UKCPR
University of Kentucky
Center for
Poverty Research

Discussion Paper Series
DP 2010-08

ISSN: 1936-9379

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

**Christopher Jepsen**
University of Kentucky

**Kenneth Troske**
University of Kentucky

**Paul Coomes**
University of Louisville

2010

Preferred citation
Jepsen, T, Troske, K, and Coomes, P. The Labor-Market Returns to Community College Degrees, Diplomas, and Certificates. *University of Kentucky Center for Poverty Research Discussion Paper Series, DP2010-08*.

Author correspondence
Christopher Jepsen, University of Kentucky, Department of Economics, 335BA Gatton B&E Bldg, Lexington, KY 40506.
Kenneth Troske, University of Kentucky, Department of Economics, 335BA Gatton B&E Bldg, Lexington, KY 40506
Paul Coomes, University of Louisville, College of Business, Department of Economics, Louisville, KY 40292

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

by


Christopher Jepsen*
University of Kentucky
Department of Economics
335BA Gatton B&E Bldg
Lexington, KY 40506-0034

Kenneth Troske
University of Kentucky
Department of Economics
335BA Gatton B&E Bldg
Lexington, KY 40506-0034

Paul Coomes
University of Louisville
College of Business
Department of Economics
Louisville, KY 40292



Abstract

This paper provides the first detailed empirical evidence of the labor-market returns to community college diplomas and certificates. Using detailed 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 $2,000 for women, compared to returns of approximately $1,500 for men. Certificates have small positive returns for men and women in most specifications. There is substantial heterogeneity in returns across fields of study. Degrees, diplomas, and certificates all correspond with higher levels of employment.



* Corresponding author.


We thank Ginny Kidwell and Darshak Patel for excellent research assistance, as well as Christina Whitfield, Alicia Crouch, Rion McDonald, and Aphy Brough at the Kentucky Community and Technical College System (KCTCS) for providing access to and help with their administrative data. We thank two anonymous referees, Thomas Bailey, Marianne Bitler, Glenn Blomquist, Christopher Bollinger, Randall Reback, and seminar participants at the Society of Labor Economists conference, the Southern Economic Association conference, Teachers College – Columbia University, University College – Dublin, and the University of Kentucky for useful comments. This project was supported with a grant from the UK Center for Poverty Research through the U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, grant number 3 U01 PE000002-06S1. This project was also funded in part by KCTCS. The opinions and conclusions expressed herein are solely those of the authors and should not be construed as representing the opinions or policy of the UKCPR or any agency of the local, state, or Federal government.

## 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 a registered nurse. 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 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. The student-level, panel data contain information on student goals and number of classes taken in the first term. These student intentions are used 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 $2,000 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 somewhat larger than previous work. For women, the $2,000 increase in quarterly earnings translates into a 50-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. Consistent with previous research, we also find positive returns for credits earned. All three award levels are associated with higher probabilities of employment, although again the largest gains are for degrees and diplomas.

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. The large overall returns mask substantial heterogeneity in returns. For example, health and vocational awards have much higher returns than business or services awards. Overall, human capital investments in community colleges lead to large gains in earnings and employment, particularly for women.

**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 10th year of schooling or the 15th year of schooling.[2] 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 derived more benefits from technical courses and math/science courses and

[2] Card (1999) notes a couple of exceptions to this statement, such as the lower return to the 11th year of schooling.

fewer benefits from less technical courses. Most of the increase in annual earnings came 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 and public community colleges using a student fixed effects as in our paper and in Jacobson, LaLonde, and Sullivan (2005a, 2005b). The authors find small and statistically insignificant differences between the labor-market returns from private and public community colleges.

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 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 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] They also find positive effects for associate's degrees, but these results become insignificant once they control for the field of study. However, it is unclear how they account for students who receive associate's degrees and then transfer to four-year institutions.

## 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 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]

[4] This information comes from the National Student Clearinghouse webpage (www.studentclearinghouse.org).

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 17 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 after their KCTCS attendance, as well as to create a comparison group that is most similar to the set of students who receive awards. In our preferred model, we further restrict the sample to individuals ages 20 to 60 at entry because the pre-KCTCS earnings of teenagers are unlikely to represent their earnings potential without KCTCS attendance. 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 the results section.

[5] We identify initial enrollment using the course enrollment data. In other words, each student's initial enrollment is the first term in which he or she is enrolled in a KCTCS course.

Table 1 contains the descriptive statistics for the 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 23 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.[6] 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. 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.[7] 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

[6] Kornfeld and Bloom (1997) show that the UI wage record data are a valid source of earnings data for low-income individuals except male youth with prior arrests (who are likely to be excluded from our preferred sample of 20-60 year olds).
[7] The 6.6 percent calculation is the authors' calculation from 2000 Census worker flow data.

national average.[8] 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*

The KCTCS database provides detailed information on the cohort of students who entered KCTCS during the 2002-2003 and 2003-2004 school years. Our analysis begins with a traditional Mincer-type schooling equation because this type of model is commonly estimated in the returns to school literature. Therefore, the returns 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 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] Based on calculations of difference in median earnings between high school graduate and associate's degree from the National Center for Higher Education Management Systems, downloaded August 5, 2011 from http://www.higheredinfo.org/dbrowser/index.php?submeasure=363&year=2007&level=nation&mode=data&state=0.

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. 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:

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

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

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

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 the 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.[9] 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 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 time trends interacted with age as well as dichotomous variables for

[9] The earnings data are measured in quarters, whereas the KCTCS data are measured by term. Therefore, we adopt the following mapping between the two. The spring semester starts in the first quarter and finishes in the second quarter. The summer term starts in the second quarter and finishes in the second quarter. The fall semester starts in the third quarter and finishes in the fourth quarter. For more information about the highest award variables, see Jepsen, Troske, and Coomes (2009).

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

nonwhite, missing race/ethnicity, and for being in the 2002-2003 cohort. Also, we 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 ($\eta$). 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 ($\tau$). The last component ($\varepsilon$) 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. We follow their protocol and estimate additional models where KCTCS attendance is measured by credits earned rather than by 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 and 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. Note that 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. Often, the comparison group is a set of individuals with a high school education but no postsecondary schooling. In contrast, our sample – and therefore our comparison group – is limited to individuals who attend community college at some point during the sample period. Because this comparison group is atypical compared with the returns to schooling literature, we compare our sample of KCTCS students with other earners in Kentucky drawn from other data sources such as Census data.

First, we compare average quarterly earnings of individuals in the KCTCS sample with the statewide average quarterly earnings for all other Kentucky workers using

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

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. All dollars are measured in 2008 dollars, deflated by the CPI-U. Note that 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 and experience in the KCTCS sample are probably lower than the average age and experience of all Kentucky workers.[13] Average wages show little if any 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 non-award students grew from around $6,000 per quarter in 2002 to close to $8,000 in the last quarter of 2007. Although the graph suggests that the KCTCS non-award sample is not an unreasonable comparison group for panel data analysis (which looks at changes over time rather than solely at levels), it does not show that the comparison group is a perfect one, either.

Next, we compare our KCTCS sample to the 2000 Census sample for Kentucky. Table 2 contains descriptive statistics between the full KCTCS sample and the

[13] The UI data do not contain age and experience. However, as we show in Table 2, KCTCS students are younger with presumably less labor-market experience than individuals from the 2000 Census.

corresponding Census sample. The table illustrates that the set of students who first attended KCTCS in between 2002 and 2004 is not a representative sample of all Kentuckians. For example, the KCTCS sample is younger and has lower earnings. Next, we compare cross-sectional regression results from the KCTCS sample with regression results from the 2000 Census, using models as shown in equation (1). The results from these regressions are shown in Table 3.[14] In both data sets, the sample is limited to individuals ages 21 to 66 (at the time of data collection). This age range is chosen to be consistent with the general sample restriction in the KCTCS data of students being ages 17 to 60 at the beginning of their first term. Annual earnings returns are higher in the Census sample than in the KCTCS sample, particularly for men. For men, the return to an associate's degree is $3,623 for the KCTCS data and $14,556 for the Census data. For women, the return is $8,807 for the KCTCS data and $10,899 for the Census data. Perhaps the differences in returns are not surprising given the differences in demographics illustrated in Table 2, especially if the simple OLS models estimated in Table 3 do not capture all relevant determinants of earnings. The higher returns in the Census sample, particularly for men, suggest that the KCTCS returns may understate returns by focusing only on individuals who have attended KCTCS.

*5.2 Cross-sectional Analysis*

Because the KCTCS data contain earnings information prior to KCTCS attendance, we estimate earnings regressions as in equation (1) where 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

[14] All results in the table are not weighted. Weighted Census results produce similar results and are available from the authors upon request.

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 $1,531 for men and $2,216 for women. These returns are roughly 25 percent of men's average quarterly earnings and 52 percent for women. The return to a diploma for men is $1,522, or 25 percent of average earnings, and the return for women is $2,014, or 47 percent of average earnings. For men, the returns for certificates are half as large as the returns for associate's degrees: $723 or 12 percent. For women, the returns to certificates are only $183 or 4 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. 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. 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.[15] Individuals who eventually receive an associate's degree award have the highest pre-KCTCS earnings of approximately $6,000 a 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

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

slightly earlier for certificate recipients.[16] 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 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*

[16] 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.

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 55 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. Note that the gender difference in returns cannot be explained by differences in the number of credits earned. For both associate's degrees and diplomas, the average number of credits earned varies little between men and women.

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 both 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 associate's degrees 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. Researchers use a variety of sophisticated methods to control for the fact the educational attainment is determined by factors that are correlated with labor-market outcomes such as earnings and employment. 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 similar to previous estimates, and little if any previous work has been done on diplomas and certificates. Still, we acknowledge that concerns about the causality may remain, so we conduct several sensitivity analyses to test the robustness of our earnings returns, as shown in Table 6. The top panel contains the results for men, and the bottom panel contains the results for women. The first column of the table contains the results from our preferred specification in Table 5, columns 4 and 8.

Students who do fail to receive any community college credits may not be an ideal comparison group because they may have fundamental differences in earnings growth. They may have had a random shock that caused them to drop out of KCTCS before completing a for-credit class, leading to lower earnings growth compared to students with awards and producing an upward bias in our estimated returns. Therefore, our first sample limitation is to exclude students who received zero credits from KCTCS, and the returns from this alternate sample are in the second column of the table. Compared to the returns for the full sample, the returns to all awards are 10 to 25 percent lower for men and 1 to 5 percent lower for women. The returns to certificates for men are no longer statistically significant from zero at the ten-percent level (two-sided test). Thus, the overall returns in our preferred specification may be slightly overstated for men because the comparison group includes students who attend KCTCS but do not receive any credits.

Students who state that they do not intend to pursue an award (degree, diploma, or certificate), called "non-award seeking" students, may not be an ideal comparison group because they differ in their educational aspirations.[17] Approximately five percent of non-award-seeking students receive an award, compared with 27 percent of award-seeking

[17] Aspirations are measured at the time of initial enrollment in the KCTCS system.

students. Although we exclude non-award seeking students from our preferred sample, we include them in the sensitivity analysis, as shown in the third column of the table. For men, the returns from this sample are roughly 25 percent larger than in the preferred sample. The returns for women are nearly identical between the two samples. Thus, if we believe that the regressions for the expanded sample (column 3) do not completely account for differences in educational aspirations (which are included as interactions with time), then the expanded sample may overstate the returns for men. However, roughly half the men state that they plan to pursue an award, so limiting the sample to men who are pursuing awards may lead to other sample selection issues.

As stated earlier, the earnings data cover through the third quarter of 2008. Students who are still enrolled in community college less than two years before will have limited information on their post-KCTCS earnings potential. Therefore, in the fourth column of Table 6 we exclude students who were still enrolled in KCTCS (i.e. signed up for at least one class) as of the fourth quarter 2006. The returns to associate's degrees and diplomas are slightly lower for the restricted sample compared to the full sample, except for a noticeable decline in the return to diplomas for men. The returns to certificates are actually higher in the restricted sample, particularly for men. Many individuals with certificates as their highest award received certificates in 2007 or 2008, suggesting that the full-sample return to certificates may be driven by the low, short-run returns to certificates rather than the larger, longer-run returns.

Rather than following students for a specific number of quarters after they leave KCTCS, the data contain earnings from the first quarter of 2000 through the third quarter of 2008 for every person in the sample. Because students who leave KCTCS early will

have more post-KCTCS observations in the regressions than students who leave KCTCS later, there is the possibility that the returns may be driven by the individuals who finished KCTCS the soonest and have the most post-KCTCS quarters (and therefore observations). 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. Thus, there is a concern that these individuals may create an upward bias in the earnings estimates in full sample. To address this potential concern, in the fifth column of Table 6, we exclude all observations (i.e. quarters, not people) that are more than 12 quarters after leaving KCTCS. In other words, for each person, the sample is limited to the first 12 post-KCTCS quarters, as well as all quarters prior to KCTCS attendance and all quarters during which the person attends KCTCS. The results from the fifth column in Table 6 provide little support for this concern aside from the lower returns to certificates for males compared to the full sample. However, the results from column 4 suggest that these lower returns may be due to lower short-run returns rather than due to positive selection of early certificate recipients.

As shown in Figure 2, KCTCS students have a drop in average earnings the two quarters before they enter KCTCS. To investigate whether this earnings drop affects our estimated returns, the results in column six of Table 6 exclude the two quarters prior to KCTCS attendance.[18] 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.

[18] We also estimated three additional models where we excluded one quarter, three quarters, and four quarters prior to KCTCS entry, respectively. The results from these models are nearly identical to the results presented in the sixth column of Table 6.

Many studies of training programs restrict analysis to individuals with some pre-training level of labor-force attachment. We employ the same idea in column seven by restricting the sample to individuals with at least five quarters of earnings in the pre-KCTCS period. Results are quite similar when we vary the cutoff for number of quarters with pre-KCTCS earnings from four to eight quarters. 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.

Because our sample is from state UI wage records, we cannot determine whether a person has left the Kentucky labor force. To study the consequences of this limitation, we restrict the sample in column eight to individuals who have at least one quarter with positive UI wages after leaving KCTCS. The returns to associate's degrees are around 10 percent higher in the restricted sample, and the returns to diplomas are 5 to 9 percent higher in the restricted sample. For men, the returns to certificates increase from $297 to $531, an increase of nearly 80 percent. For women, the increase is from $299 to $358, nearly 20 percent. Thus, the returns to certificates are much higher for individuals with an attachment to the Kentucky labor market compared with the preferred sample of KCTCS attendees. This result is not surprising because in this analysis we are excluding both individuals who have left the state as well as individuals who do not have a job after leaving KCTCS.

The fixed-effects model provides a comparison of pre-KCTCS and post-KCTCS earnings for each individual. For individuals who are under 20 when they enroll at

KCTCS, their pre-KCTCS observations are during their teenage years when their earnings might be limited by high school attendance, labor laws, and other factors. Therefore, it is possible that the fixed-effects results for these individuals will be less meaningful than for older students. Although we exclude individuals under 20 in our preferred sample, we expand the age range at initial enrollment to ages 17 to 60 (from ages 20 to 60) in the ninth column of Table 6. The returns for men are much higher with the expanded age range, especially for diplomas and certificates. The returns for women are slightly lower with the expanded age range. Thus, the inclusion of teenagers in the model may overstate the returns for men to certificates and diplomas.

Figure 2 illustrates that the earnings patterns differ between award recipients and students who do not receive an award, particularly for men. To address concerns that the students who do not receive an award may not be a good comparison group for students who do receive an award, the tenth and final column of Table 6 excludes students who did not receive an award. Therefore, the pre-KCTCS quarters serve as the comparison group, and the post-KCTCS quarters serve as the treatment group. The difference is the receipt of a KCTCS award (degree, diploma, or certificate). For men, the results show that the returns to degrees and diplomas are nearly identical in the two samples. The returns to certificates are nearly twice as large as in the preferred sample. For women, the returns to degrees and diplomas are approximately 20 percent smaller than in the preferred sample, and the returns for certificates are under $100 (and statistically insignificant). Thus, the inclusion of students without awards may overstate the returns for women, but it may understate the returns to certificates for men.

In summary, the sensitivity analysis in Table 6 shows that the overall pattern of findings in Table 5 is robust to several alternate sample definitions, although the magnitude of the return varies somewhat across samples, especially for certificates. The findings are robust to the inclusion of students with no credits or with no plans to receive an award, and to students who have few post-schooling observations or many post-schooling observations. The returns are smaller when limiting the sample to people with pre-KCTCS labor-force attachment, but the returns are larger when limiting the sample to people with post-KCTCS labor-force attachment. The returns are larger, particularly for men, when the sample is expanded to include students who were ages 17 to 60 when they entered KCTCS. The returns are smaller for women when the sample is limited to people who have earned a degree, diploma, or certificate.

The exclusion of transfer students likely understates the return to associate's degrees due to the option value of continued enrollment in four-year schools. Stange (forthcoming) shows that the overall option value of postsecondary schooling to male high school graduates is above 10 percent of the total return to education, and it is higher for moderate-ability students, many of whom attend community colleges.

Our data only follow students for up to 6.5 years after entering community college. If we assume that transfer students take four years to complete a bachelor's degree, these students would have at most 2.5 years of post-schooling data on earnings. For students who take longer than four years to complete a bachelor's degree, we have even fewer post-schooling observations. Nonetheless, we estimated specifications that included transfer students, and we found smaller returns than in the sample that excludes such students, even when we restrict the sample to individuals who enter KCTCS during the 2002-2003 school

year in order to maximize the number of post-schooling observations.[19] We interpret this finding to suggest that our time period is simply too short to include students who transfer to four-year institutions. In general, we suspect that, by excluding transfer students, our estimated returns if anything understate actual returns due to the option value of community colleges and the likely superior ability of students who transfer.

*5.6 Field of Study*

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 7 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 7 are identical to the preferred specification in Table 5 (columns 4 and 8).

In addition to labor-market returns, the table also includes the percentage of individuals in each field of study who transfer to another institution. As discussed previously, we exclude students who transfer from our analysis due to the lack of data on schooling at the subsequent institution. The inclusion of transfer percentages illustrates the extent to which our returns estimates are limited by our inability to follow transfer students. The percentage of students who transfer varies substantially by field.

[19] Because we have no information on the length of schooling at the subsequent institution, we varied the length of schooling at the subsequent institution from one quarter to six quarters. The returns were slightly higher in the models with longer lengths of schooling, but the returns were always smaller than in the specification excluding transfer students.

The table shows that, for both men and women, the highest returns are from associate's degrees in health: $3,709 for men and $4,409 for women. The returns for associate's degrees in academic subjects other than the humanities are also positive: $1,793 for men and $1,661 for women. Fewer than 10 percent of award recipients in these fields transfer to another institution. Vocational associate's degrees are associated with higher earnings of $1,268 for men and $1,545 for women. Women receive positive returns of $654 for associate's degrees in business and $316 for associate's degrees in services; for men, the results are not statistically different from zero (at the ten-percent level) for either field of study, perhaps because fewer than 100 men receive each type of award without transferring. The coefficients for associate's degrees in the humanities are not statistically different from zero at the ten percent level, but over 30 percent of award recipients transfer to other institutions. Thus, the award may provide positive labor-market returns primarily through further education at other institutions, but that analysis is beyond the scope of this paper.

Diplomas have mixed effects on earnings. Fewer than 20 men receive diplomas in business or services, and fewer than 20 women receive vocational diplomas; we do not discuss these coefficients because of the large standard errors associated with the estimates. Health-related diplomas are associated with large increases in earnings: $2,140 for men and $2,441 for women. Vocational diplomas also have large, positive effects of $1,264 for men. Services diplomas are not associated with higher earnings levels for women, although only 40 women receive such diplomas. Business diplomas for women have insignificant returns, perhaps because most business diplomas are related to office administration, a low-paying field.

Certificates also have mixed effects on earnings. Vocational certificates are associated with higher earnings of $368 for men, but the results for women are not statistically significant from zero (at the ten-percent level). For women, health certificates are associated with higher earnings of $375, and services certificates are associated with higher earnings of $241 (only significant at the ten-percent level). For men, certificates in these fields have little or no association with earnings.[20] The coefficients for business certificates are always statistically insignificant (at ten percent) for both men and women, although only 19 men receive business certificates.

*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). However, in our KCTCS sample, the number of credits earned is closely related to the highest award. Because almost all of the students who receive 50 or more credits also receive a diploma or associate's degree, we cannot disentangle the separate effects of credits earned and awards received for these individuals. Therefore, in our analysis of the returns to credits, we exclude individuals who have an award and focus on the subset of students who do not have an award. That way, we can study whether KCTCS attendance is associated with higher earnings for students who receive credits but not an award. We expand the sample in this section to include individuals who do not seek an award given the emphasis on returns to credits, not awards.

[20] The disparity for health certificates is not related to areas of study, as most of the health-related certificates are nursing-related for both men and women. Most women receive service certificates in "family and consumer sciences" whereas men are more likely to receive service certificates in "personal and culinary services." However, only 27 men received services certificates, so small sample size is an issue here.

We estimate two sets of specifications to measure the relationship between the number of credits earned and earnings. In the first set, credits are constrained to have a polynomial effect on earnings: linear, quadratic, cubic, and quartic. In the second set, the number of credits is divided into six categories: 1 to 5 credits, 6 to 10 credits, 11 to 20 credits, 21 to 35 credits, 36 to 50 credits, and 51 or more credits.

Figure 3 illustrates the returns using credits as the measure of KCTCS attendance. The top panel contains the results for men and the bottom panel contains the results for women. The results are from the specification that includes the same set of controls as our preferred specifications in previous tables: enrollment timing, demographics, intentions, time fixed effects, and student fixed effects. Appendix Table 1 contains the regression results.

For men, the results vary substantially by specification. The predicted return to 15 credits, slightly more than a term of full-time coursework, is around $200 in the linear model and $320 for the quadratic and categorical models.[21] In percentage terms, the returns for 15 credits are three to five percent. We choose 15 credits as our reference point because more than 80 percent of the students in the sample received 20 or fewer credits. Because the returns from a certificate, which typically requires between 12 and 36 credits, are around $300 (Table 5), we suspect that the non-linear specifications may overstate the estimated returns for men in this credit range.

For women, the bottom panel shows that the returns are similar between the linear and quadratic models, but the returns for the categorical model are generally higher. The

[21] Although not shown in the figure, the return to 15 credits is $413 in the cubic model and $463 in the quartic model.

returns for 15 credits are around $100 in the polynomial models and $280 in the categorical model, approximately three to seven percent of quarterly earnings.

The results in Figure 3 suggest that men and women who attend KCTCS but receive no degree, diploma, or certificate receive a small increase in earnings from the credits earned. In each specification, we can reject the hypotheses that the coefficients on the set of credit variables are jointly zero at the one-percent level. Furthermore, the size of the return – around three to seven percent for one term of full-time study – is in line with the annual returns to community college credits in previous studies (Card, 1999).

*5.8 Differences by Age*

Our sample contains a wide range of ages from 20 to 60. We explore the variation in earnings returns across the age distribution by estimating separate regressions for each age group and gender, where age is measured at the start of students' first term. We also include returns for 18 and 19 year-olds because they are the most common ages for starting postsecondary education. Figure 4 displays the coefficients for highest award received; Appendix Table 2 contains the coefficients and t-statistics. As in Figure 3, the results are from the specification that includes the most complete set of control variables. Coefficients that are statistically significant at the ten-percent level (two-sided test) are shaded in, and those that are not significant are not shaded in.

Returns vary greatly by age, award and gender. For men, the largest returns for associate's degrees are for students in their early twenties, although there are sizable returns to associate's degrees and diplomas for some older age ranges. For diplomas and certificates, the largest returns are for teenagers. The fixed effects models rely on the comparison between pre-KCTCS earnings and post-KCTCS earnings, and – as discussed

earlier – this comparison may exaggerate the returns for teenagers, who often have little or no pre-KCTCS earnings. Thus, the results for teenagers should be interpreted with caution. For all age groups, the returns to associate's degrees are often above $1,000 per quarter, and they are positive and statistically significant except for the oldest group. Returns to a diploma are often over $1,500, and they are also statistically significant for all categories except the oldest. Returns to a certificate are only positive and statistically significant for teenagers. Even though the return to certificates for men ages 45 to 59 is negative, few men in this age range receive certificates. Likely, these men are returning to school for reasons other than increasing their earnings (such as to find employment after being laid off or simply for enjoyment).

Women receive sizable returns to degrees and diplomas throughout their teens, 20s, 30s, and into their 40s. The returns for associate's degrees are in excess of $1,000 for all age categories, and returns for diplomas are above $1,500 for all but the oldest category. For certificates, the returns are only positive and significant for only three categories: ages 19, 22-24 and 30-34, with a return of approximately $500.

*5.9 Employment Returns*

In addition to studying the effect of community college awards on earnings, we also study their impact on employment. Higher earnings are a potential benefit of community colleges. Another potential benefit is increased employment, especially for individuals who, prior to entering KCTCS, face the possibility of losing their jobs. Therefore, we estimate models similar to those in equations (2) and (3), except that the dependent variable is now a dichotomous variable for having positive quarterly earnings. We refer to this variable as employment, although the category of people with no reported

earnings includes individuals who are employed in jobs that are not covered by the Kentucky Unemployment Insurance system.

Table 8 contains the regression results for employment. The table has the same layout as Table 5; the only difference is the dependent variable is now employment rather than earnings. The first four columns contain results for men, and the second four contain results for women. The rows at the bottom of the table explain the set of additional control variables in each regression.

All three awards are associated with higher probabilities of employment for both men and women. Associate's degrees are associated with an 11.0 to 12.3 percent increase for men and an 18.5 to 19.3 percent increase for women. Diplomas are associated with larger increases of 13.9 to 15.3 percent for men and 19.7 to 20.6 percent for women. Certificates are associated with increased employment probabilities of 1.5 to 2.2 for men and 8.3 to 8.6 percent for women. The table illustrates that the employment returns are not sensitive to the inclusion of different control variables. More generally, community college awards are associated with higher employment and earnings.

**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 nearly $1,500 for men and around $2,000 for women. Certificates have small positive 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. All three awards are associated with higher likelihoods of employment, although – like earnings – the largest increases are for degrees and diplomas. Although our estimated returns are large, they are comparable to previous work on associate's degrees.

Like any empirical paper, our analysis of the labor-market returns to community colleges has limitations. Because teenagers have limited labor-market experience, the fixed effects model may overstate the labor-market returns for these individuals, as illustrated in Table 6. Yet this is the group with the highest attendance at community college and is the focus of nearly all research on returns to schooling. The exclusion of transfer students potentially induces bias by excluding perhaps the most able students in community college. Furthermore, this exclusion understates the return to associate's degrees due to the option value of continued enrollment in four-year schools (Stange, forthcoming).

These findings add to an extremely limited literature on the returns to community college certificates and diplomas. Nearly all the previous literature focuses on associate's degrees or the amount of schooling received (measured by credits or years of full-time attendance). 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.

## 7. References


Bailey, Thomas, Gregory Kienzl, and David Marcotte. 2004. The Return to a Sub-Baccalaureate Education: The Effects of Schooling, Credentials, and Program of Study on Economic Outcomes. Report for National Assessment of Vocational Education, U.S. Department of Education.

Belfield, Clive R., and Thomas Bailey. 2011. T he Benefits of Attending Community College: A Review of the Evidence. *Community College Review*, 39(1): 46-68.

Card, David. 1999. The Causal Effect of Education on Earnings. In *The Handbook of Labor Economics*, Vol. 3A, eds. Orley C. Ashenfelter and David Card. New York: Elsevier Science, North-Holland: 1801-1863.

Cellini, Stephanie, and Latika Chaudhary. 2011. The Labor-Market Returns to a Private Two-Year College Education. Working paper.

Franklin, Rachel S. 2003. Domestic Migration Across Regions, Divisions and States: 1995-2000. Washington, D.C.: U.S. Deparment of Commerce, U.S. Census Bureau.

Grubb, W. Norton. 1997. The Returns to Education in the Sub-Baccalaureate Labor Market, 1984-1990. *Economics of Education Review*, 16(3): 231-245.

Grubb, W. Norton. 2002a. Learning and Earning in the Middle, Part I: National Studies of Pre-Baccalaureate Education. *Economics of Education Review*, 21(4): 299-321.

Grubb, W. Norton. 2002b. Learning and Earning in the Middle, Part II: State and Local Studies of Pre-Baccalaureate Education. *Economics of Education Review*, 21(5): 401-414.

Jacobson, Louis S., Robert J. LaLonde, and Daniel G. Sullivan. 2005a. Estimating the Returns to Community College Schooling for Displaced Workers. *Journal of Econometrics*, 125(1-2): 271-304.

Jacobson, Louis S., Robert J. LaLonde, and Daniel G. Sullivan. 2005b. The Impact of Community College Retraining on Older Displaced Workers: Should We Teach Old Dogs New Tricks? *Industrial and Labor Relations Review*, 58(3): 398-415.

Jacobson, Louis G., and Christine Mokher. 2008. Pathways to Boosting the Earnings of Low-Income Students by Increasing Their Educational Attainment. Prepared for the Bill & Melinda Gates Foundation by The Hudson Institute and CNA.

Jepsen, Christopher, Kenneth Troske, and Paul Coomes. 2009. The Labor-Market Returns to Community College Degrees, Diplomas, and Certificates. University of Kentucky Center for Poverty Research Discussion Paper Number 2009-08. Retrieved from http://www.ukcpr.org/Publications/DP2009-08.pdf.

Kane, Thomas J., and Cecilia Elena Rouse. 1995. Labor Market Returns to Two-Year and Four-Year Schools. *The American Economic Review* 85(3): 600-614.

Kellogg, Alex P., and Robert Tomsho. 2009. Obama Plans Community-College Initiative. *The Wall Street Journal*. July 14, 2009.

Kentucky Council on Postsecondary Education. 2009. Kentucky Public Colleges and Universities – Full Time Undergraduate Resident Tuition and Fees. Downloaded from http://cpe.ky.gov/info/affordability/ on September 3, 2009.

Knapp, Laura G., Janice E. Kelly-Reid, Scott A. Ginder, and Elise S. Miller. 2008. Enrollment in Postsecondary Institutions, Fall 2006; Graduation Rates, 2000 & 2003 Cohorts; and Financial Statistics, Fiscal Year 2006 (NCES 2008-173). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, D.C.

Kornfeld, Robert, and Howard S. Bloom. 1997. Measuring Program Impacts on Earnings and Employment: Do UI Wage Reports from Employers Agree with Surveys of Individuals?" Working paper, Abt Associates and New York University.

Leigh, Duane E., and Andrew M. Gill. 1997. Labor Market Returns to Community Colleges: Evidence for Returning Adults. *Journal of Human Resources* 32(2): 334-353.

Marcotte, Dave E., Thomas Bailey, Carey Borkoski, and Greg S. Kienzl. 2005. The Returns from a Community College Education: Evidence from the National Educational Longitudinal Survey. *Educational Evaluation and Policy Analysis*, 27(2):157-175.

Stange, Kevin M. Forthcoming. An Empirical Investigation of the Option Value of College Enrollment. *American Economic Journal: Applied Economics*.

Wooldridge, Jeffrey M. 2001. *Econometric Analysis of Cross Section and Panel Data*. MIT Press: Cambridge, MA.

Table 1: Descriptive Statistics, KCTCS Data

| | Men | | Women | |
|---|---|---|---|---|
| Variable | Mean | Std. Dev | Mean | Std. Dev |
| 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 |
| Percentage White | 0.769 | 0.422 | 0.768 | 0.422 |
| Percentage Nonwhite | 0.231 | 0.422 | 0.232 | 0.422 |
| 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 | 24,791 | 35,863 | 15,134 | 18,759 |
| | (26,776) | (47,129) | (22,955) | (25,138) |
| Associate's Degree | 0.056 | 0.040 | 0.114 | 0.066 |
| | (0.230) | (0.197) | (0.318) | (0.248) |
| Diploma | 0.027 | | 0.038 | |
| | (0.162) | | (0.191) | |
| Certificate | 0.046 | | 0.056 | |
| | (0.210) | | (0.230) | |
| 1+ Years College, No Degree | | 0.130 | | 0.144 |
| | | (0.337) | | (0.351) |
| <1 Year College, No Degree | | 0.063 | | 0.076 |
| | | (0.243) | | (0.264) |
| In School | 0.176 | 0.055 | 0.171 | 0.066 |
| | (0.381) | (0.227) | (0.377) | (0.249) |
| Age | 33.6 | 41.8 | 33.4 | 41.9 |
| | (11.3) | (12.3) | (10.6) | (12.2) |
| Nonwhite | 0.231 | 0.080 | 0.217 | 0.080 |
| | (0.421) | (0.271) | (0.412) | (0.271) |
| Observations | 27,610 | 60,022 | 30,815 | 61,468 |

Notes: Standard deviations are in parentheses, and standard errors are adjusted to allow for heterogeneity using Stata's "robust"option. Census observations are limited to the state of Kentucky. Each sample includes individuals ages 21 to 66. KCTCS earnings are for the fourth quarter of 2007 through the third quarter of 2008, the most recent earnings data available.

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 | 3,623 | 14,556 | 8,807 | 10,899 |
| | (6.08) | (15.55) | (26.71) | (29.15) |
| Diploma | 2,798 | | 5,874 | |
| | (3.25) | | (12.98) | |
| Certificate | 200 | | -994 | |
| | (0.31) | | (2.96) | |
| 1+ Years College, No Degree | | 10,370 | | 5,738 |
| | | (19.94) | | (20.46) |
| <1 Year College, No Degree | | 8,415 | | 4,979 |
| | | (13.65) | | (14.58) |
| In School | 8,668 | -13,512 | 17 | -4,232 |
| | (21.98) | (19.78) | (0.08) | (12.41) |
| Age | 2,922 | 4,188 | 872 | 2,084 |
| | (26.84) | (47.84) | (6.27) | (42.90) |
| Age Squared | -30 | -48 | -7 | -25 |
| | (20.31) | (45.41) | (3.37) | (43.80) |
| Nonwhite | -9,100 | -5,248 | -837 | 1,675 |
| | (16.62) | (8.74) | (3.01) | (4.45) |
| Observations | 27,610 | 58,551 | 30,815 | 60,795 |

Notes: Absolute values of t-statistics are in parentheses, and standard errors are adjusted to allow for heterogeneity using Stata's "robust"option. All models include individuals ages 21 to 66. Regressions using Census data also include controls for the following educational levels: less than high school, bachelor's degree, master's degree, and professional (or doctoral) degree. Regressions using Census data also include dummy variables for missing race/ethnicity and for students entering KCTCS during the 2002-2003 school year.

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

| | Men | Women |
|---|---|---|
| Associate's Degree | 1,531 | 2,216 |
| | (9.44) | (24.62) |
| Diploma | 1,522 | 2,014 |
| | (7.84) | (17.86) |
| Certificate | 723 | 183 |
| | (4.60) | (2.26) |
| Demographics | yes | yes |
| Intentions | yes | yes |
| Observations | 14,511 | 23,223 |

Notes: Absolute values of t-statistics are in parentheses, and standard errors are corrected to allow for heterogeneity using Stata's "robust"option. 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 |
| | (8.95) | (8.05) | (9.80) | (10.13) | (29.73) | (28.08) | (28.53) | (29.62) |
| Diploma | 1,028 | 890 | 1,130 | 1,265 | 1,955 | 1,801 | 1,893 | 1,914 |
| | (5.63) | (4.82) | (6.34) | (7.00) | (17.34) | (15.92) | (16.92) | (17.63) |
| Certificate | 95 | 43 | 248 | 297 | 286 | 235 | 324 | 299 |
| | (0.59) | (0.26) | (1.59) | (1.89) | (3.80) | (3.12) | (4.33) | (4.13) |
| Student Fixed Effect | 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: Absolute values of t-statistics are in parentheses, and standard errors are clustered by student. All models also include time fixed effects.

Table 6: Sensitivity Analysis to Alternate Samples, KCTCS Earnings Returns

| Sample | Full sample (Table 3, columns 4,8) | Exclude earned zero credits | Include non-award seeking | Exclude enrolled 2006 Q4 or later | Exclude 14+ post-KCTCS quarters | Exclude two qtrs before KCTCS entry | Employed in 5 or more pre-KCTCS quarters | Employed after leaving KCTCS | Include Ages 17 to 60 | Exclude never received award |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| | | | | | Men | | | | | |
| Associate's | 1,484 | 1,276 | 1,837 | 1,445 | 1,367 | 1,554 | 1,381 | 1,660 | 1,562 | 1,506 |
| Degree | (10.13) | (8.45) | (13.16) | (8.03) | (9.34) | (10.65) | (8.34) | (10.72) | (13.83) | (9.01) |
| Diploma | 1,265 | 1,132 | 1,530 | 1,017 | 1,210 | 1,306 | 1,354 | 1,333 | 1,666 | 1,244 |
| | (7.00) | (6.13) | (8.82) | (5.28) | (6.71) | (7.32) | (6.43) | (7.35) | (10.88) | (6.00) |
| Certificate | 297 | 224 | 377 | 375 | 213 | 276 | 261 | 531 | 523 | 550 |
| | (1.89) | (1.36) | (2.61) | (2.10) | (1.38) | (1.73) | (1.43) | (3.07) | (4.40) | (3.14) |
| Observations | 306,642 | 230,637 | 641,369 | 248,351 | 272,703 | 288,880 | 231,256 | 255,019 | 500,792 | 75,235 |
| | | | | | Women | | | | | |
| Associate's | 2,363 | 2,337 | 2,403 | 2,382 | 2,346 | 2,396 | 2,210 | 2,667 | 2,230 | 1,886 |
| Degree | (29.62) | (27.52) | (30.50) | (22.60) | (27.93) | (30.03) | (24.25) | (31.01) | (34.31) | (22.76) |
| Diploma | 1,914 | 1,835 | 1,994 | 1,873 | 1,913 | 1,975 | 1,760 | 2,077 | 1,909 | 1,443 |
| | (17.63) | (16.02) | (18.68) | (15.02) | (17.39) | (18.38) | (13.90) | (18.71) | (20.44) | (12.47) |
| Certificate | 299 | 284 | 283 | 348 | 274 | 289 | 221 | 358 | 262 | 89 |
| | (4.13) | (3.57) | (4.03) | (3.88) | (3.76) | (3.94) | (2.63) | (4.27) | (4.35) | (1.04) |
| Observations | 572,319 | 437,796 | 749,723 | 434,372 | 515,833 | 539,175 | 423,939 | 463,793 | 801,814 | 167,798 |

Notes: Absolute values of t-statistics are in parentheses, and standard errors are clustered by student. The table contains results from 20 regression models (10 specifications and 2 genders). All models also include controls for enrollment timing, demographics, student intentions, person fixed effects, and time fixed effects.

Table 7: Earnings Returns for Highest Award by Field of Study
Fixed Effects Models with KCTCS Data

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Coeff. | T-stat. | Percent Transfer | Coeff. | T-stat. | Percent Transfer |
| *Associate's Degree* | | | | | | |
| Humanities | -2 | 0.01 | 38.4% | 171 | 1.33 | 30.6% |
| Other Academic | 1,793 | 7.21 | 5.5% | 1,661 | 9.51 | 8.4% |
| Business | -138 | 0.25 | 10.9% | 654 | 4.26 | 8.1% |
| Health | 3,709 | 10.64 | 7.3% | 4,409 | 35.14 | 4.1% |
| Services | -46 | 0.11 | 27.6% | 316 | 2.07 | 18.9% |
| Vocational | 1,268 | 3.88 | 11.0% | 1,545 | 3.41 | 13.0% |
| *Diploma* | | | | | | |
| Business | -1,124 | 1.14 | 10.0% | 158 | 0.68 | 2.2% |
| Health | 2,140 | 4.33 | 3.2% | 2,441 | 20.28 | 4.9% |
| Services | 73 | 0.09 | 0.0% | -9 | 0.02 | 2.5% |
| Vocational | 1,264 | 6.35 | 3.6% | 240 | 0.26 | 5.3% |
| *Certificate* | | | | | | |
| Business | -8 | 0.01 | 0.0% | 173 | 0.76 | 3.1% |
| Health | 32 | 0.07 | 9.7% | 375 | 3.97 | 7.2% |
| Services | -141 | 0.24 | 0.0% | 241 | 1.73 | 3.5% |
| Vocational | 368 | 2.11 | 3.0% | 264 | 0.91 | 5.3% |
| Observations | | 200,045 | | | 366,507 | |

Notes: Standard errors are clustered by student. All models also include controls for enrollment timing, demographics, student intentions, person fixed effects, and time fixed effects.

Table 8: Employment Returns for Highest Award Received, Fixed Effects Models with KCTCS Data

| | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Associate's Degree | 0.112 | 0.110 | 0.123 | 0.121 | 0.193 | 0.185 | 0.190 | 0.191 |
| | (23.43) | (22.78) | (25.34) | (24.92) | (61.77) | (58.56) | (59.90) | (59.99) |
| Diploma | 0.142 | 0.139 | 0.153 | 0.152 | 0.205 | 0.197 | 0.203 | 0.206 |
| | (21.95) | (21.40) | (23.45) | (22.87) | (43.90) | (41.91) | (43.22) | (43.24) |
| Certificate | 0.015 | 0.015 | 0.022 | 0.022 | 0.084 | 0.083 | 0.086 | 0.086 |
| | (2.76) | (2.80) | (4.22) | (4.08) | (20.57) | (20.17) | (20.99) | (20.99) |
| Student Fixed Effect | 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: Absolute values of t-statistics are in parentheses, and standard errors are clustered by student. All models also include time fixed effects.

Figure 1: Average Quarterly Earnings for KCTCS Award, KCTCS Non-award, and Non-KCTCS Workers, 2002 to 2008

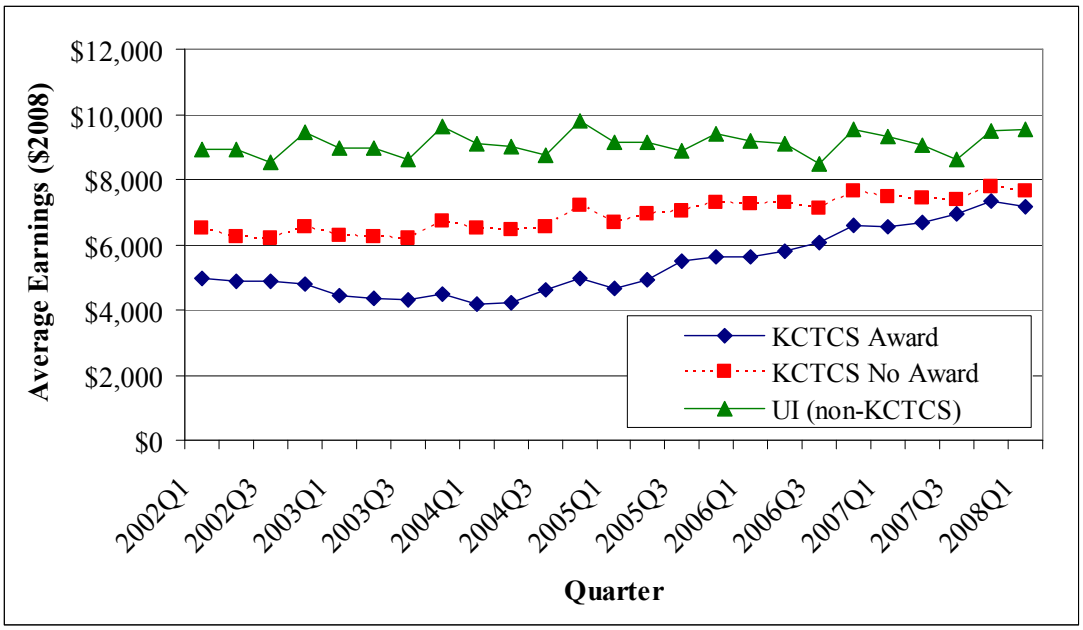
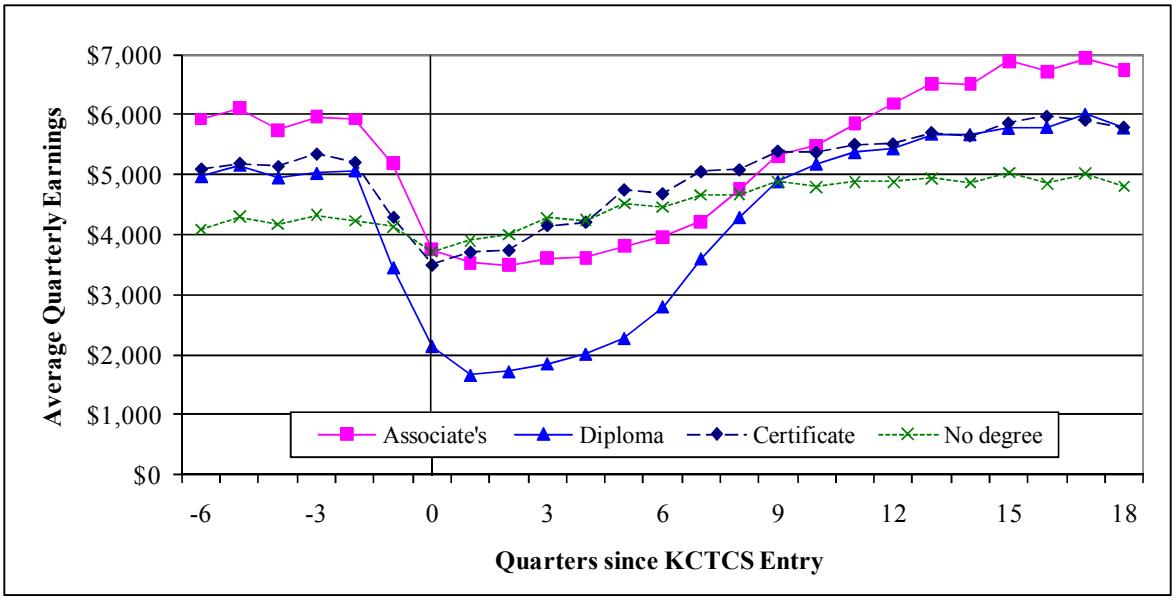


Figure 2: Quarterly Earnings by Quarters since KCTCS Entry

Men




Women

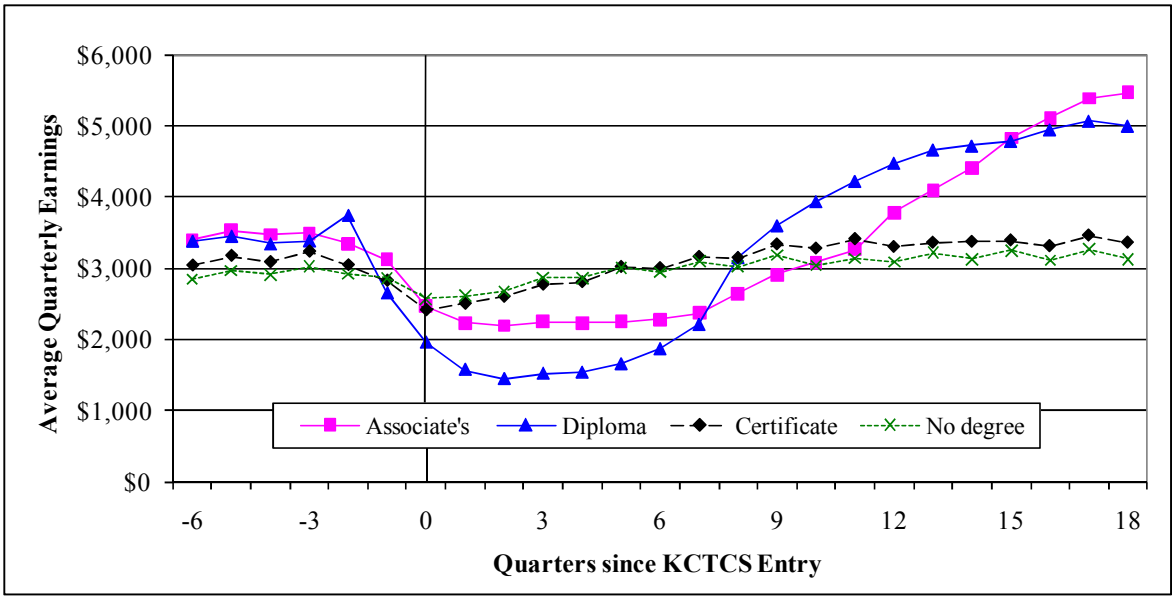
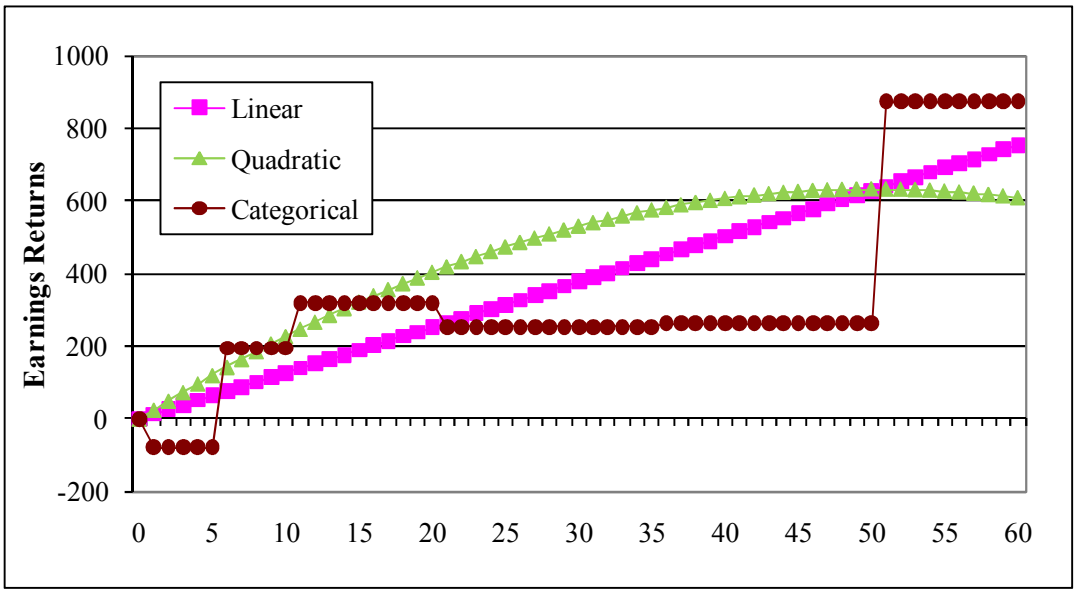
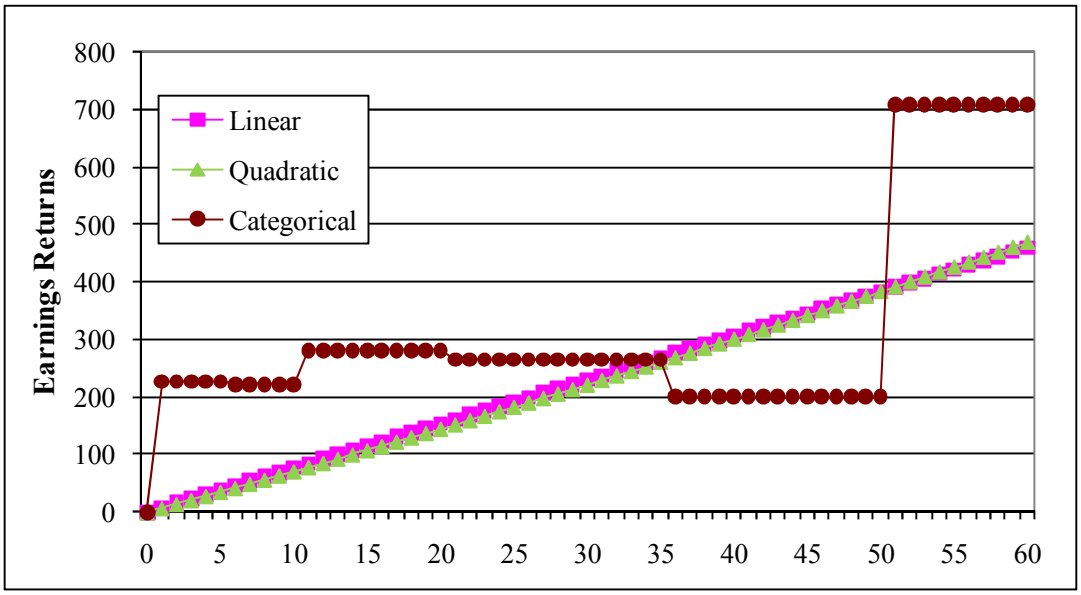


Figure 3: Earnings Returns for Credits Earned, Fixed Effects Models with KCTCS Data Excluding Students with Degrees, Diplomas, or Certificates

Men



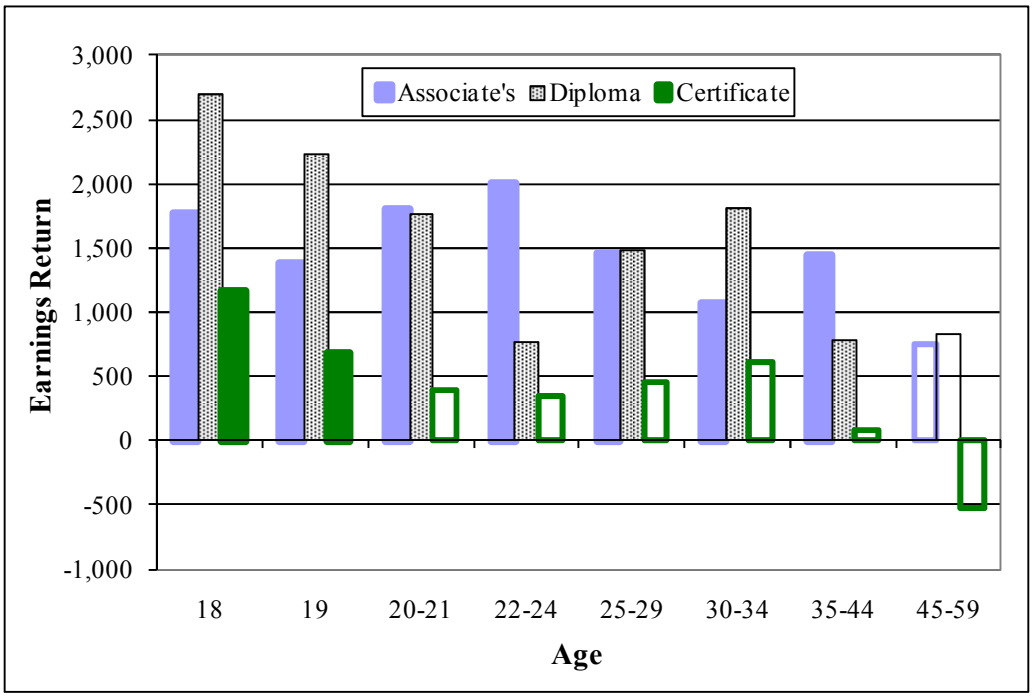

Women



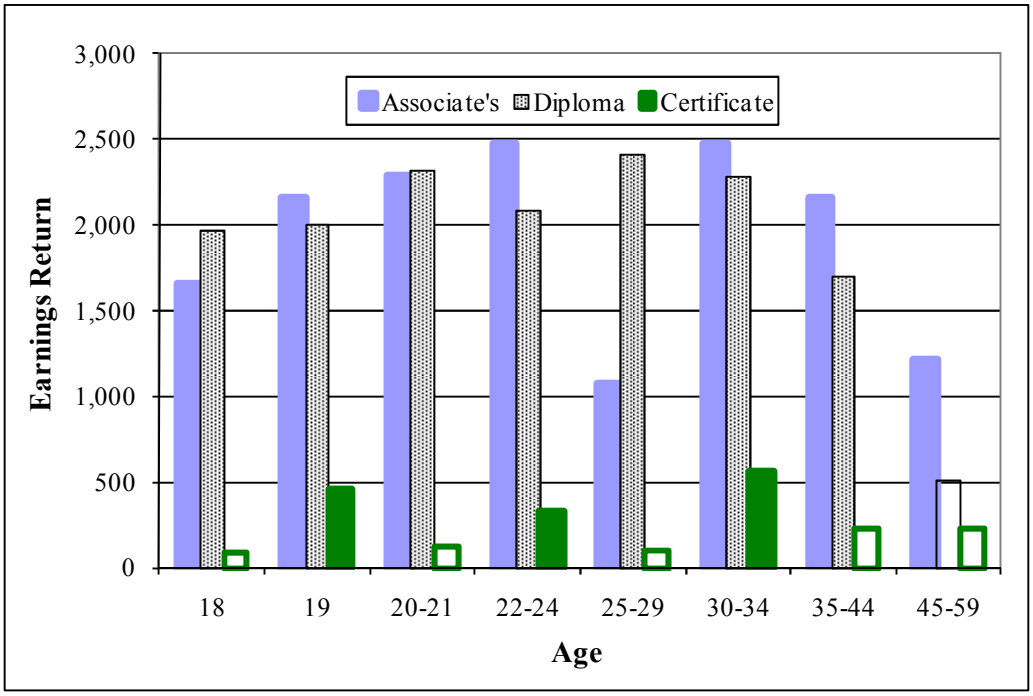

Notes: Results for cubic and quartic models are similar to the quadratic model and therefore are not included in the figure. Coefficients for credits variables are available in Appendix Table 1.

Figure 4: Earnings Returns for Highest Award Received by Age
Fixed Effects Models with KCTCS Data

Men




Women




Notes: Coefficients that are not statistically significant from zero at the ten-percent level (two-sided tests) are not shaded. The coefficient for certificates for men ages 30-34 and the coefficient for diplomas for women ages 45-59 are significant at the ten-percent level but not the five percent level.

Appendix Table 1: Earnings Returns for Credits Earned
Fixed Effects Models with KCTCS Data
Excluding Students with Degrees, Diplomas, or Certificates

| | Men | | Women | |
|---|---|---|---|---|
| | Coefficient | T-statistic | Coefficient | T-statistic |
| *Linear specification* | | | | |
| Credits | 12.6 | 4.13 | 7.7 | 4.37 |
| *Quadratic specification* | | | | |
| Credits | 25.1 | 3.40 | 6.9 | 1.33 |
| Credits squared | -25.0 | 1.97 | 1.5 | 0.17 |
| *Cubic specification* | | | | |
| Credits | 41.0 | 3.31 | 13.0 | 1.44 |
| Credits squared | -101.7 | 2.16 | -26.1 | 0.89 |
| Credits cubed | 8.0 | 1.78 | 2.7 | 1.14 |
| *Quartic specification* | | | | |
| Credits | 64.6 | 3.47 | 27.4 | 2.22 |
| Credits squared | -296.2 | 2.56 | -137.2 | 1.96 |
| Credits cubed | 51.8 | 2.31 | 27.0 | 2.00 |
| Credits quartic | -2.8 | 2.19 | -1.5 | 1.94 |
| *Categorical specification* | | | | |
| 1 to 5 credits | -79.2 | 0.68 | 226.6 | 3.05 |
| 6 to 10 credits | 193.3 | 1.48 | 222.0 | 3.18 |
| 11 to 20 credits | 318.8 | 2.31 | 280.8 | 4.06 |
| 21 to 35 credits | 252.4 | 1.51 | 265.3 | 1.53 |
| 36 to 50 credits | 261.7 | 1.12 | 200.4 | 1.74 |
| 51+ credits | 873.0 | 3.41 | 707.3 | 5.20 |

Notes: Absolute values of t-statistics are presented, and standard errors are clustered by student. All models also include controls for enrollment timing, demographics, student intentions, the average number of credits earned per quarter (in-school periods only), person fixed effects, and time fixed effects. The table reports results from 10 regressions (5 specifications and 2 genders). For men, the number of observations in each regression is 558,705; for women, the number of observations in each regression is 573,354.

Appendix Table 2: Earnings Returns for Highest Award Received by Age
Fixed Effects Models with KCTCS Data

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Associate's Degree | Diploma | Certificate | Associate's Degree | Diploma | Certificate |
| Age 18 | 1,776 | 2,693 | 1,170 | 1,655 | 1,973 | 82 |
| | (8.23) | (7.41) | (4.84) | (13.48) | (8.63) | (0.62) |
| Age 19 | 1,375 | 2,231 | 675 | 2,155 | 2,002 | 457 |
| | (4.60) | (5.51) | (2.50) | (9.98) | (6.54) | (3.00) |
| Age 20 - 21 | 1,806 | 1,768 | 390 | 2,288 | 2,319 | 123 |
| | (5.51) | (3.99) | (1.24) | (10.31) | (7.46) | (0.82) |
| Age 22 - 24 | 2,008 | 770 | 350 | 2,470 | 2,087 | 333 |
| | (5.20) | (1.98) | (1.21) | (12.58) | (8.68) | (2.02) |
| Age 25 - 29 | 1,456 | 1,481 | 462 | 1,072 | 2,406 | 103 |
| | (5.76) | (3.95) | (1.28) | (2.81) | (10.76) | (0.66) |
| Age 30 - 34 | 1,072 | 1,802 | 605 | 2,479 | 2,276 | 558 |
| | (2.81) | (4.45) | (1.64) | (12.43) | (8.19) | (2.77) |
| Age 35 - 44 | 1,439 | 785 | 81 | 2,158 | 1,704 | 227 |
| | (3.71) | (1.86) | (0.19) | (13.15) | (7.53) | (1.31) |
| Age 45 - 59 | 758 | 822 | -518 | 1,214 | 508 | 230 |
| | (1.59) | (1.26) | (0.91) | (4.64) | (1.56) | (1.02) |

Notes: Absolute values of t-statistics are in parentheses, and standard errors are clustered by student. All models also include demographics, controls in-school and post-school periods, controls for each of the two quarters prior to KCTCS entry, person fixed effects, and time fixed effects. Each age and gender combination (such as age 18 males) is from a separate regression. The table reports results from 16 regressions (8 age groups and 2 genders).