Labor Market Returns to Sub-Baccalaureate Credentials: How Much Does a Community College Degree or Certificate Pay?

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Abstract

This study provides one of the first estimates of the returns to different types of community college credentials—short-term certificates, long-term certificates, and associate degrees—across different fields of study. We exploit a rich dataset that includes matched, longitudinal college transcripts and Unemployment Insurance records for students who entered a Washington State community college in 2001–2002, and we use an individual fixed effects identification strategy to control for both observed and unobserved student characteristics that are time invariant. We find that earning an associate degree leads to positive increases in wages in almost every field (compared with earning some credits but not obtaining a credential), but that the magnitude of these effects varies greatly by field. For example, while earning an associate degree in the humanities and social sciences increases earnings by 5 percent for women, earning an associate degree in nursing increases women's earnings by 37 percent. Further, our analysis by field of study reveals that the returns to associate degrees are higher than the returns to long-term and short-term certificates within almost every field, but that a larger proportion of long-term certificates tend to be offered in high-return fields. Our findings also suggest that, unlike associate degrees and long-term certificates, short-term certificates have little or no effect on wages in most fields of study when compared with earning some credits and leaving college without a credential. Finally, the impact of credential receipt on the probability of employment and on hours worked per week is at least as significant in magnitude as the impact on wages. This suggests that part of the returns to earnings estimated in previous literature results from the greater employability of students who earn a credential rather than from increases in human capital as measured by wages.

Table of Contents

1. Introduction

As community colleges continue to enroll a large proportion of the nation's undergraduate population, an accurate estimate of the value of a community college education is essential. Thirty-seven percent of students who enrolled in a degree-granting college in the fall of 2008 did so at a two-year institution.[1] Furthermore, for many low-income and minority students in the United States, community colleges provide a relatively affordable opportunity to gain the skills needed to obtain family-supporting jobs (Hoachlander, Sikora, & Horn, 2003; Levin, 2007). Currently, the literature on the labor market value of community college credentials is relatively limited; studies on the labor market returns to credentials often focus on the returns to four-year degrees.

Unlike most four-year colleges, community colleges offer a diverse mix of credentials to students, including liberal arts and occupational associate degrees, as well as certificates of different lengths. In particular, some certificates require less than a year of full-time study to complete, while other certificates require a year of full-time study or more (Bosworth, 2010). We refer to these as short-term certificates and long-term certificates, respectively.[2] In addition, the mix of credential types awarded at community colleges varies greatly across the nation and has also changed over time even within states. For example, in 2010, only 0.1 percent of credentials awarded in New York were short-term certificates, while in Kentucky 62.9 percent of the credentials awarded were short-term certificates. At the same time, there has also been a great shift in the composition of credential type within a given state over time, mostly in favor of offering more short-term certificates. Between 2000 and 2010, the number of short-term certificates awarded increased by 151 percent nationally, increasing the share of sub-baccalaureate credentials that are short-term certificates from 16 percent to 25 percent in only a decade.[3] As short-term certificates become an ever more important part of the

[1] From published data from the Integrated Postsecondary Data System (IPEDS), obtained from http://nces.ed.gov/programs/digest/d10/tables/dt10_195.asp

[2] In some states, short-term certificates and long-term certificates have different formal names. For example, in Kentucky, long-term certificates are called "diplomas" while short-term certificates are referred to as simply "certificates."

[3] Authors' calculations using IPEDS data. The figures are based on public, degree-offering, primarily postsecondary, Title IV-eligible institutions, where at least 90 percent of credentials awarded were awarded at the sub-baccalaureate level.

picture at community colleges, it is essential to assess this trend and its implications for students. Do these short-term certificates lead to increases in wages and employment, and if so, how do these increases compare to those of longer term credentials?

This study attempts to contribute to the very limited evidence on the labor market value of different types of community college credentials by specifically addressing the following research questions:

1. To what extent do sub-baccalaureate credentials (short-term certificates, long-term certificates, and associate degrees) increase the wages of students who earn them?
2. What is the effect of these credentials on increasing the likelihood that students will be employed or, if employed, work more hours?
3. How do the wage returns to credentials vary by field of study?

We use data from the 2001–2002 cohort of first-time students in Washington State, tracked through the 2008–2009 academic year, and rely on an individual fixed effects identification strategy to examine the labor market returns to specific types of community college credentials. Our estimates of the returns to credentials include both the quantity of schooling necessary to earn each credential plus the additional value of the credential itself. Because we obtain our administrative data from community college transcript records rather than from a national survey, unlike most previous studies on the topic, we are unable to compare the value of credentials to earning a high school diploma. Instead, we estimate the value of earning a specific credential compared with enrolling at the college, earning some credits, but then exiting without earning a credential.

Our findings suggest that there is great variation in the labor market value of different credential levels, and that there is even greater variation by field of credential. While we find that associate degrees and long-term certificates increase wages, the likelihood of being employed, and hours worked, we find minimal or no positive effects for short-term certificates. We also find that associate degrees tend to have higher returns than long-term certificates within a given field.

2. Previous Empirical Literature

A vast majority of the literature on the returns to schooling has focused on the returns to education at high school and four-year colleges (for a review of this literature, see Card, 1999, 2001). By contrast, there is limited research on the returns to a community college education (Belfield & Bailey, 2011).

The existing literature on the returns to community college schooling is mostly based on Mincerian equations using cross-sectional data. These studies compared the earnings of students with different amounts of community college education (or with no college education at all) while controlling for years of work experience and observed student characteristics (Grubb, 1993; Grubb, 1997; Kerckhoff & Bell, 1998; Jacobson & Mokher, 2009; Monk-Turner, 1994; Kane & Rouse, 1995; Leigh & Gill, 1997; Bailey, Kienzl, & Marcotte, 2004). This literature is plagued by the problem of selection bias, wherein high ability and highly motivated students may be more likely than others to have both higher college attainment and higher earnings. Given that the main "unobservable" difference between more educated and less educated students that may also affect later life earnings is ability, studies that have included proxies for ability provide more credible estimates. For example, Kerckhoff and Bell (1998) were able to control for several measures of high school achievement (grade point average and scores on both mathematics and reading achievement tests) as well as the type of high school program attended (academic or vocational), approximating controls for ability and intent, along with labor force experience. Similarly, Kane and Rouse (1995) included test scores as a proxy for ability. In a review of six studies that attempted to control for differences in students' ability using proxy measures, Kane and Rouse found that the returns to one year of community college credits leads to a 5–8 percent increase in annual earnings (Kane & Rouse, 1995).

Most commonly, studies that have estimated returns to credentials have examined the returns to associate degrees, but less frequently have studies also included specific information on the returns to certificates. In their review of the literature, Bailey and Belfield (2011) summarized the evidence on the returns to associate degrees as indicating an average of a 13 percent increase in earnings for men and a 22 percent increase in earnings for women. A few studies also examined the returns to certificates. Bailey et al.

(2004) compared annual earnings for students who had attained a certificate to those of high school graduates. They found no returns to earning a certificate for men, but higher returns to earning a certificate compared with no postsecondary education for women. Furthermore, in two different studies, one using the National Longitudinal Study of 1972 and the other using Survey of Income and Program Participation (SIPP) data, Grubb found mixed evidence on whether or not certificates increased earnings (Grubb, 1997; Grubb, 2002a; Grubb, 2002b). Kerckhoff and Bell (1998), using data from the National Center for Education Statistics (High School and Beyond), found that students who earned licenses and certificates had wages that were comparable to those who earned associate degrees and were higher than those of students who had only earned a high school diploma. Neither Bailey et al., Kerckhoff and Bell, nor Grubb, however, distinguished between the returns to short-term and long-term certificates.

Only one rigorous study (Jepsen, Troske, & Coomes, 2011) has distinguished between the returns to short-term and long-term certificates, in addition to associate degrees.[4] By employing individual fixed effects, the authors were able to control for all time-invariant observable and unobservable differences among students. Using data from Kentucky State, the authors found that associate degrees and long-term certificates on average had quarterly earnings returns of nearly $2,000 for women and $1,500 for men, while short-term certificates had returns of about $300 for both men and women.

Another important question that has received limited attention from researchers is whether there is variation in returns to credits or credentials across different fields of study. There is evidence that student *perceptions* of the likely returns to a particular field of study influence their choice of field of study to begin with (Stuart, 2009; Arcidiacono, Hotz, & Kang, 2010), highlighting the importance of understanding how returns to credentials vary across fields. Grubb's research was among the first to examine the returns to sub-baccalaureate credentials by field of study. Grubb (2002a) found a large degree of variation across fields of study, generally finding that the largest positive returns were to health-related credentials, especially for women, and engineering and computer fields for men. Because of small sample sizes, Grubb (1997) was not able to

[4] Several purely descriptive studies have distinguished between short-term and long-term certificates, however; see Bosworth (2010) for a review of this literature.

examine the returns to certificates by field of study with confidence. By contrast, taking advantage of the large sample sizes of their administrative data, Jepsen et al. (2011) examined returns to associate degrees, long-term certificates, and short-term certificates across fields of study. While theirs was the first analysis of certificates of different lengths by field of study, their categories used to examine fields of study were (like most other studies that have examined fields of study) too broad to reflect the real distinctions typically made at community colleges. For example, the authors did not distinguish between nursing and other allied health programs. Thus the authors found high returns to associate degrees in "health" and in "vocational" fields and minimal or negative returns to associate degrees in "business," "services," and "humanities."

Jacobson, LaLonde, and Sullivan (2005) studied the returns to credits (rather than credentials) by field of study for displaced workers in Washington State. Their study, exploiting a longitudinal dataset that followed students for about four years after initial enrollment, used an individual fixed effect identification strategy that controlled for all time-invariant student characteristics. They found significant positive returns (about 6 percent) to one year of schooling for both men and women after allowing for a post-training adjustment period. However, these positive returns were larger for credits in more technically oriented fields (which they called "Group 1" credits), while the returns to "Group 2" credits were negative and generally not significant. Unfortunately, the study's external validity may be limited; the study's sample of displaced workers means that these results may not be generalizable to overall returns to sub-baccalaureate education. Also, the distinction between "Group 1" and "Group 2" credits is probably insufficient to understand the role that field of study plays in returns to schooling, as each category includes a wide variety of very different fields. In particular, "Group 2" courses include everything from academic social sciences and humanities, to business and "less technical vocational tracts," to basic skills and English as a second language (ESL).

A more recent study provides evidence on the influence of field of study in determining earnings after college graduation for a sample of recent high school graduates. Jacobson and Mokher (2009) tracked the 1996 cohort of ninth graders in Florida and found that among those earning a certificate or an associate degree, those with a concentration in a career and technical education (CTE) field had higher earnings in their early-to-mid 20s than those in other concentrations, even after controlling for a rich set of covariates that included high school performance and prior work experience. Moreover, once student characteristics and choice of concentration were taken into account, students who earned certificates had higher post-college earnings than students who earned associate degrees. However, this effect may be related to the fact that students who earned certificates were much more likely to concentrate in a high-return CTE field rather than in a humanities or social science field (Jacobson & Mokher, 2009).

Our study uses a similar methodology to those used by both Jepsen et al. (2011) and Jacobson et al. (2005), estimating the returns to short-term certificates, long-term certificates, and associate degrees in different fields. Also like Jepsen et al., our comparison group consists of students who earn some community college credits but leave without ever earning a credential; therefore, our results can be directly compared to the estimates provided in that paper, but are not directly comparable with the results from the cross-sectional literature that use students with a high school diploma as the comparison group.

We use data from Washington State, thus adding to the existing body of evidence by using a state that is very different from Kentucky in terms of the local labor market and credential composition at the community college system. Washington State is relatively representative of the national average in terms of the mix of credentials offered and is therefore a good state from which to provide evidence.[5] Additionally, we have a relatively long follow-up period of approximately seven years after initial entry, which is a year and half longer than the follow-up period for the sample in Kentucky. Another advantage of our data is that the Washington State Unemployment Insurance (UI) system is among the few state UI systems that can be linked with postsecondary educational data and that also records total hours worked in the quarter and quarterly earnings. Because wages are not always available, many studies examine the returns of schooling or credentials to earnings, which consists of two components: wages that according to economic theory represent workers' skills (more formally referred to as human capital),

[5] The national average mix of sub-baccalaureate credentials in 2010 was 25 percent short-term certificates, 16 percent long-term certificates, and 59 percent associate degrees. Washington is relatively close to these national averages, with 34 percent of credentials awarded in 2010 being short-term certificates, 12 percent long-term certificates, and 54 percent associate degrees. Authors' calculations using data from IPEDS.

and quantity of employment (Becker, 1962). However, in this study, we are able to calculate hourly wage rates and therefore examine the returns to wages that result from earning a credential. Finally, by using Classification of Instructional Programs (CIP) code information that is available, we are able to code a more fine-tuned measure of field of study than what has been typically used, so that community colleges can better understand the returns to credentials in different fields.

3. Data and Background

3.1 Data

Student unit-record data was obtained from the Washington State Board of Community and Technical Colleges (SBCTC). This data contains detailed, de-identified institutional records for all students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year. For the purposes of this analysis, our sample was further restricted to first-time college students in 2001–2002 (meaning, students with no prior enrollment records, transcript records, or self-reported postsecondary experience).

Student enrollment, transcript, and credential records from the SBCTC were supplemented with matched employment data from Unemployment Insurance (UI) records.[6] Additionally, records were matched with information from the National Student Clearinghouse to determine whether students transferred to four-year institutions or otherwise outside of the Washington State community and technical college system. It is important to note a key data limitation: we are unable to track categories of employment that are not recorded in UI data, so some types of employment (such as self-employment and undocumented employment) may not be represented in these data. Washington UI data include both total earnings and total hours worked each quarter, allowing for an analysis of wages in addition to an analysis of earnings.

[6] Unemployment Insurance records include records from Washington State and the nearby states of Alaska, Idaho, Montana, and Oregon, as well as federal, military, and postal service records.

Our sample was limited to students whose courses were at least partially state-funded,[7] had a valid social security number (and thus could be matched with UI records), were not international students, and were between the ages of 17 and 60 at the time they first enrolled. Additionally, since Washington State community and technical colleges serve a diverse population with a variety of education goals (including basic skills and continuing education students), we further limited our sample to students who were categorized with either an intent of baccalaureate transfer or of enrolling in a career-technical program of study. We further excluded the 7 percent of students who had no wage records during all of the 33 quarters for which we have earnings data available. This initially limited our sample to 37,438 first-time students.

Because our identification depends on the change in wages that results from obtaining a community college credential, in our primary analysis (which uses log wages as an outcome), we limit our sample to students who have wage records both prior to enrollment and after exit from the community and technical colleges. This results in a sample of 24,221 students, with a loss of about 35 percent of our initial sample. (About 27 percent of the individuals in this sample are missing any prior wage records and 13 percent are missing any post-exit wage records.) As we explain further in the results section, our estimates are robust to including those students who are missing wages either pre- or post-college or both. We use this same primary sample of 24,221 students for our descriptive analyses in Section 3.2 and for our individual fixed effects analyses, but when we consider the likelihood of employment, we include a larger sample of students, including those with zero post-college earnings.

3.2 Background on Our Sample

In evaluating the returns to sub-baccalaureate credentials, one might be concerned about the possibility of selection bias; preexisting differences among students can lead to both a greater likelihood of graduation with a particular credential and higher average earnings. Some of these preexisting differences are observed characteristics (such as

[7] This does *not* refer to the receipt by students of financial aid. Rather, this restriction excludes students who were taking only courses for which the state does not provide any full-time equivalent (FTE) funding (e.g., not-for-credit courses, contract-funded courses, or adult basic education or continuing education courses).

gender, age, socioeconomic status,[8] race, and enrollment intensity), and some are unobserved (such as ability and motivation). In developing estimates of the returns to credentials, we attempt to control for both of these using an individual fixed effects methodology. However, in order to learn more about our comparison group, we first show how observed student characteristics differ among students who end up with various sub-baccalaureate credentials and those who do not earn a credential.

Table 1 shows demographic and selected educational characteristics of the students in our sample based on the type of credential ultimately earned by these students within our tracking period of seven years.[9] It is important to note that the comparison group in our study is comprised of students who *attended* a Washington State community or technical college but who did not ultimately wind up earning an award. By contrast, some other studies in the literature (particularly those that use national survey data) include comparisons with high school graduates with no postsecondary experience. Overall, our comparison group (those who earn none of the following credentials) is disproportionately male, slightly older in age, and slightly more likely to initially enroll part time compared with the students who earn a credential. In Table 1, we see that students who earn long-term certificates are disproportionately female. Certificate earners are more likely than others to be older (over the age of 27) and from the bottom SES quintiles, while associate degree earners and students who transfer to baccalaureate institutions are much more likely to be traditional-aged students (age 19 or younger) and from the top SES quintiles.

Initial enrollment intensity also seems to be related to whether or not students earn a credential and what kind of credential students earn. About half of the students in our sample started out taking classes full time (12 or more credits per quarter). More specifically, 19 percent of the sample attempted fewer than five credits in their first

[8] The socioeconomic status (SES) measure used here was developed by CCRC researchers in collaboration with the research staff of the Washington State Board for Community and Technical Colleges (Crosta, Leinbach, & Jenkins, 2006). It sorts students into five SES quintiles and is based on the average SES characteristics in each Census block, including household income, education, and occupation.

[9] In this table, each column includes all students who earned a given credential within the tracking period of seven years, regardless of whether they also earned other credentials or transferred to a four-year institution. Some students who earned multiple credentials may therefore be included in these averages in more than one column.

Table 1
Student Characteristics, by Type of Credential Ultimately Earned

	None of the following	Short-term certificate	Long-term certificate	Associate degree	Transfer to 4-year institution
Sex					
Female (52%)	44%	54%	62%	55%	53%
Male (48%)	56%	46%	38%	45%	47%
Age at entry					
19 or younger (51%)	45%	37%	39%	70%	74%
20 to 26 (21%)	23%	21%	21%	14%	15%
27 to 45 (22%)	25%	33%	31%	14%	10%
46 or older (6%)	7%	9%	9%	3%	1%
Socioeconomic status					
Top 2 quintiles (37%)	34%	27%	34%	43%	46%
Bottom 2 quintiles (41%)	44%	50%	44%	36%	32%
Race					
White (74%)	73%	70%	76%	80%	77%
African American (5%)	6%	7%	8%	3%	4%
Latino (10%)	11%	8%	5%	7%	7%
Asian or Pacific Islander (7%)	7%	12%	9%	8%	9%
Native American (2%)	2%	1%	1%	1%	1%
Other (2%)	2%	2%	2%	1%	2%
Enrollment intensity in first quarter					
Fewer than 5 credits (19%)	25%	19%	13%	3%	5%
At least 5 but fewer than 12 credits (33%)	35%	31%	29%	23%	28%
At least 12 but fewer than 20 credits (43%)	35%	40%	43%	67%	63%
More than 20 credits (5%)	5%	10%	15%	7%	4%

quarter; 33 percent attempted at least five but fewer than 12 credits; 43 percent attempted at least 12 but fewer than 20 credits; and 5 percent attempted more than 20 credits.[10] Students who earned an associate degree or transfer were much more likely to begin with

[10] In Washington State, classes run on the quarter system. That is, there are four quarters during the year (summer, fall, winter, and spring), which roughly correspond with fiscal year quarters. A typical full-time course load might include three traditional classes (about 15 credits) per quarter for three quarters each year, so that a year of full-time study is equivalent to 45 credits. However, a student is considered by the state to be full-time if they take 12 or more credits in a given quarter.

a full-time course load, while students who earned a certificate were the most likely of anyone to take substantially more than a full-time load of credits.[11]

It is important to note that our comparison group earns a substantial number of college credits; though not reported in the table above, the median number of college-level credits earned over the course of our study by our comparison group is 10 and the mean average is 22.5 credits. To the extent that these credits might result in higher wages for our comparison group than if they had not obtained any postsecondary schooling, our estimates of the returns to credentials will be lower than estimates from other studies that used high school graduates as their comparison group. Students who earn other credentials do earn more credits on average, but the difference (especially for students who earn short-term certificates but do not earn any longer term credentials) might not be large enough to appropriately estimate the returns to the credential in comparison; for students whose highest credential earned is a short-term certificate, the median number of college-level credits earned is 26.5 and the mean is 37.8, a difference of only about 15 credits.[12]

Students earned credentials and took classes across a wide range of fields of study. Table 2 demonstrates the range of fields of study typical in Washington State community and technical colleges for men and women. The fields of study shown in Table 2 are based on students' concentrations—that is, the field of study in which students have attempted most of their college-level credits, as long as they have taken at least three classes or 12 credits within that field of study.[13] About half of the students took classes that were predominantly in the liberal arts (humanities and social science or math and science), while the other half took classes in career–technical fields. There was tremendous variation in the popularity of fields by sex. While general academic liberal

[11] Some occupational programs in Washington are run on a block schedule, where students may take classes in a cohort of five days per week (Monday to Friday) for five to six hours per day, leading to a very high credit load.

[12] Students whose highest credential earned is a long-term certificate earned 89.1 credits on average (median 77) and students whose highest credential earned is an associate degree earned 119 credits on average (median 108). Students who wind up transferring out of the system are excluded from these averages.

[13] Using students' concentrations allows us to single out the field of study in which each student is focusing their coursework, without relying on declared major, which may be unreliable for non-workforce students. See Jenkins and Weiss (2011) for more information about student concentrations in Washington State.

arts (humanities and social sciences) is the single most popular concentration for both women and men, there is divergence after that by gender. Mechanics, repair, and welding—a career–technical field—was the second most popular concentration for men, but it ranked near the bottom in popularity for women. Construction was similarly popular for men and unpopular among women. In contrast, allied health was the third most popular field for females, but ranked in the bottom half of fields of study for males.

Table 2
Fields of Study in Which Students Concentrate

	Females	Males	All
Humanities and social sciences	45%	35%	40%
Math and science	11%	9%	10%
Mechanics, repair, and welding	1%	14%	7%
Information science, communication, and design	5%	9%	7%
Business and marketing	8%	5%	6%
Allied health	10%	3%	6%
Construction	1%	9%	5%
Cosmetology, culinary, and administrative services	6%	2%	4%
Engineering sciences	1%	6%	3%
Education and childcare	5%	1%	3%
Nursing	5%	1%	3%
Protective services	1%	4%	3%
Transportation	0%	2%	1%
Other CTE/not assigned	1%	1%	1%

Note. Field of concentration refers to the field of study in which a student took the greatest number of credits or classes, with a minimum of 12 quarter credits or three classes in that field. Adapted from authors' calculations using student unit-record data for first-time students with workforce or transfer intent who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year.

Before we present our estimates of the returns to credentials, we provide a graphical analysis showing the unadjusted trajectory of wages and earnings from a year prior to college entry until about seven years after initial enrollment. The figures present the different trajectories for students who earned different levels of credentials as well as the comparison group of students who took some classes but did not earn any credentials within seven years after initial enrollment. Figure 1 displays the trajectory of earnings, and Figure 2 displays the trajectory of hourly wages, starting four quarters prior to initial enrollment and up to 28 quarters after initial enrollment.

Figure 1
Quarterly Trajectory of Earnings, by Eventual Academic Outcome

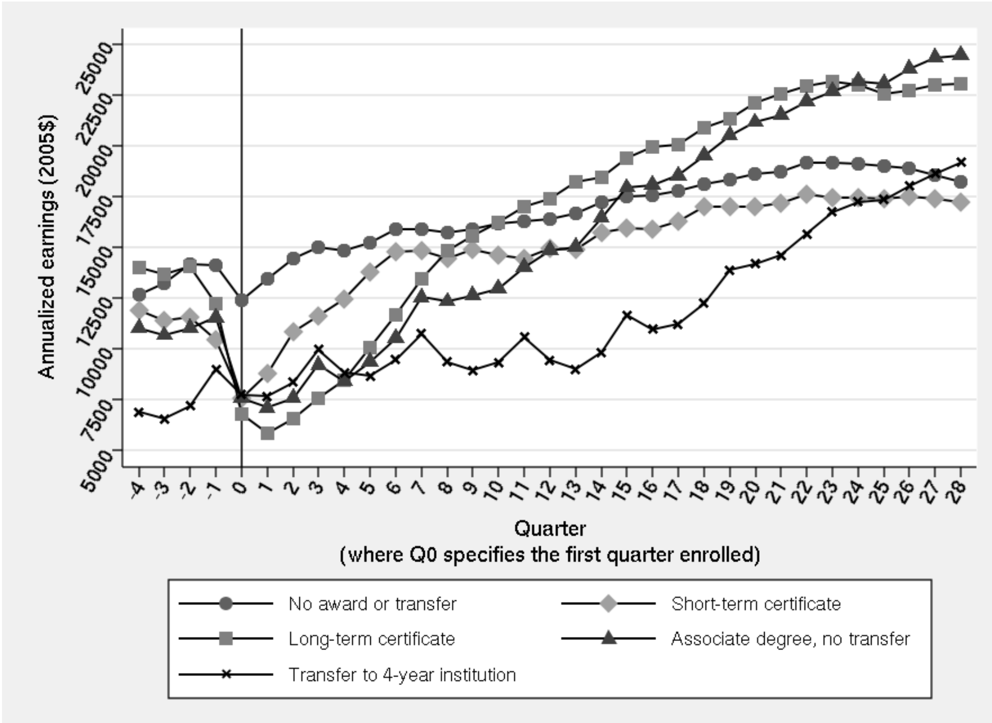
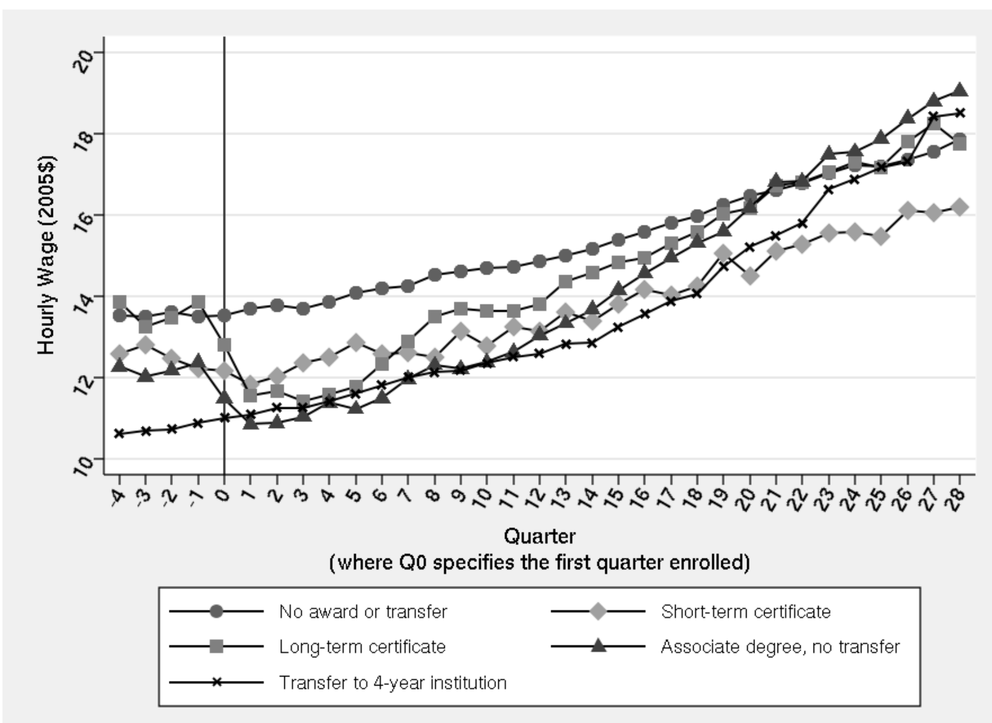


Figure 2
Quarterly Trajectory of Hourly Wages, by Eventual Academic Outcome



As both figures highlight, students who earn different types of credentials have very different initial earnings and wages. This is one reason why it is more revealing to examine differences in trajectories rather than differences in levels of earnings. Students who end up obtaining an associate degree start off with among the lowest wages and earnings, only second to students who transfer, but they end up having higher earnings and wages compared with any other student group, including both those who earn shorter credentials and the comparison group (students who enroll in college but who do not earn a credential or transfer within seven years). Students who end up earning a long-term certificate start off with higher earnings than other student groups, perhaps because they tend to include older students and dislocated workers. Students who eventually transfer to a four-year institution start with the lowest wage rates, but their wages and earnings surpass some of the other groups of students after 29 quarters. In fact, for students who eventually transfer, it appears as though having even seven years of data may be inadequate to capture their true increases in wages and earnings; their earnings and wages increase more rapidly than the overall trend in the last few quarters. Because this trend suggests that even with seven years of follow-up we may underestimate the returns to transferring, we do not report the coefficient for the effect of transfer in our analysis.

4. Methods

In this section, following our main research questions outlined in the introduction, we introduce the main models that we specify in order to answer our three main questions. Section 4.1 introduces the main equation we use to estimate the average wage increases that result from earning different credentials; Section 4.2 introduces the equations used to estimate the average employability effects of earning different credentials; and Section 4.3 introduces the equation used to estimate the wage returns to different credential levels by the field in which the credential is awarded.

4.1 Estimating Wage Returns of Earning a Credential

In this section, we examine the average effect of earning different levels of credentials (including short-term certificates, long-term certificates, and associate degrees) on wages. Following studies by Jepsen et al. (2011) and Jacobson et al. (2005), our preferred model is an individual fixed effects model. This model estimates returns to wages by comparing the trajectory of wages prior to college entry, during college, and after college attendance for students who earn a specific type of credential and for students who enroll but do not earn any credentials in the seven years after initial entry. This method resembles a multiple period difference-in-differences model. Thus, using this methodology, we are able to account for both the observable and unobservable time-invariant differences among students (such as innate ability or motivation). We then estimate a cross-sectional OLS regression, which is similar to the Mincerian equations estimated in most of the previous literature, so that we can compare our estimates to the estimates that are available when it is impossible to observe the trajectory of wages.

First, we estimate our preferred individual fixed effects model, taking advantage of the existence of quarterly information on wages, where we compare the trajectory of wages among students who earn a specific type of credential and students who leave college without earning any credentials.

Model 1: The Individual Fixed Effect Model

$$\ln Wage_{it} = \alpha + \beta(Credential)_{it} + \partial Transfer_{it} + \omega Enrolled_{it} + \lambda(Enrolled_{it} * Credential_{it})$$
$$+ \theta(Transfer_{it} * Enrolled_{it}) \quad + \psi Time_{it} + \xi(Intent * Time_{it}) + \upsilon(Demographic * Time_{it})$$
$$+ \gamma Time^2{}_{it} + \omega(Intent * Time_{it}{}^2) + \psi(Demographic * Time_{it}{}^2) + \rho_i + \eta_t + \varepsilon_{it}$$

$\ln Wage_{it}$ represents the natural logarithm of hourly wages for each individual in each quarter. Our wage records include four quarters before college entry and 29 quarters (about seven years) from initial entry, inclusive.

The key variable of interest is $Credential_{it}$, which represents a vector of dummy variables for each type of credential received at the Washington State community and technical colleges, including associate degrees, long-term certificates, and short-term certificates. This variable is coded 0 in all quarters before a student has earned a given credential (and is always coded 0 for students who never earn that credential). For each credential type, the corresponding variable (short-term certificate, long-term certificate, or associate degree) changes from 0 to 1 during the quarter in which the student first earns that credential, and is coded 1 for every quarter thereafter.

$Enrolled_{it}$ is a dummy variable that is set to 1 for every quarter during which the student is enrolled at any college (based on either Washington State community and technical college data or National Student Clearinghouse data) and 0 otherwise. This variable is included in order to account for the opportunity cost of being enrolled in school during a given quarter.

We also control for whether students transferred to a four-year institution by including a dummy variable, $Transfer_{it}$, which has the value of 1 for every quarter after a student has transferred to a four-year institution, and 0 otherwise.[14] Unlike Jepsen et al. (2011), we do not exclude from our sample students who eventually transfer to four-year institutions. Instead, we include an additional control for whether or not a student has transferred to a four-year institution during a given quarter.[15]

ρ_i represents individual fixed effects—that is, a dummy variable is included for each individual in the sample. The individual fixed effects control for all individual characteristics (observed or unobserved) that do not change over time, such as innate ability or motivation.[16]

η_t represents absolute quarter fixed effects—that is, a dummy variable is included for each year and quarter in time (absolute, not relative to a student's entry). This is included in order to control for general labor market conditions during different quarters, and to account for the bias that could arise from some students entering the labor market during more favorable conditions than others due to differences in the length of credentials or students' length of college study.

The covariates in the second line of the equation include a linear and a quadratic time trend ($Time_{it}$ and $Time^2{}_{it}$), which both control for the non-linear effect of time on

[14] We also test a model where we interact $Transfer_{it}$ with the $Credential_{it}$ dummy for receipt of an associate degree to allow for the different effect of earning an associate degree and then transferring to a four-year institution, but the results change very little. Therefore, we do not include this interaction in the final model for ease of interpretation.

[15] Excluding students who eventually transfer—an exclusion conditional on an outcome—could result in biased estimates. That is, some of the students who never transfer may have desired to transfer but failed to do so because of their preexisting characteristics, and thus may have different potential outcomes compared with the rest of our comparison group. However, even though we control for whether or not a student has transferred, we do not highlight the coefficients for the effect of transferring because we believe we do not have a lengthy enough follow-up period nor information on receipt of a bachelor's degree in order to accurately estimate the effect of baccalaureate transfer.

[16] The individual fixed effects strategy is implemented by using the "areg" command in Stata.

earnings. In addition, in order to control for any bias that may result from how student characteristics influence the trajectory of wages, we interact key student characteristics for which we have data (including demographic and intent variables) with the linear and quadratic time trends. The demographic variables include quintile of socioeconomic status, race (whether or not a student is White and non-Hispanic), and age at time of entry (19 or younger, 20–26, 27–45, or 46–60). The intent variables include two variables: a dummy variable indicating whether a student's track is for academic transfer or for workforce education, and a continuous variable that indicates the number of credits the student has enrolled in during the first quarter (enrollment intensity).

ε_{it} represents the error term.

The individual fixed effects model's objective is to estimate wage gains that result from credential receipt. Thus, in this model, we limit the sample to individuals who have some record of pre-college and post-college employment.

In this model, by including individual fixed effects, we control for all observable and unobservable time-invariant differences among students such as ability or motivation on wage levels. At the same time, by including demographic and intent controls interacted with the time trends, we control for how key observable student characteristics could affect the trajectory of wages over time. For example, as we show in Table 1, the intensity of course-taking during the first quarter of enrollment is highly correlated with completion. If such differences among students also determine the trajectory of earnings, then we should control for their effect. This methodology improves over studies that estimate Mincerinan equations that can only control for observable differences among students, whereas we can control for both observable and unobservable differences among students that change the level of earnings. We are still not able to control for unobserved differences among students that affect the trajectory of earnings. The main identifying assumption of this model is that the wages before an individual earns a credential reflects that individual's human capital, and therefore any changes in the trajectory of wages (compared with that of a student who has not earned a credential) can be attributed to earning a credential.

Second, in order to understand how our results would have been different if we had estimated a cross-sectional model similar to the traditional Mincerian equation that is used in most of the previous literature, we estimate Model 2 below:

Model 2: Mincerian Equation

$$\ln Wage_{Q25-28} = \alpha + \beta Credential_{Q24} + \partial Transfer_{Q24} + \omega Enrolled_{Q25-28} + \lambda(Enrolled_{Q25-28} * Credential_{Q24}) + \theta(Transfer_{Q24} * Enrolled_{Q25-28}) + \psi X + \varepsilon$$

In the model above, $\ln Wage_{Q25-28}$ represents the natural log of wages during the seventh year after initial enrollment (quarters 25–28). The natural log of wages is used to account for the fact that the distribution of wages is skewed to the right.

$Credential_{Q24}$ represents a vector of dummy variables for each type of credential received at the Washington State community and technical colleges, including associate degrees, long-term certificates, and short-term certificates. The value of each dummy variable for a specific type of credential is set to 1 if a student has earned that credential by the sixth year (24th quarter), prior to when the outcome of wages is measured.

$Transfer_{Q24}$ indicates whether or not a student has transferred to a four-year institution by the 25th quarter. In order to account for the opportunity cost of attending college, we control for whether the student is still enrolled during any of the quarters 25 through 28, which are the quarters when earnings outcomes are measured and then subsequently used as the dependent variable. We do so by including the dummy variable $Enrolled_{Q25-28}$, which takes the value of 1 if the student was enrolled during any of those quarters. We also interact $Enrolled_{Q25-28}$ with $Credential_{Q24}$ and $Transfer_{Q24}$ in order to control for the possibility that opportunity costs may be different for students who continue to enroll in college after completing at least one credential or transferring to a four-year university.

We also control for a vector of observable student demographic characteristics *X*, which includes race, SES, gender, age (as well as age squared to allow age to have a nonlinear relationship with earnings), high school graduation or GED status, and family dependency status. In this Mincerian-type model, age is used as a proxy for work experience. We also control for the number of credits students enroll in during the first semester at the college (a measure of enrollment intensity), as well as the season of the student's initial enrollment and an indicator for whether the first college of attendance is located within the Seattle metropolitan area.

As explained earlier, this model is plagued with the selection bias problem: it is possible that the type of student who tends to earn higher wages is also the type of student who tends to earn a credential, which would lead to overestimating the returns to schooling or credential attainment. Our objective is to understand how closely a Mincerian model would approximate the results that we would obtain by accounting for time-invariant observable and unobservable differences among students when the trajectory of wages or earnings is available.

As mentioned earlier, the sample of observations for these analyses that use hourly wages as their outcome is limited to those quarters that have wages available (i.e., those where a student is employed). Additionally, the sample of students is limited to those with some wage data both prior to initial enrollment and after college exit. However, estimates of returns to wages can be depressed if probability of employment for the sample increases, because more marginal workers (with potentially lower wages) would now be included in the portion of the sample participating in the labor market (Lee, 2009). Therefore, we should note that our estimates could reflect an underestimate of the true effect of credentials on wages.

4.2 Estimating the Effects of Earning a Credential on Probability of Employment and Hours Worked

In this section, we examine the effect of community college credentials on increasing employment. Examining employability as an outcome in addition to wages allows us to distinguish two distinct factors that would contribute to an increase in overall earnings: an increase in human capital as reflected by wage rates and an increase in hours worked or employment. Previous literature has mainly focused on examining the effect of community college schooling on earnings (for example, Kane & Rouse, 1995; Jacobson et al., 2005; Jepsen et al., 2011). However, using earnings as an outcome incorporates several factors: wages, the probability of being employed, and the number of hours worked if employed. In this paper, we separately examine the returns to these different components of earnings in order to isolate those labor market outcomes that are influenced by the receipt of community college credentials. This distinction allows us to understand roughly how much of the effect of credentials in increase in earnings is due to an increase in human capital reflected by higher wages, and how much is due to an increase in employability or employment intensity.

In order to examine employability as an outcome, we estimate two models that examine the effect of credential attainment on both the likelihood of being employed and hours worked if employed. Here, we do not use the individual fixed effects model; while the trajectory of wages or earnings are meaningful, it is not helpful to examine likelihood of employment or hours worked in terms of trajectories because there are myriad reasons behind why students move in and out of employment over time. Instead, we introduce models that are similar to the Mincerian equation introduced in Section 4.1 (Model 2), but we also control for pre-college wages in addition to the other controls, in order to account for some of the unobserved preexisting differences among students that may be reflected in wages.

Model 3: The Effect of Credential Attainment on the Likelihood of Employment

$$Employ_{Q25-28} = \alpha + \beta Credential_{Q24} + \partial Transfer_{Q24} + \omega Enrolled_{Q25-28} + \ln Wage_{Q(-4)-(-1)} + \lambda(Enrolled_{Q25-28} * Credential_{Q24}) + \theta(Transfer_{Q24} * Enrolled_{Q25-28}) + \psi X + \varepsilon$$

In this model, the outcome is whether or not a student is employed during any quarter of the seventh year (quarters 25 to 28). The other variables in the model are identical to Model 2, with the exception of $\ln Wage_{(-4)-(-1)}$, which is the natural log of quarterly wages during the year prior to college enrollment (obtained from dividing the total earnings by the total hours worked during the four quarters prior to enrollment).[17]

Then, in order to understand the full picture of employability, we examine the effect of credential attainment on increasing the hours worked conditional on employment (Model 4). Model 4 is also a lagged wage model and is identical to Model 3 except in that the outcome is hours worked 25 to 28 quarters after college entry.

[17] If a student did not work during any of the quarters of the year prior to enrollment, then the student is excluded from our sample. Because the outcome of interest is whether or not a student is employed, students who did not have any wages during quarters 25 to 28 are included.

Model 4: The Effect of Credential Attainment on Hours Worked, Conditional on Employment

$$Hours_{Q25-28} = \alpha + \beta Credential_{Q24} + \partial Transfer_{Q24} + \omega Enrolled_{Q25-28} + \log Wage_{Q(-4)-(-1)} + \lambda(Enrolled_{Q25-28} * Credential_{Q24}) + \theta(transfer_{Q24} * Enrolled_{Q25-28}) \ + \psi X \ + \varepsilon$$

Here, $Hours_{Q25-28}$ represents the average hours worked per week over the time period of quarters 25 through 28. Similar to the previous model, students are excluded from the model if they did not work in any quarters during the year prior to college enrollment. In addition, because the outcome here is hours worked conditional on employment, we exclude all students who were not employed during the seventh year after college entry when the outcome is measured. Again, in Models 3 and 4, the outcomes of students who earned a specific credential type are compared with the outcomes of students who earned some credits but who did not earn a credential.

4.3 Estimating the Wage Returns to Credentials Attainment in Different Fields

In order to study how the returns to credentials vary across fields, we estimate a model that is identical to Model 1 except that we substitute each credential dummy variable with a vector of credential-within-field dummy variables $(Credential * Field)_{it}$. That is, earning an associate degree in allied health is coded in a separate variable from earning an associate degree in construction, so these associate degrees are allowed to have completely different effects on wage returns. All the other components of the model are exactly as those delineated in Model 1, which is our preferred fixed effects model. This new model is described in Model 5:

Model 5:

$$\ln Wage_{it} = \alpha + \beta(Credential * Field)_{it} + \partial transfer_{it} + \omega Enrolled_{it} + \lambda(Enrolled_{it} * Credential_{it}) + \theta(Transfer_{it} * Enrolled_{it}) \ + \psi Time_{it} + \xi(Intent * Time_{it}) + \upsilon(Demographic * Time_{it}) + \gamma Time^2{}_{it} + \omega(Intent * Time^2{}_{it}) + \psi(Demographic * Time^2{}_{it}) + \rho_i + \eta_t + \varepsilon_{it}$$

In this model, we compare wage growth for students who earned a specific credential in a given field (for example, a long-term certificate in nursing) with students who enrolled in college but who did not earn a credential. Therefore, in this framework, we are assessing the value of a specific credential type in a given field, compared with the average value of the schooling that non-credentialed students earned, regardless of the field they were studying.

5. Results

5.1 Returns to Credentials, Reported in Ln(Wages)

Table 3 shows the results for our fixed effects models with sequentially added covariates, showing how we arrived at our preferred model, Model 1 described above. The first model listed in the table (Model M1) is the most basic model using individual fixed effects. Model M2 adds in a control for whether or not the student is currently enrolled in either a two-year or four-year college in order to account for the opportunity cost of attending college. Model M3 adds an interaction between observable student characteristics and the time trend in order to control for any differential effects of observable preexisting student characteristics on wage growth. Model M4 adds interactions between intent and enrollment intensity and the time trend to control for the effect of the differences in students' intents (academic versus vocational) and the intensity of initial course enrollment.

The reason for including the time trend and interactions with student characteristics and intent/initial course enrollment is that it is possible that these observable factors not only affect the level of wages, but also affect the trajectory of wages over time; that is, they might affect the rate of growth in wages. Though there is not much we can do to control for unobserved characteristics that may affect the rate of wage growth, we can control for some key observed characteristics. We find that overall the coefficients are very stable and are not sensitive to different specifications. This could be because the individual fixed effects are doing the "hard work" of identification and thus there is little remaining bias that the addition of different controls can help reduce.[18]

[18] Because it is possible that including a time trend may suppress the increase in wages that result from credential attainment, we also compare a model that excludes the time trend and its interactions entirely with a model that only adds the time trend and no interactions; we find that the results are very similar.

Table 3
Preferred Fixed Effects Model with Sequentially Added Controls

	Females				Males			
	M1	M2	M3	M4	M1	M2	M3	M4
Short-term certificate	−0.0534***	−0.0573***	−0.0332***	−0.0289***	−0.0311***	−0.0363***	−0.00159	−0.00236
	(0.0063)	(0.00666)	(0.00658)	(0.0066)	(0.00723)	(0.00745)	(0.00728)	(0.00729)
Long-term certificate	0.129***	0.122***	0.141***	0.144***	−0.00943	−0.0161**	0.0225***	0.0200***
	(0.00547)	(0.00578)	(0.00571)	(0.00575)	(0.00715)	(0.00741)	(0.00724)	(0.00728)
Associate degree	0.0850***	0.115***	0.0860***	0.0831***	0.0692***	0.0847***	0.0367***	0.0355***
	(0.00297)	(0.00334)	(0.00332)	(0.00334)	(0.00326)	(0.00361)	(0.00355)	(0.00357)
Currently enrolled		X	X	X		X	X	X
Includes demographic controls			X	X			X	X
Includes intent controls				X				X
n (observations)	281,077	281,077	281,077	281,077	316,816	316,816	316,816	316,816
n (students)	11,340	11,340	11,340	11,340	12,881	12,881	12,881	12,881
R-squared	0.594	0.596	0.608	0.608	0.707	0.708	0.723	0.723

Note. Robust standard errors in parentheses. Currently enrolled includes a dummy for whether the student is enrolled in a given quarter, as well as interaction terms between that dummy and each level of credential received. Demographic controls include SES, age category, and non-White interacted with the time trends. Intent controls include transfer or workforce intent, and the number of credits attempted in the first quarter, interacted with the time trends. Adapted from authors' calculations using student unit-record data for first-time students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year.

*$p < .10$. **$p < .05$. ***$p < .01$.

The results from our final and preferred model (Model M4, which estimates the equation that is specified in Model 1) indicates positive effects of long-term certificates on wages of 14.4 percent for women and 2.0 percent for men, and positive effects of associate degrees on wages of 8.3 percent for women and 3.6 percent for men. Short-term certificates do not seem to provide additional benefits to students: we see negative returns to earning short-term certificates for both women (−2.9 percent) and men (−0.2 percent), significantly so for women. These estimates represent wage advantages (or disadvantages, in the case of short-term certificates) over students in the comparison group, who earn 22.5 college credits on average. The zero or negative results for short-term certificates are concerning, and cannot be fully explained by the postsecondary experience of the comparison group, since students who earn a short-term certificate as their highest credential still earn about 15 more credits on average. One possible explanation for the zero or negative returns of the short-term certificates may be that they are concentrated in fields that have little labor market value, a possibility we will explore later in this paper. Another explanation is that students who end up earning short-term certificates are negatively selected, compared with the students who earn some credits and earn no credential; this might happen if the most qualified students in a program are offered employment prior to (and in lieu of) completing the credential, while only the less qualified students in the program remain. Although descriptive information on observable characteristics suggests that students who earn short-term certificates are relatively similar to the students in our comparison group (see Table 1), we cannot rule out the possibility that they may be negatively selected in terms of unobserved preexisting characteristics.

In order to compare our results with Jepsen et al. (2011), who used earnings as their primary outcome, we also estimate a model that is similar to Model 1 but that uses adjusted quarterly earnings (expressed in 2005 dollars) as the outcome (results not presented in table). Jepsen et al. found that associate degrees and long-term certificates (called diplomas in Kentucky) have quarterly earnings returns of nearly $2,000 for women, compared to returns of approximately $1,500 for men, while certificates have small positive returns for men and women. Our results show a relatively similar pattern to the estimates of Jepsen et al. in Kentucky, but our estimates are somewhat lower in general. Specifically, we find that a short-term certificate *decreases* female students' earnings by $142 ($p < .01$) and male students' earnings by $26. A long-term certificate increases female students' earnings by $1,319 ($p < .01$) and male students' earnings by $162 ($p < .05$). Associate degrees increase female students' earnings by $784 ($p < .01$) and male students' earnings by $381 ($p < .01$). In both studies, the comparison group includes students who earned some credits, but who did not earn a credential. The differences in the estimates obtained by the two studies could be due to differences that exist between the labor markets in Washington and Kentucky, or differences in the breakdown of fields of credentials earned, or relatively minor methodological differences between our two studies.[19]

Comparing the individual fixed effects estimates to regression estimates. Next we test how our results would be different if we were only able to estimate a cross-sectional Mincerian equation, similar to most of the previous literature (which would be estimated if one only had a cross-section of data). Using an Ordinary Least Squares (OLS) regression, we control for as many observable student characteristics as possible, using the same sample of students and a student's average wage in quarters 25 through 28 as the outcome.

As Table 4 shows, the wage returns using OLS yield somewhat higher returns, with the exception of short-term certificates for men.

Table 4
Comparison of Estimates from OLS and Individual Fixed Effects Models

	Females		**Males**	
	OLS	**Individual fixed effects**	**OLS**	**Individual fixed effects**
Short-term certificate	−0.0175	−0.0289***	−0.0756*	−0.00236
	(0.029)	(0.00660)	(0.0443)	(0.00729)
Long-term certificate	0.183***	0.144***	0.0688**	0.0200***
	(0.0302)	(0.00575)	(0.0295)	(0.00728)
Associate degree	0.102***	0.0831***	0.0878***	0.0355***
	(0.0137)	(0.00334)	(0.0137)	(0.00357)
n (observations)	11,340	281,077	12,881	316,816
n (students)	11,340	11,340	12,881	12,881
R-squared	0.065	0.608	0.123	0.723

Note. Robust standard errors in parentheses. Adapted from authors' calculations using student unit-record data for first-time students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year.

*$p < .10$. **$p < .05$. ***$p < .01$.

This suggests that students who pursue long-term certificates and associate degrees are positively selected, compared with students who only earn some credits. It is

[19] Washington and Kentucky have labor markets that are substantially different. For example, Washington State has tended to have the highest minimum wage rate in the country, while Kentucky's minimum wage has generally not been higher than the federal rate.

also noteworthy that while there is a difference of a few percentage points in the OLS results, the OLS estimates are a reasonable approximation of the individual fixed effects results.

Sensitivity checks. In choosing our preferred methodology, we face an inherent tradeoff between internal validity and external validity. In this section, we consider several possible threats to internal and external validity that could arise from our specific methodological choices. We show that estimates from our preferred methodology are robust to selecting alternate samples reflecting different methodological choices.

Table 5 shows the results for the sensitivity analysis for women and Table 6 shows the results for the sensitivity analysis for men. In both Table 5 and Table 6, the first column (Model S1) represents our main estimation results (Model 1 described above).

One concern may be that including teenagers in the sample may reduce the estimates' internal validity, because for students who are 19 or younger, pre-college wages might be from after-school or summer jobs that would not be appropriate predictors of wages later in life and are not an accurate indication of pre-college human capital. However, if it is possible to include this sample of students, it would be preferable; they make up a significant portion of the community college population and are often the population of greatest interest to policymakers. Model S2 excludes all individuals who are 20 or younger at time of initial enrollment in the college to test whether or not the estimates are sensitive to the inclusion of this group.

Another concern might be that students who are still enrolled in college toward the end of our data collection window of seven years might not have enough time in the labor market to have valid post-exit wages. Model S3 tests this by excluding individuals who are still enrolled during any of our last two years of data. Alternatively, we might not trust the quarters immediately prior to college enrollment, since these quarters may be associated with an "Ashenfelter dip."[20] Models S4 and S5 test this by excluding the quarter immediately prior to entry and the two quarters immediately prior to entry, respectively.

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[20] The Ashenfelter dip is a decrease in earnings that may appear immediately prior to entering in a vocational training program, since individuals may be more likely to enter such a program shortly after losing employment, or may discontinue employment in preparation for entering the program.

A final concern is that we err on the wrong side of maximizing internal validity (versus external validity) by limiting our sample to students who have both wages prior to enrollment and post-exit. In our preferred model, we had excluded all students from our sample if they had no wage records prior to entering college, or if they had no wage records after they exited college. The reason for making these exclusions was to obtain estimates that reflected the true "value added" to wages that results from obtaining college credentials. The tradeoff is that the results may not be generalizable to students who do not have either pre- or post-college wages. To test whether the results are robust to including students who do not have pre- or post-college wages, we add in students without pre-enrollment wages (in S6), without post-exit wages (in S7), and everyone whether or not they have pre- or post- college wages (in S8). In these cases, we code quarters during which a student does not have wages (whether they are before, during, or after college attendance) as having missing wages.

As the estimates in Table 5 and Table 6 indicate, the results are generally robust to alternate samples. In other words, the general story about the returns to different credential types is not sensitive to the sample adjustments discussed above. The fact that our sample is not sensitive to whether or not we include students who do not have prior wages could be because only 26 percent of students in the sample are missing the information. Furthermore, because we may still have wages for these students while they are enrolled in colleges, there is at least partial information about pre-credential wages for these students.

The only estimate that seems to be especially sensitive to an alternate sample specification (a difference of 3 percentage points or more) is the estimate of long-term certificates for men when we exclude teenagers (Model S2). When we exclude individuals who are 20 years old or younger from the sample, the return to wages is increased by about 4 percentage points. Thus it seems that for older males (who may be more likely to be displaced workers), long-term certificates lead to a 6 percent increase in wages, which is not insubstantial.

Table 5
Sensitivity Check of Fixed Effects Model, Females Only

Females	S1	S2	S3	S4	S5	S6	S7	S8
Short-term certificate	−0.0289***	−0.0449***	−0.0225***	−0.0314***	−0.0330***	−0.0188***	−0.0347***	−0.0224***
	(0.00660)	(0.0102)	(0.00789)	(0.00689)	(0.00729)	(0.00631)	(0.00679)	(0.00621)
Long-term certificate	0.144***	0.172***	0.145***	0.148***	0.152***	0.164***	0.149***	0.165***
	(0.00575)	(0.00864)	(0.00662)	(0.00592)	(0.00616)	(0.00541)	(0.00588)	(0.00536)
Associate degree	0.0831***	0.0872***	0.0751***	0.0838***	0.0826***	0.0827***	0.0829***	0.0822***
	(0.00334)	(0.00413)	(0.00376)	(0.00342)	(0.00351)	(0.00306)	(0.00340)	(0.00304)
n (observations)	281,077	153,305	230,954	271,614	261,726	339,711	285,889	359,131
R-squared	0.608	0.487	0.613	0.610	0.612	0.609	0.611	0.61

Note. Robust standard errors in parentheses. S1 = base model; S2 = excludes 20 or younger; S3 = exclude those individuals who are enrolled after five years (the last two years for which we have data); S4 = exclude (set to missing) all observations one quarter before enrollment (Ashenfelter dip); S5 = exclude one and two quarters prior to enrollment in college (Ashenfelter dip); S6 = include individuals who do not have wages prior to college entry and set the wage to missing in those quarters; S7 = include individuals who do not have post-colleges wages and set the wages to missing in those quarters; S8 = include those without wages in pre- and post-college period and set missing periods to missing in those quarters. Adapted from authors' calculations using student unit-record data for first-time students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year.

*p < .10. **p < .05. ***p < .01.

Table 6
Sensitivity Check of Fixed Effects Model, Males Only

Males	S1	S2	S3	S4	S5	S6	S7	S8
Short-term certificate	−0.00236	0.0203*	0.00823	−0.00398	−0.00667	0.000985	−0.000628	0.00556
	(0.00729)	(0.0121)	(0.00784)	(0.00763)	(0.00815)	(0.00718)	(0.00751)	(0.00705)
Long-term certificate	0.0200***	0.0601***	−0.00560	0.0272***	0.0372***	0.0349***	0.0276***	0.0346***
	(0.00728)	(0.0128)	(0.00802)	(0.00754)	(0.00791)	(0.00703)	(0.00750)	(0.00698)
Associate degree	0.0355***	0.0526***	0.0405***	0.0393***	0.0425***	0.0372***	0.0410***	0.0397***
	(0.00357)	(0.00454)	(0.00386)	(0.00365)	(0.00376)	(0.00331)	(0.00363)	(0.00328)
n (observations)	316,816	157,076	274,892	306,305	295,171	372,386	322,016	393,423
R-squared	0.723	0.682	0.727	0.724	0.726	0.718	0.724	0.719

Note. Robust standard errors in parentheses. S1 = base model; S2 = excludes 20 or younger; S3 = exclude those individuals who are enrolled after five years (the last two years for which we have data); S4 = exclude (set to missing) all observations one quarter before enrollment (Ashenfelter dip); S5 = exclude one and two quarters prior to enrollment in college (Ashenfelter dip); S6 = include individuals who do not have wages prior to college entry and set the wage to missing in those quarters; S7 = include individuals who do not have post-colleges wages and set the wages to missing in those quarters; S8 = include those without wages in pre- and post-college period and set missing periods to missing in those quarters. Adapted from authors' calculations using student unit-record data for first-time students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year.

*p < 0.1. **p < 0.05. ***p < 0.01.

5.2 Probability and Intensity of Employment as Outcomes

Other prior research has looked at the increase in students' earnings after graduation (Jepsen et al., 2011). As discussed earlier, using earnings as an outcome incorporates several factors including wages, the probability of being employed, and the number of hours worked if employed. Therefore, wage increases account for only part of an increase in earnings. To better understand the full impact of credential receipt upon labor market entry, we also examine students' probability of employment and hours worked weekly as outcomes.

As we explained in Section 4.2, the individual fixed effects methodology may not be as appropriate for examining probability of employment and hours worked, because the likelihood of being employed or of working part time *prior* to college entry may not be a strong predictor of the likelihood of being employed or working part time *after* college, given confounding factors such as prior enrollment in full-time education (including high school) and parenthood. Thus we use the lagged wage model introduced in Section 4.2 to estimate the effects of credential attainment on the likelihood of employment and hours worked conditional on employment.

As Table 7 indicates, long-term certificates and associate degrees have a strong, positive impact on students' likelihood of employment, and a more modest positive impact on hours worked per week for those who are employed. Earning an associate degree increases the probability of a student's being employed during the seventh year after initial enrollment by 11 percentage points for women and 8 percentage points for men. Similarly, long-term certificates increase the probability of employment 9 percentage points for women and 11 percentage points for men. However, short-term certificates do not seem to have a strong impact on being employed: the impact on both the probability of employment and hours worked weekly is indistinguishable from 0 for both men and women.

Table 7
Effects of Credential Attainment on Probability of Employment and Hours Worked

	Females		Males	
	Hours Worked Weekly[a]	**Probability of Employment**	**Hours Worked Weekly[a]**	**Probability of Employment**
Short-term certificate	0.373	0.0224	0.223	−0.0735
	(0.697)	(0.0296)	(0.976)	(0.0977)
Long-term certificate	1.800**	0.0857***	0.681	0.111***
	(0.683)	(0.0195)	(0.831)	(0.0180)
Associate degree	0.882**	0.112***	2.256***	0.0761***
	(0.340)	(0.0133)	(0.358)	(0.0149)
n (observations)	9,235	12,688	10,462	14,483
n (students)	9,235	12,688	10,462	14,483
R-squared	0.044	0.030	0.053	0.024

Note. Robust standard errors in parentheses. Adapted from authors' calculations using student unit-record data for first-time students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year.
[a]The model with hours worked weekly as an outcome is run conditional on some employment during the seventh year after enrollment.
**p* < .10. ***p* < .05. ****p* < .01.

5.3 Returns to Credentials, by Field of Study

Decisions about which level of credential a student should pursue are certainly not made in a vacuum. The length of a program (and subsequent opportunity cost) and the type of credential ultimately attained are important factors in this decision. However, it is also possible that students may choose a field of study first and then make a decision about which level of credential to pursue. In this case, the question is not so much, "Should I get a long-term certificate or an associate degree?" but rather, "Should I train to become a medical receptionist or a medical assistant?" At Renton Technical College, for example, there is a 47-credit Medical Receptionist certificate and a 105-credit Medical Assistant associate degree.

In order to understand the effect of field of study, we examine returns to credentials separately by field. Our taxonomy of field of study was adapted from the NCES classification of CIP codes using our knowledge of programs offered in Washington State. Categorizing fields of study is a process that involves tradeoffs: on the one hand, it would be ideal for substantively different programs leading to distinct occupations to be categorized separately. On the other hand, to have sufficient power to run the analysis across fields, a threshold must be met for the number of students in that field. For that reason, in the current study some distinct but relatively small programs (such as cosmetology, culinary services, and administrative services) had to be grouped together. These three programs at least have demographically similar profiles. Similarly, mechanics and repair (including, for example, automotive programs) and precision production (including welding) were merged into one category, which seems appropriate, given that both represent male-dominated vocational fields with a large amount of lab time and hands-on activity.

Another reason it is important to examine credentials by field of study is that there is tremendous variation in the breakdown of credentials offered across these fields of study. Table 8 shows the number of students in our sample who earned a given type of credential in each field.

Table 8
Number of Students in Each Credential Level and Field of Study Combination

	Females			Males		
	Associate degree	Long-term certificate	Short-term certificate	Associate degree	Long-term certificate	Short-term certificate
Humanities and social sciences	1,707	0	7	1,214	3	1
Math and science	9	0	0	34	0	0
Information science, communication, and design	67	21	16	158	65	55
Engineering sciences	22	8	12	134	29	37
Allied health	150	226	134	38	47	51
Nursing	129	176	128	18	35	16
Mechanics, repair, and welding	8	4	8	157	96	87
Protective services	11	2	10	53	11	16
Construction	3	0	14	29	9	26
Business and marketing	143	39	70	82	21	25
Education and childcare	41	22	27	1	0	1
Transportation	1	0	4	3	33	80
Cosmetology, culinary, and admin services	88	88	74	13	17	11
Other CTE/not assigned	2	1	0	1	0	9

Note. Adapted from authors' calculations using student unit-record data for first-time students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year. Sample sizes smaller than 10 were omitted from the analysis of returns to credentials by field of study and combined into the "other" category.

Regardless of gender, associate degrees are dominated by awards in humanities and social sciences, that is, by traditional liberal arts degrees, most of which are designed for transfer to baccalaureate institutions. For women, long-term certificates are dominated by awards in allied health and nursing, and to a lesser extent, cosmetology, culinary, and administrative services. Those fields, as well as business and marketing, are also prominent in short-term certificates for women. However, for men, certificates are less skewed toward specific fields, though mechanics, repair, and welding has the highest number of graduates for both short-term and long-term certificates.

A priori, it is possible that field of study determines a student's occupation upon graduation, which could have the largest effect on wages; the level of credential could be unimportant compared to the field of that credential. As explained in Section 4.3, to test which fields of study are "high-return," we run our individual fixed effects model but allow each combination of credential level and field of study to have its own separate dummy variable to capture the returns to earning that credential in that field only (Model 5). Dummy variables for each credential level and field combination are all included in a single model. Results are reported in Table 9, with three separate columns for each credential level for the sake of readability.

Short-term certificates do not, overall, show a great deal of value in terms of wage increases for students who earn them. However, there is a fair amount of variation among the coefficients. A number of short-term certificates even seem to have significant negative returns (compared to attending college but not earning a credential). Even students pursuing nursing, traditionally thought of as a high-return field, see negative returns to earning a short-term certificate (which would lead to becoming a nursing assistant or nursing aide rather than a licensed practical nurse or registered nurse). On the other hand, there are some fields where short-term certificates do seem to have value: short-term certificates in protective services for men lead to particularly high (and statistically significant) wage increases of 22.2 percent, while in transportation the returns are 6.1 percent.

Table 9
Estimates of Wage Returns to Credentials by Field of Study

	Females			Males		
	Short-term certificates	**Long-term certificates**	**Associate degrees**	**Short-term certificates**	**Long-term certificates**	**Associate degrees**
Humanities and social sciences			0.0492***			0.0139***
			(0.00391)			−0.00451
Science and mathematics						0.207***
						−0.0212
Information science, communication, and design	−0.0472	0.0372	0.0366**	−0.0568***	−0.0237	−0.00941
	(0.0384)	(0.0302)	(0.0158)	(0.0183)	(0.0178)	−0.0112
Engineering sciences	−0.0608		0.0788***	−0.0240	−0.0429	0.0793***
	(0.0398)		(0.0264)	(0.0250)	(0.0266)	−0.0113
Allied health	−0.0328***	0.0600***	0.138***	0.0135	−0.0148	0.135***
	(0.0118)	(0.00873)	(0.0105)	(0.0192)	(0.0186)	(0.0195)
Nursing	−0.0581***	0.290***	0.370***	−0.0960***	0.204***	0.268***
	(0.0126)	(0.0104)	(0.0118)	(0.0369)	(0.0223)	(0.0295)
Mechanics, repair, and welding				−0.0588***	0.0148	0.0716***
				(0.0153)	(0.0138)	(0.0100)
Protective services	0.00169		0.141***	0.222***	0.0267	0.0825***
	(0.0395)		(0.0344)	(0.0282)	(0.0364)	(0.0164)
Construction	0.121**			−0.0208		0.140***
	(0.0487)			(0.0306)		(0.0235)
Business and marketing	−0.0732***	0.0225	0.0398***	0.0401	−0.139***	0.00769
	(0.0164)	(0.0233)	(0.0107)	(0.0282)	(0.0312)	(0.0139)
Education and childcare	0.0420*	−0.0786***	0.0607***			
	(0.0239)	(0.0301)	(0.0190)			
Transportation				0.0606***	0.132***	
				(0.0180)	(0.0247)	
Cosmetology, culinary, and administrative services	0.00670	−0.0558***	0.0517***	−0.176***	−0.179***	−0.0523*
	(0.0165)	(0.0142)	(0.0131)	(0.0484)	(0.0309)	(0.0309)
Other	0.0462	0.0274	0.132***	−0.0148	0.161***	−0.144***
	(0.0320)	(0.0364)	(0.0261)	(0.0458)	(0.0371)	(0.0557)
Overall estimate to credential from separate model without fields	−0.0289***	0.144***	0.0831***	−0.00236	0.0200***	0.0355***
	(0.00660)	(0.00575)	(0.00334)	(0.00729)	(0.00728)	(0.00357)

Note. Robust standard errors in parentheses. A single model (M5) was estimated for each of the male and female subsamples. Adapted from authors' calculations using student unit-record data for first-time students who attended any of the 34 community and technical colleges in Washington State during the 2001–2002 academic year.

**p* < .10. ***p* < .05. ****p* < .01.

For long-term certificates, the variation is even more substantial. Despite women seeing impressively large returns to long-term certificates overall, only allied health and nursing are associated with statistically significant, positive returns. For women, earning a long-term certificate in allied health increases wages by 6 percentage points and earning a long-term certificate increases wages by 29 percentage points. However, it is not only the larger number of women in these fields that accounts for higher overall estimates of returns to long-term certificates for women compared to men. In fact, returns to long-term certificates are lower for men than for women in nearly every field of credential in which adequate numbers of individuals earning that credential make the comparison warranted. Some long-term certificates for men do result in positive, statistically significant returns; in particular, returns to nursing long-term certificates are 20.4 percent for men, and returns to transportation long-term certificates are 13.2 percent.

Associate degrees lead to positive returns across almost every field of study. There is variation in the magnitude of these awards (for example, nursing degrees lead to the highest returns for both women and men, 37.0 percent and 26.8 percent respectively, but associate degrees in humanities increase earnings by only about 5 percent). However, unlike the other credentials, there are almost no associate degree and field combinations that have zero or non-significant returns (none for women, and only a couple for men). Despite the fact that our overall estimates indicated it was more valuable for women to earn a long-term certificate than an associate degree, our field-specific results suggest that a more nuanced view is necessary. The high overall returns to long-term certificates are driven by the large number of certificates in allied health and especially nursing; the lower returns to associate degrees are driven mostly by degrees in humanities and social sciences.[21] In any given field (for example, nursing), it is still preferable to earn the associate degree.

Other studies (Grubb, 1997; Jepsen et al., 2011) have found large returns to credentials in healthcare, which encompasses both nursing and allied health. It is useful to note that both long-term certificates and associate degrees in nursing lead to much

[21] It is worth noting that most associate degrees in the humanities and social sciences are designed to transfer to baccalaureate institutions and may leave the door open to further education, which could result in higher returns if we followed students for a longer period. Many occupational associate degrees, on the other hand, are terminal. See Hanushek, Woessmann, and Zhang (2011) for some discussion of the relative labor-market advantages of vocational and general education programs over time.

higher returns than the other corresponding credentials in allied health, suggesting there is a need to break down the healthcare field in more detail.

6. Discussion and Conclusion

This paper adds to the literature on the returns to community college credentials by providing evidence from the 2001–2002 cohorts of students from Washington State using a rigorous methodology. Our results suggest that some credentials lead to high returns to wages, but some do not; in addition, there are large variations by the field of credential. Overall, we find that there are substantial wage returns to long-term certificates and associate degrees for women (14 percent higher quarterly wages for obtaining a long-term certificate and 8 percent higher quarterly wages for obtaining an associate degree compared with attending a college and not obtaining a credential), and modest returns for men (2 percent increase in quarterly wages for long-term certificates and 3.6 percent increase in quarterly wages for obtaining an associate degree).[22] By contrast, we find that short-term certificates have no overall labor market value in terms of increasing wages.

Furthermore, our findings suggest that high returns to earnings that are found in some of the previous studies are likely to be partly driven by greater likelihood of employment and more hours worked, in addition to the increase in wages. For both men and women, the earning of associate degrees and long-term certificates has an important role in increasing the likelihood of employment and, to a lesser extent, hours worked. Earning a long-term certificate increases the likelihood of being employed by 9 percentage points for women and by 11 percentage points for men, and it increases hours worked for those who are employed by 1.8 more hours per week for women and about 0.7 hours per week (not statistically significant) for men. Earning an associate degree leads to about an 11 percentage point greater likelihood of employment for women and an 8 percentage point greater likelihood for men. Earning a short-term certificate does not seem to have any effect on either likelihood of employment or hours worked.

[22] However, as noted, there is some sample sensitivity to the estimate on long-term certificates for men; older workers may experience slightly higher wage returns of about 6 percent.

We find that there is great variation to returns across fields of study within a given credential level. For example, earning an associate degree in nursing increases women's wages by 37 percent, whereas earning an associate degree in humanities and social sciences or information science, communication, and design increases wages by only 5 percent and 3.6 percent, respectively. Another important point is that simply comparing the average returns to associate degrees versus long-term certificates without regard to the field in which those credentials were earned can be misleading. This is because, despite the substantially higher returns to long-term certificates for women, associate degrees yield higher returns to wages *within any given field*. The reason for the higher overall average returns to long-term certificates (compared with associate degrees) for women is that the long-term certificates are more likely to be earned in high-return fields, particularly nursing. Furthermore, unlike Grubb (2002a) (who found zero to negative returns to associate degrees in some fields), we find positive and significant returns to almost all associate degrees, even though in some fields the returns are much higher than in other fields.

Our analysis by field of study shows that most short-term certificates do not lead to improved labor market outcomes for students who complete them. Even allied health and nursing, which we found to be high-return fields for longer credentials, do not have positive returns for students who earn only a short-term certificate. That said, there were some exceptions, notably protective services and transportation for men. Although we would not go as far as to say that short-term certificates never have any value, the evidence is suggestive that they tend to have minimal value over and above attending college and earning some credits. It is unclear why short-term certificates in many fields are associated with negative or zero returns. As we noted earlier, students who earn short-term certificates as their highest credential earn 38 credits on average, which is 15 credits more than the average number of credits earned by the comparison group that enrolls but does not earn any credential. Some possible explanations are that short-term certificates are earned in fields that are on average less valuable than the coursework that students accumulate when they are not pursuing a program, but our examination of returns to credentials across fields of study does not support this explanation. A more concerning possibility is that, even after accounting for the trajectory of wages, the unobserved characteristics of students who end up with short-term certificates negate any positive effects of earning a short-term certificate, such that the students who earn short-term certificates are, on average, those who cannot find jobs or are not accepted into some of the selective long-term certificate or associate degree programs.

Given that we find much higher returns to associate degrees and long-term certificates, which complements the limited evidence in the previous literature that distinguishes between the value of certificates of different lengths, community colleges should examine each short-term certificate program carefully and critically, and states should be concerned about the recent dramatic increases in the share of short-term certificates. At the same time, it is important to note that even if a program is not increasing wages and employment for its graduates, it may still be beneficial in other ways—for example, by providing entry into an occupation that a student finds desirable for other, non-economic reasons.

This study contributes to the literature on the returns to community college in several ways. First of all, the only other study on this topic that attempts to control for unobserved student characteristics is by Jepsen et al. (2011), who used data from the state of Kentucky. Our analysis using data from Washington State complements the study by Jepsen et al. by providing evidence from a different state. As we discussed earlier, Washington data has several distinct advantages—the most significant of which is that our dataset has wage records available, which allows us to understand the value of credentials in terms of increasing human capital, not just earnings. Our dataset also allows for seven years of follow-up after initial enrollment at community college, which is a year and a half longer than Jepsen et al.'s cohort. Having a longer follow-up of students' labor market outcomes is particularly important for community college students, because many of them take several years before they graduate or exit college and begin working full time. In addition, we have a somewhat more fine-tuned categorization of the field of study. This allows us to distinguish between, for example, allied health and nursing; other studies that do not distinguish between these two fields may find their returns to healthcare driven largely by extremely high returns to nursing credentials.

However, like most empirical literature, our study is not without limitations. First of all, the external validity of our results is limited since these results are from Washington State during 2001 to 2009. The returns to community college credentials may be different in other locations, and particularly after the so-called Great Recession that emerged in 2008. For this reason, we believe that it is important that similar research be conducted using data from different states and from other time periods. Secondly, even though we are able to account for most of the selection bias found in the previous literature, we are still unable to control for unobserved differences among students that affect the trajectory of wages. This may, in particular, be a problem in studying the returns to wages for traditional students, whose wages prior to entering college may not be a true reflection of their potential to earn. It is at least comforting that when we exclude teenagers from our sample, the returns to credentials do not change for most credential types (with the exception of long-term certificates for men). In general, we find that our results are very robust to various sensitivity checks.

Our study has important policy implications for state policymakers and community colleges. As we discussed earlier, possibly as a side effect of the shift in focus from enrollment to completion, there has been a dramatic increase in the number of short-term certificates offered by community colleges nationally. Although our study and the study by Jepsen et al. (2011) are the only rigorous studies that have examined the returns to short-term certificates, both studies find that these credentials have zero to very small returns. Thus, based on this emerging evidence, we believe that this dramatic national increase in the number of short-term certificates in the last decade may not have produced a commensurate increase in wages for those earning them. State policymakers may want to place greater value in investing in associate degrees and long-term certificates in high-return fields of study that are known to have positive impacts for students. More generally, we recommend that states and community colleges use this emerging evidence on the returns to different types of credentials in different fields when making decisions about program offerings. In particular, data collected for the use of reporting gainful employment statistics (now mandated by the federal government for some programs) may provide a helpful barometer to program success. However, care should be taken in interpretation, since those statistics do not account for student selection into particular programs in the first place. Finally, we believe that every state should conduct similar analyses on the labor market returns of the credentials that they offer. States should not only use the information to make decisions about program offerings, but should also make the information about labor market returns to different programs and credentials available to students alongside information on graduation rates. That way, students who attend college primarily to find a career in which to earn a living wage can make informed decisions about which program would be best to pursue.

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