Three Essays on Career and Technical Education

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To the students I have had the privilege to teach and who motivate my work every day

and

To the teachers and classmates from whom and with whom I have learned about education throughout the years.

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CHAPTER 1

Heterogeneity in High School Career and Technical Education Outcomes

This chapter has been produced with the permission of my co-author, Shaun M. Dougherty.

1.1 Introduction

Throughout the second half of the 20th century, research on vocational education generally found negative effects for participating students. In particular, vocational education 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 (Tyack, 1974; Bowles & Gintis, 1976; Anderson, 1982; Oakes, 1983). In the early 21st century, vocational education underwent a significant reinvention, highlighted in part by the shift in terminology from vocational education to Career and Technical Education (CTE), as well as increased investments by the federal government along with positioning CTE as part of a "College and Career Readiness" agenda (Author et al., 2020; Author, 2016). While many traditional vocational programs remain in place, new CTE programs tend to emphasize pathways that were explicitly designed to prepare students for postsecondary education as well careers in high-demand, high-wage areas (see Bozick & Dalton 2013; Gottfried & Plasman 2018).

Alongside the renewed policy interest and shifts in curricular foci of CTE, an emerging body of experimental and quasi-experimental research using more recent data (Bonilla, 2020; Hemelt et al., 2019; Brunner, et al., 2019; Author, 2018; Kemple & Willner, 2008) has enhanced our understanding of the causal effects of CTE program, finding some encouraging results. However, given the increasingly broad range of contexts and programs that fall within CTE, these studies are limited in that they largely treat CTE as a monolithic experience, potentially masking the extensive diversity of experiences students experience.

First, recent research has tended to focus on CTE programming within oversubscribed, specialized CTE schools, where opportunities to estimate causal impacts have arisen. However, most CTE students across the nation engage with CTE within traditional comprehensive schools or part-time centers, which may not offer the same set of experiences as whole-school models of CTE, and therefore may not produce similar effects.

Furthermore, prior research has done little to disentangle potential differences in impact among the different programs *within* CTE, or how students with different personal characteristics may differently experience returns to CTE. 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. Given the push for STEM-focused CTE programs, an emphasis on how these CTE programs may lead to different outcomes than more traditional vocational programs seems especially pertinent. We also pay close attention to differences in outcomes different student populations of interest, which is particularly relevant given the federal Perkins legislation's explicit focus on equity in access and outcomes for different student groups.

This paper begins to fill a gap in the existing research base by estimating differences in the associations between high school 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. We observe these students for between 1 and 7 years after anticipated high school graduation and find that advantages for CTE concentrators are highly heterogeneous for both college and workforce outcomes. We find that students concentrating in certain CTE fields see strong advantages in workforce, while students in other fields see stronger postsecondary outcomes. We also document that these advantages vary widely across student characteristics, with students from less-advantaged backgrounds experiencing the largest benefits. In particular, we find strong evidence that CTE may be a useful lever to help students avoid especially negative outcomes like poverty and disengagement from both education and the workforce. Though not explicitly causal in nature, our estimates hold up to a series of robustness checks which suggest that even under fairly conservative assumptions these returns cannot be explained by bias alone.

In this paper, we proceed as follows: We first review a brief history of the research base that motivates our work and the need to study heterogeneity within high school CTE. We then discuss the context, data and measures we use to explore heterogeneity within CTE. We follow with a descriptive analysis, in which we focus on differences within who opts in to CTE and into different fields of study. After introducing our analytic approach, we present results in which we explore expected differences in outcomes associated with CTE by both career clusters and populations of interest. We then test limitations to our analytic approach through a number of robustness analyses. Finally, we conclude with remarks about the significance of our findings and implications for both policymakers and researchers who study CTE.

1.2 Literature Review

Given shifts in the CTE policy landscape in recent years towards CTE as a part of a college and career readiness curriculum, an emerging body of experimental and quasi-experimental research has sought to revisit potential returns to CTE, providing some reasons for optimism for proponents. Kemple & Willner (2008), exploit a lottery for admission to nine oversubscribed Career Academies, finding 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 in one career academy in North Carolina, find an 8% increase in high school graduation rates for Career Academy participants. Similar to Kemple & Willner, Hemelt et al. find more positive effects for male students, particularly when considering college enrollment. Author (2018) and Brunner et al. (2019) both employ a regression discontinuity design using admissions score cut-offs for CTE-dedicated high school, with Author finding a 7-10% increase in the likelihood of high school graduation, and Brunner et al. finding a 31% increase in quarterly earnings (again, with returns accruing primarily to male students), though evidence of null effects on college enrollment by age 23. Bonilla (2020) uses a school district level regression discontinuity on receipt of additional funding for CTE and found a reduction in high school dropout among districts that received additional funds to spend on CTE. Importantly, these impacts were stronger for girls, but schools invested principally in health services CTE programs, which are disproportionately enrolled in by females.

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, however, is that they rely on the experiences of CTE students in oversubscribed, whole-school CTE models, which are not representative of the wide 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 course, 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 high school graduation as well as two-year college enrollment, though the two-year college enrollment increase may be partially due to some diversion of CTE students from four-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, 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 more closely 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, 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 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.

1.3 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. With approximately 21.5% of students across the state concentrating in CTE, there is a large sample of CTE concentrators within which we can examine several dimensions of heterogeneity. Moreover, the diversity of contexts in which CTE is offered in Massachusetts mirrors the diversity of contexts nationwide; about half of CTE concentrators attend CTE-dedicated schools, while another half take CTE courses within comprehensive schools. Some programs are heavily funded by the state through a Chapter 74 program, while others receive less funding and support. Finally, Massachusetts has one of the nation's longest-standing longitudinal databases to track student participation in high school CTE, enabling analysis of medium-term outcomes. Furthermore, by merging K-12 data with

National School Clearinghouse and unemployment Insurance (UI) records through the Department of Labor, we can examine outcomes for students several years after high school.

In Massachusetts, students can concentrate in ten career clusters by taking two or more years of courses in that cluster. While these career cluster are somewhat different than the 16 national career clusters promoted by AdvanceCTE, there are broad enough similarities that findings in Massachusetts can help inform our thinking heterogeneity across different career clusters nationwide (AdvanceCTE, 2018). Figure 1 displays the share of students concentrating in each 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 (Author & Harbaugh, 2020; Plasman et al., 2017).

1.4 Data

We use data from the Massachusetts state longitudinal data system (SLDS) covering cohorts of first-time 9th graders whose on-time (i.e., four years after 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, immigrant status, disability status, and English learner status. We add 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 unemployment insurance (UI) system. We observe individual student outcomes for up to seven years after their on-time 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 (for example, 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.

1.5 Measures

Our primary measure 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 CTE concentrator if they are enrolled in CTE courses for two or more school years at any time during high school. This "concentrator" definition is used for federal reporting purposes, making it a meaningful designation with implications for how much Perkins funding the state receives. It also represents a substantive commitment to CTE, above and beyond any more minor exposure students would receive from taking a single CTE course as an elective credit. Moreover, many CTE clusters are explicitly designed to be completed in two-year course sequences, with students often prepared to take licensure/certification exams, or to receive industry or state-recognized credentials after two 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 two or more years of courses *in that cluster* to be cluster concentrators (e.g., Healthcare concentrators, Construction concentrators). For those students who completed two 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.

Our key outcomes of interest are college enrollment, college completion, earnings, employment, and economic outcomes that are associated with economic dependence on the state (poverty, and 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 two- or four-year college after completing high school. We also create separate indicators to capture whether students graduate from a two-year college, a four-year college, or complete a certificate or degree at either type of institution. For labor market outcomes, we examine total annual earnings at one, three, five, and seven years after expected completion of high school, as well as binary indicators of whether individuals earned at or above the inflation-adjusted 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 one, three, five, and seven 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 outcomes known to be associated with larger negative personal and social costs.

1.6 Descriptive Analyses

Heterogeneity within CTE occurs on two clear dimensions that we explore here – the characteristics of students who become CTE concentrators relative to non-CTE students, and the characteristics of students *across* career clusters. Table 1 and Figure 2 highlight the starkness of these differences. Echoing work from other settings (Plasman et al., 2020; Author, 2018; Author et al., 2018, among others), Table 1 shows that CTE concentrators are less likely to be female, more likely to be lower-income, and more likely to be English language learners 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.

We present in Figure 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 clear 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 average, and also underrepresented in Healthcare and, Business & Consumer Sciences.

Figure 2 (see also Table A1) also highlights that prior academic performance 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 exists across clusters for lower-income students, students with disabilities, and Black and Latinx students. Also clear in Figure 2 is 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 clusters (Healthcare, Education), students are descriptively somewhat *more* likely to lead to college than the statewide average, while in others (Construction, Transportation) students are far less likely to enroll in college than the statewide average.

These underlying differences in the characteristics of students who become concentrators in the different career clusters present a compelling case that we might consider each cluster as a distinct intervention, rather than one single program, broadly labelled 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.

In Figure 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 two-year colleges than the statewide average; in some cases like Healthcare, the rate of two-year college-going is especially striking. Yet, panel 2 reveals that concentrators in each cluster are less likely to attend and complete at a four-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.

Finally, Figure 4 displays descriptive trends and differences in earnings across the different career clusters. First, CTE concentrators in *every* cluster attain higher earnings on average in the first years after their expected high school graduation, though this is at least partially due to non-concentrators being more likely to be in college (and therefore working and 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.

1.7 Analytic Approach

Because student self-selection is endemic to high school curricular choice, descriptive analyses - while informative - may obscure the role of CTE in helping students achieve certain outcomes. While a regression-based approach is prone to bias from unobserved variables that may predict selection into CTE, our approach allows us to take advantage of a statewide database in which students engage with CTE in vastly different contexts. This approach also allows for stronger generalizability, as we are able to consider CTE in both CTE-dedicated settings and comprehensive school settings, *and* across a wide-ranging of career clusters, mirroring the many different ways CTE is offered across American public schools.

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 to compare a wide range of student outcomes for students who are observably similar and had access to a similar set of school and curricular options. We specify our main model as follows:

$$Y_{ict} = \beta_1 CTE_i + \boldsymbol{X_i'}\boldsymbol{\gamma} + \pi_c + \tau_t + \epsilon_{ict} \qquad (1)$$

Here, Y_{ict} 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), $\boldsymbol{X_i'}$ is a vector of student-level covariates including demographic characteristics and 8th grade test scores and attendance, π_c

represents fixed effects for entering cohort and τ_t represents fixed effects for town of residence. Errors are clustered by the town of residence. In all models, β_1 is the coefficient of interest and represents the average population difference in a given outcome associated with CTE concentration, 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 under Limitations and Tests for Robustness.

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 performance on state assessments (both Mathematics and English Language Arts), which accounts for unobservable characteristics that would influence *both* 8th grade academic performance *and* selection into high school CTE. Cohort and town of residence fixed effects account for differential labor market trends and access to CTE offerings.

To demonstrate the merits of our approach, we fit initial models that show the stability of our estimates once we include an increasing number of controls. Following the argument in Altonji, Elder, and Taber (2005), the stability of these estimates across the more saturated models provides evidence that we have accounted for the most egregious sources of potential bias. We also apply Oster's (2019) approach by estimating how large remaining unobserved selection bias would have to be to nullify our estimates (shown below under Limitations), and find that unobserved bias would have to substantially outweigh observed explained variation for true impacts to be zero.

In Table 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.

Adding student demographic characteristics (Model 3) also reduces the magnitude of the CTE concentration estimate. Model 4 adds controls for 8th grade assessments and 8th grade attendance rates, which allow us to consider students within the context of demonstrated academic performance prior to any engagement with CTE in high school. Finally, Model 5 includes all controls from earlier models, as well as town and cohort fixed effects. Across all outcome, 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.

1.8 Results

1.8.1 Postsecondary Outcomes

In Figure 5 we present estimates of the relationship between CTE concentration and postsecondary outcomes (also presented in table form Table A2). Each panel of Figure 5 presents

β_1 for the overall population of students, male and female students, and for several populations of interests; in particular, we focus on student populations for whom there have historically been concerns and inequitable tracking into CTE. For reasons of sample size and statistical power, we present results for Black & Latinx students together, though findings are similar for both populations. Moreover, we focus on populations that have been historically underrepresented in higher education and have faced lower earnings outcomes, and thus are of particular interest to policymakers and researchers focus 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 (based on the descriptive evidence above) to attend college. Vertical bars on each coefficient result represent 95% confidence intervals, with bars not crossing 0 indicating significance at α=0.05 level. 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 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 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 & Latinx students actually 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 negative relationship is less substantial in population groups that are currently underrepresented in college-going, and is insignificant for Black & Latinx students.

Figure 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 subpopulations. However, CTE is associated with lower rates of attendance and completion at 4-year colleges (although, again, the negative associations are less prominent among for Black and Latinx students). Overall, Figure 4 highlights a picture in which CTE is associated with a modest overall decrease in college-going and, in particular, attainment. While our approach cannot definitively speak to whether CTE leads some students to substitute away from 4-year colleges and into 2-year colleges, that pattern at the intensive margins of college enrollment would be consistent with these findings.

Figure 6 (also Table A3) 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 of outcomes accruing to CTE concentrators in each specific career cluster. For example, in order 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 are descriptively most likely to attend college (Healthcare, Education) to least likely (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 probability of college attendance. The differences between the advantages for Healthcare and Education concentrators (11.9 and 10.3 percentage points) and the disadvantages for Transportation and Construction (-18.5. and -17.2) is 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 in the center 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 (for example, healthcare) have particularly aligned paths at the community college level (i.e., nursing programs), the strong relationship with 2-year college attendance is noteworthy and likely speaks to the design of the pathways.

1.8.2 Earnings

While policymakers have increasingly pointed to postsecondary education as an important intended outcome of Career and Technical Education, 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 expect to benefit financially from their engagement with CTE.

Figure 7 (Table A4) 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 education differences. Overall, CTE concentration is associated with a sizeable increase in initial earnings ($2403 in the first year after high school), with strong advantages ($2867 in annual earnings) persisting even 7 years after high school.

Figure 7 also presents clear differences in who sees positive earnings advantages from CTE. Advantages are especially strong and persistent for students who never attend college within the first 7 years after high school (whom we refer to as “No College”), with CTE No College students earning $5806 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 students see much more earnings differences from CTE concentration, while female students see only modest advantages, 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 prior achievement scores.

Figure 8 (Table A5) also explores the relationship between earnings and CTE concentration, here disaggregated by career cluster. The heterogeneity in these results across cluster are even greater than the differences across student populations presented in Figure 7, lending credence to the hypothesis that which cluster students select into is especially crucial in determining whether and how they might expect to benefit from CTE. Looking across cluster, the strongest predicted increase in earnings is associated with the Construction, Transportation, Manufacturing & Technology, and Healthcare clusters, while students in Hospitality, Agriculture, and Communications see little-to-no predicted benefit 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 advantages (especially Healthcare and Construction), the earnings advantages remain substantial (though in Transportation, the advantage noticeably declines by 7 years after high school).

1.8.3 Earnings by Gender

As Figures 7 and 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 2 make clear, students with different characteristics often opt into different clusters. Given the strong relationship with CTE and higher earnings for male students and the strong relationship with higher earnings in the most male-dominated clusters (Construction, Transportation, and Manufacturing & Technology), Figure 9 seeks to unpack the extent to which the stronger differences seen by males are mainly driven by their selection into more financially lucrative clusters. In Figure 9, we present the predicted change in earnings for male and females who select into the *same* cluster to explore whether male and female students experience expected benefits in the same way. Across the clusters, there are two distinctly different patterns.

In several clusters – notably the clusters with predominantly female enrollment, including healthcare and education – male 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 expected increases in their earnings than do female students. Among Construction students, for example, CTE concentration is associated with over $8,000 more in increased predicted annual earnings 7 years after high school for male 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 become concentrators in the clusters associated with the highest increases in earnings, and even among students *within* those clusters, male students see stronger predicted advantages, while female students see little to none.

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 UI data is that male and female concentrators within a CTE concentration may sort into different industries once employed. For example, given the strong positive earnings advantages that accrue to male - but not female - Construction concentrators, one possibility is 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 employed in more than one industry in a year, we use the industry in which they earned the largest amount). In Figure 10, we present results showing that, while differential sorting into industries may *partially* explain why male and female concentrators within the same cluster experience different earnings advantages, this does not fully explain away 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 that even for similar individuals concentrating in the same CTE cluster who go on to work in the same industry, gender-based wage gaps persist at least seven years after high school.

1.8.5 Poverty and Disengagement

While CTE may be thought of as way to *increase* earnings and education, it has also often been thought of as a tool to *reduce* the most adverse outcomes. This is of particular importance for students who face social and economic disadvantages and inequitable services 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).

Figure 11 (Table A6) explores the relationship between CTE concentration and a binary indicator of whether a student earned above the poverty line 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 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 than we might otherwise expect, even 7 years after high school. Among "No College" students, the predicted difference is steadier and remains strong throughout the observed years. In the first year after high school, 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 advantages than female concentrators, and CTE concentrators across all the populations examined here see a lower likelihood of poverty, lending strength to the argument that CTE may help students avoid poverty, at least in the early years of their adulthood.

Figure 12 (Table A7) considers the relationship between poverty avoidance and the various career clusters. Again, the strongest predicted 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.

In Figures 13 and 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 11 & 12), *or* to be enrolled in any postsecondary institution in that year. In Figure 13 (Table A8), we find some support for CTE as a tool to reduce overall disengagement, particularly among students who do not go to college. Figure 13 highlights that CTE may be especially useful in helping key populations of interest avoid disengagement. Figure 14 (Table A9) continues to find heterogeneity across cluster, with especially encouraging associations between Concentration and lower likelihoods of NEET status among students in Healthcare, Education, Construction, and Transportation.

1.9 Limitations and Tests for Robustness

A key limitation of these findings involves the possibility of omitted variable bias, particularly selection bias associated with student sorting into CTE (or into specific career clusters). While the inclusion of pre-high school assessment scores and fixed effects work to alleviate these concerns, 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 3, using both $\boldsymbol{R_{max}}$ proposed by Oster of $\boldsymbol{R_{max}}$=1.3R, and a more conservative $\boldsymbol{R_{max}}$=2R. The coefficient bound on each outcome of interest tells us the range of possible coefficients on β_1 (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 parameter **δ** represents how many times larger unobserved factors would need to be than observed characteristics to nullify the results. We next take a similar approach but with $\boldsymbol{R_{max}}$=2R. 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 findings is the rolling nature of our sample. Given data limitations, the results presented include different analytic samples based on when we can observe various outcomes; although we include cohort fixed effects, some composition threats may remain. In Tables A10 & A11, we present results that only include cohorts that can be observed for the full 7 years after high school graduation, with similar results to those presented in Tables A4 & A5.

We might also worry that students who never take CTE courses are not appropriate counterfactual group for these analyses; in particular we might worry if our observed characteristics do not account for differential selection into the different career clusters. In Tables A12 & A13, we compare students to a new counterfactual group, students who took 1 year (but no more than 1 year) in the same cluster, relying on the assumption that students taking 1 year of

Agriculture classes, for example, showed 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 is actually *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 mainly taking a CTE course as an elective, rather than indicating a more substantial interest in CTE.

Finally, we might 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, 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 full sample, indicating that our main results are not solely driven by CTE-dedicated schools. In fact, in Table A15, we present results of only those students residing in towns eligible for a vocational/technical school and find very similar results. In Table A16 and A17, we approach this idea in a different way, looking only at those students who attend comprehensive schools (i.e., did not attend a CTE-dedicated school). While this removes one key mechanism through which CTE may matter in the Massachusetts (selection of high school), Tables A16 and A17 make clear that the associations between CTE and later outcomes largely hold (albeit somewhat diminished) even at comprehensive schools.

1.10 Conclusions and Discussion

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 and Baum, 2017). Others may argue that CTE should prepare students for high-wage, high-growth jobs that they're 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 policy has worked to emphasize 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 15 demonstrates that the relationship between CTE and different student outcomes vary across student populations. Black & Latinx, Lower-Income concentrators, and those scoring poorly in 8th grade tests all see positive anticipated advantages in both dimensions – income and postsecondary enrollment. Overall, we find evidence that CTE is associated with a higher students' predicted earnings, as well as a decrease in postsecondary enrollment, indicating a set of trade-offs facing CTE students (knowingly or unknowingly) when they opt into CTE. For male students, the change in predicted outcomes are especially stark, likely in part because of the different career clusters they select.

As Figure 16 highlights, some career clusters are more positively associated with higher earnings, while others are more associated with higher rates postsecondary success. Some clusters, like Healthcare, Education, and IT perform well on both dimensions. Other clusters, like Construction and Transportation, might represent a trade-off for students, in which students can expect higher earnings, but 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 may receive explicit preparation and encouragement to continue in those programs. Other career clusters, like Construction and Transportation may be more explicit about encouraging direct entry into the workforce through apprenticeship and school-to-work programs. Encouragingly educators, no clusters fall in the bottom left quadrant of Figure 16; all clusters point to some at least *some* reassuring outcomes.

By considering a wide range of outcomes, different relationships across the career clusters, and different anticipated advantages and disadvantages 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 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 driven 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 allows them to enter the workforce immediately after high school. For some, postsecondary education may come later, as they are better able to afford college and as they need additional education and training to advance in their careers.

Finally, we find suggestive evidence that CTE may be especially beneficial as a stopgap to prevent some of the worst possible outcomes for students – poverty and disengagement, as CTE is associated with a decreased likelihood of earning below the poverty line and a decreased likelihood of being completely disengaged from both education and employment. 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. These advantages to 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 & Technology are associated with negative college outcomes, they are associated with the strongest pay-offs in terms of expected earnings.

As 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 many cases, CTE may represent a set of trade-offs between early career earnings and postsecondary education, though these trade-offs manifest themselves in heterogeneous ways. Ultimately, our findings encourage a re-framing of conversations around CTE that moves 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.

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1.12 Tables and Figures

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

Notes: Analytic sample 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 "CTE concentrator" if they are enrolled in CTE for at least two academic years.

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 performance on state assessments (both Mathematics and English Language Arts) 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.

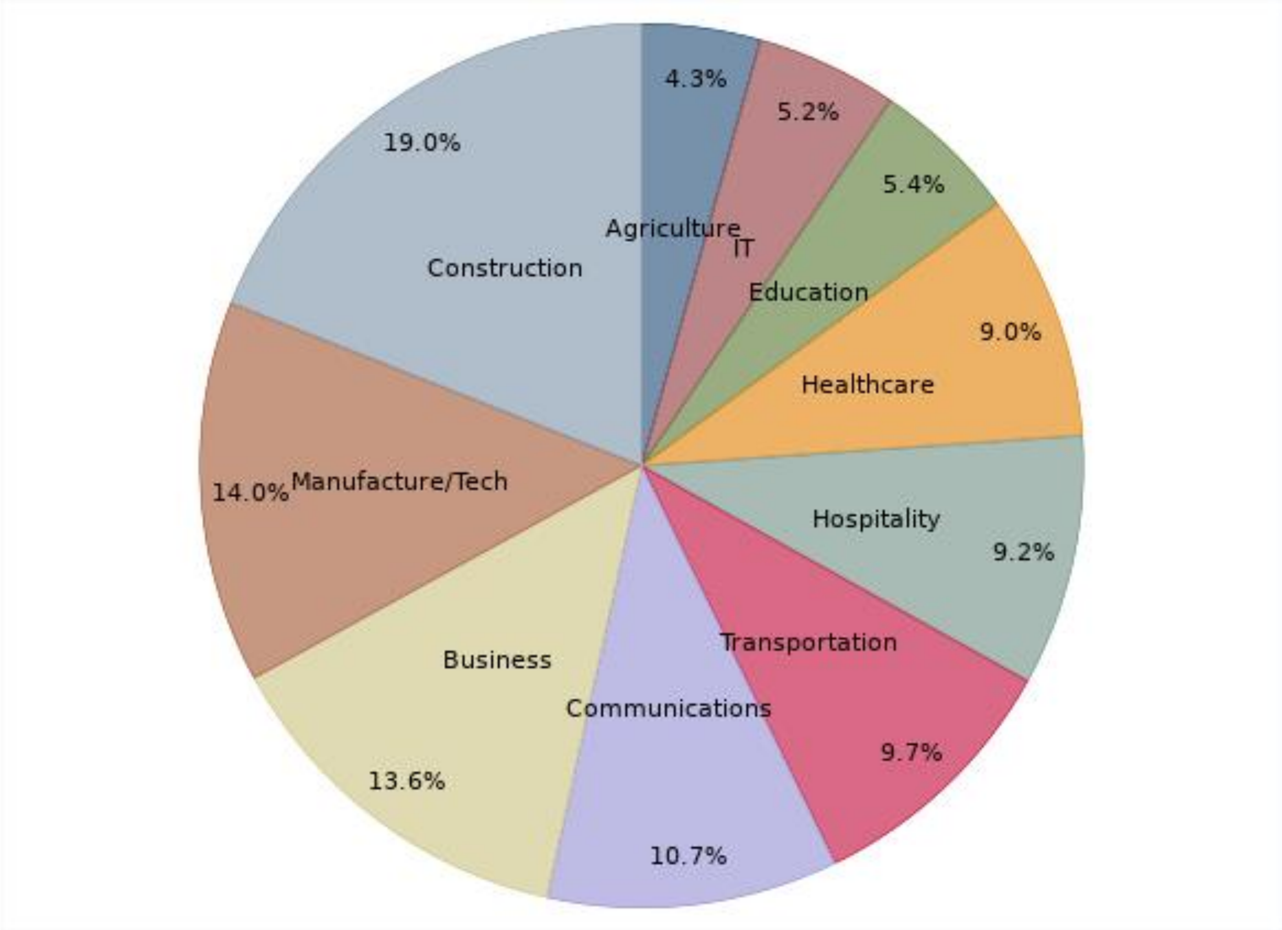
Table 1.3

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 (R_{max} =1.3R)	(.049, .043)	(-.09, -.074)	(-.037,-.028)	(.007, .007)	(-.085,-.067)	(-.072,-.055)	(2402, 2228)	(3660, 3316)	(3456, 3404)	(2867, 2912)
Bias δ (R_{max} =1.3R)	7.16	5.06	3.83	-20.14	4.33	3.97	6.59	5.23	24.05	-200.12
Coefficient Bound (R_{max} =2R)	(.049, .029)	(-.09, -.034)	(-.037,-.005)	(.007,.008)	(-.085,-.023)	(-.072,-.014)	(2402, 1803)	(3660, 2482)	(3456, 3278)	(2867, 3024)
Bias δ (R_{max} =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 "psacalc" STATA package (Oster, 2019).

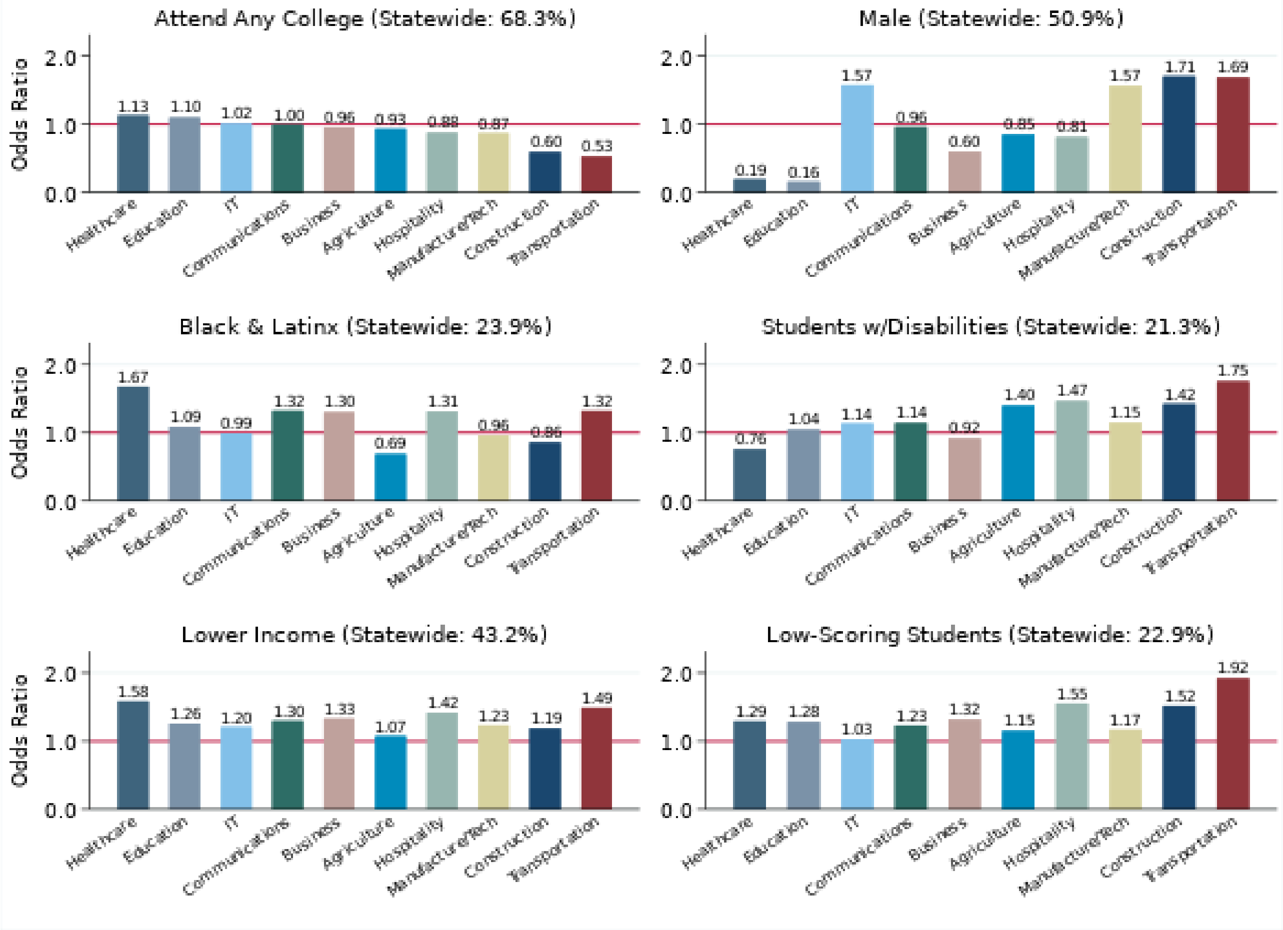
Figure 1.1
CTE concentrators by career cluster



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 a CTE concentrator in a given career cluster if they are enrolled in CTE in that career cluster for at least two academic years.

Figure 1.2

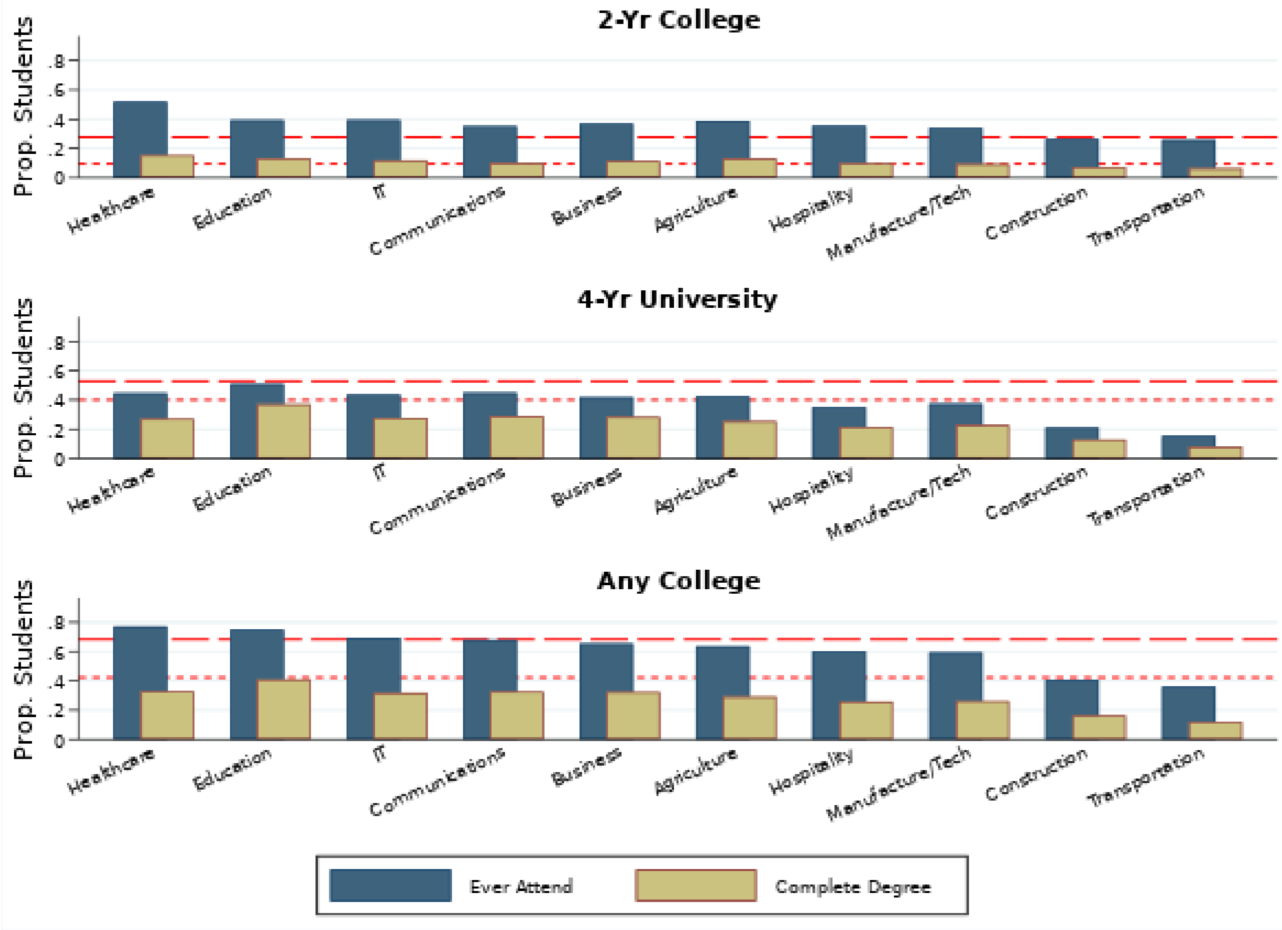
CTE concentrators characteristics in each career cluster compared to statewide student population



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 a CTE concentrator in a given career cluster if they are enrolled in CTE in that career cluster for at least two academic years.

Figure 1.3

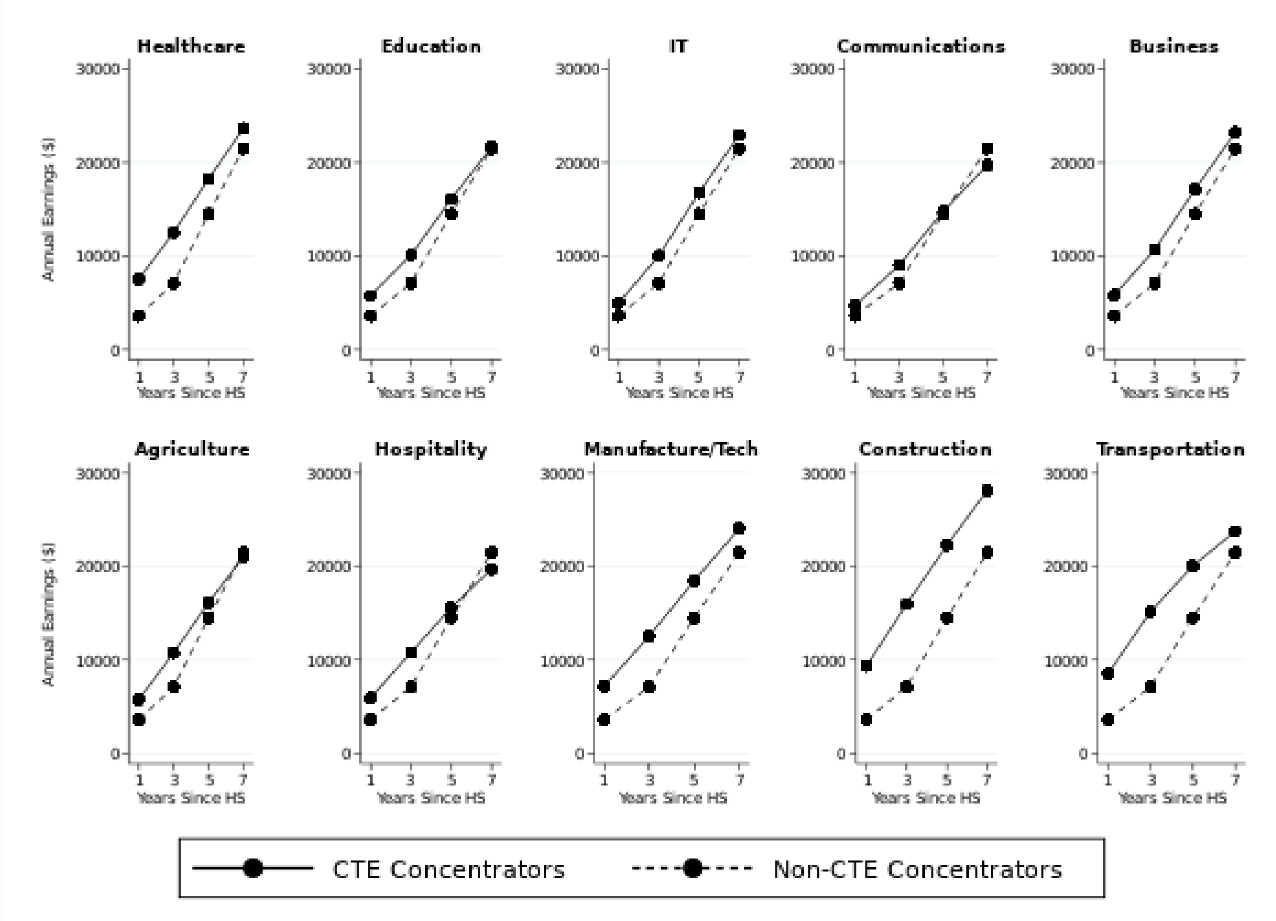
CTE concentrators rates of college attendance and completion in each career cluster compared to statewide averages



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 a CTE concentrator in a given career cluster if they are enrolled in CTE in that career cluster for at least two academic years.

Figure 1.4

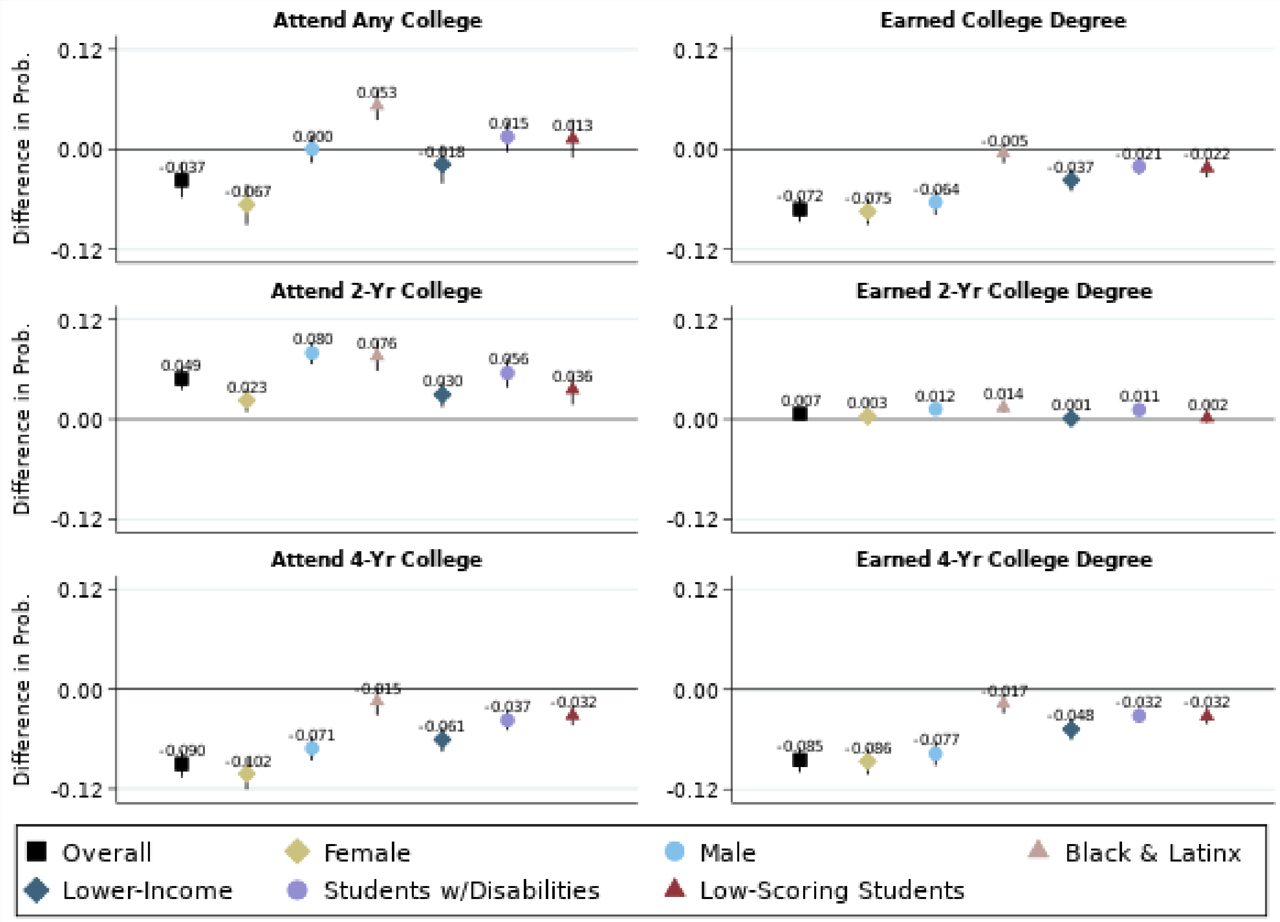
Annual earnings for CTE concentrators in each cluster compared to non-CTE concentrators, through 7 years after high school



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 a CTE concentrator 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.

Figure 1.5

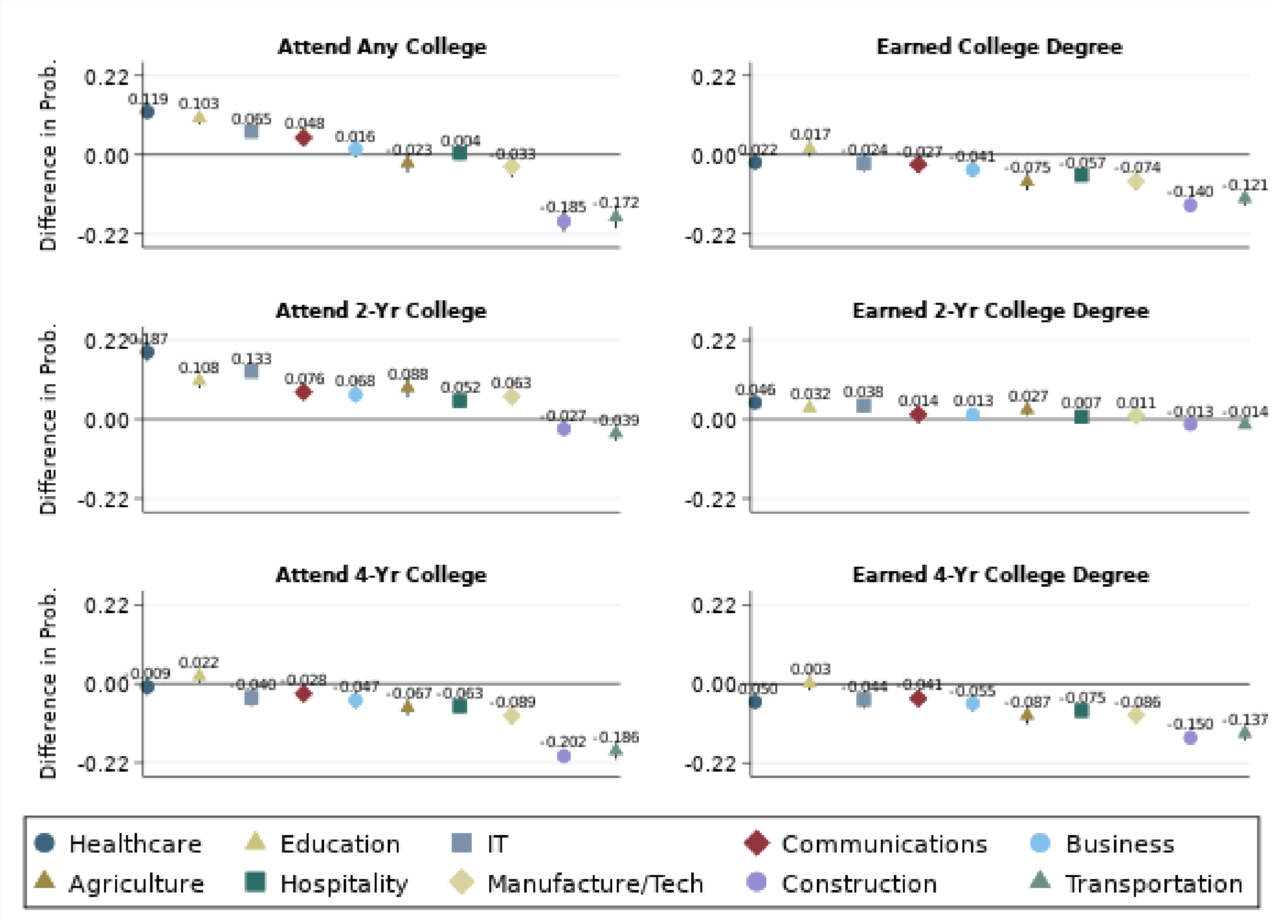
CTE concentrators' college outcomes compared to similar non-concentrators, by populations of interest



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 English Language Arts). 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 1.6

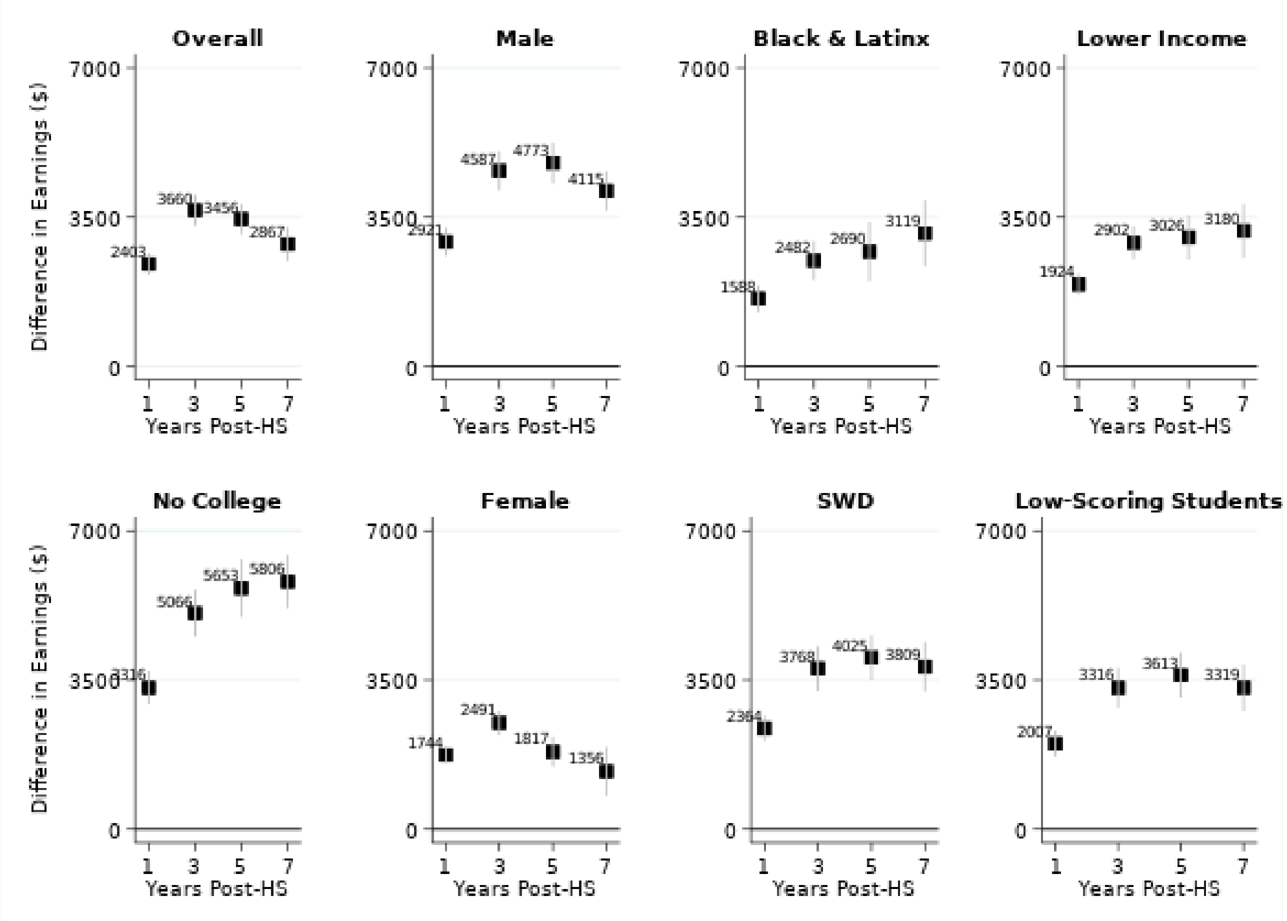
CTE concentrators' college outcomes compared to similar non-concentrators, by career cluster



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 English Language Arts). 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.

Figure 1.7

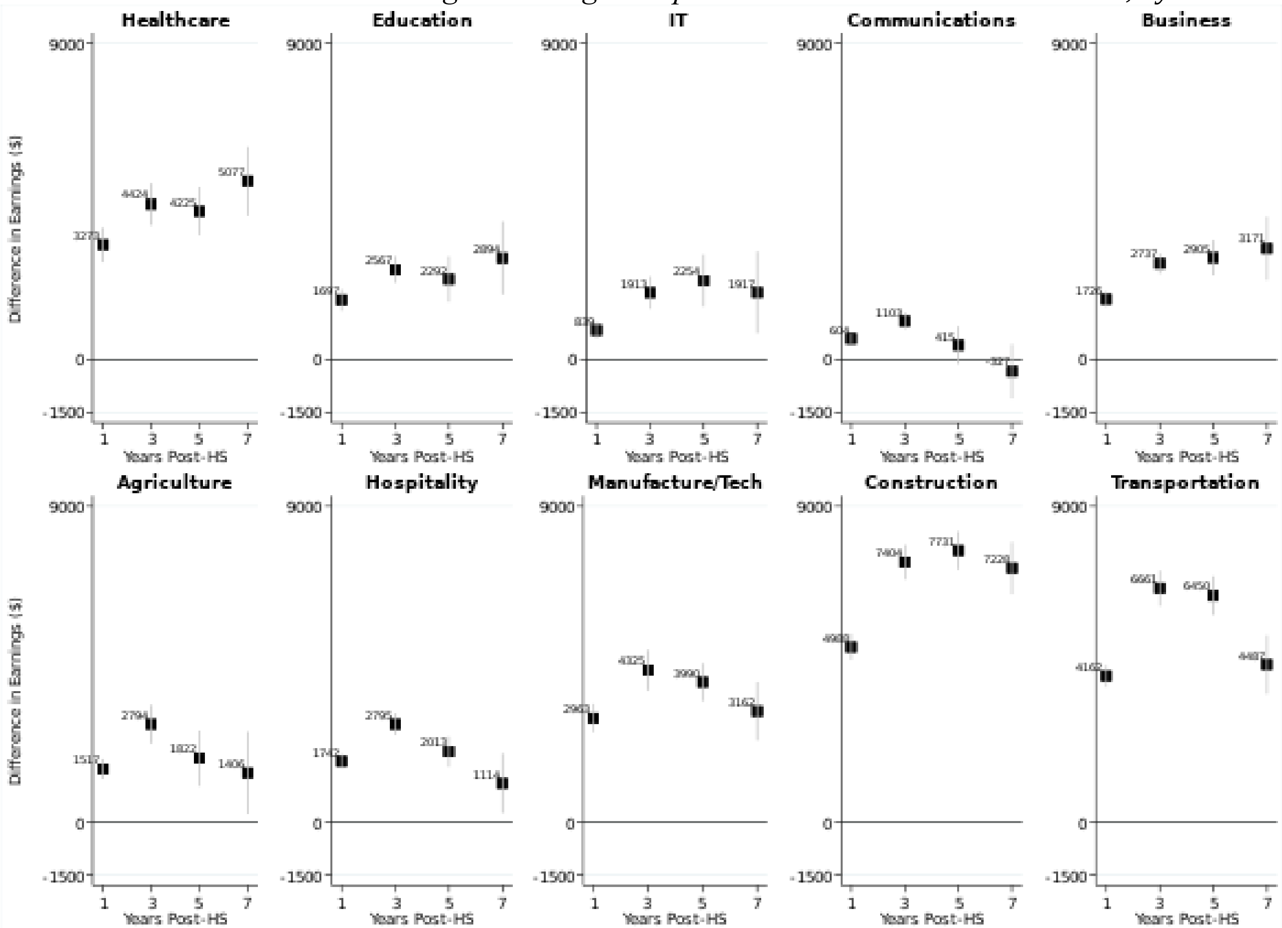
CTE concentrators' annual earnings advantage compared to similar non-concentrators, by populations of interest



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 English Language Arts). 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 1.8

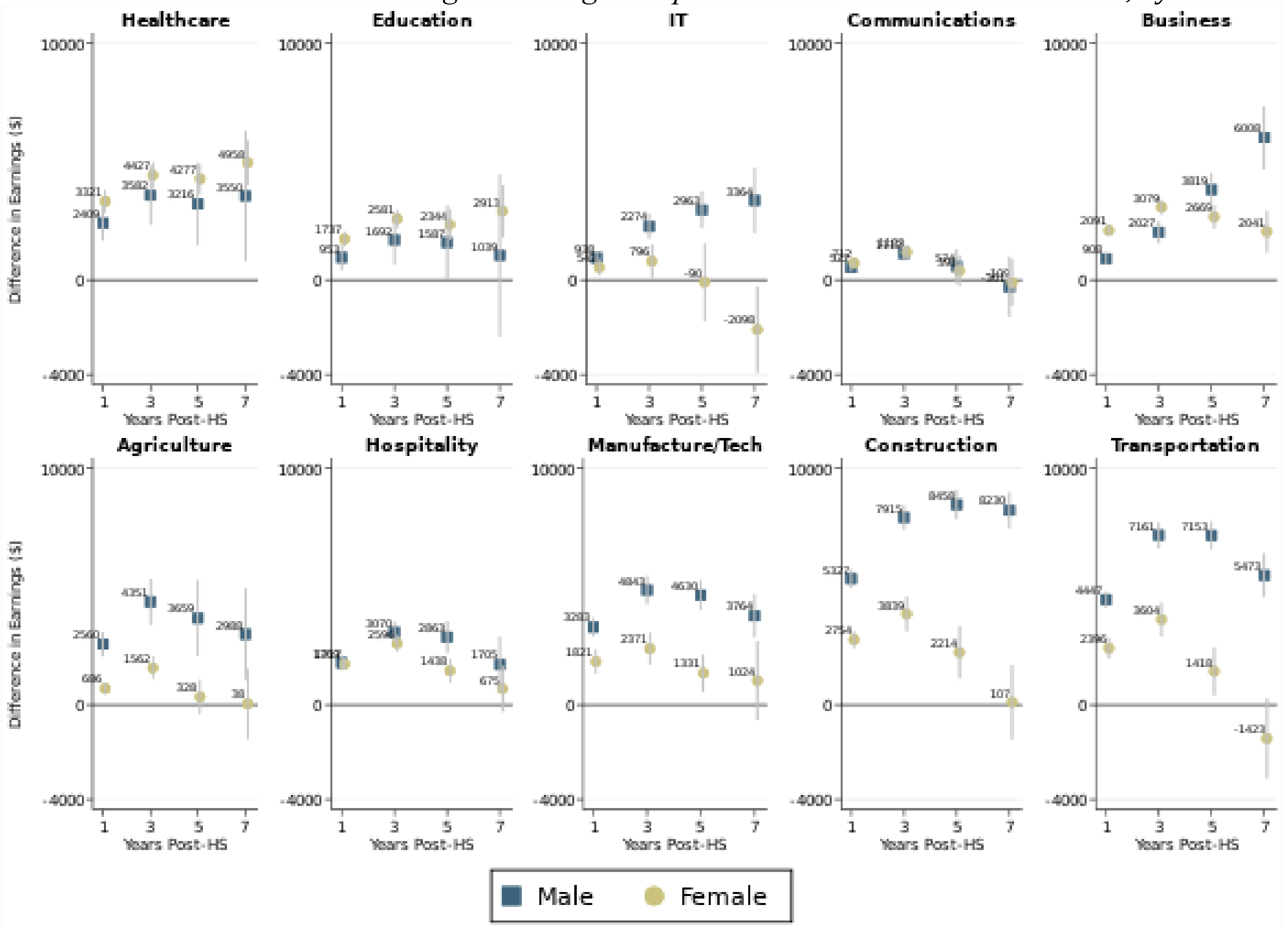
CTE concentrators' annual earnings advantage compared to similar non-concentrators, by career cluster



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 English Language Arts). 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.

Figure 1.9

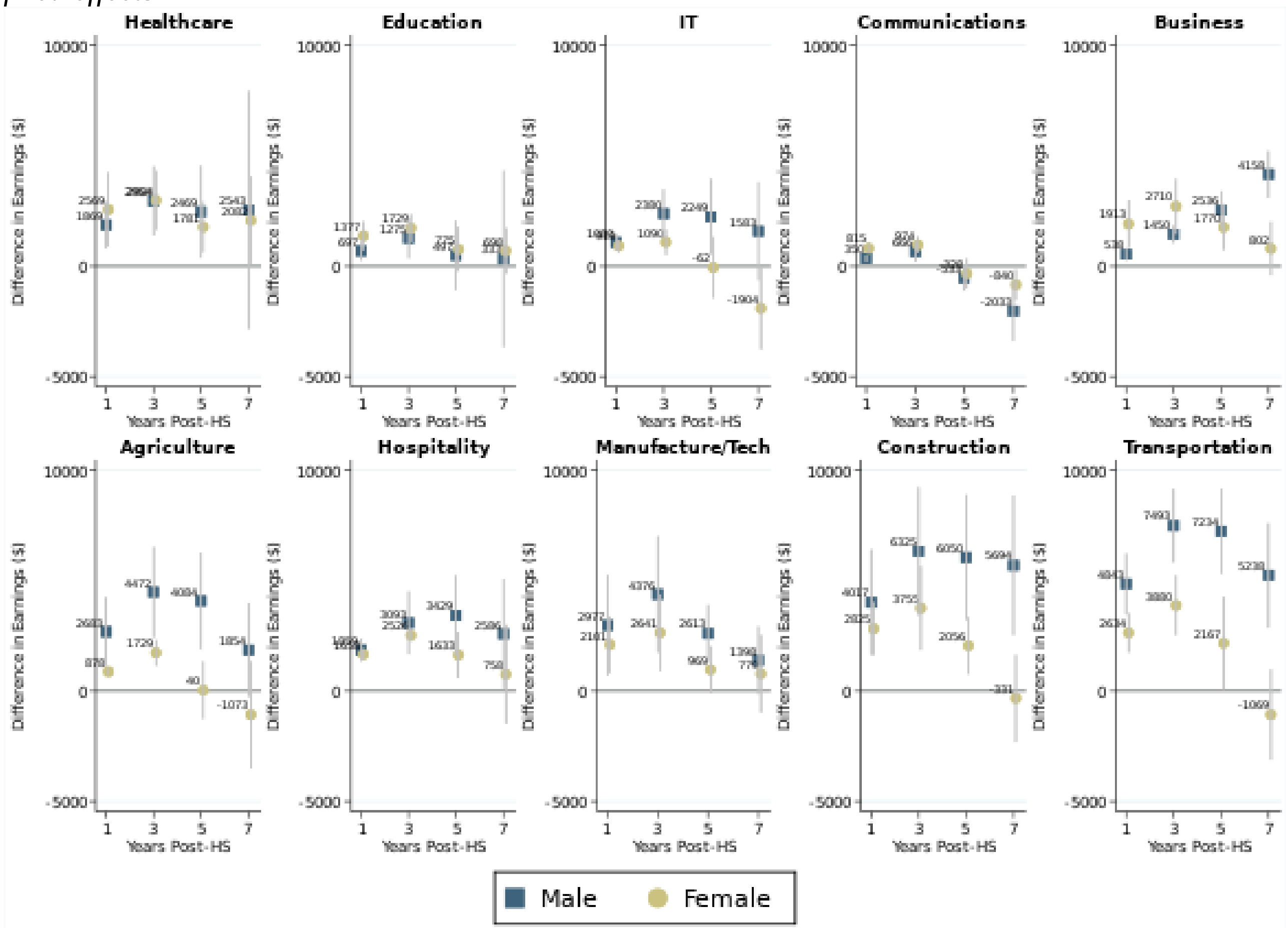
CTE concentrators' annual earnings advantage compared to similar non-concentrators, by career cluster and gender



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 English Language Arts). 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.

Figure 1.10

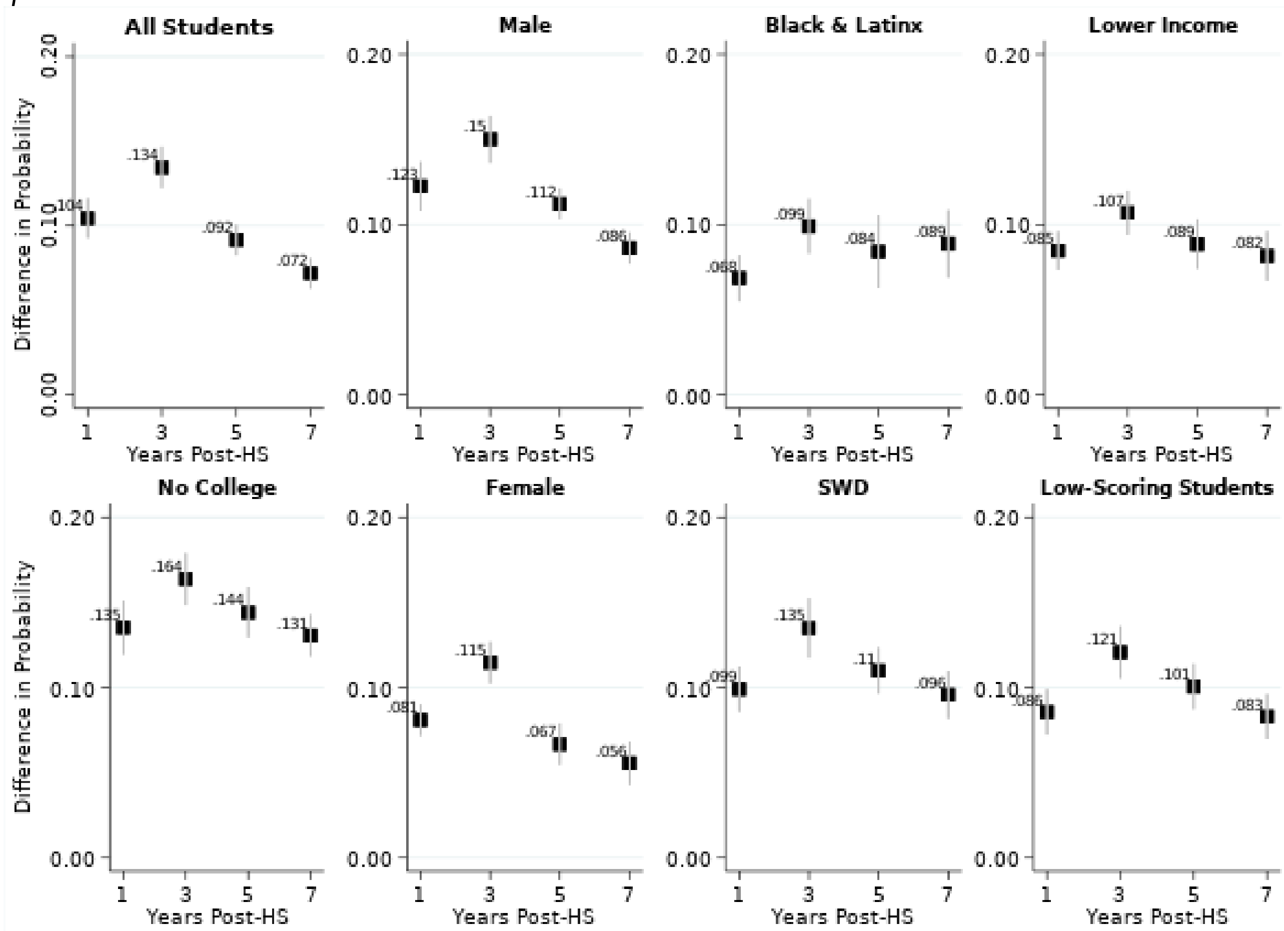
CTE concentrators' annual earnings advantage compared to similar non-concentrators, by career cluster and gender, with industry fixed effects



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 English Language Arts). 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.

Figure 1.11

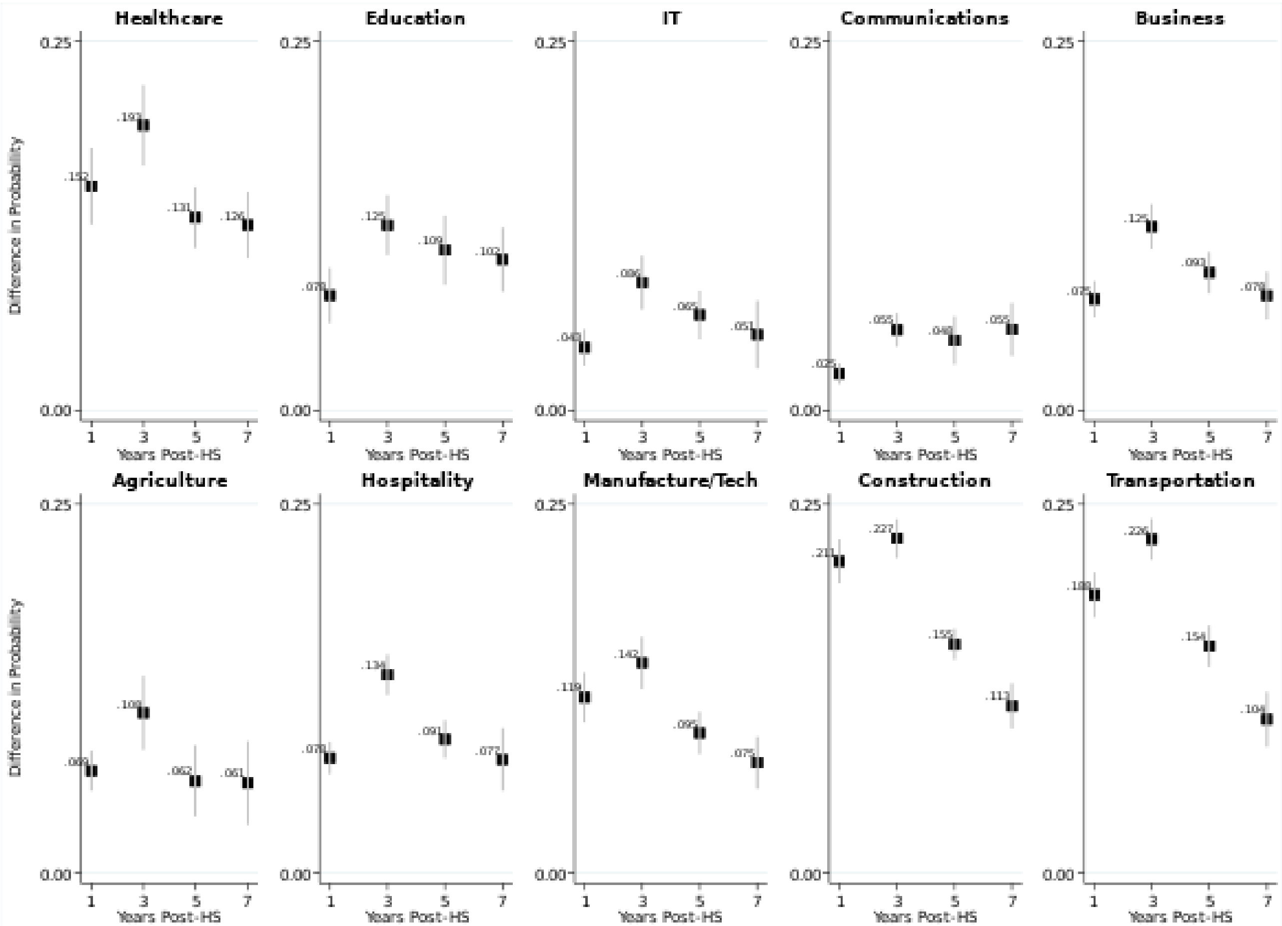
CTE concentrators' difference in likelihood of employment above poverty line compared to similar non-concentrators, by populations of interest



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 English Language Arts). 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

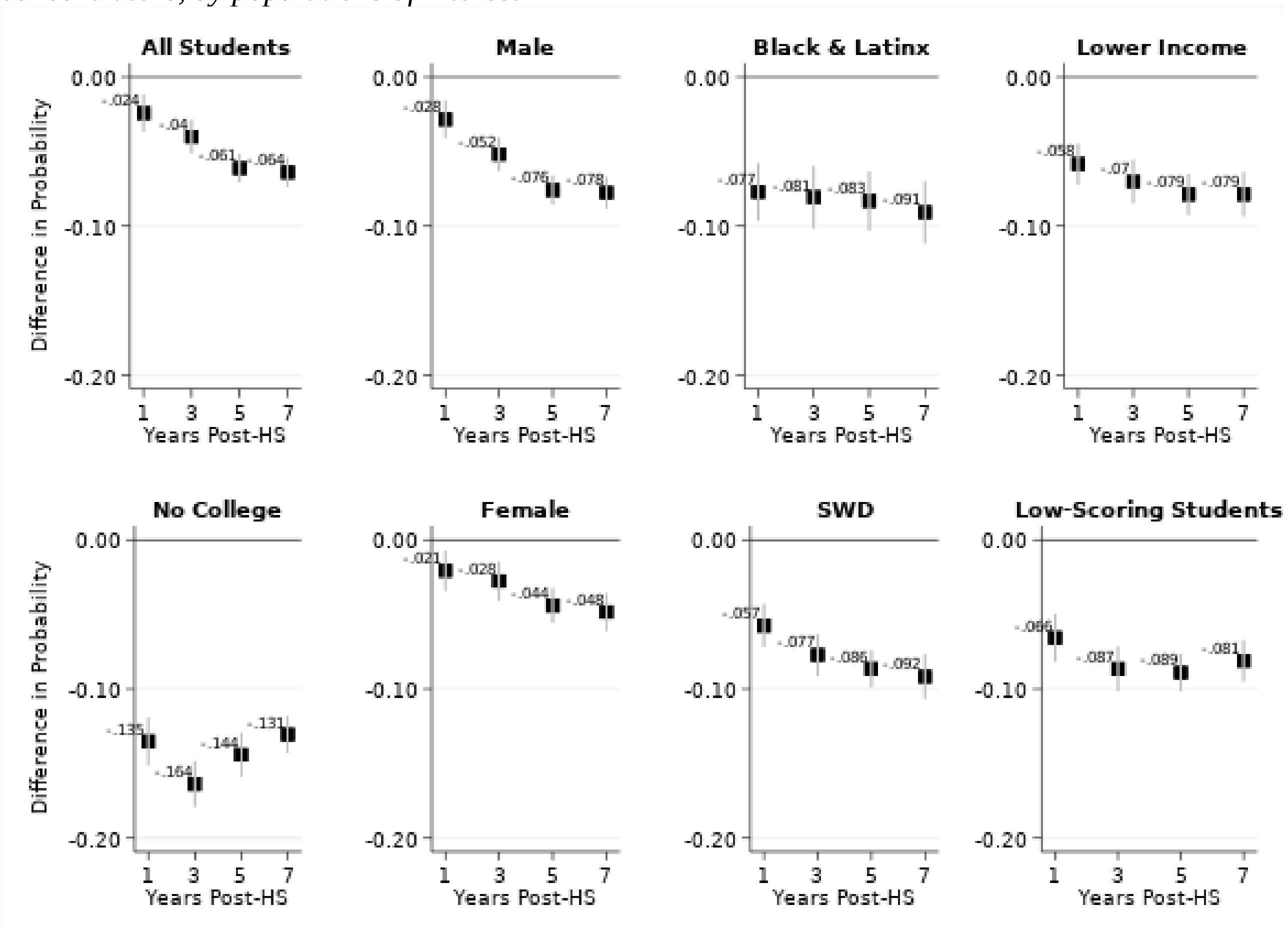
CTE concentrators' difference in likelihood of employment above poverty line compared to similar non-concentrators, by career cluster



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 English Language Arts). 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.

Figure 1.13

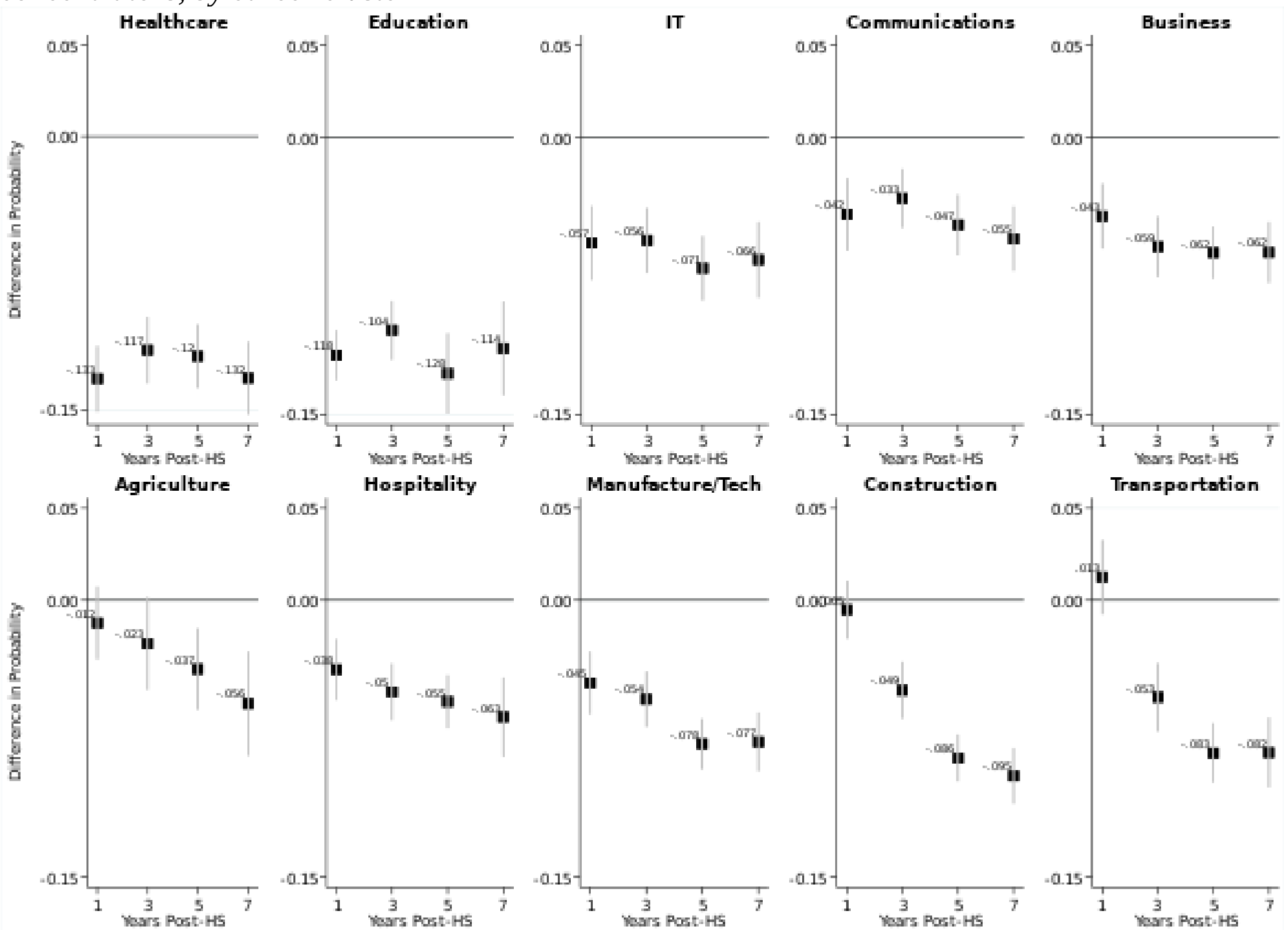
CTE concentrators' difference in likelihood of being neither employed nor in education or training (NEET) compared to similar non-concentrators, by populations of interest



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. Student are considered to be NEET if they are neither enrolled in education nor earning at or above the federal individual poverty line 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 English Language Arts). 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 individual poverty line 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 English Language Arts). 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.

Figure 1.15

CTE concentrator differences in education and earnings outcomes, by populations of interest

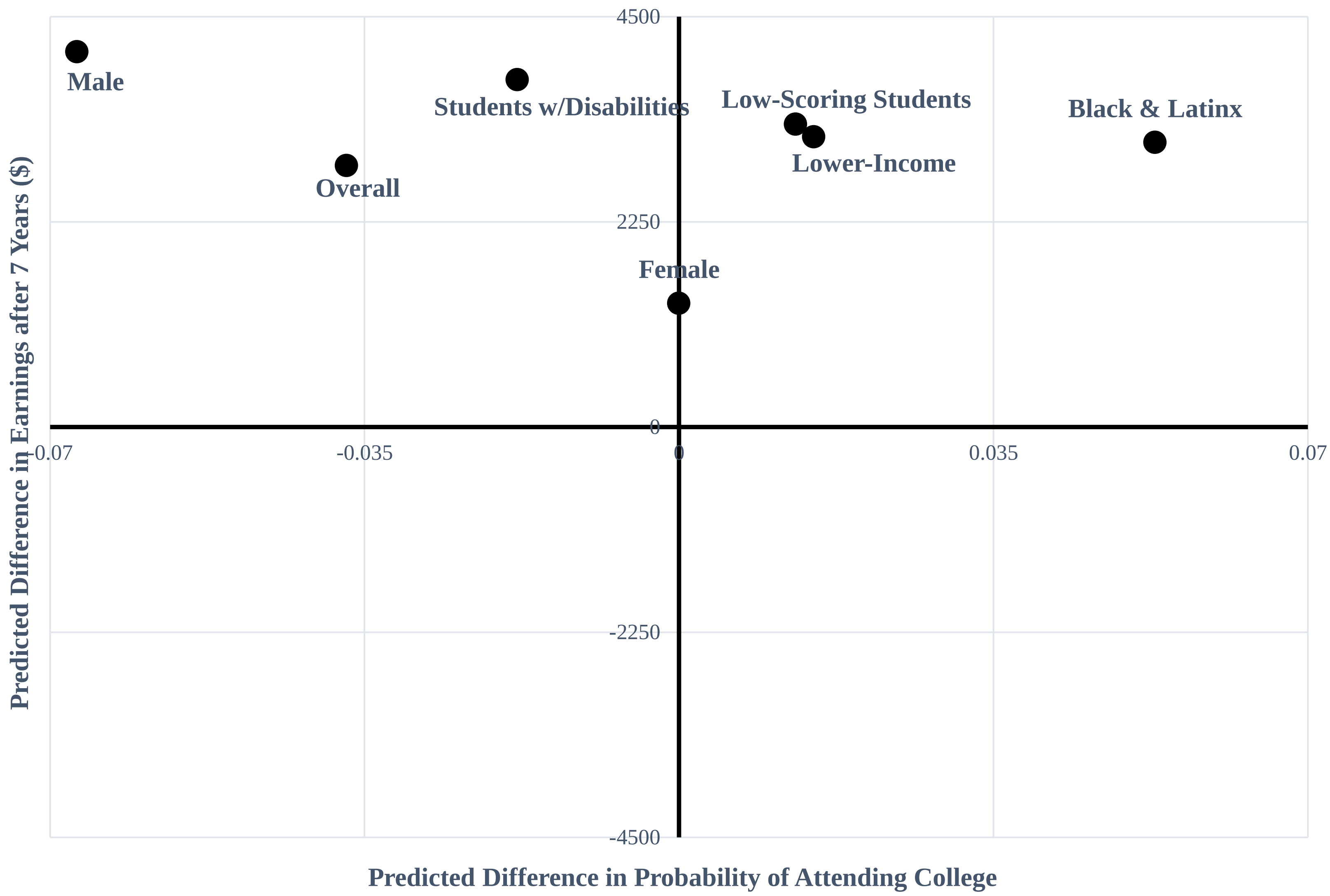
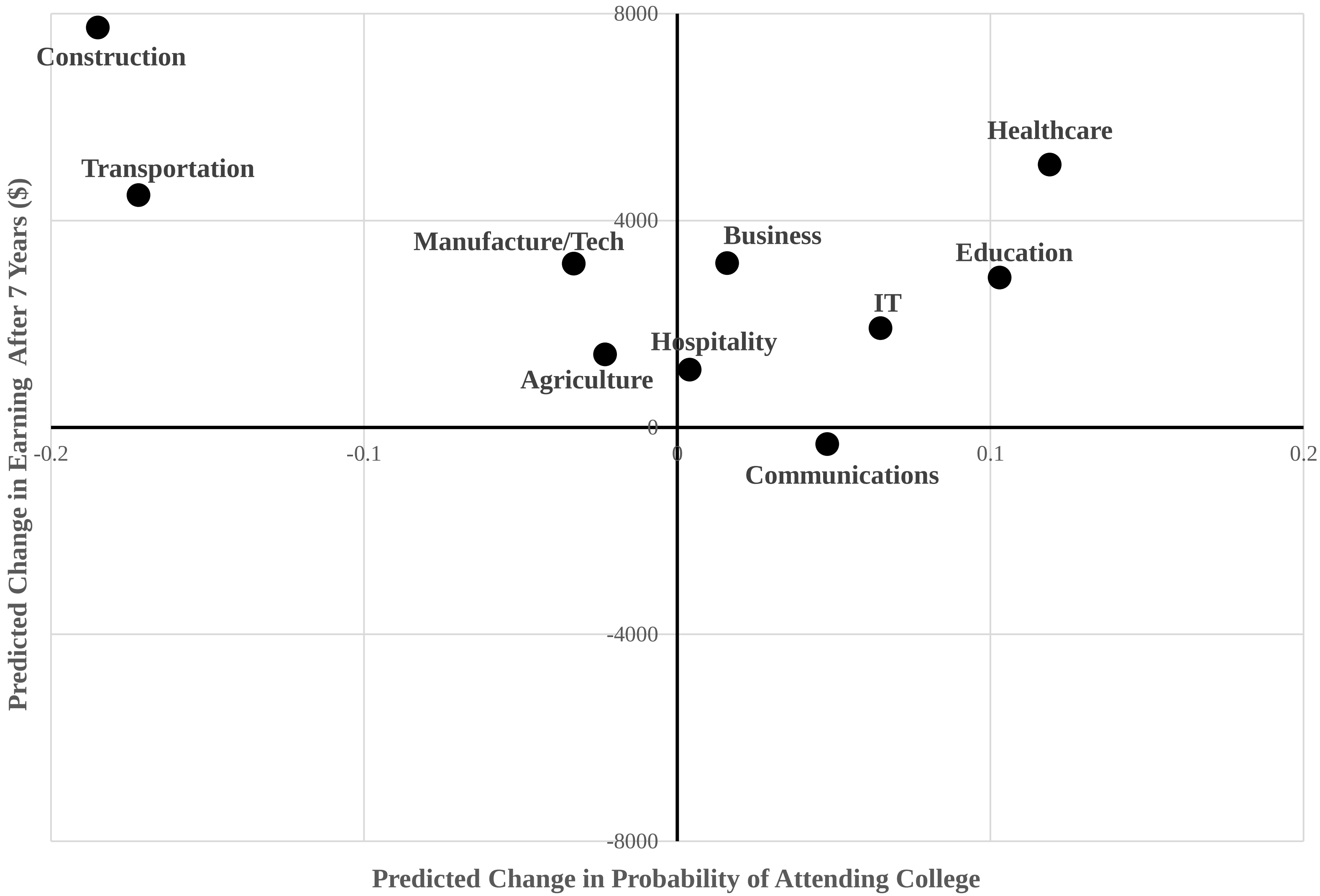


Figure 1.16
CTE concentrator differences in education and earnings outcomes, by career cluster



1.13 Appendix

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 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 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 English Language Arts). 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 English Language Arts). 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 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 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 English Language Arts). 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 English Language Arts). 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 employment above poverty line compared to similar non-concentrators, by 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 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 English Language Arts). 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 employment above poverty line 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 English Language Arts). 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 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 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 individual poverty line 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 English Language Arts). 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 individual poverty line 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 English Language Arts). 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 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 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 English Language Arts). 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 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 English Language Arts). 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 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 English Language Arts). 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 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 English Language Arts). 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 English Language Arts) 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 in the analytic samples for those respective outcomes.

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 English Language Arts) 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 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 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 English Language Arts). 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 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 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 English Language Arts). 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.

CHAPTER 2

Trade-Offs in High School Curricular Choices for Career and Technical Education Students

2.1 Introduction

Career and Technical Education (CTE) has long played a substantial, though at times controversial, role within America's system of public education. Historically referred to as vocational education, debates over CTE are rooted in foundational questions about the goals of public education, touching on such key topics as workforce preparation, academic rigor, and equity of opportunity across diverse student populations. In today's high schools, CTE plays a prominent role. The US Department of Education estimates that approximately 77% of students take at least one CTE course during high school (2019), but CTE coursetaking remains an understudied area of research at the secondary school level.

In much of the academic literature about CTE and vocational education, CTE has been closely connected with research on tracking. Vocational "tracks" were historically used as a way to maintain a degree of separation between racially minoritized students and their white peers in the wake of government-mandated racial school integration (Oakes, 1983; Anderson, 1982). Scholars in the 1970s and 1980s found compelling evidence that CTE was often low-quality, and limited students of color, low-income students, and students with disabilities from pursuing postsecondary education and socially-mobile career paths (Bowles & Gintis, 1976; Tyack, 1974; Grubb & Lazerson, 1982, among others).

More recent evidence, however, raises questions about the extent to which this research generalizes to today's policy context. Policymakers now have come to view the skills necessary for college-readiness and career-readiness to be closely aligned (Lucas, 1999; ACT, 2006; Obama, 2011), rather than as separate “college-preparatory” versus “vocational” tracks. Moreover, recent quasi-experimental studies (for example, Hemelt et al, 2019; Dougherty, 2018; Kreisman and Stange, 2018; Kemple and Willner, 2008; Brunner et al, 2019) have shown some evidence of positive impact on high school graduation and labor market outcomes for CTE students under more contemporary policy landscapes (with much less evidence of either positive or negative changes in postsecondary outcomes).

While researchers are increasingly considering the effect of CTE in today’s context, these studies generally focus directly on the actual treatment (CTE classes), with little attention to the opportunity costs associated with CTE coursetaking. However, given long-running debates about the importance of developing general versus specific skills (for example, Hanushek, et al., 2017), it is important to understand the role that CTE plays in potentially limiting student’s ability to develop general skills, particularly those skills that prepare students for postsecondary education. One potential mechanism through which CTE may matter, but that has remained unstudied, is that students who engage with CTE are, almost by definition, making curricular trade-offs. If high school seat time is a relatively fixed resource, one potential way CTE may impact students is through the courses they do *not* take in order to make room for CTE in their schedules.

2.2 Theoretical Framework and Research Questions

One of the most prominent long-running arguments against CTE is that it may limit students’ preparation for postsecondary education by reducing their access to a college preparatory curriculum. However, unlike many European countries and previous eras in the US, where students were *explicitly* separated into distinct vocational and college preparatory tracks

(Hanushek et al, 2017), this is far less common today in America's public schools today (Stone & Aliaga, 2005; Yettick et al, 2012). In an era of CTE heavily focused on "College and Career Readiness," there is a striking absence of research on the extent and ways in which CTE does inhibit students' college preparatory curriculum. Moreover, states now align college readiness requirements with high school graduation requirements (Mishkind, 2014), making it especially important to revisit assumptions about the extent to which CTE complements or restricts postsecondary preparation.

While students' time in high school is a relatively fixed resource, little is understood about the trade-offs students make when engaging with CTE. In a best-case scenario, students may simply be using CTE as a focused way to spend their electives to meet overall graduation requirements. On the other hand, some might worry if CTE coursetaking leads students to take fewer college preparatory classes. Moreover, while consideration of the intensive margin curricular choices – in which students substitute CTE classes for other classes – is important, it is also possible that for some students, change may occur at the extensive margin, with students taking CTE courses, in place of non-credit bearing classes like study hall or test preparation courses. It may be that, rather than reducing non-CTE coursetakeing, CTE could simply induce more overall coursetaking. Given the longstanding debates about CTE and its role in equity and workforce preparation, it is important to better understand these trade-offs students and schools make at both the intensive and extensive margins in order to engage with CTE.

This paper uses a robust state longitudinal data system (SLDS), including coursetaking data, along with student and school characteristics, to isolate the impact of CTE on other dimensions of high school students' curricular experience. I employ multiple quantitative approaches to answer the following questions:

Research Question 1. To what extent does CTE engagement explain different rates of coursetaking in core academic college-preparatory courses (Math, Science, Social Studies, English/Language Arts)?

Research Question 2. To what extent does CTE engagement explain different rates of coursetaking in other elective areas (including Advanced Placement/International Baccalaureate, Fine Arts, Physical Education/Health, World Languages, and Study Hall/Test Prep Courses)?

Research Question 3. Does the relationship between CTE coursetaking and coursetaking in other areas differ by student population? Specifically, to the extent that substitution patterns exist (answers to RQ1 and RQ2), how does substitution differ for students by gender, racial/ethnic, disability, English learner status, socioeconomic status, and prior academic achievement identity and status? This close attention to heterogeneous relationships is especially policy relevant given that students from particular demographics have historically been overrepresented in CTE and have been the subject of negative tracking in CTE. Additionally, do these relationships differ for students who attend CTE-dedicated high schools, compared to those at comprehensive high schools?

Research Question 4. Do the impacts of CTE differ at different levels of CTE engagement? In other words, does the change in non-CTE coursetaking induced by a student taking their first or second CTE course differ from any curricular changes induced by taking larger numbers of CTE courses?

2.3 Literature Review

2.3.1 Historical Context for Vocational Education

Since the expansion of universal schooling, American public education has grappled with several tensions over the desired goals and purpose of education (Kantor & Tyack, 1982; Goldin & Katz, 2008). One of the most distinctive characteristics of American schooling has been a long-stated goal of equity – indeed, the American universal public high school movement was a revolutionary push for egalitarianism.

Parallel to the growth of universal high school, however, was an argument that public schools' primary goal should be to prepare students for the workforce, or to "act as a transmitter between human supply and industrial demand" (Meyer, 1915). Many scholars pointed to the "sorting function" of schools, in which schools sort students in different "tracks" based on skill into the most appropriate training for the jobs they are best-suited to pursue (Bowles & Gintis, 1976; Tyack, 1974; Grubb & Lazerson, 1982).

In the 1970s and 1980s, the national perception of CTE was especially influenced by this idea that CTE was used as a tool for sorting students. Given the historical context of racial integration of public schools, vocational 'tracks' were used to keep racially minoritized students separated from their white peers (Anderson, 1982; Oakes, 1983), leading to movement away from CTE in the 1990s and early 2000s, as high schools emphasized standards and moved towards a "College for All" framework (Rosenbaum, 2001; Grubb & Lazerson, 2005; Hudson, 2014; Dougherty & Lombardi, 2016).

Recent years have seen a resurgence of interest in CTE from policymakers and school leaders. Some advocates and scholars have pointed to low rates of college completion and high levels of debt among college dropouts (Rosenbaum, 2001; Stone and Aliaga, 2005). Others have called for greater alignment between the skills needed for school and workforce, and highlighted a need to promote training for skills in-demand by employers that do not necessarily require a four-year degree, often referred to as “middle skills jobs” (Schwartz, 2016; Holzer and Baum, 2017; Caplan, 2018). The most recent reauthorization of the Perkins Act (the federal government’s primary program supporting CTE) makes this shift particularly explicit, with new language that encourages funding for CTE programs that prepare students for college *and* career, rather than programs that lead students directly into the workforce.

2.3.2 Recent Research on Returns to CTE

While a growing body of evidence supports the contention that CTE may improve some student outcomes, these studies generally face challenges of selection bias, since students selecting into CTE are likely to be meaningfully different than non-CTE students. However, these studies consistently show benefits to employment and earnings in the short and medium term (Meer, 2007; Bishop and Mane, 2004, 2005; Mane, 1999). In a relatively small number of studies supporting causal inference, research generally shows similar findings. Kemple & Willner (2008), for example, use a lottery for admission to oversubscribed career academies, finding a positive impact on earnings (driven by male students). Dougherty (2018) leverages the application process at oversubscribed vocational schools in Massachusetts, employing a regression discontinuity design to find an increased on-time graduation rate for barely-admitted students, compared to those who just missed the admission threshold. Hemelt et al (2019) also find evidence of improvements in attendance, high school graduation and college-going (with benefits accruing to male students) in a North Carolina career academy with lottery-based admission. Kreisman and Stange (2018) find that the higher wages for CTE earnings are largely a function of students who take upper-level CTE coursework, indicating that depth of CTE concentration may be especially meaningful for students. All told, there are some indicators of the potential positive returns of CTE, but far too little is understood about the mechanisms through which these benefits may accrue, and the extent to which different student populations may respond in heterogenous ways to CTE.

2.4 Data

Massachusetts provides a robust landscape in which to conduct this study, with variation across urban, suburban, and rural populations, as well as sufficient racial and socioeconomic variation to allow for consideration of heterogeneous relationships. Moreover, CTE is offered in two distinct contexts in Massachusetts – with approximately half of CTE concentrators engaging with CTE courses within comprehensive high schools, and the other half enrolling in public schools of choice that are explicitly CTE-dedicated. At these CTE-dedicated high schools, students can apply to attend if they reside within a defined region; some CTE-dedicated high schools are highly competitive and oversubscribed, while others are not competitive and undersubscribed. Students at CTE-dedicated high schools universally concentrate in CTE; students explore multiple CTE clusters in their 9th grade year before choosing a focus area starting in 10th grade. While the main focus of the study considers students across both school settings, subgroup analyses across the different contexts provide a particularly useful opportunity to generalize to different states and localities in which CTE operates either within a comprehensive school *or* at a CTE-dedicated school setting.

This study leverages a robust statewide longitudinal data system (SLDS) available through a partnership with the Massachusetts Department of Elementary and Secondary Education. Student-level data include a broad range of student records, including demographic and residential information, attendance, state standardized test scores meant to assess student learning prior to high school, graduation, and coursetaking records, including CTE coursetaking.

Coursetaking and administrative records include all students attending public schools in Massachusetts from the 2011-2012 to 2017-2018 school years, which allows me to capture the full period of expected enrollment (assuming a four-year high school timeline) for four graduating cohorts of students (those with on-time graduation from spring of 2015 through 2018, for a total of 310,524 individual students).

Given the robustness of the available data, the study allows for multiple ways of measuring CTE engagement. As a primary measure, I focus on the Massachusetts designation of CTE concentrators, which are those students identified by their school as being enrolled in a CTE program for two or more academic years ("CTE concentrators"), compared to those students not identified as CTE concentrators ("Non-concentrators"). Massachusetts uses this definition of CTE concentrators for federal reporting purposes, making it a designation with financial implications through the Perkins Act, and helping with generalization to other states that report CTE concentrators to receive federal block grants. By comparing CTE concentrators to non-concentrators, I can assess the impacts for students who make a concerted, focused investment in CTE.

In addition to the school-generated CTE concentrator label, and because many students engage with CTE without concentrating, I also use coursetaking data to estimate expected differences associated with taking each additional CTE course on coursetaking in other areas. This measure allows me to capture CTE participation for those who students who are not formally labelled as concentrators, while also leveraging the fact that some CTE concentrators take substantially more CTE courses than required by the formal concentrator threshold. Some students (especially those attending CTE-dedicated schools) likely make a clear decision about whether or not to concentrate, but for other students, the marginal choice may more likely be "Should I enroll in an additional CTE course next term?" By using both binary and continuous approaches to measures of CTE participation, I consider how these choices to take additional CTE courses matter for student coursetaking outcomes, among both concentrators and non-concentrators. Moreover, these coursetaking trade-offs may manifest differently for students taking a first or second CTE course, compared to students taking especially large numbers of CTE courses. Since these relationships may be non-linear, the continuous measure allows for an important examination of trade-offs at different rates of CTE coursetaking.

My primary outcomes of interest are the number of courses students take in areas outside of CTE. Specifically, I use 10 non-CTE course categories based on state definitions (ELA, Math, Science, Social Studies, Fine Arts, World Language, PE/Health, Military/ROTC, AP/IB, and Study Hall/Test Prep; see Figure 1 for the distribution of courses taken by students in each subject area). These course types are especially meaningful because they either A) represent courses shown by previous research to support postsecondary enrollment and success, B) represent the primary non-CTE elective subject areas in Massachusetts high schools, or C.) represent a broad category of generally non-credit bearing or non-academic subject area courses (which I call "Study Hall/Misc"), the vast majority of which are study hall, study skills, test preparation, or support classes for students with disabilities. Graduation requirements in Massachusetts include four courses in ELA and math, three courses in science and social studies, two world language courses, and one fine arts course (Massachusetts Department of Elementary and Secondary Education, 2018). Students who enroll in CTE are also able to substitute one world language course and one fine arts course, suggesting that these may be categories where trade-offs could be especially likely to occur. Because of the strict requirements in ELA, math, and to a lesser extent, science and social studies, we might expect that there is less opportunity for coursetaking trade-offs in these core academic categories, though many students do take more than the required number of courses in those subjects. Students are also required to take some health or PE each year, although districts have broad discretion in how they count this (for example, districts have discretion to count extracurricular athletic participation for this requirement).

I incorporate into my analyses include standard demographic variables shown to predict both participation in CTE and post-high school outcomes of interest. The data include indicators for gender, race, ethnicity, English language status, disability, an indicator of family economic disadvantage, students' town of residence and school attended in 8th and 9th grades. I also include three variables from middle school that capture substantial unobserved heterogeneity in students before they attend high school and are exposed to treatment (CTE classes). These include students' test scores on the required 8th grade Math and English Language Arts exams, and their 8th grade attendance rate. Because these 8th grade characteristics are collected before students attend high school, this provides valuable information about student performance and engagement prior to any exposure to CTE in high school.

2.5 Analytic Approach

There are clear descriptive differences in academic and elective coursetaking between CTE concentrators and non-concentrators. However, it is unclear whether these descriptive differences are simply due to selection based on unobserved factors or different levels of access to CTE (see Table 1 for descriptive differences among CTE concentrators). For example, I present evidence in Table 2 that CTE concentrators, on average, take fewer AP/IB courses while in high school. This may not be a surprise, given anticipated differential selection into CTE based on preferences and unobserved postsecondary intentions. CTE students also take substantially fewer fine arts and world language courses. There are minor differences in core academic courses, though these differences are largely driven by students who fail to graduate.

While these descriptive differences in coursetaking patterns are notable, I attempt to account for differential selection to provide a nuanced look at the trade-offs students make when choosing their courses.

My analytic approach takes full advantage of the scope of the population of public school students in Massachusetts over the nine-year period, allowing for the broadest generalizability across the diverse contexts in which CTE is offered. I use a regression-based framework to consider the predicted change in non-CTE coursetaking for students who were CTE concentrators compared to non-concentrators who are otherwise similar on a wide range of observable characteristics. I fit the following Ordinary Least Squares (OLS) model to answer research questions 1 & 2:

$$(1)\ Y_{ist} = \beta_1 CTE_i + +\beta_2 Total_i + \boldsymbol{X_i'\gamma} + \pi_s + \tau_t + \epsilon_{ist}$$

Where Y_{ist} is the number of courses student *i* in school *s* and graduating cohort *t* took in a given subject area (e.g., ELA, social studies, world languages, etc.), with individual models fit for each course category. CTE_i is the number of CTE courses student *i* took, and $Total_i$ is the total number of courses a student took. Controlling for the total number of courses students took is essential, because without this, any increase in CTE_i would largely be a mechanical function of students staying in school longer and taking more classes overall.

Accounting for other factors that might predict coursetaking in Model 1, $\boldsymbol{X_i'}$ represents student demographic characteristics and measures of academic performance and attendance prior to high school to help isolate the impact of CTE. τ_t represents fixed effects for graduating cohort, to account for any factors specific to a given cohort (for example, economic factors). To account for differential access to courses (both CTE and non-CTE), local norms and workforce expectations across different schools and communities, π_s represents fixed effects for high school attended in 9^{th} grade. By incorporating high school fixed effects, I consider the coursetaking behavior of students within the context of students' access to courses and to other students operating within a comparable school environment. These models represent the choices students make, after accounting for their choice of high school.

Since we might *also* be interested in capturing the mediating role of different high school course offerings and school cultures and because I cannot fully account for the extent to which unobserved factors could explain sorting into particular high schools, I also fit identical models that substitute high school fixed effects with town of residence fixed effects. These town of residence fixed effects take account of local economic & other factors that may influence coursetaking. Also, as students in towns throughout the state have the opportunity to opt into CTE-dedicated schools, considering students within the context of their town of residence allows for estimates that incorporate the range of high school choice options students have available to them, given where they live. Throughout the results, I also compare differences in estimates from these two models, which can provide an approximation of how much high school choice explains any observed differences in coursetaking. For example, if I observe strong relationships between CTE and differences in other coursetaking in other subjects in the town of residence fixed effects models, but these disappear in the high school fixed effects, that would suggest that differences in high school choice and curriculum is the key force behind these differences.

Since this study uses two measures of CTE participation, I also fit a model that incorporates the state's binary definition of a CTE Concentrator:

$$(2)\ \ Y_{ist} = \beta_1 Concentrator_i + +\beta_2 Total_i + \boldsymbol{X_i'\gamma} + \pi_s + \tau_t + \epsilon_{ist}$$

This model is identical to Model 1, except that the key predictor is now $Concentrator_i$, which is a 1 if student *i* is identified by their school to be a CTE concentrator, and 0 for all other students. As with to Model 1, I also fit models in which I substitute the high school fixed effects for town of residence and middle school fixed effects.

To answer research question 3, I adopt the specifications in models 1 & 2, but only fit them to specific subsets of students. By comparing the magnitudes of β_1 across different populations, I can observe any heterogeneity in the ways that CTE engagement may relate to coursetaking in the various non-CTE areas.

For research question 4, I consider not only whether a student participated in any or no CTE, but also among those who do participate, how in-depth was that participation. In doing so, I examine how the expected difference in coursetaking in other subjects might differ for students taking greater or fewer numbers of CTE courses. Here, I use Model 1, but allow the Average Treatment on the Treated (ATE(t)) to differ across different levels of CTE coursetaking (i.e., number of courses) by employing a dose-response model (Cerulli, 2015) that finds the ATE(t) from Model 1 at each level of CTE coursetaking (i.e., number of courses). This approach allows for heterogeneity across levels of CTE coursetaking by recognizing that the marginal trade-offs may look quite different when a student is deciding whether to take their first CTE course or their 5th. For example, schools may offer students flexibility to take a small number of electives, so a student taking a small number of CTE courses may not involve a substantial reduction in their ability to take other courses; on the other hand, when students are choosing to take their 5th, 6th, or 7th CTE course, that may involve different types of trade-offs. To account for these marginal differences, the dose-response model identifies the ATE(t) at each treatment dosage (number of courses), and fits a quadratic based on the ATE(t) at each dosage level in order to visually display how CTE engagement may differently impact non-CTE coursetaking at different doses of CTE. This allows for a more in-depth understanding of the trade-offs students make.

2.6 Results

Overall, evidence suggests that the most substantial trade-offs associated with CTE are in reduced levels of elective coursetaking, particularly in the fine arts and world languages. CTE is also associated with lower levels of AP & IB courses, along with lower rates of study hall and test prep courses. In contrast, there are only minor associations between CTE and core academic coursetaking, which might be expected given the state graduation requirements leave less flexibility in terms of ELA, math, science, and social studies. However, analysis of specific math courses suggests that there may be stronger evidence of trade-offs between CTE and more advanced coursework that often prepares students for admissions at many selective colleges. Additionally, I find evidence that any coursetaking differences associated with CTE is largely driven by students who take moderate or large numbers of CTE courses, while students who take only a CTE course or two see no or only minor expected differences in their coursetaking levels in other subjects. While some differences in the types of course trade-offs experienced by different student populations (particularly students with disabilities and students with high and low levels of pre-HS academic achievement), the results are generally consistent across a wide range of student populations. Moreover, while students' choice of high school (and any constraints related to curricular options within their high school) is responsible for some of observed trade-offs, high school context does not account for all of the differences observed here.

Turning first to research questions 1 & 2, I present in Figures 2 & 3 the marginal difference in courses taken in each of 10 course categories that is predicted by each additional CTE course taken, on average. Figure 2 includes fixed effects for students' town of residence to account for differences within the context of a student's options for high school and other local factors, and Figure 3 includes high school fixed effects to highlight differences within the context of a student's curricular options after choosing a high school to attend. In both models, CTE coursetaking predicts lower levels of coursetaking in all four core academic content areas, but these magnitudes are small (all estimates for core academic class are between 0.015 and 0.044 SDs). For example, Figure 2 indicates that, holding other student characteristics constant, each additional CTE course is associated with a .031 course decrease in ELA courses. In other words, for CTE to predict a full ELA course decrease, students would need to take roughly 32 additional CTE courses, an implausible difference that highlights the relatively insubstantial relevance of this estimate. Given that the Massachusetts Core requires students to take four ELA courses to meet graduation requirements, it is likely sensible that the elasticity of ELA (and to a lesser extent, the other core academic subjects) would be more constrained than in elective areas. While still small, the magnitudes are somewhat larger for social studies and science than ELA and math, suggesting there may be slightly more coursetaking substitution happening with social studies and sciences (which might be expected given that only three courses area required in these areas rather than four for math and science), though these differences are only significant before accounting for high school choice.

Figures 2 and 3 also demonstrate that the largest predicted differences are seen when considering electives (where students should have more latitude in their curricular choices), particularly the fine arts and world languages. For example, an additional CTE course predicts a .305-.311 course decrease in the Fine Arts, meaning that for every 3 CTE courses taken, we would expect an approximate 1 course decrease in fine arts courses. CTE coursetaking is also related to a decrease in AP/IB courses, and to study hall/test prep courses. Notably, the magnitudes of the coefficients are only modestly different when accounting for students' high school choice through high school fixed effects, indicating that these relationships remain relatively similar even after accounting for students' curricular options at their high school. One difference that does stand out here is with world languages, for which high school fixed effects reduce the expected difference by roughly half, suggesting that schools with higher rates of CTE participation may also have lower rates of world language coursetaking (echoing findings from Brunner et al, 2019, which found limited world language offerings at similar CTE-dedicated schools in Connecticut).

Figure 4-5 display results that are analogous to Figure 2-3 in specification, but instead of using the continuous coursetaking variable to measure CTE engagement, these figures use the state CTE concentrator definition of CTE concentrator (i.e., those students reported by their school to be engaged in a CTE program for 2 or more years). While many CTE courses count towards the concentrator status, the CTE concentrator measure allows greater discretion at the school level for schools to identify who they consider to be engaged in a dedicated CTE program. As such, by comparing CTE concentrators to students *not* labeled by their school as concentrators (non-concentrators), we can observe the marginal differences in non-CTE coursetaking for those with especially deep commitment to CTE to those with no or more limited exposure. As shown in Table 2, CTE Concentrators take an average of 5.7 CTE courses, while non-concentrators still take 2.2 courses, on average. As such, CTE Concentrators take an average of 3.5 more CTE courses, meaning they are making a substantially larger commitment within their schedule.

Figures 4 & 5 again show that CTE concentration is associated with essentially no differences in core academic coursetaking. Instead, more substantial relationships are again seen with electives, particularly fine arts and to a lesser extent, world language. CTE concentrators are also, across both models, predicted to take substantially fewer AP/IB and study hall/test prep courses, all else equal. The predicted differences in elective coursetaking are less dramatic in the model including high school fixed effects, suggesting the schools with greater CTE offerings also have more limited offerings and/or student interest in the other elective areas. While the larger magnitudes in Figure 4 suggest that at least some of the change of elective coursetaking is attributable to which high school students choose to attend, Figure 4 highlights that even within the context of courses offered within a given school, there are still substantial curricular trade-offs associated with CTE (again, especially with the fine arts), with CTE concentrators taking about 1 fewer fine arts class than similar non-concentrators at the same high school.

Turning next to research question 3, Figures 6-9 display outcomes for different student groups to examine how coursetaking trade-offs may differ by student population. In both figures, I present the concentrator vs. non-concentrator comparison for ease of interpretation. Additional analyses confirm similar results when using the total CTE courses measure of CTE exposure.

First, Figure 6 presents evidence related to the coursetaking trade-offs by 8th grade test scores to understand how these relationships might differ by prior academic achievement. In particular, I focus on the highest-scoring students (top 20%), lowest-scoring students (bottom 20%) and the middle 20%; the students in these three groups likely face different curricular choices (including outside of CTE) and face the likelihood of different post-high school plans, meaning that consideration of these groups separately allows some insight into how coursetaking trade-offs might present differently. While the results are mostly similar for the core academic courses, there are some differences across the testing distribution in how students experience different elective trade-offs from CTE, especially in the study hall/miscellaneous category and AP/IB classes. As Figure 6 shows, higher-scoring students see a substantial predicted decrease in AP/IB coursetaking, with high-scoring CTE concentrators taking 1.2 fewer AP/IB courses than otherwise predicted. Meanwhile, lower-scoring CTE concentrators see a larger predicted decrease in Study Hall and Miscellaneous courses. Figure 7 suggests that high schools explain approximately half of these differences. While these finding might not be surprising given that, for example, higher-scoring students are more likely to take AP/IB courses and therefore are more able to see a shift in that area, it is still important and worthwhile to consider some of these marginal trade-offs may be different for different students.

Figure 8 presents the results of an approach similar to that in Figure 7, but instead considers how the relationship between CTE and other subject areas may differ across six student populations. Figure 8 explores heterogeneity by gender, given that many studies have found gendered differences in the returns to CTE (Brunner et al, 2019; Hemelt et al, 2019; Kemple & Willner, 2008), and for racially/ethnically minoritized students, English learners, students with disabilities, and students from lower-income families (those who were ever eligible for free and reduced lunch throughout their time in high school), given that these student populations have previously been shown to be targeted by CTE programs. Again, across all student populations, there is only minor variation in predicted differences across the core academic courses. While most of the relationships are relatively steady across student populations, the most striking difference is for students with disabilities, among whom CTE concentrators are predicted to take 1.517 fewer study hall classes, a much larger difference than for any other student population examined. Similar to the finding for lower-scoring students, this indicates that CTE may be a replacement for study hall, test prep, or other miscellaneous courses, particularly for certain students who may be disproportionately placed in those courses in the absence of CTE as an alternative option.

Figure 9 illustrates similar estimates by the type of high schools students attend, to consider whether relationships differ between students who engage with CTE within the context of a comprehensive high school and those who attend CTE-dedicated schools. Because the overwhelming majority of students at CTE-dedicated high schools are CTE concentrators, I use the number of CTE courses taken for these analyses. Figure 9 illustrates that there are slightly larger predicted differences in core academic coursetaking at CTE-dedicated schools from additional courses taken. However, in the fine arts and AP/IB, the predicted difference is far larger at comprehensive high schools (where only minor relationships exist). Given the intensive CTE-focused nature of the CTE-dedicated schools, this may indicate that there may be less flexibility and potentially less offerings in the fine arts and AP/IB than at comprehensive high schools.

While the evidence presented here suggests only modest curricular trade-offs occur between CTE and coursetaking in the core academic subjects, we might wonder whether CTE is associated with students taking different courses *within* those subject areas. To consider this possibility, Figure 10 takes the most common math course types, and considers the extent to which CTE concentrators are expected to take courses in those areas than otherwise similar non-concentrator peers. Figure 10 highlights that CTE concentrators are actually nearly 10% more likely to have taken courses in the three "traditional pathway" areas as defined by the state – Algebra I, Algebra II, and Geometry (MDESE, 2017). Conversely, CTE Concentrators are less likely to take courses in advanced fields like statistics, pre-calculus, calculus, and AP/IB math. Figure 11 demonstrates that these differences are smaller when considering coursetaking within the context of a student's school.

Turning next to research question 4, Figure 12 shows the predicted average treatment effect among the treated (ATE(t)) at each level of CTE coursetaking from 1 course to 12 courses (representing approximately 99% of CTE students) using a dose-response model that estimates the ATE(t) at each dosage level of CTE coursetaking (as measured by the number of CTE courses a student takes). In other words, given that a student takes at least 1 CTE course, Figure 12 shows the predicted ATE(t) of CTE coursetaking by the number of CTE courses a student takes. Figure 12 highlights that, for most course types, the negative ATE(t) of CTE coursetaking on non-CTE coursetaking is especially driven by students who take larger numbers of CTE courses. For example, looking at Science courses as an outcome, we see that for students taking 1 or 2 CTE courses, there is essentially no expected difference in Science coursetaking. This ATE(t) begins to increase at 3 CTE courses, and for students taking 10 CTE courses, students take nearly a full science course less than we might otherwise expect. Notably, for ELA, math, social studies, science, and world language, there is no clear difference associated with a small number of CTE courses; instead, the difference presents among students taking large numbers of CTE courses (with the ATE(t) becoming especially large for World Languages). However, with the fine arts, AP/IB, and study hall courses, an expected difference is seen even at small doses of CTE coursetaking, though the estimates become substantially larger at higher dosages. This analysis highlights that the marginal trade-offs likely varies considerably for students engaging across different levels of CTE courses.

2.9 Limitations

While my analyses in this study have strong generalizability based on the large sample size and diverse set of educational contexts, there are clear limitations to causal interpretation given the potential for unobserved characteristics that may influence students' coursetaking decisions. Though strict causal interpretations may warrant caution, there is still value in a more descriptive understanding on the trade-offs take when students engage with CTE, particularly if an assumption remains among many educators, education researchers, and policymakers that CTE participation inhibits college preparatory academic coursework.

To address concerns of unobserved bias, I follow the tests proposed by Oster (2016), building upon Altonji, Elder, & Taber (2005), to identify the amount of selection on unobservable factors that would be necessary for the true effect to be zero. Tables 3 & 4 present these findings, using $\boldsymbol{R_{max}}$ values of 1.3*R* and 2*R*, as proposed by Oster. Table 3 presents coefficient bounds for the range of coefficients on β_1 (CTE Concentration) from a model with no unobserved bias to one in which unobservable characteristics explain 30% as much as the observed characteristics (resulting in a R-square 130% the size of the observed R-squared). If 0 is not within the coefficient bound, unobserved bias would need to explain the outcomes by more than 30% as much as observed characteristics. The bias **δ** represents how many times larger unobserved characteristics would have to be than observed factors for β_1 to be 0. Table 3 then presents more conservative estimates with a $\boldsymbol{R_{max}}$ of 2, in which unobserved factors would need to be as large as observed factors in order to invalidate results. These results show that the relationships found in this paper between CTE concentration and lower levels of coursetaking in the fine arts, world language, and to a lesser extent, other elective areas could withstand even large levels of unobserved variable bias before estimates would diminish to 0. On the other hand, looking at ELA, coefficient bounds overlapping 0 and bias deltas below 0 suggest that even relatively small amounts of unobserved bias could nullify the results.

Table 4 displays similar bias estimates for models with high school fixed effects. Here, non-zero relationships between CTE and world language, fine arts, military/ROTC, AP/IB and study courses would all still hold even with omitted variables as strong as all the observed variables. Again, Table 4 suggests that the small relationships found for ELA and the other core academic subjects are relatively subject to omitted variable bias, suggesting that the small relationships between CTE and core academic courses should be taken with a grain of salt.

Furthermore, while coursetaking data can provide information on how student spend their time in high school, we know far less about the quality and rigor of the courses students take. It may be possible, for example, that CTE students are in academic courses with lower-performing teachers or in less-demanding academic courses (if, for example, the rigor of academic courses was not as high as the same courses at comprehensive high school). Thus, this analysis speaks less definitively about what learning trade-offs are made when students engage with CTE, but rather, what differences occur in how students spend their time. Moreover, this analysis does not speak to how or by whom course choices are made. It is possible that these choices are made by students and families; however, if choices were made by schools and counselors, any soft tracking of students into CTE and away from electives and more advanced coursework would not be clear from this analysis.

Finally, because my models control for the total number of courses students take in high school to avoid conflated additional CTE courses with simply being in school for longer periods of time, my approach limits one potential avenue through which CTE could impact coursetaking; if CTE induces students to persist in high school longer (due to increased engagement, for example), I do not observe the role CTE plays in keeping students in school and taking more academic classes. Conversely, if CTE induces some students to leave school early (perhaps due to exposure to work), that would not be captured in these results, though a growing body of evidence suggests that CTE likely increases high school persistence and attendance (Dougherty, 2018; Gottfried & Plasman, 2018; Hemelt et al, 2019), making this a relatively small concern. Given this evidence that CTE can improve student retention, this likely means that estimates presented from this model will be somewhat conservative in nature.

2.8 Discussion

With renewed interest in CTE from policymakers and politicians, key questions remain about the ways in CTE can either benefit students through greater engagement in school and stronger career preparation, or harm students by limiting their opportunity and preparation for success in careers that require postsecondary education. Stronger evidence is beginning to emerge that CTE seems to induce positive labor market returns (at least in the short-to-mid-term range) without clear evidence of changes in educational outcomes. As this evidence base grows, this study represents one of the first quantitative attempts to consider a key mechanism through which we might expect CTE to have an impact. While CTE research generally focuses on the direct effects of CTE experiences, this research asks a novel set of research questions – simply put, does CTE participation cause students to lose other opportunities that may be important to their future success. It is currently not understood whether CTE coursetaking and concentration causes students to take fewer courses in academic preparatory classes, or whether students use CTE as a more-focused way of filling their elective opportunities. Here, I find evidence suggesting the later. Given that many states (including Massachusetts) have aligned their high school graduation requirements to college admissions requirements, this finding makes sense given the shift in high school curricular policy. It seems likely that given core academic requirements needed for high school graduation, there is simply little flexibility left in students' schedules to see major differences in the numbers of core academic courses they take. Rather, elective areas like the fine arts, AP/IB, study hall, and to an extent, world languages, might be areas where students have greater flexibility. These results suggest that CTE may operate more as an elective area for students in many cases.

However, key nuances exist in these findings with important implications. First, the types of trade-offs differ by student population. Among lower-scoring students, for example, and students with disabilities, I observe especially strong evidence of trade-offs between CTE and courses in study hall, test prep, and other support classes. On the one hand, this might suggest that these students are using CTE as a way of engaging in a more enriching, engaging curriculum that could have real-world relevance for them and their future careers. On the other hand, if students with disabilities or those struggling to pass mandatory exams are taking CTE instead of support classes or courses that include services which could benefit them, this may be a reason for concern.

Higher-scoring students, meanwhile, see especially strong trade-offs in AP/IB classes when they engage with CTE. This may call into question whether the trade-offs higher-students take to engage in CTE are as prudent, given that they may be giving up the opportunity to take classes that may set them up especially well for postsecondary admission and success, especially in more selective colleges. Similarly, while I find essentially no trade-offs between CTE and math courses in aggregate, I do find evidence of substantive trade-offs between CTE and more advanced math courses like statistics and calculus that might position high-achieving students especially well for competitive college admissions. Considering both AP/IB and advanced math courses, these findings suggest that while CTE does not appear to limit baseline college preparatory coursework, trade-offs may be more likely when considering academic electives, or college-preparatory academic courses above and beyond the high school graduation requirements. For students, families, and policymakers making decisions about how to engage with CTE (especially among higher-scoring students), a recognition of these trade-offs may be important to consider.

This study also highlights that school choice and school setting is important, but not fully determinative of the types of curricular trade-offs students might make in high school. In particular, there is substantially less variation in world languages (and to a lesser extent, fine arts) after accounting for school fixed effects, suggesting that these elective courses are simply much less common at schools where CTE is more common. Indeed, within CTE-dedicated schools, there is very little variation in these elective areas, with less than a quarter of the anticipated difference for world language courses associated with CTE compared to what was observed across the full sample. Smaller curricular trade-offs within these CTE-dedicated school contexts may make some intuitive sense; given the additional emphasis on CTE, there may simply be less room in students' schedules for additional electives. For students who choose to enter CTE-dedicated schools, then, there is a strong likelihood that there is some level of limitation on their likelihood of taking certain elective courses outside of CTE. Still, while the extensive margins in which students choose a school that is more or less focused on CTE, the intensive marginal course choices students make within the context of their high school still matter, especially for students at comprehensive high schools.

Though this analysis does not claim causality, it is unclear and worth further examination to determine which direction the causal relationship would flow between increased rates of CTE coursetaking and coursetaking in other elective areas. Perhaps some students may take CTE courses because they are uninterested in the fine arts or world languages, for example. Other students may want to take more of fine arts and world languages, but are unable to make room in their schedule after CTE courses fill the limited flexible time in their schedules. Similarly, this study cannot explain whether these differences coursetaking patterns are driven by student interest or by school offerings. For example, the lower rates of world language coursetaking at CTE-dedicated schools may simply be because the students who attend those schools are less interested in the fine arts, on average; or it may be the constraints on student schedules and limited staff or space capacity means that these schools are unable to offer as many world language or fine arts classes, even if high levels of student interest *does* exist. On the other hand, some students may explicitly view CTE and world languages as 'competitive' for time in their schedule; they may view these as elective trade-offs, and may make their coursetaking choices using this approach.

As CTE grows in popularity and policy salience, it is essential to fully understand the implications of CTE – not only the experiences students gain, but also the experiences that students lose in order to make room within their schedule. This can (and likely should) color our understanding of what CTE means for students, and how the public and policymakers should consider the trade-offs students make as they engage with CTE. Given the long and controversial history of vocational education and CTE within the American public schooling system, this work speaks to fundamental implications about access, equity, and opportunity. These results offer a counterargument to the longstanding perception that CTE serves as what many have called as a "dumping ground" for low-achieving students (Kelly & Price, 2009), and helps address gaps in the literature that researchers and policymakers need to know about the opportunities students lose through their participation in CTE. These results suggest that CTE students in the Massachusetts context are still completing courses in core college preparatory subject areas at a similar rate, though there are notable differences for students with disabilities, and students with especially low- or high-test scores. Especially for students who take only a small number of CTE courses, the trade-offs in terms of academic courses taken are minimal, although these trade-offs do become more substantial for students who take several CTE courses. Overall, CTE appears to function more as an elective for students, leading to trade-offs with other elective areas, rather than the core academic areas.

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2.10 Tables and Figures

Table 2.1. Descriptive Statistics by Concentrator Status

	All Students	CTE Concentrators	Non-CTE Concentrators	Graduates & CTE Concentrators	Graduates & Non-CTE Concentrators	Non-Graduates & CTE Concentrators	Non-Graduates & Non-CTE Concentrators
CTE Concentrator	0.21	1.00	0.00	1.00	0.00	1.00	0.00
	(0.41)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CTE Courses	2.90	5.70	2.15	5.93	2.41	3.20	0.88
	(3.20)	(4.64)	(2.14)	(4.67)	(2.17)	(3.51)	(1.40)
Male	0.51	0.55	0.50	0.54	0.48	0.59	0.57
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)	(0.50)
Black	0.10	0.09	0.10	0.09	0.09	0.12	0.14
	(0.30)	(0.29)	(0.30)	(0.29)	(0.29)	(0.32)	(0.35)
Latinx	0.18	0.21	0.17	0.20	0.14	0.33	0.35
	(0.38)	(0.41)	(0.38)	(0.40)	(0.34)	(0.47)	(0.48)
Asian	0.06	0.04	0.07	0.04	0.07	0.04	0.05
	(0.24)	(0.21)	(0.25)	(0.21)	(0.25)	(0.19)	(0.22)
Low-Income	0.47	0.59	0.44	0.57	0.38	0.82	0.70
	(0.50)	(0.49)	(0.50)	(0.50)	(0.49)	(0.38)	(0.46)
English Learner	0.10	0.08	0.10	0.07	0.07	0.17	0.24
	(0.29)	(0.27)	(0.30)	(0.26)	(0.26)	(0.38)	(0.43)
Student w/Disability	0.20	0.25	0.19	0.24	0.16	0.42	0.35
	(0.40)	(0.43)	(0.39)	(0.42)	(0.36)	(0.49)	(0.48)
8th Grade Math (Std)	-0.00	-0.28	0.07	-0.25	0.17	-0.65	-0.39
	(0.92)	(0.85)	(0.92)	(0.86)	(0.92)	(0.76)	(0.78)
8th Grade ELA (Std)	0.01	-0.28	0.08	-0.24	0.19	-0.72	-0.42
	(0.91)	(0.89)	(0.90)	(0.87)	(0.86)	(1.00)	(0.95)
8^{th} Grade Attendance	0.96	0.96	0.96	0.97	0.96	0.94	0.93
	(0.06)	(0.05)	(0.06)	(0.04)	(0.05)	(0.07)	(0.09)
Observations	310524	65307	245217	59959	203282	5348	41935

Graduating Cohorts of 2015-2018

Table 2.2. Number of Courses in Each Category by Concentrator Status

	All Students	CTE Concentrators	Non-CTE Concentrators	Graduates & CTE Concentrators	Graduates & Non-CTE Concentrators	Non-Graduates & CTE Concentrators	Non-Graduates & Non-CTE Concentrators
English/Language Arts	4.55	4.78	4.49	4.91	4.89	3.26	2.55
	(2.21)	(2.28)	(2.19)	(2.23)	(1.88)	(2.25)	(2.50)
Math	4.06	4.30	3.99	4.44	4.42	2.76	1.93
	(1.78)	(1.44)	(1.85)	(1.33)	(1.55)	(1.68)	(1.79)
Science	3.84	3.78	3.85	3.90	4.31	2.34	1.63
	(1.89)	(1.41)	(1.99)	(1.34)	(1.75)	(1.44)	(1.58)
Social Studies	4.17	4.15	4.18	4.30	4.69	2.49	1.67
	(1.99)	(1.63)	(2.08)	(1.56)	(1.78)	(1.50)	(1.52)
Fine Arts	2.29	1.05	2.63	1.07	2.93	0.79	1.15
	(2.50)	(1.71)	(2.57)	(1.74)	(2.62)	(1.39)	(1.63)
World Language	2.31	1.42	2.55	1.49	2.93	0.59	0.71
	(1.75)	(1.49)	(1.74)	(1.50)	(1.61)	(0.96)	(1.01)
PE/Health	3.99	4.40	3.88	4.51	4.26	3.07	2.03
	(2.39)	(2.20)	(2.42)	(2.17)	(2.32)	(2.07)	(2.02)
Military/ROTC	0.09	0.12	0.08	0.12	0.08	0.12	0.07
	(0.54)	(0.64)	(0.51)	(0.65)	(0.54)	(0.52)	(0.37)
AP/IB	1.33	0.59	1.52	0.64	1.82	0.03	0.06
	(2.31)	(1.47)	(2.45)	(1.52)	(2.58)	(0.25)	(0.40)
Study Hall/Test Prep/Misc	1.80	1.69	1.82	1.66	1.81	2.03	1.88
	(3.00)	(2.55)	(3.11)	(2.39)	(2.86)	(3.96)	(4.08)
CTE	2.90	5.70	2.15	5.93	2.41	3.20	0.88
	(3.20)	(4.64)	(2.14)	(4.67)	(2.17)	(3.51)	(1.40)
Observations	310524	65307	245217	59959	203282	5348	41935

Graduating Cohorts of 2015-2018

Table 2.3
Estimates of coefficient bounds and bias needed to find null results
Models with Town of Residence Fixed Effects

	ELA	**Math**	**Science**	**Social Studies**	**World Language**	**Fine Arts**	**PE/Health**	**Military/ ROTC**	**AP/IB**	**Study Hall/ Misc**
CTE Concentrator Difference	0.065	0.169	-0.065	-0.208	-1.706	-1.037	0.434	-0.033	-0.577	-0.486
Standard Error	*0.063*	*0.046*	*0.042*	*0.066*	*0.094*	*0.053*	*0.121*	*0.025*	*0.038*	*0.108*
Coefficient Bound (*R_{max}* =1.3R)	(.065, -.006)	(.169, .095)	(-.065, -.119)	(-.208, -.295)	(-1.706, -1.759)	(-1.037, -1.058)	(.434, .33)	(-.033, -.039)	(-.577, -.495)	(-.486, -.596)
Bias δ (*R_{max}* =1.3R)	0.913	2.248	-1.244	-2.464	-53.347	-240.652	3.873	-6.338	6.160	-4.488
Coefficient Bound (*R_{max}* =2R)	(.065, -.179)	(.169, 0)	(-.065, -.231)	(-.208, -.495)	(-1.706, -1.89)	(-1.037, -1.11)	(.434, .075)	(-.033, -.052)	(-.577, -.295)	(-.486, -.864)
Bias δ (*R_{max}* =2R)	0.274	0.998	-0.419	-0.778	-23.972	-86.608	1.196	-2.018	1.930	-1.389
R-Squared	0.492	0.596	0.528	0.511	0.223	0.489	0.343	0.018	0.422	0.250

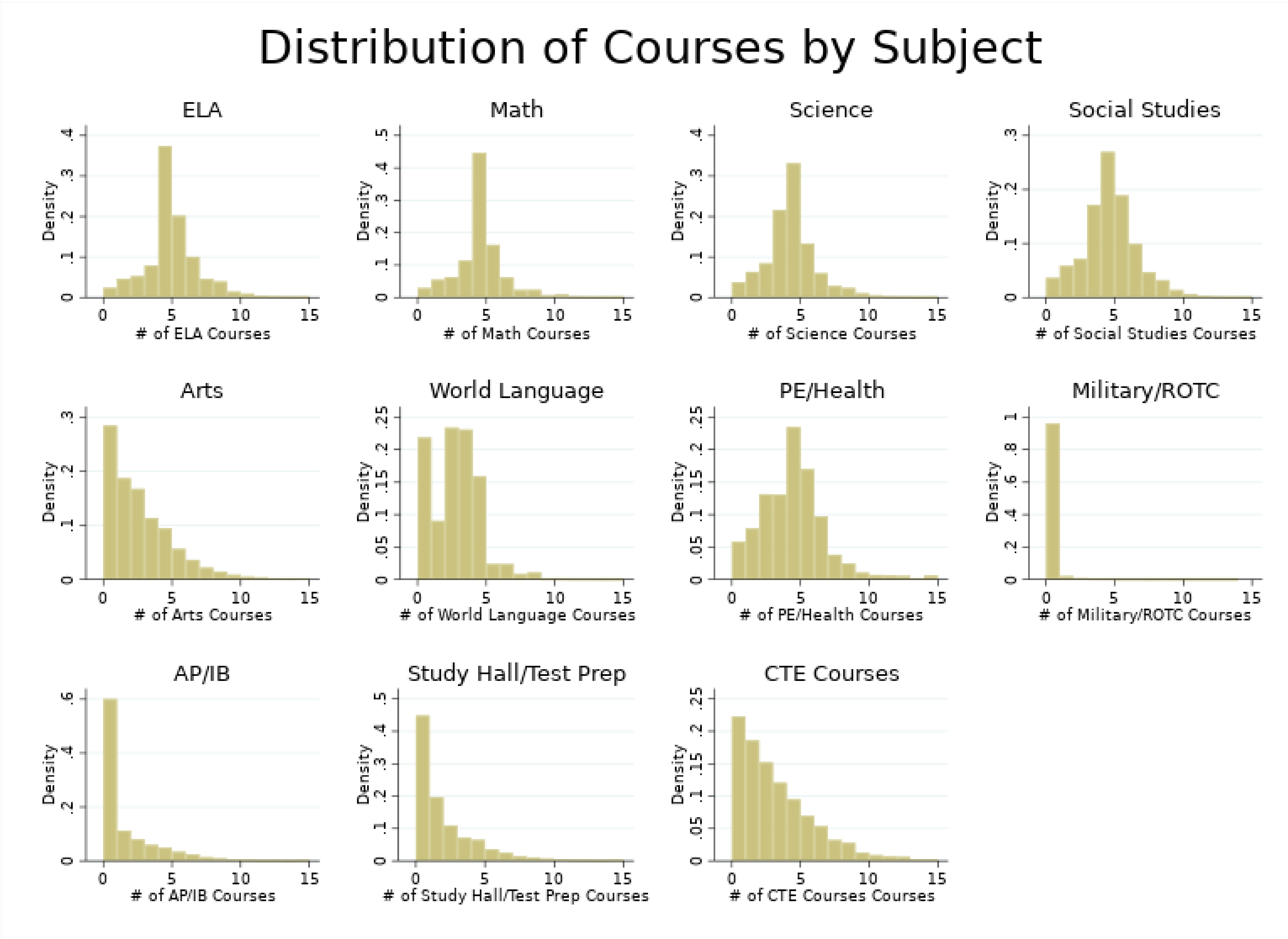
Notes: CTE Concentrator Difference, Standard Errors, and R-Squared are from Model 2 and include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2015 through 2018. Models include fixed effects for students' town of residence. Coefficient bounds refer to the range of estimates associated with CTE Concentration on each course category difference (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 "psacalc" STATA package (Oster, 2019).

Table 2.4
Estimates of coefficient bounds and bias needed to find null results
Models with High School Fixed Effects

	ELA	Math	Science	Social Studies	World Language	Fine Arts	PE/Health	Military/ ROTC	AP/IB	Study Hall/ Misc
CTE Concentrator Difference	0.134	0.181	0.033	-0.075	-1.168	-0.293	0.123	-0.041	-0.433	-0.291
Standard Error	*0.050*	*0.034*	*0.031*	*0.047*	*0.076*	*0.055*	*0.067*	*0.019*	*0.041*	*0.111*
Coefficient Bound (R_{max} =1.3R)	(.134, .04)	(.181, .085)	(.033, -.051)	(-.075, -.19)	(-1.168, -1.225)	(-.293, -.339)	(.123, .02)	(-.041, -.048)	(-.433, -.422)	(-.291, -.369)
Bias δ (R_{max} =1.3R)	1.428	1.878	0.395	-0.650	-17.839	-6.581	1.198	-4.948	33.068	-3.743
Coefficient Bound (R_{max} 2R)	(.134, -.181)	(.181, -.075)	(.033, -.251)	(-.075, -.463)	(-1.168, -1.361)	(-.293, -.447)	(.123, -.223)	(-.041, -.067)	(-.433, -.396)	(-.291, -.556)
Bias δ (R_{max} =2R)	0.429	0.710	0.119	-0.195	-6.268	-1.993	0.360	-1.545	10.026	-1.128
R-Squared	0.468	0.557	0.480	0.458	0.157	0.411	0.316	0.017	0.438	0.263

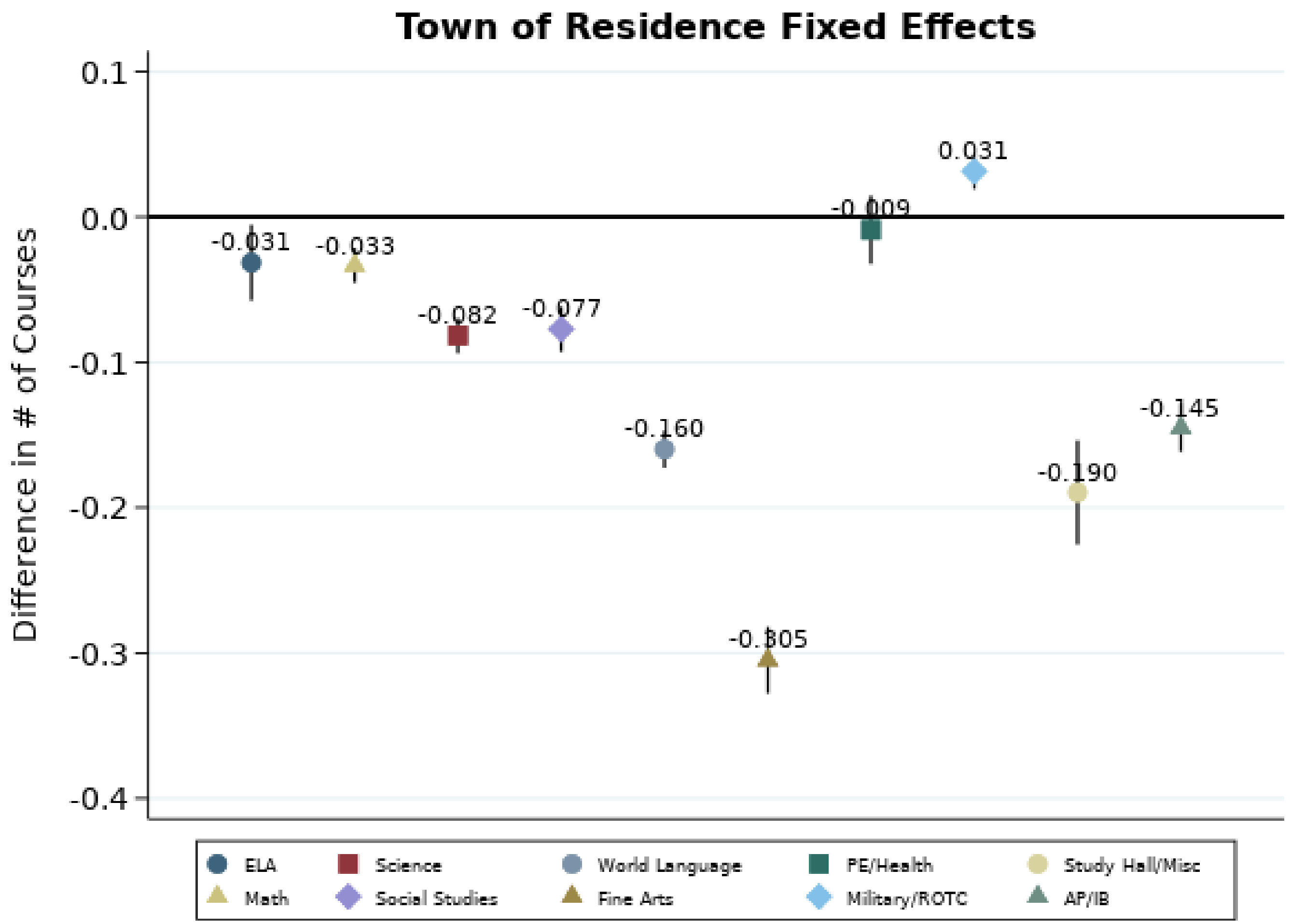
Notes: CTE Concentrator Difference, Standard Errors, and R-Squared are from Model 2 and include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2015 through 2018. Models include fixed effects for the high school a student attended in 9th grade. Coefficient bounds refer to the range of estimates associated with CTE Concentration on each course category difference (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 "psacalc" STATA package (Oster, 2019).

Figure 2.1. Coursetaking by Subject



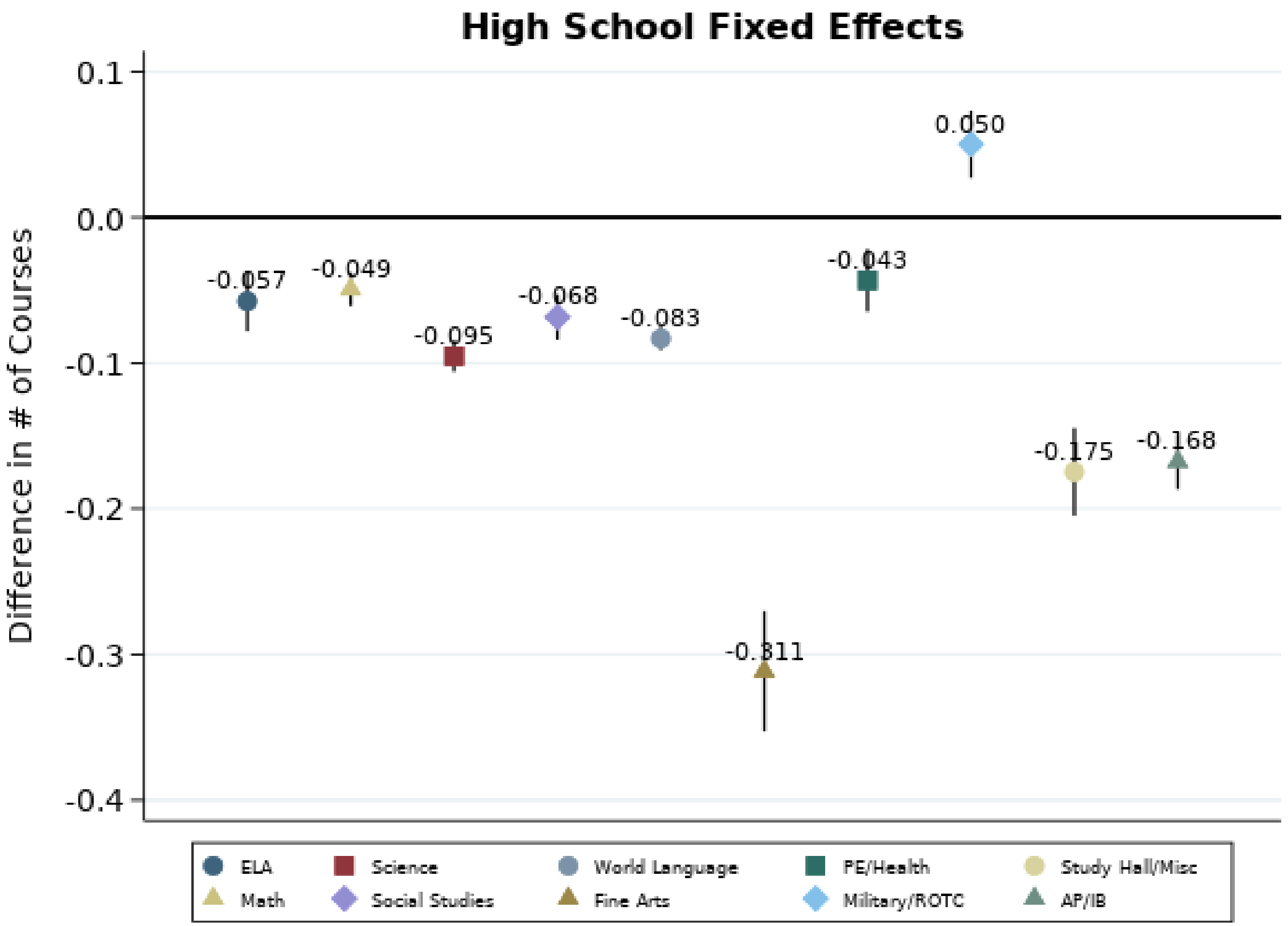
Notes: Counts of the number of students taken in high school per student. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2015 through 2018.

Figure 2.2 Differences in the # of Courses in Content Areas Predicted by An Additional CTE Course



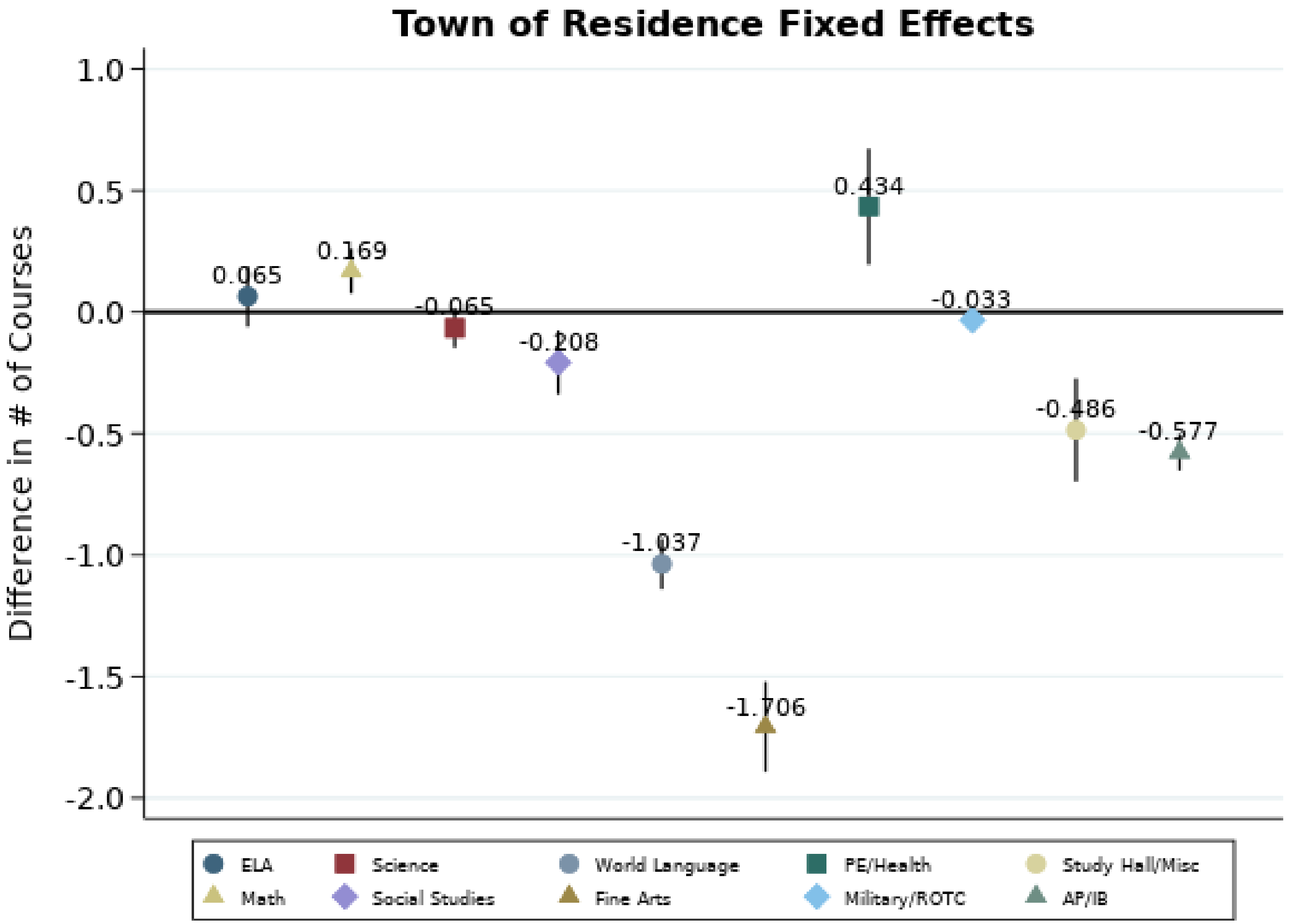
Notes: Estimates are the coefficient associated with an additional CTE course on the expected difference in the number of courses in each subject area. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both Mathematics and English Language Arts). 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 2015 through 2018.

Figure 2.3. Differences in the # of Courses in Content Areas Predicted by An Additional CTE Course



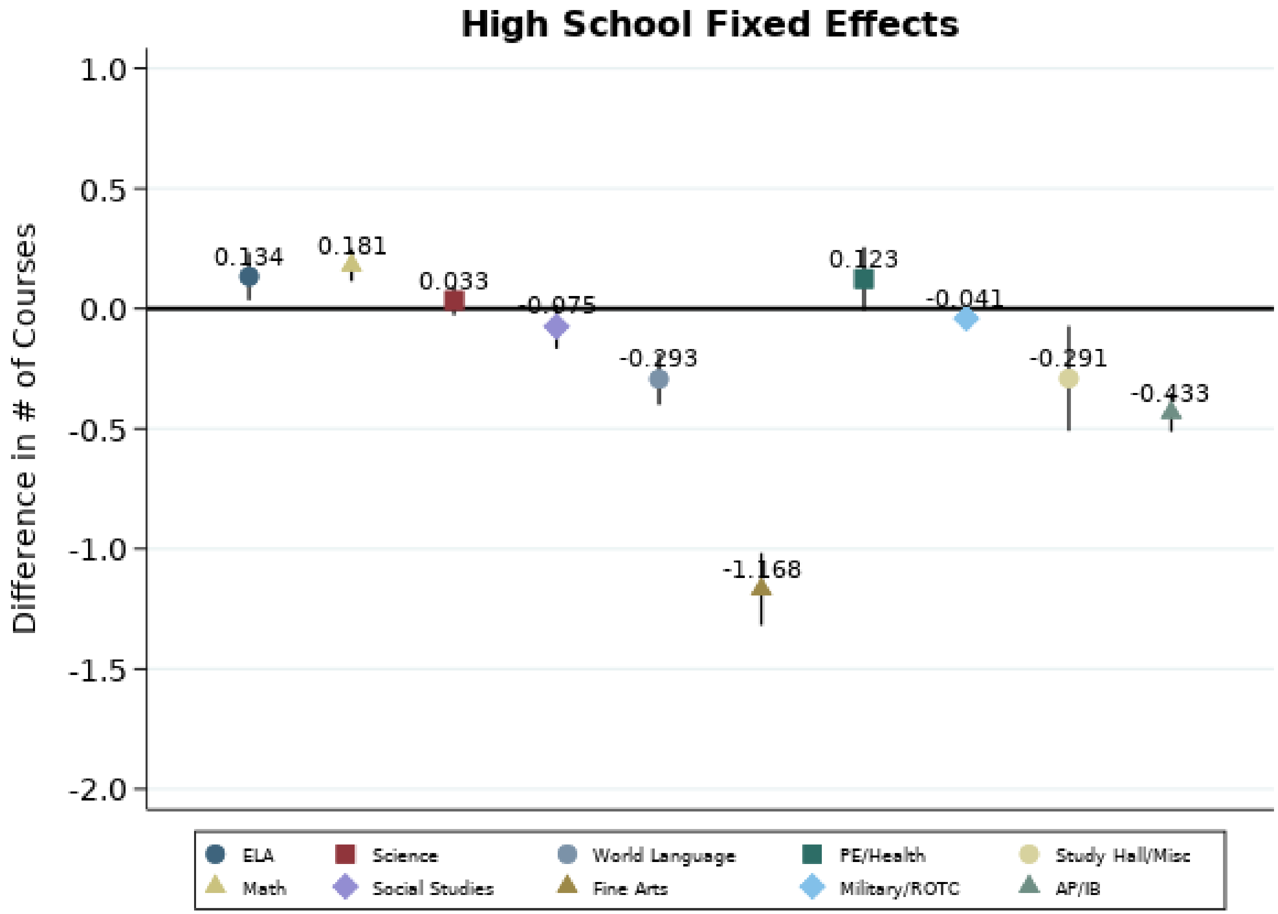
Notes: Estimates are the coefficient associated with an additional CTE course on the expected difference in the number of courses in each subject area. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both Mathematics and English Language Arts). Models also include cohort fixed effects as well as fixed effects for the high school a student attended in 9th grade, with errors clustered by high school. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2015 through 2018.

Figure 2.4 Differences in the # of Courses in Content Areas Predicted by Being a CTE Concentrator



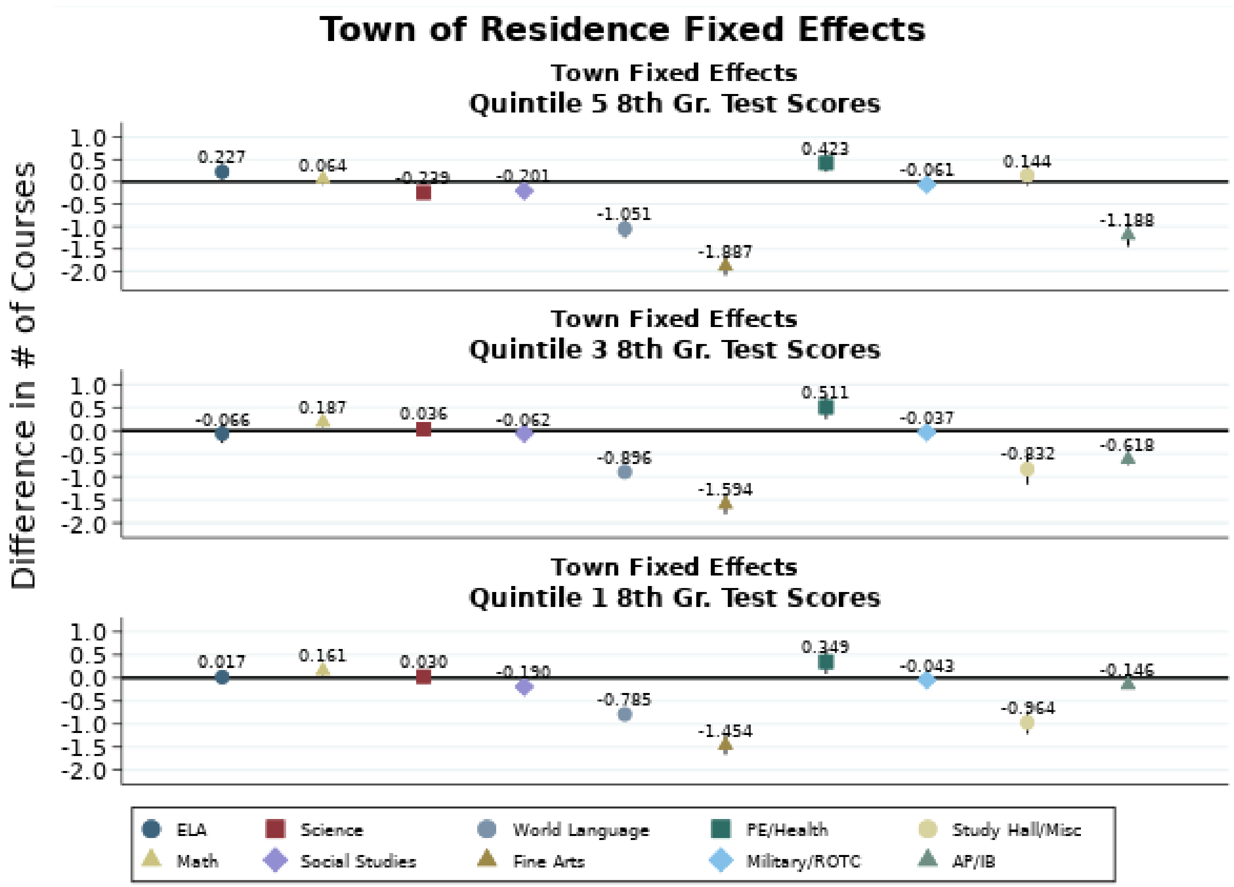
Notes: Estimates are the coefficient associated with a being a CTE Concentrator on the expected difference in the number of courses in each subject area, compared to non-CTE Concentrators who were otherwise similar on observable characteristics. CTE Concentrators are those students indicated by their school to be enrolled in CTE for two or more years. 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 English Language Arts). 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 2015 through 2018.

Figure 2.5 Differences in the # of Courses in Content Areas Predicted by Being a CTE Concentrator



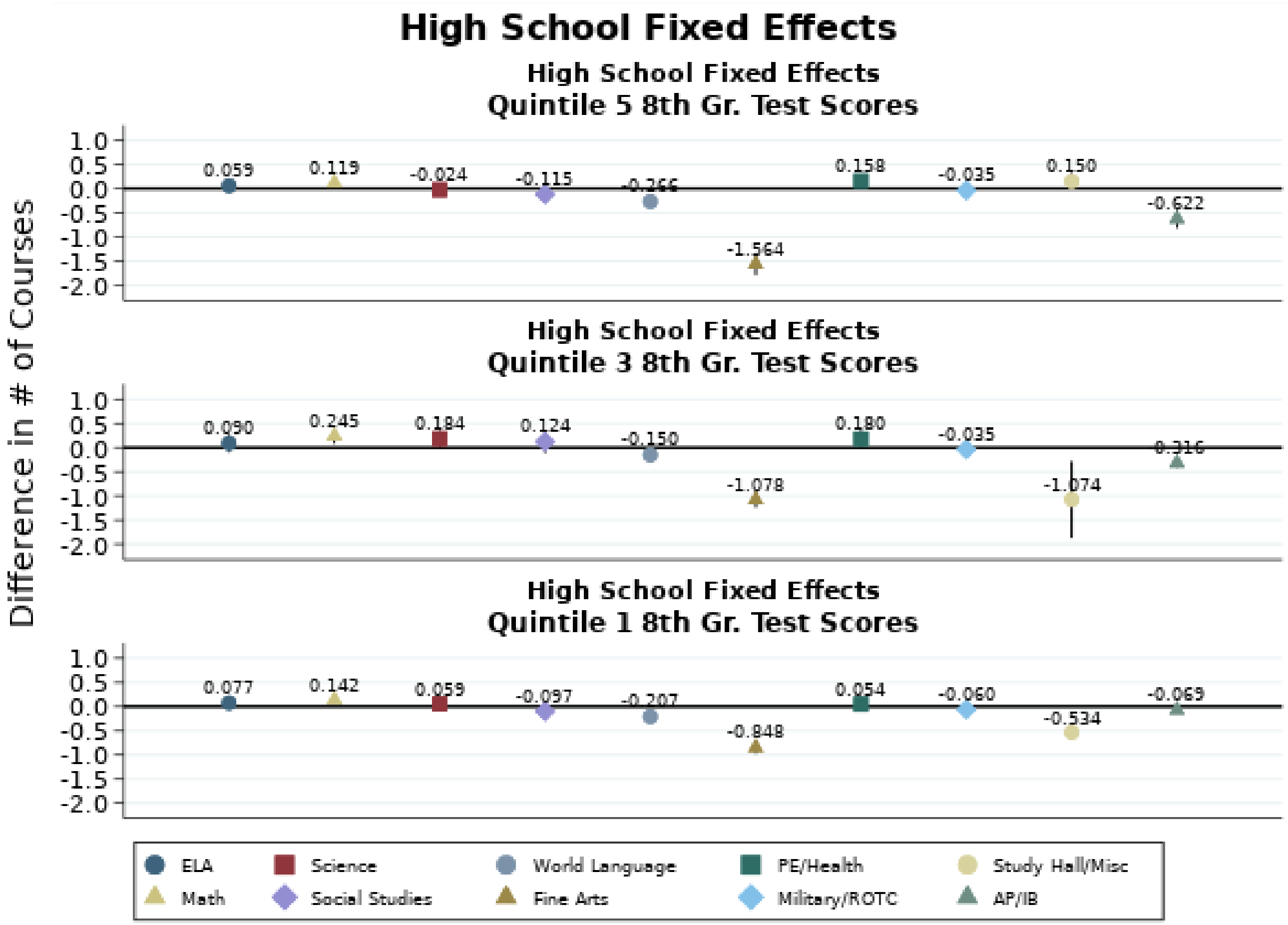
Notes: Estimates are the coefficient associated with a being a CTE Concentrator on the expected difference in the number of courses in each subject area, compared to non-CTE Concentrators who were otherwise similar on observable characteristics. CTE Concentrators are those students indicated by their school to be enrolled in CTE for two or more years. 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 English Language Arts). Models also include cohort fixed effects as well as fixed effects for the high school a student attended in 9th grade, with errors clustered by high school. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2015 through 2018.

Figure 2.6 Differences in the # of Courses in Content Areas Predicted by Being a CTE Concentrator, by Test Scores



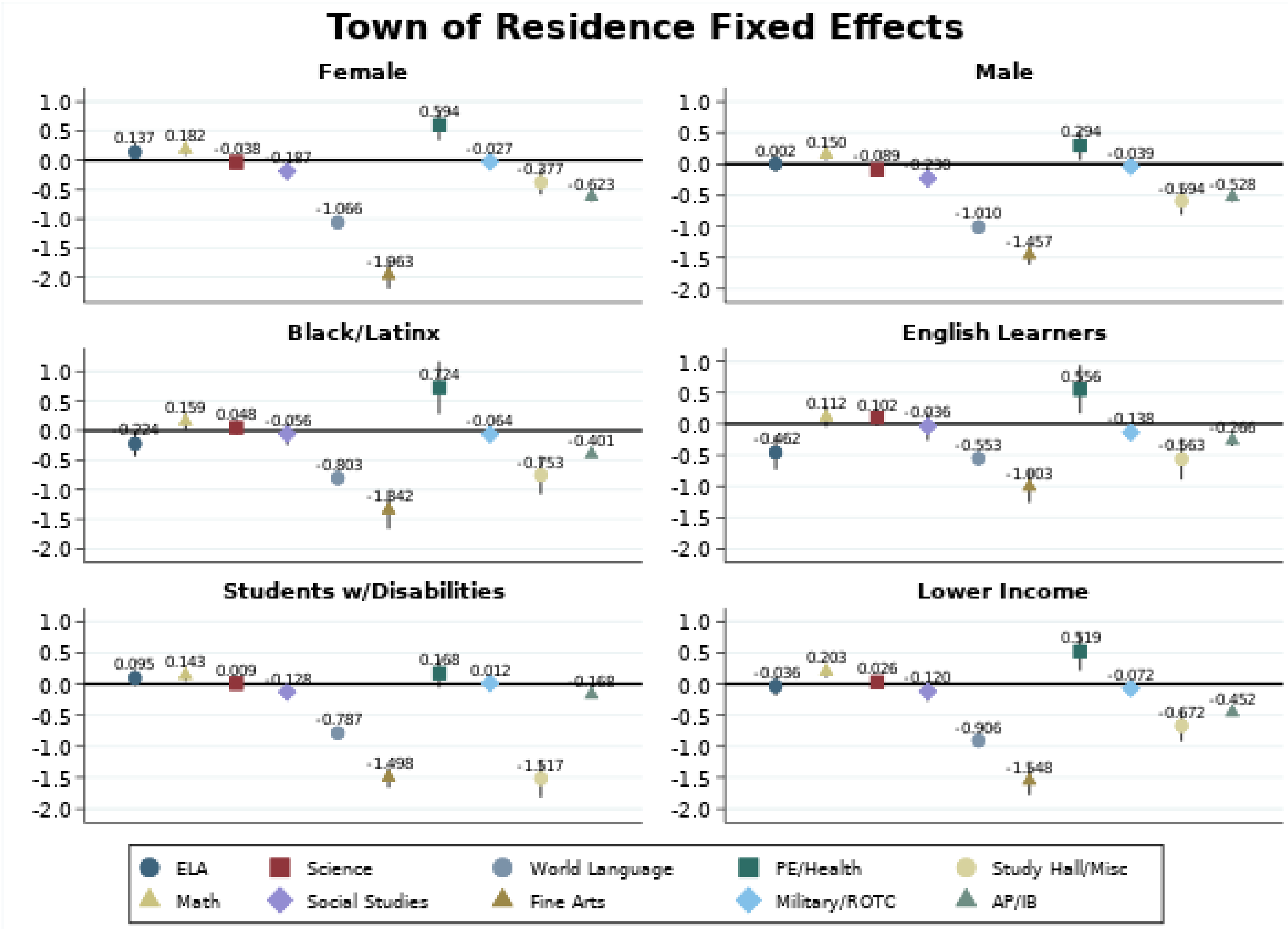
Notes: Estimates are the coefficient associated with a being a CTE Concentrator on the expected difference in the number of courses in each subject area, compared to non-CTE Concentrators who were otherwise similar on observable characteristics. CTE Concentrators are those students indicated by their school to be enrolled in CTE for two or more years. 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 English Language Arts). 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 2015 through 2018.

Figure 2.7 Differences in the # of Courses in Content Areas Predicted by Being a CTE Concentrator, by Test Scores



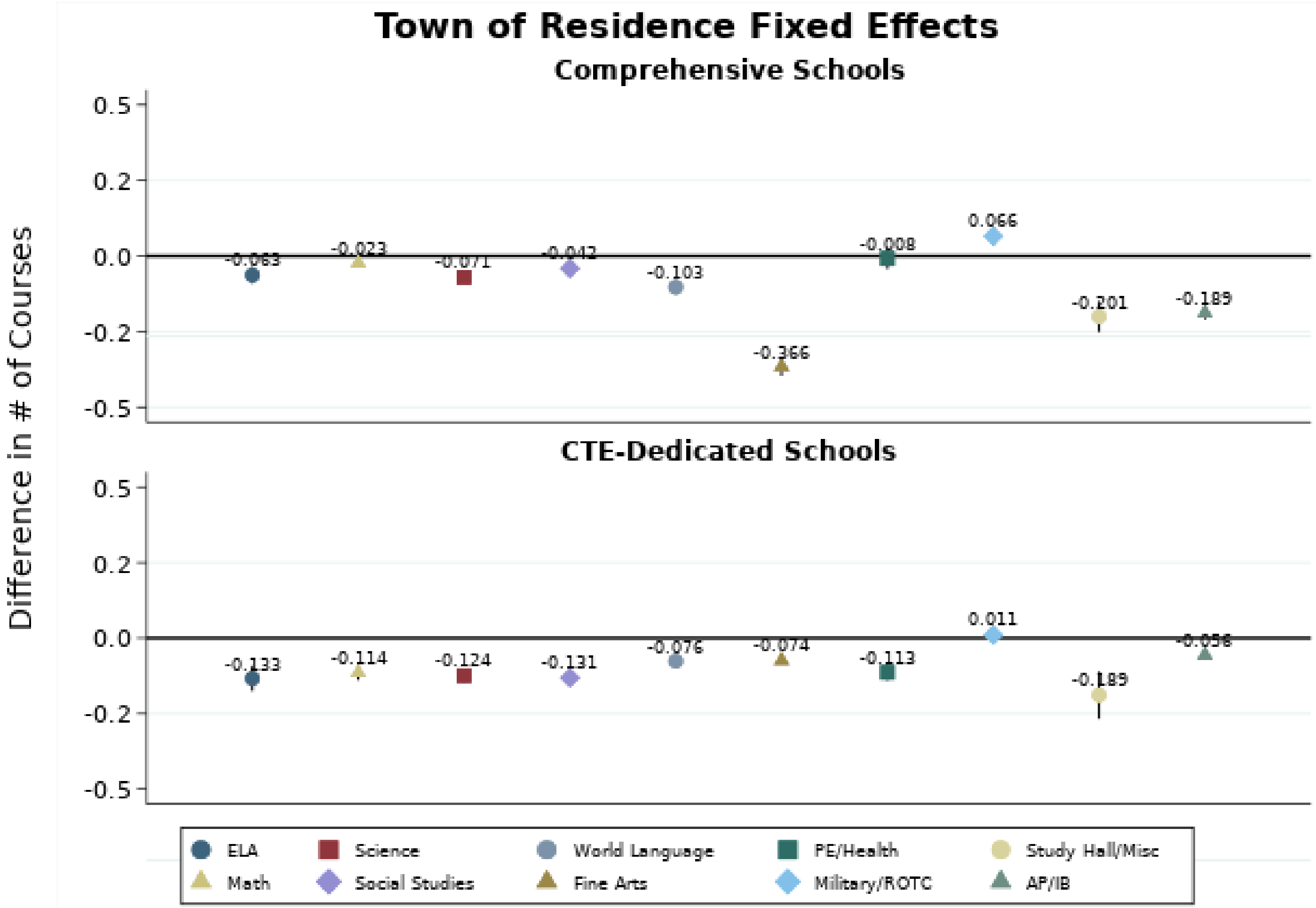
Notes: Estimates are the coefficient associated with a being a CTE Concentrator on the expected difference in the number of courses in each subject area, compared to non-CTE Concentrators who were otherwise similar on observable characteristics. CTE Concentrators are those students indicated by their school to be enrolled in CTE for two or more years. 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 English Language Arts). Models also include cohort fixed effects as well as fixed effects for the high school a student attended in 9th grade, with errors clustered by high school. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2015 through 2018.

Figure 2.8 Differences in the # of Courses in Content Areas Predicted by Being a CTE Concentrator, by Student Population



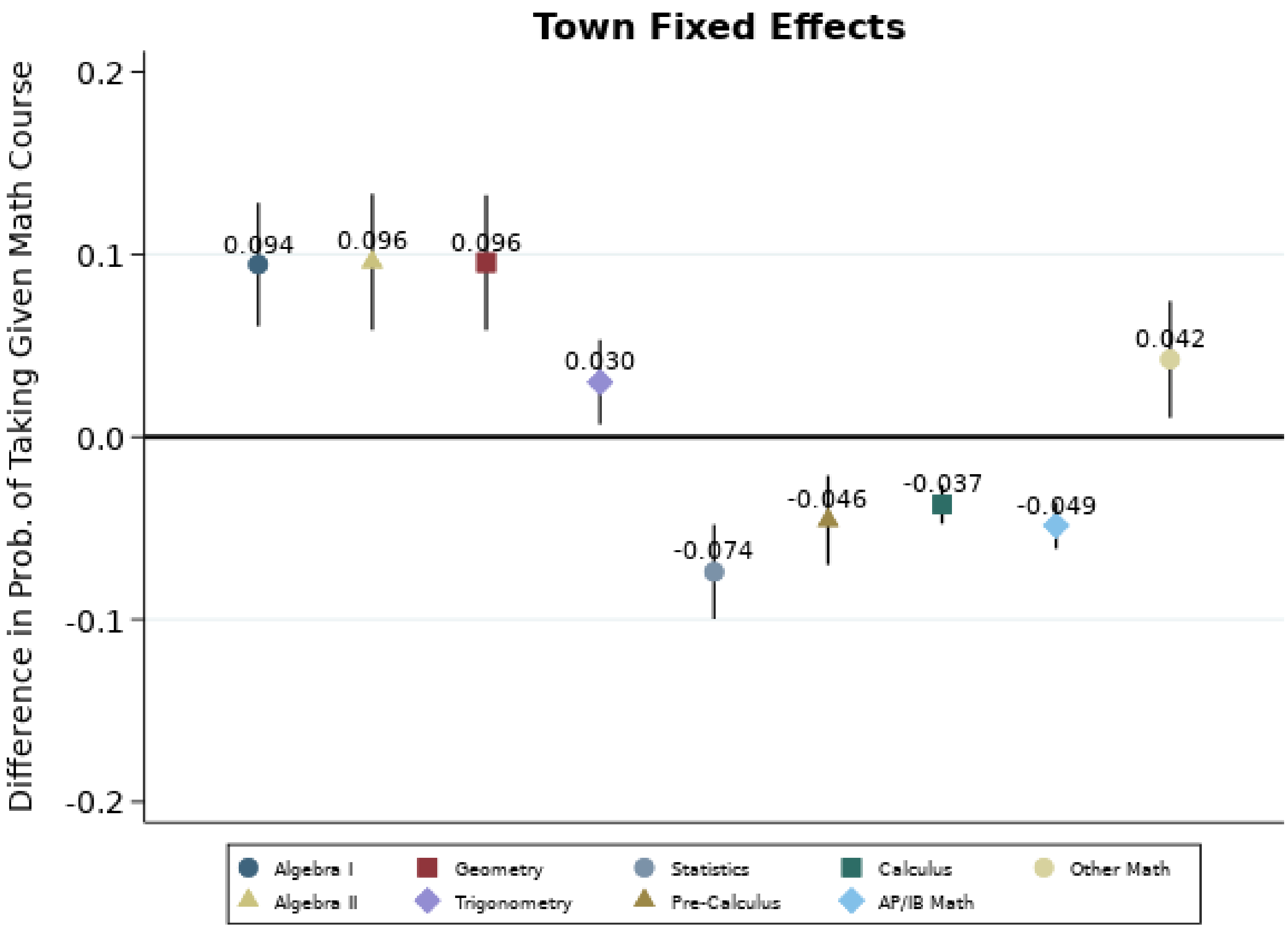
Notes: Estimates are the coefficient associated with a being a CTE Concentrator on the expected difference in the number of courses in each subject area, compared to non-CTE Concentrators who were otherwise similar on observable characteristics. CTE Concentrators are those students indicated by their school to be enrolled in CTE for two or more years. 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 English Language Arts). 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 2015 through 2018.

Figure 2.9 Differences in the # of Courses in Content Areas Predicted by An Additional CTE Course, by School Type



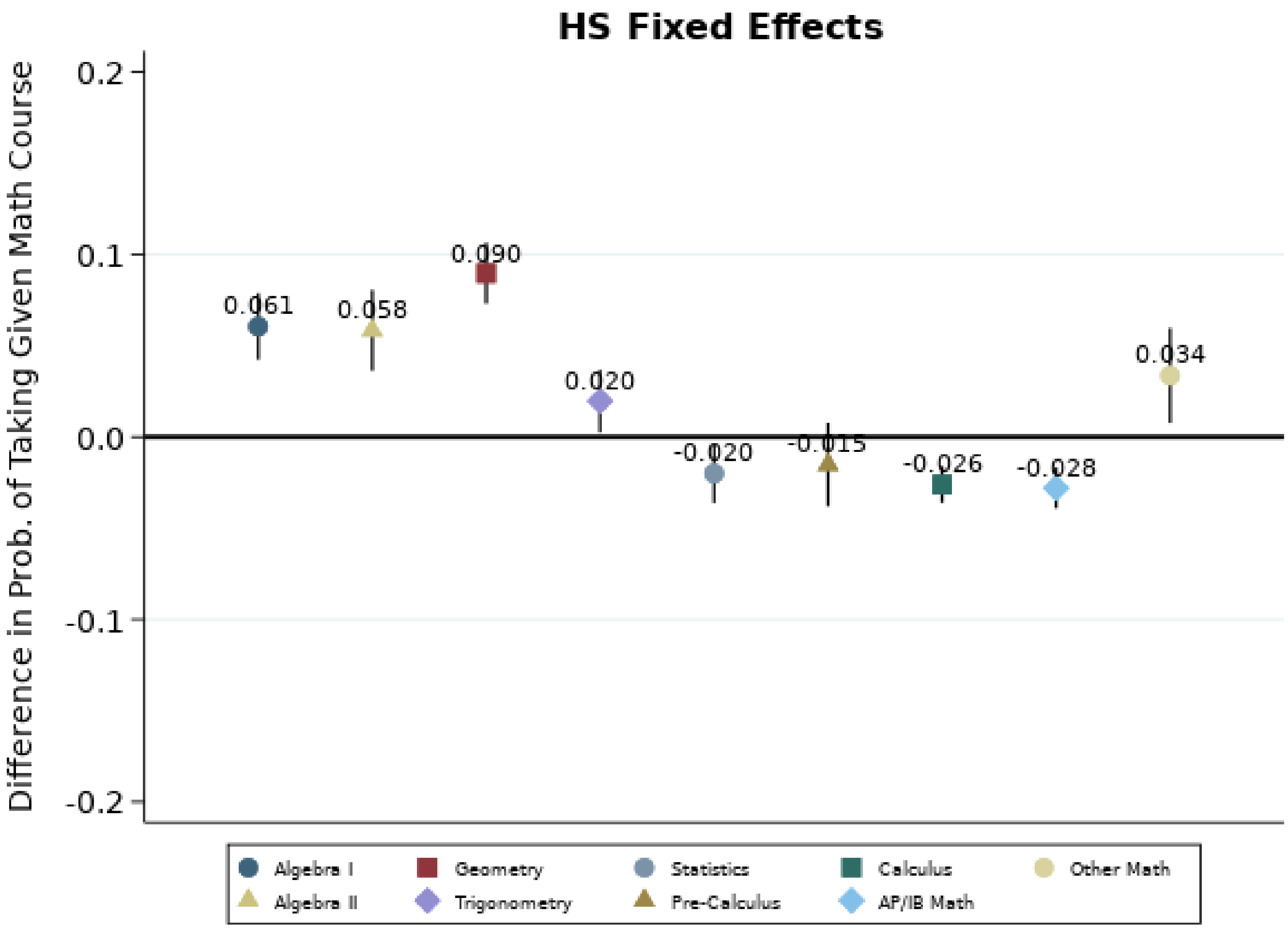
Notes: Estimates are the coefficient associated with an additional CTE course on the expected difference in the number of courses in each subject area. The top panel only includes those students enrolled in a comprehensive high school in 9th grade, and the bottom panel only includes those students in CTE-dedicated high schools in 9th grade. 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 English Language Arts). 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 2015 through 2018.

Figure 2.10 Differences in the # of Courses in Content Areas Predicted by An Additional CTE Course, by School Type



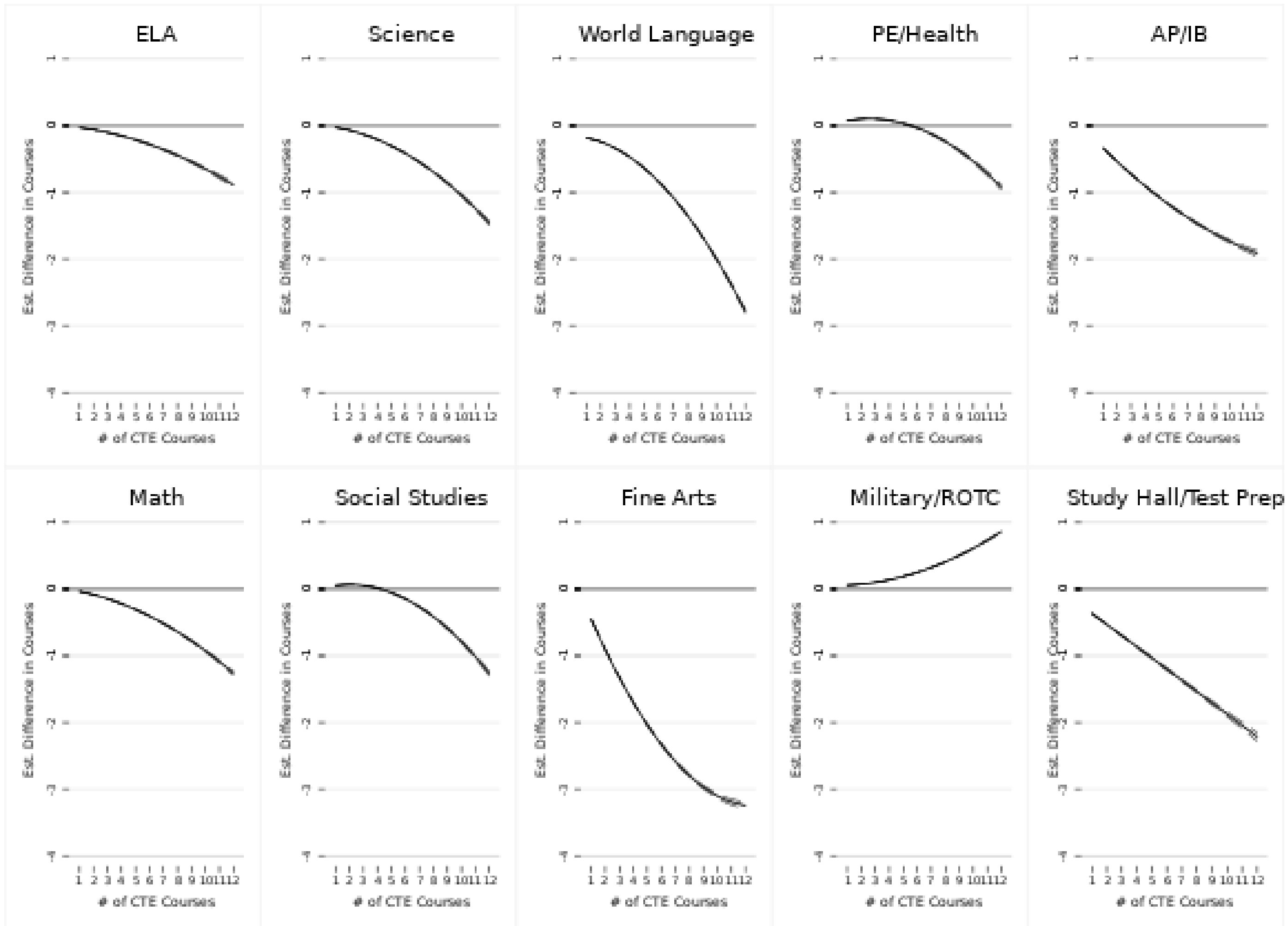
Notes: Estimates are the coefficient associated with an additional CTE course on the expected difference in the number of courses in each math course area. All models include controls for gender, race & ethnicity, lower-income status, English language learner status, immigrant status, disability status, 8th grade school attendance rates, and 8th grade performance on state assessments (both Mathematics and English Language Arts). 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 2015 through 2018.

Figure 2.11 Differences in the # of Courses in Content Areas Predicted by An Additional CTE Course, by School Type



Notes: Estimates are the coefficient associated with an additional CTE course on the expected difference in the number of courses in each math course area. 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 English Language Arts). Models also include cohort fixed effects as well as fixed effects for the high school a student attended in 9th grade, with errors clustered by high school. Analytic samples include first-time 9th graders in cohorts that would have graduated on-time from public high schools in the spring years of 2015 through 2018.

Figure 2.12 Differences in the # of Courses in Content Areas Predicted by Varying Levels of CTE Coursetaking



Notes: Lines represent the ATE(t) associated with an additional CTE course on the expected difference in the number of courses in each subject area, at a given level of treatment (number of CTE courses). 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 English Language Arts). 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 2015 through 2018. While a small number of students took more than 12 CTE courses, 12 courses represent approximately 99% of CTE course takers; for this analysis, those students taking more than 12 CTE courses were coded as taking 12 courses. Estimates are from the Stata "ctreatreg" package (Cerruli, 2015).

CHAPTER 3

Framing Public Opinion Towards Career and Technical Education

3.1 Introduction

Career and Technical Education (CTE) has long played a significant, albeit controversial, role within America's system of public education. CTE, often called Vocational Education, refers to education that is designed to provide students with the knowledge, skills and training needed for specific career paths (such as manufacturing, health sciences, construction, and information technology (IT) and typically occurs at the secondary and postsecondary levels. Debates about CTE over time have played into fundamental questions about the underlying goals of education and the role of education within American society.

While CTE fell largely out of favor among educators and policymakers in the 1990s and 2000s due to concerns that it may have limited opportunity and equity for students of color, low-income students, and those with disabilities (Bowles & Gintis, 1976; Tyack, 1974; Grubb & Lazerson, 1982; Rosenbaum, 2001, among others), it has experienced a strong resurgence in policy and political prominence in recent years (Obama, 2011; DeVos, 2018; Lee; 2018; Raimondo, 2018). The US Department of Education estimates that between 85% and 92% of students earn credit from at least one CTE course during high school (Levesque et al, 2008; Hudson, 2014), and over 98% of public high school districts offered CTE courses (Gray & Lewis, 2018).

While CTE may be reemerging in America's high schools and in policy conversations, public attitudes toward CTE remain relatively understudied. Most recent research suggest strong public support for CTE, but is mostly conducted by CTE advocacy groups (Advance CTE, 2010; Phi Delta Kappan, 2017; Cohen and Besharov, 2012; Herian, 2010). While stronger evidence of public support for CTE exists in Europe (Busemeyer et al, 2018), the history and context for CTE is quite different than in an American setting.

Within the broader education literature, evidence from experimental work suggests that public opinion on education-related issues can often be changed by providing information or framing a subject or argument in a particular way (Schueler and West, 2016; Clinton and Grissom, 2015). This suggests that education policies – such as CTE – that have not been particularly salient in public opinion may be especially ripe for framing by policy entrepreneurs – both those supportive and opposed to the growth of CTE.

3.2 Theoretical Framework

In considering the various ways in which CTE might be framed in the public discourse, I draw upon a long history of debate over nature of public education and CTE specifically, as well as contemporary arguments by those arguing for and against the expansion of CTE coursework. I focus specifically on two value-based frames in which CTE can be discussed, inequality and individualism, two economic-based frames, workforce alignment and narrow preparation, and one frame that overlays both value-based and economic-based arguments in which CTE is explicitly pitted against college access. While these five frames (see Figure 1) may often intersect and are not meant to be exhaustive of the ways in which CTE could be discussed and debated, the following provides a history and theoretical framework for why these frames are particularly relevant in the current policy landscape.

Since universal schooling efforts began, American public education has grappled with several tensions over the desired goals and purpose of education. One of the most distinctive forms of American schooling has been a long-stated goal of equity – as early as 1848, the founder of America's common school movement, Horace Mann, referred to education as a "Great Equalizer." Indeed, the American push towards universal public high school education was a revolutionary push for egalitarianism when compared to the historical norm that secondary education was solely the purview of the elite. In short, inequality and the role of schools in either combatting or perpetuating inequality has long played a central role in debates around education in the U.S.

In the 1970s and 1980s, CTE, historically referred to as vocational education, became an especially prominent part of the national conversation about inequality in schools. With court-ordered school desegregation, vocational education was often used as a way to keep racial minorities separated from their white peers through vocational 'tracks.' (Anderson, 1982; Oakes, 1983). These vocational programs were often low-quality and limited students from access to more rigorous courses that would prepare them for high-status, high earning career paths. Because of this, vocational education and tracking became linked with inequality of educational opportunities in the minds of many in the education community, and was particularly linked to inequal opportunities for racially minoritized students and those with disabilities.

Following concerns about vocational education's role in inequitable tracking, the 1990s and early 2000s saw several important policy and cultural changes that centered the role of college preparatory academics and college access in the role and mission of high schools. These changes increased the salience of a frame that vocational education limited access to college. During this period, the United States saw a dramatic rise in rates of college-going, with students who did not have access to a college-preparatory education increasingly left behind in a growing economy (Bowen and Bok, 1998). The rise of standards-based education and an accountability movement that centered the primacy of academic subjects such as English language arts and math also made vocational courses materially less important to policymakers and school leaders concerned about the measures against which they were held accountable. Many states during this period also aligned high school graduation requirements with college entry requirements, Increasingly, as high schools moved towards a "College for All" framework (Rosenbaum, 2001; Grubb & Lazerson, 2005; Hudson, 2014; Dougherty & Lombardi, 2016), vocationally education fell out of favor as it was increasingly pitted against college.

While reducing inequality has always played a prominent role in debates about the role of education in the United States, a counter-argument has also long existed that public schools' primary goal should be to prepare students for the workforce, or to "act as a transmitter between human supply and industrial demand" (Meyer, 1915). Given the broad range of occupations within the workforce, this approach to education required that different students would need substantially different educational preparation. Many scholars pointed to the "sorting function" of schools, in which schools sort students based on skill into different "tracks" where they could (at least in theory) receive the most appropriate training for the jobs they were best-suited to pursue (Bowles & Gintis, 1976; Tyack, 1974; Grubb & Lazerson, 1982). Under this sorting frame, education should be expected to meet individual students where they are, with different skills, interests and future career paths. This frame for CTE can be seen from politicians like former Democratic Rhode Island governor (and current U.S. Secretary of Commerce), whose reelection campaign for governor highlighting students who got jobs after high school specifically tailored to their individual interests and goals, like one television commercial about a student who took vocational courses because he was good with his hands and wanted a job after high school to put those skills and preferences to work (Raimondo, 2018). Recent years have also seen increasing pushback against the monolithic nature of a "College for All" model, arguing that a college preparatory curriculum may not be the best fit for all students, pointing to low rates of college completion and high levels of debt among college dropouts (Rosenbaum, 2001; Stone and Aliaga, 2005; Schwartz, 2016; Holzer and Baum, 2017; Caplan, 2018). Indeed, CTE could be viewed as a way to allow for greater levels of individualism in education, to help individual students find the best fit for them.

In recent years, policy conversations around education and workforce development have been especially prominent. Many economists have noted a "Middle Skills Gap," and suggested that schools need to train more students in specific trades in jobs that are in-demand by local employers (Holzer and Baum, 2017; Caplan, 2018, etc.). Indeed, popular news outlets regularly pushback against the "College for All" model, running pieces like *The New York Times'* "College May Not Be Worth It Anymore" (Shell, 2018). As an article in *The Chronicle of Higher Education* explains, "The question 'Is college worth it?' is a favorite of op-ed writers" (Zamudio-Suarez, 2018).

Some politicians have also seized on the framing argument that high schools should focus more on workforce development (and according to some, less on universal college preparation). Republican senator Marco Rubio, for example, memorably said in a 2015 presidential debate "We need more welders and less philosophers" (Kessler et al., 2015). The argument that education should focus more explicitly on workforce readiness is not limited to Republicans, with even Democrats like former Tennessee governor expressing that one of his biggest mistakes as governor "was to start focusing on college readiness as the goal of high school. I think I took that too far and should have focused more on other paths besides college readiness in terms of making people prepared for careers in other fields that did not require that education" (Plezas, 2018). Also in Tennessee, current governor Bill Lee ran advertisements during his campaign in which he explicitly argued schools should be more directly focused on filling gaps in the local workforce, arguing that schools need to fundamentally change and offer more vocational education because "we still have a hard time filling jobs in the trades" (Lee, 2018).

While some politicians and scholars argue for more workforce development and training in schools, others have expressed concern that an education that only narrowly trains students for a specific skill set may limit opportunities down the road, particularly as technology and the economy evolve in ways that could make specific training obsolete (Hanushek et al, 2017). These concerns are particularly evident in Congress' 2018 reauthorization of the federal law funding CTE (Perkins) where "college and career readiness" was emphasized, arguing that even those students participating in CTE should also be fully prepared for college in addition to their career training (ACT, 2006; Cellini, 2006; Obama, 2011; Yettick, 2012). Alongside the shift in naming conventions from "vocational education" to "career and technical education" is an emphasis on STEM-related fields an attempt to align the types of learning needed for both college and career success. Still, while the last two decades have seen a shift in the types of programs included under the CTE umbrella, traditional vocational courses in areas like manufacturing, construction and cosmetology remain. Giving the rapidly-changing nature of work, students who are not prepared to adapt meet changing workforce demands may face difficulty later in the careers (Autor, 2019).

These debates over the role of education and the ways to best prepare students for their place in the workforce are central to the ways that public discourse considers Career and

Technical Education. Drawing on both historical and contemporary examples, Figure 1 presents an organizing framework for how we might consider the different ways in which CTE can be framed. As the above discussion illustrates, CTE can be debated either through value-based arguments (with values such as inequality and individualism proving especially salient to CTE policy) or through economic-based arguments (like those that view CTE as a way to support workforce development, or those that caution CTE might narrowly prepare students in ways that could limit future career opportunities). At the intersection of value-based and economic-based frame is a frame of CTE in opposition to college access. While value-based arguments may have been particularly salient during the 1970s and 1980s when vocational education was under attack, today's advocates (and opponents) seem to use economic-based arguments more frequently. Moreover, some research suggests that labor-market returns loom larger in the way the American public thinks about education than in the past (Herian, 2010, Phi Delta Kappan, 2017); as such, framing CTE around workforce preparation could be especially impactful.

Used by both supporters and opponents of CTE, these frames have the potential to set the tone for how the public considers and understand CTE. This study attempts to assess the effects of discussing CTE through these frames (Individualism, Inequality, Workforce Alignment, and Narrow Preparation, College Access) on parents' support for CTE. I also undertake exploratory analysis to better understand how and why different framing messages might resonate differently with different populations.

3.3 Research Questions

This study explores the extent to which different ways of framing CTE may impact public attitude towards CTE. In particular, I focus on a population which may be especially motivated to care about different models of education – parents and families[1]. Using a survey-based experiment with respondents gathered from an online marketplace, I ask three research questions:

> Research question 1.) To what extent does exposure to different framing arguments about Career and Technical Education affect parents' support for CTE?
>
> Research question 2.) Among the five frames tested, which frames most substantially move parents' support for CTE (in positive and negative directions)?

I also collect demographic and information about the respondents in order to consider who is more or less likely to express support for CTE, and also to understand whether certain frames appeal more or less to respondents with certain characteristics. For example, given the legacy of race-based tracking of students into vocational courses that limited college opportunity, I might expect that Black parents would be less supportive of CTE, especially when CTE is framed around a message of inequality or college access. Drawing on Kinder and Sanders (1996), individuals who place particular weight on equality, Democrats and more liberal parents might be especially uncomfortable with CTE when prompted to consider that CTE inherently introduces differentiation into schools. Conversely, those who believe in Individualism (along with Republicans and more conservative parents) may be especially attracted to CTE when prompting with a framing around Individualism and personal choice. Given their own demonstrated commitment to education, parents with higher levels of education might have especially negative impression of CTE when it is framed something that limits access to college.

[1] Due to data restrictions, this analysis uses survey respondents who self-identify as parents, which may not capture the full breadth of family members who make education-related decisions for their students.

Moreover, lower-income parents may be especially sensitive to economic frames, while higher-income parents may have less concerns about their students' economic security and may have more leeway to be moved by value-based arguments. Research question 3 considers the existence of these relationships, among others:

> 3.) To what extent do parents with different personal characteristics (by gender, race/ethnicity, number of children, partisanship, ideology, education, urbanicity, and income) respond heterogeneously to different frames?

For policymakers, researchers, advocates and opponents of CTE, these questions allow for a stronger understanding of what parents are looking for from CTE (e.g., what makes CTE appealing or less appealing), how does the way CTE is presented impact support, and how do these relationships differ across different populations.

3.4 Research Design and Methods

In order to test these hypotheses, I conducted a survey-based experiment using Lucid Technologies in which respondents are randomly presented with different frames for considering CTE, and then asked a series of questions about CTE. This experimental approach, where everything about respondents should be equal, on average, with the exception of the CTE frame they receive, allows for any differences in their opinions to be attribute to the frame they received.

In recent years, there has been an increase in research using online marketplaces to conduct experiments, particularly in political science. Researchers pay a small amount to subjects who participate in studies and are able to deploy experiments more quickly and at lower costs. There are a range of platforms that offer these services and have been widely used in market research and increasingly used in academic research (Coppock, 2018; Strange et al., 2019). By far the most prominent of these online marketplaces is Amazon's Mechanical Turk (MTurk) platform, where researchers post "jobs" with an expected time to complete and payment and can then be completed by MTurk participants (who can be anyone with an Amazon account and meet the eligibility criteria laid out by the researcher). MTurk has been widely used in political science, and while there are open questions about the generalizability of results from MTurk to the broader population (MTurk participants are especially young, white, and highly-educated, for example), several studies have found that studies using MTurk and similar platforms have strong internal validity. Berensky et al. (2012) and Strange et al (2019), for example, replicate several classic social science experiments and find very similar results to the original studies using traditional samples. Meta-analyses conducted by Coppock (2018) also shows strong rates of replication.

While MTurk is the most commonly used platform, this study uses Lucid, which offers several advantages over MTurk. First, Lucid allows the researcher to obtain a sample that is representative to their population of interest according to select demographic characteristics; this avoids some of the unrepresentativeness seen in MTurk samples. Second, unlike MTurk, where all participants participate only after signing up through MTurk, Lucid aggregates participants through a variety of sources (for example, respondents might come to Lucid through a retail store to earn gift cards, or a credit card company to earn reward points). In 2015, more than 30 million unique individuals participated in at least one Lucid study (Coppock & McClellan, 2019). Finally, by using Lucid, I alleviate some of the concerns researchers have raised about "professional survey respondents" on MTurk (Rand et al., 2014; Chandler et al., 2015) since participants come from multiple sources (and are often unaware they are participants in Lucid studies). Finally, in studies comparing original, traditionally-collected samples, Lucid has been found to produce samples that more closely approximate national population estimates and more closely replicate experimental results than MTurk (Coppock & McClellan, 2019).

3.4.1 Pilot Study and Subsequent Modifications

Before collecting data for this study, I first conducted a pilot study in March 2019 with 244 respondents recruited via MTurk in order to gauge feasibility and help identify sample sizes that would be needed to obtain adequate statistical power. Pilot respondents were registered with MTurk and compensated with a small monetary payment for their time and participation.

After analyzing results from the pilot, I made several changes in addition to the survey mechanism from MTurk to Lucid. First, I added an additional experimental framing treatment arm and to increase the sample size from the pilot study. Given that a chief concern about CTE is that it may limit students' access to a college preparatory curriculum, I explicitly test the power of this frame through a "College Access" frame.

Based on a Power Analyses using the PowerUp! tool (Dong & Maynard, 2013), I set a target sample size of 1890 respondents[2], with an additional 5% (95 respondents) to provide a buffer in case some respondents had to be rejected due to failed attention checks or other concerns that might merit rejection from the sample. Assuming similar distributions and effect estimates from the pilot study hold, this should allow for effects of one-fifth of a standard deviation or greater to be detectable for all three outcome variables. Assuming 1890 respondents, approximately 315 respondents were randomly assigned into each of the control

[2] During the survey administration, a greater number of respondents completed the survey before the study was closed, so the actual sample size was slightly larger.

and five treatment arms. The study sample was limited to U.S. residents over the age of 18 who are parents of students currently age 18 or under. I set initial demographic targets with Lucid that were developed to create a sample that was representative of the U.S. population in terms of gender, race, educational attainment, partisanship, and region.[3]

One surprising finding from the pilot study was that *all* of the treatments appeared to reduce support for CTE – even the frames that were designed to *increase* support. While I cannot be certain why this occurred, there may be some plausible explanations that I considered before revising to the instrument. One plausible rationale is that the final line read by the Control group in the pilot ("Many Career and Technical Education courses aim to prepare students for jobs immediately after high school, while others also prepare students for college courses or advanced training in technical fields") may have been a strong frame in its own right, limiting its effectiveness as a true control; indeed, ending with this line may have inadvertently framed CTE as a policy that prepares students for college, which could explain why the mean support was highest among those in the "Control" who read this line last. I omitted this potentially biasing sentence from the script in the final study.

A second possible concern from the pilot was that the first words in each treatment frame ("Some policymakers argue that Career and Technical Education…") may have inadvertently introduced the idea of controversy for respondents; these frames may have even prompted respondents to consider what kind of counter-arguments *other* policymakers might make. For the full study, I change the language to "Education experts say that…" By using this language, I

[3] Late in the survey administration as certain demographic quotas were met, I slightly relaxed demographic targets. For example, demographic targets for respondents who were female and those who were highly-educated were met before those who were males and less educated. To reduce concerns that the male sample population would be disproportionately less-educated, I lifted education-level quotas for males. As such, while the sample is relatively similar on key characteristics, the sample is not perfectly representative of the U.S. population; in particular, it is somewhat more-educated than the population as a whole.

give more weight to each of the frames, and avoid raising the prospect of controversy into the treatment. Moreover, this more closely mirrors the way that advocates and opponents would introduce framing arguments.

After making these changes, I conducted strength of framing testing with 14 pre-pilot respondents where I asked respondents to rate (regardless of their own agreement or disagreement) how strong the language in each frame was. Based on this testing and subsequent feedback from pilot respondents, I made slight modification to the treatment frames to improve comparability of treatment strength. I then conducted six cognitive interviews in which I asked respondents to discuss their thought process as they went through the survey, to ensure that respondents were interpreting the survey in the way I anticipated, without confusing or misleading language.

3.4.2 Survey Instrument

Respondents were recruited and compensated through Lucid clients (such as rewards point companies) for their time and participation (see an example of a recruitment message in Appendix 1). Potential respondents were required to be a U.S. resident, above 18 years of age, parent to at least one child, and agree to participate in the study. After consent, each respondent was randomly assigned via simple random sampling into either a control condition or one of five treatment conditions. All respondents then received the following brief description about CTE that was designed to be objective and value-neutral:

> “One common category of courses in high schools today is known as "Career and Technical Education." Career and Technical Education courses (including Vocational Education courses) are designed to provide students with the knowledge, skills and training needed for specific career paths (such as Manufacturing, Health Sciences, Construction, and Information Technology (IT)).

> Career and Technical Education typically has a hands-on component, as students often work with actual equipment, complete projects, and are trained by instructors with experience in the specific career."

Respondents who were assigned to a control received no further information about CTE. Respondents assigned to one of the five treatment groups then received an additional framing argument at the end of the above paragraph:

> **Individualism**: "Education experts say that Career and Technical Education can provide individual students with greater choice, as they are better able to take courses that meet their own unique needs, interests, and goals after high school."
>
> **Inequality**: "Education experts say that Career and Technical Education can create inequality in schools, as certain students may be tracked into different educational paths that set them up for different types of experiences after high school."
>
> **Workforce Alignment**: "Education experts say that Career and Technical Education can prepare students to get jobs after high school, and that it can train students to fill the types of careers that are in-demand in the workforce."
>
> **Narrow Preparation**: "Education experts say that Career and Technical Education can teach students a narrow set of technical skills that may become out-of-date or irrelevant as the economy and technology changes, which may limit students' job prospects later in life."
>
> **College Access**: "Education experts say that Career and Technical Education can take the place of some college-preparatory and academic classes for students participating in Career and Technical Education, and may make these students less likely to attend college."

Following treatment assignment, respondents were presented with three questions, each a distinct measure of support for CTE. The first question (referred to throughout this paper as "CTE Significance") asked respondents "How significant of a role should Career and Technical Education courses play in high school education?" and provided them with seven response options from "Not significant at all" to "Extremely significant." This question was designed to have the cleanest face validity, as it is a relatively straightforward expression of the extent to which respondents believe CTE should play a role in high school. The second question ("% School Hours in CTE") asks respondents to weigh trade-offs within the high school curriculum, by dividing the percent of hours "over the course of students' time in high school" across three categories – Core Academic Courses (Math, English, Science, and Social Studies), CTE Courses, and Other Electives (such as Fine Arts, World Languages, Physical Education, and ROTC). The key variable of interest used in these analyses is the percent of time respondents thought should be spent on CTE. Finally, respondents are asked a third question ("Willingness to Pay for CTE") that asks them maximum annual increase in taxes they would be willing to pay if the money was used to expand Career and Technical Education in their school district, with options in $50 increments from $0 to $300. This question asks respondents to consider the extent whether CTE is worthwhile enough that they would be willing to monetarily support its expansion, and may capture a somewhat different, more policy-focused dimension of support for CTE than the other two measures.

The three questions about CTE were the basis of the key independent variables of interest, and were followed by a set of demographic and attitudinal questions that I use to ensure balance in random assignment and to explore potential characteristics that might moderate the impact of the framing treatments or interact with treatments in different ways. Information was collected on respondents' gender, race, political party affiliation, ideology, urbanicity, education level, income, and age. Respondents were also asked to evaluate their child's performance in school relative to others.[4] Finally, respondents were asked six questions each about their attitudes towards equality and individualism, these questions from the American National

[4] If respondents had multiple children, they were asked to consider their child who most recently attended high school. If none of their children attended high school, they were instructed to consider their oldest child.

Election Studies (ANES) were used to compose a composite score for each of the two values for each respondent – allowing us to identify how strongly each respondent valued both equality and individualism (in order to consider whether the Equality and Individual frames were more impactful for respondents who scored highly in the related values). The full survey instrument can be seen in Appendix 1.

3.4.3 Sample

Data were collected over 5 days in December 2020. 2,433 respondents participated in the survey. In order to provide assurances that the respondents in the analytic sample participated with fidelity, several precautions were taken to the enhance the quality of the analytic sample. First, Lucid automatically dropped respondents who were flagged as unlikely to be legitimate participants, including participants where multiple respondents used the same internet provider (IP) address, where participants completed the survey more quickly than plausible, or where participants failed one of the two attention checks I included in the portion of the survey where participants input their responses for the main outcomes in the study, following best practices to help identify participants who might not respond to online surveys with high levels of reliability (Aronow et al. 2020; Strange et al.2019). All told, these security checks screened out 325 respondents from the initial pool, leaving an analytic sample of 1984. The remaining respondents spent an average of 6.9 minutes on the survey, just under my predicted 8 minutes, alleviating concerns that respondents may have simply clicked through without reading the survey questions.

I also included two additional attention checks later in the survey to addressing concerns about growing rates of respondent inattentiveness in online surveys (Aronow et al., 2020). I found that 95.6% answered both correctly, and only 1.3% answering both incorrectly (26 respondents). Based on analyses of the time spent, I retained responses from those who failed only one attention check, but excluded those 26 who failed both. This helps provide additional assurance that respondents included in the sample read and participated with fidelity. In addition to the analyses presented here, I also performed analyses where I excluded respondents that failed only one attention check, but this did not substantively impact the results. Moreover, the time spent on the survey was similar for those who failed 1 attention check to those who didn't, suggesting that they simply may have made an error on those questions.

Table 1 presents descriptive statistics for respondents randomized into each of the conditions (control and the five treatment groups). The sample is somewhat similar to the population as a whole. Table 1 does show that the respondents are relatively young, female, and Democratic-leaning. While this does not pose a threat to the internal validity of the study, it should be kept in mind when considering how the results may or may not generalize.

Also evident in Table 1 is that each of the treatment groups is similar on observable characteristics. I conducted t-tests to highlight where there is a statistically significant difference between a treatment arm and the control group. While there are some differences of note (some minor imbalances in gender, Latino/a identification, the number of children respondents have, and urbanicity all have some imbalances at the .05 significance level), on the whole, though, the treatment groups are relatively well balanced, lending support to the expectation that differences in outcomes across conditions should be attributable to treatment.

As an additional balance test, I fit a set of five models for each treatment status (individualism, inequality, workforce alignment, narrow preparation, and college access) to assess whether observable characteristics predict assignment to treatment:

$$(1)\ Treatment\_Assignment_i = \theta + \boldsymbol{X_i'}\boldsymbol{\gamma} + \epsilon_i$$

where $TREATMENT\_ASSIGNMENT_i$ is 1 if a respondent was assigned to the given treatment, and 0 if a respondent was assigned to the control group. $\boldsymbol{X_i'}$ is a set of covariates (respondents' gender, race/ethnicity, age, number of children, perceptions of child performance, urbanicity, education level, income, party identification, ideology, and two composite scores for individualism and equality from the ANES). Assuming that randomization worked in creating balanced samples, these covariates should not significantly predict assignment to treatment compared to the control condition. Table 2 presents these results. Only 3 factors out of 90 (18 factors across five treatment arms) predict treatment at the .05 level, which is less that would be expected by chance (Type I error). This provides additional evidence to ease serious concerns about imbalance, again lending support to the internal validity of the inferences raised from differences across treatment condition.

3.5 Results

3.5.1 Descriptive Evidence of Support for CTE

While the primary focus of this study is to consider the impact of different framing messages on support for CTE, I first present descriptive evidence about the nature of support for CTE found in this study. Given the relative dearth of evidence about public opinion of CTE, and given that the sample is somewhat representative of the population on observable characteristics, this survey provides an opportunity to learn more about general levels of support for CTE among parents and how this support might differ across different parent populations. Given the online, relatively tech-savvy nature of Lucid participants, there may be some limits in our ability to generalize these findings to a general population, but evidence that Lucid samples have a strong history of replicating findings from other studies suggest that it is still worthwhile to examine these findings, though perhaps with a degree of caution regarding generalizability.

Table 3 presents mean differences by demographics for the three measures of support for CTE. Across all demographic groups examined, respondents were quite consistent in the level of significance CTE should play in high school education. The average CTE Significance rating for all groups fell between 5 ("Moderately Significant") and 6 ("Very Significant"). Respondents in all groups averaged between 31.89 and 35.40 in terms of the percent of school hours that should be spent on CTE. While these averages are largely similar across populations, there are some differences worth noting. For example, given the historical legacy of race-based tracking, it might be notable that Black and Latino/a parents both rate CTE slightly higher in both metrics. Suburban parents rate CTE slightly lower than both Urban and Rural parents. Meanwhile, parents with higher levels of education rate CTE as more significant, but those with less education believe more hours in high school should be spent on CTE. This suggests that the CTE significance and the percent of time on CTE measures may be interpreted somewhat differently by respondents. For example, trade-offs between time spent on academic and CTE courses may be more concerning for more-educated parents, even if they abstractly value the significance of CTE. One other possibility is that the wording in the percent hours question asks respondents to explicitly consider schools "in your state", which may feel more directly related to policies affecting their own children.

Looking at the average willingness to pay across the different populations, Table 3 displays more substantial differences. Here, white and Asian parents were willing to pay the greatest increase in taxes. Comparing respondents by urbanicity, parents from urban settings willing to pay $30.34 more than those from rural settings (with suburban parents in between).

Differences are most stark when considering parents' educational attainment, with those holding advanced degrees willing to pay $86.54 more than those with a high school degree or less. While these differences in willingness to pay across educational attainment may largely reflect a greater degree of financial stability, it is worth noting that support for taxes to pay for CTE is especially strong among those with higher education. In the appendix, I graphically display all the descriptive differences that are statistically significant (all those differences mentioned here are significant at the .05 level).

Table 4 presents predictors of support for CTE from the following models:

$$(2)\ CTE\_SIGNIFICANCE_i = \theta + \boldsymbol{X_i'\gamma} + \epsilon_i$$

$$(3)\ CTE\_PCT_i = \theta + \boldsymbol{X_i'\gamma} + \epsilon_i$$

$$(4)\ CTE\_TAXES_i = \theta + \boldsymbol{X_i'\gamma} + \epsilon_i$$

In these models, support for CTE (again using the three measures from the survey, CTE_SIGNIFICANCE, CTE_PCT, and CTE_TAXES) is a function of respondents' gender, race/ethnicity, age, number of children, their perceived school performance of their children, urbanicity, level of education, and income. Again, Table 4 highlights some consistently predictive factors, while also adding evidence that the three measures may be picking up somewhat different dimensions of support. Living in an urban area positively predicts support for CTE across all measures, even when controlling for all other measures such as education and income. Similarly, living in a rural area positively predicts both CTE significance and CTE time in school, but not a greater willingness to pay increased taxes for CTE. Women say that students should spend less time in CTE than men, all else held equal, but gender does not significantly predict the other measures. Perhaps most interesting is education; having higher levels of education predicts higher reported levels of CTE significance and especially willingness to pay for CTE, but not the amount of time in school (in fact, having a bachelor's degree is a suggestively negative predictor of how much time in school should be sent on CTE). One potential explanation is that some respondents might view the first and third measures as more abstract measures of support for CTE as a policy, while the second measure might induce some respondents to consider their own children and school more closely. In other words, having an advanced degree might predict higher levels of support and willingness to pay for CTE, but might not predict how parents with higher levels of education think CTE should be administered in their children's schools.

3.5.2 Experimental Results

Figures 1, 2, and 3 show the average responses for each of the three measures of support for CTE, by treatment condition. Each bar includes a 95% confidence interval, and the scale of the y-axis represents a half standard deviation in either direction from the overall mean for that measure.

Figure 2 shows that while differences between treatment groups are mainly in the expected direction (with those receiving positive frames saying CTE is more significant than the control group, and those receiving negative frames saying CTE is less significant than the control group), none of these differences are statistically significant, even at the .10 level. One curious finding is that those receiving a frame that CTE might reduce college access for some groups actually rated CTE the *most* significant of any group, although again, this difference was not significant.

Figure 3, examining the percent of hours students should spend in CTE, illustrates similar findings as Figure 2, with small differences in the expected direction, but no significant differences. Interestingly, with this potentially more proximal measure, the College Access Frame no longer shows the highest support, as in the potentially more abstract measure in Figure 2.

Figure 4 presents differences in willingness to pay taxes for CTE by treatment group, and shows quite different results from Figures 2 & 3. Here, respondents assigned to the "Workforce Alignment" treatment are willing to pay \$16.40 more than the control group, with all other treatment groups essentially the same as the control. Simple t-test differences of means suggest that the different is suggestively significant at the .10 level.

The results I present in Table 5 largely reinforce the simple mean differences from Table 4, but apply a regression-based framework:

$$(5)\ CTE\_Signif_i = \beta_0 + \beta_1 Individualism_i + \beta_2 Inequality_i + \beta_3 Workforce_i + \beta_4 NarrowPrep_i + \beta_5 College + \epsilon_i$$

$$(6)\ CTE\_PctHours_i = \beta_0 + \beta_1 Individualism_i + \beta_2 Inequality_i + \beta_3 Workforce_i + \beta_4 NarrowPrep_i + \beta_5 College + \epsilon_i$$

$$(7)\ CTE\_Taxes_i = \beta_0 + \beta_1 Individualism_i + \beta_2 Inequality_i + \beta_3 Workforce_i + \beta_4 NarrowPrep_i + \beta_5 College + \epsilon_i$$

For each model, support for CTE (for each of the three measures) is a function of a set of indicators for treatment that are equal to 1 if respondent *i* was selected for that treatment and 0 if they were not. β_0 represents the average support for CTE among respondents assigned to the control group, and ϵ_i represents residual error. In these models, $\beta_1 - \beta_5$ are the coefficients of interest and represent the effect of being assigned to each treatment group. Columns I-III display the results from these models. Given the minor imbalance in observable characteristics seen in Tables 1 and 2, I also fit models identical to models 5-7 except with the addition of a vector $\boldsymbol{X_i'\gamma}$ of observed covariates (gender, race/ethnicity, age, number of children, their perceived school performance of their children, urbanicity, level of education, and income) as controls. While balance checks in Table 1 and 2 suggest strong covariate balance from randomization, these models serve as an additional check of the robustness of the findings to any potential concerns of imbalance among treatment groups. These estimates from these models are displayed in columns IV-VI. While there are small differences across the two sets of estimates, results from columns I-III and IV-VI are very similar, as expected.

Table 5 again finds the strongest evidence of a treatment effect when considering the impact of workforce alignment frame on respondents' willingness to pay, with respondents receiving this frame expected to pay $14.93-$16.41 more than those in the control (both significant at the .05 level). When controlling for other covariates, Table 5 also shows suggestive evidence that the individualism frame might have increased the percent of time respondents believed should be spent on CTE.

Finally, Table 6 presents results from exploratory moderator analysis meant to help uncover potential personal characteristics that may make respondents more inclined to react - either positively or negatively to a given frame. For this analysis, I leverage all the data collected in the survey instrument, all of which were characteristics I collected because history or theory suggested the characteristics may provide relevant information about how a parent might consider CTE or engage in distinct ways to the different frames. For example, I might expect that respondents scoring highly on the composite score for inequality might be even more likely to lose support for CTE when provided with an argument that CTE could exacerbate inequality. Similarly, parents from racially minoritized backgrounds who have been subject to race-based tracking might also be especially sensitive to frames about inequality or limits to college access.

I fit a series of models similar to models 5-7 in which the three measures of CTE support are a function of a given personal characteristic **X** of respondent *i*, a series of treatment indicators equal to 1 if a respondent was assigned that treatment and 0 if not, and the interaction between the personal characteristic and treatment indicator. In order to consider the possibility that a given treatment was differentially impactful for respondents with a given characteristic, the coefficient of interest is attached to the interaction term. I fit these models for all characteristics listed in Table 2, though I only show those what statistical significance of at least p<.10 in Table 6.

The results in Table 6, while exploratory in nature, raise several interesting suggestive findings worth highlighting, with interaction terms in bold. For example, looking first at Panel A, we see that while Republican parents say CTE is more significant when it is framed as a policy that may limit college access. In fact, this is the only frame that significantly interacts with Republican status; this may be especially noteworthy given some of the previously discussed Republican politicians' messaging that explicitly pits CTE as an alternative to college. Moreover, the seeming success of an anti-college frame among Republicans may speak to increasingly negative attitudes towards higher education among the Republicans (Pew, 2017). Conversely, the college access frame was received especially negatively by Democrats (Panel C). Interestingly, in both of these cases, the interaction between these frames and partisan identification was only significant for the most symbolic of the measures, with no significant evidence of differential impact on the more tangible measures of how to allocate time in school and how much to pay in taxes.

Panels D-G highlight the frames that interacted in significant ways with parents' educational attainment. Perhaps indicating a population likely to be especially sensitive to labor market trends, those with only some college education were especially positively inclined when CTE was presented as something that could prepare students for in-demand jobs; meanwhile, those with advanced degrees responded especially negatively to this frame, perhaps indicating that parents with different levels of education may be looking for something different from high schools. Similarly, those with advanced degrees responded especially negatively when CTE was presented as something that could limit college access; this negative interaction was especially stark in the percent of hours highly-educated parents felt should be spent on CTE in schools in their state. However, this negative interaction (also seen among high income parents in Panel J) did not occur with the willingness to pay measure, adding to the suggestive evidence about how highly-educated may consider CTE differently when thinking about it as fiscal policy, rather than something happening in schools. Together with the findings by partisanship, these findings suggest that Democrats, those with advanced degrees, and higher income parents might especially susceptible to critiques about CTE when CTE is framed around workforce development and/or in explicit opposition to college, while a college-based frame may be less resonant for Republicans, lower-income, and less-educated parents.

Panels K and L highlight interesting differences in how men and women responded to different frames. Though Table 3 shows that men were descriptively willing to pay more in taxes, this gap is tightened substantially by three frames, in particular the two value-based frames and the frame warning about long-term concerns from narrow preparation and skill development in CTE. I also find notable difference by race in Panels M and N. For example, white parents respond less favorably to framing CTE around individualism, concerns about inequality, or narrow preparation than non-white parents. Perhaps counterintuitively given concerns about negative tracking, Latino/a actually respond especially favorably to a frame that says CTE will lead to different opportunities for different students. The individualism frame was received especially positively by parents who identified with multiple races or self-identified another race. Also notable is that Black respondents did not interact significantly differently to any of the respondents; given a legacy of tracking and racial inequities, one might except that inequality or college access frames might be particularly powerful for Black parents; however, I find no evidence to support that hypothesis.

Finally, Panels Q through T assess the degree to which respondents with certain values were differentially impacted by these frames. Panels Q and R illustrate that those who highly value individualism are especially favorable to CTE when it is presented through a workforce alignment frame. The frame explicitly focused on individualism did not see any significantly different response from this group, however. Panels S and T, meanwhile, highlight that the extent to which respondents value equality seems to be a strong predictor of how parents responded to several of the frames, including the inequality frame.

3.6 Discussion

Overall, this experiment provides initial evidence that the way that CTE is framed can play a role in impacting public attitudes, including about their willingness to pay additional taxes towards CTE. Of all the framing messages tested, only the frame focused on Workforce Alignment showed a significant impact, and even then, only in connection to respondents' willingness to pay higher taxes. It is notable that support for taxes encountered the most support when CTE was framed as explicitly linked to jobs and workforce development in the local area. This frame presented CTE as an economic policy lever, rather than just an educational one. However, this workforce development frame did not result in increased support for the other two measures in which support for CTE was placed more explicitly within the confines of school policy. This finding could have several implications. First, supporters of CTE might expect to find policy success when connecting CTE to workforce outcomes and to labor market needs in local communities. This seems to align with the messaging campaigns of many politicians of both parties in recent years (Raimondo, 2018; Lee, 2018, among others). Second, detractors of CTE have sometimes argued that people who support CTE often do so when framed as a broader societal policy, but are less likely to support CTE for their own children. This finding suggests that there may be some truth to that, at least when CTE is framed as a workforce development program meant to connect students to jobs.

Although most treatment effects were not significant, there is still something to be learned from the results related to the other frames. Compared to the Workforce Alignment frame, it is worth noting that the more value-based frames (around Inequality and Individualism) were less effective in moving support for CTE. There was some suggestive evidence that the Individualism frame may have modestly increased the percent of school hours parents wanted to spend on CTE, but all told, there was little evidence that these value-based frames impacted support. Similarly, the "Narrow Preparation" frame showed no signs that the argument that skills becoming obsolete were especially resonate.

Finally, perhaps the most commonly raised critique of CTE has long been that it can limit access to college preparatory classes and impede access to college. It comes as somewhat of a surprise then that this frame showed no sign of any impact. Setting aside questions of statistical significance, even directional results did not point to the frame leading to a decline in support. In fact, respondents receiving this frame actually gave CTE the *highest* significance rating (though, again, this difference was not significant). For detractors of CTE, this finding (combined with the lack of negative movement from the Inequality frame) might raise questions about whether arguments about CTE promoting inequity and unequal access to college preparation have the greatest potential for turning parents against CTE.

There could be several potential reasons that these frames were less impactful than anticipated. One is that the argument that CTE is in opposition to equality and college-going could already be baked in, to a certain extent. Parents may already be familiar with the idea of school-based tracking and exposure to different pathways (both from their own experiences in school and from their children's experiences), and so this frame may not provide a new argument that re-shapes their thinking about CTE. However, if this is the case, it suggests that parents, on the whole, accept some degree of sorting and unequal access to college preparation in high school, given the high overall levels of support for CTE found in this study. Another possible reason that the College Access frame and Inequality frame did not negatively impact support could be that some parents may actually view a degree of inequality and different levels of college preparation as a positive. This could be for many reasons, ranging from experiences with different children having different needs (indeed, those with more children *do* appear more supportive of CTE), to more pernicious motivations, like a desire to keep students separated by race or disability status. While inequality may have a very specific and negative connotation among many especially in the research and education communities, it may be that parents are more comfortable with some degree of differentiation in students' curriculum, though this is worth more exploration.

Moreover, additional exploratory moderator analyses showed that certain framing messages were particularly impactful for certain populations of parents. One particularly interesting finding was that Democrats and those with advanced degrees responded especially negatively to the frame about CTE as an obstacle to college access. While Democrats and those with higher levels of education were generally quite supportive of CTE, the College Access frame was especially likely to give them pause. Although this frame did not negatively impact support for the full sample, it did among Democrats and those with education, making the College Access frame a potentially powerful message among certain populations likely to be highly-engaged in Democratic politics and policy debates.

Finally, while the primary purpose of this study was to test the impact of different framing messages, the descriptive findings are still somewhat surprising. Given the historic legacy of negative race-based tracking and CTE, it might be surprising to see such strong support for CTE among racially minoritized, particularly Black, parents, with levels of support similar to that among white parents. Similarly, support for CTE is especially high in both urban and rural settings, with lower levels of support among suburban parents. I do find some descriptive evidence to support the hypothesis that higher-income and more educated parents might support CTE as a general policy, but might be less likely to support CTE at their own students' schools. In other words, the descriptive findings in this study do not contradict the notion that some highly-educated parents might support CTE "for other people's kids." However, this pattern appears to be largely concentrated among the most highly-educated parents, and should not be interpreted to mean that *all* parents exhibit support for CTE, but not at their own children's' school.

While more investigation needs to be done, this study does provide early suggestive evidence that economic frames appear to impact public attitudes about CTE more than value-based frames. This would be especially useful to advocates and opponents of CTE as they craft their policy narratives and messaging campaigns, as well as policymakers engaging with the topic. Furthermore, qualitative research would help uncover nuance and complexity in how and why various frames make people think differently about CTE.

More broadly, this research speaks to ongoing debates about the role of education within American society, and the sometimes-conflicting forces of equity in a capitalist and increasingly diversified economy. As Career and Technical Education rises in prominence within contemporary education policy agendas, the ensuing debates ultimately have wide-reaching implications for the ways we prepare young adults for adulthood, and will shed a light on the values and principles that we employ to mold the future of our workforce and society.

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3.7 Tables and Figures

Table 3.1 Descriptive Statistics by Treatment Status and Balance Check

	Control	Individualism Frame	Inequality Frame	Workforce Alignment Frame	Narrow Preparation Frame	College Access Frame
Woman	0.589	0.600	0.509*	0.510*	0.545	0.552
White	0.667	0.710	0.729+	0.706	0.706	0.688
Black	0.145	0.136	0.123	0.144	0.153	0.155
Latino/a	0.109	0.094	0.082	0.073	0.059*	0.109
Asian	0.050	0.027	0.022+	0.032	0.028	0.024
Other and Multiple Races	0.029	0.030	0.044	0.045	0.054	0.024
Age	38.065	39.308+	38.360	37.805	38.116	38.542
Number of Children	3.124	3.299+	3.338*	3.230	3.274	3.373**
Child Performance (5-pt scale)	3.725	3.737	3.791	3.747	3.831	3.761
Urban	0.327	0.335	0.290	0.335	0.263+	0.376
Suburban	0.383	0.384	0.397	0.444	0.441	0.397
Rural	0.289	0.281	0.312	0.220*	0.297	0.227+
HS Grad or Less	0.307	0.296	0.322	0.278	0.291	0.285
Some College	0.363	0.405	0.341	0.403	0.367	0.364
Bachelor's Degree	0.171	0.175	0.196	0.173	0.209	0.218
Advanced Degree	0.159	0.124	0.142	0.147	0.133	0.133
Income	6.201	5.915	6.404	6.444	6.144	6.373
Partisan ID (Strong D=7)	4.230	4.204	3.990	4.328	4.140	4.182
Ideology (Extremely Conservative=7)	4.044	3.891	4.151	3.933	4.068	4.064
Individualism Score (5-pt scale)	3.281	3.188	3.394+	3.331	3.270	3.339
Equality Score (5-pt scale)	3.253	3.324	3.291	3.253	3.227	3.233
Observations	339	331	317	313	354	330

Notes: Each column shows descriptive means of select characteristics for the samples assigned to each treatment group. Stars indicate significant differences from the control group from a two-sided t-test: + p<.1, * p<.05, ** p<.01, *** p<.001.

Table 3.2 Predicting Treatment Status with other Surveyed Characteristics (Balance Check)

	Individualism Frame	Inequality Frame	Workforce Alignment Frame	Narrow Preparation Frame	College Access Frame
Women	0.001	-0.092*	-0.083+	-0.059	-0.021
	(0.03)	*(-2.14)*	*(-1.92)*	*(-1.39)*	*(-0.47)*
Black	-0.062	-0.072	-0.055	0.004	-0.026
	(-0.97)	*(-1.10)*	*(-0.87)*	*(0.07)*	*(-0.43)*
Latino/a	-0.061	-0.061	-0.132+	-0.141+	-0.021
	(-0.90)	*(-0.88)*	*(-1.83)*	*(-1.95)*	*(-0.32)*
Asian	-0.177+	-0.207+	-0.139	-0.160	-0.201+
	(-1.71)	*(-1.95)*	*(-1.36)*	*(-1.59)*	*(-1.92)*
Other and Multiple Races	-0.056	0.091	0.078	0.141	-0.071
	(-0.48)	*(0.86)*	*(0.72)*	*(1.44)*	*(-0.58)*
Age	0.004+	-0.000	-0.002	-0.001	0.001
	(1.67)	*(-0.19)*	*(-0.88)*	*(-0.58)*	*(0.52)*
Number of Children	0.033+	0.034+	0.020	0.028+	0.044**
	(1.92)	*(1.91)*	*(1.21)*	*(1.72)*	*(2.63)*
Child Performance (5-pt scale)	0.012	0.012	0.001	0.035	0.000
	(0.54)	*(0.55)*	*(0.04)*	*(1.63)*	*(0.01)*
Urban	0.027	-0.031	-0.032	-0.100*	0.032
	(0.55)	*(-0.63)*	*(-0.66)*	*(-2.08)*	*(0.68)*
Rural	-0.029	-0.004	-0.102+	-0.046	-0.082
	(-0.57)	*(-0.07)*	*(-1.95)*	*(-0.94)*	*(-1.59)*
Some College	0.039	-0.038	0.035	0.026	0.005
	(0.80)	*(-0.77)*	*(0.70)*	*(0.52)*	*(0.09)*
Bachelor's Degree	0.067	0.004	-0.006	0.088	0.060
	(0.97)	*(0.06)*	*(-0.09)*	*(1.36)*	*(0.93)*
Advanced Degree	-0.028	-0.063	-0.056	0.009	-0.067
	(-0.37)	*(-0.81)*	*(-0.72)*	*(0.12)*	*(-0.86)*
Income (12-pt scale)	-0.008	0.004	0.003	-0.008	0.001
	(-1.05)	*(0.46)*	*(0.36)*	*(-0.99)*	*(0.14)*
Party ID (Strong D=7)	-0.011	-0.009	0.003	-0.000	0.000
	(-0.95)	*(-0.76)*	*(0.30)*	*(-0.03)*	*(0.01)*
Conservatism (7-pt scale)	-0.017	-0.001	-0.012	-0.006	-0.003
	(-1.19)	*(-0.08)*	*(-0.87)*	*(-0.42)*	*(-0.22)*
Individualism Score (5-pt scale)	-0.033	0.041	0.023	-0.005	0.019
	(-1.18)	*(1.49)*	*(0.81)*	*(-0.21)*	*(0.66)*
Equality Score (5-pt scale)	0.017	0.054+	-0.005	-0.021	-0.001
	(0.53)	*(1.76)*	*(-0.14)*	*(-0.69)*	*(-0.02)*
Constant	0.403+	0.152	0.552*	0.550*	0.285
	(1.75)	*(0.68)*	*(2.44)*	*(2.58)*	*(1.28)*
Observations	670	656	652	693	669

Notes: Each column represents the coefficients and standard errors of OLS regression with the specified treatment status as the dependent variable. For each, the control condition is the comparison group. Stars indicate that a characteristic significantly predicts treatment status: + p<.1, * p<.05, ** p<.01, *** p<.001.

Table 3.3 Average Support by Demographic Group

	CTE Significance	CTE % School Hours	CTE Willingness to Pay
Overall	**5.59**	**33.88**	**90.10**
Female	5.58	33.56	79.12
Male	5.61	34.27	103.83
White	5.59	33.81	93.17
Black	5.64	34.16	82.86
Latino/a	5.64	34.62	84.77
Asian	5.49	31.89	93.44
Multiple/Other Races	5.40	33.89	71.33
Urban	5.71	34.84	107.15
Suburban	5.47	32.12	85.54
Rural	5.64	35.40	76.81
HS Degree or Less	5.46	34.67	63.10
Some College	5.60	34.65	79.02
Bachelor's Degree	5.63	31.96	110.19
Advanced Degree	5.81	32.79	149.64
Low-Income	5.49	34.50	65.53
Middle-Income	5.62	34.26	90.59
High-Income	5.73	32.02	134.82
Democrats	5.64	33.95	100.00
Independents	5.56	33.87	83.96
Republicans	5.56	33.83	82.65
Liberals	5.66	33.57	110.35
Moderates	5.50	33.63	80.14
Conservatives	5.66	34.56	85.98
Observations	1984	1984	1984

Notes: Each column shows descriptive mean support for CTE using the three measures of support for CTE, by respondent characteristics.

Table 3.4 Predicting Support for CTE by Respondent Characteristics (Regardless of Treatment)

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE ($)
Women	0.048	-1.682*	-5.474
	(0.062)	*(0.691)*	*(4.060)*
Black	0.103	-0.114	1.344
	(0.086)	*(0.953)*	*(5.605)*
Latino/a	0.090	0.212	-0.366
	(0.103)	*(1.147)*	*(6.743)*
Asian	-0.080	-0.445	-7.424
	(0.167)	*(1.851)*	*(10.882)*
Other and Multiple Races	-0.178	-0.188	-12.668
	(0.151)	*(1.678)*	*(9.868)*
Age	-0.004	-0.136***	-1.069***
	(0.003)	*(0.037)*	*(0.217)*
Number of Children	0.010	-0.164	-0.074
	(0.024)	*(0.262)*	*(1.538)*
Child Performance (5-pt scale)	0.049	-0.205	1.457
	(0.031)	*(0.341)*	*(2.003)*
Urban	0.201**	2.410**	14.798**
	(0.069)	*(0.765)*	*(4.495)*
Rural	0.223**	3.003***	5.683
	(0.073)	*(0.807)*	*(4.747)*
Some College	0.138^{+}	0.482	12.288**
	(0.071)	*(0.794)*	*(4.667)*
Bachelor’s Degree	0.140	-1.985^{+}	28.800***
	(0.096)	*(1.065)*	*(6.264)*
Advanced Degree	0.267*	-1.566	57.456***
	(0.113)	*(1.259)*	*(7.402)*
Income (12-pt scale)	0.019^{+}	-0.000	4.686***
	(0.011)	*(0.122)*	*(0.716)*
Constant	5.156***	40.182***	77.140***
	(0.203)	*(2.251)*	*(13.237)*
Observations	1984	1984	1984

Notes: Each column represents the coefficients and standard errors associated with each respondent characteristic, from being Ordinary Least Squares regression, in which each of the specified outcomes of interest (CTE Significance Rating (1-7), % of School Hours that should be CTE-focused, and Support for Proposal to increase CTE spending (1-7)) is the outcome. These models include all respondents, without regard to treatment status. Stars indicate that a characteristic significantly predicts support for the given CTE support measure, all else equal: + p<.1, * p<.05, ** p<.01, *** p<.001.

Table 3.5 Ordinary Least Squares Results from Framing Treatments for Measures of CTE Support

	Models with No Controls			Models with Controls		
	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE ($)	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE ($)
Individualism Frame	0.050	1.712	-0.443	0.065	1.917^{+}	2.810
	(0.098)	*(1.089)*	*(6.832)*	*(0.098)*	*(1.086)*	*(6.302)*
Inequality Frame	-0.101	-0.081	2.473	-0.106	-0.034	1.635
	(0.099)	*(1.101)*	*(6.908)*	*(0.099)*	*(1.100)*	*(6.382)*
Workforce Alignment Frame	0.026	1.468	16.407*	0.041	1.522	14.932*
	(0.099)	*(1.104)*	*(6.931)*	*(0.099)*	*(1.102)*	*(6.395)*
Narrow Preparation Frame	-0.022	-0.468	-2.171	0.000	-0.314	-0.122
	(0.096)	*(1.071)*	*(6.719)*	*(0.096)*	*(1.071)*	*(6.214)*
College Access Frame	0.077	-0.041	-1.997	0.074	0.131	-2.871
	(0.098)	*(1.090)*	*(6.837)*	*(0.098)*	*(1.087)*	*(6.308)*
Constant	5.587***	33.469***	87.906***	4.381***	40.773***	19.107
	(0.069)	*(0.765)*	*(4.802)*	*(0.325)*	*(3.623)*	*(21.028)*
Controls				X	X	X
Observations	1984	1984	1984	1984	1984	1984

Notes: Each column represents the coefficients and standard errors associated with assignment to each treatment, where the control group is omitted. In columns 1-3, no controls are included, meaning the constant can be interpreted as the mean for the control group, with coefficients on the other treatment arms showing deviations from the control group mean. Each column represents a different measure of CTE support: CTE Significance Rating (1-7), % of School Hours that should be CTE-focused, and Support for Proposal to increase CTE spending (1-7). Columns 4-6 include all characteristic listed in Table 2 as controls. Stars indicate significance associated with the treatment assignment, compared to the control group: + p<.1, * p<.05, ** p<.01, *** p<.001.

Table 3.6 Moderator Analysis:
Exploring Statistically Significant Interactions between Respondent Characteristics and Treatment Status
(only significant coefficients on interactions and their associated treatments shown)

a. Republicans

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Republicans	-0.215		
College Access Frame	-0.105		
College Access Frame X Republicans	**0.443****		
Constant	5.678***		
Observations	1582		

b. Political Independents (No Partisan Lean)

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Independent		2.579	
Workforce Alignment Frame		2.629*	
Workforce Align. Frame X Independent		**-5.585**+	
Constant		32.911***	
Observations		1984	

c. Democrats

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Democrats	0.215		
College Access Frame	0.338*		
College Access Frame X Democrats	**-0.443***		
Constant	5.462***		
Observations	1582		

d. HS Graduate or Less

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
HS Grad or Less	-0.347*		
Narrow Preparation Frame	-0.172		
Narrow Prep. Frame X HS Grad/Less	**0.495***		
Constant	5.694***		
Observations	1984		

e. Some College

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Some College	-0.079	-0.468	-23.126*
Workforce Alignment Frame	-0.145		3.704
Workforce Align. Frame X Some College	**0.434***		**33.840***
College Access Frame		-1.496	
College Access Frame X Some College		**4.003^{+}**	
Constant	5.616***	33.639***	96.296***
Observations	1984	1984	1984

f. Bachelor's Degree

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Bachelor's Degree		0.079	
Narrow Preparation Frame		0.559	
Narrow Prep. Frame X Bach. Degree		**-4.927^{+}**	
Constant		33.456***	
Observations		1984	

g. Advanced Degree

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Advanced Degree	0.601**	1.336	88.177***
Individualism Frame	0.136		
Individ. Frame X Adv. Degree	**-0.522^{+}**		
Workforce Alignment Frame	0.108	2.292^{+}	22.208**
Workforce Align. Frame X Adv. Degree	**-0.505^{+}**	**-5.493^{+}**	**-32.071^{+}**
College Access Frame	0.163	0.864	
College Access Frame X Adv. Degree	**-0.528^{+}**	**-6.525***	
Constant	5.491***	33.256***	73.860***
Observations	1984	1984	1984

h. Low Income

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Low Income			-53.710^{***}
Narrow Preparation Frame			-13.213
Narrow Prep. Frame X Low Income			**32.316***
Constant			107.710^{***}
Observations			1984

i. Middle Income

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Middle Income			11.619
Narrow Preparation Frame			10.085
Narrow Prep. Frame X Middle Income			**-30.921***
Constant			82.902^{***}
Observations			1984

j. High Income

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
High Income		0.457	
Workforce Alignment Frame		2.667^{*}	
Workforce Align. Frame X High Income		**-5.715***	
College Access Frame		0.992	
College Access Frame X High Income		**-4.443**$^{+}$	
Constant		33.379^{***}	
Observations		1984	

k. Women

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Woman		-2.586^{+}	-40.873***
Individualism Frame			-14.503
Individualism Frame X Woman			**23.702^{+}**
Inequality Frame		-2.530	-16.424
Inequality Frame X Woman		**4.521***	**30.781***
Narrow Preparation Frame			-16.889^{+}
Narrow Prep. Frame X Woman			**23.252^{+}**
Constant		34.942***	112.230***
Observations		1984	1984

l. Men

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Man		2.586^{+}	40.873***
Individualism Frame			9.199
Individualism Frame X Man			**-23.702^{+}**
Inequality Frame		1.991	14.358
Inequality Frame X Man		**-4.521***	**-30.781***
Narrow Preparation Frame			6.363
Narrow Prep. Frame X Man			**-23.252^{+}**
Constant		32.357***	71.357***
Observations		1984	1984

m. White

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
White	0.217		
Individualism Frame	0.401*		
Individualism Frame X White	**-0.507***		
Inequality Frame	0.313^{+}		
Inequality Frame X White	**-0.587****		
Narrow Preparation Frame	0.269		
Narrow Prep. Frame X White	**-0.424***		
Constant	5.442***		
Observations	1984		

n. Latino/a

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Latino/a	-0.143	-12.211	
Inequality Frame	-0.177^{+}		-1.781
Inequality Frame X Latino/a	**0.871***		**47.831***
Constant	5.603***		89.238***
Observations	1984		1984

o. Other and Multiple Races

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Other and Multiple Races	-0.811*		
Individualism Frame	0.009		
Individid. Frame X Other/Mult. Races	**1.391***		
Constant	5.611***		
Observations	1984		

p. Rural

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Rural	-0.094		
Individualism Frame	-0.059		
Individualism Frame X Rural	**0.389^{+}**		
Constant	5.614***		
Observations	1984		

q. Respondents who value Individualism most (top 25% composite score)

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
High Indiv Score	-0.154		
Workforce Alignment Frame	-0.229		
Workforce Align. Frame X High Indiv Score	**0.565***		
Constant	5.717***		
Observations	1121		

r. Respondents who value Individualism least (bottom 25% composite score)

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Low Indiv Score	0.154		
Workforce Alignment Frame	0.336^{+}		
Workforce Align. Frame X Low Indiv. Score	**-0.565***		
Constant	5.563***		
Observations	1121		

s. Respondents who value Equality most (top 25% composite score)

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
High Equality Score		-2.598	-11.553
Inequality Frame		-2.045	-0.388
Inequality Frame X High Equal Score		**6.056****	19.274
Workforce Alignment Frame		0.510	-7.812
Workforce Align. Frame X High Equal Score			**49.047****
Narrow Preparation Frame		0.948	-13.449
Narrow Prep. Frame X High Equal Score			**33.862**+
College Access Frame		0.228	-17.778
College Access Frame X High Equal Score			**44.074****
Constant		33.917***	91.667***
Observations		1101	1101

t. Respondents who value Equality least (bottom 25% composite score)

	CTE Significance	Pct. School Hours in CTE	Willingness to Pay for CTE
Low Equality Score		2.598	11.553
Inequality Frame		4.012+	
Inequality Frame X Low Equal Score		**-6.056****	
Workforce Alignment Frame			41.235**
Workforce Align. Frame X Low Equal Score			**-49.047****
Narrow Preparation Frame			20.413
Narrow Prep. Frame X Low Equal Score			**-33.862**+
College Access Frame			26.297+
College Access Frame X Low Equal Score			**-44.074****
Constant		31.318***	80.114***
Observations		1101	1101

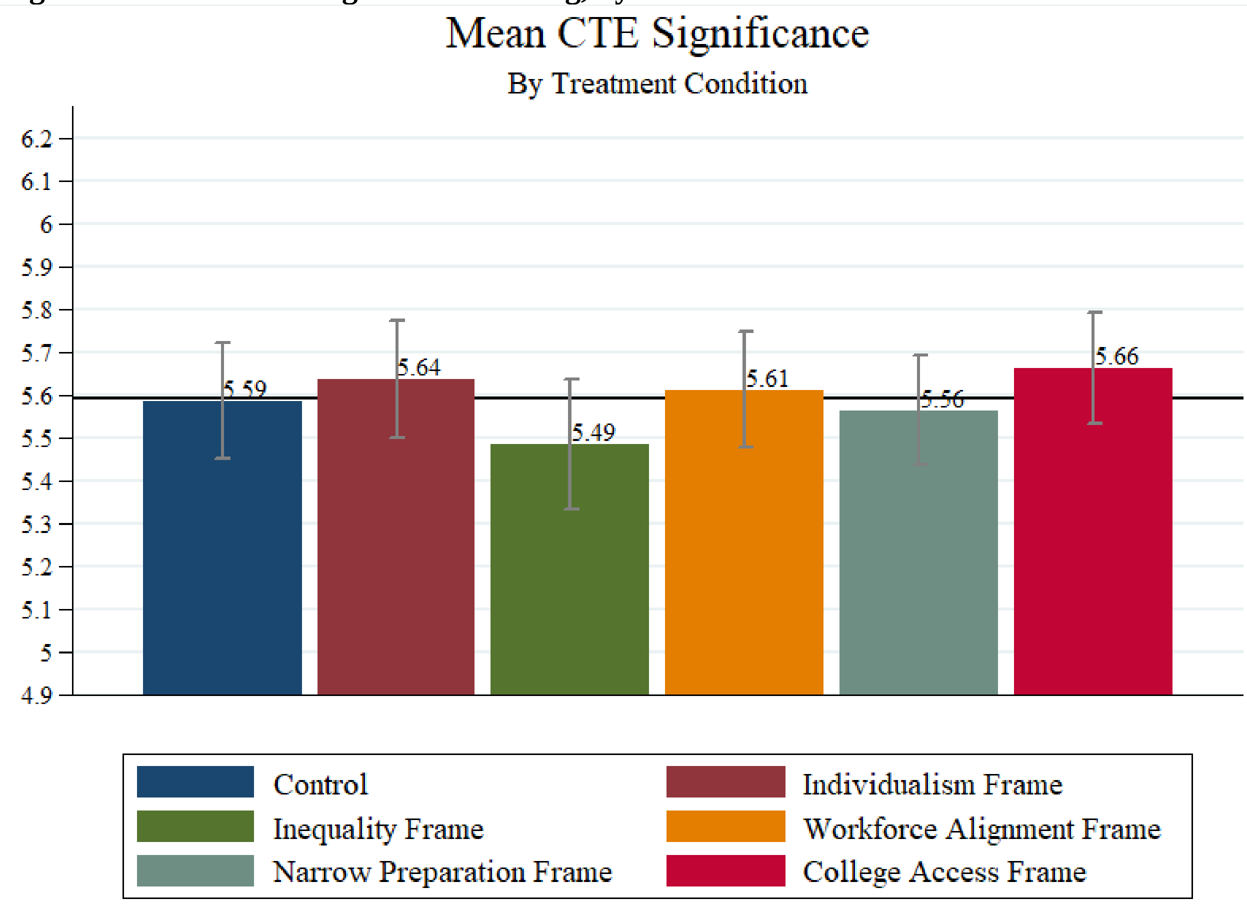
Notes: Each panel shows the coefficients and significance levels associated with the specified characteristics, the interaction between that characteristic and assignment to any treatment that was statistically significant, along with the coefficient associated with that treatment, compared to the control group. The following symbols represent statistical significance: + p<.1, * p<.05, ** p<.01, *** p<.001.

Figure 3.1 Frames for Discussing CTE

	SUPPORT	OPPOSE
VALUE-BASED ARGUMENTS	Meet individual students' needs & interests ("**Individualism**")	Different educational tracks can increase inequality ("**Inequality**")
WORKORCE-BASED ARGUMENTS	Prepare students for jobs currently in-demand ("**Workforce Alignment**")	Specific skills may not stay relevant in the future ("**Narrow Preparation**")

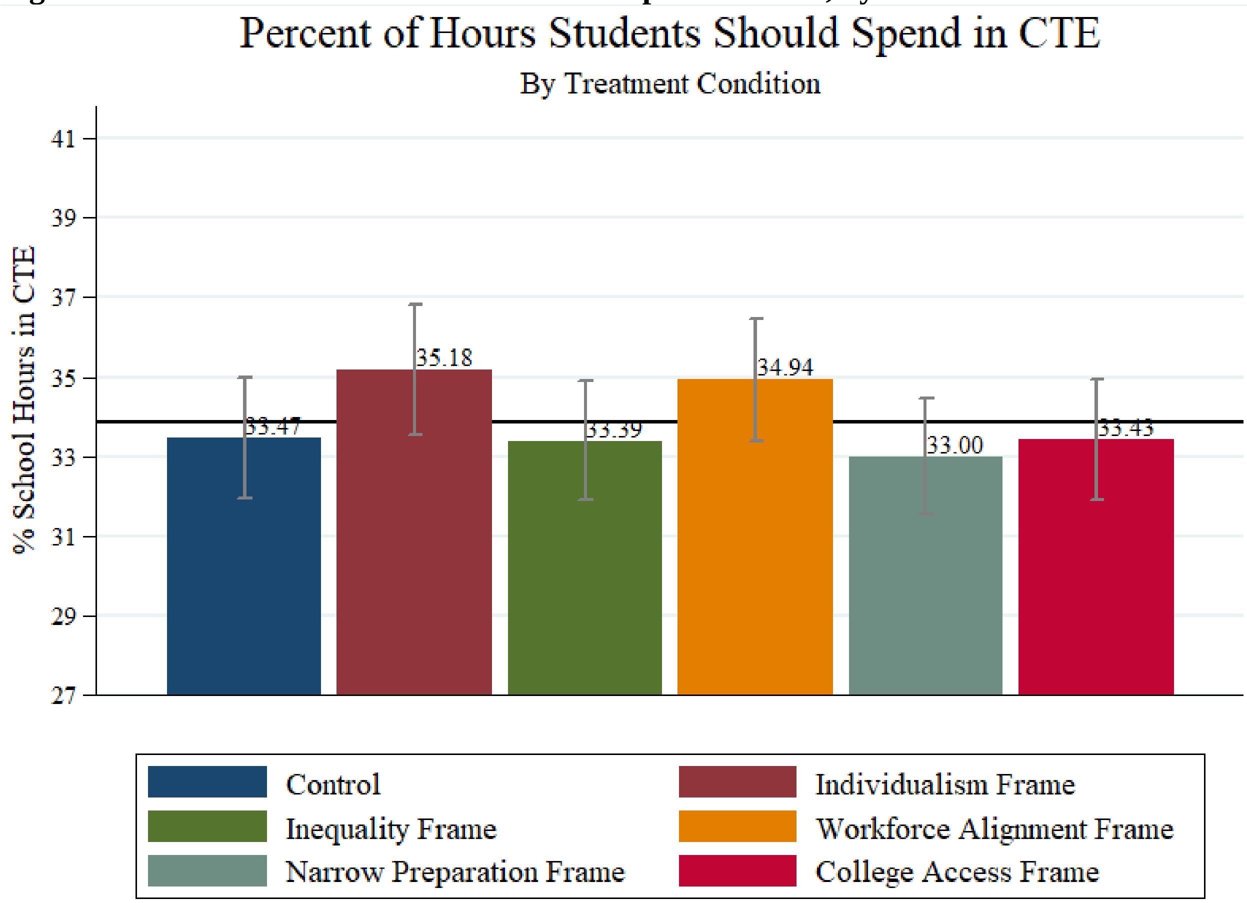
"College Preparation"

Figure 3.2 Mean CTE Significance Rating, by Treatment



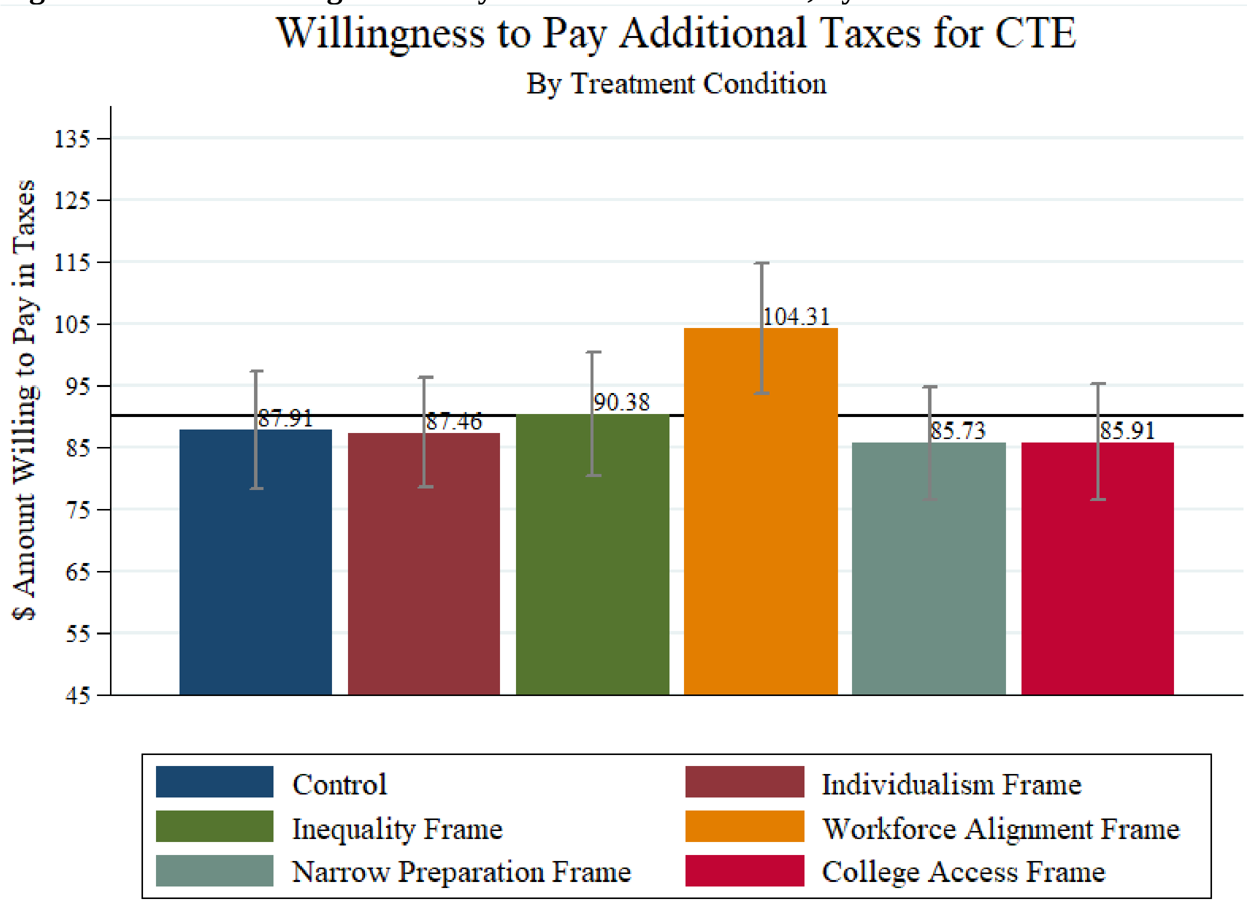
Notes: Each bar represents mean CTE significance, as reported for each treatment group. Bars represent 95% confidence intervals. The y-axis range shown here represents approximately 1 standard deviation among all respondents. The thick black horizontal line represents the mean across all respondents.

Figure 3.3 Mean % of Hours Schools Should Spend on CTE, by Treatment



Notes: Each bar represents mean hours respondents say should be spent on CTE (out of 100 total hours), as reported for each treatment group. Bars represent 95% confidence intervals. The y-axis range shown here represents approximately 1 standard deviation among all respondents. The thick black horizontal line represents the mean across all respondents.

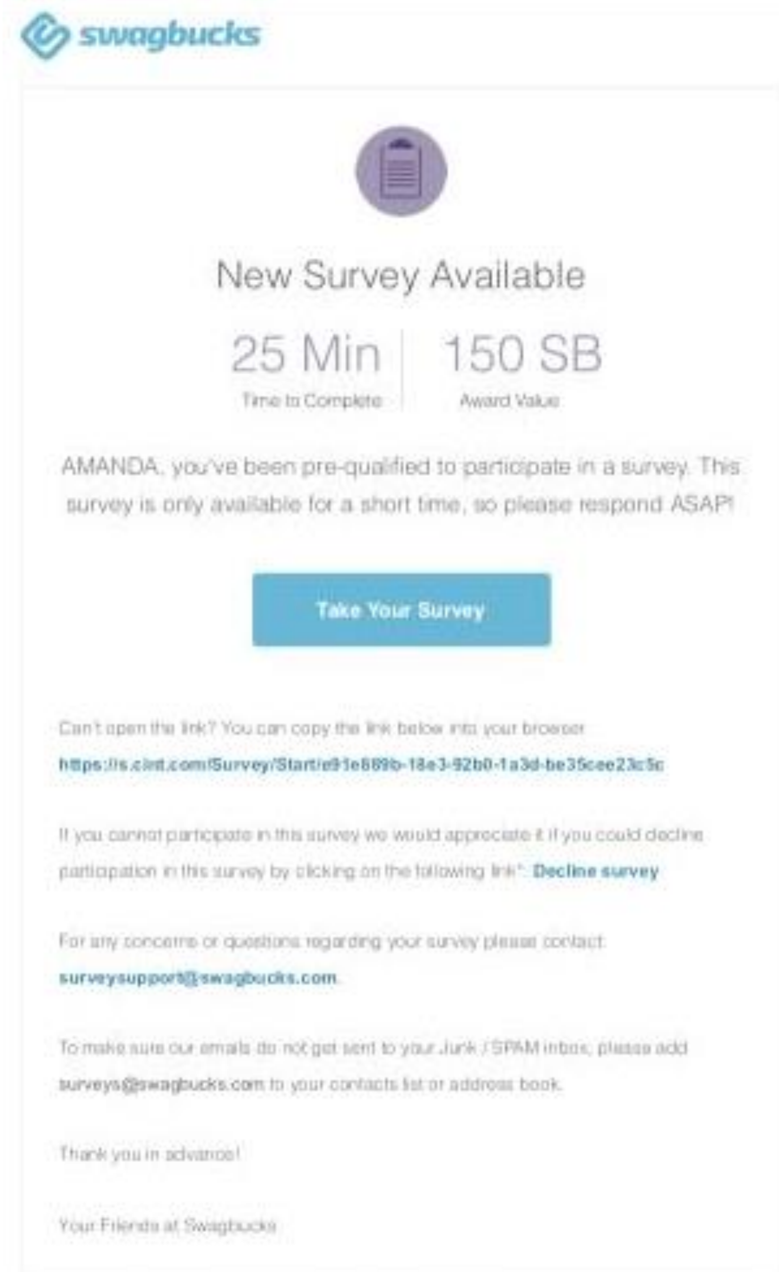
Figure 3.4 Mean Willingness to Pay in New Taxes for CTE, by Treatment



Notes: Each bar represents mean amounts respondents were willing to pay in additional taxes for CTE, as reported for each treatment group. Bars represent 95% confidence intervals. The y-axis range shown here represents approximately 1 standard deviation among all respondents. The thick black horizontal line represents the mean across all respondents.

3.8 Appendix

Appendix 1. Example Recruitment Message from Lucid Client



Appendix 2. Survey Instrument

CONSENT MESSAGE: This study is being conducted by researchers at the Department of Leadership and Policy Studies at Vanderbilt University. This study is strictly for research purposes. The researchers are not affiliated in any way with any organization other than Vanderbilt University. Your participation in this study is completely voluntary, and it should take 9-10 minutes of your time. By consenting, you acknowledge that you may be unaware of the true purposes of the research and agree to participate under this condition. You may discontinue the study at any time.

CONTACTS FOR QUESTIONS OR PROBLEMS: Contact Information: If you should have any questions about this research study, please contact Walter Ecton at walter.g.ecton@vanderbilt.edu. For additional information about your rights as a research participant in this study, please feel free to contact the Vanderbilt University Institutional Review Board Office at (615) 322-2918 or toll free at (866) 224-8273

In consideration of all of the above, I give my consent to participate in this research study. By selecting "I agree to participate in this study" you signify consent. If you select "I do NOT agree to participate in this study" you will be taken to the final screen

○ I agree to participate in this study.

○ I do NOT agree to participate in this study.

1. What is your age?

____

2. How many children do you have?

- Click to choose your response.
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10+
- I do NOT have any children.

Please read the following: One common category of courses in high schools today is known as "Career and Technical Education." Career and Technical Education courses (including Vocational Education courses) are designed to provide students with the knowledge, skills and training needed for specific career paths (such as Manufacturing, Health Sciences, Construction, and Information Technology (IT) Career and Technical Education typically has a hands-on component, as students often work with actual equipment, complete projects, and are trained by instructors with experience in the specific career.

- Click here to confirm that you have read the above statement.

Please read the following: One common category of courses in high schools today is known as "Career and Technical Education." Career and Technical Education courses (including Vocational Education courses) are designed to provide students with the knowledge, skills and training needed for specific

career paths (such as Manufacturing, Health Sciences, Construction, and Information Technology (IT)). Career and Technical Education typically has a hands-on component, as students often work with actual equipment, complete projects, and are trained by instructors with experience in the specific career.

Education experts say that Career and Technical Education can provide individual students with greater choice, as they are better able to take courses that meet their own unique needs, interests, and goals after high school.

○ Click here to confirm that you have read the above statement.

Please read the following: One common category of courses in high schools today is known as "Career and Technical Education." Career and Technical Education courses (including Vocational Education courses) are designed to provide students with the knowledge, skills and training needed for specific career paths (such as Manufacturing, Health Sciences, Construction, and Information Technology (IT)). Career and Technical Education typically has a hands-on component, as students often work with actual equipment, complete projects, and are trained by instructors with experience in the specific career.

Education experts say that Career and Technical Education can create inequality in schools, as certain students may be tracked into different educational paths that set them up for different types of experiences after high school.

○ Click here to confirm that you have read the above statement.

Please read the following: One common category of courses in high schools today is known as "Career and Technical Education." Career and Technical Education courses (including Vocational Education courses) are designed to provide students with the knowledge, skills and training needed for specific career paths (such as Manufacturing, Health Sciences, Construction, and Information Technology (IT)). Career and Technical Education typically has a hands-on component, as students often work with actual equipment, complete projects, and are trained by instructors with experience in the specific career.

Education experts say that Career and Technical Education can prepare students to get jobs after high school, and that it can train students to fill the types of careers that are in-demand in the workforce.

○ Click here to confirm that you have read the above statement.

Please read the following: One common category of courses in high schools today is known as "Career and Technical Education." Career and Technical Education courses (including Vocational Education courses) are designed to provide students with the knowledge, skills and training needed for specific career paths (such as Manufacturing, Health Sciences, Construction, and Information Technology (IT)). Career and Technical Education typically has a hands-on component, as students often work with actual equipment, complete projects, and are trained by instructors with experience in the specific career.

Education experts say that Career and Technical Education can teach students a narrow set of technical skills that may become out-of-date or irrelevant as the economy and technology changes, which may limit students' job prospects later in life.

○ Click here to confirm that you have read the above statement.

<p>Please read the following: One common category of courses in high schools today is known as "Career and Technical Education." Career and Technical Education courses (including Vocational Education courses) are designed to provide students with the knowledge, skills and training needed for specific career paths (such as Manufacturing, Health Sciences, Construction, and Information Technology (IT)). Career and Technical Education typically has a hands-on component, as students often work with actual equipment, complete projects, and are trained by instructors with experience in the specific career.

Education experts say that Career and Technical Education can take the place of some college-preparatory and academic classes for students participating in Career and Technical Education, and may make these students less likely to attend college.</p>

○ Click here to confirm that you have read the above statement.

3. How significant of a role should Career and Technical Education courses play in high school education?

- ◯ Not significant at all
- ◯ Very low significance
- ◯ Slightly significant
- ◯ Neutral
- ◯ Moderately significant
- ◯ Very significant
- ◯ Extremely significant

4. Imagine you are in charge of high schools in your state and that you are able to decide how much schools should emphasize each of the following types of classes. Over the course of students' time in high school, what percent of time do you think should be spent in each of the following types of classes (Total must add to 100):

Core Academic Courses (Math, English, Science, Social Studies) : _______
Career and Technical Education : _______
Other Electives (such as Fine Arts, World Languages, Physical Education, and ROTC) : _______

5. We know that sometimes people might fill out an online survey without reading the questions, which can make our results unreliable. Just so we can know you're paying attention, please select Mostly disagree for this question. Thank you for your attention!

- ◯ Very strongly agree
- ◯ Mostly agree
- ◯ Somewhat agree
- ◯ Neither agree nor disagree
- ◯ Somewhat disagree
- ◯ Mostly disagree
- ◯ Very strongly disagree

6. What is the maximum annual increase in taxes you would be willing to pay if the money was used to expand Career and Technical Education in your school district?

- ◯ $0 (I would not be willing to pay an annual tax increase)
- ◯ $50
- ◯ $100
- ◯ $150
- ◯ $200
- ◯ $250
- ◯ $300

Next, we'd like to ask you a few questions about yourself.

7. What is your gender?

- ◯ Woman
- ◯ Man
- ◯ Non-binary or some other gender (please specify): ____

8. Think about your oldest child. Relative to other children their age, how would you rank your child's performance in school?

- ◯ Far below average
- ◯ Somewhat below average
- ◯ Average
- ◯ Somewhat above average

- Far above average
- N/A - None of my children have been in school.

9. What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree
- High school graduate (high school diploma or equivalent including GED)
- Some college but no degree
- Associate degree in college (2-year)
- Bachelor's degree in college (4-year)
- Master's degree
- Professional or Doctoral degree (such as JD, MD, PhD)

10. Please indicate the income level that includes your entire household income last year before taxes:

- Less than $10,000
- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999

○ d$80,000 to $89,999

○ $90,000 to $99,999

○ $100,000 to $149,999

○ $150,000 or more

11. Which of these most closely fits how you identify yourself?

○ American Indian or Alaska Native

○ Asian

○ Black or African American

○ Hispanic or Latino/a

○ Middle Eastern or North African

○ Native Hawaiian or Pacific Islander

○ White

○ Something else (please specify): ____

12. Which of the following best describes the area where you live?

○ Urban

○ Suburban

○ Rural

13. Generally speaking, do you think of yourself as a Republican, a Democrat, an Independent, or what?

○ Republican

○ Democrat

○ Independent

○ Other (please specify): ____

14. Would you call yourself a strong Democrat or a not very strong Democrat?

○ Strong Democrat

○ Not Very Strong Democrat

15. Would you call yourself a strong Republican or a not very strong Republican?

○ Strong Republican

○ Not Very Strong Republican

16. Do you think of yourself as closer to the Republican Party or the Democratic party?

○ Republican Party

○ Democratic Party

○ Neither

17. Here is a 7-point scale on which the political views that people might hold are arranged from extremely liberal to extremely conservative. Where would you place yourself on this scale?

- ○ Extremely liberal
- ○ Somewhat liberal
- ○ Slightly liberal
- ○ Moderate
- ○ Slightly conservative
- ○ Somewhat conservative
- ○ Extremely conservative

Finally, we're going to ask for your opinion on several questions about the way you think about things. In each, we'll ask you how much you disagree or agree with a statement.

18. Our society should do whatever is necessary to make sure that everyone has an equal opportunity to succeed.

- ○ Disagree strongly
- ○ Disagree somewhat
- ○ Neither agree nor disagree
- ○ Agree somewhat
- ○ Agree strongly

19. We have gone too far in pushing equal rights in this country.

- Disagree strongly
- Disagree somewhat
- Neither agree nor disagree
- Agree somewhat
- Agree strongly

20. Please select Agree strongly for this question.

- Disagree strongly
- Disagree somewhat
- Neither agree nor disagree
- Agree somewhat
- Agree strongly

21. One of the big problems in this country is that we don't give everyone an equal chance.

- Disagree strongly
- Disagree somewhat
- Neither agree nor disagree
- Agree somewhat
- Agree strongly

22. This country would be better off if we worry less about how equal people are.

- ◯ Disagree strongly
- ◯ Disagree somewhat
- ◯ Neither agree nor disagree
- ◯ Agree somewhat
- ◯ Agree strongly

23. It is not really that big of a problem if some people have more of a chance in life than others.

- ◯ Disagree strongly
- ◯ Disagree somewhat
- ◯ Neither agree nor disagree
- ◯ Agree somewhat
- ◯ Agree strongly

24. If people were treated more equally in this country we would have many fewer problems.

- ◯ Disagree strongly
- ◯ Disagree somewhat
- ◯ Neither agree nor disagree
- ◯ Agree somewhat
- ◯ Agree strongly

25. Please select Disagree somewhat for this question.

- ◯ Disagree strongly
- ◯ Disagree somewhat
- ◯ Neither agree nor disagree
- ◯ Agree somewhat
- ◯ Agree strongly

26. Most people who don't get ahead should not blame the system; they have only themselves to blame.

- ○ Disagree strongly
- ○ Disagree somewhat
- ○ Neither agree nor disagree
- ○ Agree somewhat
- ○ Agree strongly

27. Hard work offers little guarantee of success.

- ○ Disagree strongly
- ○ Disagree somewhat
- ○ Neither agree nor disagree
- ○ Agree somewhat
- ○ Agree strongly

28. If people work hard they almost always get what they want.

- ○ Disagree strongly
- ○ Disagree somewhat
- ○ Neither agree nor disagree
- ○ Agree somewhat
- ○ Agree strongly

29. Most people who do not get ahead in life probably work as hard as people who do.

- ○ Disagree strongly
- ○ Disagree somewhat
- ○ Neither agree nor disagree
- ○ Agree somewhat
- ○ Agree strongly

30. Any person who is willing to work hard has a good chance at succeeding.

- ○ Disagree strongly
- ○ Disagree somewhat
- ○ Neither agree nor disagree
- ○ Agree somewhat
- ○ Agree strongly

31. Even if people try hard they often cannot reach their goals.

- ○ Disagree strongly
- ○ Disagree Somewhat
- ○ Neither agree nor disagree
- ○ Agree somewhat
- ○ Agree strongly