Title: Way Station or Launching Pad? Unpacking the Returns to Postsecondary Vocational Programs in Tennessee

Authors and Affiliations: Celeste K. Carruthers, Department of Economics and Center for Business and Economic Research, University of Tennessee; Thomas Sanford, Department of Higher Education Administration, St. Cloud State University

Background / Context: Many higher education institutions award credentials below the associate's degree level, yet little is known about the pecuniary returns to sub-baccalaureate awards like diplomas and certificates. Diplomas are awarded at the culmination of a program of study lasting one to two years, and certificates are awarded for the successful completion of portions of those programs, often within one or two semesters. Both classes of award typically focus on vocational skills, signaling a narrower but potentially deeper scope of human capital development.

Accumulating research shows significant returns to college credentials and supports the idea that more students should pursue and finish a higher education course of study, be it an accredited degree-granting program or a less rigorous certificate or diploma program. But a growing consensus about the value of higher education *per se* is tempered by the recognition that some institutions and some programs appear to have higher returns than others. In Tennessee, a relatively new funding formula incentivizes institutions to increase job placement. In other states, debates are ongoing about whether scholarships and state funding should be higher for programs that produce more jobs (National Conference of State Legislatures 2013).

Vocational training is narrow in focus, which has implications for workers' value to employers over the long term. New vocational graduates may find work more rapidly than their academic counterparts, but long-term employment prospects for vocational skills are potentially at greater risk of obsolescence from technical and economic change (Hanushek et al. 2011). Moreover, many of the skilled trades that vocational students are trained for are especially sensitive to economic fluctuations.

Our work follows most closely from that of Jepsen et al. (2012), who estimate the returns to associate's degrees, diplomas, and certificates using matched, longitudinal administrative data from Kentucky community colleges. They find that all three credentials entail significant returns in the near term, that associate's degrees increase earnings by more than diplomas, which in turn increase earnings by more than certificates, and that women typically benefit from these credentials more than men.

Purpose / Objective / Research Question / Focus of Study: We add to this body of work in two ways using administrative data on college and labor outcomes for Tennessee students and workers over the years 2000-2012. First, we highlight the potential role of state-run technology centers in producing diplomas and certificates. We compare the returns to sub-baccalaureate awards across technology centers and community colleges, characterizing immediate post-credential gains in employment and earnings as well as post-credential trends in the same. Tennessee Colleges of Applied Technology have long served as an alternative to traditional four-year and two-year higher education sectors. TCATs are renowned for fast, holistic vocational training and impressive job placement records (Hoops 2010), and they represent one solution to employers' demand for better pre-market training and policymakers' demand for expedient employment outcomes. But little is known about the quality or persistence of the jobs that TCAT alumnae find relative to employment outcomes from community college vocational programs.

Second, we delve into two potential mechanisms that connect sub-baccalaureate awards to higher earnings. First, we test whether student-workers are more likely to migrate to different industries after college and whether higher earnings accrue to those who do so. Second, we use propensity score matching estimators and earnings histories for non-students to determine the extent that higher earnings after vocational training are due to regression to the mean.

Setting: The Tennessee Board of Regents operates 27 Tennessee Colleges of Applies Technology (TCATs) throughout the state. The Tennessee Board of Regents also oversees 13 two-year community colleges. The locus of our empirical analysis is formed by students who enrolled in TCATs and community colleges between 2004 and 2008.

Population / Participants / Subjects: There are just over 41,000 individuals. We match these students to their 2000 – 2012Q2 in-state earnings and industry. This results in 1.87 million observations on TCAT and community college students. Additionally, we analyze student employment and earnings against that of a random sample of 250,000 Tennessee workers who are not observed participating in higher education.

Intervention / Program / Practice: The collective mission of the TCAT system is to offer easy access to technical training and vocational certificates and diplomas. In contrast to the state's system of community colleges, TCATs do not offer general academic programs and do not prepare students for transfer to four-year colleges. TCATs are singularly focused on training students to acquire work-ready vocational skills.[1] Tennessee community colleges offer many of the same vocational foci as Tennessee Colleges of Applied Technology, as well as terminal associate's programs in academic disciplines and programs to facilitate transfer to four-year colleges and universities.

Research Design: For baseline estimates of the returns to sub-baccalaureate awards, we estimate the following:

$$(1)\ Y_{it} = \alpha_0 + Y_{it-1} + \beta Award_{it} + \theta Award_{it} f(t) + \pi Enrolled_{it} + X_{it}\delta + \alpha_t + \varepsilon_{it},$$

where Y_{it} is term *t* employment, earnings, or industry for individual *i* and $Award_{it}$ is a set of binary indicators for students' attainment of a certificate, diploma, or associates' degree. The coefficients of interest are in the vector β and θ, which estimate the wage returns to different awards, relative to students who enrolled but did not complete a degree and relative to each student's own lagged earnings.[2] $Award_{it} f(t)$ is an interaction between the $Award_{it}$ vector and a linear function of the time

[1] Examples of TTC programs include "Collision Repair Technology," "Brick, Block, & Stone Masonry," "Health Insurance Specialist," Practical Nursing," and "Precision Metals."

[2] Results are robust in terms of sign and significance to alternative estimating equations, including two-way fixed effects models employed by Jepsen et al. (2012) and differenced models of changes in earnings over time. Of these, Equation (1) appears to be least vulnerable to heterogeneous trends in productivity that are correlated with the propensity to complete a certificate, diploma, or associate's degree.

since leaving a TCAT or community college. The coefficient β identifies any level shift in earnings attributable to different awards, whereas θ quantifies the post-award trend in employment or earnings. Enrolledit is a set of nine indicators denoting i's proximity to enrollment. This vector controls for non-monotonic patterns of earnings – i.e., the Ashenfelter's (1978) dip that is commonly observed among non-traditional students.

X_{it} controls for other time-varying determinants of wages and employment, including local unemployment rates, Pell grant eligibility and a third-degree polynomial function of age. The age-earnings polynomial profile is allowed to vary by gender, Caucasian race designation, and parental education. Last, term fixed effects (α_t) control for term-specific shocks to employment and earnings. Robust standard errors are clustered at the individual level.

To understand the role of industrial mobility, Equation (1) is supplemented with interactions between $Award_{it}$, $Award_{it}f(t)$, and indicators for students whose modal pre-college industry is different from their modal post-college industry. Coefficients on interaction terms allow us to test for whether the returns to these credentials are higher or lower for student-workers who shift into new industries after enrolling in a TCAT or community college.

Preliminary descriptive avalysis suggests that involuntary separation from the labor force often precedes enrollment, particularly for TCAT students (see Figure 1). It could be the case, then, that TCATs and community colleges serve as "way stations" for unemployed workers and that employment outcomes would have rebounded with or without postsecondary training. In order to investigate this possibility, we use propensity score matching to estimate counterfactual earnings patterns for each TCAT and community college entrant. Counterfactual wage outcomes come from a random statewide sample of workers who are not observed in Tennessee's public higher education institutions.

Specifically, we select a random sample of 250,000 unique Tennessee workers with non-missing earnings between 2004 and 2008 (the years during which we observe TCAT and community college students). Each "treated" enrollee who starts college in term *t* is matched with *k* non-students whose predicted propensity to enroll in term *t* meets the caliper criteria. We omit regions of predicted enrollment propensity without common support between student and non-student samples.

After matching students to non-students with roughly the same enrollment propensity at time $\bar{t}$, we compute the difference between inflation-adjusted earnings for each term $t \in [\bar{t} - 3, S_T]$, where S_T is the latest term that student *i* outcomes are matched to non-student outcomes. Standard errors are computed by bootstrap. We take the gap between student and non-student outcomes in the window $t \in [\bar{t}, S_T]$ to be the treatment effect of enrolling in a TCAT or community college. We expect the average treatment effect of TCAT and community college enrollment to be close to zero in the initial terms following enrollment if, much like students, matched non-students who experience declines in employment do not immediately rejoin the workforce after the matched term. We use employment

outcomes at term $\bar{t}$ and later to ascertain whether returns to TCAT and community college credentials are driven by rebounding.

Data Collection and Analysis: Postsecondary data are drawn from administrative files maintained by the Tennessee Higher Education Commission. We link students' post-secondary path to their history of in-state earnings from 2000 through the second quarter of 2012. Earnings data are drawn from files maintained by the Tennessee Department of Labor and Workforce Development and include all in-state earnings covered by Unemployment Insurance.

Findings / Results: Preliminary findings from Equation (1) (see Tables 1 and 2) indicate that associate's degrees, diplomas, and certificates all have a significantly positive impact on individual employment and earnings in Tennessee, though the returns to all but community college associate's degrees tend to erode over time. Women tend to garner higher short-term returns to sub-baccalaureate credentials than men, which is consistent with results from earlier research.

Industry analysis shows that certificates, diplomas, and associate awards all increase access to new industries, and in particular, to the health industry. Generally speaking, the highest returns to sub-baccalaureate credentials accrue to students who work in different industries after college, with the notable exception of TCAT certificate holders. These students realize *lower* immediate employment and earnings if they switch industries, but significantly positive growth in employment and earnings thereafter. This supports the notion that TCATs and community colleges promote earnings and employment by facilitating industrial mobility, albeit with short-term setbacks for some certificate recipients.

To what extent do the returns to sub-baccalaureate credentials reflect regression to the mean? Preliminary matching results for earnings are summarized in Figures 2 and 3 for, respectively, TCAT and community college entrants. TCAT entrants significantly outperform matched non-entrants three terms (or one year) after enrolling, and gains are maintained throughout the window of time we consider. Community college entrants underperform matched non-students initially, reach par two years after enrolling, and exhibit positive and ascending average treatment effects thereafter. These findings do not support the "way station" metaphor of sub-baccalaureate education. Regardless of whether they complete a TCAT or community college credential, students outperform non-students with similar earnings histories.

Conclusions: Thus far, results support the conventional wisdom that narrow vocational programs and sub-baccalaureate credentials promote job placement and immediate earnings recovery, but with the important caveat that the labor market returns to certificates and diplomas depreciate after attainment. For employment but not necessarily earnings, this depreciation is offset to some degree by industrial mobility. Industrial mobility findings support the "launching pad" metaphor of sub-baccalaureate higher education, and gains relative to matched non-students counter the "way station" metaphor.

Appendix A. References

Ashenfelter, O. C. (1978). Estimating the Effect of Training Programs on Earnings. Review Of Economics And Statistics, 6(1), 47-57.

Hanushek, E. A., Woessmann, L., & Zhang, L. (2011). General Education, Vocational Education, and Labor-Market Outcomes over the Life-Cycle. NBER Working Paper No. 17504.

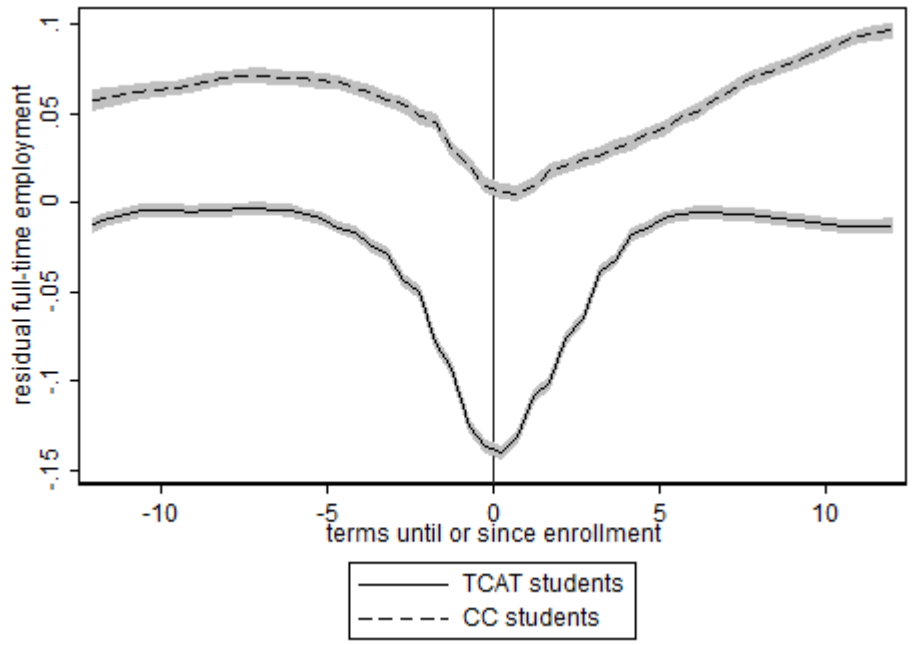
Hoops, J. (2010). "A Working Model for Student Success: The Tennessee Technology Centers. Preliminary Case Study." Complete College America. Washington, D.C. Online: http://www.completecollege.org/resources_and_reports/. Accessed July 2013.

Jepsen, C., Troske, K., & Coomes, P. (2012). The Labor-Market Returns to Community College Degrees, Diplomas, and Certificates. Forthcoming, Journal of Labor Economics.

National Conference of State Legislatures. (2013). Performance-based Funding for Higher Education. February 2013. Online: http://www.ncsl.org/issues-research/educ/performance-funding.aspx. Accessed July 2013.

Appendix B. Tables and Figures

Figure 1. Regression-adjusted likelihood of full-time employment, by time until or since TCAT or community college enrollment.



Notes: (N = 1.87 million students-terms) The figure plots mean-smoothing estimates of residuals from linear probability models estimating the likelihood of employment, controlling for age, gender, race, and term fixed effects. Employment is defined as having nominal earnings at or exceeding the full-time, minimum wage threshold.

Table 1. Equation 1 results – baseline estimates of returns to sub-baccalaureate awards in Tennessee Colleges of Applied Technology, by gender

Outcome	1(employed)			ln(wages)		
	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	Males	Females	All	Males	Females
TCAT diploma	0.052***	0.029***	0.067***	0.182***	0.065***	0.233***
	(0.002)	(0.004)	(0.003)	(0.006)	(0.012)	(0.011)
Post-TCAT diploma trend	-0.001***	1.0E-05	-0.002***	-0.008***	0.003*	-0.008***
	(2.6E-04)	(4.1E-04)	(3.3E-04)	(0.007)	(0.001)	(0.001)
TCAT certificate	0.022***	0.025***	0.021***	0.033***	0.017***	0.031***
	(0.002)	(0.002)	(0.003)	(0.004)	(0.007)	(0.008)
Post-TCAT certificate trend	-0.001***	-0.002***	-0.001	-0.003***	-0.004***	-0.004
	(0.002)	(2.5E-04)	(2.9E-04)	(4.9E-04)	(0.001)	(0.001)
Observations	1.2M	615K	586K	1.0M	534K	478K
Students	41K	21K	20K	41K	21K	20K
Overall R-squared	0.59	0.58	0.58	0.62	0.84	0.10

Notes: Robust standard errors are in parentheses below each coefficient estimate. Employment is defined as having nominal earnings at or exceeding the full-time, minimum wage threshold. Ln(wages) are the natural log of non-zero wages.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 2. Equation 1 results – baseline estimates of returns to sub-baccalaureate awards in Tennessee community colleges, by gender

Outcome	1(employed)			ln(wages)		
	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	Males	Females	All	Males	Females
CC associate's	0.067***	0.018***	0.044***	0.089***	0.042***	0.106***
	(0.002)	(0.003)	(0.002)	(0.005)	(0.007)	(0.006)
Post-CC associate's trend	0.001	0.001***	0.001***	2.3E-04	0.002**	-2.5E-04
	(2.0E-04)	(3.2E-04)	(2.5E-04)	(4.5E-04)	(7.2E-04)	(5.7E-04)
CC certificate	0.028***	0.028***	0.028***	0.037***	0.039***	0.037***
	(0.003)	(0.004)	(0.004)	(0.007)	(0.010)	(0.010)
Post-CC certificate trend	-0.001	-5.8E-04	-0.002***	-0.003	-0.001	-0.004***
	(3.1E-04)	(4.0E-04)	(4.5E-04)	(6.7E-04)	(0.001)	(0.001)
Observations	625K	208K	417K	540K	185K	356K
Students	21K	69K	14K	21K	69K	14K
Adjusted R-squared	0.42	0.50	0.05	0.49	0.47	0.05

Notes: Robust standard errors are in parentheses below each coefficient estimate. Employment is defined as having nominal earnings at or exceeding the full-time, minimum wage threshold. Ln(wages) are the natural log of non-zero wages.

* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 2. Descriptive statistics: students' modal pre-college industry (x-axis) against modal post-college industry (y-axis)

Figure 2. Matching results: Average treatment effects of Tennessee College of Applied Technology enrollment on real earnings, by term until or since enrollment

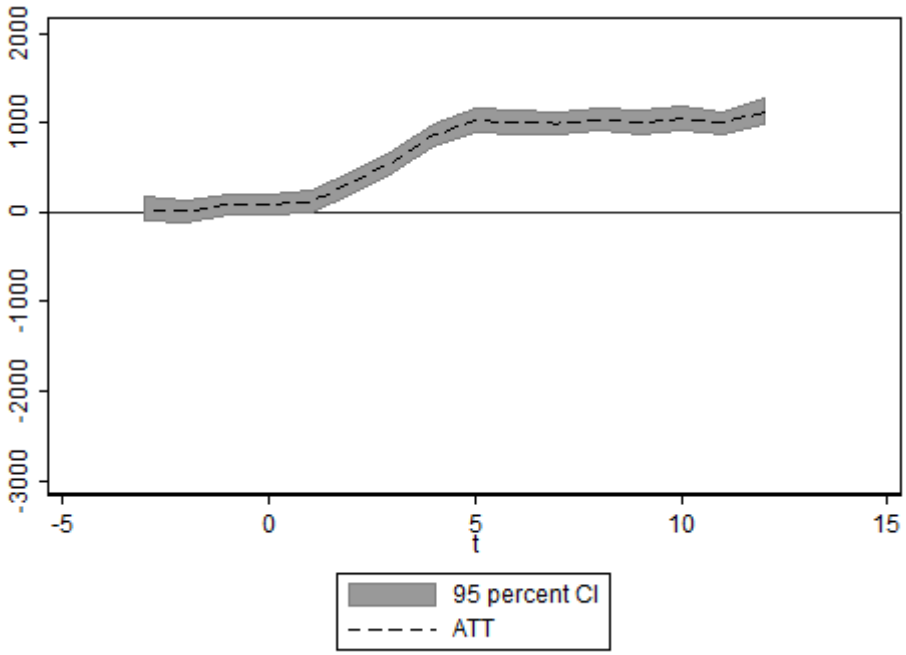


Figure 3. Matching results: Average treatment effects of community college enrollment on real earnings, by term until or since enrollment