



Returns to Vocational Credentials: Evidence from Ohio's Community and Technical Colleges

A CAPSEE Working Paper

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October 2016

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305C110011 to Teachers College, Columbia University. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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Abstract

In recent years, policymakers and academics have become increasingly interested in the returns to sub-baccalaureate degrees. This interest arises from surging demand for such programs over the 2000s, especially in the wake of the 2008 recession, as well as from President Obama's charge to dramatically increase the number of students with a college degree of some type. We estimate the returns to both community and technical colleges in the state of Ohio. We find that associate degrees generate positive earnings effects for both men and women. These positive effects occur across many fields but are strongest in health. We find that certificates also generate positive returns, but there is some heterogeneity across men and women. Men benefit from short-duration certificates while women benefit from long-duration certificates. This result is likely driven by heterogeneity in the returns across fields.

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1. Introduction

In an influential report, Carnevale, Smith, and Strohl (2010) suggest that, at current rates of college completion, the United States would be short three million college graduates by the year 2018. This human capital deficiency, the authors argue, would prevent the United States from remaining economically competitive. In this policy environment, the focus on promoting college completion has continued to grow, and the Obama administration has made repeated calls for efforts to increase the number of individuals with a postsecondary credential (e.g., The White House, Office of the Press Secretary, 2009).

The economic returns to higher education are well recognized and growing. Moreover, throughout the early 2000s, and especially during the 2008 recession, there has been rapid growth in the demand for sub-baccalaureate degrees. For example, much of the early growth in for-profit college enrollments came from the expansion of short, vocational programs which are tightly tied to labor markets. In the public market, community colleges have been the primary supplier of sub-baccalaureate degrees and certificates.

Certificates or diplomas are classified into two types by the Integrated Postsecondary Data System (IPEDS). There are long-term certificates, which require at least one full year of study, but less than two years, and short-term certificates, which require less than one year of full-time study. Between 2000 and 2012, the number of long-term certificates awarded by Title-IV eligible, public community colleges grew by 63 percent while the number of short-term certificates awarded grew by 157 percent (authors' calculations using IPEDS).

Though the value of an associate degree has been well-established (Belfield & Bailey, 2011; Kane & Rouse, 1995), until recently little was known about the economic returns to these shorter credentials. Recent studies using state longitudinal datasets have estimated the returns to short credentials in Kentucky, Washington, North Carolina, Virginia, and California (Dadgar & Trimble, 2015; Jepsen, Troske, & Coomes, 2014; Stevens, Kurlaender, & Grosz, 2015; Xu & Trimble, 2016). Each of these studies finds an economic return to short- and long-term certificates on average, but these studies have also found that there is a great deal of heterogeneity in the returns to credentials by subject (and program). Though there are some consistent findings across states, such as large returns for women completing short or long certificates in health-related fields, it is also the case that short credentials in other subject areas have more or less value in different states.

This heterogeneity in the value of different credentials across different states points to the value of studying these credentials in different local contexts. Insofar as the estimated returns to different types of vocational certificates in California may have policy implications for higher education leaders and administrators in that state, it is not clear to what extent that the same study provides guidance for community college leaders in Oregon trying to provide the best programs for their students. This study extends the literature by estimating the returns to short credentials and associate degrees in Ohio. The public higher education system in Ohio is one of

the five largest in the country. Ohio's 23 community and technical colleges enrolled almost 150,000 students on average throughout the late 1990s and early 2000s, with enrollments increasing by about 4 percent per year (authors' calculations using Ohio Board of Regents data).

One unique feature of the Ohio system, which is worth studying, is the presence of technical community colleges. While Ohio has 15 traditional community colleges (funded either by local or state governments), it also has eight technical community colleges. Traditional community colleges offer vocational sub-baccalaureate degrees and programs designed to encourage transfer to bachelor's degree granting institutions. The technical colleges focus only on vocational degrees of a "technical" nature. Specifically, Ohio's state code requires that technical colleges maintain "an appropriate range of career or technical programs designed to prepare individuals for employment in specific careers at the technical or paraprofessional level" (Ohio Board of Regents, 2001).

Empirically, it is difficult to measure the return to the sub-baccalaureate programs. Students who select into these programs systematically differ from other students. We use the same approach as Jepsen, Troske, and Coomes (2014) using student-fixed effects strategies to compare the earnings of students before and after the completion of a degree program. Similar to studies in other states, we find that associate degrees generate positive earnings effects for both men and women. These positive effects occur across many fields but are strongest in health. We find that certificates also generate positive returns, but there is some heterogeneity across men and women. Men benefit from short-duration certificates while women benefit from long-duration certificates. This result is likely driven by heterogeneity in the returns across fields. We generally find larger returns to credentials from technical colleges as opposed to those from community colleges.

This paper proceeds as follows: The next section reviews the literature. Section 3 describes our data and empirical strategy. We describe the results in section 4. Finally, section 5 concludes.

2. Literature Review

There is a growing body of evidence suggesting that there are positive and significant economic returns to short credentials offered by community colleges as well as associate degrees. A seminal paper by Kane and Rouse (1995) estimates the financial benefit to earning an associate degree at a community college. They find that men who earn associate degrees experience a 24 percent increase in earnings relative to those with only a high school diploma. Women experience a 31 percent increase.

Many of the early studies on the returns to community college credentials rely upon nationally representative surveys.¹ For example, Marcotte, Bailey, Borkoski, and Kienzl (2005) use NELS data and a Mincerian model to estimate the returns to attending a community college. They report returns for a year of full-time study, completion of an associate degree, and completion of a certificate. They find that men experience a 6 percent increase in yearly salary for each year of full-time study completed compared with men who have only a high school diploma. Earning a certificate results in a 7.9 percent increase in yearly salary and earning an associate degree increases annual earnings by 14.7 percent for men. For women, completing a year of full-time study increases yearly salary by between 8.7 and 11.1 percent. The increase resulting from earning a certificate is 17.2 percent, and completing an associate degree results in an increase in annual salary of between 40.4 and 47.6 percent, depending on which controls are included in the model.

Similarly, Leigh and Gill (1997) use NLSY data (through the 1993 wave) to estimate the returns to education for returning adults compared with students who continue directly from high school into a degree program. They define returning adults in two ways: first by the age at which a degree is completed (assuming that degree attainment after age 25 is indicative of returning adults) and second by determining that some students experience a gap greater than three years in their schooling, indicating a returning adult. Using ordinary least squares regressions controlling for previous ability, the authors find that attending a non-degree program at a community college increases earnings 8 to 10 percent more for returning adults than it does for continuing students. They find no additional effect for completing an associate degree.

As Belfield and Bailey (2011) note, the use of state administrative data represents an important new opportunity in measuring the returns to sub-baccalaureate degrees.² For example, Jepsen et al. (2014) make use of administrative data from Kentucky's public community college system for the 2002–03 and 2003–04 cohorts. Using a student fixed effects model, they examine wage effects through summer 2008. They find that associate degrees are associated with returns of \$2,363 for women and \$1,484 for men. In percentage terms, this is 56 percent for women and 24 percent for men. They find that certificates are associated with a return of approximately \$300 for both men and women, which, in percentage terms, is 7 percent for women and 5 percent for men.

Dadgar and Trimble (2015) use data from Washington State to estimate the returns to associate degrees and certificates.³ Using the cohort of students enrolled in the 2001–02 school year and an individual fixed effects model, they find that women receive a 6.3 percent return to earning an associate degree, a 15 percent return to earning a long-term certificate, and no gain to

¹ See also Bailey and Belfield (2011) who use data from the Survey of Income and Program Participation (SIPP). Backes, Holzer, and Velez. (2014) also find that technical skills acquired at sub-baccalaureate institutions have a market premium.

² Stevens, Kurlaender, and Grosz (2014) present evidence from California. Their findings are similar to those reviewed here.

³ An earlier paper by Jacobson, Lalonde, and Sullivan (2005) uses data from Washington to estimate the impact of retraining for displaced workers who return to community colleges.

earning a short-term certificate. Men experience a 2 percent return to earning an associate degree but no return to the other types of credentials. The authors also make an effort to disaggregate the results by subject area and find large returns to nursing degrees for women and to degrees in protective services for men.

Xu and Trimble (2016) use state administrative data from Virginia and North Carolina and an individual fixed effects approach to estimate the economic returns to short and long certificates from public community colleges. They find variation across these two states in the return to certificates as well as in the effect of earning a certificate on probability of employment. On average, they find that both short- and long-term certificates have positive impacts on earnings and probability of employment in both states. In addition to estimating average effects, Xu and Trimble (2016) disaggregate effects by program of study and program within broad field of study. They find considerable heterogeneity within field, across states, as well as within state, across fields of study. Their most consistent finding is positive returns to certificates in health-related fields. However, Xu and Trimble also make the point that, within health-related certificates, there is heterogeneity in returns across specific programs of study. For example, there are large, positive returns to long-term certificates in dental assisting but statistically non-significant returns to programs in medical office assisting. Finally, they compare the industries in which students were employed before and after completing their certificates, finding that some of the economic returns to these programs are due to students using these certificates to move from a low- to a high-paying industry.

The most recent set of studies, which make use of state longitudinal data (Dadgar & Trimble, 2015; Jepsen et al., 2014; Stevens, Kurlaender, & Grosz, 2014; Xu & Trimble, 2016), build on the prior literature by demonstrating that there are economic benefits to earning short credentials such as short- and long-term certificates as well as associate degrees. These studies also demonstrate that there is heterogeneity in the returns to these credentials across gender and state. Studies that disaggregate their estimates by field of study (Dadgar & Trimble, 2015; Stevens, Kurlaender & Grosz, 2014; Xu & Trimble, 2016) find that heterogeneity in returns to credentials across gender may mask heterogeneity in returns across field of study. For example, each of these studies finds large, statistically significant returns to health-related credentials, and this field of study is more likely to be chosen by women. Differences in returns across states suggest that features of individual programs as well as local labor markets and local employment regulations may mediate the effects of earning one of these credentials on future earnings. This in turn points to the importance of studying these credentials at the state level.

3. Data and Empirical Strategy

We rely on data from the Ohio Board of Regents. Our data include enrollment records describing student characteristics such as age and ethnicity, term-by-term enrollment files describing students' cumulative credits and GPAs, financial aid files which include the annual

gross income students report on their FAFSA as well as whether or not they are financially dependent on their parents. These administrative data files have been merged with unemployment insurance (UI) data which report fall quarter wages for the students in our sample both while they are in school and for up to 11 fall quarters after they graduate or leave the community or technical college in which they were enrolled. An important limitation of our data is that we do not have preenrollment earnings data. This limitation will be discussed further below.

Fifty-one thousand five-hundred ninety-eight students entered a community or technical college in Ohio in 1998, 1999, or 2000 and worked at least one term while they were enrolled in their degree program. Of these students, 5,573 went on to earn a bachelor's degree or higher. These observations are excluded from the sample in order to avoid having our estimates of the economic returns to short credentials biased by students who accumulate additional years of human capital or who are still enrolled after earning a certificate or associate degree. Table 1 displays descriptive statistics for the students in our sample, disaggregated by highest degree earned. Students who earned a bachelor's, master's, or doctoral degree are included in the last column of Table 1 to give the reader a sense of how many students who begin their higher education at a community or technical college in Ohio go on to earn one of these credentials. However, as stated above, they are excluded from the regression analysis.

Table 1: Highest Degree Earned for Students Entering a Community or Technical College in Ohio in 1998, 1999, or 2000

Characteristic	No Credential	Short-term Certificate	Long-term Certificate	Associate Degree	Bachelor's Degree or Higher
Female	0.51	0.46	0.75	0.63	0.51
Black	0.15	0.06	0.07	0.07	0.06
Hispanic	0.02	0.02	0.03	0.01	0.02
White	0.79	0.89	0.87	0.89	0.88
Asian	0.01	0.01	0.01	0.01	0.02
Age	23	24	24	21	20
Ohio resident	0.98	0.99	0.99	0.99	0.99
Educational intentions					
Some courses	0.08	0.05	0.05	0.03	0.05
Upgrade skills	0.11	0.10	0.13	0.06	0.04
Certificate	0.06	0.13	0.19	0.04	0.02
Associate degree	0.41	0.55	0.45	0.54	0.26
Transfer to 4-year institution	0.34	0.17	0.17	0.32	0.63
<i>N</i>	34,371	687	709	10,258	5,573

Note. Data is from the Ohio Board of Regents. The sample is limited to students who enrolled in a community or technical college in Ohio in 1998, 1999, or 2000 and who worked at least one term while enrolled in their program of study.

In order to explore the relationship between earning a short credential at a community or technical college and post college wages, we begin by regressing log wages on variables indicating whether the student earns a credential,

$$\ln(wage)_{it} = \beta_0 + \beta_1(Credential)_i + \beta_2(X)_i + \epsilon_t \quad (1)$$

The outcome in our study is the fourth quarter wages for student i in quarter t . We ran models with both log wages and untransformed wages. *Credential* is a series of three binary variables coded “0” before the student has earned their highest credential and “1” after the credential is granted for each of the three credential types we explore: associate degrees, less than two-year certificates, and less than one-year certificates. X is a vector of student-level covariates including race/ethnicity, the student’s age at college entry, whether the student intended to earn a credential, and whether or not the student is from in state.

Though the regression models described by equation (1) provide some initial evidence about the effect of earning a credential on future earnings, these models are unable to control for selection bias. In order to better control for nontime-varying individual characteristics, including ability and motivation, that may affect both the likelihood of degree receipt and post-college earnings, we make use of an individual fixed effects model. Our preferred specification is similar to that of Jepsen et al. (2014),

$$\begin{aligned} \ln(wage)_{it} = & \beta_0 + \beta_1(Credential)_{it} + \beta_2(Enroll)_{it} + \beta_3(X * Time)_{it} + \\ & \beta_4(Intent * Time)_{it} + \rho_i + \nu_t + \epsilon_{it} \end{aligned} \quad (2)$$

in which the outcome, *credential*, and are defined the same way as in equation (1). ρ_i , are fixed effects for each individual, while ν_t are fixed effects for quarter. *Enroll* is a set of binary variables, the first of which is coded “1” in the quarters in which the student is enrolled and “0” otherwise. This variable is meant to control for the opportunity cost of the student being enrolled. The second variable is coded “1” in the years after the student leaves school and “0” otherwise. This variable is meant to control for post school changes in earnings. X is a vector of time-varying covariates including the student’s age and county-level unemployment rates. *Intent* is a set of variables intended to control for a student’s academic intentions. This includes a variable indicating the student’s degree intentions, the number of credits the student earned in the first semester in which they were enrolled, and a variable indicating the student’s major.

4. Results

Table 2 displays the estimates from the Mincer models in which log fourth quarter wages were regressed on dummy variables indicating the type of credential completed as well as a set of student-level covariates. Columns 1 and 2 display the estimates for women and men, respectively, when the sample is comprised of all students entering a community or technical college in Ohio in 1998, 1999, or 2000, who worked at least one term during their academic program. In columns 3 and 4 the sample is more restrictive: it is comprised of students who worked their first term during college. Though our analysis focuses on the larger, first sample, the second sample may control for longer work histories than the first. For both samples, for both women and men, these simple models suggest that there are statistically significant, positive returns to each of the three degree types (short-term certificates, long-term certificates, and associate degrees). Though these regressions provide suggestive evidence that there is a positive relationship between earning a credential and future earnings for the students in our sample, we do not think these models control for selection bias (or student characteristics affecting both likelihood of earning a credential and earnings) as well as the individual fixed effects model described in equation (2).

Table 2: Simple Regressions of Log Fourth Quarter Wage on Binary Variables Indicating Highest Degree Earned

	(1)	(2)	(3)	(4)
	Worked at Least One Term During College		Worked First Term During College	
	Females	Males	Females	Males
Short certificate	0.396*** (0.105)	0.552*** (0.0749)	0.521*** (0.144)	0.683*** (0.0495)
Long certificate	0.646*** (0.0662)	0.787*** (0.0762)	0.712*** (0.0710)	0.805*** (0.0935)
Associate degree	0.894*** (0.0324)	0.892*** (0.0457)	0.943*** (0.0338)	0.978*** (0.0505)
Constant	7.176*** (0.0696)	7.376*** (0.158)	7.021*** (0.103)	7.186*** (0.126)
Observations	90,342	67,744	64,524	47,698
R-squared	0.134	0.140	0.131	0.136

Note. Data provided by the Ohio Board of Regents. Sample is comprised of students entering a community or technical college in Ohio in 1998, 1999, or 2000 who worked at least one term during college (columns 1 and 2) or who worked the first term during college (columns 3 and 4). All models include the following student-level covariates: race/ethnicity, age at entry, degree intention, and whether or not the student is an Ohio resident. “Short certificate,” “long certificate,” and “associate’s degree” are binary variables indicating the highest degree earned. These variables are coded “0” in the terms before degree receipt and “1” in the term the degree is earned as well as all terms thereafter. Standard errors are clustered by college.

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

Table 3 shows the estimates from the individual fixed effects model based on that of Jepsen et al. (2014). In addition to estimating the average effects of earning a short certificate, long certificate, or associate degree across all two-year colleges in our sample, we also run our models separately for students enrolled in community and technical colleges. The public higher education system in Ohio is distinct from the other states in which short credentials have been studied (Dadgar & Trimble, 2015; Jepsen, Troske, & Coomes, 2014; Stevens, Kurlaender, & Grosz, 2015; Xu & Trimble, 2016) in that it includes not only community colleges but also separate technical colleges. At technical colleges the emphasis in the curriculum is on vocational programs. For example, on Central Ohio Technical College’s website, the link to “all certificates and degrees” leads to a page listing potential careers and the associated majors including engineering technology careers, business and information technology careers, and healthcare careers (see <http://www.cotc.edu/Academics/pages/degrees-and-certificates.aspx>). On the other hand, at a typical community college in Ohio such as Cuyahoga Community College, searching potential academic programs suggests that, while there are many vocationally oriented offerings, workforce education is not the only focus of the curriculum (see <http://www.tri-c.edu/programs/programs-a-z.html>). Community colleges may generate better student outcomes in the long term if these schools are more able to encourage some transfer to bachelor’s degree programs because the returns to bachelor’s degree programs are likely higher than those of sub-baccalaureate programs. However, in the present study, in which we are focused on the benefits of earning shorter credentials, it is less clear ex ante whether students may fare better at community or technical colleges.

Table 3: Estimated Effect of Highest Degree Earned on Log Fourth Quarter Wages for Students Enrolled in a Community or Technical College in Ohio

	(1)	(2)	(3)	(4)	(5)	(6)
	All Colleges		Community Colleges		Technical Colleges	
	Females	Males	Females	Males	Females	Males
Short certificate	0.055 (0.0868)	0.411* (0.213)	-0.0124 (0.131)	0.0695 (0.0594)	0.074 (0.0815)	0.549*** (0.0974)
Long certificate	0.217*** (0.0688)	0.18 (0.107)	0.219** (0.0859)	0.0761* (0.0409)	0.230* (0.115)	1.236 (0.727)
Associate degree	0.264*** (0.020)	0.212*** (0.0237)	0.240*** (0.0207)	0.176*** (0.0298)	0.310*** (0.0338)	0.232*** (0.0397)
Includes individual fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Includes quarter fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Includes variables indicating enrollment?	Yes	Yes	Yes	Yes	Yes	Yes
Includes time-varying covariates?	Yes	Yes	Yes	Yes	Yes	Yes
Includes variables indicating intentions?	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.449*** (0.0405)	7.479*** (0.0654)	7.425*** (0.0373)	7.528*** (0.071)	7.428*** (0.160)	7.335*** (0.195)
Observations	90,342	67,744	71,159	54,820	12,895	8,347
Number of students	24,893	21,132	20,008	17,433	3,380	2,467
R-squared	0.240	0.264	0.223	0.234	0.295	0.415

Note. Data provided by the Ohio Board of Regents. Sample is comprised of students entering a community or technical college in Ohio in 1998, 1999, or 2000 who worked at least one term during college. All models include the following student-level covariates: race/ethnicity, age at entry, degree intention and whether or not the student is an Ohio resident. “Short certificate,” “long certificate,” and “associate’s degree” are binary variables indicating the highest degree earned. These variables are coded “0” in the terms before degree receipt and “1” in the term the degree is earned as well as all terms thereafter. Standard errors are clustered by college.

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

In Table 3, columns 1 and 2 show the estimated effect of earning a short certificate, long certificate, or associate degree for students enrolled in a public two-year college in Ohio for women and men, respectively. Columns 3 and 4 show the estimates for women or men enrolled in two-year colleges classified as community colleges, while columns 5 and 6 display the estimates for women or men enrolled in technical colleges. The most consistent finding is that there are statistically significant, positive returns on average for both men and women earning an associate degree. Moreover, these effects are found for students whether they enroll in a community or technical college, with the positive impact on log fourth quarter earnings being of slightly larger magnitude for students enrolled in a technical college. Our estimates suggest that for women enrolled in a community college, earning an associate degree increases fourth quarter wages by 27 percent on average.⁴ For women enrolled in a technical college the increase is 36 percent. The effects on earnings for men earning an associate degree are of a smaller magnitude than those for women whether they enroll in a community or technical college. For men enrolled in a community college, completing an associate degree increases fourth quarter earnings by 19 percent, on average, compared with men enrolled in a technical college who experience a 26 percent increase in earnings, on average, after completing this degree.

Another consistent finding is that women experience an economic return to earning a long certificate, regardless of whether the certificate is from a community or technical college. For men, when averaging across colleges, there is not a statistically significant effect on earnings of completing this type of credential. However, when we compare returns for students enrolled in community versus technical colleges, men enrolled in community colleges experience a statistically significant 8 percent return to earning a long certificate. This may be the result of the fields of study offered for long certificates and the differences in preferences of fields among men and women. One previous study that also found this pattern of effects for long certificates found that these credentials were commonly offered in allied health, a field more commonly chosen by women (Dadgar & Trimble, 2015). Women in our main sample who earn a long certificate at a community college experience a 24 percent increase in earnings, on average. Earning a long certificate at a technical college increases earnings for women by 26 percent, on average. Finally, for the women in our sample, earning a short certificate does not have a statistically significant effect on earnings; however, men experience a large, statistically significant return to completing this type of credential. Moreover, the effects appear to be driven by men enrolled in technical colleges. Men enrolled in technical colleges who earn a short certificate experience a statistically significant, 73 percent increase in fourth quarter earnings compared with men enrolled at community colleges who do not experience a statistically significant return to this type of credential. It seems likely that this difference is driven by heterogeneity in returns across fields of study that are found more at technical versus community colleges. This hypothesis will be explored more below.

⁴ $\% \Delta = e^{\beta_1} - 1$

As mentioned above, one of the weaknesses of our data is that it does not allow us to control for preenrollment earnings. As a result we might be underestimating effects if earnings during enrollment are already being boosted by being in college, or we might be underestimating earnings if students are working less or in a less desirable job because they are in college. It is possible that the more restrictive sample in which we condition on students having worked the first term they were enrolled does a slightly better job at capturing the effects than our main sample, at least with respect to the problem of earnings potentially already being boosted by students having some college. In order to explore this hypothesis we ran our models on this more restricted sample. Table 4 displays these estimates. The estimates using the larger sample are very similar to those for the more restricted sample. Again, there are statistically significant, positive returns on average for both men and women earning an associate degree. Another consistent finding is that women experience an economic return to earning a long certificate whether from a community or technical college, but for men there is not a statistically significant effect on earnings of completing this type of credential. This is the only case in which we find a benefit to earning a credential in the restricted sample but not in the larger sample. Women in this sample who earn a long certificate at a community college experience a 22 percent increase in earnings on average. Earning a long certificate at a technical college increases earnings for women by 26 percent on average. Finally, again similar to the more restricted sample, for the women in our sample earning a short certificate does not have a statistically significant effect on earnings; however, men experience a large, statistically significant return to completing this type of credential. Men enrolled in technical colleges who earn a short certificate experience a statistically significant, 73 percent increase in fourth quarter earnings compared with men enrolled at community colleges who do not experience a statistically significant return to this type of credential.

Table 4: Estimated Effect of Highest Degree Earned on Log Fourth Quarter Wages for Students Enrolled in a Community or Technical College in Ohio, for Students Who Worked First Term

	(1)	(2)	(3)	(4)	(5)	(6)
	All Colleges		Community Colleges		Technical Colleges	
	Females	Males	Females	Males	Females	Males
Short certificate	-0.00585 (0.106)	0.448* (0.247)	-0.21 (0.124)	0.087 (0.0634)	0.074 (0.0815)	0.549*** (0.0974)
Long certificate	0.217** (0.0802)	0.207 (0.149)	0.196* (0.0954)	0.094 (0.0942)	0.230* (0.115)	1.236 (0.727)
Associate degree	0.271*** (0.0211)	0.242*** (0.031)	0.250*** (0.0245)	0.202*** (0.0408)	0.310*** (0.0338)	0.232*** (0.0397)
Includes individual fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Includes quarter fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Includes variables indicating enrollment?	Yes	Yes	Yes	Yes	Yes	Yes
Includes time-varying covariates?	Yes	Yes	Yes	Yes	Yes	Yes
Includes variables indicating intentions?	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.401*** (0.0378)	7.490*** (0.0683)	7.386*** (0.0346)	7.535*** (0.0735)	7.428*** (0.160)	7.335*** (0.195)
Observations	64,524	47,698	51,629	39,351	12,895	8,347
Number of students	17,899	15,030	14,519	12,563	3,380	2,467
R-squared	0.241	0.27	0.228	0.238	0.295	0.415

Note. Data provided by the Ohio Board of Regents. Sample is comprised of students entering a community or technical college in Ohio in 1998, 1999, or 2000 who worked the first term during college. All models include the following student-level covariates: race/ethnicity, age at entry, degree intention and whether or not the student is an Ohio resident. “Short certificate,” “long certificate,” and “associate degree” are binary variables indicating the highest degree earned. These variables are coded “0” in the terms before degree receipt and “1” in the term the degree is earned as well as all terms thereafter. Standard errors are clustered by college.

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

Finally, we ran models separately for each field of study (defined by the first two digits of the CIP code) in which at least 10 individuals earned their highest credential in this field. Table 5 displays the counts by field of study and credential type for the highest degree earned by students in our main sample. Only fields in which at least one of the certificate types was earned by at least 10 individuals are included in this table. The majority of terminal short certificates are earned in health- and business-related fields. A large number of long certificates were earned in health-related fields within our sample, though there were also many earned in engineering technologies. Table 6 shows the coefficients on the credential indicators from the individual fixed effects model run separately by field of study. Because of small sample sizes, we do not disaggregate by gender. The first column of Table 6 shows the effect on average fourth quarter earnings of completing a short certificate as one's highest credential by field of study. Students who earn short certificates in computer and information sciences and law enforcement experience statistically significant, positive returns to their credentials. The estimates suggest that students earning a short certificate in law enforcement as their highest credential experience a 93 percent increase in fourth quarter earnings on average. Students earning a short certificate in computer and information sciences as their highest credential experience a 29 percent increase in fourth quarter earnings on average.

Table 5: Highest Degrees Awarded by Field of Study and Credential Type

Field	Short Certificates	Long Certificates	Associate Degrees
Agriculture	15		121
Natural resources	54		198
Computer and information sciences and support	31	3	366
Personal and culinary services	17		76
Education	15	6	277
Engineering technologies	76	104	1,100
Family and consumer science	13	3	167
Liberal arts, general studies	11		1,277
Parks and recreation	34	1	58
Homeland security, law enforcement, firefighting	46	3	634
Social sciences	11		25
Metal working, wood working	28	11	134
Health professions	186	490	2,663
Business, management, and marketing	128	67	2,136

Note. Data comes from the Ohio Board of Regents. Counts are for highest degree earned. Fields of study are defined by the first two digits of the CIP code. Only fields in which at least 10 individuals completed either a short or long certificate are shown.

Table 6: Effect on Log Fourth Quarter Wages of Earning a Short Credential by Type of Credential and Field of Study

Field	Short Certificates	Long Certificates	Associate Degrees
Agriculture	-0.155 (0.210)		0.0448 (0.0826)
Natural resources	0.277 (0.237)		0.307* (0.150)
Computer and information sciences and support	0.253* (0.126)		0.164*** (0.0573)
Personal and culinary services	0.397 (0.231)		0.477*** (0.131)
Education	0.189 (0.350)		0.0369 (0.0734)
Engineering technologies	0.113 (0.113)	0.0596 (0.0534)	0.194*** (0.0319)
Family and consumer science	0.424 (0.540)		0.102 (0.102)
Liberal arts, general studies	-0.449* (0.240)		-0.00773 (0.0405)
Parks and recreation	0.124 (0.0889)		0.00746 (0.0969)
Homeland security, law enforcement, firefighting	0.653*** (0.122)		0.139*** (0.0303)
Social sciences	1.804*** (0.255)		0.455* (0.252)
Metal working, wood working	-0.184*** (0.0648)	0.0969 (0.239)	0.300*** (0.0916)
Health professions	0.178 (0.127)	0.220** (0.0998)	0.503*** (0.0292)
Business, management, and marketing	0.0509 (0.165)	0.176 (0.109)	0.129*** (0.024)

Note. Data comes from the Ohio Board of Regents. Counts are for highest degree earned. Fields of study are defined by the first two digits of the CIP code. Only fields in which at least 10 individuals completed either a short or long certificate are shown.

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

There are fewer fields of study in which long certificates are awarded in the Ohio sample and many fewer fields in which more than ten students in our sample earned a long certificate as their highest credential. According to the estimates in the second column of Table 6 the only statistically significant, positive returns to long certificates are for those in health-related fields. Students who earn a long certificate in a health-related field as their highest credential experience

a 25 percent increase in average fourth quarter earnings. Above we examined the returns to long certificates on average and found that women who complete a long certificate experience increases in earnings, while men do not. Our finding that the returns to these credentials are driven by completions in health-related fields such as nursing and allied health is consistent with this previous finding because women are more likely than men to enroll in nursing and allied health fields.

Finally, we find statistically significant, positive returns to associate degrees earned in several different fields including computer and information sciences, personal and culinary services, engineering technologies, law enforcement, metal and wood working, health professions, and business. The last column in Table 6 displays these estimates. The highest returns are for students earning an associate degree as their highest degree in health-related fields. The students experience a 65 percent increase in average quarterly earnings after completing their degree. Surprisingly, those completing their degrees in personal and culinary services experience a similar return (61 percent). On the other hand, students earning associate degrees in agriculture, education, family and consumer science, liberal arts, or parks and recreation do not experience a statistically significant increase in their earnings after completing their degrees.

5. Discussion and Conclusion

This study contributes to our understanding of how earning a credential at a public two-year institution affects students' earnings after graduation. An important part of the mission of community colleges is to educate a workforce to fill the labor needs of the local economy. The value of different types of credentials offered by community colleges may thus vary according to what is valued in local labor markets. For this reason, it is important to examine these credentials in local contexts, using state-level data. This study estimates the return to community college credentials in Ohio using three cohorts of students and following them for up to 11 years after they entered a community or technical college. We find that while, on average, earning an associate degree has a positive, statistically significant effect on earnings for both women and men, whether they attend a community or technical college, men benefit more from earning short certificates, and women benefit more from earning long certificates. Moreover, we find that this heterogeneity in returns to credential type by gender is probably driven by heterogeneity in returns across fields of study. Some of the largest returns to short certificates when disaggregated by field of study are for those earning credentials in law enforcement—an area of study more frequently chosen by men—whereas the largest returns to long certificates are in health-related fields, such as nursing, which are more frequently chosen by women.

Our estimates are similar to those found in previous studies, though sometimes of a different magnitude. The other two studies most comparable to ours are Jepsen, Troske, and Coomes (2014) and Dadgar and Trimble (2015). Using administrative data from Kentucky,

Jepsen et al. find that associate degrees are associated with a 56 percent increase in quarterly wages, on average, for women and 24 percent for men. These results are similar to the estimated returns we find for men but larger than what we find for women. Diplomas (similar to what we are calling long certificates) are associated with a 45 percent increase in average quarterly wages for women, which is larger than what we find (Jepsen et al., 2014). The authors also find that men experience statistically significant returns to diplomas in Kentucky, whereas this is not the case in Ohio. Finally, Jepsen et al. find that certificates are associated with small, positive increases in average wages for both men and women (7 percent for women and 5 percent for men). We find much larger statistically significant returns to short certificates, on the order of 73 percent, but only for men. Dadgar and Trimble, using data from Washington State find positive, statistically significant returns to earning an associate degree for both men and women, but their estimates are of a much smaller magnitude than what we find in Ohio. These authors find that for women there is a 6.3 percent return to earning an associate degree, and a 2 percent return for men. There is also a 15 percent return to earning a long-term certificate for women, which they show is driven by awards in health-related fields, similar to our finding for Ohio. Also similar to our study, Dadgar and Trimble (2015) find no gain to earning a short-term certificate for women. They find that the men in their sample do not experience a statistically significant return to either type of certificate.

This heterogeneity in returns across states highlights the importance of studying community college credentials in local contexts. The economies of Kentucky, Washington, and Ohio are very different, and so it follows that the returns to different types of credentials would vary in these different contexts. The state public higher education systems are also very different across these states. In Ohio two-year colleges are divided into both community and technical colleges. Because technical colleges focus more exclusively on vocational education, it stands to reason that they might do it better, and we do find slightly higher returns to most credential types for students enrolled in technical rather than community colleges.

Finally, other factors that may affect the return to these types of credentials also vary across states, including regulations controlling access to certain labor markets. After earning some types of credentials, in order to access the labor market, students must first pass a licensing or certification exam. It is possible that the economic returns in some fields, such as nursing, are affected by local licensing regulations. More research is needed to better understand how factors such as licensing exams affect the economic returns to community college credentials.

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