The Labor-Market Returns to Community College Degrees, Diplomas, and Certificates

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Abstract

This paper provides among the first rigorous estimates of the labor-market returns to community college certificates and diplomas, as well as estimating the returns to the more commonly-studied associate's degrees. Using administrative data from Kentucky, we estimate panel-data models that control for differences among students in pre-college earnings and educational aspirations. Associate's degrees and diplomas have quarterly earnings returns of nearly $2,400 for women and $1,500 for men, compared with much smaller returns for certificates. There is substantial heterogeneity in returns across fields of study. Degrees, diplomas, and – for women – certificates correspond with higher levels of employment.

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1. Introduction

In July 2009, President Obama announced a $12 billion initiative to increase assistance to the nation's community colleges (Kellogg and Tomsho, 2009).[1] The announcement, delivered at Macomb Community College in Michigan, illustrates the administration's view that community colleges are an essential component of the nation's economy. Nationally, over 45 percent of undergraduate students in higher education were enrolled in public community colleges during the 2006-2007 school year (Knapp et al., 2008). During that year, community college enrollment was more than 2.4 million full-time students and 3.8 million part-time students.

Community colleges are diverse institutions that offer several opportunities for individuals to gain human capital. Community colleges offer a variety of each of the three types of awards: degrees, diplomas, and certificates. Certificates are primarily awarded in technical programs and typically require one or two semesters of course work. Examples include medical records coding specialist, IT network administrator, automotive mechanic, and electrician. Diplomas typically require more than a year of study and are also most common in technical fields such as surgery technology, accounting, and practical nursing. Associate's degrees require the most number of credits, 60 to 76 depending on the field of study. The curriculum for associate's degree programs have much in common with that of the first two years of a four-year college, with liberal arts and general education courses as well as those geared to specific vocations, such as registered nursing. Associate's degree credits generally are transferrable to a four-year college towards a bachelor's degree.

Recent economic research on the labor-market returns for community colleges has focused almost exclusively on the returns to associate's degrees or the returns to additional

[1] In comparison, existing federal government assistance to community colleges is around $2 billion.

years of schooling or credits. Although community colleges emphasize the benefits of diplomas and certificates, these benefits are based on anecdotal evidence rather than rigorous empirical analysis. A few studies look at the effects of certificates on labor-market outcomes, but these results are often inconclusive and are based on small samples of certificate recipients drawn from national longitudinal surveys. Given the growing importance of these awards as well as the growing importance of community colleges in general, it is important to document the economic returns associated with this form of human capital investment.

This paper provides among the first detailed empirical evidence of the labor-market returns to community college diplomas and certificates, as well as providing additional information on the returns to associate's degrees and credits earned. One unique aspect of our analysis is that to estimate these returns we exploit detailed administrative data from Kentucky, following 20 to 60 year-old students who entered the state's community college system during the 2002-2003 and 2003-2004 school years with the intent of receiving an award. Our student fixed effects model uses across-student and within-student variation to identify the labor-market returns. We include information on student goals and number of classes taken in the first term to provide comprehensive controls for potential differences in labor-market outcomes between students who complete different levels of community-college schooling. Such controls have not been included in previous studies of community college returns and therefore provide a valuable contribution to the returns-to-schooling literature.

Consistent with previous work, we find that labor-market returns to schooling are larger for women than for men. On average, women receive approximately $2,400 higher

quarterly earnings for degrees or diplomas, compared to a $1,500 increase in earnings for men. The returns to associate's degrees for men are similar to previous studies but the returns to associate's degrees for women are larger than previous work. For women, the $2,400 increase in quarterly earnings translates into a 56-percent increase in the low average earnings of women in our sample. The returns to certificates are around $300 per quarter for men and women. We also find positive returns for credits earned, and associate's degrees and diplomas are associated with large gains in employment.

As is now widely recognized, there are always questions about the generalizability of results drawn from non-experimental data. This is certainly true in our case, despite exploiting data containing detailed information about community college attendance and labor market outcomes. Strictly speaking, our results should be viewed as an estimate of the effect of the treatment on the treated--the impact of receiving an award for students who attend a community or technical college in Kentucky and then enter the labor market. We report on several analyses designed to assess the sensitivity of our results to possible differences between our sample and the larger population. Because it is impossible to examine all possible differences, readers should keep in mind the precise interpretation of our results. With these caveats in mind, our results strongly support the claims made by community colleges that associate's degrees and diplomas have large labor-market returns. Even though the returns to certificates are much more modest, the benefits to certificates likely still outweigh the costs.

2. Relation to Previous Work

Many researchers have studied the relationship between schooling and earnings. Census data show that workers with higher education levels have higher earnings. Card

(1999) summarizes the vast literature on the labor-market returns to schooling, with discussions of several of the econometric techniques used to control for potential endogeneity. Belfield and Bailey (2011) summarize the literature on returns to community colleges. Straightforward, single-equation estimates of the labor-market returns to schooling find that an additional year of schooling raises yearly earnings between five and ten percent. More complex analyses that use instrumental variables or within-family estimators (such as identical twins) tend to find returns at or above ten percent per year.

The overall rate of return generally assumes that an additional year of schooling has a similar effect on earnings whether that additional year is the 10^{th} year of schooling or the 15^{th} year of schooling. Other researchers have looked specifically at the types of schooling received, focusing in particular on high school graduation and college degrees. Kane and Rouse (1995) find that an additional year of community college corresponds with an increase of four to seven percent in annual earnings, whereas an additional year at a four-year institution produces a six to nine percent increase in annual earnings. They also find that receiving a college degree raises earnings even when compared to having completed an equivalent amount of schooling (such as four years) without completing a degree. Marcotte et al. (2005) obtain similar results for community colleges from a more recent cohort of students. Both studies use national data.

Jacobson, LaLonde, and Sullivan (2005a, 2005b) look at the labor-market returns to community colleges for a specific population, workers who have been "displaced" because their employers have closed down or moved out of the state of Washington. Although these papers have the advantage of looking at an exogenous shock to earnings, their results are not necessarily representative of the labor-market returns for all

community college students. They find that an additional year of community college increases long-term earnings by approximately nine percent for men and 13 percent for women, with slightly lower returns for older workers (age 35 or older). They also show that workers derive more benefits from technical courses and math/science courses and fewer benefits from less technical courses. Most of the increase in annual earnings comes from additional hours of work rather than from higher hourly wages.

Another technique for studying labor-market returns is to look at the highest degree received rather than the number of years of schooling. Kane and Rouse (1995) report that associate's degrees are associated with earnings increases of 24 percent for men and 31 percent for women. Leigh and Gill (1997) find similar returns, and they find that the returns are similar between continuing students and returning students. For comparison, the returns for a bachelor's degree are 42 percent for men and 51 percent for women (Kane and Rouse, 1995). The comparison group in all cases is a high school graduate.

Cellini and Chaudhary (2011) compare labor-market returns between private (predominantly for-profit) and public community colleges using a student fixed effects model as in our paper and in Jacobson, LaLonde, and Sullivan (2005a, 2005b).[2] The authors find small and statistically insignificant differences between the labor-market returns from private and public community colleges, with earnings returns of approximately 15 to 17 percent for an associate's degree.

Although most of the work on community colleges focuses on the number of credits earned and on the receipt of associate's degrees, a few papers examine labor-market

[2] Lang and Weinstein (2012) also study labor-market returns of for-profit versus not-for-profit (including public) colleges using cross-sectional earnings data. They find substantial positive effects in excess of 0.11 log points for individuals starting in associate's degree programs, but the effects are small and statistically insignificant for individuals starting in certificate programs.

returns for certificates from public and private community colleges. Marcotte et al. (2005) and Bailey et al. (2004) fail to find a consistent effect of certificates on various labor-market outcomes in their studies using longitudinal surveys from the U.S. Department of Education. In a summary of the literature, Grubb (2002a) also finds insignificant effects of certificates on wages and earnings in several earlier studies. In contrast, Grubb (1997) finds a positive association between community college certificates and earnings in the 1984 to 1990 waves of SIPP data. Jacobson and Mokher (2008) find positive effects of certificates on earnings using administrative data on recent high school attendees in Florida.[3] Similarly, there is some descriptive evidence from administrative data that certificates are associated with higher earnings (Grubb, 2002b). There are several explanations for the discrepancy in results such as the time period, the length of time between education and labor-market outcomes, and the limited availability of controls for factors such as ability and parental education.

The current paper contributes to the returns to schooling literature in two ways. First, it provides one of the first estimates of labor-market returns for community college outcomes other than associate's degrees received or credits earned. Community colleges offer a large number of certificates and diplomas, in areas such as radiologic technologist or industrial electrician. Community colleges market these programs as providing valuable, marketable skills, but the labor-market returns of these programs are not well known. Second, we study the labor-market returns for credits and associate's degrees using a large administrative data set on the population of students in one state (Kentucky). Most previous work uses Census data or survey data. The Census data are large but are a

[3] They also find positive effects for associate's degrees, but these results become insignificant once they control for the field of study.

cross section with no pre-college information. Survey data typically have small populations of community college students, and they often lack data on pre-college earnings. The administrative data allow us to control for pre-college earnings as well as for differences among students in educational goals and course enrollment in the first college term. Although Jacobson, LaLonde, and Sullivan (2005a, 2005b) also use administrative data for the state of Washington, they study the returns to credits earned rather than the returns to awards because so few displaced workers receive awards.

3. Data

The administrative data we use come from the Kentucky Community and Technical College System (KCTCS). The student demographic file contains student-level information on demographics such as age, race, and gender. The course-level data contain descriptive information on the type of course as well as the grade and the number of credits received. Data are available for each course taken by each student.

The outcome data identify each degree, certificate, and diploma awarded. Certificates are specialized programs where students can demonstrate a specific set of skills to potential employers. Schools offer certificates in several program areas. Diplomas tend to target broader areas than certificates and usually require more credits (often more than one year of full-time study). For example, KCTCS offers a diploma titled medical office assistant, which requires 44 to 47 credits; a medical administrative certificate from KCTCS requires 33 to 35 credits.

More generally, associate's degree usually require between 60 and 78 credits. Diplomas require between 36 and 68 credits, although most require at least 50 credits.

Certificates typically require between 12 and 36 credits. A course load of approximately 30 credits is considered a full-time course load for one year.

The outcome data also contain transfer information from the National Student Clearinghouse. The transfer data identify the date and school name of transfers to all participating four-year institutions from 2002 to 2006. The National Student Clearinghouse contains nearly 90 percent of all students, including all four-year schools in Kentucky and most schools in neighboring states.[4]

KCTCS receives quarterly earnings data from the state's unemployment insurance program. Total wages are reported for each person and job. Data are from the first quarter of 2000 through the third quarter of 2008.

Our focus is on two cohorts of students: those who started at KCTCS from summer 2002 to spring 2003 (i.e. the 2002-2003 school year) and those who started at KCTCS from summer 2003 to spring 2004 (i.e. the 2003-2004 school year).[5] Information on previous educational attainment at other educational institutions is not available. Furthermore, we have no information on KCTCS attendance prior to 2000.

For evaluating the labor-market returns to KCTCS, we exclude students who attend KCTCS while in correctional institutions, are less than 20 years old or more than 60 years old at the start of their first term, who transfer to a four-year school, or who do not seek an award. These students are excluded in order to study the labor-market returns of individuals most likely to be in the labor market immediately before and after their KCTCS attendance, as well as to create a comparison group that is most similar to the set

[4] This information comes from the National Student Clearinghouse webpage (www.studentclearinghouse.org).
[5] We identify initial enrollment using the course enrollment data.

of students who receive awards.[6] An additional reason for dropping the transfer students is that we do not observe their educational attainment at the subsequent institution, so the relationship between educational attainment and labor-market outcomes is impossible to measure for these students. We discuss the implications of excluding transfer students in section 5.5.

Table 1 contains the descriptive statistics for the preferred KCTCS sample. The average quarterly earnings over the entire period (2000 to 2008) is $6,142 for men and $4,245 for women (in 2008 dollars), illustrating a large gender disparity in earnings. The employment rate is 65 percent for men and 64 percent for women. The average age at entry is around 30 years, and less than 15 percent of the sample is nonwhite. Nearly 16 percent of women receive associate's degrees as their highest award, compared to only 11 percent for men. The percentage of women receiving diplomas (5.6 percent) is slightly higher than the percentage for men (5.1 percent), but men have a slightly higher percentage receiving certificates: 8.1 percent for men and 7.7 percent for women. Health is the most popular field of study for women, compared with academics and vocational for men.

The UI wage record data include the vast majority of jobs in Kentucky. The UI wage record data cover all employment except self-employment, a small subset of federal workers, informal / illegal work, and a small number of other uncovered jobs.[7] In addition, the UI wage records will not capture the earnings and employment of people who work in other states, either because they commute across state lines or because they move to another state. However, Kentucky has relatively low levels of both of these patterns.

[6] We exclude teenagers because their pre-KCTCS earnings are unlikely to represent their earnings potential without KCTCS attendance.

[7] Kornfeld and Bloom (1997) show that the UI wage record data are a valid source of earnings data for low-income individuals.

According to the 2000 Census, Kentucky has one of the lowest rates of outmigration to other states (Franklin, 2003), and 6.6 percent of Kentucky residents work outside Kentucky.[8] Census estimates show that the raw increase in earnings between high school graduates and individuals with associate's degrees is similar between Kentucky and the national average.[9] The time period of the earnings data is from 2000 to 2008, so most of the post-schooling observations are prior to the most recent recession.

4. Method

4.1 Traditional Human Capital Method

Our analysis begins with a traditional Mincer-type schooling equation because this type of model is commonly estimated in the returns to schooling literature. Our estimates from this model can be easily compared to previous estimates of the returns to community college. Equation (1) contains the model:

(1) $$EARN_i = \beta \cdot AWARD_i + \delta \cdot DEMOG_i + \varepsilon_t .$$

In this cross-sectional model, the dependent variable is either annual or average quarterly earnings from the most recent one-year period, the fourth quarter of 2007 through the third quarter of 2008. *AWARD* is a set of three dichotomous variables for highest award (associate's degree, diploma, or certificate). An associate's degree is considered the highest award offered; a diploma is considered the second highest award offered; and a certificate is considered the third highest award offered. *DEMOG* is a set of person-specific demographics such as age and race/ethnicity. Throughout the analysis, we estimate separate equations for men and women.

4.2 Preferred Student Fixed Effect Method

[8] The 6.6 percent calculation is the authors' calculation from 2000 Census worker flow data.
[9] Based on calculations of difference in mean earnings between high school graduates and associate's degree recipients using American Community Survey data from the U.S. Census Bureau.

Because the KCTCS database is a detailed panel data set with pre- and post-KCTCS earnings data, we use these data to estimate the change in earnings associated with KCTCS attendance. Specifically, we compare the post-KCTCS earnings with the pre-KCTCS earnings for two groups, those who receive awards and those who do not. The major difference between the two groups is KCTCS awards. In terms of program evaluation, our estimation technique resembles a treatment-on-the-treated model. This approach of using "dropouts" as a comparison group has been common in the job-training literature for decades (see e.g. Cooley, McGuire, and Prescott (1979)). Because we are using administrative data from KCTCS, we do not have any information for individuals who did not attend KCTCS.

Another way to think of this model is as a difference-in-differences model. As mentioned above the observations in our data set differ along two dimensions: the timing and the difference in award receipt. In other words, we compare earnings over time and between individuals over time with awards to individuals without awards. Equation (2) contains a simple difference-in-differences equation with no other controls:

(2) $$EARN_{it} = \beta \cdot AWARD_{it} + \eta_i + \tau_t + \varepsilon_{it}.$$

Equation (3) contains the more extensive multivariate regression to measure the effect of KCTCS attendance on earnings.

(3) $$EARN_{it} = \beta \cdot AWARD_{it} + \lambda \cdot ENROLL_{it} + \delta \cdot DEMOG_{it} + \gamma \cdot INTENT_{it} + \eta_i + \tau_t + \varepsilon_{it}.$$

In both equations, *i* denotes a person and *t* denotes a quarter.

EARN is the earnings for the quarter. Quarters with no reported UI earnings are assigned values of zero earnings. The spring semester is assigned a start date of the first quarter and an end date of the second quarter; the summer term is assigned a start date of

the second quarter and an end date of the third quarter; and the fall semester is assigned a start date of the third quarter and an end date of the fourth quarter.

As in previous equations, the vector *AWARD* contains three dichotomous variables (equal to zero or one): one for having an associate's degree as the highest award, one for having a diploma as the highest award, and one for having a certificate as the highest award at the beginning of the quarter. For each KCTCS outcome (degree, diploma, or certificate), the estimated change in earnings should be interpreted as the change relative to the same person's earnings before she completed the award.

ENROLL contains four dichotomous enrollment variables. The first is equal to one when the individual is attending KCTCS and zero otherwise. This variable accounts for the opportunity cost (in terms of earnings) for students while they attend KCTCS. The second variable is equal to one after the individual has finished attending KCTCS. This variable accounts for any general post-schooling changes in earnings. The third variable is equal to one for the time period two quarters before KCTCS attendance, and the fourth variable is equal to one for the time period one quarter before KCTCS attendance. These two variables control for possible pre-KCTCS dips in earnings shortly before KCTCS attendance. Figure 2 in the next section shows earnings patterns relative to KCTCS enrollment. The figure illustrates that an "Ashenfelter dip" seems to occur for award recipients in the two quarters before KCTCS enrollment.[10]

DEMOG is a set of demographic variables that change over time. Specifically, the variables are age, nonwhite, and missing race/ethnicity and an indicator that the student

[10] We do not include additional controls beyond two quarters because the data show little evidence of earnings declines beyond that period.

was in the 2002-2003 cohort, all interacted with time trends. We also include the county unemployment rate.

INTENT is a set of variables measuring students' intentions. All these variables are measured in the first semester. The variables are interacted with time because their non-interacted effects are subsumed by the student fixed effects. Students intentions are measured by the number of courses taken in the first KCTCS term and a set of dichotomous variables for each student's area of study (undecided award is the omitted category). For example, it is possible that an individual pursuing a nursing award may have a different earnings trajectory than an individual pursuing a vocational award. Similarly, given the difference in age-earning profiles, a 22 year old may have a different earnings trajectory than a 50 year old. These time-dependent differences will not be captured by the student fixed effects. By allowing different time trends based on the number of classes taken in the first term and students' initial aspirations (whether or not to pursue an award, and what field of study in which to pursue an award), we are able to compare labor-market outcomes for students with very similar earnings trajectories and intentions upon entry at KCTCS.

Unlike most studies of labor-market returns to education, we include a set of person fixed effects (η). The person fixed effects, used by Jacobson, LaLonde, and Sullivan (2005a, 2005b) and Cellini and Chaudhary (2011), capture person-specific components that are constant over time, such as race/ethnicity or innate ability.[11] In fact, the fixed effects can be thought of as the overall effect of all these time-invariant person characteristics. The inclusion of the fixed effects has the advantage of controlling for time-

[11] Jacobson, LaLonde, and Sullivan (2005a, 2005b) also include controls for short-run earnings deviations as well as its interaction with the number of credits obtained (their measure of community college schooling). The results presented in the next section are not sensitive to the inclusion of these additional variables.

invariant measures of ability and other factors that affect earnings and are correlated with community college schooling. The fixed effects model uses variation between individuals as well as variation over time within individuals to estimate the value of the parameters. Although each source of variation has weaknesses, together they provide a compelling technique for estimating the causal effect of education on earnings.

One limitation of the fixed effects approach is the assumption that the pre- and post-KCTCS earnings patterns are similar between students who received an award and students who did not receive an award. If a student receives a positive or negative shock that affects award receipt and earnings patterns, the fixed effects model will not produce valid estimates. However, this criticism is true of any of the previous studies of community college returns as well. Furthermore, we believe that, on average, the number of such shocks is likely to be small.

The model contains controls for each quarter (τ). The last component (ε) is the unobservable component of earnings. There are 35 quarters, from the first quarter of 2000 through the third quarter of 2008. Separate equations are estimated for men and women.

Jacobson, LaLonde, and Sullivan (2005a, 2005b) measure human capital accumulation in community college as the number of credits completed because few individuals in their sample of displaced workers complete an award. For comparison, we estimate an additional model that includes credits earned as well as the highest award received.

Because we measure earnings in levels and include observations with zero earnings, the coefficients represent the combined effect of employment (going from zero earnings to positive) and changes in earnings conditional on employment (a change in

earnings from one non-zero amount to another). We also consider alternative models that look directly at earnings conditional on employment as well as participation in the labor market. In the former model, the dependent variable is log earnings, where observations with zero earnings are treated as missing observations.[12] In the latter model, the dependent variable is a dichotomous variable equal to one for quarters with positive earnings. The dependent variable is zero for quarters with zero earnings or missing earnings. Earnings that are not reported to the Kentucky UI system, such as self-employment earnings and out-of-state earnings, are interpreted as not participating in the Kentucky labor market. Although the dependent variable is dichotomous, we estimate a linear probability model because it is less sensitive to distributional assumptions and it is easier to interpret (Wooldridge, 2001).

5. Results

5.1 Comparison with Other Data Sets

As mentioned previously, most previous analyses of returns to community college compare community college students to individuals outside the community college system, whereas KCTCS data only contain individuals who attended KCTCS. Therefore, we compare our sample of KCTCS students with other earners in Kentucky drawn from other data sources such as the U.S. Census.

First, we compare average quarterly earnings of individuals in the KCTCS sample with the statewide average quarterly earnings for all other Kentucky workers using aggregate UI earnings data (individual-level data are not available). Figure 1 contains average quarterly earnings from the first quarter of 2002 through the first quarter of 2008.

[12] We do not report the results from these log earnings models, but they are available from the authors upon request.

All dollars are measured in 2008 dollars, deflated by the CPI-U. The figure combines men and women because the UI data are not available by gender (or any other category, such as age). We report average quarterly earnings for three groups: KCTCS award recipients (labeled "KCTCS award"), KCTCS attendees who do not receive an award (labeled "KCTCS non-award"), and all other Kentucky workers (labeled "UI (Non KCTCS)").

Average earnings are higher for the non-KCTCS sample than for either KCTCS sample. The higher wages for non-KCTCS UI workers is to be expected because the average age in the KCTCS sample is lower than the average age of all Kentucky workers.[13] Average wages show little growth for the non-KCTCS sample. Average wages for the non-KCTCS sample drop in the summer likely due to summer-only workers such as high-school and college students. In contrast, we see that average wages grew substantially for both KCTCS samples. For example, the average for award students grew from around $5,000 per quarter in 2002 to close to $7,000 in the last quarter of 2007.

Next, we compare our KCTCS sample to 2000 Census data for Kentucky. In the Census data, we limit our sample to people ages 25 to 66 with an associate's degree, one year or more of college without a degree, or less than one year of college without a degree.[14] We also weight the Census data by race/ethnicity and age so that it is balanced with respect to KCTCS data on these two dimensions. Table 2 contains descriptive statistics for our preferred KCTCS sample and our sample drawn from Census data. The most notable difference in the data is that average earnings are lower in the KCTCS sample.

[13] The UI data do not contain age and experience. However, in unreported results, we find that KCTCS students are younger with presumably less labor-market experience than comparable individuals from the 2000 Census.

[14] These ages match the ages of the KCTCS preferred sample in the first quarter of 2008.

Using the same data as in Table 2, Table 3 contains regression results for annual returns to schooling for the KCTCS and Census data from equation (1).[15] For men, the return to an associate's degree relative to less than a year of college is $7,735 for the KCTCS data and $5,513 for the Census data. For women, the return is $10,125 for the KCTCS data and $6,624 for the Census data. The returns for one or more years of college without a degree are much smaller, especially in the Census data. In the KCTCS data, the returns are around $1,900 for men and $1,800 for women.

5.2 Cross-sectional Analysis

Our analysis begins with estimated earnings regressions as in equation (1). We also include pre-KCTCS earnings information, as well as student intentions, in a cross-sectional model. This model allows us to control for individuals' intentions and their pre-KCTCS labor-market experiences. Table 4 contains the results from these earnings regressions, where the dependent variable is the average quarterly earnings for the fourth year after enrolling in KCTCS (quarters 13 to 16). Presenting the results in terms of quarterly earnings facilitates the comparison of these results with the results from the fixed effects model presented in the following tables.

Associate's degrees are associated with higher quarterly earnings of $1,349 for men and $2,290 for women. These returns are roughly 22 percent of men's average quarterly earnings and 54 percent for women. The return to a diploma for men is $1,017, or 17 percent of average earnings, and the return for women is $1,990, or 47 percent of average earnings. For men, the returns for certificates are one third as large as the returns for associate's degrees: $496 or 8 percent. For women, the returns to certificates are only

[15] All results in the table are weighted as described above. Results using Census weights, as well as results using unweighted Census data produce similar results and are available from the authors upon request.

$221 or 5 percent. In this cross-sectional model that compares KCTCS award recipients with other KCTCS attendees based on intentions and pre-KCTCS earnings, we find sizable returns for associate's degrees and diplomas and much smaller returns for certificates.

5.3 Earnings Patterns

We begin our analysis of the longitudinal (or panel) aspect of the KCTCS data by looking at earnings patterns over time by highest award. Figure 2 shows the average quarterly earnings for men (top panel) and women (bottom panel), where each quarter is measured relative to initial attendance at KCTCS.[16] We measure time relative to entrance at KCTCS, rather than calendar quarter, for two reasons. First, students enter KCTCS at different time periods between summer 2002 and spring 2004. Quarterly earnings at a particular calendar quarter, such as the first quarter of 2006, will measure students with different levels of KCTCS schooling. Second, this arrangement of quarters allows us to illustrate clearly pre-KCTCS differences in earnings. This technique is common in evaluations of job-training programs, where researchers are concerned about the similarity of recipients and non-recipients prior to participation in job-training programs. We are able to conduct analogous comparisons for participation in KCTCS.

The top panel of Figure 2 has several interesting patterns. Men who attend KCTCS without receiving an award have the lowest pre-KCTCS earnings, with average quarterly earnings around $4,000 in most quarters.[17] Individuals who eventually receive an associate's degree award have the highest pre-KCTCS earnings of approximately $6,000 a

[16] The quarter when the student first attended KCTCS is measured as 0 on the horizontal axis of the graph. The first quarter before the student attended KCTCS is measured as –1, and the first quarter after the student attended KCTCS is measured as 1. For example, consider a student who first attended KCTCS in fall 2002. For this student, quarter 0 is July-September 2002; quarter –1 is June-August 2002; and quarter 1 is October-December 2002.

[17] As mentioned previously, all dollar figures are reported in 2008 dollars.

quarter. However, award earners – especially those who receive diplomas – experience a substantial decrease in earnings the quarter before entering KCTCS. Average earnings for diploma recipients are under $2,000 for the first four quarters after enrollment. Much of the explanation, particularly for men, is that diploma recipients have lower employment rates during these quarters. In addition, diploma recipients tend to take more credits per term than other award recipients, leaving less time for working in the labor-market. Average quarterly earnings for associate's degree and diploma recipients begin to increase dramatically approximately seven quarters after entering KCTCS; the increase occurs slightly earlier for certificate recipients.[18] By 15 quarters after entering KCTCS, the earnings for the four groups of individuals have exceeded their pre-KCTCS levels. By this time, individuals with associate's degrees have the highest earnings, and individuals without awards have the lowest earnings.

The bottom panel of Figure 2 illustrates average quarterly earnings for women. There are noticeable differences between men and women. Women have lower average earnings than men. In the quarters prior to KCTCS attendance, average quarterly earnings are relatively similar across the four education levels, except for the same decline in average earnings for award recipients – particularly diplomas – starting in the quarter before KCTCS attendance. As with men, average quarterly earnings for women with associate's degrees and diplomas start to increase around seven quarters after KCTCS attendance, with a slightly earlier increase for certificate recipients. By 12 months after initial KCTCS enrollment, the average quarterly earnings of diploma and associate's degree recipients substantially exceed average earnings of women who did not receive an

[18] Some students enter KCTCS with credits from other institutions and therefore receive an award more quickly than if they arrived at KCTCS with no credits. However, our data do not contain any information on credits obtained at other institutions prior to enrollment at KCTCS.

award. Women without awards have the lowest average earnings 18 months after initial KCTCS attendance, slightly below average earnings for certificate recipients.

Although these graphs provide a useful starting point for our discussion of labor-market returns, they look only at differences in average earnings between the four groups indicated in the graphs. Figure 2 does not control for differences in age or length of KCTCS enrollment. Therefore, we now turn to our regression analysis.

5.4 Overall Earnings Returns

Table 5 contains the effects of the highest award received on quarterly earnings from the fixed effects model. The first four columns are for men, and the second four columns are for women. The first and fifth columns contain no controls other than highest award as illustrated in equation (2). The second and sixth columns contain controls for the timing of enrollment (*ENROLL* in equation (3)). The third and seventh columns also contain demographic controls (*DEMOG* in equation (3)). The fourth and eighth columns also contain controls for student intentions (*INTENT* in equation (3)). The last specification is our preferred one because we believe that it does the best job of capturing observed differences.

The table shows that the returns for all awards fall slightly when we add controls for enrollment timing (columns 2 and 6), but returns increase moderately when demographic controls are added (columns 3 and 7). Similarly, the returns increase slightly when we include controls for student intentions (columns 4 and 8). In other words, the gap in earnings between students with and without awards is higher when we compare students with similar intentions (columns 4 and 8) than when we compare students with no regard toward their demographics or intentions (columns 2 and 6).

The table shows that associate's degrees are associated with large increases in earnings, particularly for women. In our preferred specification (columns 4 and 8), associate's degrees are associated with returns of $2,363 for women and $1,484 for men. In percentage terms of average earnings from Table 1, the return is approximately 56 percent for women and 24 percent for men.

Women also have higher returns from diplomas than men: $1,914 (column 8) versus $1,265 (column 4). In percentage terms, the returns to diplomas are 45 percent for women and 21 percent for men. For both associate's degrees and diplomas, the average number of credits earned varies little between men and women. Thus, the gender difference in returns cannot be explained by differences in the number of credits earned.

Certificates have small positive returns for women and men, although the returns for men are only significant at the ten-percent level (two-sided test) once we include controls for intentions as well as demographics and enrollment timing (column 4). In the preferred specification, certificates are associated with returns of approximately $300 for men and women, an increase of five percent for men and seven percent for women. Certificates require the least amount of coursework (usually one year or less of full-time course work), so their lower returns are not surprising.

The results from our preferred specification of the fixed effects model (columns 4 and 8 of Table 5) are generally similar to the results from the cross-sectional OLS model in Table 4, at least for associate's degrees and diplomas. The fixed effects model has slightly larger returns for these two awards except for the slightly lower returns to diplomas for women. For certificates, the inclusion of fixed effects produces smaller returns for men and larger returns for women relative to a cross-sectional OLS model.

5.5 Sensitivity Analysis

A primary concern in the returns to schooling literature is establishing the causal effect of educational attainment on earnings. We provide a relatively new application of student fixed effect models to estimate the labor-market returns to community college degrees, and we include detailed control variables including student intentions. Our results for associate's degrees are higher than previous estimates for women but are similar for men, and little if any previous work has been done on diplomas and certificates. Still, we acknowledge that concerns about the generalizability of our results may remain, so we conduct several sensitivity analyses to test the robustness of our earnings returns. More detailed results are available in Jepsen, Troske, and Coomes (2012).

We first expand the sample to include teenagers and students who initially do not intend to pursue an award and find that the returns for men are much higher and the returns for women are slightly lower. In contrast, excluding students who did not receive an award nearly doubles the returns for men and reduces the returns for women by approximately 20 percent. It appears that including teenagers or non-award seekers leads us to overstate the returns for men.

In another robustness check we exclude students who fail to receive any community college credits because they may have fundamental differences in earnings growth. Their inclusion may produce an upward bias in our estimated returns if they had a negative random shock that caused them to drop out of KCTCS and led to lower earnings growth. Compared to the returns for the full sample, the returns excluding students with zero credits are 10 to 25 percent lower for men and 1 to 5 percent lower for women. Thus,

the overall returns in our preferred specification may be slightly overstated for men because the comparison group includes students who did not receive any KCTCS credits.

Many studies of training programs restrict analysis to individuals with some pre-training level of labor-force attachment. We employ the same idea by restricting our sample to individuals with at least five quarters of earnings in the pre-KCTCS period.[19] For associate's degrees and diplomas, the returns are slightly lower for individuals with substantial pre-KCTCS labor-force attachment. The decline in earnings is more pronounced for certificates, suggesting that certificates have larger returns for individuals with weak labor-force attachment prior to enrolling in KCTCS.

We have also estimated models excluding up to four quarters prior to KCTCS attendance because they contain an "Ashenfelter dip" in earnings. The results from this sample are nearly identical to the full sample, suggesting that the pre-KCTCS earnings drop is not driving the estimated labor-market returns. The results are also quite similar, except for lower returns to certificates for males, when we exclude all quarterly observations more than 12 quarters after someone leaves KCTCS. Thus, there is little support for the concern that students who leave KCTCS after a couple of semesters are creating an upward bias in the results.[20]

Another concern about our results is that we exclude transfer students from our analysis because we do not have information on whether these students ever complete a four-year degree. If we did have information on who completed a degree, the returns for those students would be captured in the returns to a bachelor's degree and therefore would

[19] Results are quite similar when we vary the cutoff for number of quarters with pre-KCTCS earnings from four to eight quarters.

[20] Specifically, the concern is that those who finish early with awards may possess unobservable traits that are positively correlated with earnings, whereas those who finish early without an award may possess unobservable traits that are negatively correlated with earnings.

not bias our estimate of the returns to an associate's degrees. Thus, the concern with our estimated returns is that we exclude individuals who obtain an associate's degree and transfer to a four-year institution without completing a bachelor's degree. Determining the direction and size of the bias in excluding these students is extremely difficult because we have no way of identifying them.

To learn more about the potential bias from excluding transfer students, we estimate a cross-sectional model where the dependent variable is a dummy variable for transferring to a four-year institution. Controlling for student demographics and student intentions, an associate's degree is associated with a higher probability of transferring of approximately 24 percent for men and 17 percent for women. In contrast, we find a small negative association between other awards and the probability of transfer, so there is minimal bias in the returns to diplomas and certificates from excluding transfer students. We have also estimated our standard wage models including transfer students and find slightly smaller returns to awards compared to the estimates from our preferred specification. We suspect this is because we have relatively few post-schooling observations for students who transfer and because we are unable to distinguish between transfer students who are attending school full-time and not working from students who have left school but are unable to find employment. In general, we suspect that by excluding transfer students our estimated returns may understate the actual returns of an associate's degree due to the likely superior ability of students who transfer. Unfortunately, we have no way of confirming this suspicion or of assessing the size or direction of any bias. However, it is important to recognize that transfer students compose

only 9% of the total sample, so any bias resulting from excluding these students is likely to be minimal.

5.6 Heterogeneity in Returns

As illustrated in Table 1, men and women have different fields of study at KCTCS. Therefore, one explanation for the gender differences in returns (Table 5) is that returns vary by fields of study. Table 6 contains the results where the highest education level is interacted with dummy variables for six fields of study: humanities, other academic subjects (i.e. social science and science), business, health, services, and vocational. No students received diplomas or certificates in academic subjects (humanities or otherwise). Except for the highest award received variables, the models used to estimate the results in Table 6 are identical to the preferred specification in Table 5 (columns 4 and 8).

This table shows that for both men and women, the highest returns are from associate's degrees in health: around $4,000 per quarter. Associate's degrees in academic subjects other than the humanities and in vocational subjects have quarterly returns above $1,000. Diplomas in health fields also provide sizable returns, in excess of $2,000 per quarter, and, for men, vocational diplomas are associated with higher quarterly earnings of around $1,200. Certificates usually are associated with small and statistically insignificant returns except for vocational certificates for men ($368) and health certificates ($375) for women.

In other analysis we also examined differences in returns by age (See Jepsen, Troske and Coomes (2012) for more details). In these models we saw that returns vary greatly by age, award and gender. For men, the largest returns for associate's degrees – around $2,000 per quarter – are for students in their early twenties, although the returns are

above $1,000 for all but the oldest students. Men's returns to diplomas vary greatly, with the largest returns (around $1,800) for students in their early 20s through their early 30s. In every age category, men's returns to a certificate are statistically insignificant for each age range between 20 and 60. Women receive returns usually in excess of $2,000 to degrees and diplomas throughout their teens, 20s, 30s, and into their 40s. For certificates, women's returns are under $250 for most age categories.

5.7 Earnings Returns for Credits

Another way to measure the returns to KCTCS is to look at the returns to credits (see Jacobson, LaLonde, and Sullivan (2005a, 2005b) and citations within). We extend our preferred specification to include credits earned as well as highest award. This model divides the returns to the award into the returns for the credits earned and the additional returns of the award itself; what is often called the sheepskin effect.

Table 7 contains the results from this analysis. Columns 1 and 3 are the preferred specifications from columns 4 and 8 of Table 5, and they do not contain credits earned. Columns 2 and 4 contain credits earned for men and women, respectively. The results illustrate that most of the increase in earnings for associate's degrees and diplomas are from awards rather than from credits. For example, a man earning an associate's degree with 69 credits (the midpoint of the required number of credits) would receive an earnings boost of $386 per quarter from the 69 credits in addition to an earnings boost of $1,117 from the award. For a woman, the comparable numbers are $959 from the credits and $1,763 from the award.

The sheepskin effects for certificates are much lower. The sheepskin effect for men is $112 per quarter, compared with an increase in earnings of $134 per quarter for 24

credits, the midpoint of the required number of credits for certificates. For women, the sheepskin effect is $134 for the certificate, compared with an earnings increase of $333 associated with 24 credits. More generally, the returns from credits exceed the returns from the certificate at 20 credits for men and at only 10 credits for women.

5.8 Employment Returns

In addition to studying the effect of community college awards on earnings, we also study their impact on employment. See Jepsen, Troske, and Coomes (2012) for more information. For men, associate's degrees and diplomas are associated with increases in employment of 12 to 15 percent, whereas the employment returns to women for these two awards is approximately 20 percent. Certificates have employment returns of nine percent for women, but the return for men is around two percent and is not statistically significant from zero at the ten-percent level.

6. Discussion

This paper provides new estimates on the labor-market returns to certificates and diplomas offered by community colleges. More people receive these awards than receive associate's degrees, which are more commonly studied. We study the earnings returns for the cohort of students aged 20 to 60 who entered Kentucky's community college system during the 2002-2003 and 2003-2004 school years. For these students, associate's degrees and diplomas have quarterly returns of around $1,500 for men and $2,000 for women. Certificates have returns of around $300 per quarter for men and women. The highest returns for associate's degrees and diplomas are for health-related awards. The highest returns for certificates are in vocational fields for men and health fields for women. Like Jacobson, LaLonde, and Sullivan's (2005a) work on displaced workers in Washington, we

find that earning credits at a community college without receiving an award has a positive effect on earnings. Degrees and diplomas are associated with noticeably higher likelihoods of employment, and certificates have positive associations with employment for women. Although our estimated returns are large, the dollar amounts are comparable to previous work on associate's degrees.

Like many empirical papers that use non-experimental data, our results should be viewed as an estimate of the effect of the treatment on the treated. Specifically, we estimate the impact of receiving an award from a community or technical college in Kentucky and then entering the labor market. Our additional analysis should be viewed as efforts to demonstrate the generalizability of our results. Of course these efforts are always incomplete, and readers should keep in mind the limitations of our results.

These findings add to an extremely limited literature on the returns to community college certificates and diplomas. Although our study focuses on the experience in one state, the richness of the data and the similarities of community college systems around the U.S. suggest some tentative national policy conclusions. Human capital investments in community and technical college programs produce large labor-market returns, particularly for women, but the returns vary substantially among fields and awards.

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Table 1
Descriptive Statistics, KCTCS Data

	Men		Women	
Variable	Mean	Standard Deviation	Mean	Standard Deviation
Average Quarterly Earnings	6,142	4,440	4,245	3,321
Proportion Employed	0.652	0.291	0.640	0.290
Age at Entry	30.0	8.9	31.3	8.9
White	0.769	0.422	0.768	0.422
Nonwhite	0.119	0.324	0.142	0.349
Missing Race	0.112	0.315	0.090	0.286
Associate's Degree	0.112	0.316	0.159	0.365
Diploma	0.051	0.221	0.056	0.230
Certificate	0.081	0.272	0.077	0.266
No Degree or Award	0.756	0.430	0.709	0.454
Associate's Degree Fields				
Business	0.006	0.074	0.019	0.137
Health	0.021	0.145	0.074	0.262
Humanities	0.019	0.137	0.029	0.168
Other Academics	0.031	0.173	0.023	0.148
Services	0.008	0.089	0.016	0.127
Vocational	0.029	0.168	0.004	0.060
Diploma Fields				
Business	0.001	0.032	0.008	0.089
Health	0.007	0.082	0.045	0.208
Services	0.002	0.045	0.002	0.048
Vocational	0.042	0.200	0.001	0.033
Certificate Fields				
Business	0.002	0.046	0.009	0.096
Health	0.007	0.085	0.047	0.212
Services	0.003	0.055	0.017	0.129
Vocational	0.068	0.252	0.004	0.066
County Unemployment Rate	7.89	1.76	7.98	1.79
Number of Students	8,881		16,572	

Note: Earnings and employment statistics are person-level averages across all quarters of data (2000 through 2008).

Table 2
Means and Standard Deviations for 2000 Census and Full KCTCS Sample

	Men		Women	
	KCTCS	Census	KCTCS	Census
Yearly Earnings	20,756	39,728	14,590	22,095
	(22,788)	(35,456)	(15,659)	(21,457)
Associate's Degree	0.112	0.191	0.159	0.253
	(0.316)	(0.393)	(0.365)	(0.435)
1+ Years College, No Degree	0.317	0.548	0.301	0.486
	(0.465)	(0.498)	(0.459)	(0.500)
<1 Year College, No Degree	0.571	0.262	0.541	0.261
	(0.495)	(0.440)	(0.498)	(0.439)
In School	0.063	0.107	0.087	0.108
	(0.243)	(0.309)	(0.282)	(0.310)
Age	35.6	35.6	37.0	37.0
	(8.9)	(8.9)	(8.9)	(8.9)
Nonwhite	0.119	0.119	0.142	0.142
	(0.324)	(0.324)	(0.349)	(0.349)
Observations	8,881	12,082	16,572	15,229

Notes: Standard deviations are in parentheses. Each sample includes individuals ages 25 to 66. Census observations are limited to the state of Kentucky and to individuals with postsecondary education without completion of a bachelor's or postgraduate degree. Census data are weighted so that they have a similar age and race/ethnicity distribution as the KCTCS data. KCTCS earnings data are for the fourth quarter of 2007 through the third quarter of 2008, the most recent earnings data available. Census earnings data are from 1999. Earnings from both data sets are in 2008 dollars. Note that the individuals in the KCTCS data are the same as in Table 1 but are measured at a different time period.

Table 3
Cross-Sectional OLS Model with 2000 Census and KCTCS Data
Dependent Variable is Yearly Earnings (2008 $)

	Men				Women			
	KCTCS		Census		KCTCS		Census	
Associate's Degree	7,735	***	5,513	***	10,125	***	6,624	***
	(798)		(1,094)		(400)		(520)	
1+ Years of College, No degree	1,880	***	804		1,776	***	1,137	***
	(536)		(805)		(260)		(457)	
In School	7,644	***	-8,371	***	573		-3,410	***
	(1,009)		(1,022)		(410)		(618)	
Age	2,113	***	4,511	***	994	***	1,940	***
	(219)		(306)		(112)		(171)	
Age Squared	-23	***	-50	***	-10	***	-22	***
	(3)		(4)		(1)		(2)	
Nonwhite	-6,723	***	-8,554	***	311		1,085	*
	(606)		(998)		(325)		(569)	
Observations	8,881		12,082		16,572		15,229	

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote coefficients with statistical significance at the 10%, 5%, and 1% levels on two-sided tests, respectively. All models include individuals ages 25 to 66. Regressions using KCTCS data also include dummy variables for missing race/ethnicity and for students entering KCTCS during the 2002-2003 school year. The Census and KCTCS data in this table are identical to the data in Table 2 (and the KCTCS data in Table 1).

Table 4
Quarterly Earnings Returns for Highest Award Received
Cross-sectional OLS Model with KCTCS Data

	Men		Women	
Associate's Degree	1,349	***	2,290	***
	(204)		(106)	
Diploma	1,017	***	1,990	***
	(229)		(129)	
Certificate	496	***	221	**
	(207)		(96)	
Demographics	yes		yes	
Intentions	yes		yes	
Observations	8,881		16,572	

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote coefficients with statistical significance at the 10%, 5%, and 1% levels on two-sided tests, respectively. All regressions also include controls for age, age squared, nonwhite, missing race/ethnicity, earnings in each of the four quarters immediately prior to KCTCS entry, and dummy variables for term of entry.

Table 5
Earnings Returns for Highest Award Received, Fixed Effects Models with KCTCS Data

	Men							Women						
	(1)	(2)		(3)		(4)		(5)	(6)		(7)		(8)	
Associate's Degree	1,325	***	1,203	***	1,433	***	1,484	***	2,440	***	2,284	***	2,343	***	2,363	***
	(150)		(152)		(148)		(149)		(83)		(83)		(83)		(81)	
Diploma	1,028	***	890	***	1,130	***	1,265	***	1,955	***	1,801	***	1,893	***	1,914	***
	(185)		(187)		(181)		(183)		(114)		(115)		(114)		(110)	
Certificate	95		43		248		297	*	286	***	235	***	324	***	299	***
	(164)		(164)		(159)		(160)		(76)		(76)		(76)		(73)	
Student Fixed Effects	yes		yes		yes		yes		yes		yes		yes		yes	
Enrollment Timing	no		yes		yes		yes		no		yes		yes		yes	
Demographics	no		no		yes		yes		no		no		yes		yes	
Intentions	no		no		no		yes		no		no		no		yes	
Observations	306,642		306,642		306,642		306,642		572,319		572,319		572,319		572,319	

Notes: Standard errors clustered by student are in parentheses. *, **, and *** denote coefficients with statistical significance at the 10%, 5%, and 1% levels on two-sided tests, respectively. All models also include time fixed effects. An observation is a person and a quarter.

Table 6
Earnings Returns for Highest Award by Field of Study
Fixed Effects Models with KCTCS Data

	Men			Women		
	Coeff.	Std. Err.		Coeff.	Std. Err.	
Associate's Degree						
Humanities	-2	290		171	131	
Other Academic	1,793	253	***	1,661	177	***
Business	-138	551		654	156	***
Health	3,709	354	***	4,409	127	***
Services	-46	419		316	155	**
Vocational	1,268	332	***	1,545	460	***
Diploma						
Business	-1,124	1,003		158	235	
Health	2,140	502	***	2,441	122	***
Services	73	813		-9	427	
Vocational	1,264	202	***	240	945	
Certificate						
Business	-8	883		173	230	
Health	32	500		375	96	***
Services	-141	596		241	142	*
Vocational	368	177	**	264	296	
Observations	200,045			366,507		

Notes: Standard errors are clustered by student. *, **, and *** denote coefficients with statistical significance at the 10%, 5%, and 1% levels on two-sided tests, respectively. All models also include controls for enrollment timing, demographics, student intentions, person fixed effects, and time fixed effects.

Table 7
Earnings Returns for Credits Earned and Highest Award
Fixed Effects Models with KCTCS Data

	Men				Women			
	(1)		(2)		(3)		(4)	
Associate's Degree	1,484	***	1,117	***	2,363	***	1,763	***
	(149)		(170)		(81)		(90)	
Diploma	1,265	***	821	***	1,914	***	1,331	***
	(183)		(198)		(110)		(119)	
Certificate	297	*	112		299	***	134	*
	(160)		(162)		(73)		(75)	
Credits			5.6	***			14	***
			(2)				(1)	
Observations	306,642		306,642		572,319		572,319	

Notes: Standard errors clustered by student are in parentheses. *, **, and *** denote coefficients with statistical significance at the 10%, 5%, and 1% levels on two-sided tests, respectively. All models also include controls for enrollment timing, demographics, student intentions, person fixed effects, and time fixed effects.