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Labor Market Trajectories for Community College Graduates: New Evidence Spanning the Great Recession

A CAPSEE Working Paper

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April 2017

The authors' names are listed in alphabetical order; V. Minaya and J. Scott-Clayton contributed equally to this paper. The authors gratefully acknowledge Josh Hawley and Lisa Neilson at the Ohio Education Research Center, who helped facilitate our application for the restricted data utilized herein. This research 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, the U.S. Department of Education, or the Ohio Education Research Center.

An Appendix is available in a separate document available at capseecenter.org.

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Abstract

Over the past few years, a multitude of studies have examined the labor market returns to community college credentials, taking advantage of new administrative datasets that link college transcripts to quarterly earnings records and allow for comparisons of students' earnings before and after enrollment. These studies, however, typically follow students for only four to six years after initial entry, meaning they may only be observed for a year or two after graduation. Graduates' early labor market experiences may not fully capture the returns to completion, and may particularly distort comparisons of longer versus shorter duration credential programs. We extend the literature by examining returns to terminal associate degrees and certificates up to 11 years after students initially entered a community college in Ohio. We use an individual fixed-effects approach that controls for students' pre-enrollment earnings and allows the returns to credential completion to vary over time. Additionally, we examine how the returns to credential completion shift as students enter and exit the Great Recession, as well as how credentials affect other labor market outcomes such as employment stability and the likelihood of earning a "living wage." Our results confirm prior findings regarding the positive early returns to associate degrees and long-term certificates. However, the value of an associate degree grows substantially after graduation while the returns to a long-term certificate remain flat. Returns to associate degrees are notably higher during the recession (the patterns for certificates are more muted and vary by gender). Finally, we find that while both associate degrees and long-term certificates increase the likelihood and stability of employment, associate degrees lead to much higher paying jobs and a greater likelihood of earning a living wage. We conclude with a discussion of policy implications.

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1. Introduction

In the wake of the Great Recession, policymakers at both the state and federal levels have devoted increasing attention to the role of community colleges in developing a skilled and economically resilient workforce. Community colleges enroll 38 percent of the nation's undergraduates (and more than half of undergraduates who are in their first year). In addition to preparing students to transfer to baccalaureate programs, they confer over 1.9 million sub-baccalaureate credentials each year, including associate degrees, "long" certificates (for programs at least one year in length), and "short" certificates (for programs less than one year in length).[1] These sub-baccalaureate credentials are appealing to both students and policymakers because they are, in theory, quicker to attain than a bachelor's degree and are often in highly applied fields. Yet until relatively recently, far less was known about the returns to these credentials than about the more traditional bachelor's degree.

Over the past decade, this evidence gap has begun to fill in. Studies based on nationally representative survey data and controlling for incoming student characteristics (including test scores) have found substantial earnings gains for associate degree completers compared with observably similar peers who only finished high school (Bailey, Kienzl, & Marcotte, 2004; Belfield & Bailey, 2011; Marcotte, 2006; Marcotte, Bailey, Borkoski, & Kienzl, 2005; Scott-Clayton & Wen, 2017). Belfield and Bailey (2011) review this literature and find that completing an associate degree corresponds to an average estimated earnings gain of 13 percent for men and 22 percent for women, relative to high school completion only. While these studies control for observable pre-existing differences between degree completers and non-completers, their resulting estimates may nonetheless be confounded by differences in unobservable characteristics, such as motivation.

More recently, a number of studies have leveraged new longitudinal state administrative datasets that link college transcripts to quarterly earnings records and allow for comparisons of students' earnings both before and after enrollment. Using an individual "fixed-effects" approach, these studies estimate earnings gains after college relative to each individual's own pre-college earnings. This approach effectively controls not only for observable differences across individuals, but also any unobservable differences that are fixed over time. Jacobson, LaLonde, and Sullivan (2005) were the first to implement this method to examine returns to community college for displaced workers, and find that a year of community college increases earnings by about 9 percent for men and 13 percent for women.

Subsequent studies have used the fixed-effects approach to examine returns to community college credentials for a wider range of enrollees (not only displaced workers). These studies generally find substantial positive returns for both associate degrees and long certificates,

[1] Enrollment statistics are computed using National Postsecondary Student Aid Survey: 2012 via the National Center for Education Statistics (NCES) QuickStats online tabulation tool. Degree statistics are from the Digest of Education Statistics, Table 318.40 (this statistic will include some associate degrees and certificates conferred by public four-year institutions).

ranging from $1,000–$2,500 per quarter for women and $700–$1,400 per quarter for men (Bahr et al., 2015; Bettinger & Soliz, 2016; Carruthers & Sandford, 2015; Dadgar & Trimble, 2015; Jepsen, Troske, & Coomes, 2014; Liu, Belfield, & Trimble, 2015; Xu & Trimble, 2016). These same studies generally find much smaller returns for short certificates, with some finding null or even negative effects (Bahr et al, 2015; Dadgar & Trimble, 2015; Liu et al., 2015).

One of the most surprising findings from these studies is that terminal associate degrees do not appear to offer dramatically higher payoffs compared with long certificates, which require fewer credits to complete. For example, using administrative data from Kentucky, Jepsen, Troske, and Coomes (2014) find that long certificates (referred to as "diplomas" in Kentucky) have an average quarterly return of about $1,300 for men and $1,900 for women, while associate degrees have an average return of about $1,500 for men and $2,400 for women. However, because this study and others like it typically follow entrants for no more than six years post-entry, it is unclear how well these early-career estimates reflect the longer term patterns of returns.

As Jaggars and Xu (2015) note, different credentials may produce different earnings trajectories after college, not just different earnings levels, as graduates accumulate experience in the labor market. Thus, modeling patterns of earnings growth is important for predicting the longer term returns to different credentials. Using a growth-curve modeling approach that allows returns to vary over time, they find that the bulk of positive returns are not due to immediate gains in quarterly earnings upon graduation, but rather to increases in earnings growth over time. They find that associate degrees yield similar or slightly lower returns than long certificates upon college exit, but then grow substantially faster over time.

Jaggars and Xu's (2015) insight that the relative returns to different credentials may change over time is particularly important because community college students often take several years to graduate. In Ohio for example, associate degree completers took an average of 3.9 years to graduate, and certificate completers were not much faster (short certificate programs, defined as less-than-one-year in length, took an average of three years, and long certificates an average of 3.8 years from initial entry to completion). Nearly a quarter of graduates of an associate degree program took more than five years, and almost one in ten took more than seven years to finish.[2] As a result, though Jaggars and Xu follow students for 6.5 years after initial college entry, even this may not be long enough for earnings patterns to stabilize, as most graduates may have only a couple of years of post-completion earnings included in the data.

Using administrative data from the State of Ohio and an individual fixed-effects approach that compares students' earnings before and after enrollment, our study makes three contributions to the existing literature. Our primary contribution is to examine earnings for

[2] These calculations are based on the same Ohio data we use for our analysis, described in the next section. In the nationally representative Beginning Postsecondary Students Longitudinal Study (BPS):2004–2009 dataset, the average time to completion was 3.3 years for an associate degree and 2.7 years for a certificate; however, this underestimates average time to completion because the BPS only captures degrees that are earned within six years (authors' calculations using NCES QuickStats).

almost twice as long as prior studies—up to 11 years after initial entry, compared to a maximum of 6–6.5 years in Jepsen et al. (2014) and Jaggars and Xu (2015). Second, because our follow-up period spans the Great Recession, we are able to explicitly model how the returns to different credentials vary depending upon the labor market. Even though all attainment groups may suffer during recessions, research by Belfield (2015) suggests that the payoff to associate degrees relative to non-completion may increase during such periods. Finally, we examine the effects of credential attainment on outcomes that have not previously been explored using this method, including the likelihood of full-time, full-year employment, earning above a "living wage" (defined as earnings above the equivalent of a year-round, full-time job at $15 per hour, or about $30,000), and ever claiming unemployment insurance.

Consistent with previous findings, we find strong returns to associate degrees and long certificates in general, with much higher returns for women. But when we allow returns to vary over time, it becomes clear that different credentials have very different earnings trajectories: the returns to associate degrees relative to long certificates are significantly understated with short follow-up time frames. We find that the returns to associate degrees and long certificates are very similar at the point of graduation, but for associate degrees, the returns increase by $56–$61 each quarter after leaving college, compared with virtually no growth over time for long certificates. The returns to an associate degree increase substantially (relative to leaving college without any degree) during the Great Recession. For certificates, the pattern during the Great Recession is more muted and varies by gender.

When we extend our approach to examine other measures of labor market success, we find that associate degrees and to a slightly lesser extent long certificates both appear to increase the likelihood and stability of employment, for both genders. Students who earned either type of credential were more likely to be employed at all, more likely to be employed year round, and less likely to file an unemployment claim. However, associate degrees lead to substantially higher earnings and a greater likelihood of earning a living wage than do long certificates.

In the next section, we describe our empirical methodology, including our data, sample, main identification strategy, and alternative specifications. Section 3 presents the main results, overall and for selected fields. Section 4 presents additional results regarding the Great Recession and alternative measures of labor market outcomes. We conclude in Section 5 with a discussion of policy implications and suggestions for future research.

2. Empirical Methodology

Data and Sample

De-identified data were provided by the Ohio Education Research Center (OERC) under a limited-use, restricted data agreement. The OERC assembles data from multiple state agencies,

including the Ohio Board of Regents (OBR) and the Ohio Department of Job and Family Services (ODFJS), into a repository known as the Ohio Longitudinal Data Archive (OLDA).[3]

From the available higher education data, we requested elements including students' demographic characteristics, entrance and enrollment records, major choice, credits attempted, and certificate and degree completion from each of the Ohio's higher education institutions. We also requested elements from unemployment insurance (UI) data, including quarterly earnings and unemployment claims. For this study we utilize students who first entered a community college from 2001 through 2004 and labor market data from the first quarter of 2000 through the first quarter of 2013.

The data do not include any measure of students' academic ability upon admission (such as SAT/ACT scores, high school grade point average or test scores, or college entrance or placement exam scores), nor do they include financial aid application data or family income information. The data do include information on financial aid receipt for some years; however, for this study we choose to prioritize elements that are available for all analytic cohorts. An important limitation of our data is that we do not have information on students who transfer or graduate outside of the Ohio public college system, and UI data are limited to workers employed in the state (this limitation will be further discussed below).[4]

We restrict our sample to Ohio-resident U.S. citizens who entered any of Ohio's 19 community or technical colleges as a first-time college student between fall 2001 and spring 2004 with the intent of either transferring or completing a credential.[5] Because younger students do not have sufficient/reliable pre-enrollment earnings, we further restrict the sample to those aged 20–60 at entry, consistent with Jepsen et al. (2014). Also consistent with Jepsen et al. we exclude students who subsequently enroll in a four-year institution.[6] This means we estimate the effects of terminal credentials only, which does not capture any option value of transferring and completing a further degree.

Table 1 displays descriptive statistics for the 95,690 students in our sample, disaggregated by highest credential earned. The average age at first entry is around 31 years, and

[3] The following acknowledgement is required to be stated on any materials produced using workforce or higher education data accessed from the OLDA: This workforce solution was funded by a grant awarded to the U.S. Department of Labor's Employment and Training Administration. The solution was created by the Center for Human Resource Research on behalf of the Ohio Department of Job and Family Services and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any formation on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership. This solution is copyrighted by the institution that created it. Internal use, by an organization and/or personal use by an individual for non-commercial purposes, is permissible. All other uses require the prior authorization of the copyright owner.

[4] Based on authors' calculations using Census 2000 data, the average five-year mobility rate for 25 to 65 year olds with exactly an associate degree is 8 percent, while that for bachelor's degree holders of the same age is twice as high (calculations based upon those who lived in Ohio five years prior to Census date).

[5] This excludes approximately 21 percent with a different intent and 11 percent who were missing intent.

[6] Out of all first-time community college entrants in our sample, 13 percent subsequently transfer and 2.4 percent eventually earn a bachelor's degree (among those who transfer, 18 percent eventually earn a bachelor's degree).

approximately 25 percent of the sample is nonwhite. Around 14 percent of the overall sample have completed a sub-baccalaureate degree during the analytic time frame (including 17 percent of women and 10 percent of men), with associate's degrees by far the most common credential (recall that those who ever transfer to a four-year institution are excluded, so these rates are lower than the overall completion/transfer rate in the state, which is 32 percent within 6 years of entry).[7] Among women, health-related majors are the most common, while engineering-related majors are the most common for men. The average quarterly earnings in 2012 is $6,513 for men, ranging from $4,813 to $8,288 by highest degree earned, and $4,557 for women, ranging from $4,111 to $7,012 (all earnings figures are inflation adjusted to 2013 dollars).

To illustrate the intuition underlying the fixed-effects approach, Figures 1a and 1b show the patterns of earnings before, during, and after enrollment for women (Figure 1a) and men (Figure 1b), split out by eventual credential attainment outcome. Each quarter is measured relative to first entry in a two-year institution.[8] Rather than simply comparing post-completion earnings for completers and non-completers, the individual fixed-effects approach essentially compares each person's earnings after program completion to their earnings prior to enrollment. Including non-completers as a control group further allows us to account for any earnings growth that might have been expected regardless of the credential attained.

Examining patterns of pre-enrollment earnings illustrates why this is important, particularly for men. For men, credential attainment outcomes are highly correlated with pre-enrollment earnings: those who eventually complete a long certificate were earning more than $2,000 more per quarter prior to enrollment than those who eventually complete a short certificate, while non-completers and eventual associate degree holders fall in the middle, earning very roughly about $1,000 more per quarter prior to enrollment than those who eventually complete a short certificate. In striking contrast, women's pre-enrollment earnings do not vary nearly as much by eventual credential attainment. Moreover, while both genders exhibit a decline in earnings just prior to enrollment (referred to in economics as an "Ashenfelter dip"), the dip for women is more concentrated during the four terms just prior to enrollment, while for men it appears to start even earlier. These differences in pre-enrollment patterns suggest systematic differences in how individuals select into degree programs—something that the fixed-effects approach helps to address.

[7] This estimate was taken from the Ohio Community Colleges Portrait (2009), and it is based on first-time, full-time, degree-seeking students starting in fall 2002.

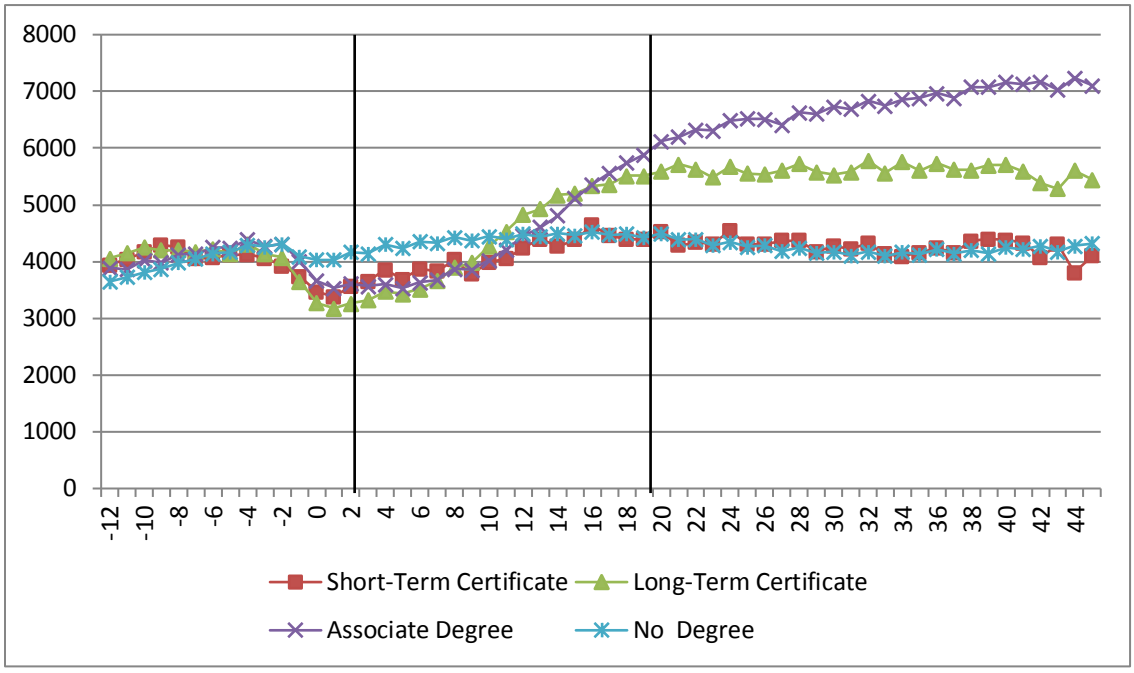
[8] The quarter when the student first enrolled in a two-year institution is measured as 0 on the horizontal axis of the graphs. The first quarter before the student enrolled in a two-year institution is measured as -1, and the first quarter after the student first enrolled in a two-year institution is measured as 1. Note that quarters with no reported UI earnings are assigned values of zero earnings.

Table 1: Descriptive Statistics

		Women					Men				
	All	Total	Less Than One-Year Award	At Least One, But Less Than Two-Year Award	Associate Degree	No Degree	Total	Less Than One-Year Award	At Least One, But Less Than Two-Year Award	Associate Degree	No Degree
If student is nonwhite	0.25	0.27	0.16	0.13	0.17	0.30	0.22	0.23	0.11	0.13	0.23
Age at entry	30.96	31.07	32.23	32.51	30.79	31.05	30.82	32.20	32.55	29.21	30.90
# first credits attempted	7.51	7.96	7.14	8.73	10.05	7.62	6.98	6.87	9.56	10.17	6.71
# last credits attempted	27.68	31.77	43.99	59.40	80.84	22.83	22.93	42.28	57.36	75.96	18.10
CIP areas											
Health	0.21	0.32	0.39	0.67	0.40	0.30	0.07	0.05	0.31	0.13	0.07
Arts & humanities	0.17	0.16	0.12	0.10	0.12	0.17	0.17	0.06	0.06	0.12	0.18
Engineering	0.14	0.03	0.02	0.01	0.02	0.03	0.26	0.21	0.36	0.26	0.26
Business	0.15	0.17	0.18	0.11	0.19	0.17	0.13	0.22	0.08	0.16	0.13
Undeclared	0.17	0.16	0.14	0.07	0.10	0.17	0.18	0.18	0.09	0.09	0.19
Other	0.18	0.17	0.14	0.05	0.18	0.17	0.17	0.27	0.09	0.24	0.18
Number of quarters since exit	26.94	25.95	20.23	18.84	18.49	27.47	28.09	23.35	19.01	20.02	28.90
Avg. quarterly warnings, 2012q1 to 2012q4	5,462	4,557	4,111	5,649	7,012	4,137	6,513	4,813	7,989	8,288	6,398
If employed four quarters in 2012	0.51	0.52	0.55	0.65	0.68	0.49	0.50	0.44	0.62	0.63	0.49
# if earning at least living wage in 2012	0.68	0.61	0.56	0.59	0.69	0.60	0.75	0.73	0.77	0.79	0.75
Ever claim UI, 2012	0.07	0.05	0.05	0.05	0.05	0.06	0.09	0.08	0.06	0.05	0.09
Number of students	95,690	51,399	691	1,340	6,821	42,547	44,291	855	343	3,112	39,981
%		100	1.34	2.61	13.27	82.78	100	1.93	0.77	7.03	90.27

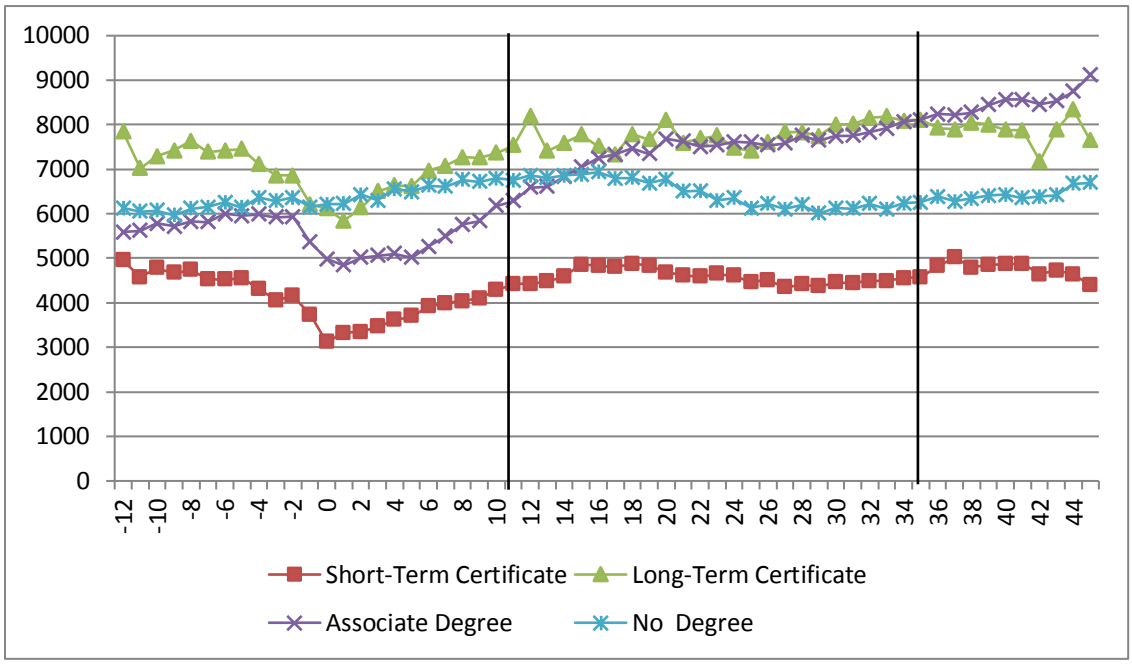
Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions who were 20–60 years old at entry and reported either a transfer or credential intent. Students who subsequently enrolled in a four-year institution are excluded. Sample restricted to Ohio residents and U.S. citizens at first enrollment. Quarters since exit is with respect to 2012Q1. Average credits completed (as of highest credential, or last enrollment if no credential). Living wage in 2012 is earning at least $30,000 per year (the equivalent of 15 dollars per hour, 40 hours per week, 50 weeks per year). Percent ever claiming unemployment since graduating is computed only for those who show up in the employment data at some point in 2012. Other CIP areas include education, law, natural science and mathematics, services, social and behavioral sciences, and trades and repair technicians.

Figure 1a: Quarterly Earnings by Quarters Since First Entry—Women



Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions followed through 2013Q1. Each quarter is measured relative to initial entry. The lines on the graph show the follow-up period of Jepsen et al. (2014), which goes through the fourth quarter of 2008.

Figure 1b: Quarterly Earnings by Quarters Since First Entry—Men



Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions followed through 2013Q1. Each quarter is measured relative to initial entry. The lines on the graph show the follow-up period of Jepsen et al. (2014), which goes through the fourth quarter of 2008.

One of the main takeaways from Figure 1 is that a long follow-up period is necessary to accurately assess returns to sub-baccalaureate credentials, particularly for associate degrees. For both genders, average quarterly earnings for those with associate degrees and long certificates start increasing around seven quarters after first entry. But it is also clear that cutting off Figure 1 at 18 or even 24 quarters post-enrollment would lead to very different conclusions about the value of different credentials. For both men and women, real earnings for associate degrees continue to grow substantially through the end of a 45-quarter (11 year) follow-up period. Meanwhile, earnings for non-completers and certificate holders remain relatively flat or even decline in real terms after the 18-quarter mark.

While Figure 1 is illustrative, our regression analysis will incorporate a much richer set of controls to account for some confounding factors that change over time. For example, some of this flattening or decline in earnings in later quarters is likely related to the Great Recession, something we can account for explicitly in our regression (by controlling for employment rates or adding calendar-quarter fixed effects to account for broader economic conditions). We describe our methodology in more detail below.

Individual Fixed Effects Model

Since we have a detailed panel dataset with pre- and post-college earnings data, we use these data to estimate the change in earnings associated with the highest degree earned in a two-year institution (associate degree, short certificate, and long certificate). We compare the post-education earnings with the pre-education earnings for two groups: those who attain associate degrees and short and long certificates, and those who do not earn a credential. This specification is a difference-in-differences model that resembles a treatment-on-the-treated model.

In the spirit of Jepsen et al. (2014) and the literature that has used this model to estimate the returns to community colleges (Bahr et al., 2015; Carruthers & Sandford, 2015; Dadgar & Trimble, 2015; Jacobson, LaLonde, & Sullivan, 2005; Xu & Trimble, 2016), we estimate the following equation separately for women and men:

$$(1) \qquad y_{it} = \alpha + \beta AWARD_{it} + \gamma ENROLL_{it} + \delta DEMOG_{it} + \partial INTENT_{it} + \eta_i + \tau_t + \varepsilon_{it}$$

where *i* indexes individuals and *t* denotes a quarter. The dependent variable y_{it} is a quarterly measure of earnings, inflated to 2013 dollars using the consumer price index. This variable is equal to zero for quarters with no earnings record. *AWARD* is a vector of three dichotomous variables equal to one or zero: one for having an associate degree as the highest award, one for having a long certificate as the highest award, and one for having a short certificate as the highest award at the beginning of the quarter *t*. For instance, an individual who received an award in 2004Q2 will have values of 0 from 2000Q1 to 2004Q1 and values of 1 from 2004Q2 on. The

comparison group will then have values of 0 in all periods. β should be interpreted as the relative change to the same person's earnings before she completed the award.

ENROLL contains a set of four dichotomous enrollment variables. In order to account for the opportunity cost while students are enrolled, the first dummy variable is equal to one when the individual is enrolled in a first two-year institution and zero otherwise. Due to the fact that the education data is available until 2011Q2, enrollment after 2011Q2 has been inputted based on last enrollment status. The second variable is equal to one after the individual has finished attending college. This variable accounts for any increase in earnings resulting from attending a two-year institution regardless of credential awarded. In other words, this dummy variable equals one for all individuals—dropouts and completers—in post-college quarters. The third variable is equal to one for the time period two quarters before first enrollment, and the fourth variable is equal to one for the time period one quarter before first enrollment. These two variables control for possible pre-enrollment dips in earnings (Ashenfelter dips) shortly before first enrollment.

DEMOG is a vector of time-variant person-specific demographics. As in Jepsen et al. (2014), we include interaction terms: (i) a time trend interacted with a dummy variable for nonwhite (and missing race/ethnicity); (ii) a time trend interacted with age at first entry in a two-year institution; and (iii) a set of cohorts of entry dummies (from 2001/02 to 2004/05), all interacted with time trends. County unemployment rate per quarter is also included. *INTENT* is a vector that measures students' intentions at first entry. All these variables are measured in the first semester and interacted with time. Students' intentions are measured by the number of credit hours attempted at first enrollment and a set of dichotomous variables for each student's area of study declared at first enrollment ("other" field is the omitted category).[9]

We also include a set of individual fixed effects (η) to control for time-invariant measures of ability and other factors such as motivation or effort that affect both earnings and the probability of completing an award. The fixed-effects model uses variation between individuals as well as variation over time, before and after earning an award, within individuals to estimate the value of the coefficients. As in a difference-in-differences approach, the fixed-effects approach assumes that the pre-enrollment and post-enrollment earnings patterns are similar between students who received an award and students who did not receive an award. If the trajectories for students with different credential outcomes vary systematically over time for reasons that have nothing to do with their credential attainment, then our approach will be biased.

[9] We use the 2010 Classification of Instructional Programs (CIP) list to create discipline areas. CIP discipline areas were created using subject codes. Missing subject codes, particularly during the first semester of enrollment, come from the 2002, 2003, and 2008 CIP lists that did not match the 2010 CIP codes. The discipline areas for these codes were imputed using the first two-digits of subject codes and double-checking subject titles. Based on the CIP list, we have the following discipline areas: arts & humanities, business, education, engineering, health, law, natural science & mathematics, services, social & behavioral sciences, and "other," which includes trades and repair technicians, interdisciplinary, and undecided majors.

Our main model also controls for each calendar quarter, τ, and for differences in macroeconomic conditions such as business cycles and the Great Recession. The last component (ε) is an idiosyncratic error term.

Alternate Fixed Effects Specifications: Allowing Returns to Vary Over Time

We use an alternate specification of equation (1) above to account for short-term and long-term effects of experience on earnings. Similar to the specifications used in Jacobson et al. (2005), Jaggars and Xu (2015), and Böckerman, Haapanen, and Jepsen (2015), we make the model more flexible by adding in an interaction term between highest credential awarded and quarters of exit since last enrollment. Quarters of exit since last enrollment have a value of 1 for the first quarter after the last record of enrollment through the first quarter of 2013, a value of 2 for two quarters of experience, etc. This interaction term allows us to capture the temporal pattern of the effect of attending a two-year institution as individuals gain more experience in the labor market. By including this parameter, the coefficient of *AWARD*, β, should be interpreted as a short-term return when quarters of exit approach zero.

In further variations on equation (1), we identify the effects of the Great Recession by adding interactions for highest credential awarded and quarters of exit before and after the Great Recession. This recession dummy is equal to one after the fourth quarter of 2008. The inclusion of these triple interactions between *AWARD*, quarters of exit, and pre- and post-recession attempts to capture the penalty of completing an award after a recessionary period.

Cross-Sectional Model

Stakeholders may be interested in additional labor market outcomes beyond average quarterly earnings. For example, we may be interested in whether credential holders' employment is stable over time, whether they are earning a so-called "living wage," or whether they experience spells of unemployment. However, not all outcomes are well suited for the individual fixed-effects specification we use for our main results. For example, filing for unemployment is relatively infrequent in a given quarter and is easier to pick up by looking at cumulative rates of receipt over several quarters. Similarly, stability of employment can only be measured over several consecutive quarters. Finally, the individual fixed-effects approach may not be ideal for binary outcomes. It is possible that directly controlling for continuous observable characteristics, including several quarters of earnings prior to enrollment, may control for pre-existing differences better than examining individuals' changes in binary outcomes before and after enrollment.

For these reasons, we complement our fixed-effects models with a cross-sectional model to examine effects of credential completion on several additional labor market outcomes. This model includes just one observation per student, and focuses on outcomes measured in 2012, our last full calendar year of UI data. Otherwise, the model specification is similar to our main fixed-effects models in terms of sample restrictions and controls included. Indeed, when controls for

individuals' pre-enrollment earnings are included in this cross-sectional specification, the model is conceptually quite similar to the individual fixed-effects specification.[10]

During this period, we focus on individuals who were not enrolled in a two-year institution. In order to deal with interstate mobility, our sample is restricted to individuals with at least one quarter of employment in 2012. If they show up in the earnings data at all, we make the assumption that they are part of the in-state labor force in 2012.

The Mincerian earnings equation is specified as follows:

$$(2) \qquad y_i = \alpha + \beta AWARD_i + \delta DEMOG_i + \partial INTENT_i + \varepsilon_i$$

where *y* is the dependent variable which was estimated separately for ever employed in 2012, conditional and unconditional average quarterly earnings, full-time employment (or if employed during the fourth quarter of 2012), if earned at least a living wage, and percent ever claiming unemployment. Living wage earnings is equal to one for those who earned at least $30,000 per year in 2012, equivalent to earning 15 dollars per hour, 40 hours per week, for 50 weeks per year. Percent ever claiming unemployment is computed only for those who show up in the employment data at some point in 2012.

AWARD is a vector of three dichotomous variables for highest award (associate degree, short certificate, and long certificate). *INTENT* is a vector that includes the number of credit hours attempted in the first term of enrollment and a set of dichotomous variables for each student's area of study declared at first enrollment. *DEMOG* is a set of person-specific demographics such as age and race/ethnicity and an indicator that the student was in the year/term cohort. This model also controls for a dummy that is equal to one for those who have earned any sub-baccalaureate credential, as well as for earnings in each of the four quarters immediately prior to first enrollment earnings.

3. Main Results

In the first two columns of Table 2, we first replicate Jepsen et al.'s (2014) approach in their analysis of Kentucky data using our Ohio data. We restrict the sample to the same entry cohorts used in Jepsen et al., and use the same length of follow-up (up to 4.5 years post-entry) with a nearly identical fixed-effects regression specification. We find a qualitatively similar pattern for women, though estimated returns are somewhat lower in Ohio than in Kentucky during this time period: $2,014 for an associate degree (versus $2,400 in Kentucky), $1,719 for a long certificate (versus $1,900 for a diploma in Kentucky), and an insignificant $174 for a short certificate (versus a significant $300 in Kentucky). For men, we find similar returns to associate

[10] As we will show, the estimated earnings returns are quite similar under both models. This is also true of Jepsen et al. (2014) who also show results for cross-sectional models controlling for pre-enrollment earnings.

degrees but much lower returns for short or long certificates: $1,363 for an associate degree (versus $1,500 in Kentucky), but only $607 for a long certificate (versus $1,300 for a diploma in Kentucky), and negative $358 for a short certificate (versus positive $300 in Kentucky).

The second two columns of Table 2 provide the main estimates for our Ohio sample, adding an additional cohort of entrants and extending the follow-up to 11 years post-entry. Extending the length of follow-up substantially increases estimated returns to associate degrees for both genders, as well as to short and long certificates for men. For women, the advantage to completing an associate degree versus a long certificate widens substantially with a longer follow-up window.

Table 2: Individual Fixed-Effects Estimates of Returns to Sub-Baccalaureate Credentials, Jepsen, et al. (2014) Replication and Extended Follow-Up

	Model 1, Jepsen et al. Replication		Model , Extended Follow-up	
	(1)	(2)	(3)	(4)
Variables	**Women**	**Men**	**Women**	**Men**
Associate degree	2,014***	1,363***	2,627***	1,741***
	(75)	(143)	(69)	(123)
Long-term certificate	1,719***	607*	1,797***	1,166***
	(134)	(357)	(115)	(310)
Short-term certificate	174	-358**	115	181
	(183)	(163)	(169)	(160)
Observations	1,213,835	1,006,040	1,803,412	1,494,688
Number of students	34,681	28,744	34,681	28,744
Average for non-graduates	$4,214	$6,633	$4,221	$6,556

Note. For Model 1, sample is restricted to fall 2002–spring 2004 first-time college entrants to two-year institutions, followed through 2008Q4. For the extended follow-up, Model 1 sample is followed through 2013Q1. For both models, we only include students who were 20–60 years old at entry and reported either a transfer or credential intent. Students who subsequently enrolled in a four-year institution are excluded. Samples are also restricted to Ohio residents and U.S. citizens at first enrollment. Quarters since exit is based on last enrollment. These models use the following for controls: (i) a dummy that is equal to one after the individual has finished attending college; (ii) enrollment, which is equal to one when the individual is attending college and zero otherwise (for the extended model, enrollment after 2011Q2 has been inputted based on last enrollment status); (iii) a dummy that is equal to one for the time period two quarters before first enrollment and another dummy that is equal to one for the time period one quarter before first enrollment; (iv) number of credit hours attempted in the first term of enrollment interacted with time; (v) a set of dichotomous variables for each student's area of study declared at first enrollment ("other" field is the omitted category) interacted with time; (vi) a set of demographic characteristics, such as age at first entry, nonwhite, missing race/ethnicity, and entry cohort dummy, all interacted with time; (vii) county unemployment rate; and (viii) fixed effects for each year/quarter.

***$p < .01$, **$p < .05$, *$p < .1$.

In Table 3, we compare our baseline estimates (Model 1) to a more nuanced model that allows returns to vary over time (Model 2). The main degree effects in Model 2 can be interpreted as the quarterly earnings gains upon completion, while the interaction effects show how these gains expand or shrink relative to non-completers over time. These interaction estimates highlight how dramatically the returns to associate degrees grow over time for both genders, while the returns to long certificates remain largely flat (the returns to short certificates are flat for women, but grow over time for men). The interaction coefficients of $56 per quarter for women and $61 per quarter for men imply that the quarterly returns to associate degrees grow by over 50 percent ($1,120) over the first five years post-graduation for women, and almost 150 percent ($1,220) over the first five years for men.

An important point for interpreting the gender differences in returns over time is that non-completer men experience much more erosion of earnings over time than do non-completer women. Thus, some of the increasing returns for men are due to declining earnings in the comparison group rather than rising earnings for attaining a credential. For example, the growth in men's return to earning a short certificate ($56 per quarter) is barely enough to outweigh the erosion of their earnings over time (-$41 per quarter).[11]

Table 3 also examines the sensitivity of our estimates to excluding any zero-earnings quarters. This serves two purposes. First, it allows us to isolate the earnings changes due to the intensive employment margin (i.e., due to increased hours or higher wages), which may be more likely to reflect true increases in human capital, rather than to the extensive margin (i.e., whether or not someone has a job at all). Second, it also addresses concerns that returns may be distorted due to patterns of out-of-state mobility (the UI data cover only in-state employment, so those working out-of-state are indistinguishable from those living in-state but not working). Note, however, that out-of-state mobility is less problematic for this sample of older community college entrants than it would be for a sample of young four-year college entrants: in contrast to the four-year context, community college graduates are no more or less likely to move out of state than community college enrollees (Scott-Clayton & Wen, 2016, Table 4).

The results of this sensitivity analysis are presented in columns 5–8. Not surprisingly, the magnitude of estimated returns is diminished across the board, reflecting the fact that some of the returns to these credentials come through a higher likelihood of employment. Nonetheless, these specifications still broadly reproduce the patterns of returns for all credentials for women and for associate degrees for men. However, excluding zero-earnings quarters reduces estimated returns for men more than for women, and for certificates more than for associate degrees, suggesting that the employment margin is more a factor for these cases. This is consistent with Xu and Trimble (2016) who find that the overall positive impact of certificates on earnings is mostly due to an increase in the probability of employment after earning a certificate. Interestingly, columns 7–8 indicate that earnings growth over time is hardly affected by this change in specification—

[11] The coefficient on "quarters since exit" for men (not shown in Table 3) is -$41 per quarter.

most of the difference can be accounted for by the main effects measured at completion (the exception to this is short certificates for men).[12]

Finally, Table 4 examines returns using our baseline and preferred specifications by field of study, focusing on the two most common fields of study—health and engineering, for women and men respectively—and grouping all other fields together (results for additional specific fields can be found in the Appendix).[13] One explanation for the gender differences in the main credential effects (Table 3) is that returns vary by fields of study, and men and women study different things. For example, this table shows that for both women *and* men, the highest quarterly earnings gains upon graduation are from health-related fields, and particularly for associate degrees: around $3,460 for women and $2,501 for men, for Model 2. Yet for men, only 13 percent of associate degrees are in health fields, compared to 40 percent for women. At the associate degree level, women's immediate returns in health are more than three times their immediate returns in other fields. For men, the immediate payoff is three to five times higher in health fields.

If we set aside health fields and focus only on students who enter to pursue other types of programs, our conclusions about the payoffs to community college credentials would look rather different. For women, returns are lower in other fields across the board, though in non-health fields we still see the pattern that returns grow substantially over time for associate degree completers, while remaining flat or falling for certificate holders. For men, long certificates in "other" fields have a much higher initial payoff than associate degrees, and in engineering fields both long and short certificates show substantial growth over time, not much smaller than the growth for associate degrees. Thus, for men, the conclusion that associate degrees dominate certificates in terms of both immediate earnings gains and earnings growth is much more dependent on field than it is for women.

[12] This is consistent with a model in which signaling effects matter more for employment than wages, and are most important at credential completion, but less important over time as employers observe productivity.

[13] To enable us to compare completers and non-completers as we do in our other analyses, we classify individuals by field of study at initial entry. While field of study at entry is not always identical to credential field, students generally remain within the fairly broad groupings that we have defined here.

Table 3: Fixed-Effects Estimates of Returns to Highest Award Received for Fall 2001–Spring 2004 Entrants Followed to 2013Q1

	All Quarters of Earnings				Quarters With Positive Earnings			
	Model 1		Model 2		Model 3		Model 4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**
Associate degree	2,711***	1,782***	2,066***	831***	2,135***	1,039***	1,777***	258***
	(56)	(97)	(56)	(96)	(54)	(92)	(54)	(89)
Long-term certificate	1,853***	1,041***	1,785***	723***	1,179***	260	1,309***	93
	(97)	(261)	(99)	(271)	(90)	(249)	(89)	(258)
Short-term certificate	386***	389***	365**	-484***	-36	-635***	302**	-872***
	(144)	(136)	(146)	(132)	(144)	(183)	(148)	(178)
Associate degree *quarters since exit			56***	61***			53***	74***
			(3)	(6)			(3)	(6)
Long-term certificate *quarters since exit			4	6			5	19
			(7)	(18)			(5)	(16)
Short-term certificate *quarters since exit			-1	56***			-18**	21*
			(8)	(8)			(8)	(12)
Observations	2,645,177	2,222,290	2,645,177	2,222,290	1,760,255	1,480,664	1,760,255	1,480,664
Number of students	49,909	41,930	49,909	41,930	48,296	40,463	48,296	40,463
Average for non-graduates	$4,295	$6,572	$4,295	$6,572	$6,578	$9,906	$6,578	$9,906

Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions followed through 2013Q1. Sample restricted to Ohio residents and U.S. citizens who were 20–60 years old at entry and reported either a transfer or credential intent. Students who subsequently enrolled in a four-year institution are excluded. Model 3 and Model 4 show returns conditional on positive earnings quarters. Model 2 and Model 4 include interaction term between highest degree awarded and quarters of exit since last enrollment. Quarters since exit is also included in these models. All these models use the following for controls: (i) a dummy that is equal to one after the individual has finished attending college; (ii) enrollment, which is equal to one when the individual is attending college and zero otherwise (enrollment after 2011Q2 has been inputted based on last enrollment status); (iii) a dummy that is equal to one for the time period two quarters before first enrollment and another dummy that is equal to one for the time period one quarter before first enrollment; (iv) number of credit hours attempted in the first term of enrollment interacted with time; (v) a set of dichotomous variables for each student's area of study declared at first enrollment ("other" field is the omitted category) interacted with time; (vi) a set of demographic characteristics, such as age at first entry, nonwhite, missing race/ethnicity, and an indicator that the student was in the 2001/02, 2002/03, or 2003/04 cohort, all interacted with time; (vii) county unemployment rate; and (viii) fixed effects for each year/quarter.

***$p < .01$, **$p < .05$, *$p < .1$.

Table 4: Heterogeneity by Degree Area

	Women						Men					
	Model 1			Model 2			Model 1			Model 2		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Variables	**Health**	**Engineer-ing**	**Other**	**Health**	**Engin-eering**	**Other**	**Health**	**Engin-eering**	**Other**	**Health**	**Engin-eering**	**Other**
Associate degree	4,275*** (96)	1,946*** (378)	1,663*** (66)	3,460*** (94)	908** (431)	1,133*** (67)	3,117*** (287)	2,414*** (201)	1,153*** (118)	2,501*** (281)	742*** (188)	518*** (119)
Long-term certificate	2,281*** (118)	494 (1,290)	1,216*** (167)	2,305*** (119)	762 (874)	1,030*** (181)	1,005** (444)	744* (417)	1,284** (499)	1,600*** (444)	-428 (457)	1,241** (498)
Short-term certificate	926*** (215)	-1,367 (1,186)	71 (192)	945*** (220)	-579 (1,230)	5 (193)	43 (655)	404 (323)	397*** (153)	-179 (667)	-794*** (308)	-387*** (149)
Associate deg. *Quarters since exit				76*** (6)	81*** (26)	42*** (4)				48*** (17)	109*** (12)	38*** (8)
Long-term cert. *Quarters since exit				-1 (8)	-23 (58)	11 (12)				-68** (30)	72*** (21)	-24 (47)
Short-term cert. *Quarters since exit				-0 (11)	-75 (65)	-0 (11)				16 (35)	72*** (25)	51*** (8)
Observations	848,530	67,416	1,729,231	848,530	67,416	1,729,231	164,936	570,068	1,487,286	164,936	570,068	1,487,286
Number of students	16,010	1,272	32,627	16,010	1,272	32,627	3,112	10,756	28,062	3,112	10,756	28,062
Average for non-graduates	$3,863	$5,547	$4,434	$3,863	$5,547	$4,434	$7,829	$7,829	$6,199	$7,829	$7,829	$6,199

Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions followed through 2013Q1. Sample restricted to Ohio residents and U.S. citizens who were 20–60 years old at entry and reported either a transfer or credential intent. Students who subsequently enrolled in a four-year institution are excluded. Model 2 includes interaction term between highest degree awarded and quarters of exit since last enrollment. Quarters since exit is also included in this model. All these models use the following controls: (i) a dummy that is equal to one after the individual has finished attending college; (ii) enrollment, which is equal to one when the individual is attending college and zero otherwise; (iii) a dummy that is equal to one for the time period two quarters before first enrollment and another dummy that is equal to one for the time period one quarter before first enrollment; (iv) number of credit hours attempted in the first term of enrollment interacted with time; (v) a set of demographic characteristics, such as age at first entry, nonwhite, missing race/ethnicity, and an indicator that the student was in the 2001/02, 2002/03 and 2003/04 cohort, all interacted with time; (vi) county unemployment rate; and (viii) fixed effects for each year/quarter. Results shown only for our baseline and preferred models, Model 1 and Model 2.

***$p < .01$, **$p < .05$, *$p < .1$.

4. Additional Findings

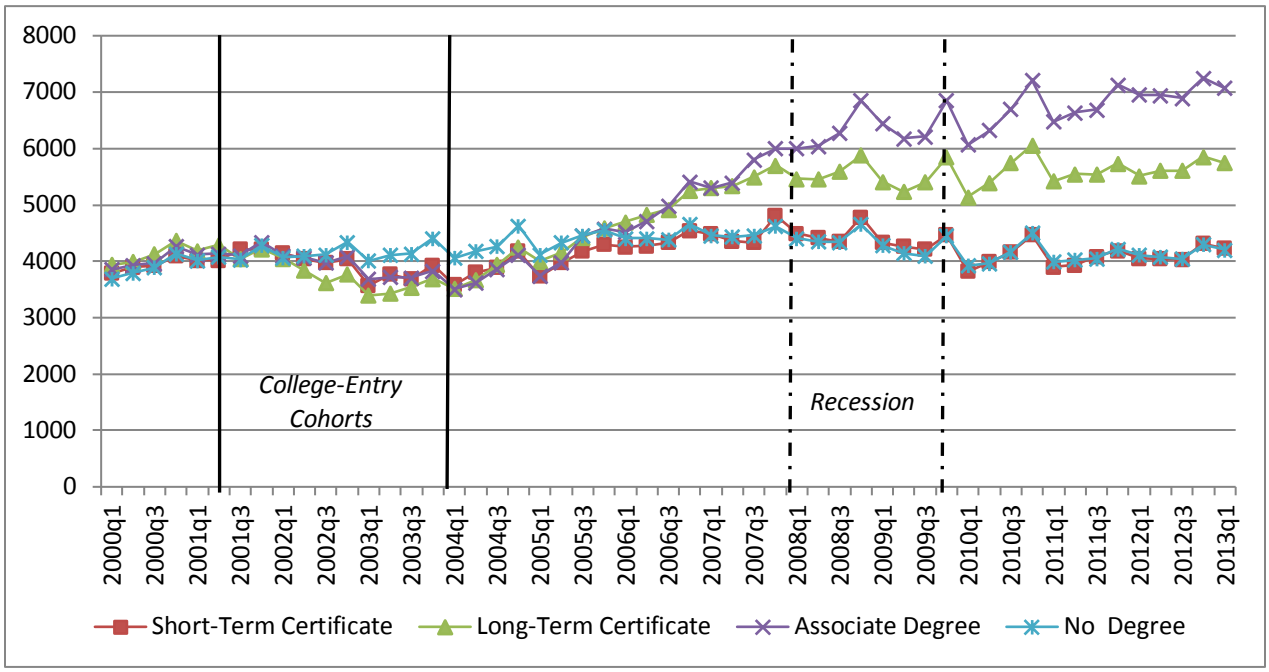
Returns to Degrees During the Great Recession

Figure 2 shows the earnings patterns by calendar quarters before, during, and after the Great Recession for women (Figure 2a) and men (Figure 2b), split out by eventual degree attainment outcome for all entry cohorts. For both genders, average quarterly earnings for non-completers and short certificates appear to have shifted downward during the Great Recession, without having fully recovered after the end of the recession. In contrast, earnings patterns for associate degree and long certificates holders are flatter and exhibit a faster recovery, particularly for women.

To illustrate how returns to credential completion change during the Great Recession, Table 5 examines estimated effects on average quarterly earnings and earnings growth during this period. (Note that we are neither estimating the effect of the Great Recession nor how returns to these sub-baccalaureate credentials recover from the recession.) To do this, in Models 5 and 6 we re-estimate equation (1) including interactions of highest credential awarded with an indicator variable for the Great Recession (i.e., a variable equal to one during calendar quarters 2008Q1 through 2009Q4).[14] Model 7 further includes triple-interactions of highest credential, the recession indicator, and quarters-since-exist to allow earnings growth to vary depending upon whether the economy is in or out of the recession. Consistent with Belfield (2015), the interaction terms between each highest credential awarded and the recession are mostly positive (and significant for associate degrees), suggesting that the relative payoff to these degrees increases during the recession. Without accounting for earnings growth, the main effects of long certificates for men during the recession is underestimated (Model 5), which indicates that earnings growth is notably smaller during the recession. Model 7 indicates that only for women who complete an associate degree is the earnings growth significantly larger when the economy is in a recession.

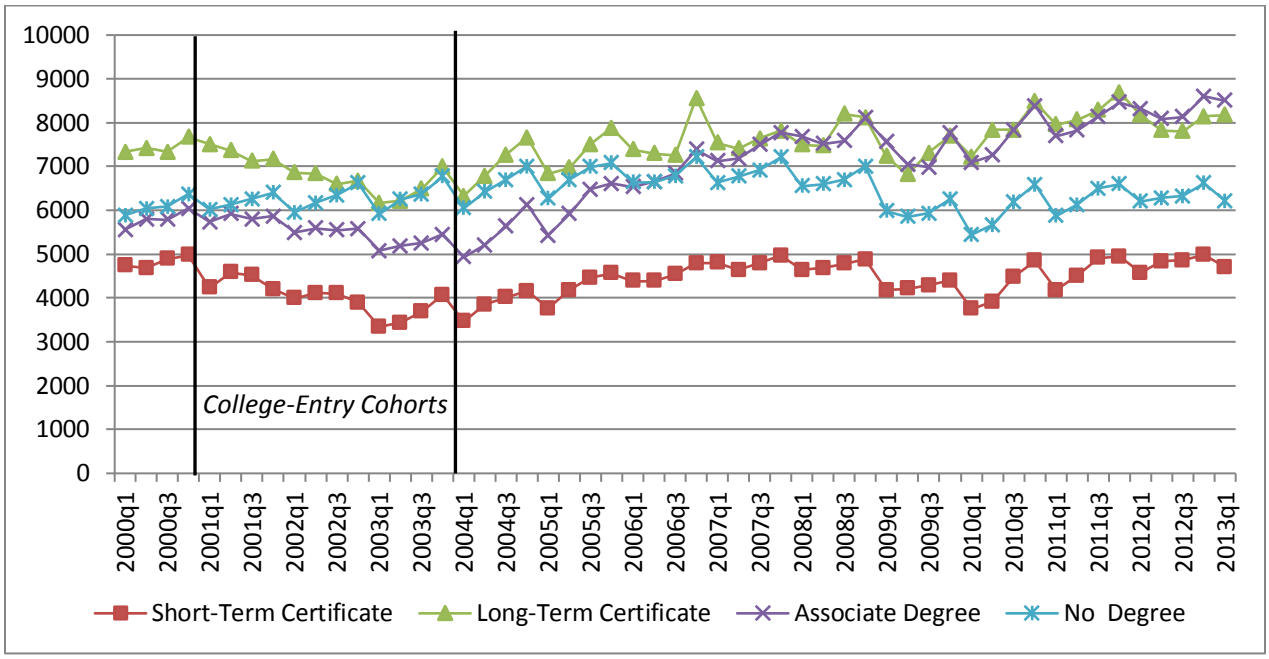
[14] The National Bureau of Economic Research defines a recession as "a period of falling economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales," and estimates that the Great Recession began in December 2007 and ended in June 2009. However, because we are particularly focused here on the labor market, we include all of 2009 in the recession since unemployment rates continued to increase through the end of 2009.

Figure 2a: Quarterly Earnings by Calendar Quarters—Women



Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions followed through 2013Q1. We define the Great Recession based on Bureau of Labor Statistics unemployment trends, which were rising between calendar quarters 2008Q1 and 2009Q4.

Figure 2b: Quarterly Earnings by Calendar Quarters—Men



Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions followed through 2013Q1. We define the Great Recession based on Bureau of Labor Statistics unemployment trends, which were rising between calendar quarters 2008Q1 and 2009Q4.

Table 5: Earnings Returns for Highest Award Received—Recession Models

	Model 5		Model 6		Model 7	
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Women	Men	Women	Men	Women	Men
Associate degree	2,663***	1,741***	1,929***	720***	1,963***	743***
	(56)	(98)	(57)	(99)	(58)	(100)
Long-term certificate	1,822***	1,091***	1,749***	778***	1,734***	687***
	(97)	(260)	(103)	(282)	(103)	(284)
Short-term certificate	352**	346**	328**	-533***	339**	-557***
	(141)	(138)	(145)	(133)	(144)	(133)
Associate degree *recession	187***	166***	391***	347***	188***	194
	(36)	(63)	(38)	(66)	(64)	(120)
Long-term certificate *recession	125*	-206	130*	-187	229*	370
	(70)	(168)	(73)	(180)	(118)	(271)
Short-term certificate *recession	143	186*	142	210**	69	420**
	(94)	(97)	(96)	(97)	(163)	(187)
Associate degree *quarters since exit			60***	63***	57***	62***
			(4)	(6)	(4)	(6)
Long-term certificate *quarters since exit			4	5	5	11
			(7)	(18)	(7)	(18)
Short-term certificate *quarters since exit			-1	56***	-1	57***
			(8)	(8)	(8)	(8)
Associate degree*quarters since exit*recession					20***	15
					(6)	(9)
Long-term cert.*quarters since exit*recession					-10	-51**
					(9)	(21)
Short-term cert.*quarters since exit*recession					6	-15
					(11)	(12)
Observations	2,645,177	2,222,290	2,645,177	2,222,290	2,645,177	2,222,290
Number of students	49,909	41,930	49,909	41,930	49,909	41,930
Average for non-graduates	$4,295	$6,572	$4,295	$6,572	$4,295	$6,572

Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions followed through 2013Q1. Sample restricted to Ohio residents and U.S. citizens who were 20–60 years old at entry and reported either a transfer or credential intent. Students who subsequently enrolled in a four-year institution are excluded. Quarters since exit is with respect to last enrollment. Recession dummy is equal to one between 2008Q1 and 2009Q4. All these models use the following controls: (i) a dummy that is equal to one after the individual has finished attending college; (ii) enrollment, which is equal to one when the individual is attending college and zero otherwise (enrollment after 2011Q2 has been inputted based on last enrollment status); (iii) a dummy that is equal to one for the time period two quarters before first enrollment and another dummy that is equal to one for the time period one quarter before first enrollment; (iv) number of credit hours attempted in the first term of enrollment interacted with time; (v) a set of dichotomous variables for each student's area of study declared at first enrollment ("other field" is the omitted category), interacted with time; (vi) a set of demographic characteristics, such as age at first entry, nonwhite, missing race/ethnicity, and an indicator that the student was in the 2001/02, 2002/03 and 2003/04 cohort, all interacted with time; (vii) county unemployment rate; and (viii) fixed effects for each year/quarter.

***$p < .01$, **$p < .05$, *$p < .1$.

Effects on Other Labor Market Outcomes

Table 6 presents estimated effects of credential completion on several additional labor market outcomes using a cross-sectional model that includes controls for earnings in each of the four quarters prior to enrollment. As described above, this model includes just one observation per student, and focuses on outcomes measured in 2012. Otherwise, the model specification is similar to our main models in terms of sample restrictions and controls included. For comparison with our original fixed-effects models, the first column of Table 6 shows estimated effects on average quarterly earnings using this cross-sectional model. Note that the pattern and magnitude of findings is very similar to the fixed-effects results except for short certificates, for which estimated returns are smaller and not significant in the cross-sectional model. This provides reassurance that the cross-sectional model is reasonable.

The second column estimates the effect of credential attainment on the likelihood of working at all (in Ohio) during 2012. We find positive effects of associate degree and long certificate completion on employment for both men and women, of about 13 percentage points for women and 8–9 percentage points for men (these increases are from a baseline of about 62 percent employed, for both genders).

To help isolate the effect on other labor market outcomes beyond the employment margin, the remaining columns of Table 6 are restricted to individuals who were employed in at least one quarter of 2012. Looking across all of these outcomes, some interesting patterns emerge. First, short certificates have no effect on these additional outcomes for men, and only a small effect on the likelihood of year-round employment for women. Second, both associate degrees and long certificates appear to have a strong positive effect on measures of employment and employment stability (though the effect is modestly larger for associate degrees). For example, both credential types increase the probability of year-round employment (by 5–7 percentage points for men and 7–10 percentage points for women), and for men, both decrease the likelihood of claiming UI (4–7 percentage point reduction from a baseline rate of 14 percent for non-completers).

Yet as we found in the fixed-effects analysis, associate degree holders receive a much bigger earnings boost conditional on employment for both genders, and are much more strongly related to the likelihood of earning a so-called "living wage" (equivalent to approximately $30,000 annually) than are those with only a long certificate. For example, the effect of an associate degree on the likelihood of earning a living wage is 25 percentage points for women (12 percentage points for men), compared to a 13 percentage point effect of a long certificate (3 percentage points for men). In summary, it appears that while associate degrees and long certificates have comparable payoffs in terms of employment and employment stability, associate degrees are more likely to offer a path to higher earnings and true economic security.

Table 6: Labor Market Returns in 2012 for Highest Award Received—Cross-Sectional OLS Analysis

Variables	Unconditional Quarterly Earnings in 2012 (1)	Ever Employed in 2012 (2)	Quaterly Earnings in 2012 (3)	If Employed Four Quarters in 2012 (4)	If Earned ≥ 30,000 in 2012 (5)	Ever Claimed UI in 2012 (6)
Panel A. Women						
Associate degree	2,762***	0.137***	2,531***	0.095***	0.245***	-0.025***
	(73)	(0.006)	(75)	(0.006)	(0.008)	(0.004)
Long-term certificate	1,325***	0.131***	887***	0.070***	0.130***	-0.012
	(135)	(0.013)	(133)	(0.012)	(0.017)	(0.009)
Short-term certificate	37	0.032	-170	0.041**	-0.006	-0.010
	(176)	(0.019)	(206)	(0.020)	(0.024)	(0.013)
Observations	47,674	47,674	30,476	30,476	30,476	30,476
R-squared	0.234	0.077	0.267	0.038	0.188	0.010
Average for non-graduates	$4,137	0.615	$6,726	0.780	0.368	0.083
Panel B. Men						
Associate degree	1,750***	0.090***	1,422***	0.071***	0.122***	-0.065***
	(135)	(0.009)	(144)	(0.008)	(0.010)	(0.006)
Long-term certificate	943**	0.077***	407	0.051**	0.039	-0.039*
	(368)	(0.025)	(381)	(0.025)	(0.031)	(0.020)
Short-term certificate	42	0.007	-293	0.014	-0.023	-0.011
	(189)	(0.017)	(246)	(0.020)	(0.023)	(0.016)
Constant	-5,392***	0.348***	213	0.644***	-0.406***	-0.192***
	(689)	(0.045)	(1,050)	(0.056)	(0.063)	(0.041)
Observations	42,126	42,126	26,372	26,372	26,372	26,372
R-squared	0.269	0.109	0.299	0.042	0.163	0.029
Average for non-graduates	$6,351	0.619	$10,262	0.782	0.607	0.135

Note. Fall 2001–spring 2004 first-time college entrants to two-year institutions who were 20–60 years old at entry and reported either a transfer or credential intent. Students who subsequently enrolled in a four-year institution are excluded. Sample restricted to Ohio residents and U.S. citizens at entry and to students who were not enrolled and with at least one quarter of employment in 2012. This model uses the following controls: (i) a dummy that is equal to one if individual has earned a two-year degree; (ii) earnings in each of the four quarters immediately prior to first enrollment; (iii) number of credit hours attempted in the first term of enrollment; (iv) a set of dichotomous variables for each student's area of study declared at first enrollment ("other field" is the omitted category); and (v) a set of demographic characteristics, such as age and age squared at first entry, nonwhite, missing race/ethnicity, and an indicator that the student was in the year/term cohort. Percent ever claiming unemployment is computed only for those who show up in the employment data at some point in 2012.

***$p < .01$, **$p < .05$, *$p < .1$.

5. Discussion and Conclusion

Using administrative data from the State of Ohio and an individual fixed-effects approach that compares students' earnings before and after enrollment, we have assessed the returns to completion of community college associate degrees and certificates. Our study builds upon the prior literature in three ways: first, we examine earnings for almost twice as long as prior studies; second, we explicitly model how the returns to different credentials change during the Great Recession; and third, we consider additional measures of labor market success that have not previously been explored using this method.

Overall, our results are broadly consistent with those of existing analyses using an individual fixed-effects approach that compares students' earnings before and after enrollment (e.g., Bahr et al., 2015; Carruthers & Sandford, 2015; Dadgar & Trimble, 2015; Jepsen et al., 2014; Liu et al., 2015; Xu & Trimble, 2016), in that associate degrees and long certificates tend to yield substantial labor market returns, and short certificates tend to yield very small (sometimes negative, and often insignificant) returns.

In fact, when we use our Ohio data to replicate Jepsen et al.'s (2014) work in Kentucky, using the same follow-up time frame with a nearly identical fixed-effects regression specification, the pattern and magnitude of our findings are very similar. For example, we find a qualitatively similar pattern for women, though estimated returns are somewhat lower in Ohio than in Kentucky during this time period: $2,014 for an associate degree (versus $2,400 in Kentucky), $1,719 for a long certificate (versus $1,900 for a diploma in Kentucky), and an insignificant $174 for a short certificate (versus a significant $300 in Kentucky). For men, we find similar returns to associate degrees but much lower returns for long and short certificates: $1,363 for an associate degree (versus $1,500 in Kentucky), but only $607 for a long certificate (versus $1,300 for a diploma in Kentucky), and negative $358 for a short certificate (versus positive $300 in Kentucky). The varied findings on short certificates could also be due to variation in local labor markets (both across geography and time) as well as in the mix of certificate fields that are offered at different institutions.

Despite this broad similarity in findings, our results also highlight the importance of modeling patterns of earnings growth over a longer period of time. When we extend our follow-up period to 11 years post-entry and allow returns to vary over time, we see that the benefit to earning an associate degree grows substantially over time, while earnings growth remains flat for long certificates. This result is qualitatively consistent with Jaggars and Xu (2015), although we estimate higher immediate returns and they estimates higher growth rates. This is likely due to the fact that earnings growth is generally much higher in the years right after credential

completion than in later years, and we are able to follow our sample for six years longer than in Jaggars and Xu (2015).[15]

We find that returns are particularly high in health-related fields for both men and women, as has been found in numerous prior studies. These findings help explain gender differences in returns, because men remain substantially underrepresented in health fields despite their high returns. Indeed, a key implication of this and similar recent work is that men appear to be foregoing substantial returns due to this underrepresentation. As shown in Table 4, only about 7 percent of male community college entrants pursue a health field, compared to 32 percent of female community college entrants. Of course, not every entrant will be interested in pursuing a health degree, but a gender disparity of this magnitude and consequence warrants further research and policy attention.

Our additional analyses, which examine other measures of labor market success, as well as how graduates fare during labor market shocks, generally reinforce the conclusion that associate degrees offer superior payoffs compared with certificates. We find that both associate degrees and long certificates increase the likelihood and stability of employment, but associate degrees appear to have a much bigger impact on overall earnings and the likelihood of earning a living wage than certificates. The advantages to earning an associate degree increase even further during the Great Recession, while the pattern for certificates is more muted and varies by gender.

In terms of policy implications, our results suggest that caution is warranted in terms of promoting certificates as equally valuable alternatives to associate degrees. While long certificates do have a substantial payoff, this payoff remains very flat or even declines over time (with the exception of engineering fields for men). In contrast, the payoff to associate degrees both starts out higher and grows more quickly over time. Also in contrast to associate degrees, the benefits of certificates appear to come disproportionately from the employment margin rather than from higher wages conditional on employment. While both margins are important to prospective workers, we might be concerned if certificates' primary value is as a signal to employers (which they may use simply to prioritize completers over non-completers in the hiring process).

A countervailing argument for certificates might be that they are easier for students to complete, and get students back in the labor force faster than a two-year degree. But even this is

[15] For comparison, Jaggars and Xu (2015), using data from Virginia, find that while associate degrees yield slightly lower returns than long certificates upon college exit for women ($437 versus $505), earnings growth over the first three years post-exit is more than two times higher in later years than in the year of exit for associate degrees ($1,740 versus $1,032 for long certificates). If we use each paper's estimates to calculate returns at three years after college exit, then quarterly returns would be around $2,432 for associate degrees versus $1,471 for long certificates in Virginia and $2,151 for associate degrees versus $1,314 for long certificates in Ohio (for an average of women and men). For these calculations, we use Jaggars and Xu's two-piece growth curve model results, which are in general very similar to the three-piece model, because it is the most similar to our specification. For associate degrees, Jaggars and Xu (2015) find earnings gains upon graduation to be $692 with growth of $145 per quarter. Using these estimates, we calculate returns at three years after college by multiplying $145 by 12 quarters and adding $692 for a total of $2,432.

not obvious, at least in Ohio: the average time to completion in our sample is 3.9 years for an associate degree and 3.8 years for a long certificate (even short certificates, which are defined as less-than-one-year programs, take an average of 3 years to complete). And while the prevalence of certificate programs has grown over time, associate degrees remain the most common by far. Finally, the fact that our sample excludes individuals who transfer to a four-year institution means that the full returns to pursuing an associate degree may even be understated here. While there is important variation in the returns to certificates across gender and field, in general, it does not appear that either long or short certificates are equivalent to associate degrees in terms of their labor market payoffs. This has implications not only for students' individual decisions, but also for state and federal accountability systems which often aggregate completion statistics across all credentials.

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