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

Mina Dadgar
Career Ladders Project
Madeline Joy Trimble
Columbia University

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 data set that includes matched, longitudinal college transcripts and Unemployment Insurance records for students who entered a Washington State community college in 2001–2002. Our findings based on an individual fixed effect model suggest that earning an associate degree or a long-term certificate is associated with increased wages, particularly for women. We find that there is greater variation in returns to wages by the field of study than by degree type.

Keywords: *labor market, value, community college, credentials*

THIRTY-SEVEN percent of students who enrolled in a degree-granting college in the fall of 2008 did so at a 2-year institution.[1] 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 for understanding the returns on the educational investment made by community college students and taxpayers.

Unlike most 4-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, whereas 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] Between 2000 and 2010, the number of short-term certificates awarded increased by 151% nationally, increasing the share of sub-baccalaureate credentials that are short-term certificates from 16% to 25% in only a decade.[3] As short-term certificates become an ever more important part of the picture at community colleges, it is essential to assess this trend and its implications for students.

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:

Research Question 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?

Research Question 2: What is the effect of these credentials on increasing the likeli-

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hood that students will be employed or, if employed, work more hours?

Research Question 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 effect strategy to examine the labor market returns to specific types of community college credentials compared with attending community college and not earning any credentials.

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. Although we find that earning associate degrees or long-term certificates is associated with increased wages, an increased likelihood of being employed, and increased hours worked, we find minimal or no positive effects for short-term certificates. We also find that associate degrees are associated with higher returns within almost any given field when compared with other credentials.

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 4-year colleges (for a review of this literature, see Card, 1999, 2001). The existing literature on the returns to community college schooling is mostly based on survey data that are cross-sectional in nature and do not provide information about the returns to community college credentials by specific fields of study. 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 (Bailey, Kienzl, & Marcotte, 2004; Grubb, 1993, 1997; Jacobson & Mokher, 2009; Kane & Rouse, 1995; Kerckhoff & Bell, 1998; Leigh & Gill, 1997; Monk-Turner, 1994). 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 1 year of community college credits leads to a 5% to 8% increase in annual earnings (Kane & Rouse, 1995).

Most commonly, studies that have estimated returns to credentials have examined the returns to associate degrees. In their review of the literature, Belfield and Bailey (2011) summarized the evidence on the returns to associate degrees as indicating an average of a 13% increase in earnings for men and a 22% increase in earnings for women. A few studies also examined the returns to certificates, but did not distinguish between certificates of different lengths. These studies have found mixed evidence on whether or not certificates increase earnings over and above a high school diploma; with some studies finding positive returns to certificates and others finding no positive returns. These articles are not able to distinguish certificates by length or field of study (Bailey et al., 2004; Grubb, 1997, 2002a, 2002b; Kerckhoff & Bell, 1998).

Only one rigorous study (Jepsen, Troske, & Coomes, 2014) 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 US$2,000 for women and US$1,500 for men, whereas short-term certificates had returns of about US$300 for both men and women.

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

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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 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. (2014) examined returns to associate degrees, long-term certificates, and short-term certificates across fields of study. 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 data set that followed students for about 4 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%) to 1 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. 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.

Our study uses a similar methodology to those used by both Jepsen et al. (2014) 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 with the estimates provided in that article, 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.

Our study contributes to previous literature by providing one of the first estimates of the returns to community college credentials across different fields of study. By using Classification of Instruction Programs (CIP) code information that is available, we are able to code a more fine-tuned measure of field of study than has been typically used, so that community colleges can better understand the returns to credentials in different fields. In addition, Washington State is one of the very few states where Unemployment Insurance (UI) data includes information on wages and thus we are able to report wage gains that are associated with earning different types of credentials.[5] Finally, using data from Washington State, we add 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.

Data and Background

Data

Student unit-record data were obtained from the Washington State Board of Community and Technical Colleges (SBCTC). These data contain 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.[6] 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 UI records.[7] In addition, records were matched with information from the National Student Clearinghouse to determine whether students transferred to 4-year institutions or otherwise outside of the Washington State community and technical college system. 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. 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 (including self-employment and undocumented employment) are not represented in these data.[8] Our sample was limited to students whose courses were at least partially state-funded,[9] 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.

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In addition, as 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 excluded students whose primary intent was not either transfer or workforce education; in effect, this primarily excludes students with the primary intent of adult basic skills or recreational coursework, 41% of the original sample. We further excluded the 7% of remaining 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, 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% of our initial sample. (About 27% of the individuals in this sample are missing any prior wage records and 13% are missing any post-exit wage records.) As we explain further in the Methods and 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 the "Background on Our Sample" section 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.

Background on Our Sample

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 7 years.[10] 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. 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 socioeconomic status (SES) quintiles, whereas 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. Students who earned an associate degree or transfer were much more likely to begin with a full-time course load, whereas students who earned a certificate were the most likely of anyone to take substantially more than a full-time load of credits.[11] In total, 54% of students who earned an associate degree by their 25th quarter after entry also transferred to a baccalaureate institution. Not reported in the table, students who earn a short-term certificate by their 25th quarter after entry (but do not earn a long-term certificate, an associate degree, nor do they transfer) earn 44 credits on average; students who earn a long-term certificate but nothing else earn 99 credits on average.

It is important to note that our comparison group earns a substantial number of college credits; 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]

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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
20–26 (21%)	23	21	21	14	15
27–45 (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
n	16,575	931	953	4,318	4,509

Note. In this table, each column includes all students who earned a given credential within the tracking period of 7 years, regardless of whether they also earned other credentials or transferred to a 4-year institution. Some students who earned multiple credentials may therefore be included in these averages in more than one column. The sample in this table includes 37,438 first-time students in Washington community and technical colleges during the 2001–2002 academic year whose courses were at least partially state-funded, who had a valid social security number (and thus could be matched with UI records) and at least some wage records during the time period examined, who were not international students, who were between the ages of 17 and 60 at the time they first enrolled, and whose primary intent was either transfer or workforce education. Students who earn a short-term certificate by their 25th quarter after entry (but do not earn a long-term certificate, an associate degree, nor do they transfer) earn 44 credits on average; students who earn a long-term certificate but nothing else earn 99 credits on average. UI = Unemployment Insurance.

Figures 1 and 2 show the differences in the trajectory of earnings (Figure 1) and wages (Figure 2) for students who end up with different types of credentials 7 years after initial college enrollment. The students who earn some credits but no credentials are the comparison group. The graphs begin with quarterly wages and earnings a year prior to enrollment and continue for up to 28 quarters after initial enrollment.

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

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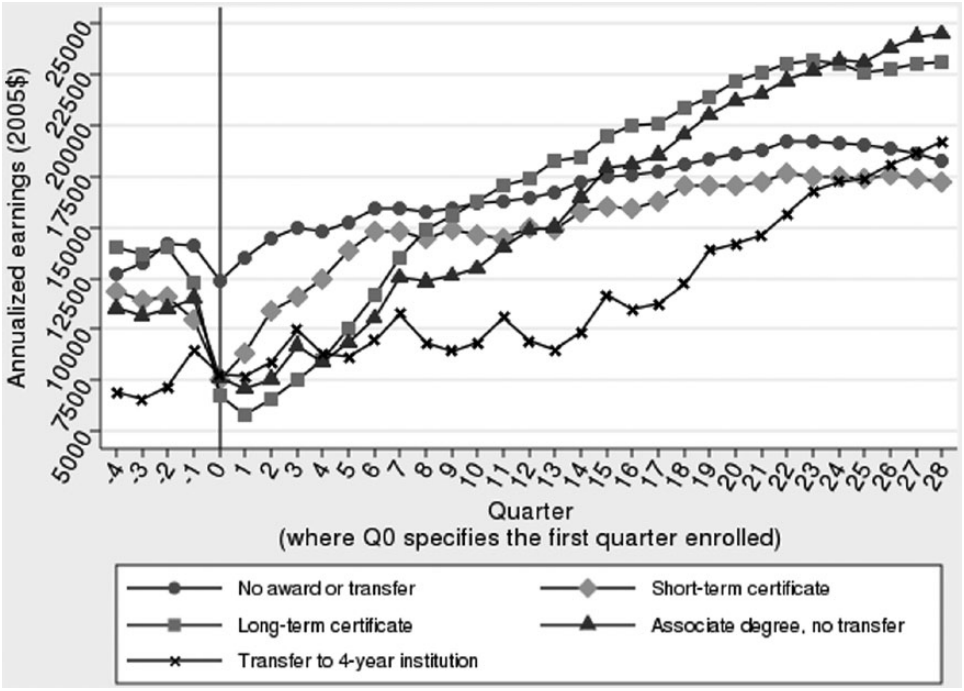

FIGURE 1. *Quarterly earnings by academic outcome.*

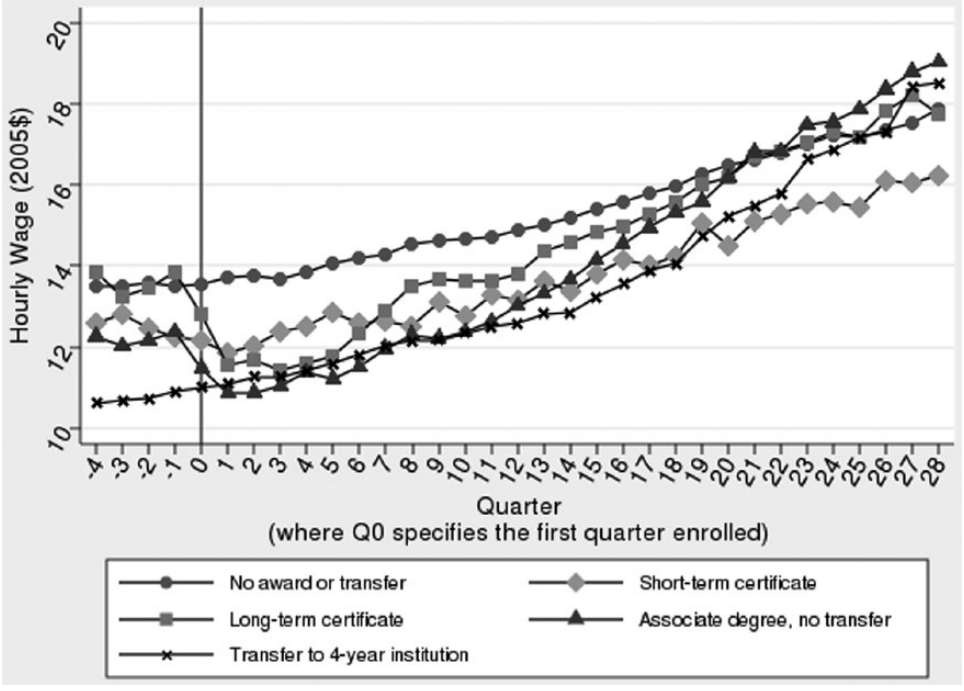

FIGURE 2. *Quarterly wage by academic outcome.*

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earnings, as many of the previous studies have done. 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 7 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 4-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 7 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 7 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.

Method and Results

In this section, following our main research questions outlined in the "Introduction" section, we introduce the main models that we specify to answer our three main questions.

Methods for 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. (2014) and Jacobson et al. (2005), our preferred model is an individual fixed effect 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 7 years after initial entry. To 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 1d: *The Individual Fixed Effect Model*

$$\begin{aligned}\ln \text{Wage}_{it} = {} & \alpha + \beta\left(\text{Credential}\right)_{it} + \partial \text{Transfer}_{it} \\ & + \omega \text{Enrolled}_{it} + \lambda\left(\text{Enrolled}_{it} \times \text{Credential}_{it}\right) \\ & + \theta\left(\text{Transfer}_{it} \times \text{Enrolled}_{it}\right) + \psi \text{Time}_{it} \\ & + \xi\left(\text{Intent} \times \text{Time}_{it}\right) \\ & + \upsilon\left(\text{Demographic} \times \text{Time}_{it}\right) \\ & + \gamma \text{Time}_{it}^2 + \omega\left(\text{Intent} \times \text{Time}_{it}^2\right) \\ & + \psi\left(\text{Demographic} \times \text{Time}_{it}^2\right) \\ & + \rho_i + \eta_t + \varepsilon_{it}.\end{aligned}$$

$\ln \text{Wage}_{it}$ 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 7 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. We include a linear and a quadratic time trend (Time_{it} and Time_{it}^2), which control for the non-linear effect of time on earnings. In addition, 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 SES,[13] race (whether or not a student is White and non-Hispanic), and age at the time of entry (19 or younger, 20–26, 27–45, or 46–60).[14] 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

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has enrolled in during the first quarter (enrollment intensity). 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 to account for the opportunity cost of being enrolled in school during a given quarter. We also control for whether students transferred to a 4-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 4-year institution, and 0 otherwise.[15] Unlike Jepsen et al. (2014), we do not exclude from our sample students who eventually transfer to 4-year institutions. Instead, we include an additional control for whether or not a student has transferred to a 4-year institution during a given quarter.[16] 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.[17] 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 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. 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. The main identifying assumption of this model is that the wages before an individual earns a credential can act as a proxy for time-invariant human capital differences that are correlated with educational credentials; therefore, we assume 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. This assumption may not be true when pre-college wages do not adequately reflect worker's earning potentials because they are in a different industry or occupation than post-college work.[18]

Table 2 shows the results for estimating Model 1 with sequentially added covariates, showing how we arrived at our preferred model, Model 1d described above. The first model listed in Table 2 (Model 1a) is the most basic model using individual fixed effects. Model 1b adds in a control for the number of credits attempted in the current semester in college to account for the opportunity cost of attending college. Model 1c adds an interaction between observable student characteristics and the time trend to control for any differential effects of observable preexisting student characteristics on wage growth. Model 1d adds interactions between intent and enrollment intensity and the time trend to control for the effect of the differences in students' intents (academic vs. 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. As the coefficients in Table 2 illustrate, the models are not sensitive to the various specifications, presumably because the individual fixed effects is doing the "hard work" of identification.[19]

There are substantial differences in the average wage gain from different credentials in our preferred model by gender (Model 1d). For women, the average return to earning an associate degree is 6.3% and a long-term certificate 15%; while short-term certificates are not associated with wage gains over and above earning some credits. For men, only associate degrees result in wage gains (a modest gain of about 2%). These estimates represent wage advantages over students in the comparison group, who earn 22.5 college credits on average. This is noteworthy because even students who earn short-term certificates earn on average about 15 more credits than students who do not earn any credentials. As we discuss in the next section, these average results appear mainly driven by the large variation in the returns to credentials by field of study. In addition, we will discuss the effect earning a credential has on the likelihood of finding a job and on hours worked.

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TABLE 2

Wage Returns by Credential Level Relative to Non-Credential Earnings, Fixed Effects Model With Sequentially Added Controls: Models 1a–d

	Females				Males			
	a	*b*	*c*	*d*	*a*	*b*	*c*	*d*
Short-term certificate	−.0534*** (.0138)	−.0535*** (.0146)	−.0331** (.0141)	−.0284** (.0141)	−.0311* (.0176)	−.0340* (.0180)	−.00218 (.0161)	−.00290 (.0162)
Long-term certificate	.129*** (.0160)	.127*** (.0169)	.146*** (.0161)	.149*** (.0162)	−.00943 (.0210)	−.0229 (.0212)	.0141 (.0192)	.0126 (.0194)
Associate degree	.0850*** (.00717)	.0894*** (.00800)	.0648*** (.00781)	.0631*** (.00786)	.0692*** (.00848)	.0612*** (.00908)	.0210** (.00857)	.0208** (.00860)
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^2	.594	.595	.606	.607	.707	.708	.722	.722

Note. Robust standard errors are given in parentheses. This sample excludes students who do not have at least some employment records both prior to college entry and after college exit. Currently enrolled includes the number of credits that a student is enrolled in a given quarter, as well as interaction terms between that variable 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. SES = socioeconomic status.

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

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 article. A more concerning 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.

Sensitivity Checks. In choosing our preferred methodology, we face an inherent trade-off 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 mainly robust to selecting alternate samples reflecting different methodological choices. Table 3 shows the results for the sensitivity analysis for women and Table 4 shows the results for the sensitivity analysis for men. In both Tables 3 and 4, the first column (Model S1) represents our main estimation results (Model 1d described above). One concern may be that for students who are younger and who work less than full-time prior to attending college, pre-college wages are not an accurate indication of earning potential. However, if it is possible to include this sample

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TABLE 3
Sensitivity Check of Fixed Effects Model, Females Only

Females	S1	S2	S3	S4	S5	S6	S7	S8
Short-term certificate	−.0284** (.0141)	−.0185 (.0284)	−.0235 (.0174)	−.0312** (.0143)	−.0327** (.0148)	−.0204 (.0134)	−.0335** (.0141)	−.0233* (.0132)
Long-term certificate	.149*** (.0162)	.0599* (.0325)	.149*** (.0188)	.153*** (.0163)	.157*** (.0167)	.170*** (.0150)	.154*** (.0161)	.171*** (.0148)
Associate degree	.0631*** (.00786)	.0199 (.0250)	.0570*** (.00906)	.0644*** (.00788)	.0643*** (.00797)	.0668*** (.00701)	.0637*** (.00782)	.0665*** (.00694)
n (observations)	281,077	59,756	230,954	271,614	261,726	339,711	285,889	359,131
R^2	.607	.713	.612	.608	.610	.607	.609	.608

Note. Robust standard errors are given in parentheses. S1 = base model; S2 = includes only students 25 or older at entry and who worked 1,000 hours or more in the year prior to entry; S3 = excludes those individuals who are enrolled after 5 years (the last 2 years for which we have data); S4 = excludes (set to missing) all observations one quarter before enrollment (Ashenfelter dip); S5 = excludes one and two quarters prior to enrollment in college (Ashenfelter dip); S6 = includes individuals who do not have wages prior to college entry and set the wage to missing in those quarters; S7 = includes individuals who do not have post-college wages and set the wages to missing in those quarters; S8 = includes 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 4
Sensitivity Check of Fixed Effects Model, Males Only

Males	S1	S2	S3	S4	S5	S6	S7	S8
Short-term certificate	−.00290 (.0162)	−.0290 (.0281)	.00859 (.0180)	−.00463 (.0165)	−.00743 (.0170)	−.000177 (.0153)	−.000975 (.0161)	.00480 (.0149)
Long-term certificate	.0126 (.0194)	−.0354 (.0306)	−.0126 (.0208)	.0192 (.0193)	.0281 (.0196)	.0292 (.0179)	.0199 (.0192)	.0292* (.0177)
Associate degree	.0208** (.00860)	−.0301 (.0217)	.0268*** (.00943)	.0243*** (.00857)	.0277*** (.00865)	.0233*** (.00761)	.0248*** (.00849)	.0247*** (.00751)
n (observations)	316,816	81,616	274,892	306,305	295,171	372,386	322,016	393,423
R^2	.722	.755	.726	.723	.725	.718	.724	.719

Note. Robust standard errors are given in parentheses. S1 = base model; S2 = includes only students 25 or older at entry and who worked 1,000 hours or more in the year prior to entry; S3 = excludes those individuals who are enrolled after 5 years (the last 2 years for which we have data); S4 = excludes (set to missing) all observations one quarter before enrollment (Ashenfelter dip); S5 = excludes one and two quarters prior to enrollment in college (Ashenfelter dip); S6 = includes individuals who do not have wages prior to college entry and set the wage to missing in those quarters; S7 = includes individuals who do not have post-college wages and set the wages to missing in those quarters; S8 = includes 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.
*$p < .10$. **$p < .05$. ***$p < .01$.

of students, it would be preferable; they make up a significant portion of the community college population and recent high school graduates are often the population of greatest interest to policymakers. Model S2 excludes all individuals who are less than 25 years old at the time of initial college enrollment or who have worked less than 1,000 hours in the year prior to college entry 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 7 years might not have enough time in the labor market to have valid

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post-exit wages. Model S3 tests this by excluding individuals who are still enrolled during any of our last 2 years of data. Alternatively, we might not trust the quarters immediately prior to college enrollment, as 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.

A final concern is that we err on the wrong side of maximizing internal validity (vs. 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 trade-off 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 Tables 3 and 4 indicate, the results are generally robust to alternate samples. When we limit the sample to older students who have held substantial pre-college employment (Model S2), the returns are somewhat lower for all credential types.

Estimating the Effects of Earning a Credential on Probability of Employment, Hours Worked, and Earnings. 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. Here, we use a Mincerian equation with pre-college wages as a control, to account for some of the unobserved preexisting differences among students that may be reflected in wages.

Model 2: *The Effect of Credential Attainment on the Likelihood of Employment*

$$\begin{aligned}\text{Outcome}_{Q25-28} = {} & \alpha + \beta\text{Credential}_{Q24} + \partial\text{Transfer}_{Q24} \\ & + \omega\text{Enrolled}_{Q25-28} + \ln\text{Wage}_{Q(-4)-(-1)} \\ & + \lambda\left(\text{Enrolled}_{Q25-28} \times \text{Credential}_{Q24}\right) \\ & + \theta\left(\text{Transfer}_{Q24} \times \text{Enrolled}_{Q25-28}\right) \\ & + \psi X + \varepsilon.\end{aligned}$$

In this model, there are three potential outcomes we examine and report: First, whether or not a student is employed during any quarter of the seventh year (quarters 25 to 28); second, the average hours worked during quarters 25 to 28 after initial enrollment, conditional on some employment; and third, total earnings during quarters 25 to 28 unconditional on being employed (i.e., including 0 earnings for students who do not work). The main independent variable of interest is whether the student has received a credential 24 quarters (6 years) after initial enrollment. We also control for whether or not a student has transferred to a 4-year college within the first 6 years and whether or not the students is enrolled at the time the outcomes are measured. Finally, we include the $\ln\text{Wage}_{(-4)-(-1)}$, which is the natural log of quarterly wages during the year prior to college enrollment to account for the initial stock of human capital for each individual. X includes all the demographic characteristics that were interacted with the time trend in Model 1d.

Results. As Table 5 indicates, long-term certificates and associate degrees are associated with an increased likelihood of employment, and a more modest positive association with hours worked per week for those who are employed. Our estimates suggest that 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

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TABLE 5
Effects of Credential Attainment on Probability of Employment and Hours Worked

	Females			Males		
	Hours worked weekly[a]	Probability of employment	Annualized earnings[a]	Hours worked weekly[a]	Probability of employment	Annualized earnings[a]
Short-term certificate	0.373	0.0224	−519.8	0.223	−0.0735	−3,861
	(.697)	(.0296)	(1,112)	(.976)	(.0977)	(2,397)
Long-term certificate	1.800**	0.0857***	6,069***	0.681	0.111***	2,963**
	(.683)	(.0195)	(1,216)	(.831)	(.0180)	(1,096)
Associate degree	0.882**	0.112***	4,207***	2.256***	0.0761***	3,667***
	(.340)	(.0133)	(425.4)	(.358)	(.0149)	(743.6)
n (observations)	9,235	12,688	12,688	10,462	14,483	14,483
n (students)	9,235	12,688	12,688	10,462	14,483	14,483
R^2	.044	.030	.137	.053	.024	.153

Note. Robust standard errors are given 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 models with hours worked weekly and annualized earnings outcomes are run conditional on some employment during the seventh year after enrollment.
*$p < .10$. **$p < .05$. ***$p < .01$.

men. However, short-term certificates are not associated with an increased likelihood of employment.

As an increase in earnings could be attributed to either an increase in wages, an increase in the number of hours worked, or both, the results with earnings as an outcome corroborate the prior evidence reported here. For women, a long-term certificate leads on average to an approximately US$6,100 return in annualized earnings while an associate degree leads on average to an approximately US$4,200 return. For men, long-term certificates represent an average increase of US$2,963 while associate degrees represent an average increase of US$3,667. Short-term certificates do not lead to a significant increase in earnings for either gender. These estimates are substantially lower than those estimated by Jepsen et al. (2014), who found in their cross-sectional analysis returns that are approximately US$9,200 for associate degrees for women, US$8,000 for long-term certificates for women, US$5,400 for associate degrees for men, and US$4,100 for long-term certificates for men. Jepsen et al. also found significant, positive returns to short-term certificates, albeit at a much reduced return compared with associate degrees and long-term certificates, which we do not find here.[21]

Estimating the Wage Returns to Credentials Attainment in Different Fields

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 $(\text{Credential} \times \text{Field})_{it}$. 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 3:

Model 3:

$$\begin{aligned}\ln \text{Wage}_{it} = {} & \alpha + \beta(\text{Credential} \times \text{Field})_{it} + \partial \text{Transfer}_{it} \\ & + \omega \text{Enrolled}_{it} + \lambda(\text{Enrolled}_{it} \times \text{Credential}_{it}) \\ & + \theta(\text{Transfer}_{it} \times \text{Enrolled}_{it}) + \psi \text{Time}_{it} \\ & + \xi(\text{Intent} \times \text{Time}_{it}) \\ & + \upsilon(\text{Demographic} \times \text{Time}_{it}) \\ & + \gamma \text{Time}_{it}^2 + \omega(\text{Intent} \times \text{Time}_{it}^2) \\ & + \psi(\text{Demographic} \times \text{Time}_{it}^2) \\ & + \rho_i + \eta_t + \varepsilon_{it}.\end{aligned}$$

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TABLE 6
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 child care	41	22	27	1	0	1
Transportation	1	0	4	3	33	80
Cosmetology, culinary, and administrative 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. CTE = career and technical education.

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. Our taxonomy of field of study was adapted from the National Center for Education Statistics (NCES) classification of CIP codes.

Results. Table 6 shows the number of students in our sample who earned a given type of credential in each field. We can see that there is tremendous variation in the breakdown of credentials offered across these fields of study; 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, while certificates are concentrated in career and technical education fields. Table 7 reports the wage returns to each credential type in each field. A single model includes all three level of credential and field combinations, though Table 7 reports a separate column for each credential level for the sake of readability.

Understanding the fact that each credential type is concentrated in specific fields of study is helpful because it shows that the average return to each level of credential is driven to a large degree by the field of study. For example, we can see that while the average returns to associate degrees for women are about half the size of the wage returns for long-term certificates, the large returns to long-term certificates are mainly driven by the high wages of women who study nursing. In fact, for women, within any given field (including nursing), the wage returns to associate degrees are higher compared with the returns to long-term certificates. The reason why the average returns to wages for women who earn long-term certificates for women are twice as women who earn associate degrees is that

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TABLE 7
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			.0525*** (.00885)			.0163 (.0106)
Science and mathematics						.205*** (.0495)
Information science, communication, and design	−.0474 (.0766)	.0365 (.0601)	.0405 (.0428)	−.0560 (.0388)	−.0294 (.0451)	−.00986 (.0258)
Engineering sciences	−.0645 (.0822)		.0822 (.0615)	−.0207 (.0345)	−.0424 (.0712)	.0819** (.0331)
Allied health	−.0341 (.0244)	.0620*** (.0232)	.144*** (.0340)	.0104 (.0349)	−.0158 (.0400)	.139 (.0872)
Nursing	−.0564** (.0243)	.293*** (.0260)	.377*** (.0273)	−.0925** (.0435)	.199*** (.0572)	.272*** (.0541)
Mechanics, repair, and welding				−.0564 (.0382)	.0122 (.0394)	.0728*** (.0254)
Protective services	−8.38e-05 (.0831)		.152* (.0865)	.221*** (.0621)	.00300 (.0977)	.0902** (.0416)
Construction	.113* (.0658)			−.0188 (.0649)		.150*** (.0502)
Business and marketing	.0746** (.0361)	.0236 (.0380)	.0445** (.0214)	.0406 (.0647)	−.142** (.0588)	.0108 (.0315)
Education and child care	.0463 (.0425)	−.0779** (.0333)	.0653* (.0385)			
Transportation				.0599 (.0400)	.133** (.0529)	
Cosmetology, culinary, and administrative services	.00510 (.0385)	−.0551* (.0333)	.0559** (.0257)	−.174** (.0768)	−.189*** (.0622)	−.0536 (.0903)
Other	.0470 (.0835)	.0329 (.0498)	.135* (.0791)	−.0166 (.103)	.157 (.115)	−.141 (.124)
Overall estimate to credential from separate model without fields	−.0285* (.0146)	.146*** (.0163)	.0870*** (.00818)	−.00181 (.0163)	.0161 (.0198)	.0380*** (.00909)

Note. Robust standard errors are given 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.
*$p < .10$. **$p < .05$. ***$p < .01$.

associate degrees are dominated by humanities and social science fields, which have fairly modest returns of a few percentage point wage gains.

As Table 7 illustrates, short-term certificates in general are not associated with large wage increases. For example, in nursing, earning an associate degree or a long-term certificate increases women's wages by about 37.7% and 29.3%, respectively, but earning a short-term certificate does not lead to any increases in wages, over and above earning some credits. This is presumably due to the fact that earning a short-term certificate in nursing leads to a different occupational trajectory (e.g., nursing assistant or nursing aide rather than a licensed practical nurse or a registered nurse). There are few fields where earning a short-term certificates increases wages over and above earning credits.

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However, earning a short-term certificate in protective services for men is associated with particularly high (and statistically significant) wage increases of 22%.

For long-term certificates, the variation is even more substantial. Despite women seeing impressively large returns to long-term certificates overall, the results are mainly driven by the high numbers of long-term certificates in nursing and allied health. For women, earning a long-term certificate in allied health is associated with an increase in wages of 6 percentage points and earning a long-term certificate in nursing is associated with an increase in wages of 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 with men. 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 are not associated with positive, statistically significant returns; in particular, returns to nursing long-term certificates are 20% for men, and returns to transportation long-term certificates are 13%.

Associate degrees are associated with positive returns across almost every field of study. There is variation in the magnitude of these awards (e.g., nursing degrees lead to the highest returns for both women and men, 37% and 27%, respectively, but associate degrees in humanities are associated with increasing women's earnings by only about 5% and do not seem to increase earnings 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. 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, however, 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.

Discussion and Conclusion

This article adds to the literature on the returns to community college credentials by providing evidence from the 2001–2002 cohorts of students from Washington State, offering detailed results on the returns across different fields of study, and including wages as an outcome. 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 (15% higher quarterly wages for obtaining a long-term certificate and 6.3% higher quarterly wages for obtaining an associate degree compared with attending a college and not obtaining a credential). For men, on average (without considering the field of study), there are only significant wage returns (and then only a modest 2%) for earning an associate degree over and above earning some credits and leaving college. For men, certificates are not associated with wage gains over and above earning some college credits without earning a credential.

Furthermore, our findings suggest that returns to earnings 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 is associated with increases in 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 is associated with an 11 percentage point greater likelihood of employment for women and an 8 percentage point greater likelihood for men. Earning a short-term certificate is not related to either likelihood of employment or hours worked.

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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 is associated with increases in women's wages (by 37.7%), whereas earning an associate degree in humanities and social sciences or information science, communication, and design is not associated with wage gains. 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, while associate degrees are dominated by humanities and social sciences, which tend to have modest returns. Furthermore, unlike Grubb (2002a)—who found zero to negative returns to associate degrees in some fields—we find positive 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 are some exceptions, notably protective services 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 only students who earn short-term certificates are 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. (2014), 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 have several distinct advantages—the most significant of which is that our data set has wage records available, which allows us to understand the value of credentials in terms of increasing human capital, not just earnings. Our data set also allows for 7 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

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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 health care 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 because 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. Second, the methodology we use in this article still does not allow us to rule out potential sources of bias resulting from unobserved differences among students that affect the trajectory of wages.

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. (2014) are the only rigorous studies to our knowledge 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. Finally, we believe that every state should conduct similar analyses on the labor market returns of the credentials that they offer. A more general question for future research is whether or not the differences in the labor market value of credentials of different length are related to the differences in knowledge and skill gains or whether they reflect differences in the extent to which these differences reflect employer knowledge of various credentials or opportunities for industry certification.

Authors' Note

The authors contributed equally to this work, and they are solely responsible for any errors.

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Notes

1. From published data from the Integrated Postsecondary Education 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," whereas 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% of credentials awarded were awarded at the sub-baccalaureate level.

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

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5. 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), 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.

6. These 34 colleges include 29 comprehensive colleges and 5 technical colleges. There is tremendous institutional variation across these colleges in the profile of credentials awarded; see Scott-Clayton and Weiss (2011) for more detail around this. In this article, we use a pooled sample from all 34 colleges; our sample size would be insufficient to conduct a between-institution analysis.

7. UI 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.

8. We do not expect that the exclusion of these categories of employment to lead to any systemic bias in the trajectory of earnings that is correlated with credential attainment. By contrast, we believe that the main problem is that our results are not generalizable to these categories of employment that are not included in the State UI data.

9. 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).

10. In this table, each column includes all students who earned a given credential within the tracking period of 7 years, regardless of whether they also earned other credentials or transferred to a 4-year institution. Some students who earned multiple credentials may therefore be included in these averages in more than one column.

11. Some occupational programs in Washington are run on a block schedule, where students may take classes in a cohort of 5 days per week (Monday to Friday) for 5 to 6 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. The socioeconomic status (SES) measure used here was developed by Community College Research Center (CCRC) researchers in collaboration with the research staff of the Washington State Board for Community and Technical Colleges (Crosta, Leinbach, Jenkins, Prince, & Whittaker, 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.

14. In general, when demographic variables are missing, we include "missing" as an additional category in the form of a dummy variable.

15. 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 4-year institution, but the results change very little. Therefore, we do not include this interaction in the final model for ease of interpretation.

16. 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 the information on receipt of a bachelor's degree necessary to accurately estimate the effect of baccalaureate transfer.

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

18. Under the extreme scenario where pre-college wages are negatively correlated with the workers' underlying motivation and ability, then if students who earn credentials have higher human capital than those who do not, the individual fixed effects method could result in estimates for the returns to credentials that are higher than their true value. We find a small but positive and statistically significant correlation between wages prior to entry and post-exit of .04 overall; the correlation is .13 for students who worked at least 1,000 hours or more in the year prior to college entry and .03 for students who did not.

19. 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.

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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, because individuals may be more likely to enter such a program shortly after losing employment, or may discontinue employment in preparation for entering the program.

21. One reason for our estimates being somewhat lower compared with Jepsen et al.'s estimates may be the differences between the labor markets in Kentucky and Washington. In addition to having a different portfolio of local industries, Washington has had a substantially higher minimum wage over the time periods studied. It may be that, in Washington, workers who have no college credential are relatively better off in finding opportunities for jobs that pay a living wage compared with those in Kentucky, thus suppressing the college wage premium (for credentialed college attendees) in Washington.

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Authors

MINA DADGAR, PhD, is the director of research at the Career Ladders Project, where she works to promote the use of evidence in community college reform to improve student educational and labor market outcomes. Her research focuses on high school to college transition, dual enrollment, developmental education, academic

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placement and multiple measures, and effective student support services strategies. She has a PhD in economics and education from Columbia University's Teachers College. She has previously worked as a researcher at West Ed and the Community College Research Center.

MADELINE JOY TRIMBLE is a data analyst at the Community College Research Center, where she conducts research in areas such as developmental education, student pathways, and the returns to community college credentials.

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