Time and Place

AN EXAMINATION OF CAREER AND TECHNICAL EDUCATION COURSE TAKING AND LABOR MARKETS ACROSS TWO HIGH SCHOOL COHORTS

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Executive Summary

Ever since the passage of the Carl D. Perkins Career and Technical Education Act of 2006, the lines historically used to separate "vocational" and "academic" students have blurred. This shift away from vocational education toward career and technical education (CTE) has come with many promising educational outcomes. CTE course taking has been associated with increased graduation rates and decreased dropout rates. High school participation in CTE courses has also been linked to numerous labor market outcomes in the short term, such as increased rates of employment and higher average wages. However, the long-term economic returns to CTE and the degree to which CTE course taking correlate with local labor market demands have been less clear.

This report seeks to address the important though unexplored relationship between the CTE courses students complete in high school and their surrounding labor market characteristics. Using national data from the National Center for Education Statistics and the Bureau of Labor Statistics, I investigate the extent to which high school CTE course taking aligns with employment rates in CTE jobs, how the relationship between CTE course taking and labor markets has evolved over time, and whether students who aspire to a bachelor's degree enroll in CTE courses in response to employment rates more than students who do not aspire to a bachelor's degree.

Findings from the data analysis indicate that modern CTE coursework is associated with rates of employment in students' local areas, that this relationship has potentially strengthened over time, and that baccalaureate aspirations do not necessarily affect the number of CTE credits students take in high school. In light of these data, policymakers should note that CTE appears to be less of a tracking mechanism today than vocational education has been in the past and that the process of aligning CTE course taking with labor markets requires updated, local labor market data that include both current and projected figures.

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Educational attainment matters. Students who drop out of high school have poorer social, civic, health, and economic outcomes.[1] By contrast, students who complete high school with a traditional four-year diploma enjoy lower rates of unemployment and higher average earnings.[2] Despite historically high tuition rates—and debt—college graduates continue to earn more over a lifetime than their counterparts with just a high school diploma.[3]

And yet, while degree completion determines future success, the paths students choose toward completion also matter.[4] For example, lifetime earnings vary by college major.[5] In high school, mathematics and science coursework predicts higher earnings, as does pursuing a STEM-related major in college.[6] Indeed, high school course taking matters a great deal.[7] This fact is perhaps most true for vocationally oriented students looking to enter the labor market immediately after high school, since high school coursework will largely shape their skill sets and readiness for the workforce.

But the lines historically used to separate "vocational" and "academic" students have blurred with the passage of the Carl D. Perkins Career and Technical Education Act of 2006 and the arrival of the college and career readiness (CCR) era. According to the US Department of Education, a CCR approach holds that "every student should graduate from high school ready for college or a career. Every student should have meaningful opportunities to choose from upon graduation from high school."[8] In the post-Perkins context, coursework once designed for so-called "vocational education" students has been redesigned and rebranded as career and technical education (CTE) and is now largely seen as an important, if not essential, tool in ensuring students are prepared for college and career.[9]

The shift away from vocational education to contemporary CTE comes with promising educational outcomes. For instance, CTE coursework has been associated with boosted rates of graduation and decreased rates of dropout.[10] High school CTE participation has been linked to numerous positive labor market outcomes in the short term, including increased rates of employment and higher average wages.[11]

The long-term economic returns to CTE are less clear.[12] What also remains unclear is the degree to which CTE course taking in high school correlates with nearby labor market demands. More specifically, even though the latest iteration of Perkins (2018) aims to "align workforce skills with labor market needs," research has yet to investigate whether students actually complete high school CTE coursework that systematically correlates with the labor market needs in their proximal geographical areas.[13] Previous research has also not examined the degree to which these relationships have changed over time as national CTE policy goals (e.g., Perkins) have shifted and perceptions of CTE have evolved.

Background

CTE today looks different from what it was in years past. First, what is now branded as CTE was originally focused around training students for agricultural and mechanical occupations that were in high demand but did not require a postsecondary degree, particularly in the postwar period. And though it was not explicitly prescribed, vocational education in years past was oriented toward less academically adept students. Vocational education was also, unfortunately, often a tracking mechanism used to sort low-income students and students of color into stagnate, low-wage occupations.

There is less evidence of this tracking today, at least according to the historical usage of the term.[14] According to the US Department of Education, students enroll in fewer CTE courses overall in high school than in previous years, though course taking in some CTE fields has increased.[15] Fewer students concentrate (i.e., complete two or more courses) in a given CTE field as well.[16] However, a larger and more diverse pool of students enroll in CTE courses in high school today than in prior years. In fact, roughly 85 to 90 percent of all students in the nation earn CTE credits in high school.[17]

That said, there is still evidence to suggest that CTE is more or less attractive to various student subgroups. For example, male and economically disadvantaged students appear to be slightly overrepresented in CTE coursework.[18] Students with disabilities are more likely to be CTE concentrators relative to their peers without disabilities.[19] Higher-performing students are also less likely to concentrate in a CTE field.[20] And rates of participation in each CTE cluster vary considerably along gender lines.[21]

Contemporary CTE is also characterized by a greater plurality of academic subjects and disciplines. While the earliest iterations of vocational education across the country were shaped around filling jobs in agriculture, vocational education broadened over time to focus on technology in the 1960s and 1970s. Today, 16 nationally recognized CTE career clusters are designed to help students transition from school to college and career by providing clear occupational pathways.[22] According to a 2014 primer from the Congressional Research Service, 94 percent of states and territories in the nation had adopted the Career Clusters Framework (CCF) by 2012.[23] Table 1 lists the 16 CTE career clusters, a shorthand reference, and the three most popular courses in each cluster, according to recent transcript data.[24]

The Importance of CTE Today

Evidence suggests that the US labor market has a skills gap characterized by a demand for middle-skills workers (i.e., those with some amount of postsecondary education or training but not necessarily a four-year degree) that outpaces supply. Although the degree to which the skills gap exists and threatens the US economy is debated, less contentious is the idea that clear and established "pathways" from high school to college and career help students.[25] Also less contentious is the notion that students should have an array of options in high school, some of which may not lead toward a bachelor's degree. CTE advocates are quick to argue that high school CTE is an important tool to combat the skills gap. They also point out that the emphasis on programs of study (POS)—intra-cluster CTE course sequences that Perkins IV called states to design—also puts contemporary CTE in a unique position to make the transition from school to career less opaque and less baccalaureate dominant.

The positive educational and labor market outcomes associated with CTE participation, combined with CTE's promise to increase the availability of skilled and talented workers, have generated broad bipartisan support for expanding CTE in the country. For this reason, the increased research activity focused on CTE in recent years is good for policymakers and school leaders looking to build and implement effective CTE programs in the nation. Yet, policymakers and school leaders are still largely in the dark regarding a fundamental target of the past two Perkins authorizations—namely, that there be an "effective alignment between high-quality CTE programs and labor market needs to equip students with

Table 1. CTE Career Clusters

Career Cluster Name	Shorthand Reference	Most Popular Courses
Architecture and Construction	Architecture	Woodworking, Drafting, and Construction
Agriculture, Food, and Natural Resources	Agriculture	Horticultural Science, Comprehensive Agriculture, and Introduction to Agriculture and Natural Resources
Arts, Audio/Video Technology, and Communication	Communications	Journalism, Publication Production, and Audio/Visual Production
Business Management and Administration	Business	Business Computer Applications, Accounting, and Introductory Business
Education and Training	Education	Early Childhood Education, Teaching Profession, and Education Workplace Experience
Finance	Finance	Accounting, Finance, and Business Economics
Government and Public Administration	Government	Public, Protective, and Government Service; Public Administration; and Public, Protective, and Government Service Workplace Experience
Health Science	Health Science	Health Care Occupations, Health Science, and Sports Medicine
Hospitality and Tourism	Hospitality	Food Service, Culinary Arts, and Nutrition and Food Preparation
Human Services	Human Services	Child Development, Cosmetology, and Childcare
Information Technology	IT	Computer Applications, Business Computer Applications, and Web Design
Law, Public Safety, Corrections, and Security	Law and Security	Forensic Science, Criminal Justice, and Business Law
Manufacturing	Manufacturing	Welding, Wood Processing, and Metalworking
Marketing	Marketing	Comprehensive Marketing, Sports and Entertainment Marketing, and Principles of Marketing
Science, Technology, Engineering, and Mathematics	STEM	Engineering Science, Principles of Engineering, and CAD Design and Software
Transportation, Distribution, and Logistics	Transportation	Automotive Mechanics, Automotive Service, and Automotive Body Repair and Refinishing

Source: Course information based on author's calculations of data from High School Longitudinal Study of 2009. Career cluster names are from Cassandria Dortch, "Career and Technical Education (CTE): A Primer," Congressional Research Service, February 10, 2014, https://fas.org/sgp/crs/misc/R42748.pdf.

21st-century skills and prepare them for in-demand occupations in high-growth industry sectors."[26]

In fact, the most recent Perkins reauthorization, signed by President Donald Trump in June 2018, includes a competitive grant program to "improve and modernize career and technical education and align workforce skills with labor market needs."[27] However, previous research has not examined the degree to which CTE course taking in high school correlates with students' surrounding labor markets, either before or after the 2006 Perkins authorization that targeted alignment as a goal. It is also unclear whether student CTE course taking in response to labor market demand changed over this time based on whether a student was seeking a bachelor's degree. This is an important question to ask, considering CTE's putative shift away from traditional "vocational education" toward increased "rigor and relevance."[28] In light of these gaps in our understanding of modern CTE, the current study sought to investigate the following research questions.

1. How is high school CTE course taking associated with rates of employment in each CTE career cluster?

2. How has the relationship between CTE course taking and labor markets changed after the 2006 Perkins reauthorization?

3. Do students with baccalaureate aspirations enroll in CTE coursework in response to employment rates differently from students who do not have baccalaureate aspirations?

There are at least two reasons why we would expect to find high school CTE course taking correlated with labor market demand (i.e., employment) in a student's geographic or economic area. The first is theoretical; the second is practical. First, theory posits that high school CTE course taking would be a function of students' perceptions of the benefits and costs associated with CTE participation. More specifically, human capital theory would suggest that students, aware of their surrounding labor markets, will pursue in-demand and remunerative educational and career pipelines over others.[29] In seeking out these pipelines, students will choose the educational pathways that equip them with requisite human capital. For example, students living in areas with high demands for skilled architecture and construction workers will engage related (CTE) coursework in school because, at least according to theory, the perceived benefits of doing so (i.e., the accrual of in-demand skills) will outweigh the costs.

Theory aside, there are also practical reasons for expecting CTE course taking in an area to align with labor market indicators and for this alignment to have strengthened over time. As was mentioned, Perkins IV (2006) required all eligible agencies to develop and offer at least one CTE POS in a given CTE cluster area. The guidelines and best practices for developing high-quality POS include the use of labor market data to determine unmet needs in the provider's area.[30] The POS provision of Perkins IV also encouraged providers to develop collaborative partnerships with local industries to develop credential or certificate awards. While these partnerships and POS-like approaches to developing CTE programs and curriculum existed well before Perkins IV, it seems reasonable to assume that the passage of Perkins IV should have further promoted and engrained these and other market-aligned approaches to CTE planning and development.

The unfortunate and frustrating reality, however, is that little empirical research has explored the degree to which students' CTE course taking in high school actually is aligned with labor market demands in their areas. As a consequence, policymakers and school leaders have been left to operate largely on the basis of theory and practical assumptions. Hence the need for the current study.

Data and Method

High school CTE course-taking data used in this report came from two National Center for Education Statistics (NCES) longitudinal studies: the Educational Longitudinal Study (ELS) of 2002 and the High School Longitudinal Study (HSLS) of 2009. Both NCES studies tracked two nationally representative cohorts of students through high school. For the ELS, students were followed from 2001 (ninth grade) through 2004 (12th grade). For the HSLS, students were followed from 2009 (ninth grade) through 2012 (12th grade). In addition to important demographic, behavioral, and academic information, complete transcript data were available for both ELS and HSLS cohorts. Consequently, it was possible to know how many academic and CTE credits students earned in high school.

CTE course taking was organized according to the CTE CCF to facilitate analysis.[31] Data from the two NCES transcript studies were then merged with publicly available Bureau of Labor Statistics (BLS) Occupational Employment Statistics (OES) data. These data provide information on employment in occupations using the Standard Occupational Classification (SOC) system at various levels of geographical aggregation (e.g., national, statistical area, and state).

The SOC system's greatest strength is the clarity it provides. For example, the SOC system classifies all US workers into "one of 867 detailed occupations according to their occupational definition. To facilitate classification, detailed occupations are combined to form 459 broad occupations, 98 minor groups, and 23 major groups."[32] One challenge with the SOC system, however, is that it does not readily map onto or translate into the CTE CCF. This means that while the SOC system provides employment statistics in an occupation (e.g., animal breeders), it does not provide employment statistics in the 16 CTE career clusters (e.g., "Agriculture, Food, and Natural Resources").

Fortunately, the current study employs a crosswalk advanced by the National Research Center for Career and Technical Education (NRCCTE) to overcome this challenge. Using the NRCCTE crosswalk, it could merge state-level BLS employment statistics by CTE career cluster into the ELS and HSLS data files, leading to two rich analytic data sets composed of students' demographic and course-taking data combined with their state labor market statistics.[33]

The analysis began by examining the descriptive trends in BLS OES employment data and CTE course taking across the two study time frames. The study then sought to test for statistical associations between CTE course taking and employment using a series of conditional linear regression models.

Results

The first place to begin this analysis was to ask the following questions: What is the frequency of employment in each of the 16 CTE career clusters, and to what degree do these observed employment rates change across region and time? We can look to Table 2 for clues. The first row of BLS OES employment data in Table 2 lists the total number of jobs across all occupations, disaggregated by US Census region. (Data in Table 2 are displayed by region to illustrate the variation in employment across geographic areas; however, in the multivariate analyses later in the report, occupational data are aggregated to the state level.)[34] The following rows show the percentage of total jobs that could be classified under each of the 16 CTE career clusters.

To the first question of what employment looks like in each of the 16 CTE career clusters, data in the second column in the top panel of Table 2 (the ELS study time frame) show that between 2000 and 2003, the greatest fraction of jobs in the nation fell in the "Business Management and Administration" (Business), "Hospitality and Tourism" (Hospitality), "Marketing," and "Manufacturing" clusters. By contrast, the clusters with the lowest rates of employment during this time frame were "Arts, Audio/Video Technology, and Communication" (Communications); STEM; "Agriculture, Food, and Natural Resources" (Agriculture); and "Government and Public Administration" (Government). Interestingly, and regarding to what degree cluster employment varies across regions, this pattern was relatively stable across US census regions. (See Figure 1.) In short, Business, Hospitality, Marketing, and Manufacturing accounted for the greatest shares of employment, and Communications, STEM, Agriculture, and Government accounted for the least, regardless of region.

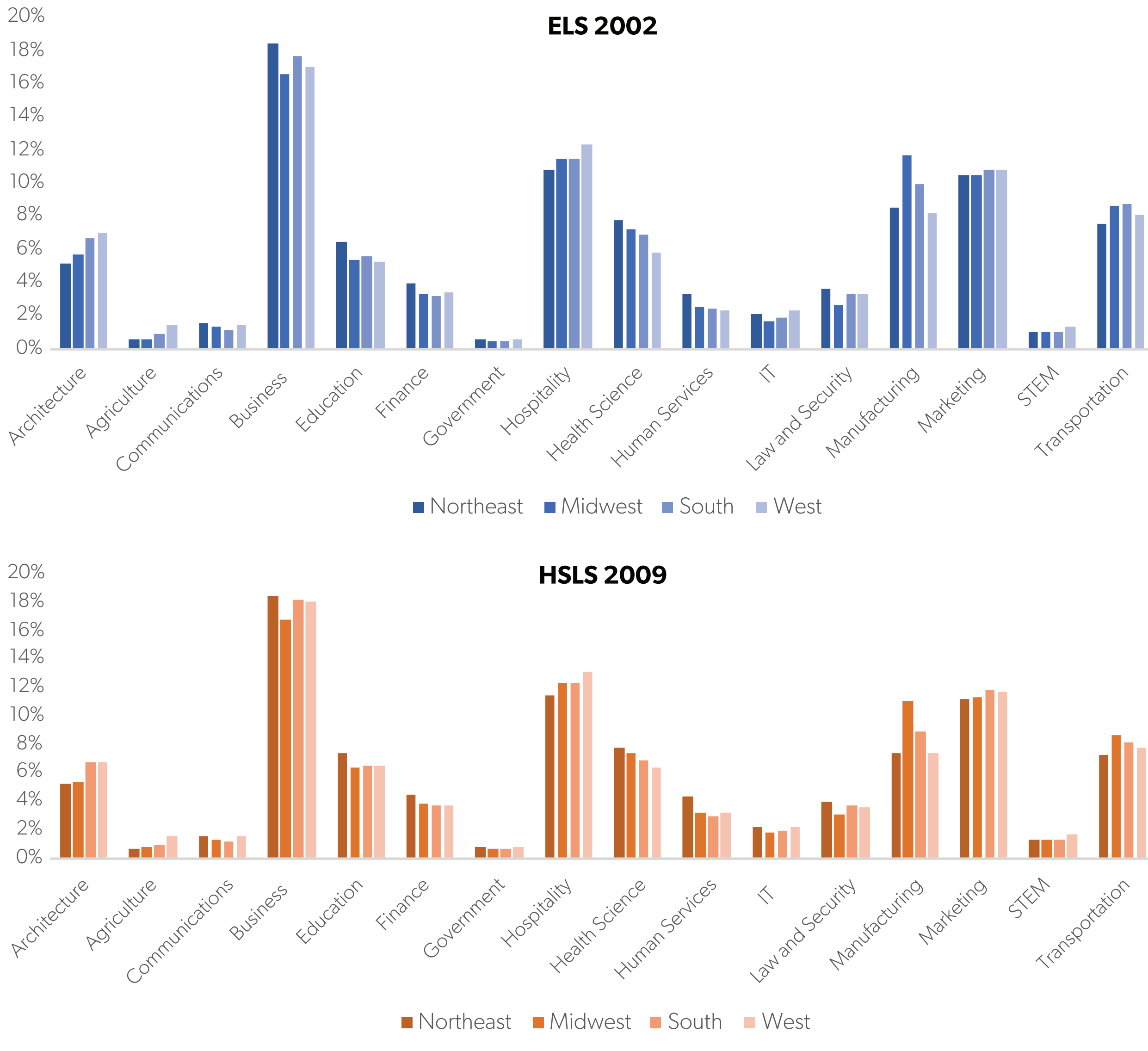
There was some interesting nuance to the story, however. For example, Figure 1, and to a greater extent Figure 2, shows that while the rates of employment in

Table 2. CTE Career Cluster Area Employment Figures

2000–03	National	Northeast	Midwest	South	West
All (1,000s)	128,202	24,612	30,825	44,873	27,890
Agriculture	6.3%	5.1%	5.7%	6.7%	7.0%
Architecture	0.9%	0.6%	0.6%	0.9%	1.4%
Communications	1.4%	1.6%	1.3%	1.1%	1.4%
Business	17.5%	18.4%	16.6%	17.7%	17.1%
Education	5.8%	6.5%	5.4%	5.6%	5.3%
Finance	3.5%	3.9%	3.3%	3.3%	3.4%
Government	0.6%	0.6%	0.5%	0.5%	0.6%
Hospitality	11.7%	10.8%	11.5%	11.5%	12.4%
Health Science	7.0%	7.8%	7.2%	6.9%	5.8%
Human Services	2.6%	3.3%	2.5%	2.4%	2.3%
IT	2.0%	2.2%	1.7%	1.9%	2.3%
Law and Security	3.3%	3.6%	2.6%	3.3%	3.3%
Manufacturing	9.9%	8.5%	11.7%	9.9%	8.2%
Marketing	10.7%	10.5%	10.5%	10.9%	10.8%
STEM	1.1%	1.0%	1.0%	1.0%	1.3%
Transportation	8.6%	7.6%	8.7%	8.7%	8.1%
2008–11	**National**	**Northeast**	**Midwest**	**South**	**West**
All (1,000s)	130,302	24,658	29,874	46,881	28,886
Agriculture	6.2%	5.3%	5.4%	6.7%	6.7%
Architecture	1.0%	0.7%	0.8%	0.9%	1.6%
Communications	1.4%	1.6%	1.4%	1.2%	1.6%
Business	18.0%	18.4%	16.9%	18.1%	18.1%
Education	6.8%	7.5%	6.4%	6.5%	6.5%
Finance	3.9%	4.5%	3.8%	3.7%	3.8%
Government	0.8%	0.8%	0.7%	0.7%	0.8%
Hospitality	12.5%	11.5%	12.4%	12.3%	13.2%
Health Science	7.2%	7.8%	7.5%	6.9%	6.4%
Human Services	3.4%	4.4%	3.3%	3.0%	3.2%
IT	2.0%	2.2%	1.8%	1.9%	2.3%
Law and Security	3.7%	4.0%	3.1%	3.8%	3.6%
Manufacturing	8.9%	7.4%	11.1%	9.0%	7.4%
Marketing	11.6%	11.2%	11.4%	11.9%	11.7%
STEM	1.5%	1.3%	1.3%	1.4%	1.7%
Transportation	8.2%	7.3%	8.7%	8.2%	7.8%

Source: Bureau of Labor Statistics, "Occupational Employment Statistics," https://www.bls.gov/oes/home.htm.

Figure 1. CTE Employment by Cluster and US Census Region, 2000–03 and 2008–11

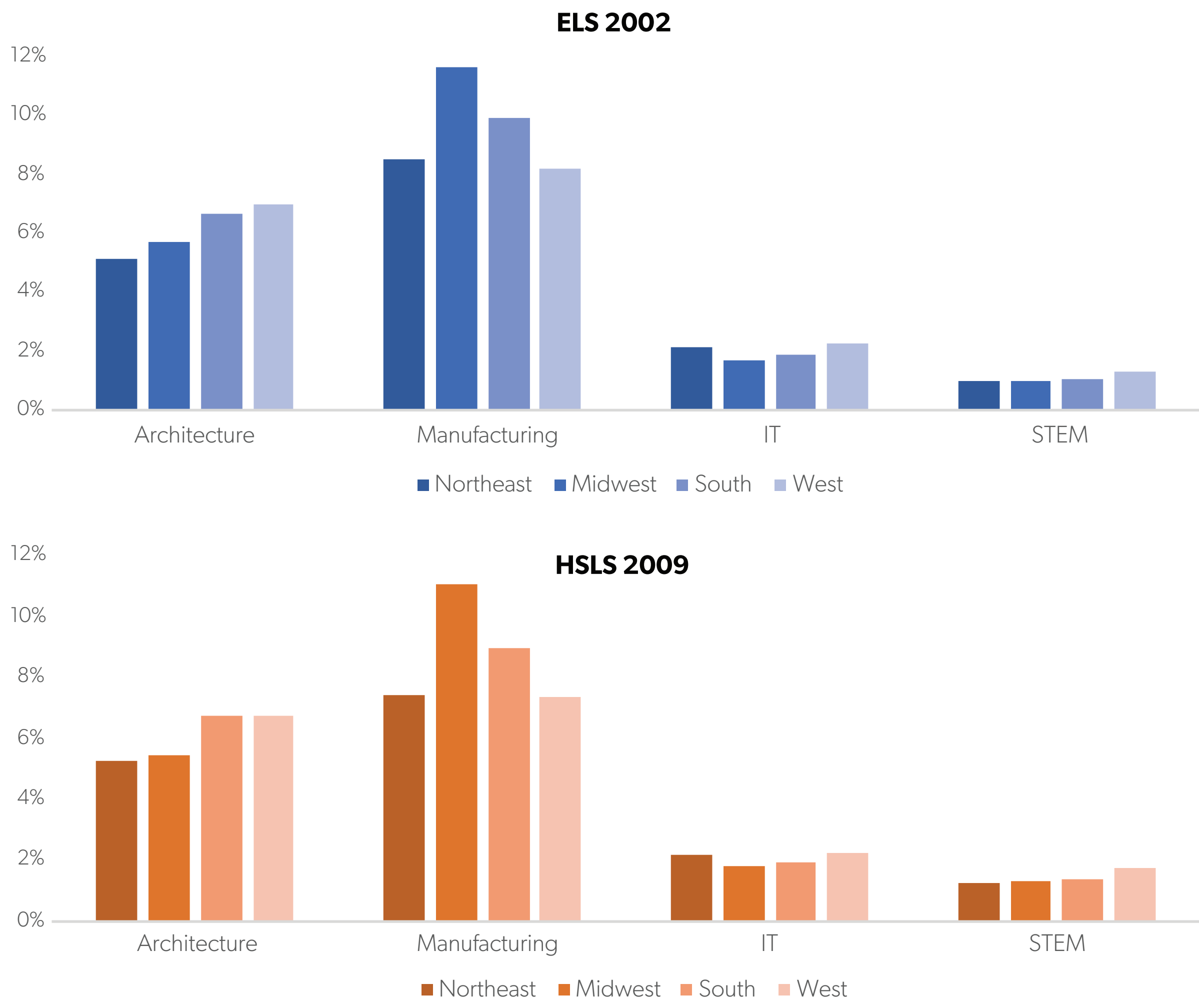


Source: Author's calculations. Data from Bureau of Labor Statistics, "Occupational Employment Statistics," https://www.bls.gov/oes/home.htm.

some cluster areas such as Communications, STEM, and "Information Technology" (IT) were relatively stable across census regions, employment rates in other cluster areas such as Architecture and Manufacturing varied more widely. For instance, the share of Manufacturing employment in the Midwest was substantially higher than it was in the Northeast and West. Employment in Architecture was substantially higher in the West than in the Northeast. On the one hand, this observed interregional variation is unsurprising and is what we would expect given prior research, but it supports the importance of using local labor market data to determine how and which CTE programs to offer.[35]

Looking at the bottom panel in Table 1 (the HSLS study time frame), we see that between 2008 and 2011, Business, Hospitality, Marketing, and Manufacturing accounted for the highest rates of employment

Figure 2. Variation in CTE Employment by Cluster and US Census Region, 2000–03 and 2008–11

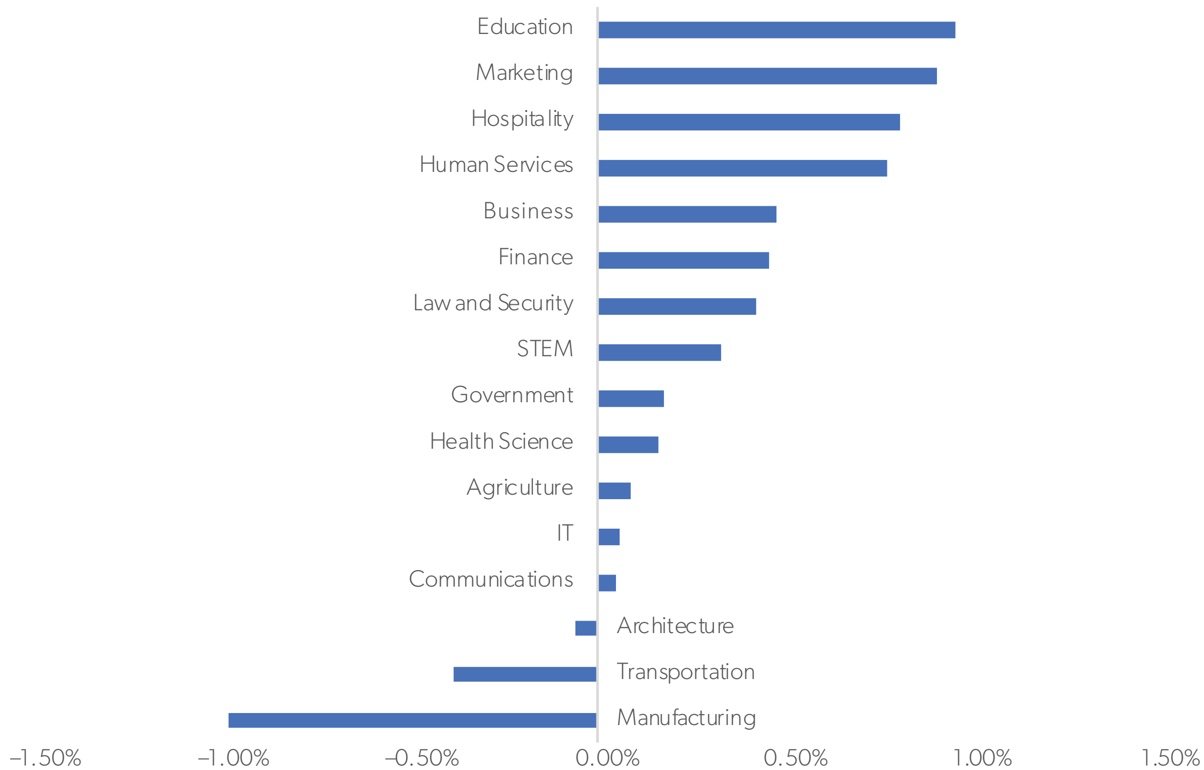


Source: Author's calculations. Data from Bureau of Labor Statistics, "Occupational Employment Statistics," https://www.bls.gov/oes/home.htm.

in the nation. STEM, Communications, Agriculture, and Government accounted for the lowest, respectively. Figure 1 illustrates this was the same pattern observed during the ELS time frame. Another similarity with the ELS time frame was that variation in employment was somewhat cluster dependent, with Manufacturing and Architecture having more interregional variation than STEM. (See Figure 2.) Again, this finding confirms prior knowledge but highlights the importance of using local labor market information to determine programmatic need.

As to the question of how employment rates changed over time across the two NCES studies, Figure 3 shows that of the 16 CTE career clusters, 13 experienced employment growth or remained relatively stable, while three experienced declines. The fraction of people working in the "Education and Training" (Education), Marketing, Hospitality, and "Human Services" clusters increased the greatest, while the fraction of people working in jobs related to Architecture; "Transportation, Distribution, and Logistics" (Transportation); and Manufacturing declined.

Figure 3. Percentage Point Change in CTE Employment Across ELS and HSLS Time Frames



Source: Author's calculations. Data from Bureau of Labor Statistics, "Occupational Employment Statistics," https://www.bls.gov/oes/home.htm.

Interestingly, though perhaps unsurprisingly, data in Table 2 show these fluctuations also varied by region. Indeed, as Figure 4 illustrates, while all regions experienced decreased rates of employment in Manufacturing, the reduction was particularly pronounced in the Northeast region. And while the Midwest and western regions saw declines in the share of people working in Architecture, there was a slight increase in the share of people working in that field in the Northeast and South.

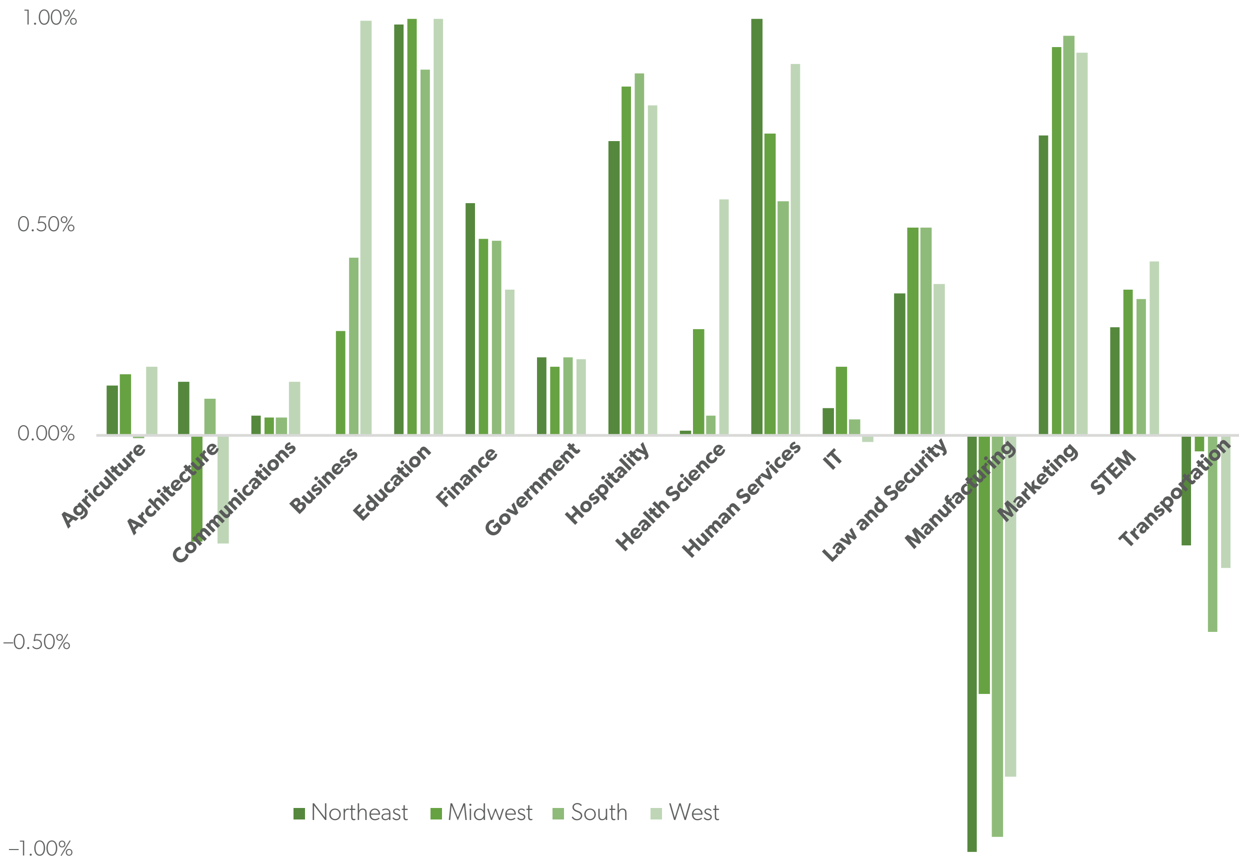
CTE Course Taking. A second but equally important question to ask was: How does high school course taking look in each of the 16 CTE career cluster areas, and, relatedly, to what degree has CTE course taking changed across region and time?

Table 3 contains the CTE course taking data for the two NCES transcript studies. The top panel of Table 3 contains the CTE course taking data for students in the ELS study; the bottom panel contains the course taking data for students in the HSLS study. The first row in both panels contains the overall average number of CTE credits students earned in high school, disaggregated by region. The remaining rows display CTE credits by the CTE cluster areas.

Looking at the top panel of Table 3, we see that students in the ELS study earned just over three CTE credits in high school, on average. Disaggregating by CTE career cluster shows that students in the ELS study earned the highest share of credits in IT, Business, and Communications. Students earned the fewest shares in STEM, Education, and Government.

Unsurprisingly, Figure 5 illustrates regional differences in CTE course taking. For example, students in the South earned an average of 3.3 CTE credits,

Figure 4. Percentage Point Change in CTE Employment Across Employment Across ELS and HSLS Time Frames, by US Census Region



Source: Author's calculations. Data from Bureau of Labor Statistics, "Occupational Employment Statistics," https://www.bls.gov/oes/home.htm.

nearly a credit more than students in the West. Also, while students in the Northeast earned relatively few credits in Agriculture, students in the Midwest and South earned three or four times as many credits in the same cluster. There was less regional variation in other cluster areas such as Transportation, STEM, and Government.

Figures in the bottom panel of Table 3 show that students in the HSLS study earned 2.8 CTE credits in high school on average. This finding closely mirrors NCES's own recent analysis of CTE course taking among HSLS students.[36] Disaggregating by CTE career cluster shows that, like ELS students, Business and Communications accounted for the greatest shares of CTE course taking among the HSLS students. HSLS students earned the fewest shares in Government and Education (also true for ELS students).

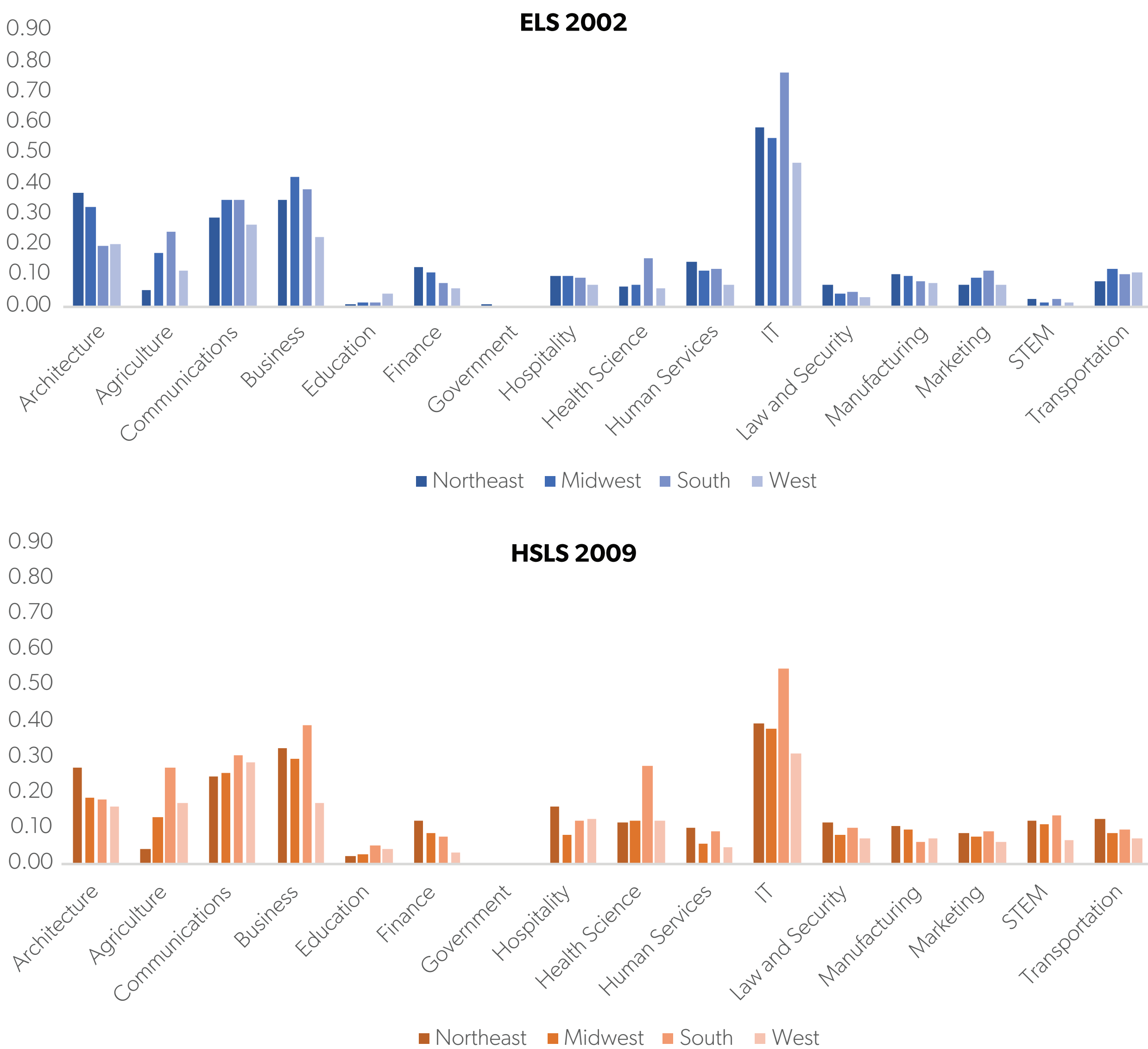
As with ELS, Table 3 and Figure 5 illustrate that CTE course taking among HSLS students varied by region. For example, Table 3 shows that HSLS students in the South earned over three CTE credits on average, again about a credit more than their peers in the West. Figure 5 shows that students in the Northeast earned more credits in Architecture than did students in the West, and students in the South and the West earned five times the credits in Agriculture than did students in the Northeast. Students in the South earned twice the CTE credits in "Health Science" than did students in the West and Midwest. This pattern was also true for students in the ELS study.

Table 3. CTE Course Taking by Credits, 2001–04 and 2009–12

ELS 2002	Full	Northeast	Midwest	South	West
Total	3.02	3.07	3.16	3.29	2.37
Agriculture	8.7%	12.2%	10.3%	6.0%	8.8%
Architecture	5.5%	1.7%	5.7%	7.4%	4.9%
Communications	10.7%	9.5%	11.0%	10.7%	11.4%
Business	11.7%	11.4%	13.4%	11.6%	9.6%
Education	0.6%	0.1%	0.4%	0.4%	1.8%
Finance	3.0%	4.2%	3.6%	2.4%	2.5%
Government	0.0%	0.0%	0.0%	0.0%	0.0%
Hospitality	3.1%	3.3%	3.2%	2.8%	3.1%
Health Science	3.3%	2.2%	2.4%	4.8%	2.6%
Human Services	3.8%	4.8%	3.8%	3.8%	3.0%
IT	20.4%	19.1%	17.5%	23.2%	19.9%
Law and Security	1.6%	2.3%	1.4%	1.5%	1.4%
Manufacturing	3.0%	3.4%	3.3%	2.5%	3.4%
Marketing	3.1%	2.4%	3.0%	3.6%	3.0%
STEM	0.6%	0.9%	0.4%	0.7%	0.6%
Transportation	3.6%	2.7%	3.9%	3.2%	4.7%
HSLS 2009	**Full**	**Northeast**	**Midwest**	**South**	**West**
Total	2.83	2.96	2.54	3.19	2.30
Agriculture	6.9%	9.2%	7.4%	5.8%	7.0%
Architecture	6.4%	1.4%	5.3%	8.5%	7.7%
Communications	9.9%	8.3%	10.1%	9.6%	12.6%
Business	11.3%	11.1%	11.7%	12.3%	7.5%
Education	1.4%	0.9%	1.2%	1.7%	1.9%
Finance	2.8%	4.1%	3.5%	2.5%	1.5%
Government	0.0%	0.0%	0.0%	0.0%	0.2%
Hospitality	4.3%	5.5%	3.3%	3.9%	5.5%
Health Science	6.6%	4.1%	4.9%	8.7%	5.5%
Human Services	2.8%	3.6%	2.2%	2.9%	2.2%
IT	15.6%	13.4%	15.1%	17.3%	13.6%
Law and Security	3.4%	3.9%	3.3%	3.3%	3.1%
Manufacturing	2.9%	3.6%	3.9%	2.0%	3.2%
Marketing	3.0%	2.9%	3.1%	3.0%	2.8%
STEM	4.1%	4.1%	4.4%	4.3%	3.0%
Transportation	3.4%	4.3%	3.5%	3.1%	3.3%

Note: Percentages do not sum to 100 because ELS and HSLS students earned CTE credits in subject areas not included in the CFF.
Source: Author's calculations. Data from National Center for Education Statistics, "Educational Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/; and National Center for Education Statistics, "High School Longitudinal Study of 2009," https://nces.ed.gov/surveys/hsls09/.

Figure 5. CTE Course Taking by Cluster and US Census Region, 2001–04 and 2009–12

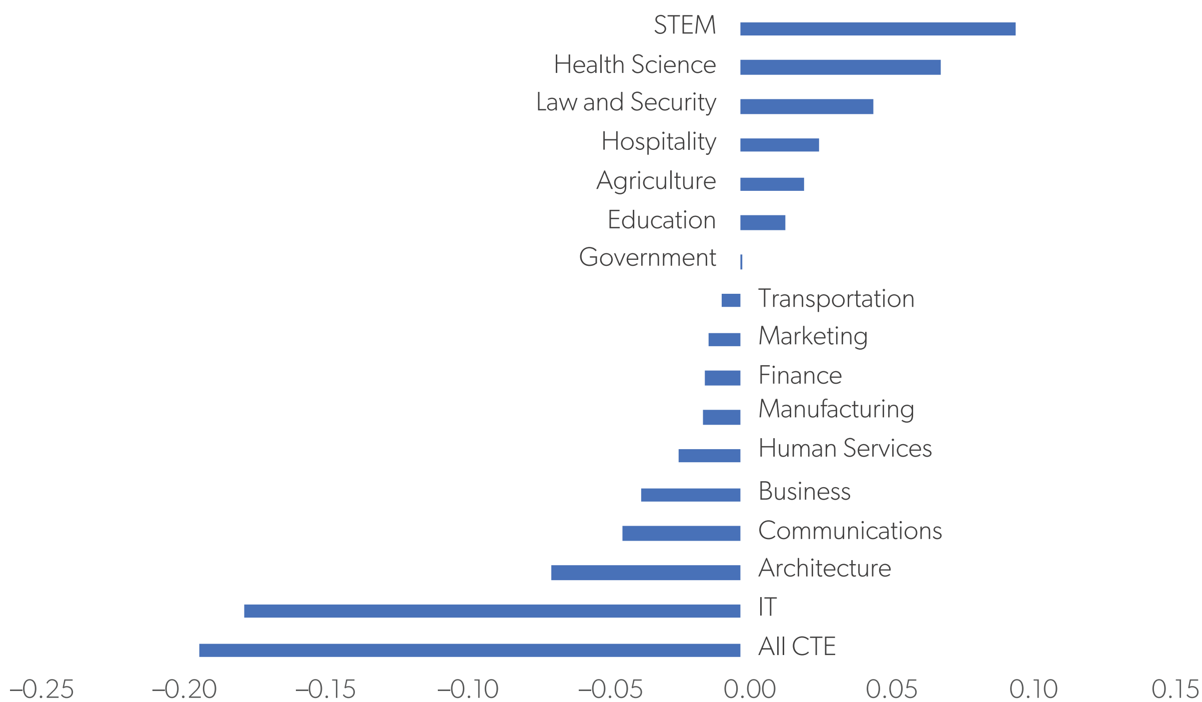


Source: Author's calculations. Data from National Center for Education Statistics, "Educational Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/; and National Center for Education Statistics, "High School Longitudinal Study of 2009," https://nces.ed.gov/surveys/hsls09/.

To the question of how CTE course taking has changed over time, the data show that students completed fewer CTE credits in HSLS than in ELS. (See Figure 6.) This finding confirms prior analyses of CTE course taking in the nation.[37] Data presented in Table 3 and Figure 6 also show that, consistent with previous analyses, course taking increased in certain CTE cluster areas and declined in others. For example, Figure 6 shows that course taking declined in Manufacturing, Business, and IT, while course taking in STEM and Health Science increased.

Figures contained in Table 3 highlight that CTE course taking is a function of not only time but also locale or region.[38] Indeed, Figure 7 shows that even though course taking in cluster areas may have moved in a direction or magnitude in one region, course

Figure 6. Changes in CTE Credits Across ELS and HSLS Time Frames



Source: Author's calculations. Data from National Center for Education Statistics, "Educational Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/; and National Center for Education Statistics, "High School Longitudinal Study of 2009," https://nces.ed.gov/surveys/hsls09/.

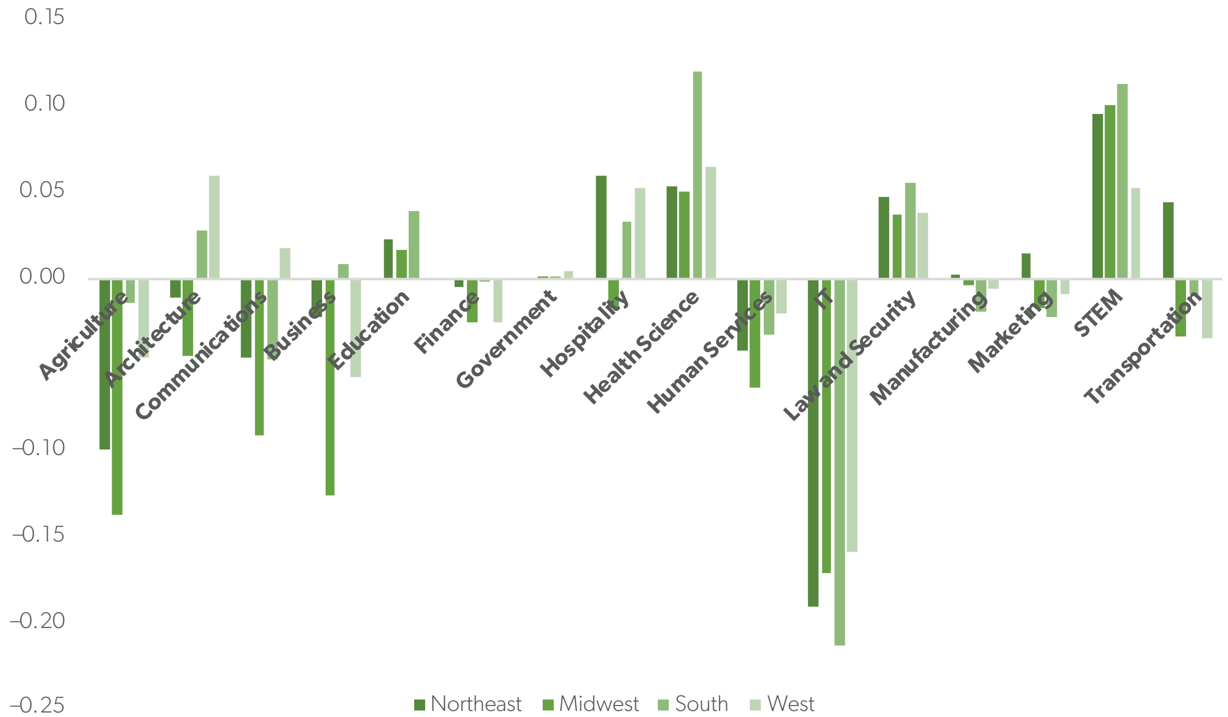
taking with that same cluster in another region may have shifted over time differently (e.g., Agriculture, Manufacturing, and Transportation).

CTE Course Taking and Labor Markets. The big remaining question was: To what degree does CTE labor market employment explain the observed variation in CTE course taking? In other words, is there a correlation between CTE course taking in high school and rates of employment in students' areas, more specifically, their home states? Table 4 contains the estimates produced by linear regression models predicting CTE course taking (in credits) from students' baccalaureate ambitions, rates of CTE cluster employment in their home states, and the interaction of these two variables. While the parameter estimates are not displayed in the table, all regression models control for gender, race, socioeconomic status, and all observed and unobserved school-level characteristics that remained relatively fixed over time (e.g., size, urbanicity, and racial and socioeconomic composition).[39]

The first column in the table shows that having plans to attend a four-year college after high school was largely unassociated with CTE course taking among ELS students. There were two exceptions. ELS students with plans to attend a four-year university after high school earned slightly more credits in IT (0.09 credits) and fewer credits in Agriculture (–0.06 credits).

The second column in the table shows that among students in the ELS study, rates of employment in a given CTE cluster did not predict increased or decreased CTE credit earnings in that same cluster, all else being equal. In other words, after controlling for gender, race, socioeconomic status, and all observed and unobserved school factors, increased rates of employment were not statistically associated with CTE credit earnings. The one exception to this

Figure 7. Change in CTE Course Taking by CTE Career Cluster and US Census Region, ELS and HSLS Time Frames



Source: Author's calculations. Data from National Center for Education Statistics, "Educational Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/; and National Center for Education Statistics, "High School Longitudinal Study of 2009," https://nces.ed.gov/surveys/hsls09/.

broad trend was Business, for which increased rates of employment were associated with increased CTE credit accumulation (0.034 credits).

Results in the third column in Table 4 indicated there was no interaction between CTE cluster employment rates and postsecondary ambitions. Put differently, ELS students with plans to attend a four-year university did not complete CTE coursework in high school in response to local rates of employment differently than students without plans to attend a four-year school.

The next column in Table 4 contains the regression estimates for the students in the HSLS study. Results show that HSLS students with baccalaureate ambitions earned more credits in STEM (0.03 credits) and IT (0.07 credits), all else being equal. HSLS baccalaureate aspirants did not earn significantly more or less CTE credits in the other CTE cluster areas. The next row contains the coefficients associated with rates of CTE cluster employment. As figures in Table 4 show, employment rates were significantly associated with increased CTE credit earnings in STEM (0.04 credits), IT (0.08 credits), "Finance" (0.08 credits), Health Science (0.27 credits), Business (0.26 credits), and Human Service (0.17 credits). Interestingly, increased employment in Hospitality predicted *decreased* Hospitality course taking. Employment was unrelated to course taking in the Architecture, Agriculture, and Manufacturing clusters.

The final column in Table 4 contains the estimated regression coefficients associated with the interaction between employment rates and baccalaureate ambitions. As with the ELS students, estimates suggest that HSLS students with plans to attend a four-year university after high school did not earn credits in

Table 4. Regression Estimates Predicting CTE Course Taking, by Credits

	ELS 2002 n = 9,200			HSLS 2009 n = 15,100		
	BA	Employment	Employment x BA	BA	Employment	Employment x BA
STEM	–0.017 (0.043)	–0.062 (0.047)	0.031 (0.042)	0.030* (0.013)	0.043** (0.014)	0.001 (0.007)
IT	0.087* (0.046)	0.026 (0.057)	–0.025 (0.030)	0.069* (0.032)	0.076*** (0.014)	–0.024 (0.012)
Finance	0.021 (0.045)	–0.004 (0.036)	0.002 (0.014)	0.021 (0.020)	0.078*** (0.007)	–0.002 (0.006)
Health Science	0.121 (0.089)	0.043 (0.056)	–0.019 (0.018)	–0.178 (0.092)	0.265*** (0.018)	0.039 (0.014)
Business	0.186 (0.197)	0.034* (0.017)	–0.006 (0.013)	0.027 (0.174)	0.263*** (0.008)	0.001 (0.010)
Architecture	–0.139 (0.077)	–0.048 (0.026)	0.009 (0.014)	–0.055 (0.079)	–0.011 (0.012)	0.008 (0.013)
Agriculture	–0.064** (0.022)	–0.024 (0.018)	0.016 (0.008)	0.003 (0.022)	–0.014 (0.025)	–0.008 (0.020)
Manufacturing	–0.292 (0.197)	–0.018 (0.035)	–0.004 (0.028)	–0.022 (0.030)	–0.014 (0.007)	0.001 (0.004)
Human Services	0.187 (0.157)	0.088 (0.077)	–0.115 (0.079)	0.008 (0.041)	0.165*** (0.025)	–0.002 (0.012)
Hospitality	–0.044 (0.111)	–0.007 (0.011)	–0.000 (0.010)	0.009 (0.071)	–0.253*** (0.011)	–0.002 (0.006)

Note: All models are estimated with controls for race, gender, socioeconomic status, and school fixed effects. Robust standard errors are in parentheses. $*p < .05$, $**p < .01$, $***p < .001$.

Source: Author's calculations. Data from National Center for Education Statistics, "Educational Longitudinal Study of 2002," https://nces.ed.gov/surveys/els2002/; National Center for Education Statistics, "High School Longitudinal Study of 2009," https://nces.ed.gov/surveys/hsls09/; and Bureau of Labor Statistics, "Occupational Employment Statistics," https://www.bls.gov/oes/home.htm.

CTE in response to variation in CTE cluster employment rates differently than students without baccalaureate ambitions.

Comparing the ELS and HSLS regression estimates shows that across the two NCES studies, having baccalaureate ambitions after high school was largely unassociated with CTE course taking. The one exception may be IT, for which having baccalaureate plans was associated with increased high school CTE course taking for both ELS and HSLS students. In contrast to the ELS estimates, CTE cluster employment was significantly associated with CTE course taking in all but three clusters in HSLS. This is a notable albeit unsurprising finding. After all, it is what we would expect to find given the "alignment" efforts built into the Perkins IV legislation.

In both the ELS and HSLS studies the interaction between baccalaureate ambitions and local CTE cluster employment rates was statistically null. This finding suggests that students do not interact with labor markets differentially based on their postsecondary plans. Practically speaking, this could indicate that two- and four-year aspirants find CTE coursework an equally valuable means toward college or career.

Discussion

This study sought to address the important though unexplored relationship between the CTE courses students complete in high school and their surrounding labor market characteristics. The study also sought to uncover how these relationships have potentially changed over region and time. Several of the findings presented here have direct relevance to CTE policymakers and school leaders.

First, an examination of employment statistics revealed that rates of employment varied by CTE cluster area, with rates of employment much higher in some clusters (e.g., Business) than others (e.g., Government). Rates of CTE cluster employment also varied by US region, but this is only true as a general statement. Indeed, some CTE clusters were less variant across regions than others. For example, the fraction of people employed in STEM was relatively stable across regions. That said, employment in Manufacturing varied widely from region to region and could, therefore, be classified as being a more "regionally dependent" occupational cluster.

Employment in clusters also changed over time. One policy implication here is that the process of attempting to align CTE course taking with labor markets must use updated, local labor market data consisting of both current and projected figures. In fact, these data are essential.

Fortunately, new Perkins V legislation encourages eligible agencies to incorporate both local labor market data and feedback from industry stakeholders in their decision-making processes. The new Perkins legislation also now requires agencies to complete a Comprehensive Local Needs Assessment (CLNA) every two years to, among other things, "meet local education or economic needs."[40] In theory, the CLNA should lead to better coordination between key stakeholders, leading to higher-quality and better-aligned CTE programs.

That said, the CLNA requirement will represent a substantial hurdle for many states, particularly those without strong support for career education, established traditions of intersegmental coordination between secondary and postsecondary institutions, and robust and accessible data systems. For states without strong data systems, third-party organizations such as Emsi and Burning Glass can provide updated, relevant labor market data to help drive decision-making.[41] The Association for Career and Technical Education has also provided guidance to states grappling with the new CLNA requirement.[42]

A second finding of potential interest to CTE researchers and policymakers is that the current study did not find evidence that students with plans to earn a baccalaureate degree take fewer CTE credits in high school, even after controlling for a range of demographic and school-level factors. ELS students with baccalaureate ambitions earned fewer credits in Agriculture; however, this relationship did not carry over to HSLS baccalaureate aspirants.

On the contrary, students with baccalaureate aspirations completed more credits in IT in both the ELS and HSLS studies. Students in the HSLS study completed more credits in STEM. These findings lend support to the notion that CTE is less of a tracking mechanism today, at least in diverting less academically skilled and aspirational students into menial vocational careers or away from college.[43] That ELS and HSLS students with and without baccalaureate aspirations did not interact with local labor markets differentially further supports this.

A third finding with tremendous policy import is that while students in the ELS study did not appear to consume CTE in high school in patterns that were statistically correlated with rates of employment in their states, CTE course taking among students in the HSLS study appeared much more aligned, which is to say that average CTE course taking increased as average employment increased. The students in each study were different, and the HSLS study sample size was larger than ELS, so there are important caveats to acknowledge related to sampling error and statistical power. That said, the size and directionality of the regression estimates indicate the differences between the ELS and HSLS studies were likely not affected materially by these issues.

Regardless, the contrast in alignment between the ELS and HSLS studies certainly does not constitute causal evidence of improved CTE alignment following the passage and reauthorization of Perkins IV in 2006. That said, the findings do offer novel and intriguing insight into largely unexplored but increasingly salient components of Perkins. Future research may want to examine whether the aligned CTE course taking observed in this report is an artificial result of some unobserved phenomenon.

For example, as CCR initiatives have spread nationwide, some states have made CTE course taking a requirement for high school graduation (e.g., Arkansas).[44] Future research will also want to examine the degree to which students actually end up employed in these CTE occupations, for it might be the case that CTE course taking is better aligned today than before but does not necessarily lead students into related career pathways. Such a reality would represent a substantial disappointment for many CTE advocates and policymakers and require additional work on building pathways in high school that end in related careers.

This report is not without at least two important limitations. First, employment statistics used in the analyses reported here were aggregated at the regional (Tables 2 and 3) and state levels (Table 4). This means that a great deal of intrastate labor market heterogeneity was unaccounted for. In fact, labor market conditions vary across states and regions in states. Silicon Valley is different from the Central Valley, even though both regions are in the overall California labor market. Aggregating to the regional and even state level, then, was less than ideal, but it was the best option available given relatively few student observations at lower levels of aggregation (e.g., ZIP code and metro). Future researchers with access to state education data systems can improve on this limitation, however.

A second limitation of the report is that the descriptive and inferential analysis reported here has relied on numerous coding schemes and crosswalks that are inherently arbitrary, to some degree or another. The SOC system is a convention, after all. The same is true for the Classification of Secondary School Courses and Secondary School Course Classification System course coding structures. And the processes involved with mapping one coding scheme onto another are fraught with challenges that might have weakened the signal captured in these analyses.

That said, the current study strived to use schemes and crosswalks developed and used by leading research and advocacy organizations in the nation, including the BLS and US Department of Education. Importantly, and as a forewarning, these and other coding and crosswalk issues will become more apparent and need future attention as more policymakers and schools become aware of the importance of aligning CTE programs with labor market demands in their area.

Conclusion

CTE coursework in high school, especially in the post–Perkins 2006 era, could supply students with alternative and clear pathways into college and career. For employers and policymakers concerned with the much-debated skills gap in the nation, this study shows that post-Perkins CTE coursework is associated with rates of employment in students' local areas and, most importantly, that this relationship has potentially strengthened over time.

State policymakers, CTE advocates, researchers, and industry representatives are likely coordinating efforts around the new Perkins reauthorization as this report comes to press. The report's results should inform their collaborations and, if anything, encourage them in their efforts. These collaborations are essential to establishing meaningful CTE pathways.

Appendix A

Importantly, while both the Educational Longitudinal Study (ELS) of 2002 and the High School Longitudinal Study (HSLS) of 2009 detail students' course-taking patterns through high school, they used different coding systems to organize this information. The National Center for Education Statistics (NCES) used the Classification of Secondary School Courses (CSSC) coding system to organize student transcripts in ELS and used the Secondary School Course Classification System (SCED) in HSLS.[45] Both course coding systems list the academic and vocational courses students completed, but the two coding systems are markedly different.

Ultimately, the analyses shared in this report required both CSSC and SCED courses to fit into the Career Clusters Framework (CCF) since that was the only meaningful way to organize Bureau of Labor Statistics Occupational Employment Statistics labor market data. It was relatively easy to map HSLS SCED codes into the career clusters using the SCED course attributes created by the SCED working group in the National Forum on Education Statistics.[46] It was much more challenging to map ELS CSSC codes into the CCF. That said, a number of crosswalk documents (and helpful individuals) made overcoming this challenge possible.

The first crosswalk document was an update of the "Secondary School Taxonomy" by Denise Bradby and Lisa Hudson.[47] Their report contained, among several helpful crosswalks and tables, a suggested mapping of CSSC course codes onto the CCF. It was this CSSC-to–career clusters mapping that informed the early stages of my report.

However, there were substantial disparities in the CTE course-taking figures created from this crosswalk and other NCES studies around the same time. Thankfully, Ghedam Bairu at NCES was kind enough to alert my attention to a 2014 CSSC-to-SCED crosswalk that was much more detailed and precise than the rough—though helpful—outline laid out in Bradby and Hudson. This 2014 crosswalk (based on SCED 2.0) was used to complete the first drafts of my report.

However, just as I was finalizing my report, Hudson mentioned a forthcoming, updated CSSC-to-SCED crosswalk created by Robin Henke et al.[48] After reaching out to the authors and learning that the new CSSC-to-SCED crosswalk could be shared after the accompanying report was released by NCES, I momentarily paused work on my report. The crosswalk was shared with me just as it was published and made publicly available on the NCES website (September 2019). I used this latest CSSC-to-SCED crosswalk to complete the necessary translation of CSSC and SCED courses in the CCF.

Appendix B

The linear regression models used to determine the statistical associations between CTE course taking and related employment in a student's home state can be expressed as follows:

$$Y_{ijs} = \alpha + \delta EMP_s + \beta BA_{ijs} + \gamma EMP{*}BA_{ijs} + \theta X_{ijs} + \delta_j + \varepsilon_{ijs}$$

where *Y* is the estimated CTE cluster credits earned by student *i* attending school *j* in state *s*. On the other side of the equation, *EMP* refers to the fraction of people employed in a given CTE cluster in a student's home state averaged over the period of the NCES cohort study, *BA* is a binary indicator for whether student *i* planned to attend a four-year university after high school, and *EMP*BA* is the interaction between cluster employment and a student's baccalaureate ambitions.

X is a vector of student-level covariates including gender, race, and a standardized measure of socioeconomic status. Importantly, the study was also able to eliminate overall between school differences using school fixed effects δ. The error term, ε_{ijs}, was clustered at the school level to account for the student observations nested in the same school.

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About the Author

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