications

Variable Set	Field	Model 4A full analytical sample	Model 4B alternate specification of time	Model 4C completed > 0 credits	Model 4D did not complete a credential	Model 4E did not transfer out of CCC system	Model 4F 20-50 years of age
Credits (Id)	Agriculture & Natural Resources†	-0.0001	-0.0001	-0.0007	-0.0005	0.0018	-0.0030
	Architecture & Related Tech†	-0.0049**	-0.0049**	-0.0052**	-0.0045	-0.0002	-0.0064
	Environmental Sciences & Tech†	-0.0109***	-0.0109***	-0.0112***	-0.0115***	-0.0063	0.0004
	Biological Sciences	-0.0034***	-0.0034***	-0.0034***	-0.0015*	-0.0038***	-0.0033**
	Business & Management†	0.0045***	0.0042***	0.0039***	0.0051***	0.0026***	0.0026***
	Media & Communications†	-0.0027***	-0.0027***	-0.0032***	-0.0028*	-0.0011	-0.0059***
	Information Technology†	0.0055***	0.0054***	0.0052***	0.0068***	0.0045***	0.0071***
	Education	0.0032***	0.0030***	0.0024***	0.0050***	0.0045***	-0.0013
	Engineering & Industrial Tech†	0.0070***	0.0066***	0.0062***	0.0080***	0.0073***	0.0070***
	Fine & Applied Arts	-0.0063***	-0.0064***	-0.0067***	-0.0061***	-0.0054***	-0.0080***
	Foreign Languages	-0.0031***	-0.0033***	-0.0035***	-0.0023**	-0.0011	0.0001
	Health†	-0.0028***	-0.0028***	-0.0031***	0.0004	-0.0024***	-0.0001
	Family & Consumer Sciences†	0.0007	0.0005	0.0001	0.0021***	0.0017***	0.0045***
	Law†	-0.0002	-0.0006	-0.0006	0.0005	0.0005	0.0036
	Humanities	0.0051***	0.0043***	0.0040***	0.0051***	0.0050***	0.0005
	Library Science†	-0.0065	-0.0056	-0.0061	-0.0004	-0.0027	0.0076
	Mathematics	0.0000	-0.0004	-0.0005	0.0008	0.0015**	-0.0003
	Physical Sciences	-0.0036***	-0.0036***	-0.0036***	-0.0021**	-0.0004	-0.0042***
	Psychology	0.0013	0.0009	0.0005	0.0017*	0.0021*	-0.0034**
	Public & Protective Services†	0.0093***	0.0091***	0.0087***	0.0110***	0.0101***	0.0102***
	Social Sciences	0.0043***	0.0039***	0.0040***	0.0046***	0.0048***	0.0029***
	Commercial Services†	-0.0104***	-0.0108***	-0.0111***	-0.0103***	-0.0102***	-0.0120***
	Interdisciplinary Studies	0.0023***	0.0018***	0.0017***	0.0024***	0.0030***	0.0035***
Credits (Sq)	Agriculture & Natural Resources†	0.0001*	0.0001*	0.0001**	0.0001**	0.0000	0.0001*
	Architecture & Related Tech†	0.0000	0.0001	0.0000	0.0000	-0.0000	0.0001
	Environmental Sciences & Tech†	0.0004	0.0004	0.0004	0.0005**	0.0002	0.0001
	Biological Sciences	-0.0001**	-0.0001*	-0.0001*	-0.0001	-0.0002***	-0.0001
	Business & Management†	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0000**	-0.0000*

	Media & Communications†	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001
	Information Technology†	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000*
	Education	-0.0000*	-0.0000	-0.0000	-0.0001***	-0.0000	0.0000
	Engineering & Industrial Tech†	-0.0001***	-0.0001***	-0.0000***	-0.0001***	-0.0001***	-0.0001***
	Fine & Applied Arts	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000
	Foreign Languages	-0.0001**	-0.0001**	-0.0001**	-0.0001*	-0.0001	-0.0002**
	Health†	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	Family & Consumer Sciences†	0.0000*	0.0000**	0.0000**	0.0000	0.0000	-0.0000
	Law†	0.0001	0.0001	0.0001	0.0000	0.0000	-0.0000
	Humanities	-0.0003***	-0.0002***	-0.0002***	-0.0003***	-0.0002***	-0.0001***
	Library Science†	0.0009*	0.0008*	0.0009*	0.0009	0.0007	0.0004
	Mathematics	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	Physical Sciences	-0.0001**	-0.0001**	-0.0001**	-0.0001***	-0.0001	-0.0001
	Psychology	-0.0001**	-0.0001**	-0.0001*	-0.0001	-0.0001	0.0002*
	Public & Protective Services†	-0.0000***	-0.0000***	-0.0000**	-0.0000***	-0.0000***	-0.0001***
	Social Sciences	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	Commercial Services†	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	Interdisciplinary Studies	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0001***
LC Award	Agriculture & Natural Resources†	0.000	-0.001	-0.006	----------	0.042	0.032
	Architecture & Related Tech†	-0.035	-0.023	-0.033	----------	-0.162	-0.048
	Environmental Sciences & Tech†	-0.090	-0.099	-0.090	----------	-0.119	0.013
	Business & Management†	0.089	0.084	0.089	----------	0.128*	0.127*
	Engineering & Industrial Tech†	-0.042	-0.038	-0.044	----------	-0.056	0.007
	Health†	0.064***	0.063***	0.061**	----------	0.077***	0.043
	Family & Consumer Sciences†	-0.110	-0.110	-0.117*	----------	-0.150**	-0.155
	Public & Protective Services†	0.038	0.034	0.037	----------	0.032	0.044
	Other Fields of Study	-0.039	-0.042	-0.041	----------	-0.123	-0.068
Short Cert	Agriculture & Natural Resources†	0.058	0.057	0.059	----------	0.069	-0.002
	Architecture & Related Tech†	-0.060	-0.058	-0.061	----------	-0.019	0.013
	Biological Sciences	0.379***	0.377***	0.376***	----------	0.423***	0.356***
	Business & Management†	0.052***	0.050***	0.052***	----------	0.079***	0.069***
	Media & Communications†	0.020	0.019	0.020	----------	0.017	0.021
	Information Technology†	0.014	0.014	0.015	----------	0.004	-0.012
	Education	-0.155*	-0.157*	-0.153*	----------	-0.206**	-0.087

	Engineering & Industrial Tech[†]	0.023	0.026*	0.024	----------	0.021	0.031*
	Fine & Applied Arts	-0.049	-0.050	-0.048	----------	-0.026	0.075
	Foreign Languages	-0.017	-0.012	-0.016	----------	-0.023	-0.115
	Health[†]	0.094***	0.094***	0.093***	----------	0.108***	0.129***
	Family & Consumer Sciences[†]	0.061***	0.063***	0.063***	----------	0.066***	0.070***
	Law[†]	0.054	0.057	0.054	----------	0.111	0.106
	Humanities	0.016	0.015	0.016	----------	-0.033	0.013
	Library Science[†]	0.088	0.097	0.087	----------	0.103	0.044
	Physical Sciences	0.160	0.153	0.155	----------	-0.036	0.145
	Public & Protective Services[†]	0.119***	0.120***	0.120***	----------	0.108***	0.093***
	Social Sciences	-0.081	-0.087	-0.081	----------	-0.026	-0.058
	Commercial Services[†]	0.087**	0.091**	0.088**	----------	0.072*	0.076
	Interdisciplinary Studies	-0.131*	-0.124	-0.128*	----------	-0.218*	-0.241*
	Other Fields of Study	0.040	0.040	0.041	----------	0.169	0.268
Long Cert	Agriculture & Natural Resources[†]	-0.107	-0.106	-0.108	----------	-0.071	-0.058
	Architecture & Related Tech[†]	-0.089	-0.097	-0.088	----------	0.002	0.137
	Business & Management[†]	0.018	0.017	0.018	----------	0.057*	-0.003
	Media & Communications[†]	0.100	0.103	0.100	----------	0.087	0.127
	Information Technology[†]	-0.004	0.000	-0.002	----------	0.023	-0.010
	Education	0.038	0.034	0.036	----------	-0.025	0.003
	Engineering & Industrial Tech[†]	0.012	0.018	0.013	----------	0.013	-0.002
	Fine & Applied Arts	0.134*	0.134*	0.133*	----------	0.154**	0.128
	Health[†]	0.255***	0.254***	0.252***	----------	0.249***	0.249***
	Family & Consumer Sciences[†]	0.018	0.016	0.017	----------	0.025	0.002
	Law[†]	0.059	0.059	0.059	----------	0.088	0.049
	Public & Protective Services[†]	0.071***	0.074***	0.074***	----------	0.058**	0.085***
	Commercial Services[†]	0.031	0.032	0.030	----------	0.031	0.000
	Interdisciplinary Studies	-0.069***	-0.067***	-0.067***	----------	-0.016	-0.065
	Other Fields of Study	0.245*	0.242	0.243	----------	0.178	0.091
Assoc Deg	Agriculture & Natural Resources[†]	0.086*	0.091*	0.088*	----------	0.076	0.004
	Architecture & Related Tech[†]	-0.037	-0.028	-0.034	----------	0.117	0.048
	Environmental Sciences & Tech[†]	-0.001	0.006	0.001	----------	0.047	0.422
	Biological Sciences	-0.011	-0.011	-0.010	----------	0.018	-0.048
	Business & Management[†]	0.029**	0.034***	0.032***	----------	-0.004	0.040**

Media & Communications†	-0.027	-0.021	-0.025	----------	0.035	0.056
Information Technology†	0.052	0.060*	0.056	----------	0.036	-0.010
Education	-0.025	-0.025	-0.026	----------	-0.045	0.146
Engineering & Industrial Tech†	0.069***	0.075***	0.075***	----------	0.077***	0.061*
Fine & Applied Arts	-0.008	0.000	-0.004	----------	0.000	0.019
Foreign Languages	-0.044	-0.038	-0.042	----------	-0.035	-0.141
Health†	0.671***	0.675***	0.674***	----------	0.633***	0.635***
Family & Consumer Sciences†	0.012	0.019	0.017	----------	0.004	0.017
Law†	0.061	0.070	0.066	----------	0.038	0.059
Humanities	0.026	0.026	0.023	----------	0.038	-0.008
Library Science†	-0.031	-0.023	-0.025	----------	-0.110	-0.072
Mathematics	0.062	0.059	0.059	----------	-0.160	0.143*
Physical Sciences	-0.009	-0.007	-0.009	----------	0.202	0.079
Psychology	-0.004	-0.002	-0.002	----------	0.088	-0.040
Public & Protective Services†	-0.011	-0.002	-0.005	----------	0.041*	-0.001
Social Sciences	-0.024*	-0.022*	-0.024*	----------	0.027	0.030
Commercial Services†	-0.091	-0.085	-0.082	----------	-0.105	-0.114
Interdisciplinary Studies	0.022***	0.027***	0.023***	----------	0.044***	0.020*
N (students)	759,489	759,489	641,706	663,910	584,454	392,750
N (student-quarters)	22,215,020	22,215,020	19,056,004	19,277,437	17,470,393	11,753,453

NOTE: *$p \leq 0.05$; **$p \leq 0.01$;***$p \leq 0.001$; † Indicates a field that is oriented primarily toward career and technical education (CTE). Standard errors available upon request.

Table 10: Span of the middle 90% (5th and 95th percentiles) of the distribution of completed credits in each field of study for those students in the analytical sample who completed at least three credits in that field, by highest credential awarded in the field

	Highest Credential Awarded in the Field				
Field of Study	No Credential Awarded	Low-Credit Award	Short-Term Certificate	Long-Term Certificate	Associate's Degree
Agriculture & Natural Resources†	3.0—24.0	3.0—46.5	10.0—53.0	17.0—73.0	19.0—73.0
Architecture & Related Technologies†	3.0—29.5	3.0—21.0	3.0—38.0	20.5—69.0	12.0—52.0
Environmental Sciences & Technologies†	3.0—6.0	3.0—4.0	----------	----------	4.0—42.0
Biological Sciences	3.0—18.0	----------	7.5—35.0	----------	10.0—27.0
Business & Management†	3.0—20.5	3.0—33.5	6.0—47.0	14.0—61.0	9.0—46.8
Media & Communications†	3.0—15.0	----------	3.0—47.0	15.0—66.0	6.0—51.0
Information Technology†	3.0—12.0	----------	4.0—48.5	11.0—54.0	9.0—53.0
Education	3.0—15.0	----------	5.5—45.0	3.0—53.5	5.5—60.5
Engineering & Industrial Technologies†	3.0—35.0	4.0—49.0	9.0—70.0	25.5—77.5	12.0—75.8
Fine & Applied Arts	3.0—17.0	----------	10.0—74.0	18.0—107.0	15.0—70.0
Foreign Languages	3.0—15.0	----------	5.0—31.0	----------	5.0—39.0
Health†	3.0—30.5	3.0—30.5	6.0—45.5	23.5—69.7	21.0—77.0
Family & Consumer Sciences†	3.0—21.0	4.0—53.5	9.0—46.0	15.0—66.0	18.0—56.0
Law†	3.0—20.0	----------	12.0—33.5	22.0—43.5	14.0—39.0
Humanities	3.0—23.0	----------	10.0—36.5	----------	12.0—42.0
Library Science†	3.0—15.0	----------	13.0—22.5	----------	14.0—23.0
Mathematics	3.0—21.0	----------	----------	----------	12.0—46.0
Physical Sciences	3.0—16.0	----------	10.0—31.0	----------	9.0—41.0
Psychology	3.0—9.0	----------	----------	----------	9.0—25.0
Public & Protective Services†	3.0—30.0	3.0—59.0	8.0—57.1	18.0—65.0	15.0—57.5
Social Sciences	3.0—21.0	----------	----------	6.0—43.0	7.0—33.0
Commercial Services†	3.0—54.0	----------	12.0—50.0	24.0—62.0	18.0—57.0
Interdisciplinary Studies	3.0—34.0	----------	3.0—57.0	3.0—18.0	3.0—24.0

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