**Career and Technical Education and Postsecondary Student Outcomes in Massachusetts: Career Clusters and Student Groups, Teacher Licensure, and Student Entry**

FINAL PROJECT REPORT

October 29, 2020

|  |  |  |
| --- | --- | --- |
| Submitted to: | Cliff Chuang  Senior Associate Commissioner for Educational Options  Massachusetts Department of Elementary and Secondary Education (DESE)  75 Pleasant Street Malden, MA 02148  E-mail: cliff.chuang@state.ma.us |  |
| Submitted by: | Roddy Theobald  American Institutes for Research  National Center for Analysis of Longitudinal Data in Education Research (CALDER)  3876 Bridge Way N., Suite 201  Seattle, WA 98103  Phone: 510-292-6105  E-mail: [rtheobald@air.org](mailto:rtheobald@air.org) |  |

| Career and Technical Education and Postsecondary Student Outcomes in Massachusetts: Career Clusters and Student Groups, Teacher Licensure, and Student Entry  October 2020  Bingjie Chen, Dan Goldhaber, Kristian Holden, Roddy Theobald CALDER, American Institutes for Research  Shaun Dougherty, Walter Ecton Vanderbilt University  Dana Ansel  Consultant |
| --- |
| American Institutes for Research  1000 Thomas Jefferson Street NW Washington, DC 20007-3835 202.403.5000  www.air.org  Copyright © 2020 American Institutes for Research. All rights reserved. |

Contents

**Page**

[Executive Summary iv](#_Toc54808141)

[Chapter 1: Heterogeneity in the Returns to High School CTE by Career Clusters and Student Groups 10](#_Toc54808142)

[Chapter 2: CTE Teacher Licensure and Long-Term Student Outcomes 42](#_Toc54808143)

[Chapter 3: Student Entry into Regional Vocational Technical High Schools in Massachusetts 58](#_Toc54808144)

[References 73](#_Toc54808145)

[Appendices 77](#_Toc54808146)

## Executive Summary

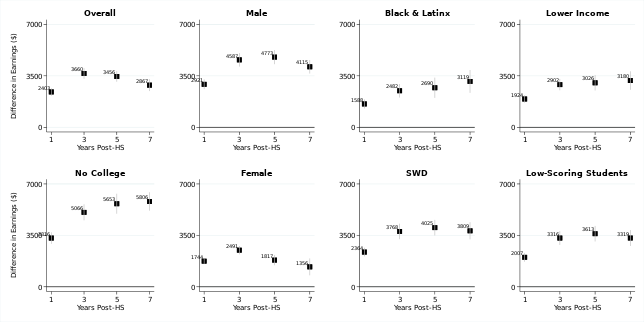
Career and technical education (CTE) has shown promise as a means of improving the postsecondary outcomes of students in public schools. Prior work from Massachusetts (Dougherty, 2018) has established a positive, causal link between student attendance in a subset of the state’s regional vocational technical schools (RVTSs) and long-term student outcomes. We build on this prior work by investigating three research topics identified by the Massachusetts Department of Elementary and Secondary Education:

1. The associations between participation in CTE programs and later student outcomes, and the potential for variation in relationships across CTE career clusters and student groups.
2. The associations between CTE teacher qualifications and later student outcomes.
3. Student entry into Massachusetts’s RVTSs.

In the executive summary, we identify and discuss six key findings on the above topics. We first discuss findings 1–4 that rely on state administrative data (related to all three topics above) that can be interpreted for the whole state. We then discuss two additional findings (5 and 6), both related to topic #3 above, that should only be interpreted for two regions of the state in which we conducted student surveys, student focus groups, and guidance counselor interviews.

***Key Finding #1:*** *Returns to CTE concentration vary across different student groups*

We use statewide administrative data to examine how concentration in CTE (defined as concentrating in CTE for 2 or more years during high school) is associated with postsecondary earnings. As shown in Figure 1, we find that the expected returns to concentrating in CTE for earnings 1, 3, 5, and 7 years after a student’s expected graduation date—i.e., the expected differences in earnings between students who do and do not concentrate in CTE, controlling for other differences between these groups of students*—are positive for all student groups*. But the expected returns are larger for male students, students who never enroll in college, and students with disabilities; note, however, that these groups are not mutually exclusive.



**Figure 1.** Earnings returns to CTE for different student groups

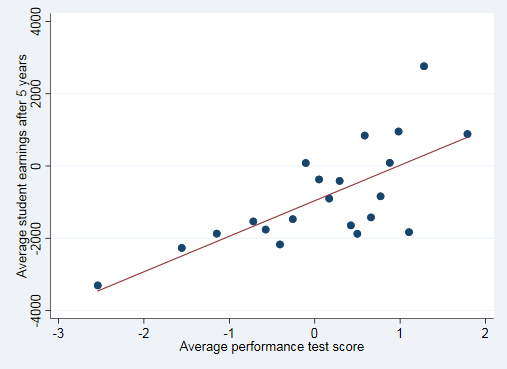
***Key Finding #2:*** *The expected returns to CTE concentration for future earnings and college attendance vary across different CTE career clusters.*

We also explore expected returns to concentration in CTE in different federally defined career clusters for both college attendance and earnings, controlling for the same differences between students who do and do not concentrate in CTE discussed above. We plot these expected returns in Figure 2, where the *x*-axis is the expected increase in the probability of attending college for students who concentrate in a specific CTE career cluster and the *y*-axis is the expected change in earnings 7 years after students’ expected high school graduation. Only one CTE career cluster (Communications) is associated with a decrease in future earnings (indicated by a point below the *x*-axis), and several CTE clusters are associated with positive outcomes for *both* college attendance and earnings (those points in the top-right quadrant). However, concentration in some clusters (particularly Construction and Transportation) is associated with higher earnings but a lower probability of attending college (points in the top-left quadrant).

**Figure 2.** Earnings and college attendance returns to different CTE clusters

***Key Finding #3:*** *Higher CTE teacher subject performance licensure test scores are positively associated with higher earnings for their students.*

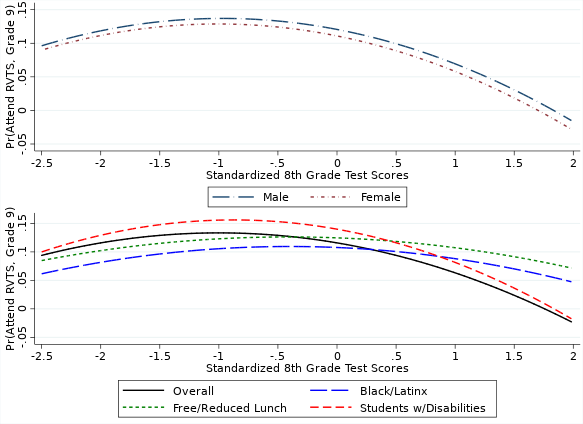
Prospective CTE teachers in Massachusetts are required to meet licensure standards, including passing subject-specific written and performance assessments intended to measure the knowledge of prospective CTE teachers in the specific courses they aim to teach. We find that CTE teachers who received better scores on these subject performance tests tend to have students with higher longer-term earnings than CTE teachers who received worse scores on these tests, controlling for other factors. As shown in Figure 3, a 1 *SD* increase in teacher performance on these tests is associated with about a $1,000 increase in average expected earnings for the teacher’s students 5 years after their expected graduation date, controlling for licensure test area and other observable differences (e.g., students’ prior test scores).



**Figure 3.** Relationships between CTE teacher subject performance licensure test scores and student earnings five years after expected high school graduation

***Key Finding #4:*** *The probability of attending a RVTS varies for different student groups across the state.*

We also leverage administrative data from the entire state to predict attending a RVTS as a function of observable student characteristics, including prior test scores and demographic information. These models control for differences in access to RVTSs across different regions of the state, and thus make comparisons between students with similar access to the RVTS system. Figure 4 shows the probability that different groups of students attend a RVTS as a function of their 8th grade test scores (averaged across math and English language arts [ELA] and standardized to have a mean of zero and standard deviation of 1). Across the state, lower performing students are more likely to attend a RVTS than higher performing students for all student groups, but controlling for these differences reveals several interesting patterns. Male students and students with disabilities are *more* likely to attend a RVTS throughout the test score distribution than female students and students without disabilities, respectively. Above-average performing students of color are also *more* likely to attend a RVTS than white students with similar test scores, while low-performing students of color are *less* likely to attend a RVTS than low-performing white students.

**

**Figure 4.** Predicted probability of attending a RVTS by average math and ELA 8th grade tests score and student characteristics

The final two findings rely on administrative data and additional data we collected as part of this project *only from two regions that agreed to participate in this portion of the study*. These regions are anonymized throughout this report, but because one region has a RVTS that is moderately oversubscribed while the other has a RVTS that is highly oversubscribed, we refer to these as the “moderately oversubscribed region” and “highly oversubscribed region” throughout this report.

***Key Finding #5:*** *A majority of 8th grade students reported that they receive enough information to make an informed high school choice, but a significantly lower proportion of students of color reported this than did white students.*

We identified 11 different feeder middle schools across 8 school districts from the regions described above. We administered surveys that were completed by almost 80% of 8th graders in these schools, and we also conducted one student focus group in each of the eleven feeder middle schools. One important finding from the surveys is that a high proportion (85%) of 8th graders report feeling that they have enough information to make an informed high school choice. However, as shown in Figure 5, this proportion was statistically significantly lower for students of color in both regions. There were also concerns expressed by students in the focus groups; as one student stated, “We have a lot of information, but I am not sure if it’s the right information.”

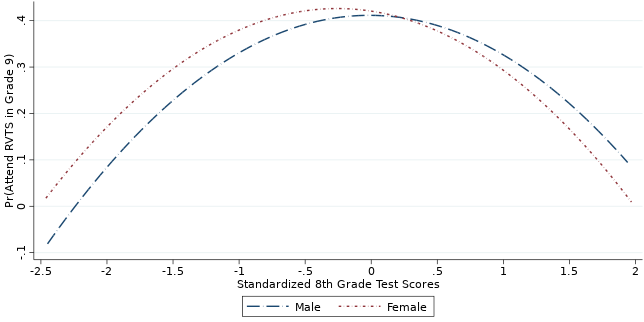
**Figure 5.** Proportion of students reporting that they have enough information to make informed high school choice

***Key Finding #6:*** *Middle school guidance counselors in the highly oversubscribed region worry that CTE has lost its mission.*

We interviewed one guidance counselor at each of the 11 focal middle schools to solicit their perspectives on the high school choice process, particularly with regards to RVTS admissions. In both regions, guidance counselors mostly characterized the relationships with the RVTS as positive, but also described some degree of scarcity of available slots at the RVTS. The counselors in the highly oversubscribed region also reported concerns that students who would benefit from a “hands on” education do not get in because of either their grades or discipline issues in middle school. As illustrated in the pull-out quote, the concern is that the very students whom they believe would benefit most from the education provided by a RVTS are not admitted to these schools. In addition, multiple counselors report that some students do not even apply to the RVTS because they “give up ... [on the] application process.”

*I feel that kids who we know would benefit from the trades are not given the opportunity. Because of their discipline or grades. They’re not top-notch students. A traditional classroom setting is not for them. And, then they’re being told you have to go to one. Because they can’t get in [to an RTVS]. That’s a huge concern. -8th grade guidance counselor*

The concerns about access to the RVTS in this region are illustrated in administrative data analysis of the relationship between 8th-grade MCAS test scores and RVTS entry in this region. Figure 6 shows the predicted probability that a student in this region attends the RVTS (*y*-axis) as a function of their 8th grade MCAS test scores (*x*-axis) and gender information (separate lines). Unlike the state as a whole (see key finding #4), low-performing students of each gender in this region are substantially less likely to attend the RVTS than peers near the middle of the test score distribution, and have about the same probability of attending as students from the top of the test score distribution.



**Figure 6.** Predicted probability of attending RVTS in highly oversubscribed region by average math and ELA 8th grade tests score and student characteristics

## Chapter 1: Heterogeneity in the Returns to High School CTE by Career Clusters and Student Groups

*The first chapter of this report is a quantitative analysis that addresses the first research topic identified by DESE, the associations between participation in CTE programs and later student outcomes, and the potential for variation in relationships across CTE career clusters and student groups.*

**1.1. Introduction**

Students who enter high school with lower grades or test scores have worse outcomes, on average, than their peers with better middle school grades or test scores (Allensworth et al., 2014; Kurlaender, Reardon, & Jackson, 2008). These less-prepared students are much less likely to earn a high school diploma, are less likely to complete a college degree, have lower employment and earnings outcomes, and are more likely to access public assistance programs throughout adulthood. Understanding which educational programs and interventions can help mitigate such undesirable outcomes, particularly for those students for whom poor outcomes are more likely, is crucial to both education and social policy.

Nationally, CTE within the context of a high school education has historically disproportionately served students from lower-income families (Dougherty, 2018; Kreisman & Stange, 2018; Plasman, Gottfried, & Klasik, 2020), students with below-average test scores in middle school, and students with disabilities (Dougherty, Grindal, & Hehir, 2018). While this has led to a long history of concerns about CTE as a pathway that has limited some students’ access to college and certain high-earning careers (see, e.g., Oakes, 1983), recent years have seen a resurgence in the prominence of CTE within education and workforce development policy, with many states increasing their investments and explicitly positioning CTE as part of a College and Career Readiness agenda (Dougherty, Gottfried, & Sublett, 2020). Increased CTE interest and commitment has been bolstered by the federal government’s 2018 Perkins Act reauthorization, which helped reframe some state efforts to reform their CTE offerings, as well as the inclusion of both college and career readiness in the Every Student Succeeds Act (ESSA).

The increased policy interest in CTE has occurred alongside a substantial growth in the body of experimental and quasi-experimental research that estimates the impacts of CTE (Bonilla, 2020; Brunner, Dougherty, & Ross, 2019; Dougherty, 2018; Hemelt, Lenard, & Paeplow, 2019; Kemple & Willner, 2008). The improvement in the evidence base marks an expansion of research that supports causal inference, using data from a more recent policy and educational context. Earlier research (with the exception of Kemple & Willner, 2008) was correlational, and used data from a decade or more in the past, raising questions about generalizability in the modern era of CTE. Some earlier analyses illustrated that specializing in particular programs within CTE could yield different expected outcomes. For instance, Bishop and Mane (2004) estimated impacts of CTE allowing for differences in these impacts by whether a student focused on general interest CTE, traditional trades, or computer-related coursework. Other research has focused on the potential benefits of specific types of CTE coursework such as applied science, technology, engineering, and math (STEM) (e.g. Bozick & Dalton 2013; Gottfried & Plasman, 2018).

Although more recent CTE literature does leverage improved causal methodology and more representative cohorts of students (e.g. more affluent and with higher test scores), these studies are not without limitations. The clearest limitation of recent research on CTE is that it largely treats CTE as a monolithic experience, potentially masking the extensive diversity of programs falling under the broad umbrella of CTE. Moreover, recent research has tended to focus on CTE programming in schools that emphasize CTE as the focal point of the high school experience, neglecting CTE that occurs within more traditional comprehensive high schools. Research has tended to focus on specialized CTE schools largely because when these schools are oversubscribed they offer opportunities to estimate causal impacts. However, most students who experience CTE in high schools across the nation do so within traditional comprehensive schools or at part-time technical centers, which may not offer the same set of experiences, and therefore may not be expected to produce effects similar to whole-school models of CTE. Furthermore, prior research has done little to disentangle potential differences in impacts based on what a student focused on in their CTE study, or what background characteristics might guide their particular choice. With the push to expand CTE beyond traditional vocational programs and new federal guidelines that encourage CTE to emphasize college and career readiness, any analysis of CTE today must grapple with heterogeneity across career clusters as diverse as STEM, Cosmetology, Healthcare, and Manufacturing.

This paper begins to fill a gap in the existing research base by estimating differences in the associations between CTE participation and various post-high school outcomes across different career clusters and for different student populations. Using administrative data from Massachusetts, we leverage factors known to be associated with selecting into CTE to observe how high school CTE program participation relates to college-going, college completion, employment, and earnings for the nine cohorts of high school students expected to graduate high school from springs 2009 to 2017 in both RVTS and CTE programs in comprehensive high schools. We observe these students for between 1 and 7 years after high school graduation and find that advantages for CTE concentrators are highly heterogeneous for both college and workforce outcomes. We also document that these advantages vary substantially across student characteristics, with students from less advantaged backgrounds experiencing the largest benefits.

The remainder of this chapter proceeds as follows. Section 1.2 provides background on the relevant literature and presents the theoretical framework for this investigation. We then describe the methods in Section 1.3, discuss the results in Section 1.4, acknowledge limitations to the analysis in Section 1.5, and provide conclusion and policy implications in Section 1.6.

**1.2. Literature Review and Theoretical Framework**

*What We Know About CTE and Student Outcomes*

Throughout the second half of the 20th century, research on vocational education generally found negative effects for participating students. In particular, vocational was shown to perpetuate curricular tracking, which prevented certain student groups—particularly students with disabilities and racially minoritized students—from accessing the academically rigorous instruction that would prepare them for college and high-earning careers (Anderson, 1982; Bowles & Gintis, 1976; Oakes, 1983; Tyack, 1974). In the early 21st century, vocational education underwent a significant reinvention, highlighted by the shift in terminology from vocational education to CTE, and an emphasis on CTE as part of a “college and career readiness” agenda (Dougherty & Lombardi, 2016). While many of the traditional vocational career clusters and programs remain in place, new CTE programs often emphasize academically rigorous (often STEM-focused) pathways that were designed to prepare students for postsecondary education as well as careers in high-demand, high-wage areas.

Given these shifts in the policy landscape in recent years, an emerging body of experimental and quasi-experimental research has sought to revisit potential returns to CTE, providing some reasons for optimism for proponents of CTE. Kemple and Willner (2008), exploiting a lottery for admission to oversubscribed Career Academies, find that Career Academy participants saw no meaningful difference in postsecondary education, but did earn 11% more per year than non-participants over the first 8 years after high school graduation, with returns concentrated among male students (who saw a 17% increase in earnings). Hemelt et al. (2019), using more recent data from a similar admissions lottery process, find an 8% increase in high school graduation rates for students who attend a specific career academy in North Carolina, along with an 8.5% in college enrollment among male students (with no observable effect for female students). Dougherty (2018) and Brunner et al. (2019) both employ a regression discontinuity design using admissions score cut-offs for CTE-dedicated high school, with Dougherty finding a 7%–10% increase in the likelihood of high school graduation, and Brunner, Dougherty, and Ross finding a 31% increase in quarterly earnings (again, with returns accruing primarily to male students), though with some evidence of negative effects on immediate college enrollment after high school. Overall, the emerging causal literature paints a picture of positive earnings returns, particularly for male students, with more mixed evidence of effects on postsecondary education. One limitation of all of these studies is that they rely on the experiences of CTE students in oversubscribed, whole-school CTE models, which may not necessarily be representative of the range of settings in which CTE is offered throughout different local contexts.

In addition to the recent experimental and quasi-experimental work, further quantitative research has enhanced our understanding of CTE in the more modern policy context and raises questions about the nuanced impact CTE may hold for participants. Kreisman and Stange (2020), for example, find evidence that participation in CTE is more widespread across academic achievement levels than in previous eras, raising doubts of whether longstanding assumptions about CTE as a “dumping ground” for low-achieving students still hold true. Kreisman and Stange also find that earnings returns largely accrue to students who take upper-level CTE courses, arguing that in-depth concentration in a particular career cluster may be important for meaningful returns. Cellini (2006) finds some evidence that CTE participation increases both high school graduation, as well as 2-year college enrollment, though this enrollment increase may be partially due to some CTE students enrolling in 2-year colleges rather than 4-year colleges. Other studies including Bishop and Mane (2004) and Meer (2007) also find evidence of positive returns that may vary across career cluster, though these results rely on older data from students attending school in an era before the shift from vocational education to CTE.

While an emerging base of research points to some positive benefits to CTE (particularly regarding earnings for male students), there are a few general limitations we seek to address. First, most research either uses relatively outdated data from a time when CTE plausibly operates much differently than today given recent policy initiatives; by using more recent data, we can speak to the current policy context. Second, many of the more recent studies only consider students in oversubscribed, CTE-dedicated school settings, limiting generalization to the other settings including undersubscribed CTE schools and comprehensive high schools; by incorporating statewide administrative data from both RVTS and CTE programs in comprehensive high schools, we can generalize more broadly to a wide range of settings in which students engage with CTE. Finally, studies generally consider CTE as a single curricular intervention, rather than exploring differences across CTE programs; given the rise of new STEM-focused CTE programs that were designed to be part of a high-rigor, college and career readiness agenda, this paper seeks to explore differences in outcomes experienced by CTE concentrators across the range of career clusters within CTE.

Because student self-selection is endemic to high school curricular choice, the study of CTE is often ill-suited to the randomization framework. Recent quasi-experimental research on CTE impacts have capitalized on oversubscription of particular schools, or in one case used awarding of competitive funding, to estimate effects. However, even in these rare cases of quasi-experimental variation, it has not been possible to estimate the impacts of particular programmatic choices within these broader CTE settings. In the current paper, we employ a methodological approach that attempts to control for factors associated with the curricular choices and decision-making processes of students. By comparing students who are similar on a wide range of characteristics and have had a similar set of curricular options available to choose from (based on where they live and the associated public school options), we consider the extent to which CTE may be predictive of student outcomes in the years following high school.

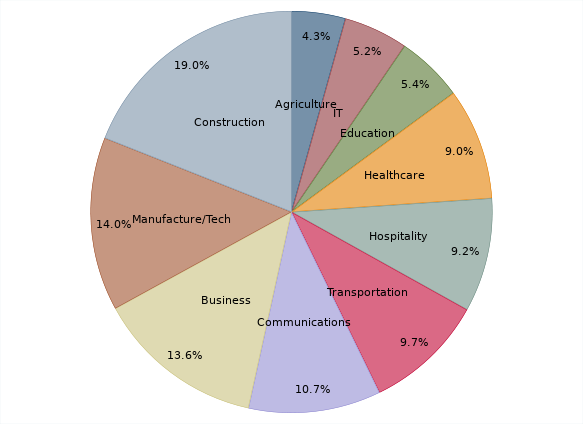
Conditional on a set of curricular choices, students may choose to expand their investment in CTE if they find it more engaging or compelling than their next-best alternative choice (e.g., choosing carpentry over taking French). Conditional on facing similar choices, coming from the same community, and attending the same high school, we make the assumption that the difference between investing in CTE for at least 2 years of 4 in high school, might be as good as chance. The result of the choice of particular CTE program then results in the accumulation of experiences, skills, and social and professional networks that may promote employment or connections to related postsecondary education. Such experiences could also simply serve, all else equal, to make school more engaging, which could increase general investments in learning that pay off in the form of college-going or workforce participation. We find evidence suggesting that the association between CTE participation in high school and post-high school outcomes, is highly heterogeneous across CTE programs and student populations.

*Context*

Massachusetts provides a compelling setting to study CTE participation in that it has a prominent, well-established system, a diverse range of program offerings, and a participation rate well suited for meaningful analysis. Approximately 21.5% of students across the state concentrate in CTE, meaning that the sample is large enough to represent a sizeable portion of students, but low enough such that participation does not necessarily mirror the statewide student demographics. Furthermore, the involvement of industry and labor groups in program oversight as well as a process to introduce new programs make programmatic offerings more dynamic and reflective of labor market needs, relative to some other states where curricular changes are bogged down by bureaucratic hurdles and have fewer ties to the local economy. Finally, Massachusetts has one of the longest standing longitudinal databases to track student participation in high school CTE, enabling analysis on all participants and curricular options across all schools over an eleven-year period. Furthermore, their merging of data with the National School Clearinghouse, and ability to merge their K–12 data with unemployment insurance (UI) records through the Department of Labor, means that key postsecondary outcomes can also be included to measure program impact.

In Massachusetts, students can concentrate in 10 career clusters by taking 2 or more years of courses in that cluster. While these career cluster are somewhat different than the 16 national career clusters promoted by AdvanceCTE (2018), there are broad similarities from which findings in Massachusetts can help inform our thinking about the national clusters. Figure 1.1 displays the share of students concentrating in each cluster (in Massachusetts, the state defines students as concentrators if they take 2 or more years of courses in any CTE cluster). The two most common clusters, Construction and Manufacturing & Technology, along with the fifth most common, Transportation, include courses that may be thought of as more “traditional vocational” courses (in so far as they include traditional trades like electrical, plumbing, construction, and auto mechanics). Still, a substantial portion of CTE students concentrate in clusters like Business & Consumer Science, Communications, Healthcare, and Information Technology that may break the mold of the common conception of old vocational programs, and may be more aligned with what some have called “new CTE” (Duncan, 2011) and STEM-aligned pathways (Dougherty & Harbaugh, 2020; Plasman, Gottfried, & Sublett, 2017).

**Figure 1.1.** CTE concentrators by career cluster



Notes: Sample includes CTE concentrators in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be CTE concentrators in a given career cluster if they are enrolled in CTE in that career cluster for at least two academic years.

**1.3. Methods**

*Data & Sample*

We use data from the Massachusetts state longitudinal data system (SLDS) covering cohorts of first-time 9th graders whose on-time (e.g., 4 years prior to entering 9th grade) graduations from high school were expected in the springs of 2009 through 2017. The dataset includes enrollment data, demographics, attendance, town of residence, Massachusetts state standardized test scores, first language, disability status (SWD), and English learner (EL) status. We also utilize college enrollment and completion data from the National School Clearinghouse, as well as quarterly earnings data reported to the Massachusetts Department of Labor through the UI system. We observe individual student outcomes data for up to 7 years after their expected on-time high school graduation year. UI records include only taxable reported earnings for non-federal employees within the state; while we consider those individuals with zero reported earnings within a year as non-earners in that year, this may exclude some earnings such as federal work or some seasonal work (e.g., in agriculture) that may go unreported to unemployment insurance. The complete dataset includes 636,776 students, approximately 21.5% of whom are CTE concentrators under the state definition used for federal reporting purposes.

*Measures*

Our key outcomes of interest are college enrollment, college completion, earnings, employment, and economic outcomes that are associated with economic dependence on the state (being neither enrolled in college nor employed). We define these outcomes as follows. First, we define enrolling in any college as a binary indicator equal to 1 if individuals are ever observed enrolling in a 2- or 4-year college after completing high school. We also create separate indicators to capture whether students enroll in a 2-year college, a 4-year college, or complete a certificate or degree at either type of institution. For labor market outcomes, we examine total annual earnings at 1, 3, 5, and 7 years after expected completion of high school, as well as binary indicators of whether individuals earned at or above the federal poverty level at each of these time periods. Our final outcomes of interest are whether students are neither employed nor enrolled in college (NEET) at 1, 3, 5, and 7 years after expected completion of high school, and whether an individual earned enough money to clear the federally defined threshold for poverty for a household size of one. These latter sets of outcomes help us understand whether students are able to avoid especially precarious outcomes. Moreover, given that individuals earning below the federal poverty threshold and not engaged in education are far more likely to rely on government assistance programs, this outcome may be of particular policy relevance given the financial implications.

Our primary predictor of interest is whether a student completed a CTE concentration when in high school. For our purposes, this means a school identifies a student as a concentrator for 2 or more school years at any time during high school. This “concentrator” definition is used by the state for federal reporting purposes, making it a meaningful designation with implications for how much Perkins funding the state receives. It represents a meaningful commitment to CTE, above and beyond any exposure students would receive from taking a single CTE course as an elective credit. Moreover, many CTE programs are explicitly designed to be completed in 2-year course sequences, with students often prepared to take licensure/certification exams, or to receive industry or state-recognized credentials after taking 2 years of CTE courses. In the analyses in which we consider the advantages for CTE concentrators in specific career clusters, we count only those students taking 2 or more years of courses *in that cluster* to be cluster concentrators (e.g., Healthcare concentrators, Construction concentrators). For those students who completed 2 or more years of CTE but not within a single cluster (sometimes referred to as CTE “dabblers”), we include them as CTE concentrators, but not as concentrators in any one cluster for the cluster-specific analyses.

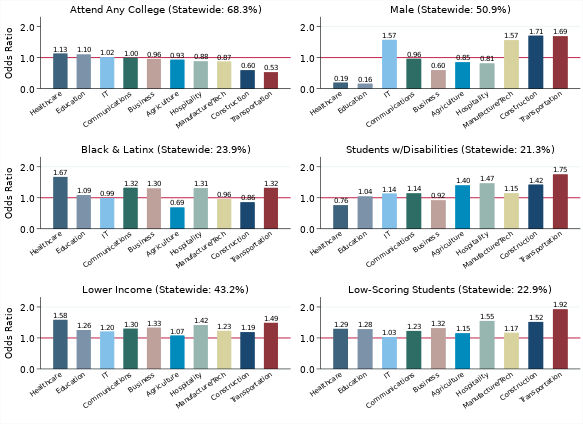
*Descriptive Analyses*

Heterogeneity within CTE occurs on two dimensions; the characteristics of students who become CTE concentrators relative to students who are not CTE concentrators, and the characteristics of students *across* career clusters. Table 1.1 and Figure 1.2 highlight the starkness of these differences. Table 1.1 shows that CTE concentrators are less likely to be female, more likely to be lower income, and more likely to be ELs than non-concentrators. In terms of racial and ethnic identity, Latinx students are especially overrepresented and Asian students underrepresented among CTE concentrators. CTE concentrators score well below the state average on 8th grade standardized tests and are nearly 13 percentage points less likely to attend and graduate from college (especially 4-year colleges) than their non-CTE peers.

**Table 1.1.** Descriptive Statistics for CTE Concentrators and Non-Concentrators

|  |  |  |
| --- | --- | --- |
|  | **CTE Concentrators** | **Non-Concentrators** |
| Female | 0.44 | 0.50 |
|  | *(0.50)* | *(0.50)* |
| Lower Income | 0.58 | 0.39 |
|  | *(0.49)* | *(0.49)* |
| Students w/Disabilities | 0.26 | 0.20 |
|  | *(0.44)* | *(0.40)* |
| Immigrant | 0.03 | 0.03 |
|  | *(0.17)* | *(0.16)* |
| English Language Learners | 0.07 | 0.05 |
|  | *(0.25)* | *(0.21)* |
| Latinx | 0.20 | 0.14 |
|  | *(0.40)* | *(0.35)* |
| Asian | 0.04 | 0.05 |
|  | *(0.19)* | *(0.23)* |
| Black | 0.10 | 0.09 |
|  | *(0.30)* | *(0.29)* |
| White | 0.70 | 0.73 |
|  | *(0.46)* | *(0.45)* |
| 8th Grade Math Score (Std.) | -0.33 | 0.08 |
|  | *(0.85)* | *(0.99)* |
| 8th Grade ELA Score (Std.) | -0.40 | -0.05 |
|  | *(0.89)* | *(0.99)* |
| 8th Grade Attendance Rate | 0.96 | 0.95 |
|  | *(0.05)* | *(0.06)* |
| Attend Regional Vocational School | 0.46 | 0.00 |
|  | *(0.50)* | *(0.06)* |
| On-Time HS Graduation Rate | 0.86 | 0.80 |
|  | (0.34) | (0.40) |
| Attend 2-Yr College | 0.35 | 0.26 |
|  | *(0.48)* | *(0.44)* |
| Attend 4-Yr College | 0.36 | 0.58 |
|  | *(0.48)* | *(0.49)* |
| College Graduate | 0.16 | 0.27 |
|  | *(0.37)* | *(0.45)* |
| Observations | 136591 | 500185 |

We present in Figure 1.2 the over- or under-representation of select student characteristics, relative to the statewide average (represented by the red line in each panel) by cluster and show variation. Perhaps the most striking differences relate to gender. Construction concentrators are 71% more male than the statewide average, with male students also widely over-represented in the Transportation, Manufacturing & Technology, and IT clusters. In contrast, male students are 84% less likely to concentrate in Education than the state, and are also underrepresented in Healthcare and Business & Consumer Sciences.

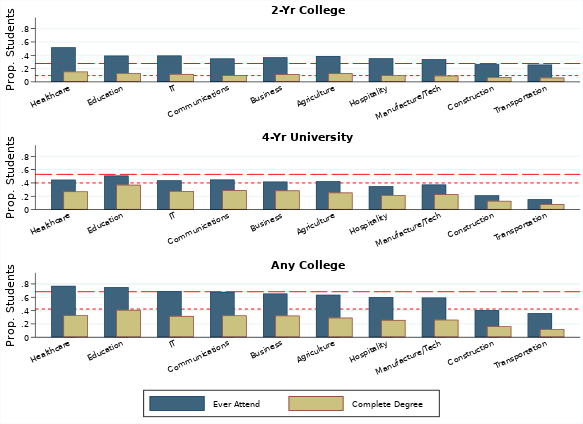
**Figure 1.2.** CTE concentrator characteristics in each career cluster compared to characteristics of the statewide student population

Notes: Each bar represents the odds ratio of student characteristics in a given career cluster, compared to the statewide average (represented by the red line). Career clusters in which a student demographic group is overrepresented are indicated by bars above the red line, and clusters in which student demographic groups are underrepresented are marked by bars below the red line. Sample all 9th grade public school students in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be CTE concentrators in a given career cluster if they are enrolled in CTE in that career cluster for at least two academic years.

Figure 1.2 (see also Table A1 in the appendix) also highlights that prior academic test scores also varies across clusters; while students scoring in the lowest quintile of 8th grade test scores are overrepresented in every cluster, low-scoring students are particularly present in Transportation, Hospitality & Tourism, and Construction. Substantial differences in selection into CTE also varies across clusters for lower income students, students with disabilities, and Black and Latinx students. Figure 1.2 also illustrates that while CTE concentrators as a whole are less likely to attend college than the statewide average, this varies widely by career cluster. In some (Healthcare, Education) students are descriptively somewhat *more* likely to lead to college than the statewide average, while in other clusters (Construction, Transportation) students are far less likely to enroll in college than the statewide average.

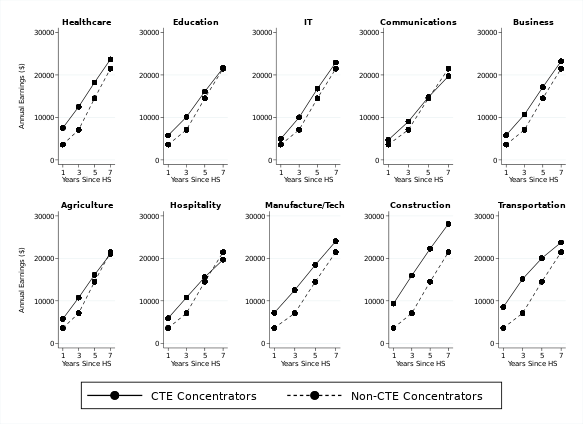
Underlying differences in the characteristics of students who become concentrators in the different career clusters cluster present a compelling case that we might consider each cluster as a distinct intervention, rather than one single program, broadly labeled as CTE. Since students who have access to and/or choose to opt into CTE vary so widely across cluster, it appears that students themselves may view the clusters quite differently. Thus, the construction of potential counterfactuals should account for those differences in models, and estimate different impacts by cluster.

**Figure 1.3.** CTE concentrators rates of college attendance and completion in each career cluster compared to statewide averages



Notes: Each bar represents the proportion of students in the specified career cluster who attend and complete at a given level, compared to the statewide averages indicated by the red dashed lines. Sample all 9th grade public school students in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples. Students are considered to be CTE concentrators in a given career cluster if they are enrolled in CTE in that career cluster for at least two academic years.

In Figure 1.3, we present descriptive differences in the rates of college-going and degree attainment, compared to the statewide averages (represented by the long red-dashed lines). Panel 1 shows that CTE concentrators in almost every cluster (Construction and Transportation excepted) are actually *more* likely to attend 2-year colleges than the statewide average; in some cases like Healthcare, the rate of 2-year college-going is especially stark. Yet, Panel 2 shows that concentrators in each cluster are less likely to attend and complete at a 4-year college (especially Construction and Transportation). Panel 3 demonstrates that, overall, there are substantial differences across cluster in how much more or less likely students are to attend any college; across every cluster, however, CTE concentrators are less likely to *complete* a college degree than the statewide average, though, again, this varies widely.

**Figure 1.4.** Annual earnings for CTE concentrators in each cluster compared to non-CTE concentrators, through 7 years after high school 

Notes: Sample all 9th grade public school students in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be CTE concentrators in a given career cluster if they are enrolled in CTE in that career cluster for at least two academic years. Non-CTE concentrators (constant across all panels) are those students not ever enrolled in CTE.

Finally, Figure 1.4 displays descriptive trends and differences in earnings across the different career clusters. First, CTE concentrators in *every* cluster earn more on average in the first years after their expected high school graduation than non-CTE concentrators, though this is at least partially due to non-concentrators being more likely to be in college (and therefore earning less, on average). Further analyses show that when considering only those students who do *not* enroll in college, CTE concentrators still maintain an advantage over non-CTE peers. By 5 and 7 years after expected high school graduation, non-CTE earnings increase rapidly, as many college-going students enter the workforce. Still, CTE concentrators in Construction, Manufacturing & Technology, Healthcare, and Transportation maintain their advantage over non-CTE concentrators. Finally, CTE concentrators’ earnings across the different clusters vary substantially at 7 years out. Using the most extreme example, the average Construction concentrator earns over $9,000 more than the average Communications concentrator.

*Analytic Approach*

While the primary aim of this analysis is to explore *heterogeneity* within CTE, we first establish the credibility of our analytic approach by fitting a model specified as follows:

(1)

Here, is a generic outcome for student *I,* in cohort *c,* and town *t*. The key predictor CTE is equal to 1 if student *i* is a CTE concentrator (zero otherwise), is a vector of student-level covariates including demographic characteristics and 8th grade test scores and attendance, represents fixed effects for entering cohort and represents fixed effects for town of residence. Errors are cluster by the town of residence. In all models is the coefficient of interest and represents the average student population difference for a given outcome associated with CTE concentrators, relative to otherwise similar non-concentrators. We also consider an alternate counterfactual group, students who take a single year of CTE but do not concentrate, which we discuss below in section 1.5.

Because of the variation in who becomes a CTE concentrator (across dimensions such as gender, disability status, and prior test scores, among others), strict causal identification of the effects of CTE presents challenges for researchers operating in the most generalizable settings. While a regression-based approach is prone to bias from unobserved variables that may predict selection into CTE, our approach does allow us to take advantage of a statewide database in which students engage with CTE in different contexts. This approach allows us to consider CTE in both CTE-dedicated settings and comprehensive school settings, *and* across a wide-ranging of career clusters, mirroring the different ways CTE is offered across American public schools.

While we cannot rule out the presence of unobserved factors predicting selection in CTE, and accordingly use non-causal language when interpreting our estimates, our models include a robust set of controls for student-level demographic information, 8th grade school attendance rates, and 8th grade test scores on state assessments (both mathematics and ELA), which account for unobservable characteristics that would influence *both* 8th grade academic test scores *and* selection into high school CTE; we also include cohort and town of residence fixed effects to account for differences in labor market trends and access to CTE offerings.

To demonstrate the merits of our approach, we fit a set of initial models that aim to show the stability of our estimates once we include a full set of controls. Following the argument in Altonji, Elter, and Taber (2005), we posit that stability in these estimates in the more saturated models is evidence that we have accounted for the most egregious sources of potential bias. Further below in section 1.5, we test the robustness of this assumption by applying the Oster (2019) approach to estimating how large the remaining bias would have to be to nullify our estimates.

In Table 1.2, we present our estimates of the relationship between CTE concentration and key student outcomes post-high school for the full student population (in the next section, we present heterogeneity of outcomes by student populations of interest and by career cluster) using five specifications of Model 1. Each specification sequentially adds controls to better isolate any difference in outcomes that might be associated with CTE concentration. Compared to Model 1, which shows unconditional differences in outcomes, Model 2 highlights that a large portion of these differences can be explained by the contexts in which students live, the years in which they enter high school, and the schools they can attend, namely through year and town of residence fixed effects. This also highlights that access to CTE offerings plays an important role, in driving unconditional differences in outcomes, but does not fully account for differences.

**Table 1.2.** Regression-adjusted estimates for CTE concentration on select outcomes for full sample

|  | **I** | **II** | **III** | **IV** | **V** |
| --- | --- | --- | --- | --- | --- |
| **Difference in 2-Yr College Attendance** | 0.089 | 0.068 | 0.082 | 0.055 | 0.049 |
| *Standard Error* | *0.008* | *0.007* | *0.008* | *0.008* | *0.007* |
| Observations | 636776 | 636776 | 636776 | 636776 | 636776 |
| **Difference in 4-Yr College Attendance** | -0.217 | -0.139 | -0.129 | -0.103 | -0.090 |
| *Standard Error* | *0.018* | *0.015* | *0.012* | *0.010* | *0.008* |
| Observations | 636776 | 636776 | 636776 | 636776 | 636776 |
| **Difference in Overall College Attendance** | -0.122 | -0.066 | -0.052 | -0.047 | -0.037 |
| *Standard Error* | *0.015* | *0.016* | *0.011* | *0.010* | *0.011* |
| Observations | 636776 | 636776 | 636776 | 636776 | 636776 |
| **Difference in 2-Yr College Degree Attainment** | 0.006 | 0.006 | 0.016 | 0.009 | 0.007 |
| *Standard Error* | *0.003* | *0.003* | *0.003* | *0.003* | *0.003* |
| Observations | 496856 | 496855 | 496856 | 496856 | 496855 |
| **Difference in 4-Yr College Degree Attainment** | -0.215 | -0.139 | -0.126 | -0.097 | -0.085 |
| *Standard Error* | *0.016* | *0.012* | *0.010* | *0.009* | *0.007* |
| Observations | 358485 | 358484 | 358485 | 358485 | 358484 |
| **Difference in Any College Degree Attainment** | -0.198 | -0.124 | -0.110 | -0.084 | -0.072 |
| *Standard Error* | *0.016* | *0.013* | *0.010* | *0.008* | *0.008* |
| Observations | 358485 | 358484 | 358485 | 358485 | 358484 |
| **1 Year Post-HS Difference in Earnings ($)** | 2921 | 2714 | 2740 | 2423 | 2403 |
| *Standard Error* | *159* | *143* | *150* | *135* | *132* |
| Observations | 636776 | 636776 | 636776 | 636776 | 636776 |
| **3 Year Post-HS Difference in Earnings ($)** | 4604 | 4245 | 4282 | 3692 | 3660 |
| *Standard Error* | *242* | *204* | *222* | *199* | *185* |
| Observations | 496856 | 496855 | 496856 | 496856 | 496855 |
| **5 Year Post-HS Difference in Earnings ($)** | 2995 | 3559 | 3665 | 3286 | 3456 |
| *Standard Error* | *223* | *284* | *237* | *195* | *182* |
| Observations | 358485 | 358484 | 358485 | 358485 | 358484 |
| **7 Year Post-HS Difference in Earnings ($)** | 1311 | 2716 | 2829 | 2568 | 2867 |
| *Standard Error* | *337* | *376* | *311* | *250* | *205* |
| Observations | 217636 | 217635 | 217636 | 217636 | 217635 |
| Controls for Demographic Characteristics | No | No | **Yes** | **Yes** | **Yes** |
| Controls for 8th Gr. Assessments & Attendance | No | No | No | **Yes** | **Yes** |
| Fixed Effects for Cohort & Town of Residence | No | **Yes** | No | No | **Yes** |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest, specified by row. Model I includes only an indicator of CTE concentration and the outcome of interest. Model II adds cohort and town of residence fixed effects, with errors clustered by town of residence. Model III includes controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, and disability status. Model IV adds 8th grade school attendance rates, and 8th grade test scores on state assessments (both Mathematics and ELA) to demographic controls. Model V includes both fixed effects and all controls. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples. For earnings outcomes, only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

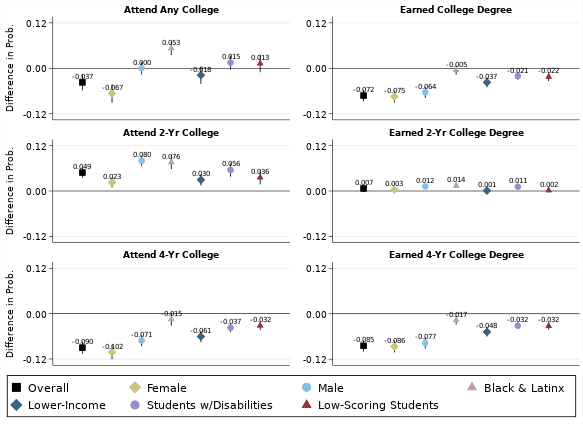
Adding student demographic characteristics (Model 3) also reduces the magnitude of the CTE concentration estimate. Model 4 adds controls for 8th grade state assessments and 8th grade attendance rates, which allow us to consider students within the context of their prior demonstrated test performance and attendance before students made choices about how to engage with CTE in high school. Finally, Model 5 includes all controls from the earlier models, as well as town and cohort fixed effects. Across all outcomes, the direction and significance of the estimates remain consistent across model specifications, lending confidence to the inference that there is some persistent contribution of CTE concentration to later outcomes. Throughout the rest of the paper, we present results using the specification from column 5 (our fully specified model in equation (1) above), which are the most conservative estimates given available data.

**1.4. Results**

*Postsecondary Outcomes*

In Figure 1.5 we present estimates of the relationship between CTE concentration and postsecondary outcomes (also presented in table form in Table A2 in the appendix). Each panel of Figure 1.5 presents for the overall student population of male and female students, and for several student populations of interests; in particular, we focus on student populations who have been historically underserved and for whom tracking into CTE might indicate “student dumping”. For reasons of sample size and statistical power, we present results for Black and Latinx students together, though findings are similar for both student populations. Moreover, we focus on student populations who have been historically underrepresented in higher education and have lower earnings, and thus are of particular interest to policymakers and researchers focused on CTE. Throughout the paper, overall results are presented first, with results then presented from left to right in order of most to least likely (descriptively) to attend college. Vertical bars on each coefficient result represent 95% confidence intervals, with bars not crossing 0 reaching significance at α=0.05. Throughout the paper, differences and advantages or disadvantages for CTE students that we discuss can be interpreted as statistically significant at the 95% level or better, unless otherwise noted. Looking first at the top-left panel of Figure 1.5, CTE concentration is associated with a 3.7 percentage point decrease on the extensive margin of attending any college; however, this estimate varies by student population. Male students see the greatest predicted decrease in college-going (6.7 percentage points), while female students see no difference in their overall rate of college-going. Conversely, Black and Latinx students see an increase in their likelihood of attending college (5.3). CTE concentration is associated with a decrease in overall degree attainment, though, interestingly, this relationship is less substantial in student groups that are currently underrepresented in college-going, and is insignificant for Black and Latinx students.

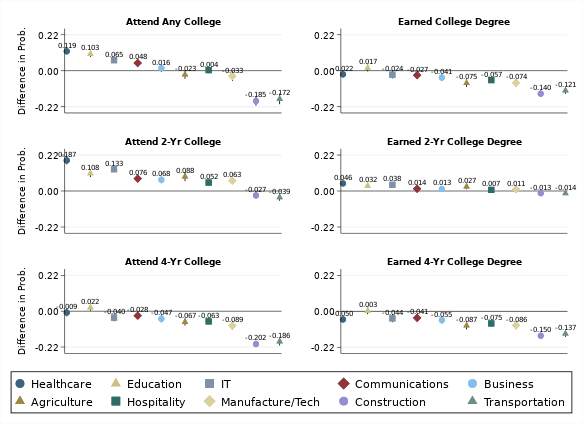
**Figure 1.5.** CTE concentrators’ college outcomes compared to similar non-concentrators, by student groups



Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both Mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples.

Figure 1.5 also presents results specifically for 2- and 4-year colleges. Here, CTE is associated with an *increase* in attending a 2-year college and smaller or insignificant decreases in 2-year college-going degree attainment across all student populations. However, CTE is associated with lower rates of attendance and completion at 4-year colleges (although, again, the negative associations are less prominent for Black and Latinx students). Overall, Figure 1.5 highlights a picture in which CTE is associated with a modest overall decrease in college-going and college degree attainment. While our approach cannot definitively speak to whether CTE leads some students to attend 2-year colleges rather than 4-year colleges, that pattern at the intensive margins of college enrollment would be consistent with these findings.

Figure 1.6 (also Table A3 in the appendix) explores the same education outcomes as above, but rather than comparing outcomes for CTE concentration more generally across different student populations, we now present differences in outcomes for CTE concentrators in each specific career cluster. For example, to estimate anticipated advantages from concentration in the Healthcare cluster, we compare Healthcare concentrators to non-CTE students who were otherwise similar on observable characteristics. For cluster-specific analyses here (and throughout the paper), concentrators in clusters other than the one under study are excluded, which allows us to examine the expected difference for students who become CTE students in a particular career cluster, compared to students who do not concentrate in CTE. Again, we arrange results from the clusters where students descriptively attend college at higher rates (Healthcare, Education) to the lowest rates (Transportation, Construction). Interestingly, even after accounting for student and local characteristics, the clusters with the highest college-going rates also see the strongest increases in the likelihood of college attendance. The differences between the rates of college attendance and degree completion for Healthcare and Education concentrators (11.9 and 10.3 percentage points) and those for Transportation and Construction (-18.5. and -17.2) are striking. For Transportation and Construction, this is driven almost entirely by large decreases in the likelihood of attending 4-year colleges (-20.2 and -18.6). Additionally, there are several clusters where students experience little to no change in their likelihood of attending college. In terms of degree attainment, decreases in college-going are especially notable for the less college-going clusters. Most of the clusters are associated with an increase in 2-year college-going, and in some cases, modest increases in 2-year college completion. Finally, some clusters (most notably Healthcare, IT, and Education) see large increases in overall and 2-year college attendance without an equivalent decrease in 4-year college attendance, suggesting that these clusters (which often require additional education to be completed at the 2-year college level) may be inducing some students to attend 2-yr colleges who otherwise might have stayed away from postsecondary education completely. Given that some career clusters (e.g., healthcare) are particularly aligned with community college level academic paths (i.e., nursing programs), the strong relationship with 2-year college attendance is noteworthy and likely speaks to the design of the pathways.

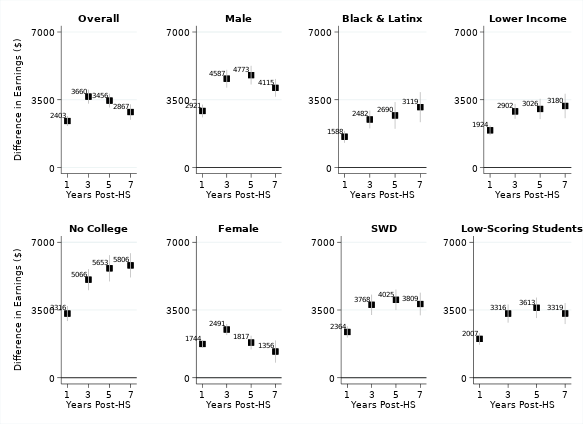
**Figure 1.6****.** CTE concentrators’ college outcomes compared to similar non-concentrators, by career cluster

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples.

*Earnings*

While policymakers have increasingly pointed to postsecondary education as an important intended outcome of CTE, another longstanding goal for students is to position themselves for increased earnings in their future careers. We turn now to the question of how students may benefit financially from their engagement with CTE.

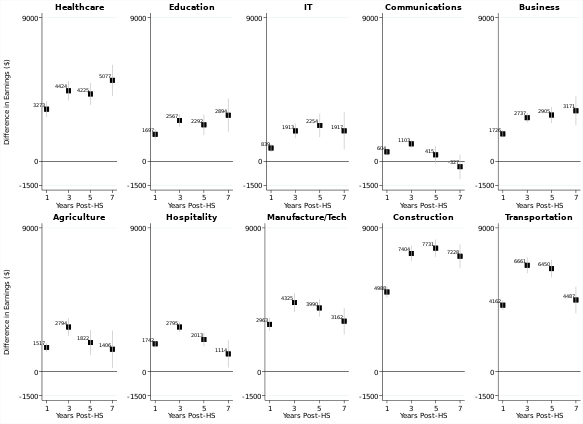
Figure 1.7 (Table A4 in the appendix) displays the predicted impact of CTE concentration 1, 3, 5, and 7 years after high school graduation, leveraging the same model used to estimate expected post-secondary education outcomes. Overall, CTE concentration is associated with a sizeable increase in initial earnings ($2,403 in the first year after high school), with strong advantages ($2,867 in annual earnings) persisting even 7 years after high school.

**Figure 1.7****.** CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by student populations of interest

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

Figure 1.7 also presents differences in who sees positive earnings advantages from CTE. Advantages are especially strong and persistent for students who do not attend any college within the first 7 years after high school graduation (whom we refer to as “No College”), with CTE No College students earning $5,806 more in the 7th post-High School year than otherwise similar “No College” peers who are not CTE concentrators. Echoing results from prior studies (Brunner et al., 2019), male CTE students see greater earnings increases than non-concentrators, while female students see only modest increases, which quickly diminish over time. Moreover, CTE is associated with an increase in earnings for several of the student populations who have been historically marginalized, especially students with disabilities, as well as lower-income students, Black and Latinx students, and students with the lowest 8th grade test scores.

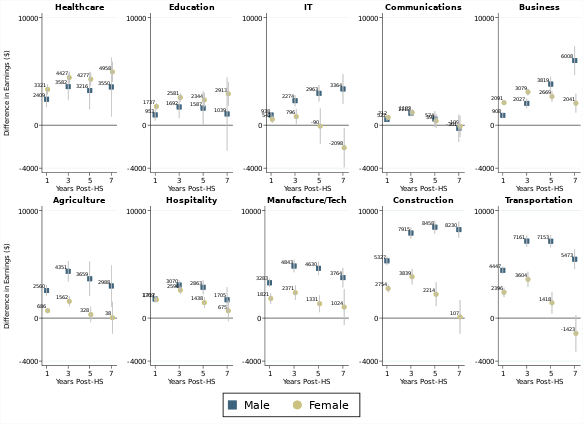
Figure 1.8 (Table A5 in the appendix) also explores the relationship between earnings and CTE concentration, here disaggregated by career cluster. The heterogeneity in these results across cluster is even greater than that across student populations presented in Figure 1.7, lending credence to the hypothesis that which cluster students engage in is especially crucial in determining whether and how their future earnings might benefit from CTE concentration. Looking across clusters, the strongest predicted increases in earnings are associated with the Construction, Transportation, Manufacturing & Technology, and Healthcare clusters, while students in Hospitality, Agriculture, and Communications see little-to-no predicted increase in their earnings, especially as students are further removed from high school graduation. In most clusters, the positive association with earnings begins to subside in years 5 and 7 (likely as college-goers reenter the workforce); still it is notable that in the career clusters with the highest predicted earning advantages (especially Healthcare and Construction), those earning increases remain substantial (though in Transportation, the advantage noticeably declines by 7 years after high school).

**Figure 1.8.** CTE concentrators’ annual earnings compared to similar non-concentrators, by career cluster 

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

*Earnings by Gender*

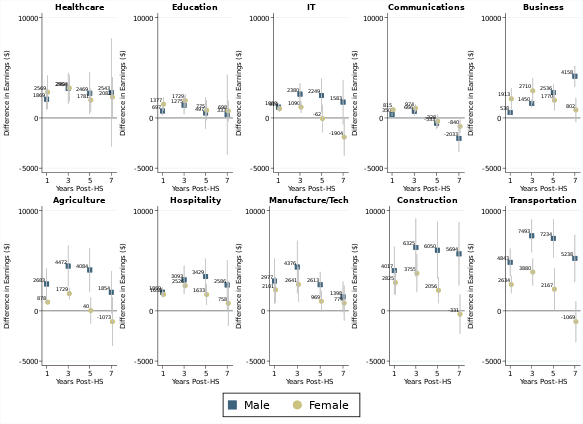
As Figures 1.7 and 1.8 jointly demonstrate, there are at least two distinct sources of heterogeneity driving differences in outcomes for students—different outcomes for different student populations and for students in different career clusters. Moreover, as descriptive results from Figure 1.2 illustrate, students with different characteristics often participate in different clusters. Given the strong relationship with CTE and higher earnings for male students and the strong relationship between higher earnings and the most male-dominated clusters (Construction, Transportation, and Manufacturing & Technology), Figure 1.9 seeks to unpack the extent to which the stronger earnings differences seen by males are mainly driven by their participation in more financially lucrative clusters. In Figure 1.9, we present the predicted change in earnings for males and females who participate in the *same* cluster to explore whether male and female students experience expected earnings benefits in the same way. Across the clusters, there are two distinctly different patterns. In several clusters—including the clusters with predominantly female enrollment, including healthcare and education—males and females appear to experience strong earnings advantages in similar ways, with mostly small or statistically insignificant differences. On the other hand, in male-dominated clusters like Transportation, Construction, IT and Manufacturing & Technology, male students experience substantially larger average increases in their earnings than do female students. Among Construction students, for example, CTE concentration for males is associated with over $8,000 more in increased predicted annual earnings 7 years after high school compared to non-concentrators, while female concentrators cannot expect any significant difference in their earnings over similar non-concentrators. Taken as a whole, male students are more likely to concentrate in the clusters associated with the highest increases in earnings, and even among students *within* those clusters, male students see stronger earnings advantages, while female students see little to none.

**Figure 1.9.** CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by career cluster and gender 

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

While there are many possible explanations for the differential advantages by gender including wage discrimination or unequal access into the most lucrative jobs within an industry, one possibility that can be explored using the UI data is that male and female concentrators within a CTE concentration may sort into different fields. For example, given the strong positive earnings advantages that accrue to male—but not female—Construction concentrators, one possibility may be that female Construction concentrators may simply be less likely to enter into a career in construction (whether by their own choice or otherwise). Using the UI data, we observe the industry in which individuals are employed 1, 3, 5, and 7 years after high school, and fit a model identical to the earlier models, except we add a fixed effect for the industry of employment (if individuals are employed in more than one industry in a year, we use the industry in which they received the highest earnings). In Figure 1.10, we present results showing that, while differential participation in industries may *partially* explain why male and female concentrators within the same cluster experience different earnings advantages, this does not appear to be the primary driver of the differences. In the two clusters with the largest gender gaps, for example, including fixed effects for employment industry only reduces the initial gender gap by 26% (Construction) and 9% (Transportation). This means, even for similar individuals who concentrate in the same CTE cluster and then go on to work in the same industry, gender-based wage gaps persist for the first seven years after high school.

**Figure 1.10.** CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by career cluster and gender, with industry fixed effects



Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

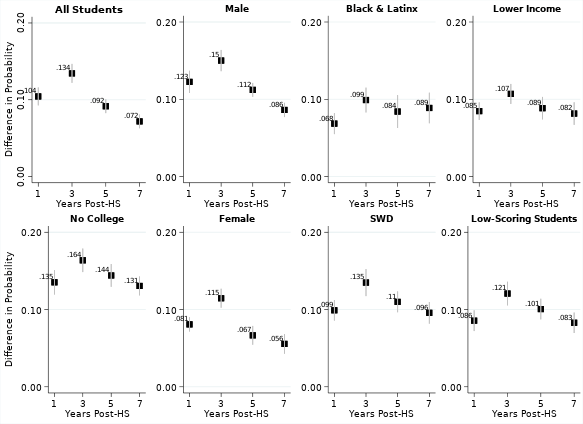
*Poverty and Disengagement*

While CTE may be thought of as a means to *increase* earnings and education, it has also often been seen as an educational model that might *reduce* adverse outcomes. This is of particular importance for students who face social and economic disadvantages that may make them vulnerable to negative outcomes after high school. CTE may therefore also be evaluated by the extent to which it reduces students’ likelihood of living in poverty, or of being Neither Employed nor in Education or Training (NEET, or disengaged), particularly for students who may have been vulnerable to those outcomes.

Figure 1.11 (Table A6 in the appendix) explores the relationship between CTE concentration and a binary indicator of whether a student earned above the poverty level in a given year. Given that the individuals in our sample are almost entirely ages 18–25, we use the single person threshold for poverty as specified by the U.S. Department of Health & Human Services, which ranges from $10,830 to $12,060 during the years under study. Looking first at the top left panel of Figure 1.11, it may not be surprising that CTE is especially associated with poverty avoidance in the early years, given that more non-CTE students are in college and therefore less likely to earn. However, while the positive relationship is not as strong by 5 and 7 years after high school, CTE students are still 7.2 percentage points more likely to avoid poverty, even 7 years after high school than similar non-CTE concentrators. Among “No College” students, the predicted difference is steadier and remains strong throughout the observed years. In the first year after high school, compared to non-CTE concentrators, CTE is associated with a 13.5 percentage point increase (and 13.1 by year 7) in the probability of avoiding poverty among “No College” students, a group that might be particularly at-risk for poverty. Again, male CTE concentrators see stronger earnings advantages than female concentrators. CTE concentrators with disabilities, lower-income students, Black and Latinx students, and those with low math scores, compared to non-CTE concentrators, also see a greater likelihood of poverty avoidance that is statistically significant through the 7th year after high school graduation. This lends strength to the argument that CTE may help students avoid poverty, at least in the early years of their adulthood.

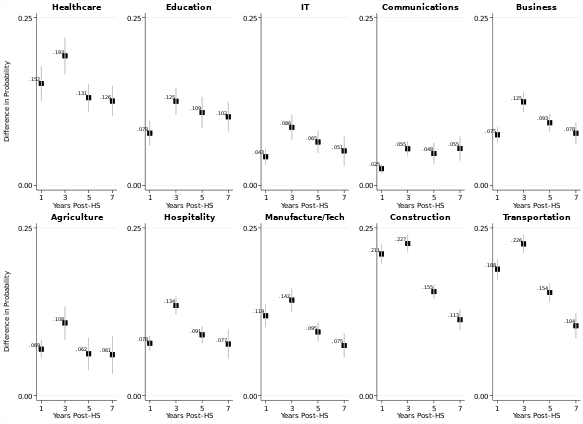
Figure 1.12 (Table A7 in the appendix) considers the relationship between poverty avoidance and the various career clusters. Again, the strongest predicted earnings benefits in the immediate post-high school years accrue to Construction and Transportation. Across all career clusters, CTE concentrators continue to be substantially more likely to *at least* earn above the poverty threshold than other observable factors would suggest, even 7 years after high school when most college-going students would have reentered the workforce.

**Figure 1.11.** CTE concentrators’ difference in likelihood of earning at or above the federal poverty level compared to similar non-concentrators, by student populations of interest



Notes: Estimates are the coefficient associated with CTE concentration on the probability of earning about the federal individual poverty threshold 1, 3, 5, and 7 years after on-time high school graduation. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

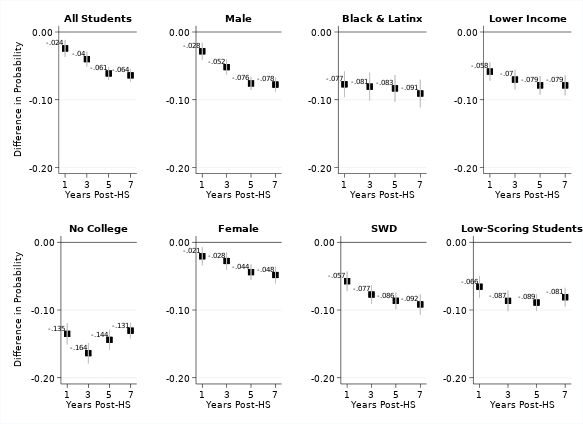
**Figure 1.12.** CTE concentrators’ difference in likelihood of earning at or above the federal poverty level compared to similar non-concentrators, by career cluster



Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the probability of earning about the federal individual poverty threshold 1, 3, 5, and 7 years after on-time high school graduation. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

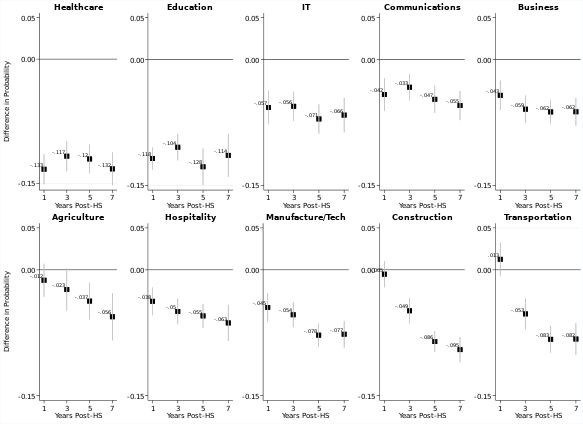
In Figures 1.13 and 1.14, we turn to a measure of disengagement that combines both education and earnings to assess the extent to which a young adult is Neither Employed nor in Education or Training (NEET). We consider someone to be NEET if they fail to *either* earn above the single-person poverty threshold (as set out in Figures 1.11 and 1.12), *or* to be enrolled in any postsecondary institution in that year. In Figure 1.13 (Table A8 in the appendix), we find some support for CTE participation to reduce overall disengagement, particularly students who do not go to college. Figure 1.13 highlights that CTE may be especially useful in helping key student populations of interest avoid disengagement, and again, may have a stronger impact for men than women. Figure 1.14 (Table A9 in the appendix) continues to find heterogeneity across cluster, with the most encouraging associations between CTE concentration and lower likelihoods of NEET status among students in Healthcare, Education, Construction, and Transportation compared to non-CTE concentrators.

**Figure 1.13*.*** *CTE concentrators’ difference in likelihood of being neither employed nor in education or training (NEET) compared to similar non-concentrators, by student groups*



Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. Student are considered to be NEET if they are neither enrolled in education nor earning at or above the federal poverty level at the specified time period. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

**Figure 1.14.** CTE concentrators’ difference in likelihood of being neither employed nor in education or training (NEET) compared to similar non-concentrators, by career cluster



Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. Student are considered to be NEET if they are neither enrolled in education nor earning at or above the federal poverty level at the specified time period. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

**1.5. Limitations**

A key limitation of these findings involves the possibility of omitted variable bias, and in particular selection bias associated with the extent to which students select into CTE (or into specific career clusters). While the inclusion of pre-high school assessment scores and fixed effects alleviate these concerns to some degree, we follow the example of Oster (2019) by examining the extent of selection on unobservable characteristics that would be needed to invalidate our results. We present the results of this test in Table 1.3 for select outcomes of interest, using both ***Rmax*** proposed by Oster of ***Rmax***=1.3*R*, and a more conservative ***Rmax***=2*R*. The coefficient bound on each outcome of interest tells us the range of possible coefficients on (CTE Concentration) from a model with no unobserved bias to potential models with unobserved characteristics explaining 30% as much selection as our observed characteristics. If 0 does not fall within this range, it tells us that unobserved bias would need to explain more than 30% as much as observed characteristics. The bias **δ** represents how many times as large as observed characteristics the unobserved factors would need to be in order to nullify the results. We next take a similar approach but with ***Rmax***=2*R*. Given that no coefficient bounds include 0 and all bias **δ**s are greater than 1, we can conclude that selection on unobservables would need to be larger than on observables to invalidate results (and in many cases, far larger).

Another threat to our results is the rolling nature of our sample. Given time limitations on our data, the results presented include different analytic samples; although we include cohort fixed effects in all models, some composition threats may remain. In Tables A10 and A11 in the appendix, we present results that only include cohorts that can be observed for the full 7 years after high school graduation. These results are generally similar to the earlier results presented in Tables A4 and A5.

We might also worry that students who never take CTE courses are not an appropriate counterfactual group for these analyses; in particular, if our observed characteristics do not account for potential differential selection into the different career clusters. In Tables A12 and A13 in the appendix, we compare students to a second counterfactual group, students who took one year of courses (but no more than one year) in the same cluster, relying on the assumption that students taking one year of Agriculture classes, for example, appear to show some interest in Agriculture and might be a more suitable comparison. These results show a mix of similar and different findings; however, we posit that this second group is *not* an appropriate counterfactual. Students taking only a single year in a career cluster are relatively rare, and exceedingly rare at the CTE-dedicated schools, in which CTE concentration is required. As such, this counterfactual primarily consists of students at comprehensive high schools who take a CTE course as an elective, rather than indicating a more substantial interest in CTE.

Finally, we might also worry that results are driven primarily by a particular type of school—especially a CTE-dedicated school that has been the focus of most recent quasi-experimental CTE research. In Table A14 in the appendix, we examine results among only those students residing in towns that were *not* eligible for a vocational/technical school. While there are small differences, the sign and significance of these results mirror the findings from the full sample, indicating that the results found in the original analyses are not solely driven by CTE-dedicated schools. In fact, in Table A15, we present results for only those students residing in towns eligible for a vocational/technical school and find results very similar to those of the full sample. In Tables A16 and A17 in the appendix, we approach this idea in a different way, looking only at those students who attend comprehensive high schools (i.e., did not attend a CTE-dedicated school). While this removes one key mechanism through which CTE may matter in Massachusetts (type of high school attended), the results in Tables A16 and A17 illustrate that the associations between CTE and later outcomes largely hold (albeit somewhat diminished) even at comprehensive high schools.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1.3.** Estimates of coefficient bounds and bias needed to find null results | | | | | | | | | |  |
|  | **2-Yr College Attend** | **4-Yr College Attend** | **Any College Attend** | **2-Yr College Degree** | **4-Yr College Degree** | **Any College Degree** | **1 Year Post-HS Earnings** | **3 Yr Post-HS Earnings** | **5 Yr Post-HS Earnings** | **7 Yr Post-HS Earnings** |
| **CTE Concentrator Difference** | 0.049\*\*\* | -0.090\*\*\* | -0.0373\*\*\* | 0.007\*\*\* | -0.085\*\*\* | -0.072\*\*\* | 2402\*\*\* | 3660\*\*\* | 3456\*\*\* | 2867\*\*\* |
| ***Standard Error*** | *0.007* | *0.008* | *0.011* | *0.003* | *0.007* | *0.008* | *132* | *185* | *182* | *205* |
| **Coefficient Bound (*Rmax* =1.3R)** | (.049, .043) | (-.09, -.074) | (-.037,-.028) | (.007, .007) | (-.085,-.067) | (-.072,-.055) | (2402, 2228) | (3660, 3316) | (3456, 3404) | (2867, 2912) |
| **Bias δ**  **(*Rmax* =1.3R)** | 7.16 | 5.06 | 3.83 | -20.14 | 4.33 | 3.97 | 6.59 | 5.23 | 24.05 | -200.12 |
| **Coefficient Bound (*Rmax* =2R)** | (.049, .029) | (-.09, -.034) | (-.037,-.005) | (.007,.008) | (-.085,-.023) | (-.072,-.014) | (2402, 1803) | (3660, 2482) | (3456, 3278) | (2867, 3024) |
| **Bias δ**  **(*Rmax* =2R)** | 2.32 | 1.58 | 1.16 | -6.07 | 1.35 | 1.23 | 2.99 | 2.44 | 9.35 | -66.16 |
| **R-Squared** | 0.045 | 0.256 | 0.191 | 0.039 | 0.221 | 0.209 | 0.069 | 0.055 | 0.037 | 0.042 |

Notes: CTE Concentrator Difference, Standard Errors, and R-Squared are from Model 1 and include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Coefficient bounds refer to the range of estimates associated with CTE Concentration on each outcome (by column) as the degree of selection on unobservables increases from none to 30% (row 3) or to 100% (row 5) of selection on observables. Bias **δ** represents the amount of selection on unobservables that would be needed to move estimates of the CTE Concentrator Difference to 0. Calculations of coefficient bourns and Bias **δ**s were conducting using the “psalcalc” STATA package (Oster, 2019).

**1.6. Conclusions and Policy Implications**

One challenge for evaluating the success of CTE programs is that it can be difficult to identify optimal outcomes. Some may view academic and college preparation as a primary goal, particularly given the economy’s increasing reliance on jobs that require postsecondary education (Carnevale et al., 2015; Holzer & Baum, 2017). Others may argue that CTE should prepare students for high-wage, high-growth jobs that they are qualified for immediately after their high school CTE experience. Ideally, CTE programs might prepare students for both college and career, as both federal and Massachusetts state policy have emphasized in recent years. One key finding from these analyses is that different CTE programs appear to help students attain different positive outcomes to varying degrees.

Figure 1.15 demonstrates that the relationship between CTE and different student outcomes vary across student populations. Black and Latinx, Lower-Income concentrators, and those scoring poorly in 8th grade tests all see both higher income and greater rates of postsecondary enrollment. Overall, we find evidence that CTE is associated with higher student predicted earnings, as well as a decrease in postsecondary enrollment, indicating a potential set of trade-offs for CTE students (knowingly or unknowingly) who participate in CTE. For male CTE concentrators, the differences in these predicted outcomes compared to male students who are not CTE concentrators, are especially marked. This is likely in part because of the different, more lucrative career clusters in which males participate.

As Figure 1.16 highlights, some career clusters are more positively associated with higher earnings, while others are more associated with higher rates of postsecondary enrollment and degree attainment. Some clusters, like Healthcare, Education, and IT are associated with increases in both dimensions. Other clusters, like Construction and Transportation, might represent a trade-off for students, in which students may attain higher earnings, but have a lower likelihood of college attendance. It is worth noting that these differences may be by design. Some programs, like Healthcare and Education, neatly tie into a postsecondary pathway, and students participating in these may receive explicit preparation and encouragement to pursue post-secondary education. Other career clusters, like Construction and Transportation may encourage direct entry into the workforce through apprenticeship and direct-to-work programs. Encouragingly for supporters of CTE, no clusters fall in the bottom left quadrant of Figure 1.16; all clusters point to at least *some* increases in either earnings or post-secondary participation.

By considering a wide range of outcomes, different relationships across the career clusters, and different anticipated outcomes to CTE across student populations, we present a nuanced picture of the wide range of heterogeneity within CTE. For advocates of CTE, these results offer encouraging evidence that CTE is associated with positive labor market outcomes, particularly for male students and students from historically marginalized backgrounds. Some of the labor market advantages may be partially offset by a decrease in college-going, particularly at the 4-year college level, at least in the first years after high school. However, earnings advantages persist for CTE concentrators even 7 years after high school, at which point most college attenders will have re-entered the workforce. Given the nature of many CTE programs, it might make intuitive sense that some CTE concentrators may be more likely to develop the skills and professional network that allow them to enter the workforce immediately after high school. For some, postsecondary education may come later, as students are better able to afford college and as they may seek additional education and training to advance in their careers.

**Figure 1.15.** CTE concentrator differences in education and earnings outcomes, by student populations of interest

**Figure 1.16.** CTE concentrator differences in college participation and earnings outcomes, by career cluster

Finally, we find suggestive evidence that CTE may be beneficial in preventing some of the worst possible outcomes for students—poverty and disengagement—as CTE is associated with an increased likelihood of earning at or above the federal poverty level and a decreased likelihood of being completely disengaged from both education and employment. These benefits of CTE are especially strong for students who do not enter college in the first 7 years after high school. As policymakers consider ways to help their most vulnerable students avoid these negative post-high school outcomes, CTE may be an especially attractive option. Moreover, while some of the traditional vocational career clusters like Construction, Transportation, and Manufacturing and Technology are associated with lower levels of college attendance and degree attainment, they are associated with the strongest pay-offs in terms of expected earnings.

As many states and districts consider their menu of CTE offerings, these findings have important implications for researchers and policymakers. Importantly, CTE outcomes are different for different types of CTE career clusters and across different student populations. Some career clusters may offer stronger benefits than others, while some students might be more poised to realize those benefits than others. In some cases, CTE may represent a set of trade-offs between attaining early career earnings and participating in postsecondary education, though these trade-offs manifest themselves in heterogeneous ways. Ultimately, our findings encourage a re-framing of conversations around CTE that move beyond the standard consideration of CTE as a single, monolithic curricular policy, to one that embraces the substantial heterogeneity across the many different student populations and programs under the broader CTE umbrella.

## Chapter 2: CTE Teacher Licensure and Long-Term Student Outcomes

*The second chapter of this report is a quantitative analysis that addresses the second research topic identified by DESE, the associations between CTE teacher qualifications and later student outcomes.*

**2.1. Introduction**

CTE shows great promise to improve post-secondary educational and earnings outcomes for students from a wide range of backgrounds (e.g., Hemelt & Lenard, 2018), and despite a decline in CTE course-taking between 1990 and 2009, there has been a resurgence of interest in CTE (e.g., Jacob, 2017). In Massachusetts, the setting of this study, the percentage of high school students engaged in CTE has increased from 10% in 2004 to 15% in 2014 (Dougherty & Harbaugh Macdonald, 2019), and causal research has linked attendance in Massachusetts’s RVTSs that offer “Chapter 74-approved programs” (defined below) to better longer term outcomes for students such as college graduation and industry-recognized certification (Dougherty, 2019). But despite a large body research showing that *academic* teachers consistently make the largest contribution in influencing student testing outcomes (e.g., Rivkin et al., 2005; Rockoff, 2004) and that teacher effectiveness predicts long-run outcomes like postsecondary enrollment and earnings (e.g., Chetty et al., 2014a; Theobald et al., 2020), very little research has examined the relationships between characteristics of CTE teachers (such as their years of experience and types of licensure) and the later outcomes of the students they teach.

Moreover, Massachusetts’s Chapter 74-approved programs include teacher licensure requirements that allow for unique insights into the experience and preparation that CTE teachers bring to the profession. The experiences and preparation of CTE teachers have not yet been connected to student post-secondary outcomes in prior research. Specifically, in Massachusetts, CTE teachers are required to pass CTE subject-specific written and performance tests to receive licensure to teach in Chapter-74 approved programs. These tests are intended to measure the knowledge of prospective CTE teachers in the specific courses they aim to teach, similar to subject-specific licensure tests taken by *academic* teachers (e.g., Praxis II, WEST-E; see Goldhaber et al., 2017). To date we are not aware of any research that has connected these novel measures of CTE teacher competencies to post-secondary student outcomes.

Therefore, we use longitudinal data from Massachusetts that link high school students in Chapter 74 programs both to their teachers in high school and to their later outcomes such as college attendance, college completion, and subsequent earnings to investigate the following two research questions:

1) Are CTE teachers’ experience and licensure status (e.g., whether or not they are licensed in the same CTE area that they teach) predictive of their students’ college attendance, college completion, and later earnings?

2) Are CTE teachers’ subject-area licensure test scores (i.e., from written and performance tests) predictive of their students’ college attendance, college completion, and later earnings?

The report proceeds as follows. Section 2.2 describes the background of CTE in Massachusetts and Massachusetts CTE teacher licensure. Section 2.3 discusses the data used for this report and the empirical model. Section 2.4 presents results and Section 2.5 concludes.

**2.2. Background**

*Chapter 74 programs in Massachusetts*

In addition to the requirements for Federal Perkins IV CTE programs, Massachusetts General Law Chapter 74 sets a more stringent set of standards that define “Chapter 74-approved programs” in the state. This designation requires that students receive CTE education consistent with standards outlined in Massachusetts Vocational Technical Education Frameworks that are aligned with business and industry standards. This setting forms a compelling area of study as prior studies—both descriptive (CEP, 2011; Fraser 2008) and causal (Dougherty, 2018)—suggest that students who participate in these CTE programs have positive benefits relative to their peers who do not participate in Chapter 74-approved programs. Moreover, Chapter 74-approved programs occur across a variety of settings: RVTS high schools where students are drawn from surrounding communities and all students participate in CTE; and Chapter 74-approved programs that are located at comprehensive high schools. We focus solely on the teachers and students in these two types of Chapter 74 programs because the licensure tests that are the focus of this study are required only for Chapter 74 programs. This study excludes other forms of CTE offered in the state, such as “Perkins Only” programs in comprehensive high schools.

CTE teacher candidates are required to earn a Chapter 74 Vocational Technical Education License before they can teach in Chapter 74-approved programs. For a preliminary license (the most common beginning teaching license in the state), a teacher candidate must possess all of the following:

* + - 1. A suitable degree (ranging from a high school diploma/GED to Bachelor’s degree);
      2. Three to 5 years of documented employment experience in the field of the license (depending on the field); and
      3. Passing scores on CTE subject matter tests and literacy skills tests, described below.

In addition, for those areas of licensure that require it (e.g. Automotive Services Excellence certification), teacher candidates must also have a state or national occupational license or certification.

*Written and performance subject matter tests*

CTE teacher candidates must pass both written and performance subject matter tests in order to receive a preliminary Vocational Technical Teacher License. The written test contains 100 multiple choice questions that pertain to a given Chapter 74 program. These questions are intended to assess the candidate’s vocational technical subject matter knowledge and the candidate’s level of technical literacy to teach a given program as described by Massachusetts frameworks.[[1]](#footnote-2) For example, the written test in electronics covers Direct Current (15%), Alternating Current (15%), Semiconductors (20%), Combinational Logic (20%), Sequential Logic (15%), and Safety and Troubleshooting (15%). The minimum passing score on this exam is 70 points out of 100.

Only after passing the written examination can candidates register for a performance subject matter test. The performance examination requires candidates to demonstrate their skills in a “hands-on” setting, in which an evaluator assesses their vocational technical skills and related knowledge. For instance, the performance examination in electronics requires the candidate to perform tasks in each of the following areas:

* Fabrication (29%; identify resistors, compute tolerance range limits, etc.)
* Analog (38%; Construct an amplifier circuit to specifications, construct and test a power supply, etc.)
* Digital (33%; identify gates, wire a flip-flop, etc.)

Performance in each area counts towards a total score, scaled from 0 to 100 points, with a minimum passing score of 70 points. It is not clear from published materials to what degree this scoring is based on objective or subjective criteria—for instance, some tasks may be evaluated on a continuum of quality (e.g., demonstrate a bevel cut) while other task are either incorrect or correct (e.g., use Ohm's Law to calculate resistance). As such, we use caution when interpreting results relating to performance subject test scores and discuss these concerns more below.

**2.3. Method**

**Table 2.1.** Student characteristics by cohort

|  | All | Cohort (by expected graduation year) | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| ***Demographics*** |  |  |  |  |  |  |  |
| White | 0.715 | 0.730 | 0.742 | 0.721 | 0.741 | 0.691 | 0.703 |
| African American | 0.049 | 0.054 | 0.055 | 0.055 | 0.043 | 0.047 | 0.052 |
| Hispanic | 0.183 | 0.165 | 0.154 | 0.166 | 0.165 | 0.204 | 0.195 |
| American Indian | 0.003 | 0.002 | 0.003 | 0.003 | 0.002 | 0.003 | 0.003 |
| Asian | 0.027 | 0.029 | 0.027 | 0.031 | 0.025 | 0.028 | 0.027 |
| Multiracial | 0.022 | 0.020 | 0.018 | 0.023 | 0.023 | 0.026 | 0.019 |
| FRL | 0.440 | 0.457 | 0.435 | 0.445 | 0.435 | 0.459 | 0.423 |
| SPED | 0.222 | 0.214 | 0.209 | 0.227 | 0.223 | 0.223 | 0.223 |
| LEP | 0.027 | 0.013 | 0.019 | 0.021 | 0.029 | 0.028 | 0.030 |
| ***Outcomes*** |  |  |  |  |  |  |  |
| Two year college enrollment | 0.287 | 0.386 | 0.357 | 0.346 | 0.302 | 0.282 | 0.223 |
| Four year college enrollment | 0.285 | 0.301 | 0.308 | 0.312 | 0.303 | 0.269 | 0.265 |
| Two year college completion | 0.065 | 0.102 | 0.089 | 0.071 | 0.050 | X | X |
| Four year college completion | 0.165 | 0.166 | 0.165 | X | X | X | X |
| Earnings X years after high school: | | | | | | | |
| 1 | $10,674 | $8921 | $9169 | $9693 | $10,203 | $11,143 | $11,647 |
| 3 | $16,398 | $14,333 | $15,534 | $16,079 | $16,245 | $17,141 | X |
| 5 | $23,245 | $21,673 | $23,291 | $23,694 | X | X | X |
| Unique student count | 60512 | 7579 | 8632 | 9969 | 11370 | 11449 | 11513 |

*Notes: This table presents summary statistics for students who participate in a Chapter 74 CTE programs and are matched to at least one CTE teacher. The columns present demographics for all students in the sample, and according to cohort, defined using expected graduation year. Outcomes for two year and four year college completion are limited to cohorts 2011 to 2014 and 2011 to 2011 and 2012, respectively, as later cohorts cannot be observed to complete college by our most recent year of NSC data (2018). Similarly, earnings outcomes are also limited to cohorts we can observe earnings in our most recent year of UI data (2019).*

*Sample*

This report focuses on the teachers and outcomes of students who are identified in the Student Information Management System (SIMS) as participating in a Chapter 74-approved program in high school. Students must be matched to teacher records in the Employment Personnel Information Management System (EPIMS) in order to associate teacher qualifications to student outcomes; this matching is done via the Student Course Schedule (SCS), first available in 2011. As described by Table 2.1, these three data sources allow us to focus on six cohorts of students with expected graduation dates from 2011 to 2016. This sample contains 60,512 unique students across Grades 9 to 12—notably, observations of students are not balanced because early cohorts are only observed in later grades at the earliest point in the data (e.g., cohort 2011 is only observed in 12th grade while cohort 2012 is observed in 11th and 12th grade). The matching strategy described above identified 2,331 unique teachers who are matched to at least one student record, of whom 823 have at least one performance subject test score.

Table 2.1 also describes a few notable features about the sample of students who participate in CTE. First, the proportion of white students has declined somewhat in recent years (from 0.73 to 0.70) while Hispanic enrollment has increased (0.17 to 0.20) and the percentage participating in Special Education and LEP has also increased.

**Table 2.2.** CTE teacher experience, alignment, and licensure test performance

|  |  |  |  |
| --- | --- | --- | --- |
| Sample: | All teachers | Taken performance subject test | |
|  |  | Any subject | Aligned test |
| ***Workforce characteristics*** |  |  |  |
| Experience | 10.52 | 4.79 | 4.64 |
| Novice | 0.15 | 0.31 | 0.32 |
|  |  |  |  |
| ***Alignment/misalignment*** |  |  |  |
| Aligned | 0.81 | 0.83 | 0.91 |
| Different program | 0.08 | 0.04 | 0.01 |
| Different CTE cluster | 0.05 | 0.03 | 0.00 |
| No license | 0.07 | 0.09 | 0.08 |
|  |  |  |  |
| ***Licensure tests*** |  |  |  |
| SD of subject area score |  | 0.11 | 0.14 |
|  |  |  |  |
| Unique Teacher Observations | 2331 | 823 | 736 |

*Notes: This table presents summary statistics for a sample of CTE teachers who are matched to at least one student who participates in a Chapter 74 CTE program. The columns present demographics for all CTE teachers in the sample, those who take at least one subject test, and those who have taken performance subject tests in the same CTE program area in which they instruct students.*

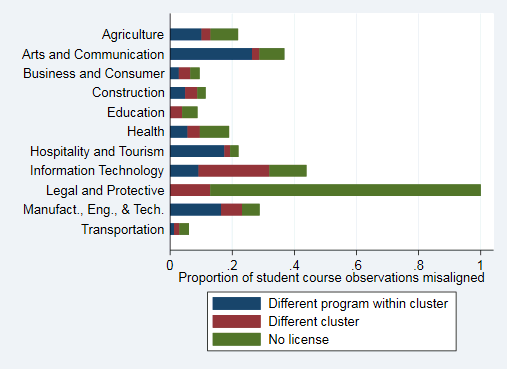
*Experience and alignment between licensure and teaching*

Massachusetts has set high standards for licensure to teach Chapter 74-approved programs. With these high standards comes the potential challenge of finding prospective CTE teacher candidates to fill these roles. To explore this, Table 2.2 uses the data above to explore CTE teacher experience and the degree to which programs are taught by licensed CTE teachers. We determine years of teaching experience using longitudinal records on teaching staff from EPIMS and count the number of school years in which we observe a given CTE teacher.[[2]](#footnote-3) Novice teacher is an indicator for CTE teachers who have 2 or fewer years of experience in Massachusetts. We also define four measures to capture the degree of alignment from fully aligned to no CTE qualifications. The first is aligned—the CTE teacher has a license that is appropriate for the program in question by the time instruction is complete. The second is “different program”—the CTE teacher has a license within the *CTE* *cluster*, but not the exact program. The third measure is “different CTE cluster”—the CTE teacher is not licensed in the same broad area that they teach, but they have a CTE license in some other cluster. And fourth, the CTE teacher does not have any CTE license. In any given year, students can be assigned to multiple teachers within a program, or multiple programs—as such we define each of these measures at the level of a “student-by-program/teacher” observation. For example, a student can have two teachers for Carpentry, where one holds an aligned license while the other is unlicensed. The pairing of one student with two teachers results in two observations for the analysis.

In general, the rate of licensure is quite high: only about 7% of observations are associated with an unlicensed CTE teacher.[[3]](#footnote-4) Relative to the high proportion of observations associated with a CTE licensed teacher, there is somewhat less *alignment* between the program area and the licensure area (81%). About 8% of observations are taught by teachers who have a license in the same cluster as the program, but not the same field within that cluster, and about 5% of observations are taught by teachers who are licensed in other clusters.

The degree of alignment between teachers and the programs they teach varies greatly by cluster, as shown by Figure 2.1. For example, in the Information Technology cluster, about 44% of observations are taught by teachers certified in a different (not Technology) cluster. Of the remaining students, roughly 13% of observations are associated with CTE teachers with licenses in the IT cluster but not the IT field of the program and 12% are taught by unlicensed CTE teachers. In contrast, in Arts and Communication 26% of observations are taught by teachers licensed in the correct cluster but in a program in which they are not licensed—twice as many Arts and Communications programs are taught by teachers licensed in the correct cluster but in a different program than IT.

**Figure 2.1.** Proportion of student course observations misaligned by cluster



*Addressing observable differences across students*

Research on *academic* teachers has long indicated that disadvantaged students are not equitably assigned to high-quality *academic* teachers (e.g., Goldhaber et al., 2015). Thus, associations between teacher qualifications and student outcomes may reflect student-teacher assignments or other potential sources of bias. Table 2.3 provides some evidence of this by comparing pre-high school student characteristics across different CTE teacher measures. The first column describes the characteristics of CTE students in the sample as a whole. For example, the average 8th grade math test scores of CTE students is about -0.39 *SD* below the average 8th grade student in the state. The largest differences in student characteristics are related to the teacher performance test, as programs served by CTE teachers with low scores on the performance subject test tend to have students with considerably lower 8th grade test scores (-0.444 vs. -0.383) and more students of color (particularly Hispanic students, 25.0% vs. 15.2%). Said simply, it is important to control for prior test scores because students who are assigned to lowest decile teachers will tend to have lower test scores relative to their peers *irrespective of their CTE instruction.* We attempt to account for these sources of non-random sorting in the models described in Section 4.

**Table 2.3.** Student demographics by licensure alignment and licensure test performance

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | All | Alignment/misalignment by type | | | |  | Subject test | |
|  |  | Aligned | Different class | Different cluster | No license |  | Not lowest decile | Lowest decile |
| ***Demographics*** |  |  |  |  |  |  |  |  |
| Math test score | -0.387 | -0.392 | -0.306 | -0.396 | -0.404 |  | -0.383 | -0.444 |
| ELA test score | -0.372 | -0.379 | -0.278 | -0.385 | -0.365 |  | -0.375 | -0.442 |
| White | 0.715 | 0.723 | 0.730 | 0.640 | 0.628 |  | 0.755 | 0.653 |
| African American | 0.049 | 0.046 | 0.059 | 0.063 | 0.073 |  | 0.043 | 0.056 |
| Hispanic | 0.183 | 0.179 | 0.156 | 0.237 | 0.233 |  | 0.152 | 0.250 |
| American Indian | 0.003 | 0.003 | 0.004 | 0.003 | 0.003 |  | 0.003 | 0.003 |
| Asian | 0.027 | 0.026 | 0.027 | 0.037 | 0.040 |  | 0.025 | 0.018 |
| Multiracial | 0.022 | 0.022 | 0.024 | 0.019 | 0.023 |  | 0.022 | 0.020 |
| FRL | 0.440 | 0.434 | 0.425 | 0.499 | 0.498 |  | 0.404 | 0.492 |
| SPED | 0.222 | 0.223 | 0.214 | 0.209 | 0.223 |  | 0.224 | 0.223 |
| LEP | 0.027 | 0.026 | 0.013 | 0.034 | 0.044 |  | 0.023 | 0.034 |
| ***Outcomes*** |  |  |  |  |  |  |  |  |
| Two year college enrollment | 0.287 | 0.282 | 0.328 | 0.337 | 0.287 |  | 0.267 | 0.277 |
| Four year college enrollment | 0.285 | 0.279 | 0.327 | 0.296 | 0.318 |  | 0.276 | 0.249 |
| Two year college completion | 0.065 | 0.063 | 0.083 | 0.074 | 0.060 |  | 0.064 | 0.057 |
| Four year college completion | 0.165 | 0.160 | 0.195 | 0.147 | 0.209 |  | 0.165 | 0.114 |
| Earnings X years after high school: |  |  |  |  |  |  |  |  |
| 1 | 10674 | 10869 | 9736 | 10059 | 9349 |  | 11231 | 10823 |
| 3 | 16398 | 16670 | 15029 | 16059 | 14275 |  | 17036 | 16392 |
| 5 | 23245 | 23547 | 21687 | 23076 | 21674 |  | 24357 | 22778 |
|  |  |  |  |  |  |  |  |  |
| Unique student count | 60512 | 56917 | 12051 | 7235 | 16460 |  | 33258 | 13667 |

*Notes: This table presents summary statistics for students who participate in a Chapter 74 CTE programs and are matched to at least one CTE teacher. The columns present demographics for all students in the sample, by whether the CTE teacher has a relevant CTE license, and by whether the CTE teacher has a lowest-decile test score on the performance subject test.*

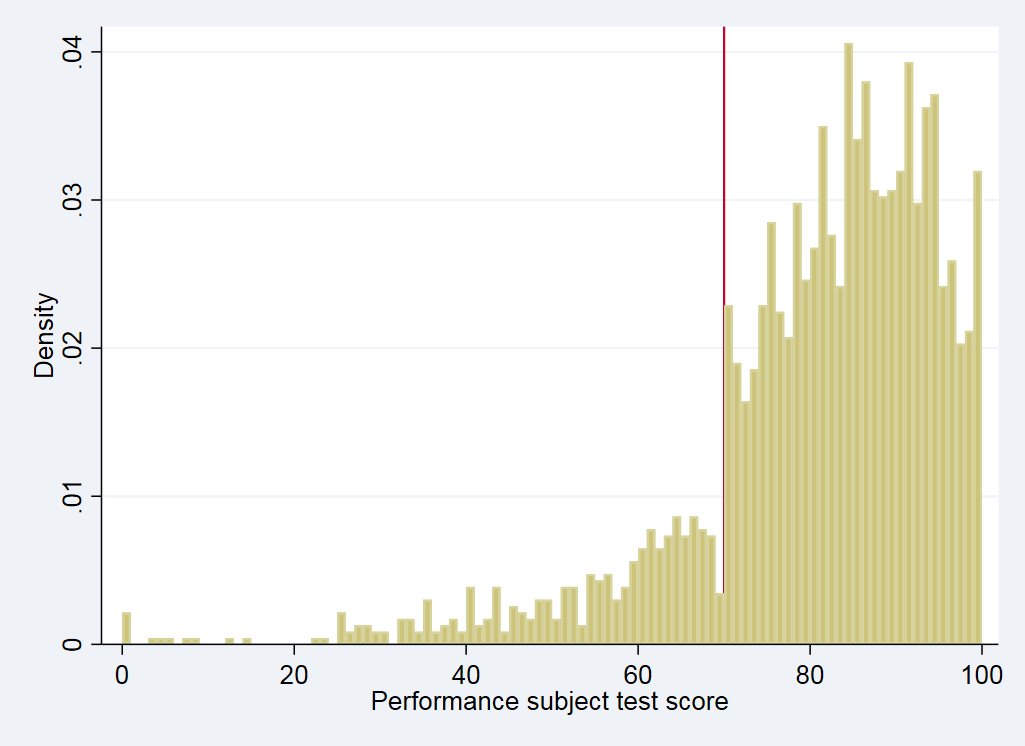
*Outcomes*

This report focuses on 2- and 4-year college enrollment and completion, and labor market earnings at different points after students’ expected high school graduation: 1, 3, and 5 years. This information comes from National Student Clearinghouse (NSC) data, available through 2017, and UI data available through 2018. One challenge is the importance of observing “long-run” earnings, which we define as earnings that are plausibly post-college for most students. For instance, a CTE program that encourages or requires 4-year college enrollment would likely decrease earnings 1 to 4 years after high school relative to students who directly enter the labor market, even if earnings are higher post-college. This is difficult because our ability to measure long-run outcomes is limited by the number of years cohorts can be observed, and later cohorts are observed for fewer years. As shown in Table 2.1, we can observe 5-year earnings outcomes only for cohorts 2011, 2012, and 2013. Similarly, we limit our analysis of 2-year college completion to cohorts 2011, 2012, 2013, and 2014 to allow for at least 3 years of post-high school observations in NSC data, and we limit our analysis of 4-year college completion to cohorts 2011 and 2012 to observe at least 5 years.

*Distributions of performance and written subject test scores*

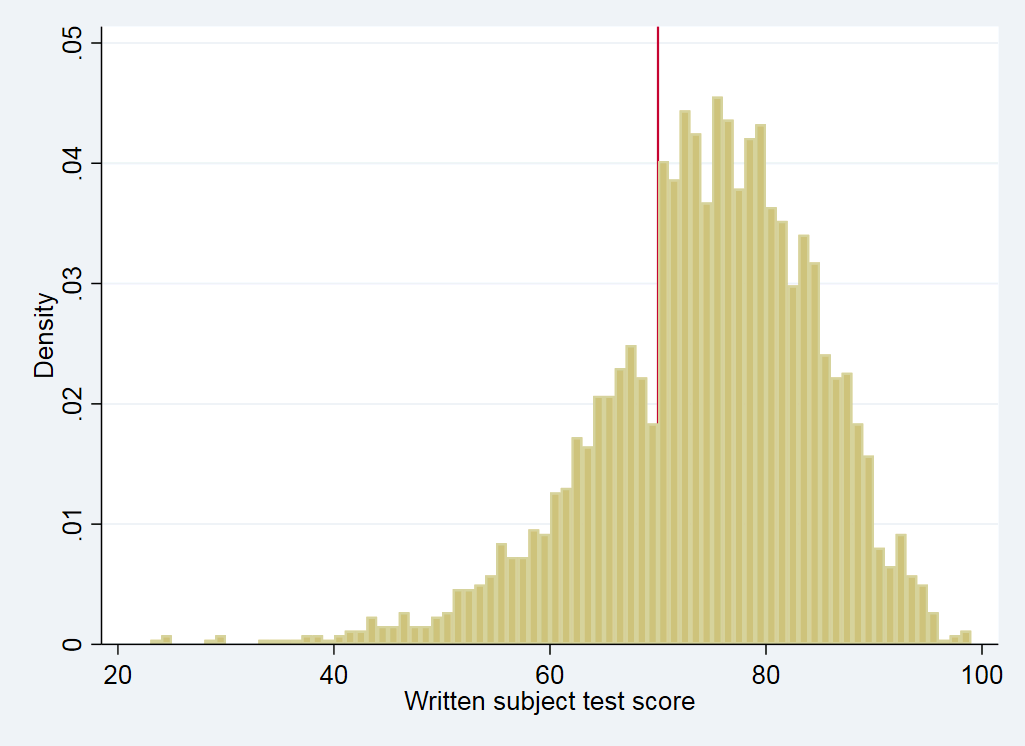
As described above, the grading of the performance subject test may be more subjective than for the written teacher licensure tests. Figure 2.2 shows the distribution of scores for the performance subject test. This is limited to “first time” test takers and pooled across subjects. These test scores range from zero to 100, with a minimum passing score of 70 points indicated by the vertical line. There is a substantial discontinuity in the distribution of test scores at this point; that is, there are nearly two times as many scores just above the 70 point cutoff as below. This is unlikely to happen by random chance, though it is unclear from the available data why this discontinuity exists. That said, a potential concern that is relevant for the analysis described in the next section is that scores just above the cutoff capture some unobservable characteristics of individuals taking the test and/or those assessing test takers are associated with receiving a passing score. We therefore consider one robustness test that drops scores within 5 points of the 70 point passing score.

**Figure 2.2.** Distribution of performance subject test scores



Interestingly, Figure 2.3 shows a similar distribution of scores for the written subject test. While this distribution is much more continuous across the range of possible scores, there is still a sizable discontinuity in the density of observations at the 70-point cutoff. As with the performance test, it is unclear from available data why this discontinuity exists, so we pursue the same robustness check in the next section that drops scores within 5 points of the 70 point passing score.

**Figure 2.3.** Distribution of written subject test scores



*Analytic Approach*

Naïve estimates of the relationship between CTE teacher qualifications and student outcomes are likely to be influenced by two sources of selection bias. First, students choose to participate in CTE, and are subsequently sorted into particular CTE clusters, programs, and possibly teachers via tracking. This type of selection confounds our estimates if high-achieving students (as measured by 8th grade MCAS scores) select into programs with more qualified teachers more frequently than their lower-achieving peers, and these high-achieving students also have better outcomes regardless of their teacher’s CTE instruction. This concern is particularly salient because, as discussed above, Table 2.2 indicates that student characteristics, such as 8th grade MCAS scores, are higher for students assigned to CTE teachers with better qualifications.

A second potential source of selection bias is related to high school tracking in academic courses. Prior academic studies provide evidence that academic tracking can confound estimates of teacher quality (e.g., Jackson, 2014); in the context of CTE, tracking of students is likely to differ across CTE programs with different academic expectations for courses meant to lead to college enrollment. For example, students enrolled in applied STEM programs are likely to be assigned more advanced coursework than students enrolled in programs like carpentry—moreover, highly qualified CTE teachers could encourage students to take more advanced coursework regardless of student’s program area. If this advanced coursework leads to better postsecondary outcomes, then it would be misattributed to CTE teachers.

We attempt to address these issues by estimating models that implicitly compare students in the same school and CTE cluster, who take the same academic courses, who had similar math and ELA test scores in 8th grade, and similar demographics and school program participation. Our identification rests on the assumption that students within the same CTE cluster and school do not nonrandomly sort to CTE teachers with better qualifications along *unobservable* dimensions. We provide full methodological details in Appendix B.

**2.4. Results**

*Experience and alignment*

Table 2.4 reports regression coefficients that associate a novice teacher indicator (relative to more experience teachers), and indicators for *aligned*, *different program, different cluster* (relative to no CTE license) to seven different student outcomes represented as columns: enrollment and completion in 2- and 4-year colleges, and earnings 1, 3, and 5 years after a student’s expected graduation date. It is important to note that, while the types of alignment differ by cluster, these estimates attempt to compare students *within the same cluster*.

**Table 2.4.** Estimated associations between experience and alignment and student outcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | College Outcomes | | | | |  | Earnings after X years: | | | |
|  | Enroll  2yr | Enroll  4yr | | Degree 2yr | Degree 4yr |  | 1 | 3 | 5 | |
| ***Experience*** | | |  | | | | | | |
| Novice | -0.006\*\* | -0.001 | | 0.004\* | 0.012\* |  | 124.581 | -47.434 | 807.252\* | |
|  | (0.003) | (0.003) | | (0.002) | (0.007) |  | (88.062) | (148.048) | (440.402) | |
|  |  |  | |  |  |  |  |  |  | |
| ***Alignment/misalignment*** | | |  | | | | | | |
| Aligned | 0.001 | -0.009\* | | 0.005 | 0.013 |  | 350.582\*\*\* | 414.421\*\* | -369.598 | |
|  | (0.004) | (0.005) | | (0.003) | (0.012) |  | (116.271) | (204.365) | (439.753) | |
| Different program | 0.014\*\* | -0.019\*\* | | 0.017\*\*\* | 0.019 |  | 177.860 | 204.834 | -745.893 | |
|  | (0.007) | (0.008) | | (0.005) | (0.015) |  | (190.531) | (308.080) | (591.966) | |
| Different cluster | -0.006 | -0.022\*\* | | 0.000 | 0.011 |  | 279.928 | 388.540 | -456.130 | |
|  | (0.008) | (0.009) | | (0.005) | (0.015) |  | (256.892) | (477.449) | (626.327) | |
|  |  |  | |  |  |  |  |  |  | |
| Observations | 408974 | 408974 | | 191241 | 45176 |  | 408974 | 300763 | 93073 | |
| Adjusted R2 | 0.090 | 0.251 | | 0.061 | 0.246 |  | 0.083 | 0.088 | 0.117 | |

*Notes: This table presents estimated coefficients from a linear regression where the dependent variable is indicated by the column. Each specification includes a cubic of 8th grade math and ELA scores, student demographics, and track by program indicators. Standard errors use two-way clustering on student and teacher IDs. See Tables 2.1 to 2.3 for sample definitions and outcome definitions.*

Beginning with Panel A, Column 1, the reported coefficient for Novice suggests that students assigned to novice CTE teachers are 0.6 percentage points less likely to attend 2-year colleges than students of experienced teachers—while Column 2 reports essentially no relationship between teacher experience and 4-year college enrollment (-0.1 percentage point). Interestingly, assignment to a novice teacher is associated with somewhat higher rates of 2-year and 4-year college completion that assignment to an experienced teacher. The last three columns report earnings after a student’s expected graduation date. There is little relationship between assignment to a novice teacher and earnings 1 or 3 years after high school, but there is marginally significant evidence of higher earnings 5 years out. This increase in average long-run earnings could reflect the higher likelihood of degree completion discussed above and the associated labor market returns.

Panel B presents coefficients for *aligned*, *different program, different cluster* (relative to no CTE license), as defined in Section 2.3. Students who are assigned to CTE teachers with a license in the program of instruction are about as likely to enroll in a 2-year college as students who are taught by CTE teachers without any CTE license. They are slightly less likely to attend 4-year colleges, though this outcome is only marginally statistically significant, and there is no statistically significant difference in degree completion relative to students taught by unlicensed CTE teachers. In contrast, students who are assigned to “aligned” CTE teachers have higher earnings 1 and 3 years after expected graduation—while relationships with long-run earnings are not statistically significant and imprecisely estimated.

We next investigate, for students who are *not* assigned to aligned teachers, whether it is better to have a teacher who at least has a license in the correct cluster relative to a teacher with no CTE license. We find that students who are assigned to teachers licensed in a *different* *program* have higher 2-year college enrollment rates and completion, and lower 4-year college enrollment rates, than students assigned to CTE teachers with no license, all else equal. And while we find little evidence that *a teacher teaching a program level course that he or she is not licensed in* is associated with higher or lower earnings, these estimates are quite imprecise.

Lastly, we examine if assignment to CTE teachers with licenses in a different cluster is better than assignment to a CTE teacher with no CTE license. We find that *different cluster* is associated with lower 4-year college enrollment, but not with degree completion or earnings.

In summary, alignment at the program level has positive impacts on earnings, while alignment at other levels is associated with mixed or negative college outcomes for students. These findings are generally consistent with the idea that the specific skills and knowledge required by CTE licensure *for a given program* are predictive of student earnings outcomes.

*Subject matter tests*

Next, we turn our attention to the subject matter tests, which include performance and written test scores. In Tables 2.5 and 2.6, each panel shows a different postsecondary outcome for 2- and 4-year college enrollment, and 2- and 4-year college completion; as well as earnings 1, 3, and 5 years after high school. For each score, we consider two types of specifications: 1) the “average score” across CTE subject areas (e.g., a teacher who scored 80 in carpentry and 90 in plumbing performance tests has an average score of 85), and 2) “matched subject scores,” performance test scores specific to the area of instruction being taught (e.g., the above teacher has the carpentry score applied only to students in a carpentry program). The estimates in Table 2.5 suggest that a CTE teacher’s scores on the written test are not associated with either college enrollment or college completion. There is some evidence that higher performance subject test scores are associated with higher 4-year college enrollment, but this is only marginally statistically significant and close to zero.

**Table 2.5.** Estimated associations between licensure test scores and college outcomes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Specification: | Average score | Matched score | Average score | Matched score |
| ***Panel A: Two year college enrollment*** |  |  |  |  |
| Performance subject test score | -0.001 | 0.000 |  |  |
|  | (0.002) | (0.003) |  |  |
| Written subject test score |  |  | 0.000 | -0.001 |
|  |  |  | (0.002) | (0.003) |
| Observations | 126065 | 78615 | 125393 | 76750 |
| Adjusted R2 | 0.093 | 0.100 | 0.093 | 0.100 |
| ***Panel B: Four year college enrollment*** |  |  |  |  |
| Performance subject test score | 0.004\* | 0.008\* |  |  |
|  | (0.003) | (0.004) |  |  |
| Written subject test score |  |  | 0.001 | 0.005 |
|  |  |  | (0.002) | (0.004) |
| Observations | 126065 | 78615 | 125393 | 76750 |
| Adjusted R2 | 0.250 | 0.261 | 0.253 | 0.265 |
| ***Panel C: Two year college completion*** |  |  |  |  |
| Performance subject test score | 0.001 | 0.002 |  |  |
|  | (0.002) | (0.003) |  |  |
| Written subject test score |  |  | 0.002 | 0.000 |
|  |  |  | (0.002) | (0.002) |
| Observations | 52985 | 36641 | 53158 | 35782 |
| Adjusted R2 | 0.077 | 0.080 | 0.076 | 0.081 |
| ***Panel D: Four year college completion*** |  |  |  |  |
| Performance subject test score | 0.006 | 0.004 |  |  |
|  | (0.007) | (0.007) |  |  |
| Written subject test score |  |  | -0.011\*\*\* | -0.003 |
|  |  |  | (0.004) | (0.005) |
| Observations | 11016 | 9086 | 11117 | 8930 |
| Adjusted R2 | 0.272 | 0.272 | 0.280 | 0.279 |

*Notes: This table presents estimated coefficients from a linear regression where the dependent variable is indicated by the panel title and the independent variable of interest is indicated by the column title. Each specification includes a cubic of 8th grade math and ELA scores, student demographics, and track by program indicators. Standard errors use two-way clustering on student and teacher IDs. See Tables 2.1 to 2.3 for sample definitions and outcome definitions.*

**Table 2.6.** Estimated associations between licensure test scores and earnings outcomes

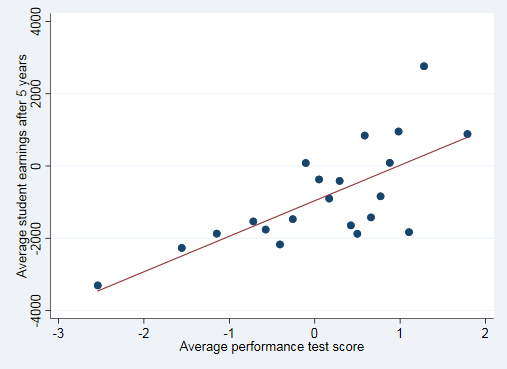
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Specification: | Average score | Matched score | Average score | Matched score |
| ***Panel A: Earnings 1 year after high school*** | |  |  |  |
| Performance subject test score | 115.683 | 134.086 |  |  |
|  | (73.163) | (124.649) |  |  |
| Written subject test score |  |  | 31.186 | 104.747 |
|  |  |  | (76.081) | (130.868) |
| Observations | 126065 | 78615 | 125393 | 76750 |
| Adjusted R2 | 0.092 | 0.104 | 0.093 | 0.104 |
| ***Panel B: Earnings 3 years after high school*** | |  |  |  |
| Performance subject test score | 307.540\*\* | 361.246 |  |  |
|  | (129.653) | (221.553) |  |  |
| Written subject test score |  |  | 25.491 | 360.129\* |
|  |  |  | (116.192) | (215.391) |
| Observations | 88395 | 56192 | 88205 | 54830 |
| Adjusted R2 | 0.092 | 0.102 | 0.090 | 0.100 |
| ***Panel C: Earnings 5 years after high school*** | |  |  |  |
| Performance subject test score | 906.531\*\*\* | 978.887\*\*\* |  |  |
|  | (307.664) | (339.039) |  |  |
| Written subject test score |  |  | 30.385 | 874.333\*\* |
|  |  |  | (281.091) | (362.879) |
| Observations | 24261 | 20170 | 24331 | 19730 |
| Adjusted R2 | 0.123 | 0.124 | 0.119 | 0.122 |

*Notes: This table presents estimated coefficients from a linear regression where the dependent variable is indicated by the panel title and the independent variable of interest is indicated by the column title. Each specification includes a cubic of 8th grade math and ELA scores, student demographics, and track by program indicators. Standard errors use two-way clustering on student and teacher IDs. See Tables 2.1 to 2.3 for sample definitions and outcome definitions.*

The results for earnings (Table 2.6) stand in sharp contrast. Both performance test scores, and to a lesser extent written test scores, are significantly positively predictive of earnings 3 and 5 years after high school. Across each panel, the point estimates are very similar between average performance test scores and subject-specific test scores; this could indicate that the ability to succeed on the performance test is a good general predictor of student earning outcomes. Interestingly, the matched performance test scores are much more important for written test: even 5 years after high school, where differences in earnings results are largest, an increase in the average written score only increases earnings by about $30 and is not statistically significant, while a one SD increase in a matched performance subject test score (i.e., a test score specific to the area of instruction) is associated with an $874 increase in earnings. Lastly, point estimates for average performance test scores and matched written test scores are roughly similar in magnitude; this could indicate that both tests capture a teacher’s knowledge of subject-specific CTE skills.

Figure 2.4 presents a graphical interpretation of the results for performance test scores shown in Table 2.6. We residualize student earnings 5 years after expected high school graduation to control for the factors described in Section 2.3 and calculate the average residualized outcome by CTE teacher—in other words, we remove the portion of student earnings that can be explained by other factors such as student test scores. Lastly, we plot the residualized earnings for students according to the performance subject test scores that they are assigned to, averaged within percentiles of five points. One conclusion from Figure 2.4 is that there is considerable heterogeneity in outcomes as performance scores increase, meaning that the variation in student outcomes associated with teacher test scores becomes greater as teacher test scores increase. More related to the research questions, though, Figure 2.4 shows an overall pattern consistent with Table 2.6—a 1 *SD* increase in teacher performance on these tests is associated with about a $1000 increase in average annual expected earnings. Figure 2.4 also suggests a linear relationship, so that increasing the performance of the lowest scoring teachers has the same impact of increasing the performance of the highest.

**Figure 2.4.** Relationships between CTE teacher subject performance licensure test scores and student earnings five years after expected high school graduation



**2.5. Conclusions**

This chapter of the report leverages longitudinal, student-teacher links to examine the association between Chapter 74 teacher experience and licensure test scores with student postsecondary outcomes (e.g., 2- and 4-year college-going, 2- and 4-year college completion, and earnings) while controlling for CTE program participation, high school tracking, and a rich set of student demographics including 8th grade test scores. The most notable finding is that CTE teachers who received better scores on subject performance tests required for Chapter 74 licensure tend to have students with higher longer term earnings than CTE teachers who received worse scores on these tests, all else equal. Specifically, a 1 *SD* increase in teacher performance on these tests is associated with a $900 increase (about 3.9%) in annual earnings 5 years after expected graduation, at approximately age 23. To place the magnitude of this estimate into context, Chetty et al., (2014b) find that a 1 *SD* increase in academic teacher value added for students’ elementary teachers is associated with a 1.3% increase in annual earnings at age 28. These findings are descriptive, and despite considerable controls in our model for student background characteristics and tracking, it is possible that these estimates do not reflect the causal impacts of CTE teachers with higher licensure test scores on student earnings. That said, this is to our knowledge the first empirical evidence about the predictive validity of CTE licensure tests in predicting student outcomes and suggests that the skills and knowledge captured by these tests are important for student learning and long-run student outcomes.

We also find that teachers who are licensed in the program area in which they teach tend to have students with higher future earnings, all else equal. This comports with theories about CTE teacher licensure that CTE teacher preparation and prior work experience (which are required to be licensed) are important for student post-secondary outcomes (e.g., Walter & Gray, 2002). Other findings are less intuitive. For example, the positive association between CTE teachers’ novice status and later student earnings contrasts with research on academic teachers, where positive returns to experience are commonly observed (e.g., Rice, 2013). However, there are reasons to think that CTE may introduce unique dynamics that are not present for academic courses. One issue is that workforce connections of CTE teachers may be an important mechanism through which students have improved employment outcomes. For example, novice CTE teachers are more proximate to their prior industry employment than veteran CTE teachers, and may be better able to place students in work studies, make recommendations, and provide references to bridge the gap between education and employment.

Finally, while this is the first study to our knowledge that has connected specific characteristics of CTE teachers to later outcomes of their students, the results should only be generalized to the specific setting of the study (i.e., Chapter 74 CTE programs in Massachusetts). This suggests future research on this topic—for example, in Perkins-approved programs in Massachusetts or CTE programs in other states—is vital to better understand the contribution of CTE teachers to long-term student outcomes.

## Chapter 3: Student Entry into Regional Vocational Technical High Schools in Massachusetts

*The third chapter of this report is a mixed-methods analysis that addresses the final research topic identified by the Massachusetts Department of Elementary and Secondary Education, student entry into the state’s regional and vocational technical schools (RVTSs).*

**3.1. Introduction**

Researchers have long noted that high-quality career and technical education (CTE) may provide an important pathway for improved, long-term outcomes for disadvantaged students, including students of color and economically disadvantaged students (e.g., Spalding et al., 2015), but empirical evidence to support this conclusion is still lacking (Dougherty & Lombardi, 2016). In particular, while prior research on CTE in Massachusetts and other states tends to find that disadvantaged students disproportionately enroll in CTE courses compared to their more advantaged peers (e.g., Cullen et al., 2013; Dougherty, 2018; Stange & Kreisman, 2014), three recent CTE trends raise concerns about access to CTE. First, despite a national increase in applied STEM course taking over the past decade (Theobald et al., 2019), disadvantaged students have not benefited from this increase and are underrepresented in STEM courses (Dougherty & Harbaugh, 2018). Second, emerging career academies—for example, a career academy in North Carolina focused on information technology and studied by Hemelt et al. (2020)—tend to enroll disproportionately high-performing students. Third, though research suggests that advanced CTE coursework is more important than introductory CTE courses (Kreisman & Strange, 2020), disadvantaged students are less likely to “concentrate” in CTE by earning three or more credits (NCES, 2013) and hence are less likely to enroll in advanced CTE courses.

In Massachusetts, the setting of this report, debates have raged about access to the state’s RVTSs, particularly since these schools rely on an application system rather than the lottery system used by many of the state’s charter schools, and many RVTSs are oversubscribed. On one side, advocates of the RVTS system point to causal research (Dougherty, 2018) demonstrating the positive impacts of attending these schools on long-term student outcomes, and the resulting benefits to the state economy (e.g., Birmingham & Murray, 2020). But on the other hand, critics of the RVTS system point to the selective application process that may have implications for access to the RVTS system for low-performing and disadvantaged students (e.g., Jonas, 2020).

In this chapter, we seek to inform these policy debates by better understanding the entry of students into the RVTS system in Massachusetts. We collected data utilizing four strategies: 1) interviews with guidance counselors at focal middle schools; 2) student surveys of 8th grade students at these same middle schools; 3) student focus groups with a sample of 8thgrade students at these middle schools; and 4) administrative data on 8th grade students from all regions and schools in the state.[[4]](#footnote-5) We use these data to address two research questions:

1. What are guidance counselor and student perceptions of the RVTS application process?
   1. What are the most important factors for 8th grade students as they consider their high school choices?
   2. What sources of information do 8th grade students receive to help inform their choices about high school?
   3. What, if any, additional activities might be helpful for students as they consider their high school choices?
2. What observable characteristics of 8th-grade students are predictive of entry into the RVTS system?

For the remainder of this mixed-methods chapter, we refer to our investigation of these research questions as the “qualitative” (RQ1) and “quantitative” (RQ2) portions of the study, though there are quantitative aspects of our investigation of RQ1 and vice versa. Section 3.2 describes our qualitative and quantitative methodology, Section 3.3 discusses the results aligned with each research question above, and Section 3.4 offers some conclusions.

**3.2. Method**

*Qualitative Methodology*

We identified two regions in Massachusetts that included a RVTS. In one region, the RVTS was moderately oversubscribed, while in the other region the RVTS was heavily oversubscribed. A representative from DESE reached out to all superintendents of the sending middle school districts to invite their participation in the study. The data components of the study included: 1) interviews with all guidance counselors who work with 8th-grade students in these schools; 2) an online survey intended for all 8th grade students in each school; and 3) a focus group with 8th-grade students in each middle school. The students who participated in the focus groups were selected by the guidance counselors, based on scheduling or other considerations. The views of these students should not be interpreted as representative of all 8th grade students in these schools.

Interviews with guidance counselors focused on their perceptions of the RVTS application process in their region. Specifically, guidance counselors were asked about the types of students from their schools who tend to apply to the regional RVTS, the activities or supports that the school offers these students, and the process for these students to apply to the RVTS (see full interview protocol in Appendix C). The student surveys were proctored by administrators in each middle school and included questions about students’ RVTS application plans, sources of information about the application process, and perceptions of the supports provided by their schools (see full student survey in Appendix D). Finally, the student focus groups included questions about student perceptions of the regional RVTS and their reasons for either applying or not applying (see full focus group protocol in Appendix E). The research design and protocols were reviewed and approved by the Institutional Review Board at the American Institutes for Research.

In one region, we collected data from all the sending middle schools, while in the other region we collected data from a subsample of the sending schools. In total, our sample included 11 middle schools across both regions. While these regions are not representative of the state, they provide a window to better understand student’s transition to high school. These data were collected in January and February 2020, before schools closed due to the public health crisis that required a shift to remote instruction in Massachusetts and across the country.

*Quantitative Methodology*

We used state administrative data on all 8th graders in the state and created indicators for whether those students attend an RVTS in 9th grade. We then fit a series of models to predict the probability that a student attended an RVTS. These models were estimated for three samples: a statewide sample and for the two samples of students in each of the two regions (moderately oversubscribed and heavily oversubscribed). All models estimated the probability that a student enrolled in an RVTS in 9th grade as a function of their 8th grade MCAS scores in math and ELA, observable demographic characteristics, indicators for disability, English language learner (ELL), and subsidized meal eligibility, as well as indicators for town of residence. The last element of modeling ensured that we were only comparing students who resided in the same town and thus faced similar constraints and opportunities with respect to their proximity to and eligibility to attend a RVTS.

**3.3. Results**

***RQ1. What are guidance counselor and student perceptions of the RVTS application process?***

***Findings from Guidance Counselor Interviews***

We interviewed all guidance counselors who work with 8th grade students in the 11 middle schools across the two regions. The goal of these interviews was to understand the guidance counselors’ perspectives about the students’ transition from middle school to high school, including the types of activities they offer students and additional supports they thought might be helpful for students to understand their high school options and the transition to high school. In both regions, we found a wide variation in the activities offered to support students’ transition to high school. The most common activities were open houses for the comprehensive high schools and the RVTS. These open houses were often organized by the high schools and offered during the weekend or evening. Other activities offered by the middle schools included: career fairs, voluntary meetings with guidance counselors, presentations in class, and interest inventories.

In both regions, guidance counselors describe some degree of scarcity of the slots available at the RVTS. They reported that some students who would benefit from a “hands on” education do not get in because of either grades or discipline issues in middle school. A counselor explains, “I feel that kids who we know would benefit from the trades are not given the opportunity. Because of their discipline or grades. They’re not top-notch students. A traditional classroom setting is not for them. And, then they’re being told you have to go to [a traditional high school]. Because they can’t get in [to an RVTS]. That’s a huge concern.”

*Moderately Oversubscribed Region*

The guidance counselors describe students who apply to the RVTS as more “hands-on” learners and those who are interested in learning a trade. Some of these students might want to go work directly after high school. Guidance counselors also report that there have been some changes in the profile of students applying to the RVTS. A counselor reports, “Over the years, people have realized that voc techs are really a viable option for people and that you can go to college from voc tech. So, you’ve seen a different type of student start applying. More academically achieving. Wanting to go to college.” Although some students with relatively higher academic achievement show interest in the RVTS, guidance counselors reported that the students who are the most academically focused generally still choose to go to a comprehensive high school.

For the most part, the counselors describe a great relationship between their middle school and the RVTS. Their districts realize that the RVTS is the right fit for some kids. As one counselor explains, “It is just about the kids. It’s a good fit for some kids. Some kids, it may not be.” Another counselor described the relationship with the RVTS and comprehensive high school in the region, “We have a great relationship with the [RVTS]. There is no real competitive animosity towards the two schools…We want to make sure that kids find the right place for them in these critical years of self -exploration.”

In this region, the guidance counselors believe that students have enough information to make an informed choice. One counselor described his approach as giving students the information and then letting them make the choice “without pushing them, without encouraging them one way or the other. Letting them choose.” The guidance counselors agree that parents have a strong influence over where students attend high school and that students have adequate information to make an informed choice.

*Heavily Oversubscribed Region*

Guidance counselors in the heavily oversubscribed regions consistently voiced concerns that the RVTS had lost its mission. A counselor expresses the concern that “voc wants the top students. [They] always want to attract more students. It seems like they’re trying to be all things for all students. [They have] almost lost the focus [for] kids who aren’t going to aspire to go to college and maybe want a more hands-on experience.” Some counselors trace the changes to the introduction of additional vocational programs, such IT, cybersecurity, and other programs beyond the traditional trades (e.g., construction and manufacturing), which occurred about 10 years ago. A counselor explains, “They’re appealing to a wider range of students over the years because they offer things that are non-traditional vocational ed.” One counselor describes the introduction of these programs as “a game changer” in terms of the change in student interest and student profile.

As a consequence, multiple counselors report that some students do not even apply to the RVTS because they “give up with the application process.” A counselor explains, “I think everybody should get accepted. Some of the kids here, that’s what they need but they’ll never get accepted there. Let me give you an example. Some kids here just have serious behavioral issues. And, they have attendance issues. Their grades aren’t really that great, but they could be the next great plumber. They could be the next great electrician.” He continues, “A lot of the kids that misbehave or don’t show up for school ... because they don’t have interest in a traditional education. They want to work with their hands.” The counselors are concerned that some of these students are not bothering to apply or will not be accepted if they do apply. One counselor offered an example of student who struggled in reading but had experience working in a mechanic shop on weekends. The counselor thought he was perfect fit for RVTS, but he wasn’t accepted. The counselors are concerned that these students who do not apply or do not get into the RVTS will not succeed in the comprehensive high school.

The guidance counselors in this region also reported concerns about what they view as misleading marketing about the RVTS programs and students’ lack of understanding of what the different certifications mean. Although the RVTS runs ads on the radio and post on billboards, counselors wonder if students fully understand the programs offered. A counselor explains, “There can be confusion that [the paralegal program] means you’re going to be a lawyer.” Other counselors had similar concerns about students’ understanding of the medical, education, and child-care programs.

According to the guidance counselors, getting accepted to the RVTS is viewed as prestigious within the community. A counselor explains, “Each year more kids are applying to CTE. It is growing in popularity. Now it seems to be the place to be. [RVTSs] have done a good job of getting away from the reputation of being for the students who weren’t as academically capable.” Another counselor reported that it is common for parents to post their children’s acceptance on social media, though other counselors report variation in how involved parents are in planning for high school.

In general, the counselors think that eighth grade is too late to start planning for high school. They are concerned that students do not have enough information to make informed choices, even though all students know about the RVTS. The guidance counselors describe tensions between the RVTS and the comprehensive high schools, although several reported that the tension is less than it has been in the past. In some of the middle schools in this region, the district does not allow the RVTS to come into the school to present information about their program to students. According to the guidance counselors, the lack of RVTS presentations at the middle school did not diminish students’ interest in the RVTS, but in their view, it prevents the guidance counselors from helping to mediate the information that students are receiving from the RVTS.

*Guidance Counselor Recommendations*

The guidance counselors offered a range of suggestions about how the process could be improved. Multiple counselors believe that more time for one-on-one conversations between middle school guidance counselors and all students would be helpful. They would like to help give students balanced information about differences in academics, social environments, activities, and peer groups.

One guidance counselor described a vision for a decision tree to help students map out their high school and post-secondary plans: “This is what I want, how do I get there?” She believes the goal should be to help students understand themselves, including what kind of learner they are and what kind of environment is best suited for to meet their needs. She also would like to help students make the connections between 8th grade, high school, college, and their goals.

Other counselors focused on the need for greater clarity about the meaning of RVTS certifications and the education requirements for professions, including nursing, medical, and legal. They believe that often students do not understand the relationship between RTVS certificates and requirements for different professions; there is confusion about the value of different RTVS certifications in the labor market. They also suggested that middle schools and RVTSs could involve people in the process of providing high school planning support who have knowledge of college admissions and career pathways as well as credibility with the students. The guidance counselors believe that having long-term outcome data from the different high schools, including college matriculation, jobs, and salaries would be helpful to show 8th grade students. They believe that students should have better and easier access to facts that might inform their choices.

***Findings from Student Surveys***

Tables F1 and F2 in Appendix F provide complete summary statistics from the 8th grade student surveys administered in the same 11 middle schools described above from the moderately oversubscribed region (Table F1) and the highly oversubscribed region (Table F2). Surveys were proctored by school administrators and thus response rates were high; 91% of all 8th grade students completed the survey in the moderately oversubscribed region, and 70% completed the survey the highly oversubscribed region, for an overall response rate of 78%. While these response rates are consistent with historical standards for survey response rates, the student survey data cannot be linked to personally identifiable information about students (following the IRB protocol for these surveys), and thus we are not able to confirm student survey respondents are representative of all 8th graders at these schools. Hence, these survey results should be interpreted with caution as they may not be representative of all student perspectives across in the two regions.

**Figure 3.1. Selected mean 8th grade student survey responses by region**

***Note. All differences in Figure 3.1 are statistically significant. Full summary statistics in Tables F1 and F2 in Appendix F.***

*Survey results across regions*

The first column of Tables F1 and F2 (Appendix F) provide overall summary statistics across all student respondents in each region. The differences in the mean student responses between the two regions are tested with a two-sided t test, and if the mean response to a given question is significantly higher *relative to the other region*, this is indicated with significance stars. All responses are reported as proportions with the exception of the first question which indicates that students in the highly oversubscribed region are more likely to have thought about high school than students in the moderately oversubscribed region. Other statistically significant differences between the regions are included in Figure 3.1 above. For example, students in the moderately oversubscribed region are more likely to prioritize academics and their friends in their high school choice and are more likely to have discussed academics and sports options with friends than students in the highly oversubscribed region.

Table F1 also highlights important demographic differences between the regions, as eighth grade students who took the survey in the moderately oversubscribed region are more likely to be white and speak English at home than students who took the survey in the highly oversubscribed region. Turning to column 1 of Table F2, students from the highly oversubscribed region are much more likely to plan to apply to the regional RVTS (55% vs. 20% in the moderately oversubscribed region), and, similarly, are more likely to report future jobs and opportunity to learn a career as the most important factor in their high school choice, report receiving information and talking to a counselor about high school options, and discuss future jobs and learning a career with friends than students from the moderately oversubscribed region than their peers in the moderately oversubscribed region. The highly oversubscribed region also has substantially more Black and Latinx students than the moderately oversubscribed region.

A few other notable findings emerge from the overall summary statistics in Tables F1 and F2. In contrast with some opinions expressed by guidance counselors above, a similarly high percentage of students in the moderately and highly oversubscribed regions (85% and 86%, respectively) report having received enough information to make a high school choice. Over 80% of students in each region also report having discussed high school options with their family. Finally, while counselors reported that students generally received enough information to inform their high school decision-making process, students report a desire to receive more information, as about 65% of students in each region want more information on programs at local high schools, about 50% of students in each region say they wish they had visited high schools, and about 40% of students in each region report wishing for more events about high school options and more opportunity to talk with counselors.

The additional columns of Tables F1 and F2 make additional comparisons *within each region* between responses of: male and female students (columns 2 and 3); white students and students of color (columns 4 and 5); and students who do and do not plan to apply to the local RVTS (columns 6 and 7). We therefore discuss these comparisons separately by region.

*Moderately Oversubscribed Region*

We first focus on comparisons between male and female students in the region (columns 2 and 3 of Table F1). Male students are more likely to have thought about high school and plan to apply to the regional RVTS, report future jobs and sports as the most important factor in their high school choice, and report having talked to a counselor than female students in the region report. Female students are more likely to identify academics and the opportunity to learn a career as the most important factor in their high school choice, report higher levels of parental involvement in high school choice, and discuss academics with their friends than male students report.

Comparisons between white students and students of color in the region (columns 4 and 5 of Table F1) reveal only a few notable differences. Students of color are more likely to report planning to apply to the RVTS and identify the opportunity to learn a career as the most important factor in their high school choice, while white students are more likely to identify academics as the most important factor in their high school choice. White students in the region are also significantly more likely (86% vs. 79%) to report having received enough information to make a high school choice than nonwhite students.

Finally, there are substantial differences between the survey responses of students who do and do not plan to apply to the regional RVTS (columns 6 and 7 of Table F1), all highlighted in Figure 3.2. For example, students who plan to apply to the RVTS are much more likely to report future jobs (57%) and opportunity to learn a career (27%) as the most important factor in their high school choice than students who do not plan to apply to the RVTS (20% and 8%, respectively). Students who plan to apply to the RVTS also report higher levels of parental involvement, are much more likely to report receiving information from various sources (the school, a counselor, etc.), and are more likely to report feeling that they have enough information to make a high school choice.

**Figure 3.2. Selected mean student survey responses for moderately oversubscribed region by plans to apply to RVTS**

***Note. All differences in Figure 3.2 are statistically significant. Full summary statistics in Table F1 in Appendix F.***

*Highly Oversubscribed Region*

Many of the patterns between student subgroups in the highly oversubscribed region (columns 2–7 of Table F2) are similar to the patterns discussed above for the moderately oversubscribed region, particularly between male and female students and between students who do and do not plan to apply to the regional RVTS. As shown in Figure 3.3, though, differences in responses between white students and students of color in the highly oversubscribed region are more pronounced than in the moderately oversubscribed region, which is notable because this region has substantially more students of color. As in the moderately oversubscribed region, white students in the highly oversubscribed region are significantly more likely (90% vs. 81%) to report having received enough information to make a high school choice than nonwhite students in the region. Unlike the moderately oversubscribed region, though, students of color in the highly oversubscribed region are also less likely to report having discussed high school choice with their family, school held events, or schools help to learn about high school options.

**Figure 3.3. Selected mean student survey responses for highly oversubscribed region by student race**

***Note. All differences in Figure 3.3 are statistically significant. Full summary statistics in Table F2 in Appendix F.***

***Findings from Student Focus Groups***

*Moderately Oversubscribed Region*

In this region, according to focus group students, the RVTS is viewed as a school for students who want to learn a trade or for kids who want a job right out of high school. At the same time, multiple students expressed the desire for exposure to trades without going to a RVTS. Students want to learn about different jobs and different occupations. One student explains, “I think it’d be cool if we could have trade programs in public high schools. If you’re not sure if you want to pursue a trade or academic, you can still get good academics but also do a trade on the side.”

Some students describe the pressure of needing to know what they want to do after high school. Students were mixed in their views about whether the RVTS is better for students who know what they want to do or whether the RVTS is a good option for students who don’t know what they want to do after high school. In one focus group, one student stated that the RVTS is for students who know what they want to do after high school. She explained, “It’s like you need to know what you want to do before you go there.” In contrast, another student in the same focus group replied, “I don’t know what I want to do. There is exploratory at voc tech so you can try out the different courses. Then you can pick.”

Students were also mixed in their views about whether they had enough information to make an informed choice. A student explained, “You definitely have to do your own research.” Another student reported that “We did a jobs unit. So, we worked on jobs we might want to do in the future. We kind of talked about high schools a bit. But we just briefed over it. That was it.” One student sums up the views of many: “We have a lot of information but I am not sure if it’s the right information.” Students clearly want more information about how the high school affects their college options. They want to know what the choice will mean for their future.

*Heavily Oversubscribed Region*

The RVTS has a clear presence in this region. Although students say prestige is not an important factor, they consistently talked about wanting to see if they can get into the RVTS. A student described that “Voc is like the school everybody wants to go to for the most part. It just has a good reputation. I think it’s because you have to be yourself and be smart to get in. It’s a challenge [to apply and get accepted.]” Students like that it is competitive to get into the RVTS.

In this region, the topic of high school has been on the students’ minds for a while. In two different focus groups, students reported that they have been thinking about high school since at least 5th grade. One student explains, “I decided in 5th grade. I have always wanted to be a lawyer and then when I found out they had a legal program there, and that was a good way to branch into it.”

Other students who live in an urban area reported that their parents wanted them to go to RVTS. According to these students, their parents believe the comprehensive high school is a “bad” school. Students also talked about how the RVTS prepares them for future careers. A student explained, “Voc sets you up for the future because it gets you job experience.” Another student elaborates, “People mostly go to Voc just to leave … with a nice job.” Some students believe that “Voc is basically a school that makes you not need to go to college.” Students in this region talk about the strengths of the RVTS and some students and their parents also believe that the urban comprehensive high school is not a strong school.

Students were mixed in their views about whether they had received enough information to make an informed choice. Multiple students would like the comprehensive high schools, RVTS, and private schools to come to the middle schools. They also expressed a desire for shadow days opportunities at the different high schools and more opportunities to explore their interests.

Students would like greater clarity and transparency about the RVTS process after applying. While the students know how to apply to the RVTS, they would like to know what happens after the application. Their questions include: whether any tests are required after getting in; whether admitted students can visit the school; and how competitive it is to get in. The application process is clearly weighing on the minds of some students, and they believe more information would be helpful.

**Table 3.3.** Models Predicting RVTS Attendance in 9th Grade

|  | (1) | (2) | (3) | (4) | (5) |
| --- | --- | --- | --- | --- | --- |
|  | RVTS | RVTS | RVTS | RVTS | RVTS |
|  |  |  |  |  |  |
| Male | 0.0122\*\*\* | 0.0104\*\*\* | 0.00702\*\*\* | 0.00688\*\*\* | 0.00671\*\*\* |
|  | (0.000755) | (0.00220) | (0.000742) | (0.00195) | (0.00196) |
| Black | -0.0795\*\*\* | -0.0380\*\*\* | -0.0916\*\*\* | -0.0500\*\*\* | -0.0479\*\*\* |
|  | (0.00137) | (0.00802) | (0.00135) | (0.00942) | (0.00949) |
| Latinx | -0.0268\*\*\* | -0.00793 | -0.0303\*\*\* | -0.00921 | -0.00679 |
|  | (0.00119) | (0.00732) | (0.00118) | (0.00661) | (0.00654) |
| Asian | -0.0625\*\*\* | -0.0419\*\*\* | -0.0553\*\*\* | -0.0433\*\*\* | -0.0468\*\*\* |
|  | (0.00174) | (0.00647) | (0.00173) | (0.00779) | (0.00775) |
| Low-Income | 0.0661\*\*\* | 0.0339\*\*\* | 0.0576\*\*\* | 0.0355\*\*\* | 0.0400\*\*\* |
|  | (0.000882) | (0.00426) | (0.000909) | (0.00499) | (0.00514) |
| English Learner | -0.0206\*\*\* | -0.0287\*\*\* | -0.0317\*\*\* | -0.0292\*\*\* | -0.0136\*\*\* |
|  | (0.00183) | (0.00776) | (0.00187) | (0.00657) | (0.00422) |
| Student with Disability | 0.0363\*\*\* | 0.0441\*\*\* | 0.0193\*\*\* | 0.0382\*\*\* | 0.0367\*\*\* |
|  | (0.000934) | (0.00645) | (0.00104) | (0.00433) | (0.00435) |
| 8th Gr. Test Scores (Std.) |  |  | -0.0487\*\*\* | -0.0319\*\*\* | -0.0488\*\*\* |
|  |  |  | (0.000536) | (0.00316) | (0.00325) |
| 8th Gr. Test Scores Squared |  |  | -0.0174\*\*\* | -0.0167\*\*\* | -0.00825\*\*\* |
|  |  |  | (0.000411) | (0.00284) | (0.00220) |
| 8th Gr. Attendance Rate |  |  | 0.775\*\*\* | 0.666\*\*\* | 0.654\*\*\* |
|  |  |  | (0.00626) | (0.153) | (0.153) |
| 8th Gr. Test X SWD |  |  |  |  | 0.00145 |
|  |  |  |  |  | (0.00238) |
| 8th Gr. Test X Low-Income |  |  |  |  | 0.0386\*\*\* |
|  |  |  |  |  | (0.00478) |
| 8th Gr. Test X EL |  |  |  |  | 0.0117\* |
|  |  |  |  |  | (0.00674) |
| Constant | 0.0745\*\*\* | 0.0803\*\*\* | -0.639\*\*\* | -0.536\*\*\* | -0.526\*\*\* |
|  | (0.000644) | (0.00458) | (0.00608) | (0.146) | (0.145) |
| Town Fixed Effects |  | YES |  | YES | YES |
| Cohort Fixed Effects |  | YES |  | YES | YES |
| Observations | 636,776 | 636,776 | 636,776 | 636,776 | 636,776 |
| Adjusted R-squared | 0.017 | 0.120 | 0.053 | 0.144 | 0.146 |
| Notes: Table 3.3 represents results for Ordinarily Least Squares regression, with standard errors in parentheses. X indicates interaction. Stars represent significance: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Outcome is attending an RVTS school in 9th grade. Includes students attending Massachusetts public high schools in the cohorts with on-time graduation from 2009-2017. 8th grade test scores are the average of the standardized 8th grade Math and ELA state MCAS assessments. Students without any 8th grade data (attendance rates and test scores) are excluded from these analyses; in cases where only some 8th grade data are missing for a student, that value is mean imputed and marked with a missingness indicator, which is included in all models (not shown in Table 3.3). | | | | | |

***RQ2. What observable characteristics of Massachusetts 8th-grade students state-wide are predictive of entry into the RVTS system?***

Table 3.3 reports relationships between observable characteristics of 8th grade students and their probability of attending a RVTS, estimated across all 8th grade students in the state. Overall, we find that there are differences in how RVTS attendance relates to student characteristics. On average, students with the highest 8th grade MCAS scores are less likely to attend, on average, than their lower scoring peers, as are students who identify as Black or Asian (controlling for the other variables in these models). We also see that, controlling for MCAS scores, boys are more likely than girls to attend, as are students with disabilities, and low-income students. We also find that adding controls for town of residence increases the explanatory power of the models, which suggests the likelihood of attending an RVTS differs substantially across towns.

In Figure 3.4, we present the predicted probabilities of enrolling in an RVTS as a function of 8th grade MCAS scores and a host of student characteristics that are of import when considering equity in access. As suggested by the model estimates discussed above, lower performing students are more likely to attend a RVTS for all student groups, but controlling for these differences reveals several interesting patterns. Male students and students with disabilities are more likely to attend a RVTS *throughout the test score distribution* than female students and students without disabilities, respectively. *Above-average performing* students of color are also more likely to attend a RVTS than white students with similar test scores, while *low-performing* students of color are less likely to attend a RVTS than low-performing white students.

We also present analogous estimates from models estimated just for the two regions that are the focus of the qualitative study. We find a few differences between these communities and the state as a whole. These differences are most apparent in Figures 3.5 and 3.6, which duplicate the statewide relationships presented in Figure 3.4. In particular, we note that in both communities students are more likely to attend an RVTS on average than students elsewhere in the state, which provides important context for interpreting the findings from the qualitative study discussed earlier. Further, in the moderately oversubscribed community, students who scored lower on the 8th grad MCAS were much more likely to attend an RVTS than lower-scoring students in the other community, or the state as a whole.

**Figure 3.4.** Fitted probability of attending an RVTS using statewide data

Fitted probability of attending an RVTS using statewide data.

**Figure 3.5.** Fitted probability of attending an RVTS in the heavily oversubscribed region.

Fitted probability of attending an RVTS in the heavily oversubscribed region.

**Figure 3.6.** Fitted probability of attending an RVTS in the moderately oversubscribed region.

Fitted probability of attending an RVTS in the moderately oversubscribed region.

Perhaps the most notable difference is the relationship between prior test scores and probability of attending a RVTS in the highly oversubscribed region compared to the state as a whole. In particular, unlike the state as a whole, low-performing students regardless of gender or demographic characteristics in this region are substantially less likely to attend the RVTS than peers near the middle of the test score distribution, and have about the same probability of attending as students from the top of the test score distribution. This reflects some of the concerns voiced in the guidance counselor interviews about limited access to the RVTS for low-performing students in this region.

**3.4. Conclusions**

We draw three primary conclusions from this investigation into student entry into the RVTS system in Massachusetts. First, while 8th grade guidance counselors mostly characterized the relationships between their middle schools and the RVTS as positive, they also communicated concerns that CTE has “lost its mission” in the state. Specifically, they described scarcity of the slots available at the RVTS and reported that some students who would benefit from a “hands on” education do not get in because of either their grades or discipline issues. These perceptions reflect broader concerns about access to the RVTS system discussed in the introduction.

Second, we found that 8th grade students who participated in the survey have mixed views about whether they have received enough information to make an informed high school choice. On the one hand, 85% of 8th graders report feeling that they have enough information to make an informed high school choice. On the other hand, this proportion was significantly lower for students of color in both regions, which reflects concerns about equitable access to information in the RVTS application process. Additionally, on average, all students surveyed reported wanting even more information to inform their high school decision-making process. Concerns about information access also came through in the student focus groups, which points to possible improvements in publicizing, codifying the information provided, and providing support for the application process for all students.

Finally, the administrative data analysis suggests that patterns of entry into RVTS vary for different student groups. The analytic models estimated across the entire state suggest that higher-performing students are less likely to attend a RVTS regardless of student group, but even controlling for differences in prior test scores between students with and without disabilities, students with disabilities are more likely to attend a RVTS than students without disabilities. Above-average performing students of color are also more likely to attend a RVTS than similar white students, while low-performing students of color are less likely to attend a RVTS than low-performing white students. Neither the student surveys nor other data collected as part of this project clarify what is driving this relationship, so further research is necessary to explore access to the RVTS system for low-performing students of color.

## References

|  |
| --- |
| AdvanceCTE (2018). Career clusters. Silver Spring, MD. Retrieved from Advance CTE. https://www.careertech.org/career-clusters.  Allensworth, E. M., Gwynne, J. A., Moore, P., & De la Torre, M. (2014). Looking Forward to High School and College: Middle Grade Indicators of Readiness in Chicago Public Schools. University of Chicago Consortium on Chicago School Research.  Anderson, J. (1982). The Historical Development of Black Vocational Education. In H. Kantor & D.B. Tyack (eds.), Work, Youth and Schooling: Historical Perspectives on Vocational Education. Stanford, CA: Stanford University Press, 180-222.  Birmingham, T. & Murray, T. (2020). Don’t mess with the success of voc-tech high schools. *CommonWealth,* February 7, 2020. |
| Bishop, J. & Mane, F. (2004). The Impacts of Career-Technical Education on High School Labor Market Success. *Economics of Education Review*, 23(4), 381-402. |
| Bonilla, S. (2020). The Dropout Effects of Career Pathways: Evidence from California. *Economics of Education Review.* Forthcoming.  Bowles, S. & Gintis, H. (1976). Schooling in Capitalist America, (57). New York, NY: Basic Books. |
| Bozick, R., & Dalton, B. (2013). Balancing career and technical education with academic coursework: The consequences for mathematics achievement in high school*. Educational Evaluation and Policy Analysis*, 35(2), 123-138. |
| Brunner, E., Dougherty, S., & Ross, S. (2019). The Effects of Career and Technical Education: Evidence from the Connecticut Technical High School System. EdWorkingPaper, No. 2019-047. Retrieved from Annenberg Institute at Brown University: http://www.edworkingpapers.com/ai19-112. |
| Carnevale, A. P., Jayasundera, T., & Gulish, A. (2015*). Good jobs are back: College graduates are first in line.* Georgetown University Center on Education and the Workforce. <http://hdl.handle.net/10822/1050310>  Cellini, S. (2006). Smoothing the Transition to College? The Effect of Tech-Ed Programs on Educational Attainment. *Economics of Education Review*, 25, 304-411. |
| Center on Education Policy (CEP). 2011. State high school tests: Changes in state policies and the impact of the college and career readiness movement. Washington, DC: CEP. |
| Chetty, R., Friedman, J. N., & Rockoff, J. E. (2014a). Measuring the impacts of teachers I: Evaluating bias in teacher value-added estimates. *American Economic Review*, *104*(9), 2593-2632. |
| Chetty, R., Friedman, J. N., & Rockoff, J. E. (2014b). Measuring the Impacts of Teachers II: Teacher value-added and student outcomes in adulthood. *American Economic Review*, *104*(9), 2633–2679. |
| Cullen, J. B., Levitt, S. D., Robertson, E., & Sadoff, S. (2013). What can be done to improve struggling high schools? *Journal of Economic Perspectives*, *27*(2), 133–152. doi:10.1257/jep.27.2.133. |
| Dougherty, S. M. (2018). The effect of career and technical education on human capital accumulation: Causal evidence from Massachusetts. *Education Finance and Policy*, *13*(2), 119–148.  Dougherty, S. M., Grindal, T., & Hehir, T. (2018). The impact of career and technical education on students with disabilities. *Journal of Disability Policy Studies*, 29(2), 108-118. |
| Dougherty, S. M., & Harbaugh, I. (in press). Can growth in the availability of STEM technical education improve equitable access? *Journal of Vocational Education & Training*. |
| Dougherty, S. M., & Lombardi, A. R. (2016). From vocational education to career readiness: The ongoing work of linking education and the labor market. *Review of Research in Education*, *40*(1), 326-355. |
| Dougherty, S. M., Gottfried, M. A., & Sublett, C. (2019). Does increasing career and technical education coursework in high school boost educational attainment and labor market outcomes? *Journal of Education Finance, 44*(4), 423-447.  Duncan, A. (2001). The New CTE: Secretary Duncan's Remarks on Career and Technical Education. Speech at Harvard University Graduate School of Education. https://www.ed.gov/news/speeches/new-cte-secretary-duncans-remarks-career-and-technical-education. |
| Fraser, Alison L. 2008. Vocational-technical education in Massachusetts. Available http://steamcurriculum.weebly.com/uploads/2/5/5/8/25586003/voc\_tech\_ma\_pioneer\_institute.pdf. Accessed 9 August 2017. |
| Goldhaber, D., Gratz, T., & Theobald, R. (2017). What’s in a teacher test? Assessing the relationship between teacher licensure test scores and student STEM achievement and course-taking. *Economics of Education Review*, *61*(Supplement C), 112–129. |
| Goldhaber, D., Lavery, L., & Theobald, R. (2015). Uneven playing field? Assessing the teacher quality gap between advantaged and disadvantaged students. *Educational Researcher, 44*(5), 293-307. |
| Goldhaber, D., Wolff, M., & Daly, T. (2020). Assessing the Accuracy of Elementary School Test Scores as Predictors of Students’ High School Outcomes. CALDER Working Paper No. 235-0520. |
| Gottfried, M. A., & Plasman, J. S. (2018). Linking the timing of career and technical education coursetaking with high school dropout and college-going behavior. *American Educational Research Journal*, 55(2), 325-361.  Heckman, J. J., & Sedlacek, G. (1985). Heterogeneity, aggregation, and market wage functions: an empirical model of self-selection in the labor market. *Journal of Political Economy*, 93(6), 1077-1125. |
| Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor economics*, *24*(3), 411-482. |
| Hemelt, S.W. & Lenard, M.A. (2018). Career academies and the resurgence of career and technical education in the United States (CALDER Policy Brief No. 8-0918-1). Washington, DC: National Center for Analysis of Longitudinal Data in Education Research. |
| Hemelt, S.W., Lenard, M.A., & Paeplow, C.G. (2019). Building bridges to life after high school: Contemporary career academies and student outcomes. *Economics of Education Review*, 68, 161-178. |
| Holzer, H. J., & Baum, S. (2017). *Making college work: Pathways to success for disadvantaged students*. Washington, D.C.: Brookings Institution Press. |
| Jackson, C. K. (2014). Teacher quality at the high school level: The importance of accounting for tracks. *Journal of Labor Economics*, *32*(4), 645-684. |
| Jacob, B. A. (2017). What we know about career and technical education in high school. *Washington, DC: Brookings Institution. Accessed July*, *19*, 2019. |
| Jonas, M. (2020). Voc-tech schools facing scrutiny over admissions policies. *CommonWealth,* February 6, 2020. |
| Kemple, J. & Willner, C. (2008). Career Academies: Long-term impacts on labor-market outcomes, educational attainment, and transitions to adulthood. New York: MDRC. |
| Kreisman, D., & Stange, K. (2020). Vocational and career tech education in American high schools: The value of depth over breadth. *Education Finance and Policy*, *15*(1), 11-44.  Kurlaender, M., Reardon, S.F., and Jackson, J. (2008). Middle school predictors of high school achievement in three California school districts. California Dropout Research Project. Retrieved from http://www.cdrp.ucsb.edu/dropouts/pubs\_reports.htm.  Meer, J. (2007). Evidence on the Returns to Secondary Vocational Education. *Economics of Education Review*, 26(5), 559-573.  Oakes, J. (1983). Limiting Opportunity: Student race and curricular differences in secondary vocational education. *American Journal of Education*, 91, 328-355.  Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business & Economic Statistics*, 37(2), 187-204.  Plasman, J.S., Gottfried, M.A., & Klasik, D. (2020). Trending up: A cross-cohort exploration of STEM career and technical education participation by low-income students. *Journal of Education for Students Placed at Risk*, 25(1), 55-78.  Plasman, J.S., Gottried, M.A., & Sublett, C. (2017). Are the academic CTE cluster pipeline? Linking high school CTE coursetaking and postsecondary credentials*. Career and Technical Education Research*, 42(3), 219-242. |
| Rice, J. K. (2013). Learning from experience? Evidence on the impact and distribution of teacher experience and the implications for teacher policy. *Education Finance and Policy*, *8*(3), 332-348. |
| Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, *73*(2), 417-458. |
| Rockoff, J. E. (2004). The impact of individual teachers on student achievement: Evidence from panel data. *American economic review*, *94*(2), 247-252. |
| Spaulding, S., Lerman, R. I., Holzer, H. J., & Eyster, L. (2015). *Expanding economic opportunity for young men and boys of color through employment and training* (p. 2). Urban Institute. |
| Stange, K., & Kreisman, D. (2014, July). *Does vocational course-taking ease school-to-work transitions? A dynamic choice model*. Paper presented at the Building Human Capital and Economic Potential Conference, Madison, WI. |
| Theobald, R. J., Goldhaber, D. D., Gratz, T. M., & Holden, K. L. (2020). High school English Language Arts teachers and postsecondary outcomes for students with and without disabilities. *Journal of Disability Policy Studies*, 1044207320919899. |
| Theobald, R., Plasman, J., Gottfried, M., Gratz, T., Holden, K., & Goldhaber, D. (2019). Sometimes less, sometimes more: Trends in career and technical education participation for students with disabilities. CALDER Working Paper No. 220-0819.  Tyack, D. (1974). The One Best System: A history of American urban education (95). Cambridge, MA: Harvard University Press. |
| U.S. Department of Education. Institute of Education Sciences, National Center for Education Statistics. Table H201. Percentage of public high school graduates with each career and technical education (CTE) coursetaking pattern, by student race/ethnicity and sex: 2013. |

## Appendices

**Appendix A. Additional Tables for *Heterogeneity in the Returns to High School CTE by Career Clusters and Student Groups***

Table A1

*Descriptive Statistics for Concentrators in Each Career Cluster*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Health | Educ | IT | Comms | Bus | Ag | Hosp | Manu | Cons | Tran |
| Female | 0.90 | 0.92 | 0.20 | 0.51 | 0.70 | 0.57 | 0.59 | 0.20 | 0.13 | 0.14 |
| Lower Income | 0.68 | 0.54 | 0.52 | 0.56 | 0.57 | 0.46 | 0.61 | 0.53 | 0.51 | 0.64 |
| Students w/Disabilities | 0.16 | 0.22 | 0.24 | 0.24 | 0.20 | 0.30 | 0.31 | 0.24 | 0.30 | 0.37 |
| Immigrant | 0.05 | 0.02 | 0.03 | 0.03 | 0.03 | 0.01 | 0.02 | 0.03 | 0.02 | 0.03 |
| English Language Learners | 0.09 | 0.05 | 0.06 | 0.06 | 0.07 | 0.02 | 0.05 | 0.06 | 0.05 | 0.08 |
| Latinx | 0.25 | 0.17 | 0.16 | 0.20 | 0.21 | 0.10 | 0.22 | 0.16 | 0.15 | 0.25 |
| Asian | 0.06 | 0.03 | 0.05 | 0.04 | 0.04 | 0.01 | 0.02 | 0.04 | 0.02 | 0.03 |
| Black | 0.16 | 0.09 | 0.08 | 0.12 | 0.10 | 0.06 | 0.10 | 0.07 | 0.06 | 0.07 |
| White | 0.57 | 0.72 | 0.74 | 0.66 | 0.68 | 0.85 | 0.69 | 0.75 | 0.81 | 0.69 |
| 8th Grade Math Score (Std.) | -0.40 | -0.33 | -0.09 | -0.26 | -0.32 | -0.26 | -0.45 | -0.12 | -0.38 | -0.55 |
| 8th Grade ELA Score (Std.) | -0.29 | -0.25 | -0.23 | -0.25 | -0.33 | -0.24 | -0.46 | -0.32 | -0.54 | -0.70 |
| 8th Grade Attendance Rate | 0.97 | 0.96 | 0.97 | 0.96 | 0.96 | 0.97 | 0.96 | 0.97 | 0.97 | 0.97 |
| Attend Regional Vocational School | 0.52 | 0.25 | 0.45 | 0.35 | 0.44 | 0.78 | 0.49 | 0.56 | 0.68 | 0.60 |
| On-Time HS Graduation Rate | 0.93 | 0.92 | 0.90 | 0.89 | 0.90 | 0.90 | 0.88 | 0.90 | 0.90 | 0.84 |
| Attend 2-Yr College | 0.52 | 0.40 | 0.40 | 0.35 | 0.37 | 0.39 | 0.36 | 0.34 | 0.27 | 0.26 |
| Attend 4-Yr College | 0.45 | 0.51 | 0.44 | 0.45 | 0.42 | 0.42 | 0.35 | 0.38 | 0.21 | 0.15 |
| College Graduate | 0.19 | 0.24 | 0.19 | 0.19 | 0.19 | 0.18 | 0.17 | 0.15 | 0.10 | 0.08 |
| Observations | 10036 | 6027 | 5808 | 12108 | 15283 | 4872 | 10213 | 15603 | 21370 | 10784 |

Notes: Includes first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table A2  *CTE concentrators’ college outcomes compared to similar non-concentrators, by student populations of interest* | | | | | | | |
|  | **Overall** | **Male** | **Female** | **Black & Latinx** | **Students w/Disabilities** | **Lower Income** | **Low-Scoring Students** |
| **Difference in 2-Yr**  **College Attendance** | .049 | .023 | .08 | .076 | .03 | .056 | .036 |
| *Standard Error* | *.007* | *.007* | *.007* | *.009* | *.008* | *.009* | *.009* |
| Observations | 636776 | 324143 | 312631 | 152303 | 135540 | 274911 | 145784 |
| **Difference in 4-Yr**  **College Attendance** | -.09 | -.102 | -.071 | -.015 | -.061 | -.037 | -.032 |
| *Standard Error* | *.008* | *.01* | *.007* | *.009* | *.007* | *.006* | *.006* |
| Observations | 636776 | 324143 | 312631 | 152303 | 135540 | 274911 | 145784 |
| **Difference in Overall**  **College Attendance** | -.037 | -.067 | . | .053 | -.018 | .015 | .013 |
| *Standard Error* | *.011* | *.012* | *.008* | *.009* | *.012* | *.009* | *.012* |
| Observations | 636776 | 324143 | 312631 | 152303 | 135540 | 274911 | 145784 |
| **Difference in 2-Yr**  **College Degree Attainment** | .007 | .003 | .012 | .014 | .001 | .011 | .002 |
| *Standard Error* | *.003* | *.002* | *.003* | *.003* | *.002* | *.003* | *.003* |
| Observations | 496855 | 253277 | 243577 | 116827 | 104938 | 209543 | 116992 |
| **Difference in 4-Yr**  **College Degree Attainment** | -.085 | -.086 | -.077 | -.017 | -.048 | -.032 | -.032 |
| *Standard Error* | *.007* | *.008* | *.007* | *.006* | *.006* | *.004* | *.005* |
| Observations | 358484 | 182869 | 175613 | 83680 | 74980 | 147412 | 88580 |
| **Difference in Overall**  **College Degree Attainment** | -.072 | -.075 | -.064 | -.005 | -.037 | -.021 | -.022 |
| *Standard Error* | *.008* | *.008* | *.008* | *.006* | *.007* | *.005* | *.006* |
| Observations | 358484 | 182869 | 175613 | 83680 | 74980 | 147412 | 88580 |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples.

Table A3

*CTE concentrators’ college outcomes compared to similar non-concentrators, by career cluster*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Health** | **Educ** | **IT** | **Comms** | **Bus** | **Ag** | **Hosp** | **Manu** | **Cons** | **Tran** |
| **Difference in 2-Yr**  **College Attendance** | .187 | .108 | .133 | .076 | .068 | .088 | .052 | .063 | -.027 | -0.039 |
| *Standard Error* | *.012* | *.011* | *.009* | *.009* | *.01* | *.014* | *.009* | *.009* | *.009* | *0.011* |
| Observations | 511028 | 507019 | 506800 | 513100 | 516275 | 505865 | 511205 | 516594 | 522362 | 511775 |
| **Difference in 4-Yr**  **College Attendance** | -.009 | .022 | -.04 | -.028 | -.047 | -.067 | -.063 | -.089 | -.202 | -0.186 |
| *Standard Error* | *.012* | *.01* | *.012* | *.01* | *.011* | *.011* | *.008* | *.013* | *.01* | *0.012* |
| Observations | 511028 | 507019 | 506800 | 513100 | 516275 | 505865 | 511205 | 516594 | 522362 | 511775 |
| **Difference in Overall**  **College Attendance** | .119 | .103 | .065 | .048 | .016 | -.023 | .004 | -.033 | -.185 | -0.172 |
| *Standard Error* | *.009* | *.009* | *.009* | *.01* | *.011* | *.013* | *.009* | *.015* | *.014* | *0.016* |
| Observations | 511028 | 507019 | 506800 | 513100 | 516275 | 505865 | 511205 | 516594 | 522362 | 511775 |
| **Difference in 2-Yr**  **College Degree Attainment** | .046 | .032 | .038 | .014 | .013 | .027 | .007 | .011 | -.013 | -0.014 |
| *Standard Error* | *.006* | *.005* | *.005* | *.004* | *.005* | *.008* | *.005* | *.004* | *.003* | *0.004* |
| Observations | 399463 | 396526 | 396235 | 401167 | 403633 | 395593 | 399816 | 403598 | 408350 | 400281 |
| **Difference in 4-Yr**  **College Degree Attainment** | -.05 | .003 | -.044 | -.041 | -.055 | -.087 | -.075 | -.086 | -.15 | -0.137 |
| *Standard Error* | *.009* | *.011* | *.012* | *.009* | *.011* | *.012* | *.008* | *.012* | *.009* | *0.010* |
| Observations | 288029 | 285969 | 285858 | 289395 | 291284 | 285428 | 288317 | 291012 | 294591 | 288863 |
| **Difference in Overall**  **College Degree Attainment** | -.022 | .017 | -.024 | -.027 | -.041 | -.075 | -.057 | -.074 | -.14 | -0.121 |
| *Standard Error* | *.01* | *.01* | *.012* | *.01* | *.011* | *.012* | *.008* | *.012* | *.01* | *0.011* |
| Observations | 288029 | 285969 | 285858 | 289395 | 291284 | 285428 | 288317 | 291012 | 294591 | 288863 |

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A4  *CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by student populations of interest* | | | | | | | | |  |
|  |  | **Overall** | **No College** | **Male** | **Female** | **Black & Latinx** | **Students w/Disabilities** | **Lower Income** | **Low-Scoring Students** |
|  | **1 Year Post-HS Difference**  **in Earnings ($)** | 2403 | 3316 | 2921 | 1744 | 1588 | 2364 | 1924 | 2007 |
|  | *Standard Error* | *132* | *198* | *169* | *94* | *158* | *150* | *129* | *155* |
|  | Observations | 636776 | 135540 | 324143 | 312631 | 152303 | 135540 | 274911 | 145784 |
|  | **3 Year Post-HS Difference**  **in Earnings ($)** | 3660 | 5066 | 4587 | 2491 | 2482 | 3768 | 2902 | 3316 |
|  | *Standard Error* | *185* | *278* | *235* | *145* | *235* | *269* | *196* | *239* |
|  | Observations | 496855 | 104938 | 253277 | 243577 | 116827 | 104938 | 209543 | 116992 |
|  | **5 Year Post-HS Difference**  **in Earnings ($)** | 3456 | 5653 | 4773 | 1817 | 2690 | 4025 | 3026 | 3613 |
|  | *Standard Error* | *182* | *348* | *246* | *179* | *352* | *271* | *267* | *270* |
|  | Observations | 358484 | 74980 | 182869 | 175613 | 83680 | 74980 | 147412 | 88580 |
|  | **7 Year Post-HS Difference**  **in Earnings ($)** | 2867 | 5806 | 4115 | 1356 | 3119 | 3809 | 3180 | 3319 |
|  | *Standard Error* | *205* | *320* | *235* | *293* | *396* | *299* | *322* | *278* |
|  | Observations | 217635 | 44917 | 111118 | 106514 | 50569 | 44917 | 87405 | 60416 |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A5  *CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by career cluster* | | | | | | | | | |  |  |
|  |  | **Health** | **Educ** | **IT** | **Comms** | **Bus** | **Ag** | **Hosp** | **Manu** | **Cons** | **Tran** |
|  | **1 Year Post-HS Difference in Earnings ($)** | 3273 | 1697 | 839 | 604 | 1726 | 1517 | 1742 | 2963 | 4988 | 4162 |
|  | *Standard Error* | *251* | *156* | *120* | *67* | *112* | *144* | *104* | *206* | *188* | *159* |
|  | Observations | 511028 | 507019 | 506800 | 513100 | 516275 | 505865 | 511205 | 516594 | 522362 | 511775 |
|  | **3 Year Post-HS Difference in Earnings ($)** | 4424 | 2567 | 1913 | 1103 | 2737 | 2794 | 2795 | 4325 | 7404 | 6661 |
|  | *Standard Error* | *308* | *194* | *235* | *116* | *149* | *281* | *158* | *297* | *252* | *258* |
|  | Observations | 399463 | 396526 | 396235 | 401167 | 403633 | 395593 | 399816 | 403598 | 408350 | 400281 |
|  | **5 Year Post-HS Difference in Earnings ($)** | 4225 | 2292 | 2254 | 415 | 2905 | 1822 | 2013 | 3990 | 7731 | 6450 |
|  | *Standard Error* | *350* | *330* | *377* | *277* | *255* | *402* | *217* | *277* | *277* | *281* |
|  | Observations | 288029 | 285969 | 285858 | 289395 | 291284 | 285428 | 288317 | 291012 | 294591 | 288863 |
|  | **7 Year Post-HS Difference in Earnings ($)** | 5077 | 2894 | 1917 | -327 | 3171 | 1406 | 1114 | 3162 | 7228 | 4487 |
|  | *Standard Error* | *498* | *533* | *594* | *395* | *463* | *599* | *435* | *423* | *379* | *426* |
|  | Observations | 174814 | 173685 | 173659 | 175550 | 177227 | 173347 | 175050 | 176700 | 178990 | 175526 |

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A6  *CTE concentrators’ difference in likelihood of earning at or above the federal poverty level compared to similar non-concentrators, by student populations of interest* | | | | | | | | |
|  | **Overall** | **No College** | **Male** | **Female** | **Black & Latinx** | **Students w/Disabilities** | **Lower Income** | **Low-Scoring Students** |
| **Difference in Rate of Employment**  **above Poverty 1 Year Post-HS** | .104 | .135 | .123 | .081 | .068 | .099 | .085 | .086 |
| *Standard Error* | *.006* | *.008* | *.007* | *.005* | *.007* | *.007* | *.006* | *.007* |
| Observations | 636776 | 202008 | 324143 | 312631 | 152303 | 135540 | 274911 | 145784 |
| **Difference in Rate of Employment**  **above Poverty 3 Year Post-HS** | .134 | .164 | .15 | .115 | .099 | .135 | .107 | .121 |
| *Standard Error* | *.006* | *.008* | *.007* | *.006* | *.008* | *.009* | *.007* | *.008* |
| Observations | 496855 | 153557 | 253277 | 243577 | 116827 | 104938 | 209543 | 116992 |
| **Difference in Rate of Employment**  **above Poverty 5 Year Post-HS** | .092 | .144 | .112 | .067 | .084 | .11 | .089 | .101 |
| *Standard Error* | *.005* | *.008* | *.005* | *.006* | *.011* | *.007* | *.007* | *.007* |
| Observations | 358484 | 110860 | 182869 | 175613 | 83680 | 74980 | 147412 | 88580 |
| **Difference in Rate of Employment**  **above Poverty 7 Year Post-HS** | .072 | .131 | .086 | .056 | .089 | .096 | .082 | .083 |
| Standard Error | .005 | .006 | .005 | .006 | .01 | .007 | .007 | .007 |
| Observations | 217635 | 68008 | 111118 | 106514 | 50569 | 44917 | 87405 | 60416 |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |
| Table A7  *CTE concentrators’ difference in likelihood of earning at or above the federal poverty level compared to similar non-concentrators, by career cluster* | | | | | | | | | | |
|  | **Health** | **Educ** | **IT** | **Comms** | **Bus** | **Ag** | **Hosp** | **Manu** | **Cons** | **Tran** |
| **Difference in Rate of Employment**  **above Poverty 1 Year Post-HS** | .152 | .078 | .043 | .025 | .075 | .069 | .078 | .119 | .211 | .188 |
| *Standard Error* | *.013* | *.01* | *.006* | *.004* | *.006* | *.007* | *.006* | *.009* | *.008* | *.008* |
| Observations | 511028 | 507019 | 506800 | 513100 | 516275 | 505865 | 511205 | 516594 | 522362 | 511775 |
| **Difference in Rate of Employment**  **above Poverty 3 Year Post-HS** | .193 | .125 | .086 | .055 | .125 | .108 | .134 | .142 | .227 | .226 |
| *Standard Error* | *.014* | *.01* | *.009* | *.006* | *.008* | *.013* | *.007* | *.009* | *.007* | *.007* |
| Observations | 399463 | 396526 | 396235 | 401167 | 403633 | 395593 | 399816 | 403598 | 408350 | 400281 |
| **Difference in Rate of Employment**  **above Poverty 5 Year Post-HS** | .131 | .109 | .065 | .048 | .093 | .062 | .091 | .095 | .155 | .154 |
| *Standard Error* | *.01* | *.012* | *.008* | *.008* | *.007* | *.012* | *.006* | *.007* | *.005* | *.007* |
| Observations | 288029 | 285969 | 285858 | 289395 | 291284 | 285428 | 288317 | 291012 | 294591 | 288863 |
| **Difference in Rate of Employment**  **above Poverty 7 Year Post-HS** | .126 | .102 | .051 | .055 | .078 | .061 | .077 | .075 | .113 | .104 |
| *Standard Error* | *.011* | *.011* | *.012* | *.009* | *.008* | *.014* | *.011* | *.009* | *.008* | *.009* |
| Observations | 174814 | 173685 | 173659 | 175550 | 177227 | 173347 | 175050 | 176700 | 178990 | 175526 |

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A8  *CTE concentrators’ difference in likelihood of being neither employed nor in education or training (NEET) compared to similar non-concentrators, by student populations of interest* | | | | | | | | |
|  | **Overall** | **No College** | **Male** | **Female** | **Black & Latinx** | **Students w/Disabilities** | **Lower Income** | **Low-Scoring Students** |
| **Difference in NEET rate**  **1 Year Post-HS** | -.024 | -.135 | -.028 | -.021 | -.077 | -.057 | -.058 | -.066 |
| *Observations* | *.006* | *.008* | *.006* | *.007* | *.01* | *.007* | *.007* | *.008* |
|  | 636776 | 202008 | 324143 | 312631 | 152303 | 135540 | 274911 | 145784 |
| **Difference in NEET rate**  **3 Year Post-HS** | -.04 | -.164 | -.052 | -.028 | -.081 | -.077 | -.07 | -.087 |
| *Observations* | *.006* | *.008* | *.006* | *.007* | *.011* | *.007* | *.007* | *.008* |
|  | 496855 | 153557 | 253277 | 243577 | 116827 | 104938 | 209543 | 116992 |
| **Difference in NEET rate**  **5 Year Post-HS** | -.061 | -.144 | -.076 | -.044 | -.083 | -.086 | -.079 | -.089 |
| *Observations* | *.005* | *.008* | *.005* | *.006* | *.01* | *.006* | *.007* | *.006* |
|  | 358484 | 110860 | 182869 | 175613 | 83680 | 74980 | 147412 | 88580 |
| **Difference in NEET rate**  **7 Year Post-HS** | -.064 | -.131 | -.078 | -.048 | -.091 | -.092 | -.079 | -.081 |
| *Observations* | *.005* | *.006* | *.005* | *.006* | *.01* | *.008* | *.008* | *.007* |
|  | 217635 | 68008 | 111118 | 106514 | 50569 | 44917 | 87405 | 60416 |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. Student are considered to be NEET if they are neither enrolled in education nor earning at or above the federal poverty level at the specified time period. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A9  *CTE concentrators’ difference in likelihood of being neither employed nor in education or training (NEET) compared to similar non-concentrators, by career cluster* | | | | | | | | | | |
|  | **Health** | **Educ** | **IT** | **Comms** | **Bus** | **Ag** | **Hosp** | **Manu** | **Cons** | **Tran** |
| **Difference in NEET rate**  **1 Year Post-HS** | -.133 | -.118 | -.057 | -.042 | -.043 | -.012 | -.038 | -.045 | -.005 | .013 |
| *Standard Error* | *.009* | *.007* | *.01* | *.01* | *.009* | *.01* | *.008* | *.009* | *.008* | *.01* |
| Observations | 511028 | 507019 | 506800 | 513100 | 516275 | 505865 | 511205 | 516594 | 522362 | 511775 |
| **Difference in NEET rate**  **3 Year Post-HS** | -.117 | -.104 | -.056 | -.033 | -.059 | -.023 | -.05 | -.054 | -.049 | -.053 |
| *Standard Error* | *.009* | *.008* | *.009* | *.008* | *.008* | *.013* | *.008* | *.008* | *.008* | *.009* |
| Observations | 399463 | 396526 | 396235 | 401167 | 403633 | 395593 | 399816 | 403598 | 408350 | 400281 |
| **Difference in NEET rate**  **5 Year Post-HS** | -.12 | -.128 | -.071 | -.047 | -.062 | -.037 | -.055 | -.078 | -.086 | -.083 |
| *Standard Error* | *.009* | *.011* | *.009* | *.008* | *.007* | *.011* | *.007* | *.007* | *.006* | *.008* |
| Observations | 288029 | 285969 | 285858 | 289395 | 291284 | 285428 | 288317 | 291012 | 294591 | 288863 |
| **Difference in NEET rate**  **7 Year Post-HS** | -.132 | -.114 | -.066 | -.055 | -.062 | -.056 | -.063 | -.077 | -.095 | -.082 |
| *Standard Error* | *.01* | *.013* | *.01* | *.009* | *.008* | *.014* | *.011* | *.008* | *.008* | *.01* |
| Observations | 174814 | 173685 | 173659 | 175550 | 177227 | 173347 | 175050 | 176700 | 178990 | 175526 |

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. Student are considered to be NEET if they are neither enrolled in education nor earning at or above the federal poverty level at the specified time period. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table A10  *CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by student populations of interest, using only those cohorts that can be observed 7 years after High School* | | | | | | | |
|  | **Overall** | **No College** | **Male** | **Female** | **Black & Latinx** | **Students w/Disabilities** | **Lower Income** | | **Low-Scoring Students** |
| **1 Year Post-HS Difference in Earnings ($)** | 1757 | 2330 | 2061 | 1367 | 1194 | 1743 | 1395 | | 1414 |
| *Standard Error* | *100* | *168* | *128* | *81* | *136* | *128* | *110* | | *116* |
| Observations | 217635 | 68008 | 111118 | 106514 | 50569 | 44917 | 87405 | | 60416 |
| **3 Year Post-HS Difference**  **in Earnings ($)** | 3236 | 4308 | 3991 | 2289 | 2253 | 3347 | 2574 | | 2919 |
| *Standard Error* | *159* | *260* | *205* | *138* | *198* | *252* | *180* | | *207* |
| Observations | 217635 | 68008 | 111118 | 106514 | 50569 | 44917 | 87405 | | 60416 |
| **5 Year Post-HS Difference**  **in Earnings ($)** | 3253 | 5133 | 4397 | 1837 | 2628 | 3688 | 2977 | | 3284 |
| *Standard Error* | *160* | *309* | *209* | *184* | *293* | *246* | *256* | | *227* |
| Observations | 217635 | 68008 | 111118 | 106514 | 50569 | 44917 | 87405 | | 60416 |
| **7 Year Post-HS Difference**  **in Earnings ($)** | 2867 | 5806 | 4115 | 1356 | 3119 | 3809 | 3180 | | 3319 |
| *Standard Error* | *205* | *320* | *235* | *293* | *396* | *299* | *322* | | *278* |
| Observations | 217635 | 68008 | 111118 | 106514 | 50569 | 44917 | 87405 | | 60416 |
| Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. To maintain a stable sample, only those cohorts for whom earnings could be observed 7 years after on-time high school graduation are included in the analytic samples for all respective outcomes. | | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A11  *CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by student populations of interest*  *Using only those cohorts that can be observed 7 years after High School* | | | | | | | | |  |  |
|  | **Health** | **Edu** | **IT** | **Comms** | **Bus** | **Ag** | **Hosp** | **Manu** | **Cons** | **Tran** |
| **1 Year Post-HS Difference**  **in Earnings ($)** | 3133 | 1399 | 630 | 510 | 1369 | 1139 | 1383 | 2281 | 3356 | 3036 |
| *Standard Error* | *220* | *123* | *167* | *87* | *117* | *146* | *123* | *181* | *144* | *164* |
| Observations | 174814 | 173685 | 173659 | 175550 | 177227 | 173347 | 175050 | 176700 | 178990 | 175526 |
| **3 Year Post-HS Difference**  **in Earnings ($)** | 4636 | 2523 | 1834 | 1134 | 2598 | 2795 | 2500 | 3868 | 6212 | 5562 |
| *Standard Error* | *305* | *226* | *288* | *157* | *154* | *391* | *205* | *249* | *236* | *260* |
| Observations | 174814 | 173685 | 173659 | 175550 | 177227 | 173347 | 175050 | 176700 | 178990 | 175526 |
| **5 Year Post-HS Difference**  **in Earnings ($)** | 4440 | 2577 | 2038 | 455 | 3287 | 2120 | 2047 | 3818 | 6846 | 5953 |
| *Standard Error* | *355* | *428* | *450* | *308* | *301* | *423* | *283* | *285* | *281* | *284* |
| Observations | 174814 | 173685 | 173659 | 175550 | 177227 | 173347 | 175050 | 176700 | 178990 | 175526 |
| **7 Year Post-HS Difference**  **in Earnings ($)** | 5077 | 2894 | 1917 | -327 | 3171 | 1406 | 1114 | 3162 | 7228 | 4487 |
| *Standard Error* | *498* | *533* | *594* | *395* | *463* | *599* | *435* | *423* | *379* | *426* |
| Observations | 174814 | 173685 | 173659 | 175550 | 177227 | 173347 | 175050 | 176700 | 178990 | 175526 |

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who were never enrolled as a CTE student. To maintain a stable sample, only those cohorts for whom earnings could be observed 7 years after on-time high school graduation are included in the analytic samples for all respective outcomes.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A12  *CTE concentrators’ college outcomes compared to similar non-concentrators, by student populations of interest*  *Alternate comparison group: Students taking course(s) in each given CTE cluster for only one year* | | | | | | | | | |  |
|  | **Health** | **Educ** | **IT** | **Comms** | **Bus** | **Ag** | **Hosp** | **Manu** | **Cons** | **Tran** |
| **Difference in 2-Yr**  **College Attendance** | .091 | .041 | .063 | .029 | .02 | .081 | .018 | .031 | .001 | .021 |
| *Standard Error* | *.022* | *.013* | *.013* | *.009* | *.013* | *.019* | *.009* | *.01* | *.011* | *.01* |
| Observations | 15123 | 12772 | 10317 | 23334 | 29996 | 6378 | 16850 | 24221 | 26696 | 14125 |
| **Difference in 4-Yr**  **College Attendance** | .039 | .054 | .024 | .015 | .006 | .037 | .002 | -.005 | -.017 | -.001 |
| *Standard Error* | *.016* | *.01* | *.014* | *.008* | *.011* | *.019* | *.009* | *.017* | *.006* | *.009* |
| Observations | 15123 | 12772 | 10317 | 23334 | 29996 | 6378 | 16850 | 24221 | 26696 | 14125 |
| **Difference in Overall**  **College Attendance** | .091 | .072 | .065 | .049 | .025 | .086 | .017 | .022 | -.012 | .021 |
| *Standard Error* | *.02* | *.012* | *.015* | *.009* | *.012* | *.025* | *.01* | *.015* | *.011* | *.012* |
| Observations | 15123 | 12772 | 10317 | 23334 | 29996 | 6378 | 16850 | 24221 | 26696 | 14125 |
| **Difference in 2-Yr**  **College Degree Attainment** | .036 | .024 | .025 | .006 | .009 | .034 | .011 | .014 | .003 | .013 |
| *Standard Error* | *.009* | *.007* | *.007* | *.005* | *.007* | *.011* | *.005* | *.005* | *.005* | *.005* |
| Observations | 11669 | 10210 | 8152 | 18443 | 23584 | 5043 | 13369 | 18503 | 20779 | 11222 |
| **Difference in 4-Yr**  **College Degree Attainment** | .023 | .037 | .024 | -.002 | -.001 | .015 | -.01 | -.015 | -.006 | .001 |
| *Standard Error* | *.011* | *.01* | *.014* | *.009* | *.01* | *.02* | *.011* | *.014* | *.007* | *.008* |
| Observations | 8352 | 7496 | 6109 | 13581 | 17211 | 3761 | 9535 | 13166 | 15008 | 8171 |
| **Difference in Overall**  **College Degree Attainment** | .039 | .037 | .027 | .005 | .006 | .033 | .000 | -.004 | -.008 | .014 |
| *Standard Error* | *.013* | *.01* | *.015* | *.009* | *.01* | *.021* | *.011* | *.014* | *.009* | *.009* |
| Observations | 8352 | 7496 | 6109 | 13581 | 17211 | 3761 | 9535 | 13166 | 15008 | 8171 |

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who enrolled in 1 (but no more than 1) year in the specified career cluster. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A13  *CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by student populations of interest*  *Alternate comparison group: Students taking course(s) in each given CTE cluster for only one year* | | | | | | | | | | |
|  | **Health** | **Educ** | **IT** | **Comms** | **Bus** | **Ag** | **Hosp** | **Manu** | **Cons** | **Tran** |
| **1 Year Post-HS Difference**  **in Earnings ($)** | 1559 | 613 | 249 | 112 | 680 | 261 | 719 | 1489 | 2645 | 2369 |
| *Standard Errors* | *250* | *148* | *143* | *79* | *96* | *202* | *119* | *215* | *157* | *192* |
| Observations | 15123 | 12772 | 10317 | 23334 | 29996 | 6378 | 16850 | 24221 | 26696 | 14125 |
| **3 Year Post-HS Difference**  **in Earnings ($)** | 2096 | 841 | 935 | -52 | 1240 | 1547 | 1241 | 2065 | 4292 | 4363 |
| *Standard Errors* | *328* | *180* | *266* | *183* | *156* | *419* | *234* | *301* | *237* | *320* |
| Observations | 11669 | 10210 | 8152 | 18443 | 23584 | 5043 | 13369 | 18503 | 20779 | 11222 |
| **5 Year Post-HS Difference**  **in Earnings ($)** | 2607 | 926 | 1560 | 113 | 2004 | 2430 | 1091 | 2289 | 5518 | 4958 |
| *Standard Errors* | *428* | *317* | *436* | *315* | *327* | *700* | *383* | *327* | *378* | *508* |
| Observations | 8352 | 7496 | 6109 | 13581 | 17211 | 3761 | 9535 | 13166 | 15008 | 8171 |
| **7 Year Post-HS Difference**  **in Earnings ($)** | 3127 | 1083 | 1131 | -31 | 3024 | 5076 | 924 | 2426 | 7102 | 5066 |
| *Standard Errors* | *601* | *653* | *848* | *525* | *442* | *1099* | *481* | *618* | *663* | *795* |
| Observations | 4810 | 4528 | 3841 | 7901 | 10984 | 2120 | 5495 | 7835 | 8997 | 4832 |

Notes: Estimates are the coefficient associated with CTE concentration in each given cluster on the outcomes of interest (specified by row) with estimates for each CTE cluster indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “concentrator” in a specific career cluster if they are enrolled in the given cluster for at least two academic years. Comparison students are those who enrolled in 1 (but no more than 1) year in the specified career cluster. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A14  *Regression-adjusted estimates for CTE concentration on select outcomes*  *Among only students NOT residentially eligible for a vocational/technical school* | | | | | |
|  | **I** | **II** | **III** | **IV** | **V** |
| **Difference in 2-Yr College Attendance** | 0.038 | 0.038 | 0.034 | 0.012 | 0.023 |
| *Standard Error* | *0.012* | *0.007* | *0.011* | *0.010* | *0.008* |
| Observations | 114735 | 114735 | 114735 | 114735 | 114735 |
| **Difference in 4-Yr College Attendance** | -0.210 | -0.180 | -0.124 | -0.098 | -0.097 |
| *Standard Error* | *0.034* | *0.028* | *0.024* | *0.019* | *0.017* |
| Observations | 114735 | 114735 | 114735 | 114735 | 114735 |
| **Difference in Overall College Attendance** | -0.142 | -0.117 | -0.073 | -0.064 | -0.058 |
| *Standard Error* | *0.026* | *0.025* | *0.020* | *0.017* | *0.016* |
| Observations | 114735 | 114735 | 114735 | 114735 | 114735 |
| **Difference in 2-Yr College Degree Attainment** | -0.015 | -0.009 | -0.001 | -0.008 | -0.002 |
| *Standard Error* | *0.006* | *0.006* | *0.005* | *0.005* | *0.005* |
| Observations | 89522 | 89521 | 89522 | 89522 | 89521 |
| **Difference in 4-Yr College Degree Attainment** | -0.215 | -0.174 | -0.124 | -0.092 | -0.084 |
| *Standard Error* | *0.026* | *0.022* | *0.018* | *0.015* | *0.013* |
| Observations | 64495 | 64494 | 64495 | 64495 | 64494 |
| **Difference in Overall College Degree Attainment** | -0.201 | -0.159 | -0.111 | -0.083 | -0.072 |
| Standard Error | 0.024 | 0.020 | 0.017 | 0.014 | 0.013 |
| Observations | 64495 | 64494 | 64495 | 64495 | 64494 |
| **1 Year Post-HS Difference in Earnings ($)** | 2534 | 2490 | 2350 | 2095 | 2149 |
| *Standard Error* | *234* | *203* | *222* | *219* | *187* |
| Observations | 114735 | 114735 | 114735 | 114735 | 114735 |
| **3 Year Post-HS Difference in Earnings ($)** | 4226 | 4099 | 3868 | 3391 | 3446 |
| *Standard Error* | *325* | *236* | *306* | *296* | *223* |
| Observations | 89522 | 89521 | 89522 | 89522 | 89521 |
| **5 Year Post-HS Difference in Earnings ($)** | 2933 | 3326 | 3480 | 3275 | 3507 |
| *Standard Error* | *403* | *297* | *375* | *354* | *259* |
| Observations | 64495 | 64494 | 64495 | 64495 | 64494 |
| **7 Year Post-HS Difference in Earnings ($)** | 1519 | 2440 | 2751 | 2650 | 3047 |
| *Standard Error* | *805* | *619* | *762* | *713* | *539* |
| Observations | 38981 | 38981 | 38981 | 38981 | 38981 |
| Controls for Demographic Characteristics | No | No | **Yes** | **Yes** | **Yes** |
| Controls for 8th Gr. Assessments & Attendance | No | No | No | **Yes** | **Yes** |
| Fixed Effects for Cohort & Town of Residence | No | **Yes** | No | No | **Yes** |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest, specified by row. Model I includes only an indicator of CTE concentration and the outcome of interest. Model II adds cohort and town of residence fixed effects, with errors clustered by town of residence. Model III includes controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, and disability status. Model IV adds 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA) to demographic controls. Model V includes both fixed effects and all controls. Analytic samples include first-time 9th graders from towns of residence in which students are *not* eligible to attend a CTE-dedicated school, and in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples. For earnings outcomes, only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table A15  *Regression-adjusted estimates for CTE concentration on select outcomes*  *Among only students residentially eligible for a vocational/technical school* | | | | | |
|  | **I** | **II** | **III** | **IV** | **V** |
| **Difference in 2-Yr College Attendance** | 0.100 | 0.074 | 0.092 | 0.064 | 0.054 |
| *Standard Error* | *0.009* | *0.007* | *0.009* | *0.009* | *0.008* |
| Observations | 522041 | 522041 | 522041 | 522041 | 522041 |
| **Difference in 4-Yr College Attendance** | -0.219 | -0.130 | -0.130 | -0.103 | -0.088 |
| *Standard Error* | *0.021* | *0.016* | *0.014* | *0.011* | *0.009* |
| Observations | 522041 | 522041 | 522041 | 522041 | 522041 |
| **Difference in Overall College Attendance** | -0.117 | -0.055 | -0.047 | -0.043 | -0.033 |
| *Standard Error* | *0.018* | *0.018* | *0.013* | *0.011* | *0.012* |
| Observations | 522041 | 522041 | 522041 | 522041 | 522041 |
| **Difference in 2-Yr College Degree Attainment** | 0.010 | 0.009 | 0.020 | 0.013 | 0.009 |
| *Standard Error* | *0.003* | *0.004* | *0.003* | *0.003* | *0.003* |
| Observations | 407334 | 407334 | 407334 | 407334 | 407334 |
| **Difference in 4-Yr College Degree Attainment** | -0.214 | -0.131 | -0.126 | -0.097 | -0.084 |
| *Standard Error* | *0.019* | *0.014* | *0.012* | *0.010* | *0.009* |
| Observations | 293990 | 293990 | 293990 | 293990 | 293990 |
| **Difference in Overall College Degree Attainment** | -0.197 | -0.116 | -0.109 | -0.084 | -0.072 |
| *Standard Error* | *0.019* | *0.014* | *0.011* | *0.010* | *0.009* |
| Observations | 293990 | 293990 | 293990 | 293990 | 293990 |
| **1 Year Post-HS Difference in Earnings ($)** | 3004 | 2764 | 2825 | 2496 | 2460 |
| *Standard Error* | *191* | *172* | *182* | *163* | *159* |
| Observations | 522041 | 522041 | 522041 | 522041 | 522041 |
| **3 Year Post-HS Difference in Earnings ($)** | 4682.626 | 4278.087 | 4371.572 | 3761.551 | 3707.557 |
| *Standard Error* | *290.845* | *244.349* | *268.879* | *239.457* | *224.545* |
| Observations | 407334 | 407334 | 407334 | 407334 | 407334 |
| **5 Year Post-HS Difference in Earnings ($)** | 3007 | 3609 | 3702 | 3293 | 3448 |
| *Standard Error* | *255* | *341* | *282* | *227* | *216* |
| Observations | 293990 | 293990 | 293990 | 293990 | 293990 |
| **7 Year Post-HS Difference in Earnings ($)** | 1261 | 2772 | 2833 | 2548 | 2837 |
| *Standard Error* | *372* | *436* | *341* | *262* | *223* |
| Observations | 178655 | 178654 | 178655 | 178655 | 178654 |
| Controls for Demographic Characteristics | No | No | **Yes** | **Yes** | **Yes** |
| Controls for 8th Gr. Assessments & Attendance | No | No | No | **Yes** | **Yes** |
| Fixed Effects for Cohort & Town of Residence | No | **Yes** | No | No | **Yes** |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest, specified by row. Model I includes only an indicator of CTE concentration and the outcome of interest. Model II adds cohort and town of residence fixed effects, with errors clustered by town of residence. Model III includes controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, and disability status. Model IV adds 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA) to demographic controls. Model V includes both fixed effects and all controls. Analytic samples include first-time 9th graders from towns of residence in which students are eligible to attend a CTE-dedicated school, and in cohorts that would have graduated on-time from public high schools in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. For degree attainment outcomes, only those cohorts who would have enough time for “on-time” degree attainment are included in the analytic samples. For earnings outcomes, only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table A16  *CTE concentrators’ annual earnings advantage compared to similar non-concentrators, by student populations of interest*  *Sample only includes students at comprehensive schools* | | | | | | | |
|  | **Overall** | **Male** | **Female** | **Black & Latinx** | **Students w/Disabilities** | **Lower Income** | **Low-Scoring Students** |
| **Difference in 2-Yr**  **College Attendance** | .051 | .037 | .071 | .076 | .043 | .067 | .059 |
| *Stand Error* | *.008* | *.008* | *.008* | *.009* | *.007* | *.009* | *.008* |
| Observations | 572314 | 288785 | 283528 | 137832 | 116806 | 239706 | 125436 |
| **Difference in 4-Yr**  **College Attendance** | -.039 | -.045 | -.028 | -.006 | -.028 | -.015 | -.007 |
| *Stand Error* | *.008* | *.009* | *.009* | *.012* | *.006* | *.008* | *.006* |
| Observations | 572314 | 288785 | 283528 | 137832 | 116806 | 239706 | 125436 |
| **Difference in Overall**  **College Attendance** | .011 | -.005 | .035 | .061 | .023 | .043 | .05 |
| *Stand Error* | *.01* | *.012* | *.008* | *.011* | *.01* | *.009* | *.01* |
| Observations | 572314 | 288785 | 283528 | 137832 | 116806 | 239706 | 125436 |
| **Difference in 2-Yr**  **College Degree Attainment** | .006 | .004 | .009 | .011 | .003 | .011 | .008 |
| *Stand Error* | *.003* | *.003* | *.004* | *.003* | *.003* | *.003* | *.003* |
| Observations | 447059 | 225676 | 221383 | 105829 | 90538 | 182568 | 100708 |
| **Difference in 4-Yr**  **College Degree Attainment** | -.038 | -.042 | -.031 | -.011 | -.023 | -.017 | -.012 |
| *Stand Error* | *.007* | *.007* | *.008* | *.009* | *.005* | *.007* | *.004* |
| Observations | 323099 | 163084 | 160015 | 75960 | 64743 | 128494 | 76331 |
| **Difference in Overall**  **College Degree Attainment** | -.03 | -.034 | -.022 | -.002 | -.014 | -.008 | -.003 |
| *Stand Error* | *.006* | *.007* | *.007* | *.008* | *.006* | *.007* | *.005* |
| Observations | 323099 | 163084 | 160015 | 75960 | 64743 | 128494 | 76331 |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders at *comprehensive* public schools in cohorts that would have graduated on-time in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A17  *CTE concentrators’ college outcomes compared to similar non-concentrators, by student populations of interest*  *Sample only includes students at comprehensive schools* | | | | | | | | |
|  | **Overall** | **No College** | **Male** | **Female** | **Black & Latinx** | **Students w/Disabilities** | **Lower Income** | **Low-Scoring Students** |
| **1 Year Post-HS Difference**  **in Earnings ($)** | 1403 | 2009 | 1594 | 1174 | 1182 | 1461 | 1288 | 1297 |
| *Standard Errors* | *118* | *181* | *150* | *98* | *155* | *144* | *117* | *140* |
| Observations | 572314 | 172461 | 288785 | 283528 | 137832 | 116806 | 239706 | 125436 |
| **3 Year Post-HS Difference**  **in Earnings ($)** | 2355 | 3419 | 2861 | 1765 | 1967 | 2511 | 2065 | 2366 |
| *Standard Errors* | *170* | *285* | *213* | *164* | *209* | *297* | *168* | *230* |
| Observations | 447059 | 131281 | 225676 | 221383 | 105829 | 90538 | 182568 | 100708 |
| **5 Year Post-HS Difference**  **in Earnings ($)** | 2645 | 3982 | 3313 | 1846 | 2241 | 2868 | 2328 | 2684 |
| *Standard Errors* | *240* | *390* | *264* | *292* | *366* | *315* | *281* | *281* |
| Observations | 323099 | 95041 | 163084 | 160015 | 75960 | 64743 | 128494 | 76331 |
| **7 Year Post-HS Difference**  **in Earnings ($)** | 2710 | 4343 | 3193 | 2287 | 2962 | 2808 | 2671 | 2632 |
| *Standard Errors* | *284* | *401* | *275* | *425* | *468* | *365* | *344* | *304* |
| Observations | 196492 | 58414 | 99172 | 97318 | 45966 | 38811 | 76152 | 52115 |

Notes: Estimates are the coefficient associated with CTE concentration on the outcomes of interest (specified by row) with estimates for each student population of interest, indicated by column. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both mathematics and ELA). Models also include cohort and town of residence fixed effects, with errors clustered by town of residence. Analytic samples include first-time 9th graders at *comprehensive* public schools in cohorts that would have graduated on-time in the spring years of 2009 through 2017. Students are considered to be a “CTE concentrator” if they are enrolled in CTE for at least two academic years. Comparison students are those who were never enrolled as a CTE student. Only those cohorts for whom earnings could be observed 1, 3, 5, and 7 years after on-time high school graduation are included in the analytic samples for those respective outcomes.

**Appendix B. Methodological Details for *CTE Teacher Licensure and Long-Term Student Outcomes***

We estimate models with the following form:

where is a postsecondary outcome (2- or 4-year college enrollment, completion, or earnings) for student focusing in a given CTE cluster (e.g. agriculture, applied STEM), in “academic track” , and assigned to CTE teacher for school year . The first two terms are intended to address non-random selection on observable student characteristics. is a vector of student ’s prior test scores in 8th grade for math and ELA. This is an important control variable because there is substantial evidence that test scores influences selection into CTE relative to academic tracks (e.g., Dougherty and Harbaugh Macdonald, 2019), as well as being highly correlated with long-term labor market outcomes (e.g. Heckman et al., 2006). We follow standard practice and include a cubic in math and ELA scores to capture the potential for nonlinearity between outcomes and test scores (e.g., increases in prior test scores may have a stronger relationship with labor market outcomes for higher-performing students). The second term is a vector of student demographics (race/ethnicity, gender) and school program participation (free or reduced price lunch, special education, limited English proficiency), which tend to be associated with CTE participation.

The term includes the key variables of interest on the qualifications of CTE teachers: an indicator for novice defined as having less than three years of experience; indicators for CTE licensure and alignment with the program of study; and written and performance test scores on the CTE subject test. We standardize test scores on the subject test so each coefficient can be interpreted as the expected increase in a given outcomes associated with a 1 *SD* increase in CTE teacher test scores. Due to the relatively large number of tests (48 tests across CTE program areas) and relatively few test takers (823 unique test takers as reported by Table 3.2), we standardize by test subject but not by year.[[5]](#footnote-6) Moreover, we estimate models separately according to two specifications of these tests scores for individual teachers: 1) average teacher CTE subject test scores across programs (e.g. a teacher who scored 80 in carpentry and 90 in plumbing performance tests has an average score of 85), and 2) subject test scores specific to the program of instruction (e.g. the above teacher has the carpentry score applied only to students in a carpentry program).

The second-to-last term, , represents a fixed-effect for CTE cluster by academic track. These fixed effects are important for comparing students *within tracks,* so that they have similar course-taking patterns outside of CTE. Following Jackson (2014), the indicators for academic tracks specify patterns of coursetaking within each high school by subject and level of instruction for the 10 most commonly enrolled courses for students in Massachusetts. To illustrate, students who take the same courses but at different schools are placed in separate tracks, as are students within the same school who take the same English courses but enroll in courses with different levels of Algebra instruction. We interact these track indicators with CTE cluster indicators to account for the fact that programs are likely to be paired with and benefit from different patterns of academic course-taking. For instance, we seek to compare students who take advanced math course sequences and enroll in applied STEM to other students who also take advanced math courses and enroll in applied STEM.

**Appendix C. Guidance Counselor Interview Questions**

1. To get started, can you introduce yourself? How long have you been at xx Middle School?

I am curious to learn about students’ transition from middle school to high school.

1. Which high schools from xx middle school do students attend?
   1. Is there one high school that most students attend?
   2. Do you know what percentage attend xx High School and what percentage attend yy CTE? What other high schools (if any) do students attend?
   3. Have these percentages shifted over time? If so, when did they start changing and how have they changed? Do you have a sense of what is behind the change?
2. Do you notice differences in which students apply to yy CTE school, compared with the students who attend xx High School? Do the different schools have different reputations? E.g. CTE is for a certain type of student? If so, do these reputations affect which students apply to xx CTE?
3. What activities or support does xx school offer to help students decide about high school options?
   1. Are there any presentations or other events about the different high school options at your school? If yes, can you tell me more about these events? Who convenes these events? What is the content? Is the audience families, students, both?
   2. Do students have the opportunity to visit high schools during the school day? If so, which ones and when does that occur? If not, have there been opportunities in the past for students to visit high schools, including yy CTE?
   3. Are there any yy CTE and/or xx High School evening or weekend open houses?
   4. Are there opportunities for parents to visit yy CTE, xx High School, or other high schools?
   5. Do any representatives from high schools come to the middle school to talk with students? If so, which ones?
   6. [If necessary] Do any representatives from yy CTE come to the middle school to talk with students? If not, do you know why not?
   7. Do you offer one-on-one student meetings with a guidance counselor to discuss high school options? If so, are they voluntary or required? Can parents/guardians attend these meetings?
   8. Are there any written materials distributed to students and/or their families about high schools or making decisions about which high school to attend? If so, what kinds materials? And what do these materials cover? Are they available in multiple languages?
   9. Any other activities?
4. What is the timeline for these activities?
5. Can you tell me a bit about the factors that influence what you do to help support students in their high school decisions/choices? E.g. Who in the school decides about the activities? Is the same year after year or has it changed? Are there certain dynamics between the middle school and high schools? Can you explain?
6. In your work with students, do you discuss the requirements for entry for different high schools? Do you share that information with parents and guardians?
7. Do you engage the parents/families in the high school decision-making process? If so, how?
8. What is your sense of how involved parents/families are in the process?
9. How would you say students make their decision about which high school to attend?
   1. What information do you believe is most important for students?
   2. Do you think students have adequate information to make an informed choice?
   3. If not, what additional information would be helpful?

**Appendix D. 8th Grade Student Survey Questions**

1. What grade are you currently in?
   1. 8th grade
   2. Other, please specify: [text box]
2. Which school do you attend? (Drop down menu with the middle schools in the region)
3. How much have you thought much about which high school you want to attend?
   1. A lot
   2. Somewhat
   3. A little
   4. Not at all
4. Which high schools are you considering attending next year? (Drop down menu with high schools in the region. Check the names of all of the schools that you are currently considering.)
5. Do you have a first choice for high school? Yes/No
   1. If yes, which school? (Drop down menu with high schools in the region)
   2. If yes, how certain are you that you will attend your first choice?
      1. Very
      2. Somewhat
      3. Not certain at all
   3. [For students who are very certain], can you describe why the school is your first choice?\_\_\_\_\_\_\_\_\_\_\_\_\_
6. [If yy CTE is not selected in #4], Do you know if you are eligible to apply to yy CTE? Yes/No/Don’t Know
   1. Do you plan to apply to yy CTE? Yes/No/Don’t Know
7. In thinking about which high school to attend, what’s the most important aspect for you?
   1. Academics
   2. Future job opportunities
   3. Sport opportunities
   4. Convenience
   5. Where my friends are
   6. Reputation
   7. Safety
   8. Opportunity to learn a career or specific occupation

Other, please specify: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Do you know if any of the high schools you are considering have requirements to attend? Yes/No/Don’t Know
   1. If yes, do the high schools have any requirements? Yes/No
   2. If yes, what is your understanding of the requirements to get into the high schools you’ve mentioned? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How involved are your parents, other family members, or guardians in your decision about which high school to attend?
   1. A lot
   2. Somewhat
   3. A little
   4. Not at all
3. How involved are your friends in your decision about which high school to attend?
   1. A lot
   2. Somewhat
   3. A little
   4. Not at all
4. Has xx middle school helped you learn about different high school options? Yes/No
5. If yes,
   1. Have there been any events or other activities at school related to high school options? Yes/No/Don’t know
      1. If yes, what type of events? Please specify: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      2. If yes, when was/were the event(s)?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Have you or your family received any flyers or brochures or information about high schools? Yes/No/Don’t Know
      1. If yes, when did you get this information?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      2. If yes, where did you get this information?
         1. Guidance Counselor/middle school
         2. In the mail
         3. Don’t know
         4. Other: Please specify\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Have you talked with a guidance counselor? Yes/No
      1. If yes, when did you speak with the guidance counselor?\_\_\_\_\_\_\_\_\_
      2. If yes, were you required to speak with a guidance counselor? Yes/No/Don’t Know
   4. Have you visited any high schools? Yes/No
      1. If yes, which high school(s)?(Drop down menu with high schools in the region and for other, please specify)
      2. If yes, was the visit arranged by xx middle school? Yes/No
      3. If no, who arranged the visit? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. Is there anything else that xx middle school has done to help you learn about your high school options: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Have your parents or family members talked to you about high school options? Yes/No
   1. If yes, when was your first conversation about high school?\_\_\_\_\_\_\_\_\_\_\_
   2. If yes, what did they talk with you about? Choose all that apply:
      1. Academics
      2. Future job opportunities
      3. Sport opportunities
      4. Convenience
      5. Where my friends are
      6. Reputation
      7. Safety
      8. Opportunity to learn a career or specific occupation
      9. Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Do you have friends or older siblings attending high school in the area? Yes/No
   1. If yes, which high school(s). Select all that apply. Drop down menu with high schools in the area
   2. If yes, have they talked with you about high school? Yes/No
   3. If yes, what did they talk with you about? Choose all that apply.
      1. Academics
      2. Future job opportunities
      3. Sport opportunities
      4. Convenience
      5. Where my friends are
      6. Reputation
      7. Safety
      8. Opportunity to learn a career or specific occupation
      9. Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. [Skip if CTE is addressed in Question #13. If it is not addressed, then] Do you have friends or older siblings who go to CTE school? Yes/No
   1. If yes, have they talked with you about CTE school? Yes/No
   2. If yes, can you describe their advice:
      1. Academics
      2. Future job opportunities
      3. Sport opportunities
      4. Convenience
      5. Where my friends are
      6. Reputation
      7. Safety
      8. Opportunity to learn a career or specific occupation
      9. Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. What activity/event and/or conversation has been the most helpful as you consider your high school options?
10. Do you think you have enough information to make a good high school choice? Yes/No
    1. If no, what other type of information and/or activities would be helpful for you?
       1. More events at school?
       2. Conversations with the guidance counselor?
       3. Visiting different high schools?
       4. More information about the different programs at different high schools?
       5. Other information. Please explain:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. What is your gender? Male/Female/Other
12. What is your race or ethnicity?
    1. White
    2. African-American or Black
    3. Hispanic/Latino (Any Race)
    4. Asian
    5. American Indian or Alaska Native
    6. Native Hawaiian or Other Pacific Islander
    7. Other
13. What language do you speak at home?
    1. English
    2. Spanish
    3. Portuguese
    4. Other:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix E. 8th Grade Student Focus Group Protocol**

1. To start, can we go around and each of you please tell me your name, your grade, and how long you have been at this school?

I know that graduation probably feels a long way away. I want to spend some time talking a bit about what all of you are thinking about for next year.

1. Which high schools do kids from xx middle school go to?

*In addition to public high school and CTE, probe for charter schools or other independent schools*

1. Can you tell me a bit about how you are thinking about your decision? What’s most important to you for your high school?
2. In thinking about which high school to attend, can you tell me a little about how important or not important these things are to you?
   1. Academics
   2. Future job opportunities
   3. Sport opportunities
   4. Convenience
   5. Where my friends are
   6. Reputation
   7. Safety
   8. Opportunity to learn a career or specific occupation
   9. Other?
3. Have you thought much about which high school you want to go to? [Count hands and report number]

*Probe if needed: Would you say you have thought a lot, somewhat, a little or not at all about high school?*

* 1. For those of you who have thought about which high school you want to go to, how certain are you? Definitely know, medium, don’t really know, haven’t thought much about it?

1. Which high schools are you thinking about for next year?
2. What do you know about xx High School or yy CTE? What have you heard from others about these different schools?

*If needed, explain further: like are they thought of for certain kinds of kids, and not for others?*

1. What’s the first word that comes to your mind when you think of xx High School? How about yy CTE? Any other school that is mentioned?
2. How many are planning to apply to yy CTE? [Count number and report]
   1. For those who are, can you tell me why?
   2. For those who are not, can you tell me why not?
3. What is your understanding of the requirements, if any, to get into the high schools you’ve mentioned?
4. How involved are your parents, other family members, or guardians in your decisions?
5. What type of information have you received to help you think about high school?
   1. Has xx middle school done anything to help you decide which high school to attend next year? If so, what?
   2. Have there been any events or other activities at school that have focused on high school options? If so, what kind? When?
   3. Have you gotten any flyers or brochures or information? If so, what kind? when? From whom?
   4. Have you talked with a guidance counselor about where you will attend high school? If so, was it required?
   5. Have your parents or family members talked to you about high school options?
   6. Have you visited any high schools? If so, who arranged the visit?
   7. Do you have friends or older siblings in high school? What high schools are they attending? Are you hearing things from them about their schools? If so, what kinds of things?
   8. Do you have friends or older siblings who go to a CTE school? If so, have you talked to them about CTE school? What have you learned?
6. Of all of the things that we just discussed, which of these things has been the most helpful for you in making a decision about what high school to attend?
7. Do you feel like you have enough information to make a good choice? If not, what other type of information or activities would be helpful for you?

**Appendix F. Additional Tables for *Student Entry into RVTSs in Massachusetts***

**Table F1.** Survey Results from 8th Grade Students (Moderately Oversubscribed Region)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Overall | Female | Male | White | Students of Color | Plans to apply | Does not plan to apply |
| Student has thought about HS (1-4, 1 high) | 1.878\*\*\* | 1.719 | 1.996\*\*\* | 1.870 | 1.922 | 1.324 | 2.029\*\*\* |
| Student has a first choice HS | 0.845 | 0.864 | 0.825 | 0.847 | 0.843 | 0.855 | 0.842 |
| Eligible for Region RVTS | 0.501 | 0.522 | 0.490 | 0.515 | 0.438 | 0.815\*\*\* | 0.420 |
| DK if eligible for Region RVTS | 0.453 | 0.440 | 0.459 | 0.452 | 0.445 | 0.173 | 0.527\*\*\* |
| Plans to apply for Region RVTS | 0.207 | 0.169 | 0.232\* | 0.190 | 0.276\* | 1.000\*\*\* | 0.000 |
| DK if plans to apply for Region RVTS | 0.126 | 0.101 | 0.146+ | 0.112 | 0.197\*\* | 0.000 | 0.159\*\*\* |
| Academics most important | 0.297\*\*\* | 0.356\*\* | 0.254 | 0.314\* | 0.219 | 0.075 | 0.357\*\*\* |
| Future jobs most important | 0.280 | 0.241 | 0.313\* | 0.282 | 0.258 | 0.572\*\*\* | 0.205 |
| Sports most important | 0.149 | 0.090 | 0.196\*\*\* | 0.145 | 0.172 | 0.035 | 0.178\*\*\* |
| Where my friends are most important | 0.103\*\*\* | 0.101 | 0.102 | 0.103 | 0.094 | 0.023 | 0.123\*\*\* |
| Reputation most important | 0.010 | 0.008 | 0.009 | 0.010 | 0.008 | 0.006 | 0.011 |
| Safety most important | 0.006 | 0.005 | 0.007 | 0.004 | 0.016 | 0.000 | 0.008 |
| Opportunity to learn career most important | 0.121 | 0.153\* | 0.097 | 0.107 | 0.195\*\* | 0.266\*\*\* | 0.083 |
| HS(s) student is considering have reqs | 0.379 | 0.351 | 0.397 | 0.376 | 0.364 | 0.728\*\*\* | 0.287 |
| DK if HS(s) student is considering have reqs | 0.381\*\* | 0.390 | 0.371 | 0.381 | 0.403 | 0.254 | 0.415\*\*\* |
| Parents' level of involvement (out of 4) | 3.115 | 3.245\*\*\* | 3.015 | 3.114 | 3.117 | 3.477\*\*\* | 3.018 |
| Friends' level of involvement (out of 4) | 2.466 | 2.499 | 2.437 | 2.456 | 2.523 | 2.372 | 2.491 |
| School has helped learn about HS options | 0.808\* | 0.804 | 0.819 | 0.813 | 0.781 | 0.808 | 0.809 |
| School held events related to HS | 0.632\* | 0.668+ | 0.603 | 0.640 | 0.580 | 0.630 | 0.632 |
| DK if school held events related to HS | 0.270 | 0.247 | 0.286 | 0.260 | 0.330 | 0.290 | 0.265 |
| Student/family received materials about HS | 0.410 | 0.433 | 0.395 | 0.398 | 0.485 | 0.571\*\*\* | 0.371 |
| DK if stud/fam received materials about HS | 0.371\*\*\* | 0.331 | 0.400+ | 0.387\* | 0.273 | 0.323 | 0.382 |
| Student has talked with counselor | 0.345 | 0.298 | 0.384\* | 0.339 | 0.394 | 0.559\*\*\* | 0.288 |
| Student was required to talk with counselor | 0.246 | 0.276 | 0.230 | 0.236 | 0.297 | 0.342\* | 0.200 |
| DK if required to talk with counselor | 0.211 | 0.172 | 0.237 | 0.230+ | 0.108 | 0.171 | 0.227 |
| Student has visited HS(s) | 0.738 | 0.733 | 0.743 | 0.744 | 0.695 | 0.847\*\*\* | 0.709 |
| Family has discussed HS options | 0.805 | 0.831 | 0.786 | 0.803 | 0.822 | 0.988\*\*\* | 0.756 |
| Student has older friends of siblings in HS | 0.728 | 0.754 | 0.709 | 0.742\* | 0.636 | 0.591 | 0.764\*\*\* |
| Student has enough info to make HS choice | 0.848 | 0.842 | 0.854 | 0.858\* | 0.789 | 0.924\*\* | 0.828 |
| Student/family received materials from MS | 0.300 | 0.339 | 0.255 | 0.315 | 0.234 | 0.347 | 0.282 |
| Student/family received materials from mail | 0.630\* | 0.638 | 0.624 | 0.617 | 0.702 | 0.600 | 0.641 |
| Friends discussed academics | 0.760\*\* | 0.813\*\* | 0.704 | 0.771 | 0.706 | 0.700 | 0.774 |
| Friends discussed future jobs | 0.394 | 0.370 | 0.412 | 0.382 | 0.456 | 0.675\*\*\* | 0.337 |
| Friends discussed sports | 0.589\*\* | 0.543 | 0.637\* | 0.611\* | 0.471 | 0.438 | 0.621\*\* |
| Friends discussed convenience | 0.158 | 0.174 | 0.146 | 0.158 | 0.162 | 0.113 | 0.168 |
| Friends discussed where friends attend | 0.303\*\* | 0.343+ | 0.265 | 0.308 | 0.279 | 0.200 | 0.324\* |
| Friends discussed reputation | 0.149 | 0.157 | 0.142 | 0.148 | 0.147 | 0.125 | 0.155 |
| Friends discussed safety | 0.132 | 0.143 | 0.119 | 0.125 | 0.176 | 0.163 | 0.126 |
| Friends discussed learning career | 0.249 | 0.261 | 0.235 | 0.237 | 0.309 | 0.400\*\*\* | 0.218 |
| Student wishes for more events | 0.439 | 0.491 | 0.385 | 0.448 | 0.407 | 0.167 | 0.468\* |
| Student wants more talks with counselor | 0.366 | 0.333 | 0.400 | 0.365 | 0.370 | 0.583 | 0.342 |
| Students wish they visited other HSs | 0.537 | 0.614+ | 0.462 | 0.583+ | 0.370 | 0.417 | 0.550 |
| Students wish for info on programs at HS | 0.650 | 0.649 | 0.646 | 0.646 | 0.667 | 0.833 | 0.631 |
| Female | 0.447 | 1.000\*\*\* | 0.000 | 0.459 | 0.400 | 0.371 | 0.467\* |
| White | 0.844\*\*\* | 0.864 | 0.833 | 1.000\*\*\* | 0.000 | 0.792 | 0.860\* |
| Black | 0.036 | 0.030 | 0.042 | 0.000 | 0.233\*\*\* | 0.042 | 0.033 |
| Latinx | 0.048 | 0.046 | 0.051 | 0.000 | 0.310\*\*\* | 0.077+ | 0.041 |
| Asian | 0.021 | 0.014 | 0.022 | 0.000 | 0.132\*\*\* | 0.018 | 0.021 |
| Student speaks English at home | 0.952\*\*\* | 0.959 | 0.952 | 0.989\*\*\* | 0.752 | 0.930 | 0.958 |
| Observations | 850 | 367 | 454 | 700 | 129 | 173 | 662 |

+ p<0.10,\* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Significance symbols are from two-tailed t-tests comparing female & male respondents, white and nonwhite respondents, and respondents planning and not planning to apply to the vocational school in their region. Significance symbols are in the column corresponding to the higher observed response. Significance symbols in the Overall column represent a significantly *larger* response for all respondents in this region, compared to respondents in Table D2.

**Table F2.** Survey Results from 8th Grade Students (Highly Oversubscribed Region)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Overall | Female | Male | White | Students of Color | Plans to apply | Does not plan to apply |
| Student has thought about HS (1-4, 1 high) | 1.684 | 1.590 | 1.730\*\* | 1.641 | 1.742\* | 1.481 | 1.921\*\*\* |
| Student has a first choice HS | 0.862 | 0.850 | 0.869 | 0.871 | 0.847 | 0.883\* | 0.836 |
| Eligible for Region RVTS | 0.594 | 0.650 | 0.558 | 0.670 | 0.497 | 0.788\*\* | 0.358 |
| DK if eligible for Region RVTS | 0.357 | 0.304 | 0.395 | 0.298 | 0.431 | 0.208 | 0.538 |
| Plans to apply for Region RVTS | 0.547\*\*\* | 0.534 | 0.565 | 0.555 | 0.541 | 1.000\*\*\* | 0.000 |
| DK if plan apply for Region RVTS | 0.144 | 0.119 | 0.154 | 0.118 | 0.176 | 0.000 | 0.317 |
| Academics most important | 0.191 | 0.266\*\*\* | 0.134 | 0.227\*\*\* | 0.143 | 0.124 | 0.271\*\*\* |
| Future jobs most important | 0.380\*\*\* | 0.362 | 0.395 | 0.370 | 0.391 | 0.487\*\*\* | 0.249 |
| Sports most important | 0.138 | 0.087 | 0.186\*\*\* | 0.111 | 0.172\*\* | 0.076 | 0.214\*\*\* |
| Where my friends are most important | 0.044 | 0.048 | 0.038 | 0.043 | 0.047 | 0.029 | 0.063\*\* |
| Reputation most important | 0.014 | 0.014 | 0.013 | 0.013 | 0.016 | 0.013 | 0.014 |
| Safety most important | 0.010 | 0.012 | 0.009 | 0.003 | 0.020\*\* | 0.007 | 0.014 |
| Opportunity to learn career most important | 0.178\*\*\* | 0.171 | 0.183 | 0.182 | 0.179 | 0.237\*\*\* | 0.108 |
| HS(s) student is considering have reqs | 0.529\*\*\* | 0.490 | 0.570\* | 0.564\*\* | 0.478 | 0.699\*\*\* | 0.321 |
| DK if HS(s) considering have reqs | 0.323 | 0.347+ | 0.294 | 0.285 | 0.372\*\* | 0.269 | 0.392\*\*\* |
| Parents' level of involvement (out of 4) | 3.232\*\* | 3.294\* | 3.184 | 3.201 | 3.272 | 3.418\*\*\* | 2.996 |
| Friends' level of involvement (out of 4) | 2.448 | 2.481 | 2.433 | 2.414 | 2.501 | 2.494+ | 2.391 |
| School has helped learn about HS options | 0.767 | 0.778 | 0.769 | 0.793\* | 0.727 | 0.766 | 0.766 |
| School held events related to HS | 0.578 | 0.596 | 0.557 | 0.619\*\* | 0.508 | 0.586 | 0.570 |
| DK if school held events related to HS | 0.316+ | 0.301 | 0.335 | 0.283 | 0.369\*\* | 0.306 | 0.326 |
| Student/family received materials about HS | 0.547\*\*\* | 0.628\*\*\* | 0.468 | 0.549 | 0.534 | 0.600\*\*\* | 0.481 |
| DK if stud/fam received materials about HS | 0.272 | 0.212 | 0.331\*\*\* | 0.297+ | 0.234 | 0.234 | 0.316\*\* |
| Student has talked with counselor | 0.411\*\* | 0.410 | 0.406 | 0.422 | 0.397 | 0.434 | 0.386 |
| Student was required to talk with counselor | 0.221 | 0.228 | 0.206 | 0.212 | 0.219 | 0.215 | 0.224 |
| DK if required to talk with counselor | 0.212 | 0.196 | 0.230 | 0.207 | 0.219 | 0.200 | 0.231 |
| Student has visited HS(s) | 0.794\*\* | 0.810 | 0.776 | 0.809 | 0.771 | 0.828\*\* | 0.752 |
| Family has discussed HS options | 0.857\*\* | 0.875 | 0.842 | 0.879\*\* | 0.822 | 0.920\*\*\* | 0.778 |
| Student has older friends of siblings in HS | 0.722 | 0.755\* | 0.693 | 0.729 | 0.717 | 0.724 | 0.721 |
| Student has enough info to make HS choice | 0.864 | 0.859 | 0.881 | 0.902\*\*\* | 0.810 | 0.884\* | 0.842 |
| Student/family received materials from MS | 0.354 | 0.383 | 0.319 | 0.366 | 0.333 | 0.333 | 0.388 |
| Student/family received materials from mail | 0.552 | 0.563 | 0.532 | 0.522 | 0.596 | 0.577 | 0.517 |
| Friends discussed academics | 0.679 | 0.750\*\*\* | 0.622 | 0.719\* | 0.626 | 0.706+ | 0.641 |
| Friends discussed future jobs | 0.589\*\*\* | 0.563 | 0.619 | 0.594 | 0.588 | 0.698\*\*\* | 0.450 |
| Friends discussed sports | 0.491 | 0.480 | 0.514 | 0.491 | 0.490 | 0.474 | 0.519 |
| Friends discussed convenience | 0.134 | 0.180\*\* | 0.094 | 0.145 | 0.121 | 0.113 | 0.164+ |
| Friends discussed where friends attend | 0.229 | 0.247 | 0.199 | 0.253 | 0.198 | 0.206 | 0.263+ |
| Friends discussed reputation | 0.144 | 0.157 | 0.122 | 0.153 | 0.132 | 0.137 | 0.156 |
| Friends discussed safety | 0.175+ | 0.187 | 0.150 | 0.165 | 0.191 | 0.172 | 0.183 |
| Friends discussed learning career | 0.345\*\*\* | 0.390\* | 0.308 | 0.338 | 0.358 | 0.407\*\*\* | 0.267 |
| Student wishes for more events | 0.401 | 0.435 | 0.403 | 0.414 | 0.393 | 0.412 | 0.384 |
| Student wants more talks with counselor | 0.303 | 0.348 | 0.290 | 0.379 | 0.250 | 0.397\* | 0.219 |
| Students wish they visited other HSs | 0.493 | 0.594\* | 0.371 | 0.552 | 0.452 | 0.529 | 0.466 |
| Students wish for info on programs at HS | 0.648 | 0.739+ | 0.581 | 0.707 | 0.607 | 0.632 | 0.671 |
| Female | 0.483 | 1.000\*\*\* | 0.000 | 0.479 | 0.489 | 0.471 | 0.502 |
| White | 0.581 | 0.584 | 0.594 | 1.000\*\*\* | 0.000 | 0.589 | 0.575 |
| Black | 0.092\*\*\* | 0.088 | 0.098 | 0.000 | 0.220\*\*\* | 0.082 | 0.104 |
| Latinx | 0.200\*\*\* | 0.205 | 0.195 | 0.000 | 0.477\*\*\* | 0.219+ | 0.177 |
| Asian | 0.026 | 0.020 | 0.026 | 0.000 | 0.062\*\*\* | 0.012 | 0.044\*\* |
| Student speaks English at home | 0.818 | 0.815 | 0.827 | 0.966\*\*\* | 0.611 | 0.812 | 0.829 |
| Observations | 1110 | 498 | 533 | 623 | 449 | 595 | 492 |

+ p<0.10,\* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Significance symbols are from two-tailed t-tests comparing female & male respondents, white and nonwhite respondents, and respondents planning and not planning to apply to the vocational school in their region. Significance symbols are in the column corresponding to the higher observed response. Significance symbols in the Overall column represent a significantly *larger* response for all respondents in this region, compared to respondents in Table D1.

| Logo of the American Institutes for Research |
| --- |
| Established in 1946, the American Institutes for  Research (AIR) is an independent, nonpartisan,  not-for-profit organization that conducts behavioral and social science research on important social issues and delivers technical assistance, both domestically and internationally, in the areas of education, health, and workforce productivity. |
| MAKING RESEARCH **RELEVANT** |
| AMERICAN INSTITUTES FOR RESEARCH  1000 Thomas Jefferson Street NW  Washington, DC 20007-3835 | 202.403.5000  www.air.org |

1. The content of the tests are described in detail here: <https://www.gltech.org/site/default.aspx?PageType=14&DomainID=69&PageID=241&ModuleInstanceID=273&ViewID=1e008a8a-8e8a-4ca0-9472-a8f4a723a4a7&IsMoreExpandedView=True>, accessed 8/19/2020. [↑](#footnote-ref-2)
2. Note that EPIMS does not have the ability to track teacher experience outside of the state. [↑](#footnote-ref-3)
3. About 33% (or 125 individuals) of these unlicensed teachers hold an academic teacher license, while the other 66% (251 individuals) had no academic license. [↑](#footnote-ref-4)
4. DESE also administered a parent survey that had a response rate that was too low to include in this report. [↑](#footnote-ref-5)
5. One implication of not normalizing over years is that test performance will tend to improve over time, and thus, more recently tested cohorts of teachers will tend to have higher scores than older cohorts. [↑](#footnote-ref-6)