Abstract Title Page

Title:

High School Career and Technical Education Participation and Initial College Enrollment: Evidence from Arkansas

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Abstract Body

Limit 4 pages single-spaced.

Background / Context:

Recent focus on college and career readiness has tended to emphasize college going, with less detail on how the career readiness is to be measured or achieved. For over 100 years industry and educators has understood that career and technical education in high school is one avenue through which some measure of career readiness might be achieved Lazerson & Grubb, 1974). However, almost no research has sought to understand this potential linkage between high school CTE participation and college going. Some earlier work has explored whether CTE participants in high school entered the work force and how they have fared in terms of wages (Neumark & Rothstein, 2006; Bishop & Mane, 2005), while more recent work has focused on how CTE participants in community college have fared in the workforce (Kurleander, Stevens, & Grosz, 2014; Trimble & Xu, 2014). Some extant research has established a strong linkage between dual enrollment programs and college going, but none that have focused specifically on high school CTE programs. The absence of this literature is in part a response to the assumption (and reality) that many individuals trained in the traditional trades did not need or stand to benefit professionally from postsecondary education. However, as CTE offerings in high schools have shifted over time, there are an increasing number of professions that require post-secondary education, and that are natural extensions of programs offered in high school CTE programs.

Understanding the pathways that students follow between high school CTE programs and postsecondary education will provide evidence from which policy makers can design programs and policies that enhance or expand the availability or utilization of such pathways.

Purpose / Objective / Research Question / Focus of Study:

This paper uses rich administrative data from Arkansas to understand whether and how high school CTE programs are related to initial enrollment in college after high school. This descriptive work is designed to inform how other state and local policy makers understand the potential role of high school CTE participation in building human capital pathways to contribute to an informed society and a skilled workforce that reflects labor market demands.

Specifically this paper addresses the following research questions.

1. Which high school CTE programs are associated with students enrolling in post-secondary education just after high school?

2. Are the probabilities that a student who participated in CTE in high school any different from an otherwise similar student who did not participate in CTE, or who participated to a different extent?

3. What student, program, or enrollment factors are associated with initial college going? These factors include: gender, family income, urbanicity, prior work experience, or dual enrollment.

Setting:

This study is set in Arkansas and uses data that were made available through the Arkansas Research Center, which coordinates data for K-12, higher education, career and technical education, and the department of labor. It contains student demographic, secondary enrollment and course taking, assessment, graduation, post-secondary, and labor market data. The dataset is supplemented with data from the National Center for Education Statistics, which adds information on school governance (charter or not) and location (urban, rural, suburban).

The ARC dataset is among a very few in the United States that allow for the tracking of students from the K-12 public education system into both college and/or the workforce. We were able to follow three cohorts of ninth graders who started high school in 2008, 2009, and 2010. We observe what classes they took in high school, and follow them through at least one year, and up to three years, past graduation. The dataset tells us whether they graduated from high school, then whether they enrolled in a two- or four-year college or went straight into the workforce (and what their wages are). The cohorts include over 100,000 individual students, and more than 350,000 student-year observations (See Table 1).

Population / Participants / Subjects:

Summary statistics for the students included in this analyses are presented in Table 2. The students reflect the demographics of the whole state of Arkansas as well as the southeastern United States more generally. The state has a higher share of lower-income students and more African American students than the national average, but also demonstrates higher CTE participation and lower post-secondary education rates.

Intervention / Program / Practice:

Students in Arkansas can access CTE in comprehensive high schools, career clusters, or in career academies, though over 85 percent take CTE coursework in high school at their local comprehensive high school. Arkansas follows the career cluster model adopted by the National Association for Career and Technical Education (NACTE). Programs are organized into sixteen career clusters (e.g. “Health Services”), each of which includes multiple “programs of study” (sets of courses intended to serve as a pathway to a specific career). Importantly, and quite unique to Arkansas, in 2014 the state implemented the “Smart Core” in its effort to ensure that graduating high school students are college and career ready. In order to graduate, students must complete four units each of English and math; three units each of social studies and science; half of a unit each of arts, economics, health and safety, PE and oral communication; and *six units of career-focused courses*. Though not all courses must explicitly be designated as CTE coursework, there is a recent focus on career readiness and a policy to mandate some level of preparation.

Design:

This study is observational in nature, but uses rich covariates and fixed effects for cohorts and geography to reduce potential bias in the estimates. Research question one is answered by

generating summary statistics on postsecondary enrollment among students who concentrated in CTE within each of 16 clusters (Table 3), relative to those who did not concentrate in a CTE cluster or who never took a CTE course.

For the second and third research questions the primary outcomes of interest are indicators of whether a student enrolls in a two- or four-year college immediately after high school, which are equal to one of the student enrolls in the respective school type, and zero otherwise. I also create a global indicator of whether they initially enrolled in any college.

The key predictor of interest is a measure of exposure to CTE in high school. Note that a binary indicator of whether a student ever participated in CTE is not viable in Arkansas where over 90 percent of students have taken at least one CTE course in high school. Instead, CTE participation is measured in two ways, as the total number of CTE courses taken in high school, and whether a student completes a concentration in a particular industrial cluster (concentrators take a designated set of three or more courses in a defined plan of study).

To answer the first research question I generated summary statistics on the prior performance, demographic characteristics, CTE participation measures, and educational and labor market outcomes of students. Acknowledging that summary statistics are descriptive only, and do not support the ability to make inferences about how student characteristics or CTE participation may relate to later outcomes, I then fit a series of regression models that allowed me to understand the relationship between measures of CTE participation and student outcomes while accounting for a host of observable characteristics of the students themselves. These models capitalize on a rich set of demographic and educational covariates that are available for students in Arkansas. For two of the three graduation cohorts these covariates include middle-school measures that necessarily predate student exposure to CTE in high school. This data is not available for the third cohort, but results are not sensitive to the exclusion of this cohort. Student-level control variables include gender, indicators for race/ethnicity, free-lunch status, disability and ELL status, as well as measures of standardized test performance and attendance in the 8th grade. The assumption that I make in taking this approach is that conditional on these observable factors students are similar in their probability of selecting into post-secondary education, and that all remaining differences in their outcomes should be attributable to their differences in CTE participation.

Estimates of the association between CTE participation in high school and the probability of initially enrolling in college were generated according to the following statistical model:

$$\mathrm{P(ENROLL = 1)_{icr}} = \alpha_0 + \alpha_1 \mathrm{CTE_{icr}} + \mathbf{X'_i}\boldsymbol{\gamma} + \pi_c + \tau_r + \varepsilon_{icr} \quad (1)$$

For student i in cohort c, in town of residence r, and where $\mathbf{X_i}$ is a vector of student covariates described above, and π_c, τ_r are fixed effects for graduation cohort and town of residence respectively, and ε_{icr} is a heteroscedasticity robust error term clustered at the high-school level.

To investigate the third research question I then added mediators including dual enrollment participation, prior work experience, low-income status, and urbanicity to detect whether overall

relationships between CTE and college going might be explained by these other student-level variables.

Findings / Results:

Overall I find that there are substantial differences in the college going behavior of students who are, and are not CTE concentrators, and further differences among the 16 CTE concentrations (Table 3). I also find that CTE participation in high school is associated with modestly higher probabilities of enrolling in postsecondary education in Arkansas, and that CTE concentrators are slightly less likely to enroll immediately in high school (Table 4). Importantly, dual enrollment participation in high school is an important mediator of the relationship between CTE concentrator status and enrolling in college (Table 5). Dual enrollment participants who are also CTE concentrators have a net increase in their probability of attending college right after high school while those who did not participate in dual enrollment see negative associations. Though not reported here, there is also some evidence that whether a student resides in a city, suburb, or rural area also mediates the association of CTE exposure in high school and college going. Specifically, being a CTE concentrator is more associated with college going outside of rural areas.

Conclusions:

Students who participate in more CTE in high school or who are CTE concentrators are not, on average, substantially different in their probability of attending college just after high school relative to their peers who are not CTE concentrators or who take fewer CTE courses in high school. There is clear evidence, however, that among CTE concentrators programs like health services have a much higher rate of enrolling in college. For the cohorts examined in this paper it is possible that the differences could be attributable to low labor market expectations based on the Great Recession or may reflect clear career ladders or articulation agreements that allow students to pursue meaningful certifications or degree programs just after high school. This paper constitutes a first effort towards understanding these potential linkages.

The state of Arkansas has made a concerted policy push to use career readiness a component of the K-12 course requirements through the Smart Core. While that policy change is not the explicit focus on this study, the existence of this policy focus in a state that otherwise has below-average educational outcomes makes it a compelling case study. In particular, the findings from this novel descriptive study looking at college pathways for high school CTE participants may present some clear opportunities for experimental interventions that could influence college going related to labor market demand or that might reduce information asymmetries.

Appendices

Not included in page count.

Appendix A. References

Bishop, J. H., & Mane, F. (2005). Raising academic standards and vocational concentrators: Are they better off or worse off? Education Economics, 13, 171–187.

Kurlaender, M., Huff-Stevens, A., & Gros, M. (2014). Career technical education and labor market outcomes: Evidence from California community colleges. Conference paper. Building Human Capital and Economic Potential. Madison, Wisconsin. July 2014.

Lazerson, M., & Grubb, W. N. (1974). American Education and Vocationalism: A Documentary History, 1870-1970.

Neumark, D., & Rothstein, D. (2006). School-to-career programs and transitions to employment and higher education. Economics of Education Review, 25, 374–393.

Trimble, M., & Xu, D. (2013) Estimating the Returns to Short-Term and Long-Term Certificates. APPAM Conference Paper.

Appendix B. Tables and Figures

Not included in page count.

Table 1. Student Data

	Cohort 1	Cohort 2	Cohort 3
Three years after high school	2014	2015	2016
Two years after high school	2013	2014	2015
One year after high school	2012	2013	2014
12th Grade	2011	2012	2013
11th Grade	2010	2011	2012
10th Grade	2009	2010	2011
9th Grade	2008	2009	2010
Number of students	36,090	35,985	32,358

Note: “2008” indicates the 2008-09 school year. Data are not yet available for the gray cells.

Table 2. Sample Characteristics

	(1) All Students	(2) Free-lunch Eligible	(3) Ever CTE	(4) CTE Concentrator
(A) Controls				
Male	0.515	0.515	0.511	0.497
Asian	0.673	0.569	0.675	0.704
Black	0.223	0.299	0.224	0.213
Latino	0.077	0.104	0.075	0.062
White	0.014	0.013	0.013	0.009
Low Income	0.683	1	0.683	0.675
Special Education	0.119	0.146	0.116	0.123
English Learner	0.041	0.057	0.039	0.03
Standardized Math Score, 8th	0.016	-0.111	0.015	0.015
Standardized ELA Score, 8th	0.016	-0.098	0.018	0.022
Total Days Absent, Grade 9	9.962	11.488	9.734	7.496
(B) CTE Exposure				
Ever Took a CTE Course	0.889	0.89	1	1
Years in CTE Course	2.343	2.354	2.633	3.417
CTE Courses Taken	4.933	5.034	5.544	8.458
CTE Program Concentrator	0.297	0.294	0.334	1
CTE Program Completer	0.264	0.253	0.296	0.731
(C) Outcomes				
Graduated High School, 4 years	0.632	0.578	0.689	0.925
Graduated High School, Ever	0.65	0.599	0.708	0.937
Initially Enroll, Any College	0.216	0.161	0.23	0.272
Initially Enroll, 2-year College	0.149	0.117	0.16	0.2
Initially Enroll, 4-year College	0.073	0.047	0.077	0.081
Initially Employed	0.565	0.552	0.596	0.639
Average Quarterly Earnings	858.65	862.87	905.21	1015.9
Initial Quarters Worked	1.5	1.45	1.59	1.73
Grade 11 ELA Zscore	0	-0.25	-0.01	-0.1
Missing ELA Score	0.33	0.38	0.27	0.12
Employed, Grade 11	0.33	0.31	0.36	0.39
Grade 11, Quarterly Wage	394.14	385.08	431.15	462.14
N	104,433	71,387	61,816	31,113

Notes: Mean values of key variables are shown for all students in the 9th grade cohorts who entered in the fall semesters of 2007 through 2009.

Table 3. Characteristics of CTE Concentrators and Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Agr., Food & Nat. Res.	Archit. & Constr,.	Arts, AV Tech. &Commun.	Business & Mgmt.	Educ. & Training	Finance	Gov't & Pub. Admin.	Health Services
Male	0.791	0.9	0.485	0.395	0.081	0.435	0.573	0.203
White	0.878	0.654	0.664	0.585	0.752	0.664	0.541	0.649
Black	0.073	0.221	0.216	0.347	0.092	0.24	0.388	0.21
Latino	0.029	0.096	0.081	0.045	0.117	0.07	0.031	0.093
Low Income	0.621	0.597	0.505	0.64	0.598	0.578	0.786	0.579
Special Ed.	0.009	0.021	0.02	0.004	0.005	0.006	0.024	0.005
ELL	0.012	0.041	0.034	0.012	0.058	0.015	0.008	0.028
CTE Years	3.917	3.948	3.748	3.774	3.929	3.87	3.912	3.94
Total CTE Courses	9.597	7.954	6.205	7.85	8.129	8.465	7.577	8.614
Dual Enrolled	0.083	0.083	0.144	0.135	0.213	0.187	0.066	0.268
Graduated HS	0.964	0.937	0.956	0.976	0.969	0.972	0.952	0.971
Enroll Two-year	0.133	0.093	0.195	0.159	0.168	0.182	0.101	0.26
Enroll Four-year	0.043	0.048	0.075	0.081	0.148	0.094	0.039	0.122
Initial Quart. Wage	919.114	871.339	627.291	676.564	847.696	739.078	712.523	721.23
Grade 11 ELA Z-score	-0.249	-0.248	0.23	0.15	0.125	0.284	-0.239	0.28
N	7608	1145	1015	895	356	719	1375	3184

	Hospital. & Tourism	Human Svcs.	Info. Tech.	Law,Safety & Secur.	Manufact.	Marketing Sales,&Svcs.	STEM	Transport. & Logistics
Male	0.296	0.162	0.47	0.552	0.948	0.399	0.837	0.938
White	0.551	0.619	0.732	0.641	0.758	0.602	0.732	0.718
Black	0.351	0.303	0.174	0.254	0.15	0.266	0.101	0.157
Latino	0.081	0.052	0.056	0.085	0.07	0.108	0.119	0.102
Low Income	0.713	0.751	0.59	0.654	0.651	0.587	0.462	0.695
Special Ed.	0.016	0.02	0.005	0.015	0.032	0.008	0.003	0.039
ELL	0.019	0.021	0.018	0.013	0.035	0.063	0.033	0.047
CTE Years	3.872	3.904	3.91	3.889	3.834	3.772	3.89	3.895
Total CTE Courses	8.73	9.011	8.663	7.647	7.53	7.062	6.938	7.845
Dual Enrolled	0.115	0.105	0.151	0.314	0.379	0.093	0.216	0.321
Graduated HS	0.961	0.95	0.963	0.952	0.941	0.933	0.978	0.918
Enroll Two-year	0.146	0.138	0.167	0.254	0.286	0.087	0.16	0.238
Enroll Four-year	0.057	0.05	0.103	0.077	0.097	0.064	0.142	0.053
Initial Quart. Wage	760.333	703.457	640.748	930.163	1095.015	945.499	790.38	1028.53
Grade 11 ELA Z-score	-0.216	-0.226	0.219	-0.134	-0.526	0.106	0.333	-0.544
N	415	7938	7459	527	978	948	504	982

Notes: Mean values of key variables are shown for all students in the 9th grade cohorts who entered in the fall semesters of 2007 through 2009.

Table 4: Heterogeneity of the Effect of Participating in Career and Technical Education in Arkansas by Dual Enrollment Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7))
	High School Graduation		Post Secondary Enrollment			Employment	
	Graduated 4 years	Graduated Ever	Enrolled Any	Enrolled 2 Year	Enrolled 4 Year	Employed	Initial Wage
Ever CTE Courses	0.358***	0.367***	0.070***	0.056***	0.015***	0.150***	219.643***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.006)	(13.097)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259
Years in CTE Courses	0.092***	0.093***	0.013***	0.012***	0.000	0.035***	63.534***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(2.850)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259
Total Courses	0.051***	0.051***	0.007***	0.007***	-0.000	0.016***	32.243***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(1.545)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259
CTE Concentrator	0.090***	0.087***	-0.008***	-0.005**	-0.003**	0.017***	83.567***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(8.218)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259

Notes: Heteroskedasticity robust standard errors clustered by school are in parentheses (* p<.10 ** p<.05 *** p<.01). Estimates are of the effects of being a CTE concentrator wher the comparison group are students who have never taken a CTE designated course The coefficients shown were generated using OLS, and specifications include fixed effects for graduation cohort and high school. All estimates also control for student characteristics including race, gender, income, disability, and language-learner status.

Table 5: Heterogeneity of the Effect of Participating in Career and Technical Education in Arkansas by Dual Enrollment Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7))
	High School Graduation		Post Secondary Enrollment			Employment	
	Graduated 4 years	Graduated Ever	Enrolled Any	Enrolled 2 Year	Enrolled 4 Year	Employed	Initial Wage
Ever CTE Courses - Non DE	0.363***	0.371***	0.069***	0.056***	0.015***	0.151***	218.782***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.006)	(13.174)
Ever CTE Courses - DE	0.10	0.11	0.09	0.08	-0.01	0.11	262.19
	(0.014)	(0.014)	(0.021)	(0.020)	(0.018)	(0.022)	(37.912)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259
Years in CTE Courses- Non DE	0.093***	0.094***	0.012***	0.012***	0.001	0.035***	62.983***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(2.869)
Years in CTE Courses - DE	0.04	0.05	0.02	0.03	-0.01	0.03	81.85
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(9.166)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259
Total Courses - Non DE	0.051***	0.052***	0.006***	0.007***	-0.000	0.016***	32.205***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(1.556)
Total Courses - DE	0.03	0.03	0.01	0.01	-0.01	0.01	33.30
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(4.152)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259
CTE Concentrator - Non DE	0.095***	0.091***	-0.047***	-0.034***	-0.014***	0.016***	84.944***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(8.800)
CTE Concentrator - DE	0.02	0.01	0.07	0.07	-0.01	0.01	51.75
	(0.007)	(0.007)	(0.010)	(0.009)	(0.008)	(0.010)	(26.558)
N	330,259	330,259	330,259	330,259	330,259	330,259	330,259

Notes: Heteroskedasticity robust standard errors clustered by school are in parentheses (* p<.10 ** p<.05 *** p<.01). Estimates are of the effects of being a CTE concentrator wher the comparison group are students who have never taken a CTE designated course The coefficients shown were generated using OLS, and specifications include fixed effects for graduation cohort and high school. All estimates also control for student characteristics including race, gender, income, disability, and language-learner status.