

SREE Symposium Overview

Emerging Causal Evidence on Career and Technical Education Program Impacts and Measuring the Factors that Support their Effectiveness

Career and technical education (CTE) has re-taken a prominent place on the education reform stage in last five years. With encouragement from the federal government, including the recent reauthorization of the Perkins Act that will distribute \$1.3 billion annually over the next six years, a growing number of states and school districts have undertaken CTE reforms aimed at preparing students for both college and careers. Arkansas, Connecticut, Massachusetts, and New York have been particularly ambitious in both raising academic standards and providing CTE coursework and learning experiences that are aligned with these standards.

Changes to federal and state policy have been joined by research attempting to set the theoretical and empirical bases for the potential benefits of CTE options in high school (for an overview see Cullen, et al., 2013). Yet only a few studies can make causal claims about the impact of CTE participation (*e.g.*, a true experiment with Career Academies, Kemple & Willner, 2008, and a quasi-experiment, Dougherty, 2018). Even fewer studies attempt to connect causal estimates of CTE impacts with evidence on programmatic characteristics and student experiences that may be moderators or mediators of CTE effects.

The studies that serve as the foundation of this symposium provide an important addition to the evidence base that can make strong causal claims when estimating the impact of CTE participation in high school. They also directly engage questions and concerns from the field about tensions and tradeoffs in expanding programs that reflect extensive variation in both characteristics and quality. In particular, the designs and available data for these studies present unique opportunities to assess the degree to which impacts vary based on student and program characteristics and particular aspects of students' experiences.

The first pair of studies – Papers 1 and 2 – focus on New York City, which includes more than 200 CTE options for students. The second pair – Papers 3 and 4 – focus on the state of Connecticut and its system of more than 16 regional CTE high schools. Each includes a causal impact study: a naturally occurring randomized controlled trial (RCT) in New York City and a naturally occurring regression discontinuity design (RDD) in Connecticut. They also include a rigorous and in-depth analysis of the design and implementation of core CTE program components and the local contexts within which they operate. Much of the data for these implementation studies, and many of the questions that they engage, were developed in conjunction with school and central office staff in the respective locations.

The presentations will summarize preliminary findings from the impact analysis and provide an overview of the data that is available, and the analyses underway, for the implementation and process analysis. The goal of the symposium is to engage the panelists and audience in a discussion about strategies and challenges that can inform the integration of impact and implementation research in order to address questions about the conditions under which CTE programs may be more or less effective, and the potential barriers that impede their expansion.

Paper 1: An Early Look at the Effects of Career and Technical Education Programs in New York City

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Background:

The New York City Department of Education (NYCDOE) oversees the largest and most diverse system of urban career and technical education (CTE) programs in the country. After several decades of limited growth in its CTE programs, the NYCDOE undertook a major expansion beginning in 2003. The number of high schools offering CTE programs more than doubled over a 10-year period (Jacoby & Dougherty, 2016). In the 2013-2014 school year, CTE programs were offered in 145 of the City's nearly 400 high schools, with 47 of those high schools dedicated exclusively to CTE.

Purpose:

The impact study uses natural lotteries that result from the NYC High School Admissions Process (HSAP) to generate causal estimates of CTE impacts on both high school graduation and diploma receipt as well as on college enrollment and persistence. This paper will draw on a total sample of 20,832 students that competed in lotteries for one of 79 unique CTE programs between 2007 and 2013. For this sample we will first explore the contrast in services induced by winning a CTE lottery. The impact analysis for this paper will then address the following four research questions:

1. What is the impact of being assigned to a CTE program on the likelihood of graduating from high school in four years with a New York State Regents Diploma?
2. What is the impact of being assigned to a CTE program on the likelihood of enrolling in a two- or four-year college in the year following on-time graduation from high school?
3. What is the impact of being assigned to a CTE program on the likelihood of remaining enrolled in college for two consecutive years following on-time graduation from high school?
4. What is the impact of being assigned to a CTE program on the likelihood of completing college within four years following on-time graduation from high school?

The data available for this paper will enable the study to estimate impacts on on-time high school graduation rates for the full sample of 20,832 students. For the earlier cohorts of students, we will present impacts on college enrollment, persistence and completion over the four years following on-time high school graduation.

Prior research shows that approximately 30 percent of NYC 9th graders earn a college degree within 10 years of entering high school. By far, the largest leak in this educational

pipeline occurs at high school graduation when fully 30 percent of 9th graders fail to graduate within four years (Black and Coca, 2017). For this reason, we designate high school graduation as a primary outcome for this paper. We designate college persistence or completion over the four years follow high school graduation our second primary outcome for this paper.

Setting:

NYC's CTE programs enroll approximately 60,000 students through a system of school choice. The scope and diversity of CTE programming in New York City combined with a school choice system that clearly identifies the factors that places students into programs creates a unique and yet widely relevant setting in which to assess the impact of CTE programs on student outcomes.

Research Design:

The impact study will use a naturally occurring randomized control trial (RCT) design that results from the NYC high school admissions process to generate causal estimates of CTE impacts on both proximal and long-term student outcomes. As part of the High School Application Process, 8th grade students submit applications that list up to 12 high school programs that they would like to attend. For non-selective programs that are oversubscribed, HSAPS uses a randomized lottery to make the final determination about assignment. More than half of the City's CTE programs include non-selective admissions criteria. Based on our preliminary analysis, about half of these have been sufficiently oversubscribed at least once to generate such a lottery.

The treatment group in this study will be assigned to enroll in a given CTE program in their list of choices. The control group, also having included this CTE program in their preference list, will forgo this option and be assigned to enroll in another option on their choice list. The basic approach for the present analysis is to estimate, for each lottery, differences in mean outcomes for treatment and control group members and to average the results across lotteries. At its basic level, this averaging will identify the intent to treat (ITT) effect—*i.e.*, the effect of winning a first-choice CTE program lottery on students' outcomes, regardless of enrollment patterns.

Results:

Although final specifications are being made to the model, the study will focus on students who listed as their first choice one of 79 CTE programs that were oversubscribed and relied on a lottery for their admissions decisions between 2007 and 2013. Roughly 33 percent of these students were assigned at random to enroll in the CTE program of their choice. The remaining 67 percent were not assigned to their first choice program and assigned to a high school program listed subsequently in their applications. After identifying a lottery-based sample of more than 20,000 students, we assessed the internal validity (of our analysis sample by regressing students' exogenous demographic characteristics (race/ethnicity, gender, etc.) and middle school attendance and test scores on the outcome of a given lottery (win/lose). The

regressions also included a set of lottery indicators that identify the lottery a given applicant belongs (lottery fixed intercepts). Our baseline analyses show a high degree of equivalence between treatment and control group students across demographic characteristics and measures of students' prior academic achievement. Any differences that do occur are very small.

Conclusions/ Implications:

This study represents an important addition to the evidence base that can make strong causal claims when estimating the impact of CTE participation in high school.

Paper 2: Measuring Program Characteristics, Experiences, and Quality in New York City's Career and Technical Education System

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Background:

Our conceptual framework for measuring CTE program elements and quality begins with the core tenets of CTE in New York City. The NYCDOE developed these tenets, in large part, as a direct response to growing national consensus about the core principles underlying high-quality CTE experiences and the U.S. Department of Education's "blueprint for the transformation of CTE" (U.S. Department of Education, 2012; Stone, 2014). NYCDOE relies on the following principles to drive CTE programming design and implementation:

- 1) Preparing students for college and careers.
- 2) Engaging business and industry.
- 3) Building a bridge from secondary to postsecondary education or training.
- 4) Creating opportunities for students to work.
- 5) Embracing industry-recognized occupational credentials.

Purpose:

The primary goal of the implementation study is to use the elements mentioned above to investigate the mechanisms – the mediators and moderators – undergirding the relationships between CTE participation and student outcomes (Paper 1). NYCDOE requires CTE programs to report on the presence or absence of these elements annually. In this paper, we will use these data to provide a deeper account of the state of, and variability in, CTE offerings in New York City. We will examine whether and to what extent the tenets of high-quality CTE are evidenced in the City's programs during the period of study, and the extent to which the NYCDOE data has developed and obtained reliable and consistent information on programs, especially those that conduct lotteries to admit to students. Because the presence, volume, and quality of these data may, like oversubscription status, be an indicator of program quality, we propose to complement

analyses of the program element data with a qualitative document analysis and analyses of administrative data to best assess variation.

Setting:

As with Paper 1, the setting is NYC high schools that offer CTE programs and that have been serving students over approximately the last decade. Though the outcomes analysis focuses on oversubscribed programs where students are admitted by lottery, the implementation study focuses on all CTE programs in high schools across the city to better understand the whole landscape of program offerings and to allow us to gauge the external validity of the findings from the study of oversubscribed programs, in so far as we can compare observable elements of programs.

Research Design:

We begin by providing a detailed description of the CTE landscape in NYC and an assessment of its evolution from 2007 to 2017. Next, drawing from administrative data provided by the NYCDOE, we examine the variation in and the evolution of the features of CTE programs in New York City. Specifically, we will detail the CTE curricular options available to students, the extent of CTE programs' engagement with business and postsecondary sector, and the organizational structures that may contribute to differences in outcomes such as teacher qualifications and experience, CTE theme, and geographic location.

Results:

To date, we have been able to utilize an electronic scraping procedure to extract relevant data on course sequence, work-based learning, teachers, and postsecondary partnerships from schools and programs that filed Program Accountability Forms (PAFs) and Self-Evaluation Forms (SEFs) with the NYCDOE. Utilizing the academic year 2013-14 as a test case, we have identified roughly 2/3 of the City's CTE programs have data on one or more of the above program elements that can be extracted by scraping the PAFs. The absence of data on 100% of programs leads us to consider a more comprehensive plan for extracting relevant data from a wider array of programs and across a maximal number of years in our data.

In order to better understand the data shared by the NYCDOE, we have built and coded a database of all files collected by the NYCDOE for accountability purposes, which includes over 35,000 files ranging from 2012 to 2018. Ideally, these files would include not only standardized forms such as SEFs and PAFs, but also less standardized (but still relevant) files such as curriculum maps, articulation agreements with postsecondary institutions, documentation of partnerships with local business, etc. As of now, these files are tagged as potential PAFs, SEFs, and sortable by school building and year.

Currently, progress is still being made in identifying to which program a file should be attached. When a school has multiple CTE programs, they are distinguished by a CIP code; the files, however, are only most consistently sorted by school. As a result, we have used other, identifiable files (namely scraped PAFs and SEFs) to tag "co-folded" files as those most likely

to be from the same program. As a result, a significant number of the 35,000 files are being tagged as associated with a particular CIP. Next steps include a diverse set of codes for these files to 1) establish patterns of existence for some categories of documents (i.e. does each program have a curriculum map?) and 2) further analyze the contents of these documents.

Conclusions/ Implications:

Increased interest in CTE in high school as a component of secondary education in the U.S. has meant the rapid policy innovation in this space. Most of this innovation is taking place in the absence of high quality evidence of effectiveness, and too often does not explicitly consider what makes a high quality CTE program. This evidence provides insight into how practitioners and policymakers (as well as researchers) might make use of a non-traditional set of administrative data to better assess the variation in and quality of elements of CTE program that are increasingly accepted in some corners as key ingredients for high quality CTE programs.

Paper 3: The Causal Impact of Attending a Career Technical High School on Student Achievement, High-School Graduation, and College Enrollment

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Background:

Observational research has documented the association between participating in CTE and academic and labor-market outcomes, yet only a few studies can make causal claims about the impact of CTE participation (one true experiment, Kemple & Willner, 2008, and one quasi-experiment, Dougherty, 2015). Many of these studies demonstrate that students with CTE training in high school enjoy higher probabilities of employment and higher subsequent wages (Bishop & Mane, 2006; Meer, 2007; Neumark & Rothstein, 2006). The main concern with the non-experimental literature relates to the fact that, though students enrolled in CTE programs and more traditional high school settings may seem comparable on observable characteristics, they clearly differ in their choice of whether to pursue CTE in high school, and so may also differ in other unobserved ways. Since most CTE programs allow students to select in and out freely, it is hard to obtain unbiased estimates of the effect of CTE participation. This research adds to the very small research base that can make causal claims about the impact of CTE participation in high school on student outcomes.

Purpose:

In this study, we leverage the conditions for a naturally occurring regression discontinuity design (RDD) to estimate the effects of being admitted to and attending one of 16 specialized high schools in Connecticut (CTHSS) where all students have access to and participate in CTE. In contrast to most high schools that offer only a few CTE programs and only some students

participate, these schools provide greater choice of CTE programs in an environment where all students pursue at least one CTE program. Our aim is to estimate the causal impact of being just admitted to and attending one of these schools, relative to applying but just missing an offer of admission. In this study we focus on high school attendance, standardized test scores, high school completion, and enrolling in postsecondary education or training as our outcomes of interest.

Setting:

We use school application data from over 54,000 students who entered high school in the fall years of 2006 through 2015 and follow them longitudinally through the state administrative data and the National School Clearinghouse. Student applicants to one (or more) of each of the 16 high schools represent towns from across the state of Connecticut. Whereas traditional comprehensive high schools offer an average of about three CTE programs of study the CTHSS schools average more than 10 per school. Students in the CTHSS schools also get to explore multiple CTE programs in grade 9 before choosing a preferred program. In grades 10 through 12 they have a steady cohort of peers and associated teachers as they pursue specialized training in their chosen area of study, while also completing the standard set of academic coursework required to earn a high school diploma.

Research Design:

The application data support the use of a fuzzy regression discontinuity design that we employ to estimate the causal effects of being admitted to and attending one of these schools on students' probability of completing high school and enrolling in postsecondary education. Specifically, we use a student's application score and its position relative to the school-year specific cutoff for admission to determine whether they received a quasi-random offer of admission. We then model the effect of being just eligible and receiving an offer on the probability that the student enrolls in a CTHSS school. In the second stage we then capitalize on the exogenous variation in enrollment that is attributable to the offer of admission to estimate the causal effect of attending a CTHSS school on subsequent outcomes. In addition to estimating this treatment on the treated estimate using instrumental variables and two-stage least squares, we also estimate the policy relevant reduced-form effect of receiving an offer of admission.

All estimation is done using optimal bandwidth choice as suggested by Calonico, Cattaneo, and Titiunik (2014) with a triangular kernel, though we test the sensitivity of all results to choice of bandwidth and functional form. We cluster standard errors at the school-by-year lottery level.

Results:

Our findings suggest that marginal students who were induced into attending a CTHSS school are 7-10 percentage points more likely to graduate from high school, and 3-5 percentage points more likely to enroll in college than their similar peers who applied but just missed being

admitted. Results are robust to various specifications. Tests for heterogeneous effects suggest that though boys may see larger benefits to high school completion, girls see larger effects for college going. Importantly, despite serving students in both urban and suburban settings, results appear to be similar for students residing in different contexts.

Conclusion:

Our results suggest that access to specialized high schools that provide greater choice of CTE offerings, and different learning environments may improve educational attainment and persistence among youth interested in CTE. This is especially important as schools and education policy experts increasingly focus on college and career readiness, including what educational models or programs may best promote desirable outcomes.

Paper 4: Building a Framework For and Measuring Participation in Connecticut's CTE Programs

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Background:

Participating in career and technical education (CTE) programs during high school has been shown to give students access to rigorous academic coursework while demonstrating how core academic skills can be applied in the marketplace, thereby contributing both general and specific forms of human capital development (see Kelly & Price, 2009; Plank, De Luca, and Estacion, 2008, among others). Thus, taking CTE participation in high school may provide complementary sets of experiences that enhance academic experiences and workforce preparation of high school aged youth. Yet, despite some evidence that CTE in high school can boost wages (Kemple & Willner, 2008; Neumark & Rothstein, 2006), or increase high school completion (Dougherty, 2018; Gottfried & Plasman, 2017), there is little known about the specific experiences of high school youth in CTE that might contribute to these positive outcomes.

Purpose:

In this paper, we present a theory of change and outline elements of the CTE experience that may mediate or moderate the relationship between CTE participation in high school and student-level outcomes while in high school as well as after high school. We also aimed to produce descriptive data from a novel approach to school-level data collection in which we gather information about specific CTE program components that are hypothesized to relate to program quality and that could explain the effects seen in other causal impact studies of CTE. Based on prior research, we hypothesize that student exposure to these program components and learning opportunities influence short-term and intermediate outcomes during high schools that include general engagement in school, achievement in both academic and CTE domains, and social and behavioral competencies. In addition, we posit that longer-term outcomes will be influenced both directly by student experiences in CTE programs and indirectly through the influences that those experiences have on intermediate outcomes.

Setting:

The setting for this study is public high schools in Connecticut, with an emphasis on a subset of public high schools of choice called the Connecticut Technical High School System (CTHSS). The CTHSS is a group of 17 high schools serving the entire state, and spread across the state geographically, to which students can apply and that provides access to increase variety and dosage of CTE coursework in high school. Students apply to these schools in 8th grade, and because they are all oversubscribed, are quasi-randomly admitted. Students that are not admitted to a CTHSS school, or who choose not to apply, may still access CTE coursework, though with fewer program options, in their traditional comprehensive high school. We aimed to survey CTE directors in all schools to learn more about the educational environment and options with respect to CTE in their respective settings.

Analytic Approach:

The subject of another study addresses the causal impact of attending, where as in this study we aim to produce data that can be used to construct measures that could serve as mediators or moderators in the causal analysis.

Using publically available data on CTE program directors across all high schools in Connecticut, we amassed a sample of possible respondents to a survey. We then called all schools to verify the name, email, and phone numbers for the relevant contact people. The survey was then deployed via email (with a link to the Qualtrics platform where it was hosted), with weekly follow-up emails sent to non-respondents. Follow-up emails were sent over a period of 5 weeks.

The content of the survey was designed to capture information about:

1. CTE Program offerings
2. Characteristics of teachers in their programs
3. Counseling for college and career awareness and preparation
4. Work-based learning and employer partnerships
5. Partnerships and programing connected to higher education.

Results:

Despite optimism that we would receive broad-based support for survey completion, the initial response rate was below 30 percent. However, we then decided to refocus efforts on schools in the CTHSS because they were less numerous, had a clear central administrative structure that could help ensure data collection, and were the focus of the causal impact analysis in which the measures we could collect might be used as mediators.

In this paper, we present descriptive findings from this statewide survey, with an emphasis on the responses from CTHSS schools who had a nearly 100% rate of completion.

Conclusion:

These descriptive findings and reporting on the data collection structure and process provide context for new approaches to understanding the mechanisms through which CTE might affect outcomes, and a foundation for more nuanced mediation analyses. This paper is among the

first to present a formal framework to consider the policy impact of CTE participation, while also forwarding a model and proof of concept for collecting such data from a state educational system. Data from this study will have direct utility to the parallel impact evaluation (Paper 3), which will use this study's measures as mediators and moderators to understand heterogeneity of effects by program characteristics. In addition, this study will inform the work of policy makers and practitioners interested in better measuring and collecting important elements of CTE program implementation.