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The Academic Impacts of Career and Technical Schools:

A Case Study of a Large Urban School District

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EXECUTIVE SUMMARY

With growing public recognition that too many students in the United States fail to complete high school and that those who do graduate often are inadequately prepared for success in postsecondary education and the workforce, policymakers and education leaders are turning their attention afresh to the American high school. Within the past decade, public investments and private donors have sought to remake the high school in various ways: by organizing high schools around unifying themes, creating improved curricula for students who enter high school underprepared, developing standards and end-of-course exams, breaking larger high schools into smaller units, and creating small autonomous schools.

Despite this flurry of activity, there has been relatively little discussion about the role of Career and Technical schools in preparing students to enter higher education and the workforce. More than 90 percent of the approximately 18,000 public high schools in the United States offer some type of career and technical education course. However, for approximately 900 high schools known as "career and technical high schools" (CTE schools), workforce preparation is the central and primary mission. In 2002, career and technical high schools enrolled approximately nine percent of the in-school population of tenth grade students in the United States.

A result of the lack of research focus to CTE *schools* (as opposed to just CTE *courses* taken at any type of school) is that there has been no gathering of evidence on the effects of CTE schools on a variety of student outcomes, including academic achievement, labor market outcomes, and postsecondary enrollment. This report addresses basic questions about academic outcomes associated with CTE schools:

- What is the effect of CTE schools on **educational attainment**, specifically credit accumulation, grade promotion, and graduation?

- What is the effect of CTE schools on **college-preparatory course taking** in mathematics, science, and foreign language?

- What effect do CTE schools have on **academic performance,** specifically grade point average (GPA), and academic growth in mathematics and reading comprehension?

This report presents findings from a case study of five CTE schools in the School District of Philadelphia. Three cohorts of students – the Classes of 2003, 2004, and 2005 – are the focus of this report. Students in these cohorts were admitted to the CTE schools through a lottery that admitted students through random selection, taking into account student race/ethnicity in order to achieve court-ordered racial balance in the schools. This study takes advantage of this so-called "natural experiment" by comparing outcomes for applicants who were admitted with those for students who did not receive an acceptance. Two types of estimates are created for each outcome: 1) an *Intent-to-Treat*

estimate, which compares outcomes for students who were accepted to CTE schools to outcomes for students who were not accepted, and 2) a *Dosage estimate*, which compares students who attended a CTE school to students who did not attend.

Key findings include:

- **CTE schools had higher on-time graduation rates in each of the three cohorts**. This CTE advantage continued to five-year graduation rates for the two cohorts for which these data were available and to the six-year graduation rates for the one cohort for which data were available (13-27% increase in individual's odds of graduating using ITT estimate and 111-183% increase using Dosage estimate). Likewise, there were CTE impacts on total credits earned (0.7 - .0.8 credits with ITT estimate, and 5.9 - 6.6 credits with Dosage estimate) and total CTE courses taken (0.33-0.38 with ITT estimate, and 2.30-2.34 with Dosage estimate).

- **CTE schools had a substantial impact on the probability of successfully completing the college preparatory mathematics sequence of Algebra 1, Algebra 2, and Geometry.** The Intent-to-Treat estimates placed the odds of completing this course sequence as one-quarter to one-third greater for CTE students (25-32% increase in the odds of completing the sequence), while the Dosage estimates placed the odds for CTE attenders as between two and three times as great as for those who attended other schools (232-255% increase in odds of completing mathematics course sequence).

- **The Intent-to-Treat and Dosage estimates of impact for completing both Chemistry and Physics credits were inconsistent across cohorts and often not statistically significant.**

- **The Intent-to-Treat estimates of impact for earning two course credits in foreign language were inconsistent across cohorts.** However, the Dosage estimate indicated a substantial CTE impact (145-148% increase in odds of completing foreign language course sequence), with those who attended CTE schools having over twice the odds of successfully completing two years of a foreign language.

- **Across the cohorts, CTE schools had virtually no impact on achievement growth from 8th to 11th grade.** The CTE effect for learning growth in mathematics and reading comprehension was generally statistically insignificant, and the effects were always small.

A descriptive analysis of mean outcomes by cohort and CTE school indicates that while the magnitude of the differences between treatment and control students varies from school to school, the impacts are not being driven by a single CTE school or subset of schools.

The Context of Career and Technical Education in Philadelphia

During the school years that are the focus of this study (1999-2000 through 2004-2005), the School District of Philadelphia had four high schools whose primary focus was on providing career and technical training for students who hoped either to pursue postsecondary education or enter the workforce immediately after high school. A fifth high school was given CTE status for the Class of 2005. These high schools served students from across the district.

There were many more applicants in each cohort than the CTE schools could serve, and the CTE schools admitted students using a lottery that took into account only student race/ethnicity (to achieve racial balance) and how highly each student had prioritized the school on his application form. For the Class of 2003, CTE schools entered all applicants into their lotteries, regardless of their prior achievement, attendance, or behavior. For the Classes of 2004 and 2005, each of the CTE schools pre-screened applicants for school-related performance. After students with weaker records were removed from the applicant pool, the lottery was conducted. As a result of this pre-screening, the CTE Classes of 2004 and 2005 entered high school with stronger prior academic performance than the Class of 2003.

Career and technical courses were offered at most of the approximately 40 public high schools in Philadelphia. Some of the larger neighborhood high schools had a variety of CTE courses of study that rivaled those of the CTE schools. But in general, the greatest variety of occupationally-focused courses was to be found at the career and technical high schools. Across both CTE and neighborhood high schools, the period 1999-2005 saw a gradual decrease in the variety of CTE schools, including a decline in the number of single-class courses of study (e.g. child care). At the same time, the number of students across the district who enrolled in any CTE course during high school rose slightly.

During the Vallas administration (2002-2007), and under pressure from Perkins III requirements, the district began to emphasize courses of CTE study that allowed students to earn certificates, corresponded to areas of job growth and opportunity in the local labor market, and enabled partnerships with local companies and city government (e.g. fire fighting). However, during the time that the Classes of 2003 through 2005 were attending in high school, this work of focusing and aligning programs of study with local industry was just getting underway. It is important to be clear that, in general, the CTE programs that Philadelphia's students experienced did not garner any award or notice for being exemplary, nor were they cutting edge models of excellence (Philadelphia Workforce Innovation Board, 2008; Philadelphia Youth Network. 2009). However, it is also noteworthy that the career and technical high schools operated within a district context that supported high school choice and that encouraged all high schools to offer college preparatory courses in mathematics, science, and foreign language.

How were CTE impacts measured?

This study relies entirely on student record data kept by the School District of Philadelphia. These data include enrollment and graduation status, transcript information (including course grades), test scores, attendance, special education status, English-language-learner status, and school(s) attended, from eighth grade forward, in addition to applications to high schools and high school admissions decisions.

Two strategies are used to model Intent-to-Treat estimates. The first strategy, which uses a multilevel model, allows students to be represented in the data set multiple times, with the frequency equivalent to the number of CTE schools applied to. Students are nested within a specific lottery/cohort combination. In this model, the treatment and control groups resulting from each school's lottery for each cohort are compared. By comparing students within the same lottery, we eliminate any bias that might have resulted from different CTE schools using different criteria to pre-screen applicants into their lottery; this is of concern for the Classes of 2004 and 2005. However, a disadvantage of this model is that it potentially underestimates the impact of CTE schools as a whole since some students who are considered "treatment" students at one CTE school are considered "controls" at another CTE school.

Our second modeling technique uses fixed effects, with controls for the school(s) to which the student applied and their cohort. Students are represented once in the data set. The advantage of this modeling strategy is that it will not produce an underestimate of CTE effects as serious as the multilevel strategy described above; its disadvantage is that it does not directly compare students who were accepted and not accepted to particular CTE schools.

The statistical significance of the estimates and direction of the effects produced by these two Intent-to-Treat strategies are consistent across most outcomes.

The Dosage estimate uses the multilevel modeling strategy described above but introduces a control for the proportion of the time a student attended a CTE school while enrolled in a Philadelphia public high school.

All models controlled for student race/ethnicity, since empirical analysis demonstrated that the probability of acceptance at particular CTE schools in particular cohorts varied according to racial/ethnic background.

Implications

This research is a case study of the effects of CTE schools in a particular large-city school district during a particular time period that spanned Perkins III and Perkins IV. As with any case study, a full interpretation of the results must take into account how the city's social and educational context affects how CTE schools are supported and perceived by the community and district staff. While this report does not present an

exhaustive analysis of how parents and students view Philadelphia's CTE schools, the empirical data demonstrate that in Philadelphia, the Career and Technical high schools were highly sought after. Large percentages of eighth graders applied to at least one CTE school for high school.

Further, while the CTE schools in Philadelphia were rather ordinary in terms of their occupational foci and curriculum, they were subject to school district efforts to increase college-preparatory course taking in all high schools. Thus, there were many opportunities for students at Philadelphia's CTE schools to take college-preparatory mathematics, science, and foreign language. The high percentages of CTE students who earned credits in these courses supports the argument that, in this context, CTE schools did not behave as a "dead end" school or a "school of last resort." One of the clear messages of this report, then, is that *it is not always or necessarily the case that CTE schools are associated with weaker academic outcomes for students.* In some situations – Philadelphia being one of them – academic outcomes for CTE schools may equal or exceed those of other schools in the district. That these impacts were observed in a research study that used randomized design strengthens the validity of this assertion.

It is beyond the scope of this study to establish the mechanisms by which CTE schools come to have the impacts we observe. Several differing, but not mutually exclusive, mechanisms could be hypothesized. Perhaps there is something powerful about CTE education, including the possibility that it helps students to see more clearly the connections between schooling and workplace success. Or, there may be nothing intrinsically important about CTE as a school focus; instead, the important factor may just be that the school had a focus, in contrast to neighborhood high schools, which try to be all things to all students. There may be peer effects associated with bringing together students who have the personal advantages and prior achievement, demonstrated by participating in school choice and being pre-screened into the lottery (for the Classes of 2004 and 2005). Students may perceive CTE schools as being special and work to maintain their grades and behavior so as not to be "returned" to their neighborhood high schools for inadequate performance.

It would be a mistake to conclude - purely from this empirical analysis - that an approach to high school curriculum that emphasizes career and technical education is superior to other curricular focuses. On the other hand, it would be equally mistaken to dismiss career and technical education schools as *necessarily*, in all educational contexts, reducing the probability that students will graduate from high school and earn credits in gate keeping courses needed for admission to and success in postsecondary education.

CHAPTER ONE

INTRODUCTION

With growing public recognition that too many students in the United States fail to complete high school and that those who do graduate are often inadequately prepared for success in postsecondary education and the workforce, policymakers and education leaders are turning their attention afresh to the American high school. Within the past decade, public investments and private donors have sought to remake the high school in various ways: by organizing high schools around unifying themes, creating improved curricula for students who enter high school underprepared, developing standards and end-of-course exams, breaking larger high schools into smaller units, and creating small autonomous schools.

Despite this flurry of activity, there has been relatively little public discussion about the role of Career and Technical schools in preparing students to enter higher education and the workforce. More than 90 percent of the approximately 18,000 public high schools in the United States offer some type of career and technical education course (Levesque, Laird, Hensley, Choy, Cataldi, & Hudson, 2008). However, for approximately 900 high schools known as "career and technical high schools" (CTE schools), workforce preparation is the central and primary mission. In 2002, approximately half of American tenth graders were served by a public school district in which attending a CTE[1] school was an option. Career and technical high schools enrolled approximately nine percent of the in-school population of tenth grade students in the United States.

The fundamental question that this report seeks to answer is: *What is the effect of career and technical schools on high school students' academic outcomes?* This question differs in subtle but important ways from the questions that researchers typically have asked about the effects of career and technical education. Much of the research, including the work that we review below, has examined whether CTE coursework has an impact on outcomes such as graduation rates or mathematics achievement - regardless of the type of school in which the CTE courses are taken. Our work differs from these analyses by examining outcomes in which the school itself is the intervention.

[1] The Perkins Act of 1998 (often referred to as "Perkins III") encouraged the use of the term "career and technical education" in place of "vocational education." "Career and technical education" is meant to describe a curriculum approach that blends rigorous academics and career preparation, in contrast to the term "vocational," which was not intended be academically rigorous. In reporting results for career-related education supported by Perkins I and II, we describe this type of education as "vocational." For results from studies of education supported by Perkins III and Perkins IV, we use the term "career and technical education."

There are several arguments for gathering evidence on the achievement and graduation effects of *schools* that are devoted exclusively to CTE (as opposed to CTE coursework offered in comprehensive high schools). First, given the importance of preparing students both for work and additional post-high school education, it is useful to know whether CTE schools decrease the probability that students will complete rigorous academic coursework necessary for postsecondary success. Critics of vocational education have argued that workforce preparation courses historically have been an academic "dead-end," limiting student access to and success in rigorous academic coursework. Taking courses that are career-focused involves some opportunity cost: less time in the school day to prepare for or to study advanced mathematics, science, or foreign language. At CTE schools, the focus on preparation for work could result in less academic press for college-preparatory coursework and fewer course offerings in advanced academic subjects.

At the same time, proponents of career and technical education have argued that courses related to students' occupational interests may serve as a "carrot" for them to attend school and to engage – at some level – with academic content that they might view as less relevant and appealing. Some students, particularly early on in their high school careers, may view doing well (or well enough) in their academic classes as an investment that they need to make in order to take the career and technical courses they desire. Further, at schools that do a good job of showing students how academic content relates to their occupational interests, students may develop intrinsic motivation for doing well in mathematics, science, and other academic subjects. If CTE schools are able to engage students at an earlier point in high school through career-focused coursework – and if they are able to provide this "hook" because their specific institutional mission is CTE education – then there may be a good argument for supporting stand-alone CTE schools, in addition to or instead of CTE coursework at comprehensive high schools. A related argument is that by moving more quickly to demonstrate the connection between what students are learning in school and what they can do in the workplace after high school, CTE schools may increase the percentage of students who earn a high school diploma.

The effect of CTE schools on student outcomes may vary by district context, particularly by urbanicity. Research on school choice systems in large urban districts has suggested that students who participate in high school choice often are more advantaged than those who do not. Students who submit applications often have parents who are more engaged in and informed about the school choice process, which can be complex in some cities (Moore and Davenport, 1990). As a result, CTE schools may serve a group of students whose parents are more involved and ambitious for their children, or at the very least, who have talked with their children about life after high school. It is difficult to assess how much of any effect of CTE schools is the result of CTE education itself, as opposed to the assembling of students who had the resources to negotiate the school choice process.

Each of the arguments for investigating the effects of CTE schools suggests a mechanism by which attending a CTE school may be linked to more positive (or negative) academic outcomes for students. The primary purpose of this report is to

establish whether there is an association between attending CTE schools and student outcomes. To examine these possible associations, we conduct a quantitative case study of three cohorts of students in a single school district – the School District of Philadelphia – that has several career and technical high schools. Although we present descriptive information that may provide suggestive evidence about these mechanisms, it is not our purpose to provide a rigorous assessment of *how*, if at all, CTE schools affect student outcomes. Given the dearth of information on the effects of CTE schools and the challenge of establishing credible comparison groups, we focus instead on establishing the existence and magnitude of these effects.

The Challenges of Assessing the Effects of CTE Schools

National data indicate that, on average, CTE schools serve students who differ systematically from those who attend comprehensive high schools. For example, CTE schools are more than twice as likely as other schools to have moderate levels of students from low-income families, defined as 31 percent to 50 percent of the student body (52 percent for CTE schools versus approximately 20 percent of other schools). CTE schools also served higher percentages of students with an Individualized Education Program. Further, CTE schools are larger on average than other high schools. (Levesque et al., 2008). In any assessment of the effects of CTE schools, these differences in the student populations served by the schools, as well as of the schools themselves, needs to be taken into account.

In social science, an ideal assessment of the effect of an intervention such as CTE education would use a random-assignment strategy, in which students who have indicated an interest in CTE education are randomly assigned to experience either a CTE school or another type of school. Occasionally, this random assignment process is mimicked in so-called "natural experiments," the primary purpose of which may have been to distribute a relatively rare but sought-after good in an impartial manner. Such was the case with Philadelphia's CTE high schools for several years beginning in the late 1990s. During that time period, Philadelphia's CTE schools were substantially "oversubscribed," meaning that there were many more applicants than available seats at the schools. As a result, Philadelphia used a lottery to offer admission to its CTE schools.

In this report, we take advantage of this "natural experiment" in Philadelphia to assess the impact of CTE schools. A random assignment process provides greater assurance that any unobserved or unobservable differences between students who are accepted to CTE schools and those who are not are distributed randomly between the two groups. It is this random assignment process that gives this study its methodological strength.

This report examines outcomes for the Classes of 2003, 2004, and 2005 (that is, students who began high school in the fall of 1999, 2000, and 2001, respectively). For the Class of 2003, all applicants to the CTE schools were entered into a lottery regardless of their previous academic achievement, attendance, or school behavior. Beginning with the Class of 2004, the CTE schools began to "pre-screen" applicants before conducting

the lottery. At some schools, 50 percent or more of the applicants were screened out on the basis of prior achievement before the lottery was conducted, thereby creating a more academically select lottery pool. Although it is important to be clear about the group of students to which results from the different classes may be generalized, the students nevertheless were offered admission through a random selection method.

A Study that Spans Perkins III

For CTE students in the Classes of 2003, 2004, or 2005 who graduated on time (that is, within four years of entering high school), their high school experience was shaped by "Perkins III" – the federal program that provides substantial support for career and technical education. Perkins III emphasized rigorous academic coursework as well as work-related experiences. Perkins III did have accountability indicators; however, it did not have a strong focus on academic outcomes, clear programs of study, and linkages to post-secondary education to the extent that its successor, Perkins IV (passed in 2006) had. Since almost all of the students in this study had left high school by the time Perkins IV became law, this study addresses outcomes for students under Perkins III. It may be thought of a baseline for a later study of student outcomes under the subsequent Perkins legislation.

In Chapter Two, we describe in greater detail the context of career and technical education in the School District Philadelphia during the time period under consideration. Here, we note that while the CTE schools did not necessarily offer the career majors linked to industry standards that are envisioned by Perkins IV, all students at the CTE schools in Philadelphia were required *by the school district* to take and pass college-preparatory academic courses for promotion and graduation. We can observe this academic emphasis in math course enrollments; for example, for the Class of 2003, 75 percent of the students at CTE schools were enrolled in Algebra 1 or an equivalent during their first two years in high school. Further, interviews with Philadelphia parents during 1996 (several years prior to the high school entrance of the Class of 2003) indicate that parents viewed the CTE schools as preparing their children for college as well as giving them a practical workplace skill (Neild, 2005). It is most appropriate, then, to consider students who attended Philadelphia's CTE schools as *dual concentrators*[2]: that is, students who took both college preparatory and career-related coursework. Students who did not attend CTE schools may have been either *academic concentrators* (with few or no CTE courses) or *dual concentrators*. Because of district requirements, students without exceptionalities could not be *vocational concentrators* only and earn the credits required to graduate.

[2] Plank (2001) defines three types of students: academic concentrators, vocational concentrators, and dual concentrators. Dual concentrators take substantial numbers of college-preparatory courses as well as a substantial number of vocational courses.

Research Questions and Data

We examine the effect of CTE schools on a range of academic outcomes for students. Specifically, we address the following:

- What is the effect of CTE schools on **educational attainment**, specifically credit accumulation, grade promotion, and graduation?

- What is the effect of CTE schools on **college-preparatory course taking** in mathematics, science, and foreign language?

- What effect do CTE schools have on **academic performance,** specifically grade point average (GPA) and academic growth in mathematics and reading comprehension?

To estimate the effects of CTE schools, we use administrative data on individual students, from School District of Philadelphia records. These data span students' eighth grade year through their on-time date of graduation. For the Class of 2003, we can track student graduation outcomes to six years past the entrance to high school; for the Class of 2004, we follow students for five years after the start of ninth grade.

We estimate the impact of CTE schools in several ways. Our Intent-to-Treat analysis estimates the overall impact of offering the "treatment" of CTE schools to students in the district. Additional analyses adjust for the fact that not every accepted student chose to attend a CTE school. Finally, we compare effects for students who actually attended the CTE schools to those who did not attend, regardless of whether they received an acceptance.

To place the impact estimates in context, we present descriptive data on the availability of CTE courses in the district's high schools, as well as the percentage and characteristics of students who enrolled in CTE courses district-wide.

The Effects of Career and Technical Education

While there has been considerable work on the effects of CTE course taking, there is relatively little research that addresses the impact on academic outcomes of attending a career and technical high school. This latter analysis would involve an examination of the effects of CTE courses in a specific type of school location, with comparison students potentially enrolled in CTE courses at other types of schools, particularly neighborhood comprehensive high schools.

Although research has not examined the effects of CTE schools *per se*, several studies have considered the impact of Career Academies. Career Academies typically are

not physically or administratively separate schools, but rather career-related programs housed at comprehensive high schools. Often students must apply to participate in a Career Academy. One study of this type examined the impact on graduation rates of "opting out" of a neighborhood high school to attend a Career Academy in the Chicago Public Schools (Cullen, Jacob, and Levitt, 2000). The researchers found that students who opted out of their neighborhood high school to attend a Career Academy had increased odds of completing tenth grade, completing eleventh grade, and graduating from high school; at the same time, students who were assigned to a Career Academy because of geographic residence also experienced these benefits. The fact that a subgroup of Career Academy students was selected by lottery to attend these schools adds to the strength of the argument that there was something about the curriculum, climate, or other features of these Academies that had an impact on student attainment. This Chicago analysis did not provide an empirical exploration of the reasons why Career Academies were associated with higher promotion and graduation rates.

A rigorous national evaluation of Career Academies (small schools-within-a-school at comprehensive high schools), which used randomized assignment, found that among students who were at high risk of dropping out of high school, the Career Academies substantially increased their attendance, academic course-taking, credits earned toward graduation, and on-time graduation rates. Graduation rates also increased among students who were least likely to drop out of school. When the data for all Career Academy students was pooled, however, there was no statistically significant effect of the Academies on the rates at which students graduated from high school or earned a GED (Kemple & Snipes, 2000; Kemple, 2004). Further, the Career Academies did not increase scores on standardized tests in reading and mathematics.

However, a second study of Career Academies, which also used random assignment, found that participating in the Career Academies had a negative effect on graduation rates (Crain, Allen, Thaler, Sullivan, Zellman, Little, & Quigley, 1999). The researchers hypothesized that the academic standards of the Career Academies, combined with the lack of academic support, could have contributed to the lower graduation rates of the Academies.

Below, in order to provide some additional context for our results from the case study of Philadelphia, we summarize research on the relationship between CTE course taking – regardless of the type of school in which the courses were taken - and key academic outcomes. It is important to keep in mind that, for the most part, the studies we cite compared outcomes for students who took vocational or CTE courses with those for students who did not take such courses. In contrast, the current study compares outcomes for students accepted to CTE schools to those of students who were not accepted, but who nevertheless may have taken CTE courses at the school they ultimately attended.

For some outcomes – such as graduation rates –the findings from the studies summarized below are quite discrepant. When examining these discrepant findings, it is important to keep in mind the nature of the course work and the sample. For example, is the coursework "vocational" (in the sense of preparation for the workplace but not

necessarily for postsecondary education) or "career and technical education" (that is, coursework that seeks to blend academic and career offerings)? Is the sample nationally representative, or is it a case study of a city or of a few schools? How does the study control for pre-existing differences between students who enroll in different amounts of vocational or CTE course work?

The Effect of CTE Coursework on Enrollment, Attendance, Promotion, and Graduation

One of the goals of career and technical education is to engage students in their education by making clear the connections between what they are learning in their classes and their occupational interests. If students come to understand that what they are learning in chemistry or mathematics will be useful in their future careers, they may be more willing to put in the work needed to learn the material and earn passing grades in these classes. Alternatively, if they enjoy their career and technical classes, they may be more inclined to tolerate their academic classes even if they still find the connections with their future difficult to discern. Seeing some future benefit to completing high school classes – particularly academic classes – may be especially important for students who arrive in high school with a negative view of school and/or of themselves as capable learners.

Students' engagement in schooling is demonstrated, at a minimum, by attending school and accumulating at least some course credits. Ultimately, engagement in schooling should lead to high school graduation – if not "on-time" (within four years), then within five or six years after entering high school.

Previous research on the effect of CTE or vocational coursework on graduation rates (or dropout rates) has produced mixed evidence, with some finding a positive effect, others observing negative effects, and a third group finding no impact. Using data from the High School and Beyond study, Arum (1998) found that vocational course work increased the odds of earning high school diploma, a finding mirrored in a 2006 analysis by Cellini, using data from 1997 National Longitudinal Survey of Youth. A study by Plank et al. (2008) adds more nuance to the debate. These researchers argue that graduation rates are higher among students who have taken a mix of vocational and academic courses in a ratio of three to four.

In contrast, a study by Ainsworth and Roscigno (2005) that used data from the National Educational Longitudinal Study (NELS 88) found a negative effect on graduation rates of "blue collar" vocational course work. The Crain et al. work cited above (1999) has a similar negative finding.

A third group of studies finds no effect of CTE coursework on graduation rates. The Career Academies study referenced above (Kemple & Snipes, 2000) found no effect on graduation rates. Using data from the Education Longitudinal Study (ELS), Bozick and Dalton (2007) find that there is a negligible effect of occupational course taking on high school completion. However, it should be noted that students must have been

promoted to tenth grade to be in the ELS. This feature of the study means that in large urban districts, where many of the most at-risk students are never promoted to tenth grade, an important subgroup of eventual dropouts is excluded from the study.

The Effect of CTE Coursework on Academic Achievement

The evidence on the effect of CTE course taking on academic growth as measured by standardized test scores is much more consistent than its effect on graduation. In short, there is good evidence that students who are *vocational or dual concentrators* experience smaller learning gains in mathematics or reading comprehension than *academic concentrators* (Kaufman, Bradby, & Teitelbaum, 2000; Plank, 2001). Given that vocational concentrators do not take the same college-preparatory course sequences as academic concentrators, it makes sense that they would not experience the same learning gains in academic subjects (although they might experience greater learning gains in CTE subjects). However, there is evidence dual concentrators have greater gains than vocational concentrators (Agodini, 2001).

Given the evidence that academic concentrators appear to out-gain those who are dual concentrators, it is plausible that CTE schools may be associated with smaller learning gains in academic subjects. That is because students at the CTE schools in this study are dual concentrators (taking courses in both academic and career-related subjects), while those at other schools are a mix of dual concentrators or academic concentrators. The district's policy of having all students take college-preparatory academic courses means that, theoretically at least, there were no students who were vocational concentrators in the Classes of 2003 through 2005.

CHAPTER TWO

THE CONTEXT OF CAREER AND TECHNICAL EDUCATION IN PHILADELPHIA

During the 2004-2005 school year - the on-time graduation year of the third cohort of students examined in this study - the School District of Philadelphia was the tenth largest school district in the United States, with 187,547 students (Garofano & Sable, 2008). Like many other large urban school districts, the district served a population of students that was mostly minority and mostly from low-income families. During 2004-2005, 86 percent of the students in Philadelphia's schools were members of minority groups, and 69 percent were eligible for free or reduced price lunch (Garofano & Sable, 2008). Approximately 65 percent of the students were African American, 15 percent were Latino, 5 percent were Asian, and 15 percent were White (Balfanz et al, 2007).

Philadelphia's Public High Schools

Of the School District of Philadelphia's 270 non-charter schools[3] during 2004-2005, 44 were high schools (Garofano & Sable, 2008). During the time period covered by this study, there were three main types of non-charter high schools in Philadelphia: neighborhood high schools, special admissions schools (otherwise known as "magnet" schools), and career and technical education schools.

Neighborhood high schools served students living in a particular geographical area. Although students were permitted to apply to other schools throughout the city, each student had a "default" neighborhood high school based on residence. Students who did not gain admission to another school via the high school choice process were assigned to their "default" high school. Neighborhood high schools also served students from outside the catchment area who applied for admission, were accepted, and chose to attend. The high schools were permitted to accept students from outside the catchment area if there were spaces available. Some of the programs located in the neighborhood high schools were permitted by the school district to screen applicants on the basis of prior academic achievement, attendance, and school behavior; others were required to accept applicants randomly, using a lottery.

During the time period covered this report, all of the neighborhood high schools offered some courses that can be categorized as career/technical education (for example, accounting). However, the extent to which students could pursue training in a specific

[3] At the time the Classes of 2003 through 2005 were applying to high school (that is, the falls of 1998, 1999, and 2000, respectively), there were relatively few charter high schools, and of these, there were no charter high schools that provided career and technical education of the sort available in the five high schools that are the focus of this report.

occupation and the quality and condition of the relevant labs and internships varied from school to school.[4]

Special admissions schools served students from across the school district and were permitted to select students based on their seventh and eighth grade course marks, attendance, behavior marks, and test scores, as well as an interview or audition if required. When the cohorts that are the focus of this report were applying to high schools, special admissions schools included competitive exam schools that were founded in the mid-19th century (Central and Girls' High School); schools that were established more recently and offered themes such as engineering, international study, or the arts; and schools without a specific theme that offered college-preparatory curricula. The specific student achievement levels and other criteria required for admission varied from school to school. About 13 percent of the students in cohorts that are the target of this analysis attended one of these special admissions schools.

Career and Technical Education schools (long known in local parlance as "Area Vocational and Technical Schools," or AVTS's), provided career-related education in addition to traditional academic subjects. These schools had no residential catchment areas but served students from across the city. All eighth graders applying to be part of the Class of 2003 were entered into a lottery, but for the Classes of 2004 and 2005, the CTE schools were permitted to shape their lottery by first screening students for previous achievement and attendance, and then conducting the lottery. For the Classes of 2003 and 2004, students could apply to one or more of four CTE schools: Bok, Dobbins, Mastbaum, and Saul. The Class of 2005 could apply one or more of these four schools, plus an additional school (Swenson) that had become an independent entity and accepted students from throughout the city.

In addition to these non-charter high schools, there were 17 charter schools that served Philadelphia students in grades 9 through 12. Although many of the charter high school had a thematic emphasis, there were no charter high schools that offered programs of the type that would place it under Philadelphia's rubric of a Career and Technical school. One charter school, YouthBuild, provided construction experience along with academic subjects, but this school was for students who already had dropped out of school and were re-enrolling to complete their high school education.

Tables 2.1 and 2.2 summarize key data for the three categories of non-charter high schools and for charter high schools, as well as for each high school within these categories.[5] Of note is that, in terms of the percentage of students eligible for free and reduced lunch and the racial/ethnic distribution of the student body, CTE schools are more similar to neighborhood high schools than to special admit schools or charter schools.

[4] Access to career and technical courses in the neighborhood high schools is described in greater detail in Chapter 4.

[5] After the Class of 2005 was admitted, Philadelphia added a sixth CTE school. This school is reflected in the 2005 data presented here, although it is not addressed in the remainder of the report, since none of the focus students could have applied to this school.

Table 2.1: Summary Data for Public High Schools in Philadelphia, by School Type, 2004-2005

School type	Number of schools	N of students	% free/ reduced lunch
Career and Technical Schools	6	5,394	60.1%
Special Admit	16	9,822	15.3
Neighborhood	25	39,629	63.1
Charter	17	10,601	17.2
District Total	**64**	**65,446**	**48.2**

SOURCE: Common Core of Data, 2004-2005, National Center for Education Statistics

Table 2.2: Racial and Ethnic Composition of Public High Schools in Philadelphia, by School Type, 2004-2005

School type	% African American	% Asian	% Latino	% White
Career and Technical Schools	70.1%	3.2%	11.5%	15.0%
Special Admit	57.2	12.3	5.7	24.6
Neighborhood	67.7	5.6	14.2	12.2
Charter	54.8	2.1	23.3	19.8
District Percentage	**64.2**	**5.9**	**14.2**	**15.5**

SOURCE: Common Core of Data, 2004-2005, National Center for Education Statistics

The Career and Technical High Schools

Table 2.3 summarizes key data for each of the five career and technical high schools that are the focus of this study. There are notable differences between the schools in terms of the percentage of students who are low-income, student racial and ethnic distribution, and achievement. For example, Saul High School and Swenson High School serve considerably smaller numbers of students who are eligible for free or reduced price lunch, in comparison to the other three CTE schools. Likewise, these two schools also have the highest graduation rates.

Table 2.3: Summary of Key CTE School Characteristics, 1999-2000 to 2004-2005

School	Year Founded	Mean School Size Over Study Period	Class of '03 6 Yr Grad Rate	Major Fields of Study	Racial/Ethnic Distribution	Mean % FRP Lunch Eligible
Bok	1938	1,000 Students	69%	Building Trades, Cosmetology, Computer Tech, Child Care, Allied Health	76% African-American, 12% Asian, 9% White, 4% Latino	80%
Dobbins	1938	1,600-1,800 Students	72%	Business Ed, Graphics, Computers, Electronics, Food Services, Cosmetology	98% African-American, 2% All Others	80-85%
Mastbaum	1929	1,200 Students	70%	Building Trades, Auto Mechanic, Culinary Arts, Child Care, Business Data Mgmt	54% African-American, 33% Latino, 11% White, 2% Asian	Over 90%
Saul	1943	600-700 Students	87%	Agriculture and Animal Care	57% African-American, 35% White, 5% Latino, 1% Asian	19%
Swenson	2001	800-950 Students	72% (Class of '05 4 Yr Rate)	Construction, Engineering, Information Tech, Transportation Tech, Health Occs, Hotel, Restaurant, Travel & Tourism	48% White, 33% African-American, 14% Latino, 4% Asian	19%

Source: Analysis of School District of Philadelphia data and www.phila.k12.pa.us

The descriptions of each of the CTE schools in the study - their histories, students, and curriculum offerings – are presented below, referencing Table 2.3.

Mastbaum Vocational-Technical High School. Mastbaum High School, founded in 1929, is Philadelphia's oldest vocational-technical high school. During the years that are the focus of this study, the school's career and technical curriculum included traditional CTE electives, including building trades (carpentry, electricity, and welding); auto mechanics; commercial art; and cosmetology. Beginning in 2002 and 2003, Mastbaum began to offer courses of study that reflected 21st century technologies and/or job categories that were expanding in the Philadelphia area. These included culinary arts, child care, business data management, and web design.

During the 2004-2005 school year, approximately 1,200 students were enrolled in the school. Along with the other CTE schools, Mastbaum was allowed to become more

selective with its freshman admissions starting with the Class of 2004 cohort. With the implementation of a screening process for the CTE lottery, Mastbaum's graduation rates have continued to increase over the district-wide graduation rate. The four year graduation rate for Mastbaum's Class of 2005 was 69 percent, compared to a district graduation rate of roughly 52 percent.

Bok Vocational-Technical High School. The success and appeal of Mastbaum High School in its first decade led to the founding of two additional CTE schools in 1938, one of which was the Edward Bok Vocational-Technical School. During the years that the students in this study were in high school, Bok's curriculum offerings included building trades, computer technology, cosmetology, child care, and allied health professions. Beginning in 2003, engineering technology was added, and cosmetology was phased out.

Approximately 1,000 students attended in Bok in each of the study years. The four year graduation rate of Bok's Class of 2005 was 86 percent, 34 percentage points above the district rate.

Murrell Dobbins Career and Technical Education High School. The success of Mastbaum also led to the opening of the Muriel Dobbins Career and Technical Education High School in 1938. During the study years of 1999-2000 to 2004-2005, Dobbins offered a diverse array of CTE courses in the areas of business education, graphic occupations, computers, electronics, cosmetology, food services/baking, and design.

Dobbins is the largest CTE school in the district, with roughly 1600 to 1800 students enrolled each year between the 1999-2000 and 2003-2004 school years. This number dropped to 1,247 for the 2004-2005 school year. The four year graduation rate of Bok's Class of 2005 was 80 percent, a 28 percentage point advantage over the district's four year graduation rate.

W.B. Saul High School of Agricultural Sciences. W.B. Saul High School first opened its doors in 1943 as the Wissahickon Farm School, the first CTE school in the Philadelphia public school system with an emphasis on a specific vocational field: the agricultural industry. To this day, the school's only CTE offerings are in the field of agricultural industry and production.

Approximately 600 to 710 students attended Saul during the study period, with its enrollment hitting a high of 710 students in the 2002-03 school year, trending downward to just fewer than 600 for the 2004-05 school year.

Graduation rates for Saul were very high, even prior to the beginning of the screened lottery process for CTE admission. The six year graduation rate for Saul's Class of 2001 was 83 percent. This rate rose to 87 percent for the Class of 2003. The four year graduation rate for the Class of 2005 was 83 percent, more than 30 percentage points above the four year graduation rate for the school district as a whole.

Swenson Arts and Technology High School. Although only the Class of 2005 could apply to Swenson Arts and Technology High School, this school has existed in several forms since 1977. Swenson opened that year as a half-day skills center for students who attended their home high schools for academic instruction. In 1992, Swenson was transformed into a campus for Abraham Lincoln High School (a neighborhood high school), and over time was transitioned into a full time, comprehensive CTE school. This transition was complete in time for the 2001-2002 school year. Swenson has six career clusters: Construction Technology, Engineering Technology, Information Technology, Transportation Technology, Health Occupations, and the Hotel, Restaurant, Travel and Tourism Academy[6].

Enrollment at Swenson grew slightly between the 2001-2002 and 2004-2005 school years (from 764 to 923 students), making it the second smallest CTE school in the study. The four year graduation rate for Swenson's Class of 2005 was 72 percent, 20 percentage points higher than the four year graduation rate for the district.

The High School Application and Admission Process

Each fall, the high school choice process begins for Philadelphia eighth graders who plan to attend public high schools or who are considering the public schools as an option. Although students can apply to transfer to another school outside of their attendance zone for any grade K-12, the majority of transfer applications are from eighth graders who seek to enroll in various high schools in the city.

The high percentage of students who apply to one or more high schools indicates that school choice has become a normalized part of the transition to high school in Philadelphia. Among students who were eighth graders in the Philadelphia public schools during 1998-1999 (potential members of the Class of 2003), 70 percent applied to at least one high school outside of their attendance zone. For eighth graders in 1999-2000 and 2000-2001, the percentages were 69 percent and 62 percent, respectively. Research on subsequent cohorts of Philadelphia's incoming ninth grade students indicated that this downward trend was an aberration, as rates of students applying to schools outside of their attendance zones have recently increased, reaching 65 percent for the class of 2007, and 73 percent for the class of 2010 (Research for Action, forthcoming).

The School District of Philadelphia publishes annually a high school admissions booklet outlining the various schools and programs to which students may apply and the admission requirements, if any, for each school or program. In November of students' eighth grade year, they submit a completed application form to the guidance counselor at their eighth grade school. A sample high school application form (for the Class of 2009)

[6] We use the term career clusters here as this is what Swenson's website refers to these areas as. These academies do not overlap completely with the definition of career clusters from careerclusters.org.

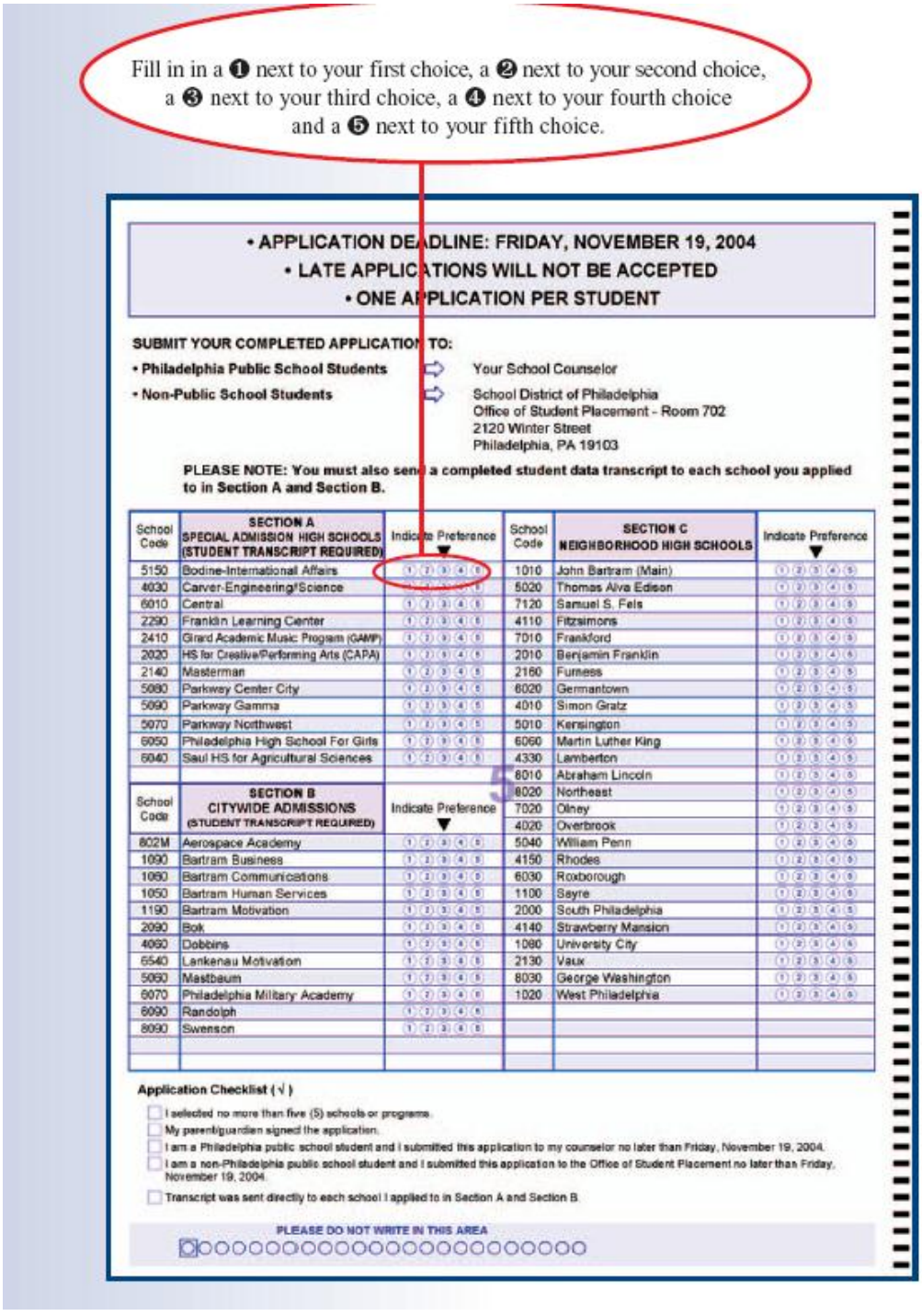
appears in Figure 2.1.[7] The organization of the form and some of the rules governing high school choice for the Class of 2009 were different from those for the Classes of 2003 through 2005, but nevertheless the application form highlights several notable features of the choice program that stayed the same over this period.

One feature of note is that students were permitted to apply to multiple schools or programs. The number of schools to which students were permitted to apply varied from cohort to cohort. For the Classes of 2004 and 2005, we observe in our data that some students applied to as many as ten high schools. For the Class of 2003, some students applied to as many as 16 choices. This large number of applications for the Class of 2003 was due in part to a feature of the application process that year that permitted students to apply to multiple lottery-based programs within the same school.

Second, students were asked to rank their school choices in terms of preference. All else being equal, a student who indicated that a particular school was their first choice had a better chance of being admitted than a student who indicated that the school was a lower-ranked choice on his list of preferred schools.

[7] Since this is a retrospective study, we do not have easy access to application forms from almost a decade ago - when the Class of 2003 was applying to high school. We therefore use a more recent form as an illustration.

Figure 2.1: Sample High School Application Form for Eighth Grade Students, School District of Philadelphia, Fall 2004



Fill in in a ❶ next to your first choice, a ❷ next to your second choice, a ❸ next to your third choice, a ❹ next to your fourth choice and a ❺ next to your fifth choice.

• APPLICATION DEADLINE: FRIDAY, NOVEMBER 19, 2004
• LATE APPLICATIONS WILL NOT BE ACCEPTED
• ONE APPLICATION PER STUDENT

SUBMIT YOUR COMPLETED APPLICATION TO:

- Philadelphia Public School Students ⇨ Your School Counselor
- Non-Public School Students ⇨ School District of Philadelphia, Office of Student Placement - Room 702, 2120 Winter Street, Philadelphia, PA 19103

PLEASE NOTE: You must also send a completed student data transcript to each school you applied to in Section A and Section B.

School Code	SECTION A SPECIAL ADMISSION HIGH SCHOOLS (STUDENT TRANSCRIPT REQUIRED)	Indicate Preference ▼
5150	Bodine-International Affairs	
4030	Carver-Engineering/Science	
6010	Central	
2290	Franklin Learning Center	
2410	Girard Academic Music Program (GAMP)	
2020	HS for Creative/Performing Arts (CAPA)	
2140	Masterman	
5080	Parkway Center City	
5090	Parkway Gamma	
5070	Parkway Northwest	
6050	Philadelphia High School For Girls	
6040	Saul HS for Agricultural Sciences	

School Code	SECTION B CITYWIDE ADMISSIONS (STUDENT TRANSCRIPT REQUIRED)	Indicate Preference ▼
802M	Aerospace Academy	
1090	Bartram Business	
1060	Bartram Communications	
1050	Bartram Human Services	
1190	Bartram Motivation	
2090	Bok	
4060	Dobbins	
6540	Lankenau Motivation	
5060	Mastbaum	
6070	Philadelphia Military Academy	
6090	Randolph	
8090	Swenson	

School Code	SECTION C NEIGHBORHOOD HIGH SCHOOLS	Indicate Preference ▼
1010	John Bartram (Main)	
5020	Thomas Alva Edison	
7120	Samuel S. Fels	
4110	Fitzsimons	
7010	Frankford	
2010	Benjamin Franklin	
2160	Furness	
6020	Germantown	
4010	Simon Gratz	
5010	Kensington	
6060	Martin Luther King	
4330	Lamberton	
6010	Abraham Lincoln	
8020	Northeast	
7020	Olney	
4020	Overbrook	
5040	William Penn	
4150	Rhodes	
6030	Roxborough	
1100	Sayre	
2000	South Philadelphia	
4140	Strawberry Mansion	
1080	University City	
2130	Vaux	
8030	George Washington	
1020	West Philadelphia	

Application Checklist (√)

- ☐ I selected no more than five (5) schools or programs.
- ☐ My parent/guardian signed the application.
- ☐ I am a Philadelphia public school student and I submitted this application to my counselor no later than Friday, November 19, 2004.
- ☐ I am a non-Philadelphia public school student and I submitted this application to the Office of Student Placement no later than Friday, November 19, 2004.
- ☐ Transcript was sent directly to each school I applied to in Section A and Section B.

PLEASE DO NOT WRITE IN THIS AREA

SOURCE: School District of Philadelphia Office of Secondary Education, Planning Guide for 8th Grade Students, 2004.

After student high school application forms were submitted, individual schools and the district began the process of determining which students would receive offers of admission. Students were admitted to high schools through several types of processes. The way in which an admissions decision was reached depended on the categories of schools to which students applied. **Special admissions schools** made their own admissions decisions; **lottery-based programs** made admissions decisions randomly from their pool of applicants.

Special admissions schools. Although admissions materials state that these the special admissions schools screened applicants on the basis of previous academic achievement, attendance, and school behavior, and sometimes an interview and/or audition, almost nothing is known publicly about how school or district personnel weighed this information to come to a final admissions decision. What we do know is that students who applied to multiple special admissions schools could receive more than one offer of admission. For example, if a top-notch student applied to four special admissions schools, she well could have received four offers of admission from these schools. Since special admissions schools are in competition with each other, they need to be mindful of their admissions "yield," much as colleges need to make their own estimations of how many admitted students will enroll. We do not know what kinds of models, if any, the special admissions schools have used to predict yield.

Lottery admissions schools. For the Class of 2003, all students who applied to a lottery-based school were entered into the lottery, regardless of prior academic achievement, attendance, or behavior; there was no initial screening to make sure that applicants in the lottery pool met any particular criteria. The lottery was conducted using a computer algorithm that took into account student racial/ethnic background in order to promote racial balance (see below). A lottery for each school was first conducted for students who ranked that school as their first choice. Students who were admitted to their first-choice school or program were taken out of the lottery for any subsequent choices they listed; **students could receive only one offer of admission to a lottery-based school or program.** After this first round of the lottery was conducted, any student who did not receive admission at their first choice school and who had indicated a second choice school was entered into a second round of the lottery. If a student was not a "winner" in the second round, then the lottery tried to place students in their third-choice school. This process was repeated for as many choices as students had made, up to the maximum number allowed (in years when a maximum was stipulated).

For the Classes of 2004 and 2005, the admissions process for at least some **lottery schools** had two stages. The Career and Technical schools that are the focus of the paper used this two-stage process. The first stage was the *crafting of the lottery pool*. At this stage, applicants were screened by the individual schools for having requisite academic, attendance, and behavioral characteristics and, sometimes, based on their interest in the career fields offered and/or performance in an interview. In the second stage, *the lottery was conducted for students who had been "screened in" to the lottery*. The lottery for each school was conducted first for students who had indicated that the school was their

first choice, then for students who had indicated that the school was their second choice, and so on.

The number of acceptances that students received depended in part on whether they applied only to lottery admissions schools. Students who applied only to lottery-based programs could be accepted only to one program; in the end, their choice about which school to attend was between their neighborhood high school and the one other school to which they had been accepted. Students who applied to multiple special admissions schools, or to at least one special admissions school and at least one lottery-based school, however, had the possibility of being accepted to more than one school.

The Impact of Desegregation on High School Admissions

Regardless of whether the high school selected students on the basis of previous achievement and behavior or uses a lottery to admit students, all schools were required to seek racial balance. This requirement stems from a series of court orders starting in 1972. Philadelphia's main strategy for creating racially balanced public schools has been its option for parents to seek school transfers for their children.

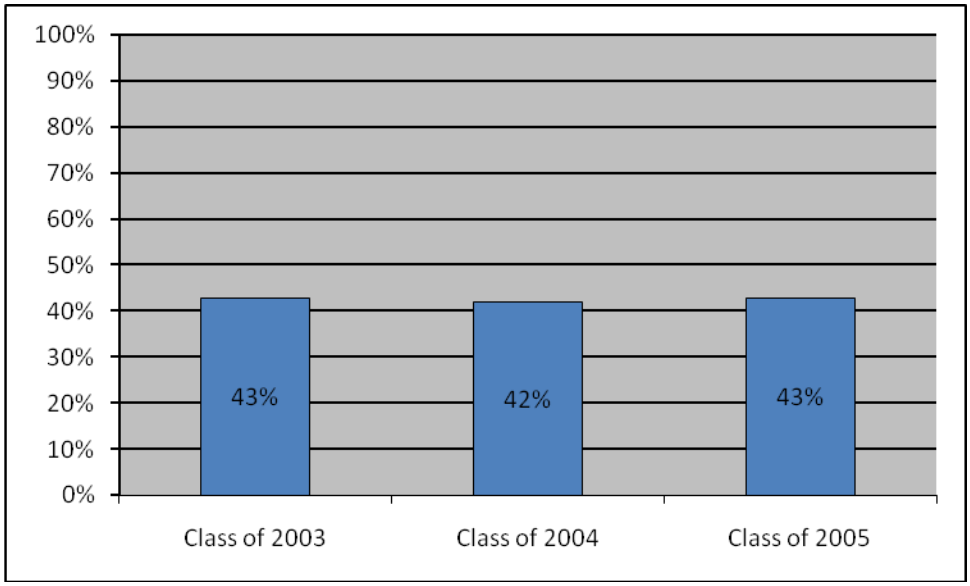
This requirement of seeking racial balance means that student racial/ethnic background is taken into account in determining which students will be admitted. Previous research on acceptances at special admissions schools shows that White students, who are a numeric minority in the public schools, have higher odds of being admitted to a special admissions school, all else being equal (Neild, 1999). Regressions predicting acceptance to a CTE school for the Classes of 2003, 2004, or 2005 show that the only set of student characteristics that consistently predicts acceptance is racial or ethnic background (see Tables 3.6 – 3.8). We do not have the access to the specific formula that the district used to admit students based on their racial or ethnic background. Specific information on how admissions rates varied by student demographic factors are described in Chapter Five.

Demand for Career and Technical Schools in Philadelphia

By almost any measure, the CTE schools in Philadelphia were a strong draw among rising ninth graders. Although it is not clear how much students were interested in CTE schools because they hoped to escape chaotic or dangerous neighborhood high schools or because they were genuinely interested in the career and technical offerings of the schools, what *is* clear is that the schools were substantially oversubscribed. Among students who were eighth graders during the 1998-1999 school year (and who, therefore, were potential members of the Class of 2003), 43 percent (a total of 6,647 students) applied to at least one CTE high school; among those who applied to any school (including special admit schools and neighborhood high schools), 61 percent applied to a CTE school. The percentages were similar for the Classes of 2004 and 2005: 42 percent

(8,825 students) and 43 percent (5,371 students) of all eighth graders, respectively, applied to at least one CTE school (Figure 2.2).

Figure 2.2: Percentage of 8th Grade Students Applying to at Least One CTE School for 9th Grade



SOURCE: Analysis of student data from the School District of Philadelphia.

When the demographics of applicants to CTE schools *as a group* are compared to those of non-applicants, it is clear that while there are some notable demographic differences, there are relatively small differences in terms of prior academic achievement. In other words, as a group, CTE applicants are broadly representative of students as a whole in the school district, at least in terms of observable academic characteristics. They are not the weakest students, nor are they the "cream of the crop." A wide range of the students in the district apply to at least one CTE school for high school.

Table 2.4 shows that a higher percentage of CTE applicants than non-applicants were African American and a smaller percentage were Asian or White. Hispanic students were represented more or less equally within CTE applicants and non-applicants. While not shown in Table 2.4, applicants to CTE schools were almost evenly divided between males and females (just over 50 percent female for all classes).

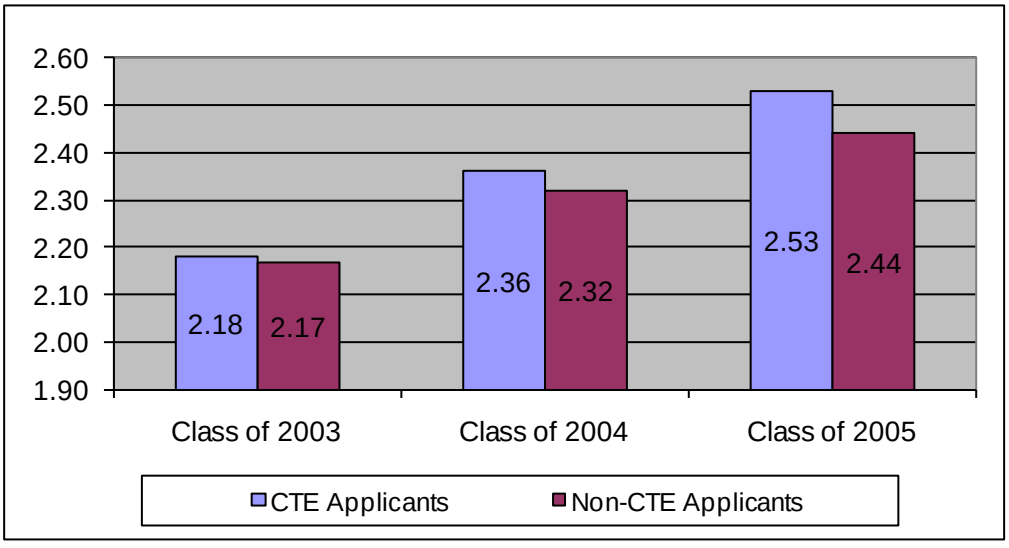
Table 2.4: Race/Ethnicity of Students, by Cohort and Application to a Career and Technical School (Percentages)

	Class of 2003		Class of 2004		Class of 2005	
	CTE Applicants	Non-Applicants	CTE Applicants	Non-Applicants	CTE Applicants	Non-Applicants
African-American	72.7%	60.6%	72.3%	61.6%	69.2%	62.9%
White	12.6	21.2	12.5	20.9	14.8	19.1
Hispanic	10.7	11.9	11.3	11.8	11.7	10.6
Asian-American	3.8	6.1	3.7	5.6	3.7	7.1
Other (including Biracial/Multiracial)	0.3	0.2	0.2	0.2	0.6	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	7,024	9,902	7,428	11,273	7,842	10,966

SOURCE: Analysis of student data from the School District of Philadelphia.

Although there are slight differences between CTE applicants and non-applicants in terms of eighth grade GPA, attendance, and scores on the PSSA (the state's standardized student assessment), the differences are relatively minor. Students who applied to CTE schools had an average eighth grade GPA that was slightly above that of non-applicants (Figure 2.3). In addition, for each class, the mean eighth grade attendance rate for those who applied to CTE schools was approximately one percentage point higher than for those who did not apply to CTE schools.

Figure 2.3: Mean 8th Grade GPA, by Cohort and Application to a Career and Technical School



SOURCE: Analysis of student data from the School District of Philadelphia.

On the state eighth grade assessment of reading and mathematics skills, CTE applicants were virtually indistinguishable from non-applicants in the distribution across "Below Basic," "Basic," "Advanced," and "Proficient" categories (Tables 2.5 and 2.6). CTE applicants were somewhat less likely than non-applicants to score at the Proficient or Advanced Level. At the same time, between 16 and 21 percent of the CTE applicants scored at the Proficient or Advanced levels, indicating that a cross-section of students applied to at least one CTE school. In mathematics, a district-wide increase in the percentage of students scoring Basic or above was accompanied by an increase in the percentage of CTE applicants with scores at this level.

Table 2.5: Percentage of Students in Each Proficiency Category on the Eighth Grade State Standardized Test in Reading, by Cohort and Application to a Career and Technical High School

	Class of 2003		Class of 2004		Class of 2005	
	CTE Applicants	Non-Applicants	CTE Applicants	Non-Applicants	CTE Applicants	Non-Applicants
Below Basic	56.6%	53.1%	59.6%	55.3%	51.2%	53.7%
Basic	25.5	24.4	24.3	23.2	28.1	24.0
Proficient	15.8	18.3	14.3	17.2	18.8	19.1
Advanced	2.1	4.2	1.8	4.2	1.9	3.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	7,024	9,902	7,428	11,273	7,842	10,966

SOURCE: Analysis of student data from the School District of Philadelphia.

Table 2.6: Percentage of Students in Each Proficiency Category on the Eighth Grade State Standardized Test in Mathematics, by Cohort and Application to a Career and Technical High School

	Class of 2003		Class of 2004		Class of 2005	
	CTE Applicants	Non-Applicants	CTE Applicants	Non-Applicants	CTE Applicants	Non-Applicants
Below Basic	70.8%	66.5%	73.5%	68.8%	64.3%	63.8%
Basic	18.1	18.0	15.0	15.3	22.5	20.8
Proficient	10.0	12.6	10.4	13.1	12.0	12.7
Advanced	1.2	2.9	1.2	2.8	1.3	2.8
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	7,024	9,902	7,428	11,273	7,842	10,966

SOURCE: Analysis of student data from the School District of Philadelphia.

Demand for Specific Career and Technical Schools

Although *as a group*, CTE applicants were reasonably comparable to all eighth graders in terms of gender, race and ethnicity, GPA, attendance, and scores on the eighth grade state assessment, there were substantial differences by school in the demographic and academic characteristics of the applicant pool. **It is important to be aware of these between-school differences in the applicant pools because they carry over into differences in the characteristics of students who are admitted and, ultimately, who attend the schools.** It also underscores the importance of comparing outcomes on a school-by-school basis; on average, students who applied to Saul are not the same kinds of students who applied to Bok.

The racial/ethnic composition each school's applicant pool varied greatly (Table 2.7). For example, in each cohort, 92 percent of the applicant pool at Dobbins was African American, in contrast to roughly 60 percent at Mastbaum. Similarly, while White students formed just 5 percent of the applicant pool at Bok, they consistently were about 20 percent of the applicants at Saul. Latino students had a clear preference for Mastbaum over any of the other CTE schools.

Table 2.7: Racial and Ethnic Composition of Applicants, by Career and Technical High School and Cohort (Percentages)

	Bok	Dobbins	Mastbaum	Saul	Swenson
Class of 2003					
African American	85.7%	92.0%	61.2%	66.7%	--
Asian	5.7	1.5	4.0	4.8	--
Latino	2.9	4.2	20.2	6.5	--
White	5.6	2.2	14.7	21.4	--
Class of 2004					
African American	83.7%	92.4%	62.4%	64.9%	--
Asian	7.1	0.9	2.1	3.2	--
Latino	2.9	4.5	21.2	7.2	--
White	6.2	2.1	14.2	24.5	--
Class of 2005					
African American	82.3%	91.9%	60.9%	63.0%	56.0%
Asian	6.0	1.3	2.6	3.4	4.0
Latino	3.9	4.4	22.2	9.4	11.9
White	7.6	2.0	13.6	24.3	27.6

SOURCE: Analysis of student data from the School District of Philadelphia.

There was a clear hierarchy among the CTE schools in terms of the academic skill level of their applicant pools, as demonstrated through scores on the state's standardized test for eighth graders (Table 2.8). Saul High School – the agricultural school - had a higher achieving applicant pool than the other CTE schools; it consistently had higher

percentages of applicants scoring at the advanced or proficient level and fewer applicants at the Below Basic level. Among the remaining three schools, Mastbaum (and Swenson, for the Class of 2005) had the most academically accomplished pool of applicants. Bok and Dobbins fell below the other schools in terms of eighth grade GPA and state standardized test scores, with Dobbins applicants very slightly outperforming Bok applicants.

Table 2.8: Percentage of Applicants Scoring Below Basic and Advanced/Proficient on Eighth Grade Math and Reading Test, by School and Cohort

	Bok	Dobbins	Mastbaum	Saul	Swenson
Class of 2003					
Reading					
Below Basic	62.9%	60.8%	56.4%	47.3%	--
Advanced/Proficient	13.1	13.9	17.8	26.2	--
Mathematics					
Below Basic	76.2	75.1	70.0	62.1	--
Advanced/Proficient	7.4	8.2	11.8	16.5	--
Class of 2004					
Reading					
Below Basic	65.7%	65.3%	61.4%	48.7%	--
Advanced/Proficient	11.3	12.0	14.3	24.4	--
Mathematics					
Below Basic	79.0	78.9	74.7	64.8	--
Advanced/Proficient	7.7	8.4	10.3	17.2	--
Class of 2005					
Reading					
Below Basic	57.9%	56.5%	53.9%	40.4%	46.7%
Advanced/Proficient	15.1	15.5	18.6	30.6	24.1
Mathematics					
Below Basic	69.5	70.7	67.2	54.9	61.8
Advanced/Proficient	9.6	8.5	11.9	19.4	15.1

SOURCE: Analysis of student data from the School District of Philadelphia.

A Final Note on Context: The Impact on High Schools of the State Takeover

In December 2001, a decade of conflict between the City of Philadelphia and the Commonwealth of Pennsylvania over the funding and management of the city's public school system culminated in an agreement in which the state assumed control of the city's schools. The agreement replaced Philadelphia's Board of Education with a School Reform Commission, comprised of three members named by the Governor and two members appointed by the Mayor.

Even in the months prior to the state takeover, the state's interest in exploring private sector involvement in managing schools had been evident. Acting Governor Mark Schweiker advocated hiring Edison Schools, Inc. to assume many of the functions of the school district's central office and to manage 60 low performing schools (Christman, Gold, and Herold, 2006). Under considerable pressure from community groups and the city, the state scaled back its envisioned role for Edison Schools, Inc. and other private education management organizations. Central office functions were not privatized, but Edison and several other for-profit and non-profit education management organizations were awarded contracts to manage approximately 45 schools. An additional 30 low-performing schools were given additional per-pupil resources and/or grouped into a special organizational unit within the school district in order to provide support for their improvement.

As background to this analysis of outcomes for students in Career and Technical High Schools, it is important to know that only one of the city's public high schools - a neighborhood high school - came under the management of a private provider. The experiment with private management of schools that unfolded in Philadelphia was really a case of private management of elementary and middle schools. *The Career and Technical high schools that are the focus of this report had no private school managers to which they were required to report.*

Until 2003, Philadelphia's high schools were almost unaffected by the state takeover, at least in comparison to the elementary and middle schools. In fall 2003, however, School District of Philadelphia CEO Paul Vallas initiated a "Secondary Education Movement" for the city's high schools. There were two main features of this initiative: 1) a core curriculum in academic subjects, developed by Kaplan K12 Education Services; and 2) the development of new non-charter "small schools," organized around occupational and academic themes. The Class of 2003 would have been untouched by the high school initiative, except perhaps for those members of the class who remained in high school past June 2003. For the high school Classes of 2004 and 2005, only the first part of the initiative - the core curriculum - is likely to have had much of an impact on their school experiences, and even then, the impact would have been limited to their later years in high school.

CHAPTER THREE

STUDY DESIGN

This study has two main parts: 1) a descriptive analysis of the availability of career and technical courses in Philadelphia's public high schools, and 2) an assessment of key academic outcomes for students who were accepted to one of the Career and Technical high schools. To assess academic outcomes, this study takes advantage of a "natural experiment" in the School District of Philadelphia, in which applicants to Career and Technical high schools were randomly selected to be offered admission to a school. This section of the report describes the research design, variables, and statistical models that we used to produce the analysis of access to Career and Technical courses and estimates of academic impacts.

Definition of the Three Cohorts of Students

Our analysis focuses on the availability of Career and Technical courses and on academic outcomes for students who were members of the School District of Philadelphia high school Classes of 2003, 2004, and 2005. For our analysis of the availability of Career and Technical courses (Chapter 4), we examine the courses that were available to *any* student who was a member of one of those cohorts in Philadelphia, regardless of whether he or she had applied to one of the Career and Technical high schools.

For the analysis of academic outcomes for students who applied to a Career and Technical high school (Chapter 5), we restrict our focus to students who:

1) attended Philadelphia public schools for eighth grade *and*
2) applied to a Career and Technical high school for ninth grade in the autumn of 1998 (the Class of 2003), 1999 (Class of 2004), or 2000 (Class of 2005) *and*
3) attended a Philadelphia public high school during the following school year.

Eighth grade students who applied to a Career and Technical high school but were not promoted to ninth grade for the next school year were not included in this analysis. Students who transferred into the district in ninth grade or later were not included in the analysis. Likewise, students who left Philadelphia's public schools before beginning high school were excluded from the analysis, since their academic outcomes for high school could not be observed.

General Description of Data Sets

The analyses presented in this report rely entirely on administrative data sets obtained from the School District of Philadelphia. These data sets provide individual-level information about students: their course-taking, course grades, progress toward high school graduation, attendance, test scores, schools attended, and high school choice participation and outcomes. These data sets cover the period from School Year 1998-1999 through School Year 2004-2005 (the on-time graduation date of the Class of 2005). The files contain a unique identifier for each student so that their data can be combined into a longitudinal data set. Comparisons of the data observed in the administrative data sets to publicly available data sources for overlapping measures, as well as inspection of data through the merging of various sub-data sets, provided confidence that the data were accurately recorded and reported for the population.

The types of data sets we use and the associated variables for each are as follows:

- Courses taken, course grades, and credits earned. For each school year, the course taking file provides a list of courses in which each student was enrolled; the final course grade (A-F) received for each course; the number of credits that the student earned for the course; and the academic area in which the student earned that credit. Academic areas include core subjects required for graduation (mathematics, English, social studies, and science) and elective credits.

- Enrollment, graduation, and withdrawal from school. For each school year, these files contain two key variables that indicate whether the student's *last known status for that school year* was "enrolled," "withdrawn," or "unclear." Students who were no longer listed on the district's enrollment rolls for any reason were listed as "withdrawn." A second variable provides detail on the reason for a student's withdrawal from the school district. For example, a student could have been removed from the school rolls because he or she graduated, dropped out, died, or transferred to another school district, among other reasons.

- Attendance. For each school year, the number of days present at school and the number of days enrolled in school is available. These two variables permit a calculation of the attendance rate.

- High school choice variables. This file identifies each high school to which the student applied; whether each school was the student's first choice, second choice, and so on; the outcome of that student's application (accepted or not accepted to each school); and if the student was not accepted, the reason why (for example, GPA or attendance was too low to meet the school's standards for admission).

- Miscellaneous student-level data. These files include demographic data, including race/ethnicity, gender, and birth date; coding for exceptionalities, including

receiving special education and/or English-Language-Learner services; and the *last* school attended for that school year.

- School-level data. These data include percentage of students who are low income at the school and whether the school is a CTE school, neighborhood high school, or special admissions school.

Study Design for Analysis of CTE Outcomes

In the most basic sense, this study examines the impact of the opportunity to attend a Career and Technical high school on academic outcomes. We take advantage of a natural experiment in Philadelphia in which applicants to the city's Career and Technical high schools were randomly selected to receive an offer of admission. This natural experiment allows us to control for student interest in Career and Technical high schools as well as family or school support or student initiative that would lead the student to participate in the high school choice process in the first place. In this section, we review and expand on important features of the lottery system and district records about applications and acceptances as they relate to our construction of the treatment and control groups.

Students Included in this Study

Studies of school choice repeatedly have shown that students who participate in school choice programs differ in important ways from those who do not participate. Often, students who apply to any school outside of their attendance zone have higher test scores, report card grades, and/or attendance than those who do not apply (Moore and Davenport, 1990; Martinez et al, 1995); likewise, their parents are more likely to have completed more schooling and to have been more involved at the students' previous school (Furstenburg et al, 1999, Martinez et al, 1995). Further, students who apply to Career and Technical schools may have different occupational and academic interests from those who do not apply to such schools. In order to control for the potential bias that these factors may introduce, this study examines outcomes *only* for students who applied to at least one of the CTE schools.

For the Class of 2003, all students who applied to each particular Career and Technical school were entered into the lottery; there was no shaping of the lottery pool by screening out applicants on the basis of unacceptable prior attendance, course grades, behavior, or performance in an interview. Therefore, for the Class of 2003, all applicants appear in this study, either as treatment or control.

However, for the Classes of 2004 and 2005, each school conducted a pre-screening of applicants. In each of the CTE schools, a substantial percentage of applicants were excluded from the lottery as a result of this screening process. Table 3.1 shows the percentages of applicants who were not entered into the lottery at each school,

for each cohort. For both cohorts, Dobbins and Saul screened out more than half of their applicants. The percentage of applicants screened out of the lottery by Mastbaum rose a full 23 percentage points between the Class of 2004 and the Class of 2005.

Table 3.1: Percentage of Applicants Not Entered into the Lottery, By School and Cohort

	Class of 2004	N not entered	Class of 2005	N not entered
Bok	37.3%	950	42.6%	1,044
Dobbins	53.8	1,976	55.0	1,915
Mastbaum	43.4	1,481	65.1	2,148
Saul	52.4	914	55.5	904
Swenson	n/a	n/a	60.2	1,188

SOURCE: Analysis of student data from the School District of Philadelphia.

A comparison of students who were *screened in* to the lottery and those who were *screened out* indicates that the Career and Technical schools shaped their lotteries to include higher achieving students and those who had better attendance in the middle grades. Table 3.2 compares characteristics of applicants in the Class of 2005 for each CTE school, by whether they were entered into the lottery.

At each CTE school, applicants who were not entered into the lottery had, on average, lower eighth grade GPAs, lower eighth grade standardized test scores in reading and math, and lower eighth grade attendance rates than students who were allowed to participate in the lotteries. At some schools, the differences were quite stark between the students who were entered into the lottery and those who were not. At Saul, for example, 71 percent of those who were screened out of the lottery scored Below Basic on the eighth grade standardized test of reading, in comparison to 25 percent of those who were entered into the lottery.

Applicants who were not entered into the CTE school lotteries also were disproportionately male and overage for their grade. At Bok, African American students disproportionately were entered into the lottery, but at Mastbaum and Saul, they were disproportionately screened out of the lottery.

For this study, we consider a student to have been entered into the lottery only if he or she successfully made it through this initial screening. Put differently, each student in our treatment and control groups for the Classes of 2004 and 2005 was *screened into* the lottery at one or more of the Career and Technical schools. Further, since the Class of 2003 had no screening criteria, and since the criteria may have been applied differently to the Classes of 2004 and 2005, we compare outcomes for students accepted to a particular high school *only* to those students who applied but were not

accepted to that school for the same cohort. This strategy ensures that we compare outcomes for students who are indeed comparable.

As we showed in Chapter 2, there is considerable difference between schools in the academic and demographic features of their applicants. For the Classes of 2004 and 2005, the pre-screening of students prior to conducting the lottery reduced some of these differences, but some differences remained in the applicants pools. These differences are clearly observable in Table 3.2. For example, while approximately 60 percent of the students who were entered into the lottery at Bok, Dobbins, and Mastbaum scored at the Below Basic level in mathematics, fewer than 40 percent of those entered into Saul's lottery scored at that level.

Treatment Crossover

In addition to the Career and Technical high schools, there were numerous other public high schools in the city to which students could apply. Students could have been accepted to more than one high school, with acceptance contingent on the specific combination of schools to which they applied as well as their academic, attendance, and behavior histories. Students who were accepted to multiple high schools would have to make a decision about which offer of admission to accept. Even if they were accepted only to one high school, they still were faced with a decision of whether to accept that offer or attend their default neighborhood high school.

The fact that the high school choice system in Philadelphia made *offers of admission to high schools* rather than *placements at high schools* means that there were many students who were, in research parlance, "assigned to the treatment" but did not experience that treatment. Rather, they attended their neighborhood high school, a special admissions school, or left the non-charter public system entirely. In addition, there were a few students for whom we have no record of their admission to a particular Career and Technical school but who appear on that school's rolls for ninth grade anyway. These students were assigned to the control group but managed to experience the treatment anyway. We take into account these crossover students in our estimates of Treatment-on-Treated (TOT) and Local Average Treatment Effects (LATE), described below. Table 3.9 displays the treatment crossover patterns.

Table 3.2: Comparison of Class of 2005 Applicants Who Were Entered and Not Entered into the Lottery, by School

	Bok		Dobbins		Mastbaum		Saul		Swenson	
	ENTERED LOTTERY	DID NOT ENTER	ENTERED LOTTERY	DID NOT ENTER	ENTERED LOTTERY	DID NOT ENTER	ENTERED LOTTERY	DID NOT ENTER	ENTERED LOTTERY	DID NOT ENTER
DEMOGRAPHIC VARIABLES										
% FEMALE	59.96	51.66	60.67	55.11	55.59	50.07	60.24	46.47	44.27	43.26
% AFRICAN-AMERICAN	76.43	86.73	89.47	91.13	55.63	62.56	54.38	66.43	48.33	59.11
% WHITE	8.17	6.54	1.90	2.02	14.38	12.85	28.97	19.11	31.78	23.96
% HISPANIC	5.50	5.17	6.02	6.00	26.25	21.17	11.59	11.07	13.35	12.67
% ASIAN-AMERICAN	9.47	1.37	2.09	0.53	2.77	2.60	4.16	2.91	5.34	3.13
% BIRACIAL/MULTIRACIAL	0.43	0.20	0.52	0.32	0.98	0.82	0.89	0.47	1.20	1.13
% ENTERING 9TH GRADE OVERAGE	15.18	20.04	11.57	19.43	13.64	19.46	5.36	15.75	16.64	16.17
ACADEMIC VARIABLES										
MEAN 8TH GRADE GPA	2.63	2.11	2.70	2.29	2.77	2.37	3.01	2.43	2.70	2.43
% "BELOW BASIC" ON PSSA-READING	48.93	71.01	44.78	66.61	45.33	58.84	24.77	53.53	40.45	50.79
% "BELOW BASIC" ON PSSA-MATH	61.40	81.17	61.33	78.64	58.39	72.18	38.76	68.45	55.62	65.93
MEAN 8TH GRADE ATTENDANCE RATE	91.50	84.41	92.45	86.84	92.82	86.32	94.07	88.49	91.90	88.61
N	1,409	1,044	1,570	1,915	1,153	2,148	725	904	787	1,188

SOURCE: Analysis of student data from the School District of Philadelphia.

Classification of Students as Applicants, Treatment Group Members, and Control Group Members

In this section, we outline our decision rules for classifying students as 1) applicants; 2) treatment group members for a particular cohort and school; and 3) control group members for a particular cohort and school. These details are particularly important with regard to classifying students as treatment or control students, since we had to make some assumptions in categorizing a subset of these students.

Identification of CTE Applicants

Using a data file that includes student identifiers and the school district numbers of the specific high schools to which the student applied, we are able to determine which students applied to each of the CTE schools. This file includes whether each school is the student's first choice school, second, choice school, and so on.

Identification of Applicants who were "Screened Out" of the CTE Lotteries

For the Classes of 2004 and 2005, some applicants were not entered into the lottery at one or more of the CTE schools to which they applied because they were "screened out" on the basis of middle grades academic achievement, attendance, behavior, and/or perhaps other indicators of which we are not aware. Two specific variables alert us to the students who were "screened out" of the lotteries:

1) **A status code**. Students received a code of "1" if they were accepted; "2" if the student was not accepted to and/or did not attend the school; "3" if the student was waitlisted; or "4" if no action was taken on the application.

2) **A basis code.** For those who received a status code of "2," indicating that they were not accepted to and/or did not attend the school, a second code indicated the "reason for disapproval." These reasons are placed beside each school to which the student applied but was not accepted and/or did not attend.

Students receive a status code and a basis code for <u>each school</u> to which he or she applied. These data provide information on the student's admission status at each school.

We coded as "not enrolled in the lottery" any application with a status code of "2" and one of the basis codes shown in Table 3.3. The full list of school choice status and basis codes appears in Table A.1, located in the Appendix. By far, the most commonly assigned code among those who were not entered into the lottery was "58": "The interview and/or screening criterion was not met." This appears to be a catch-all code, since "screening criterion" could include grade, test scores, attendance, behavior, or any other information deemed relevant about the student. *Since a code of "58" for a*

particular school indicates that the student was not entered into the lottery, these students were removed from the analysis for that school. They were placed neither in the treatment group nor the control group.

Table 3.3: Disapproval Reasons Given for Students who Applied to CTE Schools

BASIS NUMBER	BASIS DESCRIPTION
54	DISAPPROVAL - INCOMPLETE DATA ON STUDENT TRANSCRIPT
56	DISAPPROVAL - THE PUPIL PROGRESS REPORT REQUIREMENTS WERE NOT MET
57	DISAPPROVAL - THE ATTENDANCE AND/OR LATENESS RECORD UNSATISFACTORY
58	DISAPPROVAL - THE INTERVIEW AND/OR SCREENING CRITERION WAS NOT MET
59	DISAPPROVAL - THE AUDITION AND/OR PORTFOLIO CRITERION WAS NOT MET
60	DISAPPROVAL - THE INTERVIEW, TESTING OR AUDITION WAS NOT ATTENDED
61	DISAPPROVAL – APPLIED TO MORE THAN THE PERMITTED NUMBER OF SCHOOLS
62	DISAPPROVAL - THE PROGRAM IS NOT AVAILABLE

SOURCE: School District of Philadelphia Office of Secondary Education

Classification of Students into Treatment and Control

As we worked on the high school choice files from the school district, we observed that there were some applicants whose admissions status could be identified with certainty and others whose admissions status we would need to estimate. Our lack of certainty regarding the admissions status of a subset of students in each cohort arises from the fact that the school district overwrote its electronic high school choice data files after the admissions season was over and students had both received their acceptances and made their choice of where to attend high school. In addition, the lottery is not reproducible because the district used the date and time on the computer at the moment the lottery was begun as the "seed" for conducting the random selection of students.

Using the status and basis codes described above, we can identify some applicants who unquestionably were accepted to a CTE school to which they applied. These students have a basis code of "1," indicating that they were admitted to a particular CTE school. As confirmation, with few exceptions, the students who received a basis code of "1" for a particular school are listed in district data as having attended that CTE school for ninth grade. Conversely, with few exceptions, those who attended a CTE school for ninth grade have a basis code of "1".

However, for students who were entered into a lottery for a CTE school but did not attend that particular school for ninth grade, it is more difficult to determine whether they were admitted. For these students, we cannot determine from the status and basis codes for each CTE school alone whether the student was 1) admitted to a particular CTE school and chose not to attend the school, or 2) was not admitted to the CTE school and therefore did not have the option of attending. These students have a basis code of "3," indicating "Accepted Placement at Another Approved School Listed." The insertion of this basis code occurred when the files were overwritten after the admissions season. An "approved school" could have been the student's own neighborhood high school, or another lottery-based school, or one of the selective admissions schools. **It is important to note that in all cases where we cannot conclusively determine admissions outcomes, the student did not attend the CTE school of interest.**

For some of these students with basis codes of "3", we can make a reasonable inference that they were not admitted to a CTE school. We can infer this because one of the features of high school choice in Philadelphia is that students could only be admitted to one lottery based school. Therefore, if a student received a status code of "1" to a school other than the CTE school for which we are trying to determine admission, then that student could not possibly have been accepted to the CTE school of interest.

Once we use these strategies to determine whether students were admitted, some students remain whose admissions status is unknown. In many cases, these were students who also had applied and were admitted to one or more special admissions schools and chose to attend one of these special admissions schools. Table 3.4 shows the percentage of students whose status was unknown for each school and cohort, after we had identified 1) students who received a basis code of "1," indicating admission to a CTE school, and 2) students who received a basis code of "1" to another lottery school, indicating that they could not have been accepted to the CTE school of interest.

For each school and each cohort, there are a non-trivial percentage of students whose admissions status cannot conclusively be known. Second, the percentages of applicants whose admission status is unknown are higher for the Class of 2003 than for either the Class of 2004 or 2005. For Bok, the percentage of unknowns among Class of 2003 applicants is dramatically higher than that of either of the successive two cohorts. However, for the Classes of 2004 and 2005, only Saul has a percentage of unclear students that exceeds 26 percent. In most cases, the percentages are in the range of 20 percent to 25 percent.

Table 3.4: Percentages of Students Accepted, Not Accepted, and of Unclear Status in School District Data, By School and Cohort

	Class of 2003	Class of 2004	Class of 2005
Bok			
Accepted	13%	23%	24%
Not accepted	21	58	52
Unclear	65	19	23
N	2,666	1,597	1,409
Dobbins			
Accepted	17%	39%	45%
Not accepted	50	43	30
Unclear	33	18	25
N	3,715	1,697	1,570
Mastbaum			
Accepted	16%	28%	44%
Not accepted	52	55	30
Unclear	32	18	26
N	3,164	1,935	1,153
Saul			
Accepted	12%	31%	40%
Not accepted	46	31	25
Unclear	41	38	35
N	2,056	829	725
Swenson			
Accepted	n/a	n/a	37%
Not accepted	n/a	n/a	45
Unclear	n/a	n/a	18
N	n/a	n/a	787

SOURCE: Analysis of student data from the School District of Philadelphia.

Random Assignment of Students with Unclear Admissions Status to Treatment or Control

For students whose admissions status was unclear, we randomly designated a percentage of these students as "accepted" or "not accepted" using a simulated lottery. We cannot mimic the school district's lottery exactly, since we do not know the precise way in which student race/ethnicity was taken into account in selecting students. Further, we can only estimate the percentage of students who were accepted in the first round of the lottery for each school, the percentage accepted in second round, and so on. It is important to remember that none of the students whose admission status was unclear – and therefore whom we included in the simulated lottery – actually attended a CTE school. We simply designate some of the students with an unknown status as "treatment" students and some as "control" in order to calculate Intent-to-Treat effects and Local Average Treatment Effects (described below).

Our specific strategy for selecting students was as follows. We examined acceptance rates for those whose admissions status was known, for each school and each cohort. Since acceptance rates are higher for students who indicate that the school is a more preferred choice, we calculated an acceptance rate for each ranking, each school, and each cohort. For example, among members of the Class of 2004 who ranked Bok as a first choice and whose admissions status we could determine using strategies outlined above, we determined that 74 percent were accepted. Therefore, for students whose admissions status was unclear and who had listed Bok as a first choice, we randomly designated 74 percent of these students as "accepted."

We repeated this same strategy for students whose admissions status was unclear and who had ranked one of the other CTE schools as their first choice. To mimic the school district's lottery, any student who was accepted at a first choice CTE school was automatically designated as "not accepted" at any of the other CTE schools to which he or she had applied. Next, we randomly designated as "accepted" students who ranked a CTE school as a second choice and who had not been designated as "accepted" in our first round of random selection. We repeated this process for seven rounds for the Class of 2003 and 10 rounds for the Classes of 2004 and 2005. We stopped at seven rounds for the Class of 2003 because the admission rates were negligible after that point.

Tables A.2 through A.4 (located in the appendix) show how the percentage of applicants designated as "accepted," "not accepted," and "unknown" changed with each round of the lottery that we simulated. The final column of each of these tables indicates the final percentage and number of students at each school who were considered "accepted" and "not accepted" for this study.

Tables A.5 through A.7 (in the appendix) indicate the percentage of students who we estimated were accepted at each round, for each school. We used these percentages to accept students in the simulated lottery for those whose admissions status was unclear.

Comparison of Treatment and Control Groups

Table 3.5 summarizes the percentage of students whom we designated as accepted at each CTE school and the total number of applicants, for each year. The accepted students include those whose school district data indicated that they had been accepted as well as students who were "winners" in the simulated lottery that we conducted. The admissions rates for the Class of 2003 are considerably lower than those for the Classes of 2004 and 2005 because in the two latter years, schools screened out a considerable percentage of students *prior* to conducting the lottery.

Table 3.5: Percentage and Number of Students Designated as Accepted for this Study, by School and Cohort

	Bok	Dobbins	Mastbaum	Saul	Swenson
Class of 2003					
% accepted	22.02	24.60	22.44	20.18	--
N in lottery	2,666	3,715	3,164	2,506	--
Class of 2004					
% accepted	36.94	52.56	41.29	65.38	--
N in lottery	1,597	1,697	1,935	829	--
Class of 2005					
% accepted	40.45	62.61	64.35	69.93	49.68
N in lottery	1,409	1,570	1,153	725	787

SOURCE: Analysis of student data from the School District of Philadelphia.

To assess whether the lotteries really appear to have been conducted randomly, we examined the predictors of being accepted to each of the schools for each of the cohorts. If we were to see few or no statistically significant predictors of acceptance, then we would have confidence that a randomized lottery actually took place. Tables 3.6 through 3.8 present estimates from these logistic regressions.

In the main, the academic and attendance differences between those who were accepted and those who were not are not statistically significant. In cases where academic or attendance differences are statistically significant, the magnitude of the difference is miniscule (for example, the eighth grade mathematics score for Bok for the Class of 2004). An exception is that for some years and some schools, Special Education students were less likely to be accepted. Since a "Special Education" classification includes a broad spectrum of disability, including mental retardation and physical disabilities such as blindness, it is possible that the schools could not provide the specialized services that some of their Special Education applicants would have needed to succeed.

There are two sets of variables that are consistently significant predictors of acceptance. First, a student's race or ethnicity is a predictor in at least two schools in each cohort. For example, for the Class of 2003, African American students had lower odds than Whites of being accepted to Bok and Mastbaum, but twice the odds of Whites of being accepted to Dobbins. These effects demonstrate that in most cases the lotteries are not completely random because of the need to achieve racial balance in these schools. Whether a particular racial or ethnic group has an admissions advantage depends in part on how many individuals from that group apply to the school. For the Classes of 2004 and 2005, admissions rates also are affected by the percentage of the applicants from a particular racial or ethnic group that are "screened out" of the lottery on the basis of insufficiently strong academic or attendance histories.

The second set of variables that predicts acceptance is whether the student applied to other CTE schools and the ranking that was given to each CTE school. Applying to other CTE schools reduces the odds of being accepted to a given CTE school, since students could only be accepted to a single school. In addition, students who indicated that a CTE school was one of their top choices (with 1=most desired) had higher odds of being admitted to the school than those who were more interested in another school.

In sum, the regressions indicate that with the exception of race or ethnicity for some schools in some years, accepted and non-accepted students are comparable on key characteristics. Therefore, it is highly plausible that a genuine lottery was conducted; that is, a random assignment process actually occurred, without tinkering by principals or other district administrators. However, given the consistent effects of race/ethnicity on the odds of receiving an acceptance to a CTE school, we control for student race/ethnicity in some of our estimates of impact.

Tables A.8 through A.10 (Appendix A) present the mean values of the variables included in these regression models, for accepted and non-accepted students at each school. With the exception of race/ethnicity, the differences between students were minimal. Differences in eighth grade standardized test scale scores for math and reading between groups were within four to five points in nearly every school and every cohort. Differences in eighth grade attendance rates were within two to three percentage points, while differences in eighth grade GPA between accepted and non-accepted students were generally no more than 0.1 percentage points, with Saul's classes of 2003 and 2004, and Mastbaum's class of 2003 being the largest exceptions.

Table 3.6: Regressions Predicting Acceptance at Each School, for Applicants in the Class of 2003

	Bok	Dobbins	Mastbaum	Saul
African American	0.235***	2.424*	0.543*	0.783
	(0.064)	(0.944)	(0.137)	(0.107)
Asian	0.296**	2.510	0.356	0.666
	(0.127)	(1.424)	(0.213)	(0.299)
Latino	0.313**	1.693	0.809	0.468**
	(0.123)	(0.918)	(0.248)	(0.131)
Race/ethnicity missing	0.170	1.732	--	0.228
	(0.240)	(1.944)		(0.260)
Female	0.808	1.072	0.898	1.157
	(0.091)	(0.110)	(0.066)	(0.203)
Special Education	0.457***	1.117	0.906	0.793
	(0.099)	(0.162)	(0.157)	(0.108)
English Language Learner	1.330	1.086	1.341	0.965
	(0.392)	(0.412)	(0.302)	(0.374)
Reading score, 8th grade	0.999	1.000	1.000	1.001
	(0.001)	(0.000)	(0.000)	(0.000)
Reading score missing	0.504	1.095	0.929	2.892
	(0.330)	(0.415)	(0.270)	(1.875)
Math score, 8th grade	1.000	1.000	1.000	1.000
	(0.001)	(0.001)	(0.001)	(0.001)
Math score missing	0.700	0.745	0.718	0.469
	(0.451)	(0.523)	(0.558)	(0.365)
Percent of days attended, 8th grade	0.995	1.035***	1.032*	1.027*
	(0.008)	(0.010)	(0.013)	(0.011)
Attendance percent missing	0.535	20.352***	12.467	12.728*
	(0.529)	(16.486)	(17.444)	(16.140)
GPA, 8th grade	0.948	1.052	1.198**	1.242
	(0.114)	(0.079)	(0.076)	(0.153)
GPA data missing	0.322*	0.818	3.009***	2.479
	(0.160)	(0.339)	(0.776)	(1.230)
Applied to Bok	--	0.862	1.199	1.092
		(0.147)	(0.259)	(0.228)
Applied to Dobbins	0.868	--	0.930	0.747
	(0.124)		(0.182)	(0.147)
Applied to Mastbaum	0.843	0.837	--	0.744
	(0.184)	(0.145)		(0.146)
Applied to Saul	0.880	0.957	0.947	--
	(0.177)	(0.107)	(0.112)	
Ranking given to this school	0.231***	0.706***	0.731***	0.730**
	(0.037)	(0.073)	(0.059)	(0.072)
Intercept	88.166***	0.014***	0.031**	0.031***
	(60.496)	(0.015)	(0.036)	(0.031)
Pseudo R-squared	.29	.08	.09	.11
N	**2,615**	**3,637**	**3,077**	**1,962**

SOURCE: Analysis of student data from the School District of Philadelphia.
Standard errors in parentheses
*p<.05 **p<.01 ***p<.00

Table 3.7: Regressions Predicting Acceptance at Each School, for Applicants in the Class of 2004

	Bok	Dobbins	Mastbaum	Saul
African American	3.088***	3.804***	0.114***	0.474***
	(0.774)	(1.494)	(0.024)	(0.096)
Asian	4.831***	5.827***	0.234***	0.894
	(1.616)	(2.957)	(0.094)	(0.474)
Latino	2.889*	1.910	0.209***	0.637
	(1.394)	(1.007)	(0.058)	(0.192)
Race/ethnicity missing	0.537	--	0.224***	0.200
	(0.482)	--	(0.094)	(0.223)
Female	1.255	1.015	0.937	0.922
	(0.169)	(0.101)	(0.078)	(0.146)
Special Education	1.509	0.505**	1.246	0.336**
	(0.526)	(0.106)	(0.332)	(0.137)
English Language Learner	1.075	--	0.361**	--
	(0.512)	--	(0.135)	--
Reading score, 8th grade	1.001*	1.001*	1.001	1.001
	(0.000)	(0.000)	(0.000)	(0.001)
Reading score missing	2.067	2.351	2.347	2.755
	(0.919)	(1.226)	(1.386)	(2.392)
Math score, 8th grade	1.003***	1.000	1.001	1.004***
	(0.001)	(0.000)	(0.001)	(0.001)
Math score missing	31.678***	0.975	0.924	72.930***
	(23.719)	(0.555)	(0.646)	(80.287)
Percent of days attended, 8th grade	1.018*	0.998	0.992	0.971
	(0.009)	(0.009)	(0.008)	(0.018)
Attendance percent missing	2.090	1.327	0.534	0.067
	(1.481)	(1.020)	(0.446)	(0.115)
GPA, 8th grade	1.105	1.138	1.380**	2.091***
	(0.150)	(0.133)	(0.173)	(0.468)
GPA data missing	1.427	1.363	1.855	9.435***
	(0.600)	(0.429)	(0.655)	(5.978)
Applied to Bok	--	0.902	1.049	0.797
	--	(0.130)	(0.165)	(0.206)
Applied to Dobbins	0.756	--	0.587***	0.864
	(0.126)	--	(0.083)	(0.193)
Applied to Mastbaum	0.705*	0.697**	--	0.437***
	(0.111)	(0.081)	--	(0.091)
Applied to Saul	1.569	0.795	0.787	--
	(0.540)	(0.155)	(0.219)	--
Ranking given to this school	0.641***	0.799***	0.697***	0.654***
	(0.026)	(0.018)	(0.027)	(0.025)
Intercept	0.003***	0.265	4.236	0.238
	(0.002)	(0.304)	(3.823)	(0.442)
Pseudo R-squared	.18	.08	.22	.27
N	**1,597**	**1,682**	**1,935**	**824**

SOURCE: Analysis of student data from the School District of Philadelphia.
Standard errors in parentheses
*p<.05 **p<.01 ***p<.001

Table 3.8: Regressions Predicting Acceptance at Each School, for Applicants in the Class of 2005

	Bok	Dobbins	Mastbaum	Saul	Swenson
African American	0.864	0.761	2.369**	0.265**	0.542
	(0.333)	(0.291)	(0.640)	(0.119)	(0.258)
Asian	0.695	2.538	3.136	1.870	0.678
	(0.667)	(1.467)	(3.509)	(2.610)	(0.672)
Latino	0.682	1.258	1.487	0.388*	0.331**
	(0.227)	(0.493)	(0.398)	(0.167)	(0.128)
Race/ethnicity missing	1.101	1.374	1.873	0.475	0.382**
	(0.436)	(0.618)	(0.621)	(0.191)	(0.138)
Female	0.960	0.895	1.253	0.918	1.497*
	(0.139)	(0.122)	(0.162)	(0.159)	(0.258)
Special Education	0.841	1.356	1.688*	0.916	0.250***
	(0.182)	(0.270)	(0.412)	(0.293)	(0.096)
English Language Learner	0.371**	1.206	0.403	--	0.463
	(0.130)	(1.171)	(0.377)	--	(0.248)
Reading score, 8th grade	1.001	0.999	1.000	1.001	1.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Reading score missing	2.353	0.591	2.001	0.797	0.886
	(1.688)	(0.502)	(1.482)	(1.496)	(0.736)
Math score, 8th grade	1.001	1.001	1.001	1.001	1.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Math score missing	2.096	2.172	0.412	24.411	6.339
	(1.764)	(1.831)	(0.339)	(53.449)	(6.590)
% of days attended, 8th grade	1.007	0.988	0.993	1.017	0.975
	(0.009)	(0.012)	(0.011)	(0.019)	(0.016)
Attendance missing	0.784	0.527	1.116	5.679	0.096
	(0.644)	(0.581)	(1.131)	(8.945)	(0.129)
GPA, 8th grade	1.042	1.065	1.140	0.867	0.983
	(0.110)	(0.147)	(0.155)	(0.172)	(0.203)
GPA data missing	1.059	0.573	1.616	0.469	0.654
	(0.247)	(0.271)	(0.726)	(0.285)	(0.375)
Applied to Bok	--	0.509***	0.526**	0.438*	1.020
	--	(0.060)	(0.108)	(0.151)	(0.296)
Applied to Dobbins	0.471***	--	0.597***	0.565*	0.415***
	(0.082)	--	(0.088)	(0.138)	(0.092)
Applied to Mastbaum	0.475***	0.349***	--	0.391***	1.035
	(0.090)	(0.050)	--	(0.082)	(0.216)
Applied to Saul	0.515*	0.370***	0.421***	--	0.873
	(0.151)	(0.065)	(0.080)	--	(0.258)
Applied to Swenson	0.419*	0.683	0.281***	0.196***	--
	(0.144)	(0.163)	(0.050)	(0.064)	--
Ranking given to this school	0.694***	0.875***	0.724***	0.738***	0.631***
	(0.028)	(0.020)	(0.025)	(0.024)	(0.032)
Intercept	0.365	7.595	1.784	0.892	17.829
	(0.439)	(8.174)	(2.349)	(1.586)	(34.652)
Pseudo R-squared	.17	.09	.18	.20	.23
N	**1,409**	**1,570**	**1,153**	**721**	**787**

SOURCE: Analysis of student data from the School District of Philadelphia.
Standard errors in parentheses
*p<.05 **p<.01 ***p<.001

Estimates of Impact and Modeling Strategies

In Chapter Five, we present several different estimates of impact of the CTE schools. The three estimates that we present in the main body of the report are the Intent-to-Treat estimate, the Local Average Treatment Effect estimate, and the Dosage estimate.

The **Intent-to-Treat estimate** answers the question: "What was the effect on key academic outcomes of offering the *opportunity to attend* a Career and Technical High School?" In this analysis, students who were offered a place at the school are considered to be the Treatment Group, *regardless of whether they actually attended the CTE school*. Students who were not admitted – who did not "win" the lottery – are considered to be the control group. The **Local Average Treatment Effect estimate** is derived similarly to the ITT estimate, but the resulting coefficients are then divided by the difference in treatment-receipt rates between the treatment and control group. The LATE estimates thus take into account the treatment crossover effect which may lower ITT estimate of CTE impacts. The LATE estimates are also equivalent to an instrumental-variables estimate. In contrast, the **Dosage estimate** incorporates a variable for the number of years that a student actually attended a CTE school, regardless of whether he or she was accepted to the lottery. For the ITT/LATE estimates, we control for race/ethnicity and the ranking the student gave the school on the application. We control for these factors since the regressions presented in Tables 3.6 through 3.8 provide empirical evidence for the importance of these factors in admissions decisions. For the Dosage estimate, we control for these two factors, plus other academic and demographic factors: gender, special education status, English Language Learner status, entering high school overage (15 years or older), and eighth grade GPA.

Table 3.9 demonstrates why it is important to produce each of both an ITT/LATE and Dosage estimate. This table pools students from across the three cohorts. First, almost 3,500 students who were accepted to CTE schools did not attend a CTE school. Second, of those who were accepted and ever attended a CTE school, not all attended a CTE school for four years. Some students dropped out; others returned to their neighborhood high schools. Third, approximately 100 students at the CTE schools did not have an acceptance indicated in the school district's data. They may have managed to be assigned to a CTE school somehow, perhaps through a parent's direct intervention with the principal, or there may have been a few mistakes in the data files that we received from the district.

Table 3.9: Number of Students Attending Career and Technical High Schools, by Admissions Status and Number of Years Attended

	Years at a CTE school					
ALL COHORTS	**0**	**1**	**2**	**3**	**4**	**N**
Not Accepted to any CTE school	7,386	11	17	27	54	7,495
Accepted to any CTE school	3,497	718	724	705	2,487	8,131
Total Students	10,883	729	741	732	2,541	15,626
CLASS OF 2003	**0**	**1**	**2**	**3**	**4**	**N**
Not Accepted to any CTE school	4,307	2	6	12	21	4,348
Accepted to any CTE school	1,110	169	201	225	790	2,495
Total Students	5,417	171	207	237	811	6,843
CLASS OF 2004	**0**	**1**	**2**	**3**	**4**	**N**
Not Accepted to any CTE school	1,901	5	11	10	28	1,955
Accepted to any CTE school	1,090	233	239	240	806	2,608
Total Students	2,991	238	250	250	834	4,563
CLASS OF 2005	**0**	**1**	**2**	**3**	**4**	**N**
Not Accepted to any CTE school	1,178	4	0	5	5	1,192
Accepted to any CTE school	1,297	316	284	240	891	3,028
Total Students	2,475	320	284	245	896	4,220

SOURCE: Analysis of student data from the School District of Philadelphia.

We use two different modeling strategies to estimate CTE Intent-to-Treat effects. We use these two strategies for the following reason. Since the CTE schools used different screening criteria to shape their cohorts before conducting their lotteries, and since these criteria are unknown to us, it is important to compare outcomes for students who were accepted to the same lottery.

The first modeling strategy – a **mixed model** that includes both fixed and random effects - allows students to be represented in the data set multiple times. The number of times that students appear in the data set is equivalent to the number of CTE schools to which he or she applied. We use multilevel modeling (Raudenbush & Bryk, 2002; Seltzer, Choi, & Thum, 2003), with students nested within lotteries. Since students who were entered into the lottery at more than one CTE school are represented in the data set more than one time, we use robust standard errors to correct for the non-independence of

some observations (White 1982). Separate models were estimated for the three different cohorts. In essence, then, we find the CTE effect for each lottery and create an average across all CTE lotteries for a given cohort.

It is essential to note that this modeling strategy produces conservative estimates of the overall impact of CTE schools. This is because a student who applied to multiple CTE schools and attended one of them will be included as a "treatment" student once for the lottery to which he or she was accepted and as a "control" one or more times for other lotteries to which the student applied but was not accepted. The potential impact on CTE effects of this modeling strategy is highlighted by Table 3.10, which shows the percentage of students who were rejected from specific CTE schools who attended another CTE school. For example, of the 2,079 Class of 2003 applicants to Bok who were not accepted, 12 percent enrolled at one of the other three CTE schools for their freshman year. The potential for depressing any positive effects of CTE is particularly acute for the Class of 2005, in which between approximately one-quarter and one-third of the rejected applicants enrolled at other CTE schools. (LATE and Dosage estimates were also based upon this mixed model strategy.)

Table 3.10: Percentage of Students Not Accepted Who Attended Another CTE School, by Cohort and School

	Bok	Dobbins	Mastbaum	Saul	Swenson	Any CTE School
Class of 2003						
% attended other CTE school	12.4%	10.5%	11.0%	12.7%	--	12.1%
N not selected in lottery	2,079	2,801	2,454	1,641	--	5,763
Class of 2004						
% attended other CTE school	21.4%	17.9%	22.8%	17.1%	--	20.0%
N not selected in lottery	1,007	805	1,136	287	--	2,684
Class of 2005						
% attended other CTE school	23.6%	31.4%	36.5%	31.7%	23.0%	24.0%
N not selected in lottery	839	587	411	218	396	2,036

SOURCE: Analysis of student data from the School District of Philadelphia.

Given the potential of this modeling strategy to underestimate the overall effects of CTE schools, we produced a set of fixed-effects estimates in which students are represented only once in the data set. The dependent variable is a dummy variable for whether the student was accepted to *any* CTE school. Instead of nesting students within lotteries, we included a set of four dummy variables (five variables for the Class of 2005) indicating whether the student was included in a lottery for a specific school. This modeling strategy has the disadvantage of not being able to control for the ranking that a student gave a specific school on their application (which we know had an impact on a student's probability of being accepted, and potentially indicated more or less serious

interest in CTE education), nor does it compare students to others who were not accepted to a particular school. It has the advantage, however, of not including in the control groups any students who attended CTE schools.

To achieve racial balance in the schools, the lottery took into account student race or ethnicity. The regressions presented in Tables A.8 through A.10 indicate that race/ethnicity and the ranking given to the school were the only consistent statistically significant differences between students who were accepted and those who were not. Therefore, we control for race/ethnicity in both types of models; we control for the ranking given to each school in the first model.

The equation we use for both the **Intent-to-Treat and Local Average Treatment Effect mixed models** is as follows. This equation is for continuous variables such as scores on standardized tests; for binary dependent variables, we use a multilevel logit model.

Level One

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\textit{Accepted to Lottery l in year y})_{ij} +$$

$$\beta_{2j}(\textit{African American})_{ij} + \beta_{3j}(\textit{Asian})_{ij} + \beta_{4j}(\textit{Latino})_{ij} +$$

$$\beta_{5jk}(\textit{Other ethnicity})_{ij} + \beta_{6jk}(\textit{Ranking given to school})_{ij} + r_{ij}$$

Level Two

$$\beta_{0j} = \gamma_{00j} + u_{0k}$$
$$\beta_{1j} = \gamma_{01j}$$
$$\beta_{2j} = \gamma_{02j}$$
$$\beta_{3j} = \gamma_{03j}$$
$$\beta_{4j} = \gamma_{04j}$$
$$\beta_{5j} = \gamma_{05j}$$

The equation for the Intent-to-Treat fixed-effects estimates is as follows. Binary dependent variables were modeled with a logit model.

$$Y = \beta_0 + \beta_1(\textit{Accepted}) + \beta_2(\textit{White}) + \beta_3(\textit{Asian}) + \beta_4(\textit{Latino}) +$$

$$\beta_5(\textit{In School A Lottery}) + \beta_6(\textit{In School B Lottery}) +$$

$$\beta_7(\textit{In School C Lottery}) + \beta_8(\textit{In School D Lottery}) + r$$

For estimates of **Dosage effects,** we used a mixed-model approach, with each student potentially represented multiple times in the data set. This model introduces a control for the proportion of the first four years of high school that a student actually attended a CTE school, as well as controls for whether the student received special education in 8th grade, received English Language Learner services in 8th grade, whether the student entered high school overage, and 8th grade GPA. The Dosage equation for continuous dependent variables is as follows. Binary dependent variables were modeled with a multilevel logit model.

Level One

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\textit{Number of Years Attended a CTE School})_{ij} +$$
$$\beta_{2j}(\textit{African American})_{ij} + \beta_{3j}(\textit{Asian})_{ij} + \beta_{4j}(\textit{Latino})_{ij} +$$
$$\beta_{5jk}(\textit{Number of CTE Schools Applied to})_{ij} +$$
$$\beta_{6jk}(\textit{Ranking given to school})_{ij} + \beta_{7jk}(\textit{Female})_{ij} +$$
$$\beta_{8jk}(\textit{Special Education})_{ij} + \beta_{9jk}(\textit{English Language Learner})_{ij} +$$
$$\beta_{10jk}(\textit{Overage})_{ij} + \beta_{11jk}(\textit{GPA in } 8^{th} \textit{ grade})_{ij} + r_{ij}$$

Level Two

$$\beta_{0j} = \gamma_{00k} + u_{0k}$$
$$\beta_{1j} = \gamma_{01j}$$
$$\beta_{2j} = \gamma_{02j}$$
$$\beta_{3j} = \gamma_{03j}$$
$$\beta_{4j} = \gamma_{04j}$$
$$\beta_{5j} = \gamma_{05j}$$
$$\beta_{6j} = \gamma_{06j}$$
$$\beta_{7j} = \gamma_{07j}$$
$$\beta_{8j} = \gamma_{08j}$$
$$\beta_{9j} = \gamma_{09j}$$
$$\beta_{10j} = \gamma_{10j}$$
$$\beta_{11j} = \gamma_{11j}$$

CHAPTER FOUR

AVAILABILITY OF AND ENROLLMENT IN CTE COURSES AND COURSES OF STUDY ACROSS THE DISTRICT, 1999-2000 TO 2004-2005

The question that motivates this chapter is a basic one: to what extent were students who did not attend a CTE high school able to take CTE courses at their neighborhood high schools? In other words, how unique was the experience of attending a CTE school?

To explore this question, this chapter examines CTE course availability across all of the district's high schools, including disciplinary, neighborhood, special admission, and, of course, CTE schools. We find that students who were zoned to some of the larger neighborhood high schools could expect to find a range of CTE courses comparable to what they could have experienced at a CTE school. However, most students in the district did not have the wide range of CTE courses that those at CTE schools had. Importantly, many of the CTE course offerings at the neighborhood high schools were for general labor market preparation, not preparation for a specific occupation. Further, the vast majority of students in the district (approximately 67 percent) took no CTE courses during the time they were enrolled in high school.

CTE Courses of Study at the District's High Schools

To identify CTE courses, we used the *Secondary School Taxonomy*, created by the National Center for Education Statistics. CTE courses - along with academic, enrichment, and special education courses - are one of four course types at the highest level of aggregation in this taxonomy. Within the category of CTE courses, there are three distinct subtypes: Family and Consumer Sciences Education (FCSE), General Labor Market Preparation (GLMP), and Occupational Education. **Family and Consumer Sciences courses** entail subjects such as parenting skills, home economics, and domestic maintenance that prepare students for family life, as opposed to imparting more marketable job skills. **General Labor Market Preparation courses** develop skills that are not applicable to one specific occupational area, such as keyboarding, computer literacy, and searching for jobs. **Occupational Education courses**, on the other hand, relate to specific, marketable skills.

The Secondary School Taxonomy further breaks down these Occupational Education courses into ten specific occupational fields:

1. Agriculture and Natural Resources
2. Science, Technology, Engineering, and Mathematics (STEM)
3. Architecture and Construction
4. Business
5. Computer and Information Sciences (CIS)
6. Health Sciences
7. Manufacturing, Repair, and Transportation (MRT)
8. Communications and Design
9. Personal Services and Culinary Arts
10. Public Services

Within the Secondary School Taxonomy, courses are mutually exclusive between each field and sub-field.

An analysis of course offerings for all Philadelphia public high schools during the six years in which the study cohorts would have been enrolled in high school if they were on-track to graduate (1999-2000 through 2004-2005) shows that many students who did not attend a CTE high school still had available to them a wide variety of CTE courses. For this analysis, we grouped the course offerings at each school into rough courses of study based on observation of the course codes and course titles in the transcript files. Although the course codes were not standard across the school district during most of this time period, within each school we were able to identify sequences of course codes and course titles that clearly were intended to be a sequence or at least a set of related courses. In some cases, the course titles clearly indicate a sequence (e.g. Hotel, Restaurant, and Tourism I; HRT II; HRT III). In other cases, the course titles and codes together demonstrate that they are a set of related courses (e.g. Pastry Chef; Bakery Chef). In some cases, a stand-alone course is counted as a single-course sequence. This was especially true of courses that were not in an occupational training field (for example, typing/word processing, a single course taken by a large number of students). Some occupational training courses, such as Child Care, also tended to consist of a single course offering.

Table 4.1 shows, by high school, the number of CTE course sequences (including course "sequences" of only one course, such as Child Care) offered during each of the study years. In addition, in the last three columns, the mean number of sequences offered within each of the Secondary School Taxonomy's main CTE categories (Family and Consumer Education, General Labor Market, and Occupational Preparation) is shown for each school. For more detail on each school's course offerings, by course type and school year, see Appendix B.

In each of the study years, students at most of the CTE schools had a substantial number of CTE course sequences from which to choose, in comparison to students at most of the neighborhood, magnet, and other schools in the district. Saul High School –

the agricultural CTE school – was a clear exception, offering between two and four course sequences during the time period; given its small size and relatively more restricted focus on animal care, this limited number of course sequences probably makes sense.

What also is notable is that between 1999-2000 and 2004-2005, the number of course sequences declined dramatically at the CTE schools. For example, twenty-three course sequences were offered at Dobbins in 1999-2000, but by 2004-2005, it had fallen to eleven. This decline in the number of sequences offered can be seen across the neighborhood high schools as well. It appears that during this time period, many of the schools cut back on the number of single-course sequences they offered and also reduced the number of multi-course sequences. At Martin Luther King High School, for example, the number of sequences fell from sixteen in 2002-03 to four in 2003-04. This precipitous decline was due almost entirely to reducing the number of single courses of study, including eliminating several business courses, word processing and computer courses, and child care. In addition, a culinary program was ended.[8] As we will show later, this general cutback in the number of different types of CTE courses and sequences does not mean that fewer students were taking CTE courses; in fact, there were modest increases in the percentage of students taking any CTE courses and the percentage taking four or more CTE courses. But it does mean that the schools appeared to be focusing on a few CTE areas.

Students who attended neighborhood high schools had relatively good access to CTE courses, particularly if they attended one of the larger schools. During 2004-2005, two of the neighborhood high schools, Lincoln and Edison, had more than 16 and 21 course sequences, respectively. This number of sequences was larger than at any of the CTE schools. More typically, neighborhood high schools tended to offer between five and nine course sequences.

Not surprisingly, special admissions schools, which had a stated mission to prepare students for college, had few or no CTE course offerings. Five of Philadelphia's fourteen special admissions schools had no CTE course offerings over the six year study period. Of the nine other schools, the highest average number of CTE courses offered yearly was 3.7, with the remaining eight schools averaging between one and two CTE courses offered yearly. In addition, none of the disciplinary schools ever had more than a single CTE course offered in any year.

School size was a strong correlate of number and type of CTE courses offered. Larger neighborhood schools, with more than 1,000 students on average over the study years, had more CTE course offerings, on average, than schools with an average enrollment fewer than 1,000 students. Schools of medium size, with an average enrollment between 700 and 1,000 students had an average of between 3.8 and 9.5 CTE course sequences. With one exception, small high schools, with an average enrollment under 700 students, offered two or fewer CTE course sequences per year on average.

[8] Martin Luther King High School also had a private manager at this time, Foundations Inc.

While the number of CTE course sequences offered in larger neighborhood high schools was similar to the number of CTE course sequences offered by CTE schools, there were considerable differences between neighborhood schools and CTE schools in the types of CTE courses offered. Importantly, **nearly all of the CTE course offerings at CTE schools were occupational training courses.** In contrast, neighborhood high schools were more likely than CTE schools to offer General Labor Market Preparation classes, as well as Family and Consumer Science courses. On average, all but one CTE school averaged one or fewer General Labor Market Preparation (GLMP) course offering per year (with Dobbins offering nearly two per year on average). In contrast, 14 of the 18 neighborhood high schools with average enrollments of more than 1,000 students averaged at least 1.5 GLMP course offerings per year. Further, three of the five study CTE schools did not offer a single Family and Consumer Science (FCSE) course between the 1999-2000 and 2004-05 school years, while the other two study CTE schools averaged less than one FCSE course per year. While FCSE course offerings were rare among all Philadelphia high schools, the majority of neighborhood schools offered these courses at least once over the six year study period.

Table 4.1: Career and Technical Course Offerings for Each Philadelphia High School, by Course Type and School Year

			Number of CTE course sequences						Mean number of course sequences, by CTE category			
School	**Type**	**Size**	**99-00**	**00-01**	**01-02**	**02-03**	**03-04**	**04-05**	**CTE**	**OCC**	**GLMP**	**FCSE**
Randolph	CTE	Small	n/a	n/a	n/a	n/a	n/a	11	11.0	10.0	1.0	0.0
Saul Agricultural HS*	CTE	Small	3	3	4	4	3	2	3.2	3.2	0.0	0.0
Edward Bok Tech HS	CTE	Medium	10	10	10	9	6	8	8.8	8.5	0.3	0.0
Swenson Arts & Tech HS	Neighborhood, then CTE for Class of 2005	Medium	n/a	17	18	18	13	13	15.8	14.8	0.4	0.6
Dobbins AVTHS	CTE	Large	23	21	21	23	22	11	20.2	18.3	1.8	0.0
Jules Mastbaum AVTS	CTE	Large	22	21	19	19	12	12	17.5	16.2	0.7	0.7
HS for Business & Technology	New Small School	Small	n/a	n/a	n/a	n/a	n/a	1	1.0	1.0	0.0	0.0
Robeson School for Human Services	New Small School	Small	n/a	n/a	n/a	n/a	1	1	1.0	1.0	0.0	0.0
The Communications Technology School	New Small School	Small	n/a	n/a	n/a	n/a	1	2	1.5	1.5	0.0	0.0
HS for Creative & Performing Arts)	Magnet	Small	0	0	0	0	6	6	2.0	2.0	0.0	0.0
Charles Carroll School	Magnet	Small	2	1	1	0	2	0	1.0	0.7	0.3	0.0
Franklin Learning Center	Magnet	Small	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Lankenau HS	Magnet	Small	0	0	0	0	1	1	0.3	0.3	0.0	0.0
Parkway Programs	Magnet	Small	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Philadelphia Regional High	Magnet	Small	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Stephen Douglass School	Magnet	Small	2	2	2	2	2	2	2.0	1.0	1.0	0.0
William Bodine HS	Magnet	Small	4	4	4	4	5	1	3.7	2.0	1.7	0.0
Youth Study Center	Magnet	Small	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Central High	Magnet	Large	0	0	0	0	4	4	1.3	0.8	0.5	0.0
Girls' High	Magnet	Large	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Charles Audenreid SHS	Neighborhood	Small	5	3	2	3	0	0	2.2	2.2	0.0	0.0
Roberts Vaux HS	Neighborhood	Small	n/a	n/a	n/a	n/a	n/a	3	0.5	0.3	0.2	0.0
Ben Franklin HS	Neighborhood	Medium	10	8	9	10	6	7	8.3	8.3	0.0	0.0

			Number of CTE course sequences						Mean number of course sequences, by CTE category			
School	**Type**	**Size**	**99-00**	**00-01**	**01-02**	**02-03**	**03-04**	**04-05**	**CTE**	**OCC**	**GLMP**	**FCSE**
Horace Furness HS	Neighborhood	Medium	1	7	6	3	3	3	3.8	2.7	1.2	0.0
Strawberry Mansion HS	Neighborhood	Medium	14	11	11	11	6	4	9.5	7.3	1.5	0.7
Abraham Lincoln HS	Neighborhood	Large	30	17	14	15	15	16	17.8	14.7	2.0	1.2
Bartram	Neighborhood	Large	14	10	8	10	3	2	7.8	6.2	0.7	0.0
Carver HS	Neighborhood	Large	3	2	2	2	6	5	3.3	3.3	0.0	0.0
Edison HS	Neighborhood	Large	27	27	26	27	18	21	24.3	23.2	1.0	0.2
Frankford HS	Neighborhood	Large	19	18	15	15	13	13	15.5	12.8	2.7	0.0
George Washington HS	Neighborhood	Large	15	15	13	13	8	8	12.0	10.3	1.5	0.2
Germantown HS	Neighborhood	Large	11	10	11	6	3	5	7.7	6.8	0.8	0.0
Kensington HS	Neighborhood	Large	10	10	7	5	4	4	6.7	4.7	1.8	0.2
Martin Luther King HS	Neighborhood	Large	15	17	15	16	4	7	12.3	10.7	1.0	0.7
Northeast HS	Neighborhood	Large	9	12	8	10	11	10	10.0	7.5	2.5	0.0
Olney HS	Neighborhood	Large	18	20	19	13	12	7	14.8	10.8	3.3	0.7
Overbrook HS	Neighborhood	Large	13	18	16	29	7	9	15.3	12.2	2.5	0.7
Roxborough HS	Neighborhood	Large	12	13	11	18	7	7	11.3	9.7	1.7	0.0
Samuel Fels HS	Neighborhood	Large	11	12	10	10	6	6	9.2	5.5	3.5	0.2
Simon Gratz HS	Neighborhood	Large	16	12	13	16	10	8	12.5	9.8	2.5	0.2
South Philadelphia HS	Neighborhood	Large	16	15	14	14	5	7	11.8	8.5	2.2	1.2
University City HS	Neighborhood	Large	13	15	12	11	10	9	11.7	7.8	3.8	0.0
West Philadelphia HS	Neighborhood	Large	16	15	13	13	7	4	8.7	7.8	3.5	0.0
William Penn HS	Neighborhood	Large	14	13	11	10	5	5	9.7	7.0	2.3	0.3
Allegheny	Disciplinary	Small	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Boone Schools	Disciplinary	Small	0	0	0	0	0	1	0.2	0.2	0.0	0.0
Delaware Valley HS	Disciplinary	Small	0	0	0	0	0	0	0.0	0.0	0.0	0.0
E.S. Miller School	Disciplinary	Small	1	1	0	0	0	0	0.3	0.0	0.3	0.0
Shallcross School	Disciplinary	Small	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Hunting Park HS	Disciplinary	Large	0	0	0	0	0	0	0.0	0.0	0.0	0.0

SOURCE: Analysis of student data from the School District of Philadelphia.

Who Enrolled in CTE Courses?

Although about 80 percent of the high school students in each of the cohorts attended a CTE school or a neighborhood school for at least one year (where they theoretically could have enrolled in a CTE course), roughly two-thirds of high school students across the district did not enroll in any CTE courses while in high school.[9] Of the remaining students, between ten and eleven percent of each cohort took a single CTE course and another seven percent took two courses.[10] This means that between eighty-three and eighty-five percent of the cohort did not take enough CTE courses to count as a "vocational concentrator" in a specific area.[11] Roughly fifteen to seventeen percent of students in each cohort took three or more CTE courses over their high school career in the district. The maximum number of CTE courses taken was thirteen for the classes of 2003 and 2005, and twelve for the Class of 2004.

Table 4.2: Number of Career and Technical Courses Taken, by Cohort (Percentages)

	Class of 2003	Class of 2004	Class of 2005
Zero	66.5%	67.2%	65.0%
One	11.2	10.1	11.0
Two	6.9	7.03	7.0
Three or more	15.4	15.7	17.0
TOTAL	100.0	100.0	100.0
N	16,926	18,701	18,808

SOURCE: Analysis of student data from the School District of Philadelphia.

In each cohort, the majority of students of all racial/ethnic backgrounds took no CTE courses during their high school years (Tables 4.3 – 4.5). There are some differences between racial and ethnic groups in the percentage of students taking any CTE courses or many CTE courses. For example, African American and Latino students were more likely than White or Asian students to take one or more CTE courses in high school, with a difference across the cohorts ranging between ten to fifteen percentage points, roughly. Similarly, a higher percentage of African American and Latino students took three or more CTE courses during high school. For the Class of 2003, eighteen

[9] The analysis in this section is based on all ninth graders in 1999-2000, 2000-2001, and 2001-2002 who were not known to be repeater ninth graders.

[10] All subsequent analyses of course taking examine the number of classes taken, as opposed to a description of the number of areas in which courses were offered. For example, schools offering Culinary Arts 1, 2 and 3 would be considered to offer classes in one area according to Figure 4.1. However, if a student took all three courses, that would count as taking three separate courses within all subsequent analyses.

[11] "Vocational concentrator" is defined as having taken three courses in a specific CTE area during the high school years.

percent of African American students took at least three CTE courses, compared to sixteen percent of Latinos, ten percent of Whites and just under eight percent of Asians (Table 4.3).

Within each racial/ethnic group, slight increases in the percentage of students taking any CTE courses and three or more CTE courses can be observed between the Classes of 2003 and 2005.

Table 4.3: Number of Career and Technical Courses Taken, by Race/Ethnicity, Class of 2003 (Percentages)

# of CTE Courses	African-American	White	Latino	Asian-American	Other	Missing	Total
Zero	61.6%	76.4%	64.7%	79.0%	87.5%	84.2%	66.5%
One or Two	20.4	13.8	19.3	13.3	7.5	4.3	18.1
Three or more	18.0	9.9	15.9	7.7	5.0	11.5	15.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	10,091	3,384	2,021	921	40	469	16,926

SOURCE: Analysis of student data from the School District of Philadelphia.

Table 4.4: Number of Career and Technical Courses Taken, by Race/Ethnicity, Class of 2004 (Percentages)

# of CTE Courses	African-American	White	Latino	Asian-American	Other	Missing	Total
Zero	64.4%	75.6%	64.3%	74.9%	88.5%	68.8%	67.17
One or Two	18.1	14.0	18.5	15.2	7.7	6.3	17.16
Three or more	17.5	10.5	17.2	9.9	3.9	25.0	15.67
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	11,719	3,685	2,292	937	52	16	18,701

SOURCE: Analysis of student data from the School District of Philadelphia.

Table 4.5: Number of Career and Technical Courses Taken, by Race/Ethnicity, Class of 2005 (Percentages)

# of CTE Courses	African-American	White	Latino	Asian-American	Other	Missing	Total
Zero	59.0%	72.5%	58.4%	73.4%	84.3%	98.3%	65.0%
One or Two	20.6	14.1	23.0	14.9	7.2	1.1	11.0
Three or more	20.4	13.4	18.7	11.7	8.6	0.6	24.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	11,012	3,118	2,220	922	70	1,466	18,808

SOURCE: Analysis of student data from the School District of Philadelphia.

In all three cohorts, the differences between the rates of males and females who enrolled in no CTE courses and the differences between the rates of males and females took three or more CTE courses were no greater than 1.5 percentage points (Table 4.6).

Table 4.6: Number of Career and Technical Courses Taken, by Cohort and Gender (Percentages)

	Class of 2003		Class of 2004		Class of 2005	
# of CTE courses	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Zero	65.49	66.01	67.31	67.03	62.95	61.56
One or Two	18.37	18.66	17.19	17.13	18.51	20.22
Three or more	16.44	15.33	15.50	15.84	18.54	18.22
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	8,341	8,134	9,580	9,114	8,647	8,743

SOURCE: Analysis of student data from the School District of Philadelphia.

Students who scored at the Below Basic level in reading and/or mathematics on the eighth grade state standardized assessment were more likely than those with Proficient or Advanced scores to have taken any CTE course during high school. For example, in the Class of 2003, roughly over forty-five percent of those with Below Basic reading scores took at least one CTE course, in comparison to approximately twenty-five percent of those who scored at the Proficient or Advanced level (Table 4.7). Approximately similar percentages of students with Below Basic versus Proficient or Advanced scores in mathematics took any CTE courses (Table 4.8).

It is notable that more than half of the students who were Below Basic in reading and/or mathematics – and thus might not have been good candidates for attending college after completing high school - had no courses that would provide direct workforce preparation. At the same time, for these cohorts, CTE courses were not simply the province of the least academically-skilled. In the Class of 2005, for example, seventeen

percent of those who scored Proficient or Advanced in reading and fifteen percent of those who scores Proficient or Advanced in mathematics took three or more CTE courses.

Table 4.7: Number of CTE Courses Taken, by Cohort and Proficiency Level on Eighth Grade State Standardized Test of Reading[12] (Percentages)

	Class of 2003		Class of 2004		Class of 2005	
# of CTE Courses	**Below Basic**	**Proficient/ Advanced**	**Below Basic**	**Proficient/ Advanced**	**Below Basic**	**Proficient/ Advanced**
Zero	54.11	75.78	56.66	73.10	55.46	66.48
One or Two	24.14	13.91	22.75	13.97	23.19	16.51
Three or more	21.75	10.31	20.59	12.93	21.35	16.99
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	6,335	2,708	7,153	2,792	7,003	3,118

SOURCE: Analysis of student data from the School District of Philadelphia.

Table 4.8: Number of CTE Courses Taken, by Cohort and Proficiency Level on Eighth Grade State Standardized Test of Mathematics[13] (Percentages)

	Class of 2003		Class of 2004		Class of 2005	
# of CTE Courses	**Below Basic**	**Proficient/ Advanced**	**Below Basic**	**Proficient/ Advanced**	**Below Basic**	**Proficient/ Advanced**
Zero	55.17	79.72	57.00	74.15	54.84	69.83
One or Two	23.06	11.83	22.18	13.88	23.17	15.22
Three or more	21.77	8.45	20.82	12.03	22.01	14.95
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	8,026	1,903	9,125	2,112	8,560	2,201

SOURCE: Analysis of student data from the School District of Philadelphia.

Areas of Concentration in Career and Technical Education

Between fifteen percent and seventeen percent of the students in the three cohorts took three or more CTE courses. A significant proportion of the students who made up this fifteen to seventeen percent were *CTE concentrators*[14] – that is, students who took **three or more courses** in at least one specific CTE area over their academic career. These areas include one of ten occupational specialty areas: agriculture and natural

[12] 11.3% of the Class of 2003, 9.6% of the Class of 2004, and 8.1% of the Class of 2005 are missing 8th Grade Reading PSSA scores.
[13] 9.3% of the Class of 2003, 8.6% of the Class of 2004, and 7.9% of the Class of 2005 are missing 8th Grade Reading PSSA scores.
[14] This is a new term for "vocational concentrators."

resources, science, technology, engineering and mathematics, architecture/construction, business, computer and information sciences, health sciences, manufacturing, repair and transportation, communications and design, personal services and culinary arts, and public services. The percentage of all students who were vocational concentrators was 6.2 percent for the Class of 2003, 6.6 percent for the Class of 2004, and 9.1 percent for the Class of 2005 (Table 4.9).

Within the ten occupational concentration areas, the business field clearly had the greatest number of concentrators for each cohort, ranging from 1.58 percent for the Class of 2003 to 2.66 percent for the Class of 2005. For the Class of 2005, the next most common CTE concentration area was Personal Services and Culinary Arts, with 1.71 percent of the Class of 2005 concentrating in this area. Agriculture and Natural Resources was third, with 1.07 percent of all students concentrating in this area.

The least common occupational areas were Public Services (no concentrators), Architecture and Construction, Health Sciences, and Science, Technology, Engineering, and Mathematics (each less than .6 percent).

The areas experiencing the greatest growth in concentrators between the Class of 2003 and the Class of 2005 were Business, which grew by approximately one percentage point, or almost 200 students, and Personal Services and Culinary Arts, which grew by one half of a percentage point. We originally defined a vocational concentrator as a student taking two, instead of three or more courses in a specific CTE area. Tables B.2 and B.3 (Appendix B) display the empirical consequences of using a two course, rather than three course, threshold of being a vocational concentrator. As expected, the percentage of students who could be considered vocational concentrators increases when using the two-course definition. Depending on the cohort, the percentage of students who could be classified as CTE concentrators according the less stringent two CTE courses definition increased by 60 percent to 100 percent.

Table 4.9: Percentage of Students Concentrating in Each CTE Area, by Cohort*

	Class of 2003	Class of 2004	Class of 2005
Total Concentrators in Any Area	**6.2%**	**6.9%**	**9.1%**
Agriculture & Natural Resources	1.0	1.0	1.1
Science, Technology, Engineering, & Mathematics	0.3	0.1	0.3
Architecture and Construction	0.3	0.4	0.6
Business	1.6	1.9	2.7
Computer and Information Sciences	0.3	0.4	0.8
Health Sciences	0.3	0.2	0.5
Manufacturing, Repair, and Transportation	0.9	0.9	0.9
Communications and Design	0.5	0.6	0.7
Personal Services and Culinary Arts	1.2	1.5	1.7
Public Services	0.00	0.00	0.00
Total Students	16,926	18,701	18,808

*In this table, a CTE concentrator is defined as a student who has taken three or more CTE courses
SOURCE: Analysis of student data from the School District of Philadelphia.

Nearly every student who was a vocational concentrator concentrated in a single area (Table 4.10). Within the handful of students with multiple concentration areas, all but one had exactly two concentration areas.

Table 4.10: Number of Occupational Concentration Areas for all Students with at Least One Vocational Concentration Area, by Cohort (Percentages)*

	Class of 2003	Class of 2004	Class of 2005
One Area of Concentration	98.1%	98.8%	98.4%
Two Areas of Concentration	1.9	1.2	1.6
Three Areas of Concentration	0.0	0.1	0.0
Total	100.0	100.0	100.0
Total Students	1,053	1,283	1,705

*In this table, a CTE concentrator is defined as a student who has taken three or more CTE courses
SOURCE: Analysis of student data from the School District of Philadelphia.

In Which Grades Did Students Take CTE Courses?

Table 4.11 displays the timing, as well as the extent of CTE course enrollment, for students who took and received a final grade in at least one CTE course over their high school career. The percentage of students who took at least one CTE course during high school remained relatively steady across the three cohorts, as did total number of CTE courses taken. Overall, the first two years of high school had the greatest amount of CTE course taking, in large part because many students reached the legal school-leaving age (17 years) by the third year of high school and began to drop out of school.

For each cohort, the first year of high school saw an average of 0.70 to 0.76 CTE courses taken. For the Classes of 2003 and 2005, the average number of CTE courses taken grew slightly in the second year of high school, while the average number of CTE courses taken declined slightly for the Class of 2004. Slight declines continued for the Class of 2003 and the Class of 2004 in the third year of high school, while the Class of 2005 saw a 0.01 increase to 0.73 courses taken. The lowest number of CTE courses taken for each cohort was during the fourth year in high school, with a range of 0.54 to 0.6 classes. This drop from previous years is likely due to the large number of students not enrolled in a School District of Philadelphia school four years after entering high school (that is, a number had dropped out by that time). The average total number of CTE courses taken for each cohort was nearly identical, ranging from 2.66 for the Class of 2003 to 2.76 for the Class of 2004.

Table 4.11: Mean Number of CTE Courses Taken by Year, For Students with at Least One CTE Course Taken

Years After CTE Application	Class of 2003	Class of 2004	Class of 2005
Year One	0.70	0.76	0.71
Year Two	0.78	0.74	0.72
Year Three	0.64	0.66	0.73
Year Four	0.54	0.60	0.56
Total	2.66	2.76	2.72
N	5,665	6,140	6,579

SOURCE: Analysis of student data from the School District of Philadelphia.

The Timing of CTE Course Taking Among CTE Applicants

One of the key questions regarding Career and Technical High Schools is whether a school that focuses on CTE is more likely than other schools to have students enroll in CTE courses during the freshman year – even if the comparison schools also happen to have CTE programs of study. If students at CTE schools were more likely to enroll in CTE courses as freshmen – and if students CTE schools had better promotion and retention rates – then this might be evidence that taking CTE courses early in the high school career "hooks" students into the school.

Table 4.12 examines the association between attending a CTE school on CTE course taking within two groups of students: 1) those who attended a CTE school in their first year of high school and 2) those that applied to a CTE school, but attended a non-CTE school in the School District of Philadelphia one year after application.[15] Table 4.12 serves as an examination of the effects of attending a CTE school, comparing two groups of students who expressed at least some interest in CTE courses (as evidenced by their application to a CTE school).

Table 4.12 provides little support for the argument that, among students who have any interest in CTE coursework, CTE course taking is greater during the first year of high school among students at CTE schools. Among students in the Class of 2003, the mean number of CTE courses taken at CTE schools was *lower* than at other schools, while it was greater for the Class of 2004, and equal for the Class of 2005. However, it is also clear that in subsequent years, the mean number of CTE courses taken at CTE schools was dramatically higher than at other schools. Among students in the Class of 2005, for example, the mean number of CTE courses taken was twice as high for those attending CTE schools during Year Three, and nearly twice as high for Year Two and Year Four.

Table 4.12: Mean Number of CTE Courses Taken by Year, by Attendance at a CTE School

Year in High School	Class of 2003		Class of 2004		Class of 2005	
	Attended CTE School in First Year of HS	Applied but did not attend CTE School	Attended CTE School in First Year of HS	Applied but did not attend CTE School	Attended CTE School in First Year of HS	Applied but did not attend CTE School
Year One	0.19	0.30	0.50	0.30	0.36	0.36
Year Two	1.00	0.37	0.80	0.40	0.80	0.45
Year Three	0.82	0.32	0.78	0.35	0.90	0.45
Year Four	0.69	0.26	0.69	0.33	0.64	0.35
Total	2.70	1.25	2.77	1.38	2.70	1.61
N	1,450	5,111	1,639	5,064	1,527	5,372

SOURCE: Analysis of student data from the School District of Philadelphia.

For each cohort, on average, students who attended a CTE school during their first year of high school took considerably more CTE courses than students who applied to but did not attend a CTE school in their first year. The mean total number of CTE courses taken by students who attended a CTE school was 2.69 for the Classes of 2003 and 2005 and 2.77 for the Class of 2004. In contrast, members of the Class of 2003 who did not attend a CTE school took 1.25 CTE courses; for the Classes of 2004 and 2005 the averages were 1.38 and 1.61, respectively. The average number of courses taken by students who applied to a CTE school but did not attend one in the first year of high

[15] By first year of high school, we mean the 9th grade, as students who transferred into SDP were not included in any analyses.

school increased by cohort, but was less than half of the average for students who began high school in a CTE school for the Class of 2003 and Class of 2004.

CHAPTER FIVE

COMPARISON OF ACADEMIC OUTCOMES FOR COHORTS FOR YEARS ONE THROUGH FOUR OF HIGH SCHOOL

Were there academic effects of Career and Technical high schools, as indicated by higher promotion and graduation rates, greater academic growth, more consistent school attendance, and/or more college-preparatory course taking in mathematics, science, and foreign language? In this chapter, we examine key academic outcomes for three cohorts of students (members of the Classes of 2003, 2004, and 2005) who applied for admission to at least one CTE school. We present outcomes for each year in high school, followed by a summary of overall outcomes during high school. Separate estimates are presented for each cohort.

In contrast to the previous chapter, in which where we presented data for all students in the district regardless of whether they applied to a CTE school, this chapter focuses *only on those students who applied to and were entered into the lottery at least one CTE school.*

Tables C.1 and C.2 (located in Appendix C) present variable definitions, means, standard deviations, and number of cases for the variables used in the analyses in this chapter.

Descriptive Comparison of Key Academic Outcomes

In this section, we present basic descriptive data on total high school GPA, high school attendance, credits earned, and graduation rates for the three cohorts of students. This descriptive information provides a basic portrait of the overall levels of each outcome variable. For each outcome, we provide two comparisons:

- a comparison between the treatment and control groups, with "treatment" indicating that they were accepted to a CTE school (Table 5.1), and
- a comparison between those who actually attended a CTE school and those who did not (Table 5.2).

It is important to keep in mind that these values have not been adjusted for pre-high school student characteristics.

Tables 5.1 and 5.2 tell two main stories. First, students who were accepted to CTE schools had higher high school GPAs, high school attendance, credits earned, and graduation rates than those who were not accepted to CTE schools. A higher percentage of students accepted to CTE schools earned credits in Algebra 1, Algebra 2, Geometry,

and Chemistry and completed at least two years of a foreign language (Table 5.1). Similar differences existed between students who actually attended CTE schools and those who did not attend CTE schools (Table 5.2).

The second story that is apparent in Tables 5.1 and 5.2 is that outcomes are not particularly good for any group of students. For each comparison and each cohort, the total GPA was less than a C, on average. Mean attendance was in the low 80-percent range, at best – meaning that students, on average, missed the equivalent of about seven weeks of school each year. In terms of credits earned, the mean was below the number needed to graduate (23 credits). And none of the comparisons or groups had six-year graduation rates of even 70 percent.

Table 5.1: Comparison of Academic Outcomes, by CTE Acceptance Status, for the Classes of 2003, 2004, and 2005

	Class of 2003		Class of 2004		Class of 2005	
	Accepted to any CTE School	Not Accepted to a CTE School	Accepted to any CTE School	Not Accepted to a CTE School	Accepted to any CTE School	Not Accepted to a CTE School
Mean total GPA	1.64	1.53	1.70	1.42	1.64	1.41
Mean total attendance	78.0	74.0	81.2	74.3	82.3	76.0
Mean total credits earned	19.11	16.62	20.38	16.47	20.98	16.94
% graduated on-time	53.4	46.4	63.0	45.6	62.0	45.7
% graduated in 5 Years	60.9	54.7	69.3	55.0	+	+
% graduated in 6 Years	63.6	57.0	+	+	+	+
% earned Algebra 1 credit	67.5	50.2	67.4	51.1	70.7	58.9
% earned Algebra 2 credit	50.8	44.2	58.8	44.1	62.4	47.5
% earned Geometry credit	57.0	44.4	64.3	46.9	64.0	44.1
% earned Chemistry credit	50.6	46.0	59.0	44.3	60.4	45.3
% earned Physics credit	21.0	21.8	17.4	21.4	30.2	27.0
% earned 2 Foreign Language credits	72.6	67.5	77.0	64.0	81.4	64.5
N	2,531	4,493	2,650	4,778	3,050	4,792

+ Data not available.

SOURCE: Analysis of student data from the School District of Philadelphia.

Table 5.2: Comparison of Academic Outcomes, by CTE Enrollment Status, for the Classes of 2003, 2004, and 2005

	Class of 2003		Class of 2004		Class of 2005	
	Attended any CTE School	Did not attend any CTE School	Attended any CTE School	Did not attend any CTE School	Attended any CTE School	Did not attend any CTE School
Mean total GPA	1.66	1.55	1.58	1.51	1.52	1.48
Mean total attendance	80.1	74.1	81.4	75.4	83.2	76.4
Mean total credits earned	20.61	16.66	21.29	16.86	22.52	17.07
% graduated on-time	55.2	47.2	60.8	49.4	62.1	49.0
% graduated in 5 Years	62.0	55.6	66.7	58.3	+	+
% graduated in 6 Years	64.6	58.0	+	+	+	+
% earned Algebra 1 credit	76.6	50.7	76.1	51.1	77.9	59.0
% earned Algebra 2 credit	53.5	44.7	58.2	46.8	63.0	50.5
% earned Geometry credit	63.9	44.6	69.9	48.1	71.1	45.9
% earned Chemistry credit	51.5	46.6	56.6	47.7	59.5	48.8
% earned Physics credit	20.1	22.0	14.2	21.8	28.0	28.5
% earned 2 Foreign Language credits	74.1	68.0	76.1	66.5	83.7	67.3
N	1,391	4,942	1,506	5,100	1,630	5,352

+ Data not available.

SOURCE: Analysis of student data from the School District of Philadelphia.

Intent-to-Treat Estimates of CTE School Impacts

Table 5.3 summarizes Intent-to-Treat and Local Average Treatment Effects estimates of CTE school impacts on key academic outcomes: graduation, GPA, academic growth, and college-preparatory course completion. For comparison, estimates from both a mixed model ITT and a fixed effects ITT model, discussed in Chapter 3, are presented in Table 5.3. Each of these sets of estimates includes controls for student race/ethnicity.[16]

In general, the estimates from the fixed-effects models are larger than those obtained from the mixed model. In addition, for the Class of 2005, many of the fixed-effects estimates are statistically significant, while those from the mixed model are not. Finally, both the mixed model and fixed effects model estimates indicate that the Class of 2005 did not perform as well as either the Classes of 2003 or 2004, although many of the

[16] Intent-to-Treat estimates for each year in high school (9th grade, Year Two, Year Three, and Year Four) are presented in Tables C.4 through C.7 (Appendix C).

effects continued to be in favor of CTE schools. It is beyond the scope of this report to explain why these differences existed across cohorts. The LATE estimates follow the same pattern and significance as the ITT estimates, but the impacts are of a larger magnitude as they take into account treatment crossover effects that may depress ITT estimates of impact.

Table 5.3 shows that the most consistent positive effects of the CTE schools are those related to educational attainment – in this case, graduation from high school. For both the Classes of 2003 and 2004, estimates from both the mixed model and fixed-effect model indicate a positive effect of CTE schools. As per the ITT estimate for these two classes, students who were accepted to CTE schools had odds of graduating on time that were one-third higher than students who applied to but were not accepted to a CTE school. For the LATE estimates, the odds of graduating on time are roughly double for those students who were accepted to CTE schools. For the Class of 2005, the fixed-effect estimate indicates that students accepted to CTE schools had odds of graduating on time that were 20 percent higher than students who were not accepted. The estimate from the mixed model is not statistically significant for the Class of 2005.

The CTE school effect also is seen in the odds of graduation within five years of entering high school and, for the Class of 2003, six year graduation. Each of the estimates for the Class of 2003 places odds of five year graduation at least 30 percent higher for students accepted to CTE schools; for the Class of 2004, the odds are at least 20 percent higher. For the Class of 2003, the odds of graduation within six years were 30 percent higher for CTE applicants who were accepted.

Given the graduation advantage of CTE schools, it makes sense that the CTE treatment group earned more credits over the course of their high school careers. For the Class of 2003, both mixed model and fixed-effects estimates indicate at least a two credit CTE advantage; for the Class of 2004, the effect starts at approximately one credit. The CTE effect on credit accumulation for the Class of 2005 is less than one credit, according to the fixed effects estimate; the estimates from the mixed models are not statistically significant. Not surprisingly, the CTE effect is positive for the number of CTE courses taken during high school.

GPA effects of CTE schools are inconsistent, with positive effects for some cohorts and modeling strategies and negative effects for others. In all case, the effects are small – less than one third of a GPA point. A reasonable conclusion is that, overall, the effects of CTE schools on GPA were a wash. The same conclusion applies to academic growth in reading comprehension and mathematics. For some cohorts, the direction of the CTE effect is negative; for others, it is positive. With the exception of the mixed models for the Class of 2004, none of the effects is statistically significant at the .05 level (although some of the mathematics estimates approach statistical significance).

As a check on potential bias in total GPA and academic growth introduced by differential attrition of CTE and non-CTE students during high school, we produced a second set of ITT estimates, filling in the missing data using multiple imputation

(Allison, 2000). These estimates – along with those for Dosage, discussed later - are presented in Table C.3 (Appendix C). Estimates for GPA and academic growth in mathematics using imputed data are similar to the estimates with missing cases excluded (Table 5.3). Using imputed data, estimates for reading growth show a consistently negative pattern but the difference between CTE and non-CTE students is small.

Table 5.3: Estimated Intent-to-Treat and Local Average Treatment Effect CTE Impacts on Academic Outcomes, Classes of 2003, 2004, and 2005 *

	Class of 2003			Class of 2004			Class of 2005		
	ITT	**LATE**	**Fixed Effects**	**ITT**	**LATE**	**Fixed Effects**	**ITT**	**LATE**	**Fixed Effects**
On-time graduation	**1.33 (.000)**	**1.97 (.000)**	**1.36 (.000)**	**1.36 (.000)**	**2.55 (.000)**	**1.31 (.000)**	1.09 (.168)	1.42 (.168)	**1.20 (.012)**
Five Year Graduation	**1.30 (.000)**	**1.87 (.000)**	**1.33 (.000)**	**1.24 (.001)**	**1.90 (.001)**	**1.22 (.002)**	+	+	+
Six Year Graduation	**1.31 (.000)**	**1.89 (.000)**	**1.36 (.000)**	+	+	+	+	+	+
Total Credits Earned	**2.16 (.000)**	**5.14 (.000)**	**2.52 (.000)**	**.91 (.001)**	**2.75 (.001)**	**1.16 (.000)**	3.14 (.909)	12.56 (.909)	**.83 (.014)**
Number of CTE Courses Taken	**.63 (.000)**	**1.50 (.000)**	**.84 (.000)**	**.12 (.034)**	**.37 (.034)**	**.63 (.000)**	-.07 (.280)	-.28 (.280)	**.79 (.000)**
Total GPA	**.13 (.000)**	**.32 (.000)**	**.11 (.000)**	**.09 (.000)**	**.27 (.000)**	-.05 (.077)	.02 (.430)	.08 (.430)	**-.14 (.000)**
Academic growth – mathematics	-0.77 (.062)	-1.83 (.062)	-.82 (.069)	**1.16 (.012)**	**3.52 (.012)**	.53 (.296)	0.77 (.091)	3.08 (.091)	-.14 (.801)
Academic growth – reading	-0.04 (.930)	-0.09 (.930)	.06 (.901)	**0.94 (.038)**	**2.85 (.038)**	.32 (.532)	0.11 (.772)	0.44 (.772)	-.61 (.214)
Completed Algebra 1, Algebra 2, Geometry	**1.57 (.000)**	**2.94 (.000)**	**1.78 (.000)**	**1.39 (.000)**	**2.70 (.000)**	**1.76 (.000)**	1.07 (.302)	1.30 (.302)	**1.36 (.002)**
Completed 2 years of a foreign language	**1.28 (.000)**	**1.80 (.000)**	**1.29 (.000)**	1.14 (.074)	1.49 (.074)	1.00 (.971)	1.02 (.793)	1.09 (.793)	1.13 (.218)
Completed Chemistry and Physics	1.09 (.209)	1.22 (.209)	1.00 (.994)	**0.71 (.000)**	**0.35 (.000)**	**.51 (.000)**	0.91 (.184)	0.67 (.184)	**.76 (.002)**

SOURCE: Analysis of student data from the School District of Philadelphia.
*Statistical significance levels in parentheses. Estimates with p<.05 in bold.
+Data not available to produce these calculations

The Intent-to-Treat estimates of CTE effects also are inconsistent with regard to completion of college-preparatory coursework. There are substantial positive CTE effects across cohorts and estimation methods for completion of a three-course sequence in Algebra 1, Algebra 2, and Geometry. The odds for CTE range from 36 percent greater to almost 200 percent greater.

For the Class of 2003, the CTE impact on completion of two or more years of a foreign language are statistically significant and substantial, with odds at least 25 percent higher. However, the Classes of 2004 and 2005 do not share this advantage. Although the effects are mostly positive, they are small and not statistically significant.

The effects for completion of Chemistry and Physics are genuinely mixed. For the Class of 2003, there is no statistically significant difference between accepted and non-accepted students, but for the Class of 2004, students accepted to CTE schools have lower odds of completing the two-course science sequence. The fixed effects model for the Class of 2005 also indicates a CTE disadvantage.

Intent-to-Treat Effects by School and Cohort

To confirm that the Intent-to-Treat effects of CTE schools that we observed – particularly those that indicated a consistent CTE advantage (graduation, credit accumulation, and completion of a college-preparatory mathematics sequence) - were not being driven by one or two schools, we compared the mean outcomes for *accepted and non-accepted students* for each school and each cohort. These comparisons are presented in Tables C.8 through C.16 (Appendix C). Since these tables are intended as quick checks on the possibility that one or two schools are producing the mostly positive effect of CTE schools, the outcomes are not adjusted for student race/ethnicity or the ranking that students gave to the school on their application for admission. To preserve the confidentiality of the individual schools, we report them only as Schools A through E.

The tables indicate that for all outcomes except one (completion of science coursework), the effects of CTE schools apply across the four schools (or five schools, depending on the cohort). In general, the effects tend to be largest for School D, particularly with regard to successful completion of college-preparatory coursework in mathematics (Table C.14) and science (Table C.15). For two of the three cohorts, School D is the only CTE school to show a positive effect for science. For the other outcomes, including School D in the analyses has the effect of increasing the magnitude of the CTE effect, rather than changing the direction of the effect.

Another trend across outcomes is that School A tends to lag behind the other CTE schools, with a number of indicators on which students who were accepted to the school did worse than those who were not accepted (e.g. total GPA, credits earned, and the number of CTE courses taken). However, there are other indicators for which the trend for School A is either mixed or mostly positive.

Dosage Effects

Table 5.4 presents estimates of CTE Dosage effects.[17] Whereas the Intent-to-Treat and Local Average Treatment Effect estimates compare outcomes for accepted and non-accepted students, the Dosage estimates compare outcomes for CTE attenders and non-attenders. As is the case for all estimates of CTE impact, only students who applied to at least one CTE school were included in the analysis. The Dosage estimates include a control for the proportion of the first four years of high school that a student attended a CTE school. In order to control for student background characteristics that may have had an impact on outcomes, the Dosage model also controls for the number of CTE schools the student applied to, special education and English Language Learner status, being overage for grade (that is, 15 years or older at the start of ninth grade), gender, and eighth grade GPA.

Overall, the Dosage effects of CTE schools are statistically significant, positive, and fairly substantial across the three cohorts. Members of the Classes of 2003 and 2004 who attended CTE schools had double the odds of graduating from high school on time; the effect was positive but not statistically significant for the Class of 2005. Likewise, the Classes of 2003 and 2004 had more than double the odds of graduating within five or six years of entering high school. In all three cohorts, the CTE effect for total credit accumulation across four years of high school was between 4.7 and 6.2 credits – approximately one entire school year's worth of credits. There also is a positive CTE effect for the number of CTE courses taken. For the Classes of 2003 and 2004, there was a positive CTE effect on GPA, but there was a negative effect for the Class of 2005.

There is only one statistically significant difference in growth in mathematics or reading comprehension, a negative CTE effect for mathematics for the Class of 2005. However, the estimate for mathematics for the Class of 2004 and the reading estimate for 2005 approach statistical significance, with negative CTE effects. It is important to note that in each cohort more CTE attenders than non-attenders took the 11th grade standardized test. For example, in the Class of 2005, 73 percent of students attending CTE schools took the test in reading comprehension, in comparison to 57 percent of students who did not attend CTE schools. The key reasons why students did not take the 11th grade test include not earning enough credits to be promoted to 11th grade within four years of starting high school and/or dropping out of high school. However, the Dosage estimates control for pre-high school demographic and academic characteristics that are associated with earning relatively few credits and dropping out of school.

The Dosage estimates show a substantial CTE advantage for college preparatory course completion. The effect is particularly notable for Algebra 1, Algebra 2, and Geometry, where CTE attenders in the Class of 2003 had triple the odds of earning credits in each of the three mathematics courses; for the Class of 2004, the odds for CTE attenders are more than quadruple those for non-attenders. For the Class of 2005, the odds for CTE attenders are almost double those of non-attenders.

[17] Year-by-year estimates of Dosage effects are presented in Tables C.3 – C.6 (Appendix C).

There is a substantial CTE effect for successful completion of at least two years of foreign language. For each cohort, the odds for CTE attenders were more than double those of students who did not attend CTE schools.

The effects are genuinely mixed for successful completion of the chemistry and physics course sequence. The effect for the Class of 2003 is not statistically significant; for the Class of 2004, the odds for CTE attenders are considerably lower than for non-attenders; and for the Class of 2005, the odds are considerably greater for CTE attenders. The direction and magnitude of the science effects are so inconsistent from cohort to cohort that no pattern can be discerned.

Table 5.4: Estimated Dosage CTE Impacts on Academic Outcomes, Classes of 2003, 2004, and 2005 *

	Class of 2003	Class of 2004	Class of 2005
On-time graduation	**2.28 (.000)**	**2.63 (.000)**	1.19 (.241)
Five Year Graduation	**2.10 (.000)**	**2.53 (.000)**	+
Six Year Graduation	**2.17 (.000)**	+	+
Total Credits Earned	**6.16 (.000)**	**6.16 (.000)**	**4.7 (.000)**
Number of CTE Courses Taken	**2.00 (.000)**	**2.30 (.000)**	**4.16 (.000)**
Total GPA	**.20 (.000)**	**.11 (.000)**	**-.27 (.000)**
Academic growth – mathematics	**-1.72 (.000)**	-1.10 (.062)	-1.00 (.269)
Academic growth – reading	.28 (.507)	-.50 (.395)	-1.45 (.079)
Completed Algebra 1, Algebra 2, Geometry	**3.29 (.000)**	**4.43 (.000)**	**1.98 (.000)**
Completed 2 years of a foreign language	**2.43 (.000)**	**2.87 (.000**	**2.40 (.000)**
Completed Chemistry and Physics	.92 (.283)	**.26 (.000)**	**2.78 (.000)**

DISCUSSION

The analyses presented in this report address scholarly and policy territory that is both old and new. On the one hand, there has been considerable research on the academic effects of taking career and technical education courses. The findings from these previous studies have been contradictory, in part because the research designs typically are hampered by selection bias. At the same time, there has been almost no research on academic outcomes associated with attending a career and technical *school*. Considering that almost 10 percent of American high school students attend high schools with primary and explicit missions to prepare students for careers – including careers that require additional postsecondary education – this study helps to fill a gap in current knowledge about outcomes associated with attending one of these so-called "CTE schools."

This report describes the CTE schools, high school choice process, availability of CTE courses, and impact of CTE schools on academic outcomes for a single district (the School District of Philadelphia) during a specific set of years prior to and slightly overlapping with Perkins IV. The research is, in the end, a case study of the effects of CTE schools in a particular large-city school district. As with any case study, a full interpretation of the results must take into account how the city's social and educational context affects how CTE schools are supported and perceived by the community and district staff. While this report does not present an exhaustive analysis of how parents and students view Philadelphia's CTE schools, the empirical data demonstrate that in Philadelphia, the Career and Technical high schools were highly sought after. Large percentages of eighth graders applied to at least one CTE school for high school. Further, CTE schools are not viewed by parents as providing only low-level skills. Interviews with parents of Philadelphia eighth graders who were going through the high school admissions process suggest that some parents perceive CTE schools to be a way to access college-preparatory courses while giving the student a set of skills to "fall back on" (Neild, 2005).

Further, while the CTE schools in Philadelphia were rather run-of-the-mill in terms of the occupational foci and curriculum, they were subject to school district efforts to increase college-preparatory course taking in all high schools. Thus, there were many opportunities for students at CTE schools to take college-preparatory mathematics, science, and foreign language. The high percentages of CTE students who earned credits in these courses supports the argument that CTE schools did not behave as a "dead end" school or a "school of last resort." In cities where parents and students perceive CTE schools as an undesirable option, or in school districts where CTE schools are treated as appropriate only for students who have no other skills, the effects of CTE schools could be quite different. One of the clear messages of this report, however, is that *it is not always or necessarily the case that CTE schools are associated with weaker academic outcomes for students.* In some situations – Philadelphia being one of them – academic outcomes for CTE schools may equal or exceed those of other schools in the district.

That these impacts were observed in a research study that used randomized design strengthens the validity of this assertion.

It is beyond the scope of this report to investigate the mechanisms that produce the CTE school impacts that we observe. However, we suggest several potential mechanisms that may contribute to the CTE school impacts on educational attainment, credit accumulation, and course completion in mathematics and foreign language. These hypothesized mechanisms, which are not mutually exclusive, await further investigation with data that are more nuanced than the administrative records to which we have had access. Several plausible hypotheses are as follows:

- There is something unique about career and technical education that contributes positively to student academic outcomes. According to this hypothesis, Career and Technical Education schools may increase student commitment to completing high school by emphasizing the connection between schooling and workplace success in students' high school careers. A corollary of this argument is that CTE schools may be more likely than neighborhood high schools to offer CTE courses to freshmen, which reinforces the schooling-workplace connection during the critical high school transition year. With regard to this corollary argument, we note that, among those who were entered into the Philadelphia's CTE lotteries, students at CTE schools were no more likely than students at other types of schools to take a CTE course during their freshman year.

- The effect of Career and Technical schools results from CTE schools having a clear thematic focus relative to neighborhood high schools. According to this argument, it is not necessarily the particular focus (CTE, in this case) of the schools that makes a difference, but rather the fact that the schools *have* a focus. The focus may allow the faculty to plan more coherently and maintain a more stable staff committed to a specific vision of what the school should offer students.

- Career and Technical schools bring together groups of students who have the personal and/or family resources to submit a high school choice application and travel to a school that is typically located outside of their immediate neighborhood, as well as better academic records than students not entered into the lottery. This argument would suggest that a student's peers create the CTE effect. By including only students who were able to negotiate the school choice process and who had sufficiently strong prior achievement or attendance to be entered into the lottery, CTE schools serve a more select group of peers who exert subtle or over pressure on each other to achieve. A corollary to this argument is that the CTE schools were able to return students to their neighborhood high schools if they failed to meet academic and/or behavioral expectations – thus removing them from the peer mix at the school.

- Individual students believe that attending a Career and Technical school is a special privilege, which they work to retain. Since Career and Technical

> Education schools are "choice schools" in a context like Philadelphia and admissions rates are low, attending a CTE school is viewed as a privilege. Students know that they can be "returned" to their neighborhood high schools for acting out or underperforming academically, so they behave better and try harder in their classes.

With regard to these hypotheses, it is important to note that career and technical education *per se* is only one of the hypothesized mechanisms. It would be a mistake to conclude that this research supports an approach to high school curriculum that emphasizes career and technical education over other curricular focuses. On the other hand, it would be equally mistaken to dismiss career and technical education schools as *necessarily* – in all educational contexts - reducing the probability that students will graduate from high school and earn credits in gate keeping courses needed for admission to and success in postsecondary education. The empirical evidence makes clear that CTE schools in Philadelphia were associated with considerable student advantage in terms of graduation and college preparatory course taking.

We conclude with a reminder that although this study has identified many positive effects for CTE schools, there is still considerable room for improvement of student academic outcomes – regardless of whether students attended CTE schools or other schools. Although a considerably higher percentage of students who were accepted to CTE schools graduated on time in comparison to those who were not accepted (62 percent versus 46 percent, for the Class of 2005), it is deeply concerning that almost 40 percent of the students accepted to CTE schools did not graduate within four years of beginning high school. The graduation rates are very similar for students who actually attended CTE schools. Likewise, although there was a considerable CTE effect for successfully completing the Algebra 1/Algebra 2/Geometry course sequence, almost 30 percent of those who were accepted to CTE schools for the Class of 2005 did not earn an Algebra 1 credit. These findings remind us that, in an urban context where graduation from high school and college enrollment is not the norm, there is still a great deal of work to be done to keep students on the pathway to graduation and help them acquire the knowledge and skills they need to succeed in a 21st century economy.

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APPENDIX A

Table A.1: Full List of Status and Basis Codes used in School District of Philadelphia High School Admissions Files

Status Code	Basis Code	Basis Description
2	02	DISAPPROVAL - APPLICATION WAS NOT APPROVED
2	03	DISAPPROVAL - ACCEPTED PLACEMENT AT ANOTHER APPROVED SCHOOL LISTED
2	04	DISAPPROVAL - RESCINDED THE PLACEMENT PER YOUR REQUEST
2	05	DISAPPROVAL - NOT IN ACCORDANCE WITH TRANSFER POLICY
2	06	DISAPPROVAL - TRANSFER RESCINDED -NO LONGER ELIGIBLE FOR ADMISSION
2	07	DISAPPROVAL - APPLICATION WAS RECEIVED AFTER THE FILING DEADLINE
2	08	DISAPPROVAL - APPLICATION WAS NOT APPROVED
2	09	DISAPPROVAL - YOUR CHILD WAS NOT SELECTED IN THE LOTTERY
2	51	DISAPPROVAL - APPLICATION WAS NOT APPROVED
2	52	DISAPPROVAL - THE SCHOOL IS OVERCROWDED
2	53	DISAPPROVAL - THE CLASS AND/OR GRADE IS OVERCROWDED
2	54	DISAPPROVAL - INCOMPLETE DATA ON STUDENT TRANSCRIPT
2	55	DISAPPROVAL - READING AND/OR MATH SCORES BELOW REQUIRED PERCENTILE
2	56	DISAPPROVAL - THE PUPIL PROGRESS REPORT REQUIREMENTS WERE NOT MET
2	57	DISAPPROVAL - THE ATTENDANCE AND/OR LATENESS RECORD UNSATISFACTORY
2	58	DISAPPROVAL - THE INTERVIEW AND/OR SCREENING CRITERION WAS NOT MET
2	59	DISAPPROVAL - THE AUDITION AND/OR PORTFOLIO CRITERION WAS NOT MET
2	60	DISAPPROVAL - THE INTERVIEW, TESTING OR AUDITION WAS NOT ATTENDED
2	61	DISAPPROVAL - STUDENT MAY ONLY APPLY TO FIVE SCHOOLS
2	62	DISAPPROVAL - THE PROGRAM IS NOT AVAILABLE
2	63	DISAPPROVAL - THE APPLICATION WAS RECEIVED LATE
2	64	DISAPPROVAL - YOUR CHILD IS NOT ONE OF THE LOWEST ACHIEVING STUDENTS
2	73	DISAPPROVAL - ACCEPTED PLACEMENT AT ANOTHER APPROVED SCHOOL LISTED
2	74	DISAPPROVAL - RESCINDED THE PLACEMENT PER YOUR REQUEST
2	75	DISAPPROVAL - ADMISSION CRITERIA WAS NOT MET
2	76	DISAPPROVAL - TRANSFER RESCINDED -NO LONGER ELIGIBLE FOR ADMISSION
3	01	YOUR CHILD IS ON THE WAITLIST. YOU WILL BE CONTACTED IF THERE IS SPACE
3	70	YOUR CHILD IS ON THE WAITLIST. YOU WILL BE CONTACTED IF THERE IS SPACE
4	00	NO DISPOSITION HAS BEEN MADE TO DATE

SOURCE: School District of Philadelphia Office of Secondary Education

Table A.2: Percentage Accepted, Not Accepted, and Unknown, for Class of 2003, by CTE School

	Initial status (before random assignment)	After first round	After second round	After third round	After fourth round	After fifth round	After sixth round	After seventh round	After assignment of remaining unknowns to "not accepted"
Bok									
Accepted	13.47% (359)	20.33% (542)	21.94% (585)	21.94% (585)	21.94% (585)	21.94% (585)	21.94% (585)	22.02% (587)	22.02% (587)
Not Accepted	21.34 (569)	39.38 (1,050)	51.91 (1,384)	60.69 (1,618)	66.13 (1,763)	69.65 (1,857)	72.21 (1,925)	73.78 (1,967)	77.98 (2,079)
Unknown	65.19 (1,738)	40.29 (1,074)	26.14 (697)	17.37 (463)	11.93 (318)	8.40 (224)	5.85 (156)	4.20 (112)	0
Total	100 (2,666)	100 (2,666)	100 (2,666)	100 (2,666)	100 (2,666)	100 (2,666)	100 (2,666)	100 (2,666)	100 (2,666)
Dobbins									
Accepted	16.96 (630)	20.19 (750)	22.10 (821)	23.12 (859)	23.77 (883)	24.23 (900)	24.52 (911)	24.60 (914)	24.60 (914)
Not Accepted	49.72 (1,847)	58.30 (2,166)	63.26 (2,350)	66.89 (2,485)	69.23 (2,572)	70.90 (2,634)	72.06 (2,677)	72.89 (2,708)	75.40 (2,801)
Unknown	33.32 (1,238)	21.51 (799)	14.64 (544)	9.99 (371)	7 (260)	4.87 (181)	3.42 (127)	2.50 (93)	0
Total	100 (3,715)	100 (3,715)	100 (3,715)	100 (3,715)	100 (3,715)	100 (3,715)	100 (3,715)	100 (3,715)	100 (3,715)
Mastbaum									
Accepted	16.37 (518)	19.53 (618)	20.99 (664)	21.59 (683)	21.93 (694)	22.19 (702)	22.38 (708)	22.44 (710)	22.44 (710)
Not Accepted	51.96 (1,644)	59.29 (1,876)	65.23 (2,064)	69.31 (2,193)	71.81 (2,272)	73.61 (2,329)	74.75 (2,365)	75.66 (2,394)	77.56 (2,434)
Unknown	31.67 (1,002)	21.18 (670)	13.78 (436)	9.1 (288)	6.26 (198)	4.20 (133)	2.88 (91)	1.90 (60)	0
Total	100 (3,164)	100 (3,164)	100 (3,164)	100 (3,164)	100 (3,164)	100 (3,164)	100 (3,164)	100 (3,164)	100 (3,164)
Saul									
Accepted	12.40 (255)	17.32 (356)	18.34 (377)	19.11 (393)	19.46 (400)	19.70 (405)	20.14 (414)	20.18 (415)	20.18 (415)
Not Accepted	46.40 (954)	58.03 (1,193)	64.45 (1,325)	68.73 (1,413)	71.79 (1,476)	74.08 (1,523)	75.78 (1,558)	76.90 (1,581)	79.82 (1,641)
Unknown	41.20 (847)	24.66 (507)	17.22 (354)	12.16 (250)	8.75 (180)	6.23 (128)	4.09 (84)	2.92 (60)	0
Total	100 (2,056)	100 (2,066)	100 (2,066)	100 (2,506)	100 (2,506)	100 (2,506)	100 (2,506)	100 (2,506)	100 (2,506)

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.3: Percentage Accepted, Not Accepted, and Unknown, for Class of 2004, by CTE School

	Initial status (before random assignment)	After first round	After second round	After third round	After fourth round	After fifth round	After sixth round	After seventh round	After eighth round	After ninth round	After tenth round	After assignment of remaining unknowns to "not accepted"
Bok												
Accepted	22.92% (366)	36.26% (579)	36.38% (581)	36.51% (583)	36.57% (584)	36.69% (586)	36.76% (587)	36.82% (588)	36.88% (589)	36.94% (590)	36.94% (590)	36.94% (590)
Not Accepted	58.92 (941)	60.68 (969)	60.68 (969)	60.68 (969)	60.68 (969)	60.80 (971)	60.80 (971)	60.80 (971)	60.80 (971)	60.80 (971)	60.80 (971)	63.06 (1,007)
Unknown	18.16 (290)	3.07 (49)	2.94 (47)	2.82 (45)	2.76 (44)	2.50 (40)	2.44 (39)	2.38 (38)	2.32 (37)	2.25 (36)	2.25 (36)	0
Total	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)	100 (1,597)
Dobbins												
Accepted	38.66 (656)	51.56 (875)	51.74 (878)	51.80 (879)	51.80 (879)	51.97 (882)	52.03 (883)	52.21 (886)	52.45 (890)	52.56 (892)	52.56 (892)	52.56 (892)
Not Accepted	43.78 (743)	46.14 (783)	46.14 (783)	46.14 (783)	46.14 (783)	46.14 (783)	46.14 (783)	46.14 (783)	46.14 (783)	46.14 (783)	46.14 (783)	47.44 (805)
Unknown	17.56 (298)	2.3 (39)	2.12 (36)	2.06 (35)	2.06 (35)	1.89 (32)	1.83 (31)	1.65 (28)	1.41 (24)	1.30 (22)	1.30 (22)	0
Total	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)	100 (1,697)
Mastbaum												
Accepted	27.86 (539)	40.57 (785)	40.72 (788)	40.98 (793)	41.09 (795)	41.19 (797)	41.24 (798)	41.24 (798)	41.29 (799)	41.29 (799)	41.29 (799)	41.29 (799)
Not Accepted	55.35 (1,071)	56.85 (1,100)	56.90 (1,101)	56.90 (1,101)	56.90 (1,101)	56.90 (1,101)	56.95 (1,102)	56.95 (1,102)	56.95 (1,102)	56.95 (1,102)	56.95 (1,102)	58.71 (1,136)
Unknown	16.8 (320)	2.58 (50)	2.38 (46)	2.12 (41)	2.02 (39)	1.91 (37)	1.81 (35)	1.81 (35)	1.76 (34)	1.76 (34)	1.76 (34)	0
Total	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)	100 (1,935)

Table A.3 continued, next page

Table A.3, continued: Percentage Accepted, Not Accepted, and Unknown, for Class of 2004, by CTE School

	Initial status (before random assignment)	After first round	After second round	After third round	After fourth round	After fifth round	After sixth round	After seventh round	After eighth round	After ninth round	After tenth round	After assignment of remaining unknowns to "not accepted"
Saul												
Accepted	31.24% (259)	64.66% (536)	64.66% (536)	64.78% (537)	64.90% (538)	65.14% (540)	65.26% (541)	65.38% (542)	65.38% (542)	65.38% (542)	65.38% (542)	65.38% (542)
Not Accepted	32.09 (266)	33.66 (279)	33.66 (279)	33.66 (279)	33.66 (279)	33.66 (279)	33.66 (279)	33.66 (279)	33.66 (279)	33.66 (279)	33.66 (279)	34.62 (287)
Unknown	36.67 (304)	1.69 (14)	1.69 (14)	1.57 (13)	1.45 (12)	1.21 (10)	1.09 (9)	0.97 (8)	0.97 (8)	0.97 (8)	0.97 (8)	0
Total	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)	100 (829)

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.4: Percentage Accepted, Not Accepted, and Unknown, for Class of 2005, by CTE School

	Initial status (before random assignment)	After first round	After second round	After third round	After fourth round	After fifth round	After sixth round	After seventh round	After eighth round	After ninth round	After tenth round	After assignment of remaining unknowns to "not accepted"
Bok												
Accepted	24.41% (344)	39.67% (559)	39.89% (562)	39.96% (563)	40.03% (564)	40.10% (565)	40.24% (567)	40.31% (568)	40.45% (570)	40.45% (570)	40.45% (570)	40.45% (570)
Not Accepted	54.79 (772)	56.64 (798)	56.64 (798)	56.71 (799)	56.78 (800)	56.92 (802)	56.92 (802)	56.92 (802)	56.92 (802)	56.92 (802)	56.99 (803)	59.55 (839)
Unknown	20.79 (293)	3.69 (52)	3.48 (49)	3.34 (47)	3.19 (45)	2.98 (42)	2.84 (40)	2.77 (39)	2.63 (37)	2.63 (37)	2.56 (36)	0
Total	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)	100 (1,409)
Dobbins												
Accepted	44.90 (705)	58.85 (924)	59.49 (934)	59.94 (941)	60.32 (947)	60.76 (954)	61.34 (963)	61.66 (968)	62.10 (975)	62.61 (983)	62.61 (983)	62.61 (983)
Not Accepted	31.91 (501)	34.59 (543)	34.59 (543)	34.59 (543)	34.71 (545)	34.71 (545)	34.78 (546)	34.78 (546)	34.78 (546)	34.78 (546)	34.78 (546)	37.39 (587)
Unknown	23.18 (364)	6.56 (103)	5.92 (93)	5.48 (86)	4.97 (78)	4.52 (71)	3.89 (61)	3.57 (56)	3.12 (49)	2.61 (41)	2.61 (41)	0
Total	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)	100 (1,570)
Mastbaum												
Accepted	43.89 (506)	63.05 (727)	63.31 (730)	63.66 (734)	63.92 (737)	64.09 (739)	64.18 (740)	64.35 (742)	64.35 (742)	64.35 (742)	64.35 (742)	64.35 (742)
Not Accepted	32.44 (374)	34.26 (395)	34.26 (395)	34.26 (395)	34.43 (397)	34.52 (398)	34.52 (398)	34.52 (398)	34.52 (398)	34.52 (398)	34.52 (398)	35.65 (411)
Unknown	23.68 (273)	2.69 (31)	2.43 (28)	2.08 (24)	1.65 (19)	1.39 (16)	1.30 (15)	1.13 (13)	1.13 (13)	1.13 (13)	1.13 (13)	0
Total	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)	100 (1,153)

Table A.4 continued, next page

Table A.4, continued: Percentage Accepted, Not Accepted, and Unknown, for Class of 2005, by CTE School

Saul												
Accepted	40.00% (290)	65.66% (476)	66.21% (480)	66.76% (484)	67.59% (490)	68.14% (494)	68.83% (499)	69.24% (502)	69.52% (504)	69.93% (507)	69.93% (507)	69.93% (507)
Not Accepted	25.93 (188)	27.45 (199)	27.45 (199)	27.59 (200)	27.72 (201)	27.72 (201)	27.72 (201)	27.72 (201)	27.72 (201)	27.72 (201)	27.72 (201)	30.07 (218)
Unknown	34.07 (247)	6.90 (50)	6.34 (46)	5.66 (41)	4.69 (34)	4.14 (30)	3.45 (25)	3.03 (22)	2.76 (20)	2.34 (17)	2.34 (17)	0
Total	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)	100 (725)
Swenson												
Accepted	37.48 (295)	48.54 (382)	48.79 (384)	48.92 (385)	49.17 (387)	49.30 (388)	49.43 (389)	49.56 (390)	49.68 (391)	49.68 (391)	49.68 (391)	49.68 (391)
Not Accepted	46.12 (363)	47.90 (377)	47.90 (377)	47.90 (377)	47.90 (377)	47.90 (377)	47.90 (377)	47.90 (377)	47.90 (377)	47.90 (377)	47.90 (377)	50.32 (396)
Unknown	16.39 (129)	3.56 (28)	3.30 (26)	3.18 (25)	2.92 (23)	2.80 (22)	2.67 (21)	2.54 (20)	2.41 (19)	2.41 (19)	2.41 (19)	0
Total	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)	100 (787)

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.5: Percentage of Students Accepted in Each Simulated Lottery Round, by School, for the Class of 2003

	First round	Second round	Third round	Fourth round	Fifth round	Sixth round	Seventh round
Bok	30.00%	11.46%	0.00%	0.00%	0%	0%	5.56%
Dobbins	29.65	28.00	22.09	21.52	21.17	19.54	9.72
Mastbaum	35.58	19.56	13.00	11.73	11.94	15.28	7.84
Saul	32.29	13.93	15.00	10	10	20.00	5.71

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.6: Percentage of Students Accepted in Each Simulated Lottery Round, by School, for the Class of 2004

	First round	Second round	Third round	Fourth round	Fifth round	Sixth round	Seventh round	Eighth round	Ninth round	Tenth round
Bok	73.61%	52.11%	22.35%	13.66%	20%	22%	19%	18.87%	20.25%	22.00%
Dobbins	73.33	56.59	55.81	49.21	53.38	52.38	50.00	47.29	42	59.09
Mastbaum	75.66	51.40	44.66	29.03	25.29	24.85	28.26	23.71	21	24.14
Saul	91.14	no cases	53.75	71	65	48.53	70.65	53.42	56	37.50

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.7: Percentage of Students Accepted in Each Simulated Lottery Round, by School, for the Class of 2005

	First round	Second round	Third round	Fourth round	Fifth round	Sixth round	Seventh round	Eighth round	Ninth round	Tenth round
Bok	73.45%	54.23%	19.64%	17.73%	28.21%	23.42%	22.22%	24.10%	20.90%	7.69%
Dobbins	60.22	64.34	60.99	62.93	63.28	65.87	58.33	66.99	67.65	50.00
Mastbaum	80.85	68.23	72.00	63.43	50.45	48.86	57.35	40.32	37.50	60.00
Saul	75.19	72.22	74.68	63.41	61.54	77.27	60.71	71.74	70.97	80.00
Swenson	67.82	53.90	48.24	42.35	41.46	32.61	32.61	40.91	32.26	33.33

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.8: Descriptive Summary of Student Characteristics by Acceptance in School Admission Lottery, Class of 2003

CLASS OF 2003								
	Bok		Dobbins		Mastbaum		Saul	
	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED
% AFRICAN AMERICAN	78	88	95	91	49	65	56	69
% ASIAN	1	5	1	2	3	4	4	5
% LATINO	2	3	3	5	26	18	5	7
% FEMALE	52	57	57	54	49	53	53	50
% SPECIAL EDUCATION	10	12	12	11	12	12	19	18
% ENGLISH LANGUAGE LEARNER	4	2	1	1	4	3	2	3
MEAN READING SCORE, 8TH GRADE	26.04	29.37	29.47	29.22	32.27	30.63	38.93	33.74
MEAN MATH SCORE, 8TH GRADE	25.75	28.13	27.67	27.82	31.87	29.55	36.11	32.24
% DAYS ATTENDED, 8TH GRADE	86	88	91	88	91	88	92	89
MEAN GPA, 8TH GRADE	2.04	2.13	2.17	2.09	2.34	2.15	2.55	2.31
MEAN RANKING GIVEN TO THIS SCHOOL	1.24	3.29	1.86	2.96	2.02	3.16	1.93	3.52
N	587	2,079	914	2,801	710	2,454	415	1,641

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.9: Descriptive Summary Student Characteristics by Acceptance in School Admission Lottery, Class of 2004

CLASS OF 2004								
	Bok		Dobbins		Mastbaum		Saul	
	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED
% AFRICAN AMERICAN	78	79	95	89	40	76	48	73
% ASIAN	14	8	1	1	3	3	4	3
% LATINO	2	3	3	6	29	16	7	8
% FEMALE	58	56	57	53	51	56	57	54
% SPECIAL EDUCATION	6	4	9	15	7	4	6	13
% ENGLISH LANGUAGE LEARNER	2	1	0	0	<1	1	1	0
MEAN READING SCORE, 8TH GRADE	32.33	30.53	32.80	31.17	33.72	32.34	45.35	35.24
MEAN MATH SCORE, 8TH GRADE	32.36	29.74	31.71	31.74	32.95	31.90	43.47	32.16
% DAYS ATTENDED, 8TH GRADE	92	91	92	92	92	92	94	94
MEAN GPA, 8TH GRADE	2.50	2.41	2.55	2.51	2.67	2.56	2.95	2.69
MEAN RANKING GIVEN TO THIS SCHOOL	2.76	4.83	3.20	4.50	2.81	4.67	3.58	5.62
N	590	1,007	892	805	799	1,136	542	287

SOURCE: Analysis of student data from the School District of Philadelphia.

Table A.10: Descriptive Summary Student Characteristics by Acceptance in School Admission Lottery, Class of 2005

CLASS OF 2005										
	Bok		Dobbins		Mastbaum		Saul		Swenson	
	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED	ACCEPTED	NOT ACCEPTED
% AFRICAN AMERICAN	73	79	92	86	49	67	51	63	38	59
% ASIAN	11	8	2	2	2	3	5	2	7	3
% LATINO	4	6	5	8	31	17	10	16	12	15
% FEMALE	58	61	60	61	57	52	61	59	46	43
% SPECIAL EDUCATION	10	11	15	10	9	7	18	15	11	26
% ENGLISH LANGUAGE LEARNER	4	4	<1	<1	1	1	1	0	2	1
MEAN READING SCORE, 8TH GRADE	33.82	33.43	33.83	35.92	35.17	35.36	45.84	41.19	38.15	34.53
MEAN MATH SCORE, 8TH GRADE	33.67	32.98	32.72	33.94	35.12	34.76	43.29	38.69	36.88	33.26
% DAYS ATTENDED, 8TH GRADE	91	92	93	93	93	93	94	94	91	93
MEAN GPA, 8TH GRADE	2.62	2.63	2.68	2.73	2.79	2.74	3.02	2.99	2.67	2.72
MEAN RANKING GIVEN TO THIS SCHOOL	2.64	4.59	3.36	4.08	2.99	4.68	3.47	5.28	2.59	4.57
N	570	839	983	587	742	411	507	218	391	396

SOURCE: Analysis of student data from the School District of Philadelphia.

APPENDIX B

Table B.1: CTE Courses Offered in Philadelphia Public Schools: 1999-00 through 2004-05

School	Courses	Years Offered[18]
Bartram HS	Accounting	1999, 2000, 2001, 2002, 2003
	Career Exploration	1999
	Communications	1999, 2000, 2001, 2002
	Film	2001
	Health Technician/Health Care	1999, 2000, 2001, 2002, 2003, 2004
	Intro to Business	2002
	Job Skills	1999, 2000
	Journalism	1999, 2000, 2001, 2002
	Keyboarding	1999
	Mass Communication/ Mass Media	1999, 2001, 2002
	Medical/Legal Studies	1999, 2000, 2001, 2002
	MIS & Business Data	2003, 2004
	Nursing/Nurse Assistant	2002, 2003, 2004
	Office Aide/Office Practices	1999, 2002
	Radio	1999, 2000
	Television Production	1999, 2000, 2001, 2002
	Intro to Tourism	1999, 2000
	Travel Destinations	1999, 2000
West Philadelphia HS	Accounting	1999, 2000, 2003, 2004
	Aut Bus Of	1999
	Auto Body	1999, 2000, 2001, 2002
	Auto Electronics	1999, 2000, 2001, 2002
	Auto Mechanics	1999, 2000, 2001, 2002, 2003, 2004
	Auto OC	1999, 2000, 2001, 2002
	Auto Suspension	2001, 2002
	Business Technology	2004
	Career Exploration	1999, 2000
	Computers/Computer Technology	1999, 2000, 2001, 2002
	Computer Science	2003
	Desktop Publishing	2002
	Entrepreneurship	1999, 2000, 2001, 2002, 2003
	Graphic Design	2004
	Hospitality	1999, 2000, 2001, 2002, 2003
	Information Management	2003
	Intro to Business	1999, 2000, 2001, 2002
	Keyboarding/Word Processing	2000, 2001, 2002
	Microsoft Office	1999, 2000
	Multimedia/Internet	1999, 2000, 2001, 2002, 2003
	Office Practices	1999, 2000, 2001
	OJT/Work Experience/ Vocational Training	1999, 2000, 2001, 2002
	Retail	1999, 2000
Robeson School for Human Services	Computer/Info Systems	2003, 2004

[18] The fall of the school year is used in this table. For example, 2000 refers to the 2000-2001 school year.

School	Courses	Years Offered
The Communications Technology School	Graphic Design	2004
	Radio & Television	2003, 2004
University City HS	Accounting	2002
	Agriculture	2003, 2004
	Business Data Processing	2003, 2004
	Business Technology	2003
	Career Exploration	1999, 2000
	Carpentry	2003, 2004
	Child Care	2003
	CISCO	1999, 2000, 2001, 2002
	Computer Graphics	1999, 2000, 2001, 2002
	Computer Programming	2004
	Computers/Intro to Computers	2000, 2001, 2002, 2003, 2004
	Health Care	2001, 2003, 2004
	Health Records	1999, 2000, 2001
	Keyboarding/Word Processing	1999, 2000, 2001, 2002
	Medical Office	1999, 2000
	Microsoft Access	2000
	Microsoft Excel	1999, 2000, 2001, 2002
	Microsoft Word	1999, 2000, 2001
	Multimedia	1999, 2000
	Office Skills	1999, 2000, 2001, 2002, 2003, 2004
	OJT/Work Experience	1999, 2000, 2001, 2002
	Power Point	1999, 2000, 2001, 2002
	Psychology	2002
	TV/Video Producing	1999, 2000, 2001, 2002, 2003, 2004
	Web & Internet	2003, 2004
Philadelphia HS for Business & Technology	Business Finance	2004
	Business Technology	2004
E.S. Miller School	Computer Science	1999, 2000
South Philadelphia HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Auto Business	1999, 2001, 2002
	Business Data	2003, 2004
	Business Law	1999, 2000, 2002
	Career Development	1999, 2000, 2001
	Computers/Intro to Computers	1999, 2000, 2001, 2002
	Culinary Arts	1999, 2003, 2004
	Domestics/Domestic Maintenance	1999, 2000, 2001, 2002
	Employment Practices/Principles	1999, 2000, 2001, 2002
	Entrepreneurship	1999, 2004
	Feminine Technologies	2000
	Finance/Financial Planning	2000, 2001, 2002
	Food Service/Professional Cooking	2000
	Foods (Vocational)	2001, 2002
	Health Care	2004
	Hospitality	1999, 2000, 2001, 2002
	Hotel Management	2003, 2004
	Info Law	2001
	Intro to Business	1999, 2000, 2001, 2002
	Investment Banking	1999, 2000

School	Courses	Years Offered
S. Phila, cont'd	Keyboarding/Word/Info Processing	1999, 2000, 2001, 2002, 2003, 2004
	Office Practices	2002
	Systems Applications	1999
	Travel & Tourism	1999, 2000, 2001, 2002
	Vocational Skills	1999, 2000, 2001, 2002
Ben Franklin HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Banking & Credit	1999
	Business/Business Systems	1999, 2001, 2002, 2003, 2004
	Communications	1999, 2000, 2001
	Computer Applications	1999, 2001, 2002
	CAD	2002
	Consumer Finance	2000
	Culinary Arts	2001, 2002, 2003, 2004
	E Commerce	2001, 2002
	E Finance	1999
	Entrepreneurship	1999, 2000
	Financial Planning	1999
	Hospitality	1999, 2000, 2001, 2002
	Hotel Management	2003, 2004
	Information Management	2003, 2004
	Information Technology	2000
	Marketing & Media	1999
	Medical Terminology	2004
	Office Practices	2000, 2001, 2002
	Tourism	2000
	Typing	2001
	Web Design/Web Information	2002, 2003, 2004
Philadelphia HS for the Creative & Performing Arts (CAPA)	Computer TK	2003, 2004
	Costume Design	2003, 2004
	Graphic Design	2003, 2004
	Film-Video	2003, 2004
	Communications	2003, 2004
	Computer Programming	2003, 2004
Edward Bok Tech HS	Building Trades	1999, 2000, 2001
	Business Technology	1999, 2000, 2002, 2003, 2004
	CAD Technology	1999, 2001
	Career Exploration/Job Search	2000, 2001
	Carpentry	2002, 2003, 2004
	Child Care	2001, 2002, 2003, 2004
	Computer Maintenance	2002
	Computer Technology	1999, 2000, 2001, 2002
	Cosmetology	1999, 2000, 2001, 2002
	Culinary Arts	2004
	Desktop Publishing	1999, 2000
	Electrician	2004
	Engineering Technology	2003, 2004
	Food Service	1999, 2000, 2001
	Health Care	1999, 2000, 2001, 2004
	Home Aide	2001, 2002
	IP Programming/Maintenance	1999, 2000

School	Courses	Years Offered
Bok, cont'd	Nurse's Assistant	1999, 2000, 2001, 2002, 2003, 2004
	Web Design	2002, 2003
Charles Audenried SHS	Accounting	1999, 2000
	Business Technology	2002
	Business/Economics	2002
	Entrepreneurship	1999, 2000
	Health Technology	1999
	Information Processing	1999
	Information Technology	2000, 2001, 2002
	Technology	1999, 2001
Roberts Vaux HS	Accounting	2004
	Business	2004
	Computer Science	2004
Horace Furness HS	Business Systems	2004
	Career Opportunities	1999, 2000, 2001
	CISCO	2000, 2001, 2002, 2003, 2004
	Computer Literacy	2002
	Computer/Information Systems	2001, 2003
	Desktop/Desktop Publishing	2000, 2001
	Financial Planning	2000
	Marketing-Advertising	2000
	Office 2000	2000, 2001, 2002
	Oracle	2000, 2001
	Web Design	2003, 2004
School 222	Communication	2003, 2004
	Family & Consumer	2003, 2004
Boone School	Computer Programming	2004
Simon Gratz HS	Accounting	1999
	Architectural Design	2002
	Auto Body	1999, 2000
	Auto Careers	2000
	Auto Mechanics	1999, 2000
	Business Technology/Review	1999, 2003
	Career Exploration	2001
	CISCO	1999, 2000, 2001, 2002
	Computer Applications/Technology	1999, 2000, 2001
	Computer Literacy	1999
	Computer Programming/CIS	2002, 2003, 2004
	Computer Science	1999, 2000, 2001, 2002, 2003, 2004
	Culinary Arts	2003, 2004
	Desktop Publishing	2001, 2002
	Employment Principles	1999
	Entrepreneurship	2001, 2002
	Graphic Design	1999, 2000, 2001, 2002, 2003, 2004
	Health Technology	2003, 2004
	Home Economics	1999
	Hospitality	2000, 2001, 2002
	Intro to Business/Business Systems	2002, 2003

School	Courses	Years Offered
Gratz, cont'd	Intro to Travel & Tourism	1999, 2000, 2001, 2002
	Intro to/Advanced Technology	1999, 2000, 2001, 2002
	Job Skills	1999
	Keyboarding/Word Processing	1999, 2000, 2001, 2002
	Lodging/Hotel Management	2001, 2002, 2003, 2004
	Microsoft Office	2002
	Shop Manager	1999
	Systems Applications	2000, 2001, 2002
	Travel Destinations	2001, 2002
	Travel Service Management	2003, 2004
	Web Design	2002, 2003, 2004
Overbrook HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Architectural Drafting	2004
	Banking & Credit	2000, 2001, 2002, 2004
	Business Principles	2001, 2002
	Business Technology	2003
	Business/Business Communication	1999, 2000, 2001, 2002
	Business-Human Relations	2002
	Clerical Practices	2000, 2002
	Computer Lab	2002
	Consumer Accounting	2000, 2002
	Computer Technology/Applications	1999, 2000, 2002
	Desktop Publishing	1999, 2000, 2001, 2002
	Economics-Finance/Intro to Finance	1999, 2000, 2003, 2004
	Electronics	2004
	Entrepreneurship	1999, 2000, 2001, 2002
	Family & Consumer	1999, 2000, 2001, 2002
	Financial Planning/Records	1999, 2000, 2001, 2002
	Financial Services	1999, 2000, 2001, 2002
	Global Business	2002
	Global Health	2001
	Health Careers	2000
	Health Information	1999, 2000, 2001, 2002
	Information Systems	2003, 2004
	International Finance	2001, 2002
	Intro to Business	2001, 2002
	Intro to Technology/Tech Com	2001, 2002
	Job Search/Careers	1999, 2000, 2001, 2002
	Keyboarding/Word Processing	1999, 2000, 2001, 2002
	Marketing	2002
	Medical Lab Assistant	2003, 2004
	Medical Research Technician	2003, 2004
	Microsoft Office	2002
	Microsoft Word	2002
	Money Management	2000, 2001, 2002
	OJT/Work Experience	1999
	Power Point	2002
	Securities & Insurance	2000, 2001, 2002, 2003, 2004
	Stock Market	2002
	Web Design	2001, 2002

School	Courses	Years Offered
Carver HS	CISCO	1999, 2000, 2001, 2002, 2003, 2004
	Computer Drafting	1999
	Computer Information Systems	2003, 2004
	Computer Maintenance	2003
	Computer Programming	2003, 2004
	Desktop Publishing	1999, 2000, 2001, 2002
	Graphic Design	2003, 2004
	Web & Information	2003, 2004
Dobbins AVTHS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Auto Body	1999, 2000, 2001, 2002, 2003
	Auto Business Office	1999, 2000, 2001, 2002
	Auto Mechanics	1999, 2000, 2001, 2002, 2003
	Baking	1999, 2000, 2001, 2002, 2003, 2004
	Building Trades	1999
	Business Communication	1999, 2000, 2001, 2002, 2003
	Business Data Processing	2003, 2004
	Career Exploration/Job Search	1999, 2003, 2004
	Carpentry	1999, 2000, 2001, 2002, 2003
	CISCO	2003
	Computer Programming	2003, 2004
	Computer Repair	1999
	Computer Science	1999, 2000, 2001, 2002, 2003
	Cosmetology	1999, 2000, 2001, 2002, 2003, 2004
	Electrician	1999, 2000, 2001, 2002
	Electronic Maintenance	1999, 2000, 2001, 2002, 2003
	Electronics	1999, 2000, 2001, 2002, 2003, 2004
	Entrepreneurship	1999, 2000, 2001, 2002, 2003
	Fashion Design	1999, 2000, 2001, 2002, 2003, 2004
	Food Service	1999, 2000, 2001, 2002, 2003, 2004
	Graphic Occupations	1999, 2000, 2001, 2002
	Health RELT/Health Technology	1999, 2000, 2001, 2002, 2003
	Info Processing/Keyboarding/ Word Processing	1999, 2000, 2001, 2002
	Intro to Business	2001, 2002
	Intro to Computers	2000, 2001, 2002
	Plumbing	1999, 2000, 2001, 2002, 2003
	Printing	2003, 2004
	Web Design	2002, 2003, 2004
	Welding	1999, 2000, 2001, 2002, 2003
Strawberry Mansion HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Business Law	1999, 2000, 2002
	Business Practices/Business Systems	2001, 2003, 2004
	C++	1999
	Clerical Practices	1999, 2000, 2001, 2002
	Computer Graphics	1999
	Computer Science	1999
	Computer Technology	2003, 2004
	Con Ed Science	1999, 2000, 2001, 2002
	Culinary Arts	2000, 2001, 2002, 2003
	Desktop Publishing	1999, 2000, 2001, 2002
	Entrepreneurship	2000, 2001, 2002

School	Courses	Years Offered
Mansion, cont'd	General Machine Operation	2003
	Microsoft Office	1999, 2000, 2001, 2002
	MIS	2003, 2004
	Office Technology	1999
	Systems Applications	1999, 2000, 2001, 2002
	Travel & Tourism/Travel Service	1999, 2000, 2001, 2002, 2003
	Travel Destinations	1999
	Word Processing	1999, 2000, 2001, 2002
Kensington HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Business Technology	2004
	Career Development/Exploration	1999, 2000
	Comp Law	1999
	Computer Graphics	1999, 2000
	Computer Science	2003, 2004
	Computer Applications	1999, 2000, 2001, 2002
	Culinary Arts	2003, 2004
	Home Technology	1999
	Job Readiness/Career Skills	1999, 2000
	Systems Applications	1999, 2000, 2001
	Travel Destinations	2000, 2001, 2002
	Travel/Intro to Travel	1999, 2000, 2001, 2002
	Word Processing/Keyboarding	1999, 2000, 2001, 2002, 2003
	Work Study	2000, 2001
Edison HS	Accounting	1999, 2000, 2001, 2002, 2003
	Architectural Drafting	1999, 2000, 2001, 2002, 2003, 2004
	Audio-Visual Communication Tech	1999, 2000, 2001, 2002
	Auto Body	1999, 2000, 2001, 2002, 2003, 2004
	Auto Business Office	1999, 2000, 2001, 2002
	Auto Mechanics	1999, 2000, 2001, 2002, 2003, 2004
	Baking	1999, 2000, 2001, 2002, 2003, 2004
	Business Concepts/ Business & Finance	1999, 2000, 2001, 2002, 2004
	Business Law	1999, 2000, 2001, 2002
	Business Technology	2004
	Child Care	1999, 2000, 2001, 2002, 2003, 2004
	Communication Services	1999, 2000, 2001, 2002
	Computer Code	1999, 2001, 2002
	Computer Repair	2000
	Computers/Computer Applications/ Computer Systems	1999, 2000, 2001, 2002, 2004
	Consumer Ed	2002
	Cosmetology	1999, 2000, 2001, 2002, 2003, 2004
	Electrical Installation	2003, 2004
	Electrical Mechanics	1999, 2000, 2001, 2002
	Electrician	2000
	Entrepreneurship	1999, 2000, 2001, 2002
	Food Service	1999, 2000, 2001, 2002, 2003, 2004
	Graphic Design	2003, 2004
	Health Care	1999, 2000
	Heating/AC Repair	1999, 2000, 2001, 2002, 2003, 2004
	Info Processing/Keyboarding/ Word Processing	1999, 2000, 2001, 2002

School	Courses	Years Offered
Edison, cont'd	Job Skills	1999, 2000
	Major Appliances	2003, 2004
	Material Management	2001, 2002, 2003, 2004
	Medical Lab	2003, 2004
	Medical Records	1999, 2000, 2001, 2002, 2003, 2004
	Mis Business	2003
	Radio & TV	2003, 2004
	Small Business Management	2001, 2002
	Speedwriting	1999, 2000
	Vending Machine Repair	1999, 2000, 2001, 2002
	Visual Communications	1999, 2000, 2001, 2002
	Web Page Design	2004
	Welding	1999, 2000, 2001, 2002, 2003, 2004
William Penn HS	Accounting	1999, 2001, 2002, 2003, 2004
	Auto Business Office	1999, 2000, 2001, 2002
	Business	1999, 2000
	CISCO	1999, 2000, 2001, 2002
	Communication Services	2000, 2001
	Computer Applications	1999, 2000
	Computer Technology	1999, 2000, 2001, 2002, 2003, 2004
	Entrepreneurship	1999, 2000
	HC Technology	2003, 2004
	Home Economics	2001, 2002
	Info Processing/Typing/Word Processing/Keyboarding	1999, 2000, 2001, 2002
	Intro to Business	1999, 2000
	Job Search/Careers	1999, 2000, 2001, 2002
	Job Skills	1999, 2001, 2002
	Job Training/Work Applications/ Work Experience/ Vocational Internship	1999, 2000, 2001, 2002
	Lotus	1999, 2000
	Mass Media/Radio & TV	1999, 2000, 2001, 2003, 2004
	Medical Office Practices	2001, 2002
	MIS	2003, 2004
	Spreadsheets	2001, 2002
Jules Mastbaum AVTS	Accounting	1999, 2000, 2001, 2002
	Appliance Installation	2003, 2004
	Auto Business Office	1999, 2000, 2001, 2002
	Auto Mechanics	1999, 2000, 2001, 2002, 2003, 2004
	Business Data	2003, 2004
	Business Essentials	2001, 2002
	Business Coop	1999
	Cabinet Making	1999, 2000
	Carpentry	1999, 2000, 2001, 2002, **2003, 2004**
	Child Care	2003, 2004
	Clerical Practices	1999, 2000
	Clothing	1999, 2000
	Computer Server	1999
	Commercial Art	1999, 2000, 2001, 2002, 2003, 2004
	Communication Technology	2001
	Cosmetology	1999, 2000, 2001, 2002, 2003, 2004

School	Courses	Years Offered
Mastbaum, cont'd	Culinary Arts	2002, 2003, 2004
	Design Technology	2002
	Draft Design	1999, 2000, 2001
	Electrical Mechanics	1999, 2000, 2001, 2002, 2003, 2004
	Electrical Technician	1999, 2000, 2001, 2002, 2003, 2004
	Electronics	2000, 2001, 2002
	Essentials of IT	2002
	Food Service	1999, 2000, 2001
	Home Economics	1999, 2000, 2001, 2002
	Info Processing/Typing/Word Processing	1999, 2000, 2001, 2002
	Internet Technology	2001
	Java	2002
	Machine Shop	1999, 2000
	Medical Records	1999, 2000, 2001
	Sheet Metal	1999, 2000
	Shorthand Writing	1999, 2000
	Technology Exploration	2001, 2002
	Web Design	2002, 2003, 2004
	Welding	1999, 2000, 2001, 2002, 2003, 2004
William Bodine HS	Accounting	1999, 2000, 2001, 2002, 2003
	Business Law	1999, 2000, 2001, 2002, 2003
	Computers	1999, 2000, 2001, 2002, 2003
	Computer Science	2004
	Microsoft Certification	2003
	Typing	1999, 2000, 2001, 2002
	Web Design	200344
Stephen Douglass School	Building Maintenance	1999, 2000, 2001, 2002, 2003, 2004
	Computers	2003, 2004
	Work/Career Experience	1999, 2000, 2001, 2002
Charles Carroll School	Computers	1999, 2003
	Fashion	1999, 2000, 2001, 2003
Central HS	Communications/Media	2003
	Computer Science	2003, 2004
	Graphics	2003, 2004
	Internet	2003
	Radio & TV	2004
	Web Design	2004
Germantown HS	Accounting	1999, 2001, 2002, 2004
	Business Law	1999, 2000, 2001
	Business Practices	1999, 2001
	Business Systems	2003, 2004
	Business Writing	2001
	Computer Applications	1999, 2000
	Computer Networking	2000, 2001
	Culinary Arts	1999, 2000, 2001, 2002, 2003, 2004
	Electronics	1999, 2000
	Graphics/Graphic Design	1999, 2000, 2001, 2002, 2003
	Information Processing	1999, 2000, 2001, 2002

School	Courses	Years Offered
Germantown, cont'd	Information Systems	2004
	Intro to Communications	2000
	Intro to Computers/Computer Literacy	1999, 2000, 2001, 2002
	Marketing	1999, 2001, 2002
	PRJ Investment	1999, 2000
	Web Design	2001, 2004
Roxborough HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Business Management	1999
	Business Skills	1999, 2000
	Business Technology	2004
	Career Exploration	2004
	Child Education	2004
	Clerical Practices /Clerical Lab/ Clerical Skills	1999, 2000, 2001, 2002
	Communication Technology	2003
	Computer Information Systems	2000, 2001, 2002
	Computer Pres	2000, 2001, 2002
	Computer Serv	2000
	Culinary Arts	2000, 2001, 2002, 2003
	Desktop Publishing	1999
	Entrepreneurship	2004
	Hotel Management	1999, 2003
	Information Systems	1999, 2003
	Intro to Business	1999, 2000, 2001, 2002
	Keyboarding	1999, 2000, 2001, 2002
	Market Management	2002
	Multimedia	2002
	Personal Finance	2002
	Radio & TV	2003, 2004
	Retail/Retail Management	1999, 2000, 2001, 2002
	Travel Destinations	2000, 2001, 2002
	Travel & Tourism	1999, 2000, 2001, 2002
	TV-Video Production	2002
	Vocational Skills	2002
	Web Graphics	2002
	Web Quest/Web Info	2002, 2003, 2004
	Work Experience	1999, 2000, 2001, 2002
Saul Agricultural HS	Agricultural History	1999, 2000, 2001, 2003
	Agricultural Production	1999, 2000, 2001, 2002
	Agriculture	1999, 2000, 2001, 2002, 2003, 2004
	Natural MKU	2002
	Natural Resources	2001, 2002, 2003, 2004
ML King HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Automotive Technology	1999, 2000, 2001, 2002, 2003
	Business Computers	2002
	Career Exploration	2004
	Child Care	1999, 2000, 2001, 2002
	Communications Technology	2004
	Computer Science	2003, 2004
	Culinary Arts	1999, 2000, 2001, 2002

School	Courses	Years Offered
King, cont'd	Desktop/Vis Computers	1999, 2000, 2001, 2002
	Engineering Design	1999, 2000, 2001, 2002, 2004
	Engineering Processes	2000
	Finance	2000, 2001, 2002
	Foods	1999, 2000, 2001, 2002
	Graphic Design	2003, 2004
	Info Processing/Word Processing	1999, 2000, 2001, 2002
	Intro to Business	1999, 2000, 2001, 2002
	Travel & Tourism	1999, 2000
	Small Business Management	1999, 2000, 2001, 2002
	Travel Destinations	1999, 2000, 2001, 2002
	Vocational – Adams Mark Hotel	1999, 2000, 2001, 2002
	Vocational – Germantown Hospital	1999, 2000, 2001, 2002
	Vocational – LaSalle	1999, 2000, 2001, 2002
	Web Design	2004
Randolph	Auto Body	2004
	Auto Mechanics	2004
	Career Exploration	2004
	Carpentry	2004
	Computers	2004
	Culinary Arts	2004
	Electrical	2004
	Food Service	2004
	Health Technology	2004
	Plumbing	2004
	Welding	2004
Frankford HS	911 Response	2000
	Accounting	1999, 2000, 2001, 2002, 2003
	Adv Mac Pro	1999, 2000, 2001, 2002
	Architectural Drafting	2003, 2004
	Building Engineering	2000, 2001, 2002
	Building Maintenance	2001, 2002, 2003, 2004
	Business & Finance	2004
	Business Technology	2004
	Careers/Job Search	1999, 2000, 2001
	Carpentry	1999, 2000, 2001, 2002, 2003, 2004
	Computer Drafting	1999, 2000, 2001
	Computer Literacy/Applications	1999, 2000
	Computer Programming	2003, 2004
	Culinary Arts	1999, 2000, 2001, 2002, 2003, 2004
	Data Administration	2003, 2004
	Desktop Publishing	1999, 2002
	Electronics	1999
	Employment Practices	1999, 2000, 2001
	Engineering Technology	2003, 2004
	EXP Shop	1999, 2000
	Graphic Arts	1999, 2000, 2001, 2002
	Info Processing/Word Processing	1999, 2000, 2001, 2002
	Information Systems	2003, 2004
	Intro to Business	2002

School	Courses	Years Offered
Frankford, cont'd	Management & Business	2003
	Mechanical Drawing	2002
	Office Technology	1999, 2000, 2001, 2002
	OJT/Work Experience	1999, 2000, 2001, 2002
	Personal Finance	1999, 2000, 2001, 2002
	Radio & TV	2003, 2004
	Restaurant Management	1999
	Travel Destinations	1999, 2000, 2001
	Web Design	2003, 2004
Olney High School	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	A+/Robotics	1999, 2000, 2001, 2002
	Architectural Drafting	2003, 2004
	Business Law/Intro to Business & Law	1999, 2000, 2001, 2002
	Business Forms	2003
	Careers/Career Education	1999, 2000, 2001, 2002, 2003, 2004
	Carpentry	2004
	CISCO	2001
	Communication Design	1999, 2000, 2001
	Computer Skills/Beginning Comp	1999, 2000, 2001
	Construction	2003
	Drafting	1999, 2001
	Employment Principles	1999, 2000, 2001, 2002
	Entrepreneurship	1999, 2000
	Family & Consumer Science	2000, 2001
	Food Science	1999, 2000
	Graphic Arts	1999, 2000
	Health Care	2003, 2004
	Health Occupations	2000, 2001
	Hospitality Practices	1999, 2000, 2001, 2002
	Hotel Management	2002
	Human Relations	1999
	Information Processing	1999, 2000, 2002
	Information Systems	1999, 2000, 2003, 2004
	Job Prep	2001, 2002, 2003
	Law Enforcement	2003
	Marketing/Intro to Marketing/ Marketing Ed	1999, 2000, 2001, 2002, 2003
	Medical Assistant	2003, 2004
	System Applications	2000, 2001
	Technology/Intro to Technology	2001, 2002
	Travel & Tourism	1999
	Travel Destinations	2000, 2001
	Web Page Design	2000, 2001, 2002, 2003
	Work Experience/Work Base	1999, 2000, 2001, 2002
Samuel Fels HS	Accounting	1999, 2000, 2001, 2002
	Business Technology	2004
	Career Success/Career Exploration	1999, 2000, 2001
	Career Technology	1999, 2000, 2001
	Clerical Skills	1999, 2000
	Communication Technology	2003, 2004
	Computer Systems/Networking	2003, 2004

School	Courses	Years Offered
Fels, cont'd	Computer Science	2003, 2004
	Consumer Science	2002
	Culinary Arts	1999, 2000, 2001, 2002
	Data Analysis	1999, 2000, 2001, 2002
	Design Technology	1999, 2000, 2001, 2002
	Radio & TV	2003, 2004
	Graphic Design/Computer Art	1999, 2000, 2002, 2003, 2004
	Info Processing/Keyboarding/ Word Processing/Data Entry	1999, 2000, 2001, 2002, 2003
	Intro to Computers	1999, 2000, 2001, 2002
	OJT/Work Experience	1999, 2000, 2001, 2002
	Video	2000, 2001, 2002
Abraham Lincoln HS	A+ Training	2003, 2004
	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Agricultural Mechanics	2000
	Auto Maintenance	1999
	Auto Tech	1999
	Baking	2000, 2001, 2002, 2003
	Basic Design	1999
	Business Careers	2001, 2002
	Business Office	1999
	Business Processes	2001
	Carpentry	2000
	Clerical	1999
	Computer Applications/Network	2002**,** 2003
	Computer Drafting & Design	1999, 2000, 2001
	Construction	1999
	Consumer Science	1999
	Communications	1999
	Cosmetology	1999
	Culinary Arts/Culinary Creations	1999
	Desktop Publishing	1999, 2000
	Electronics	1999
	Electronic Maintenance/Electrician	1999
	Entrepreneurship	2004
	Environmental Technology	1999, 2000, 2001, 2003, 2004
	Florist	1999, 2000, 2001, 2002, 2003, 2004
	Food Production	1999
	Graphic Design	2003, 2004
	Greenhouse	1999, 2000, 2001, 2002, 2003, 2004
	Health Care	2004
	Home Management	1999, 2000, 2001, 2002, 2003, 2004
	Horticulture	1999, 2000, 2001, 2002
	HTML	2002
	Info Processing/Keyboarding/ Word Processing	1999, 2000, 2001, 2002
	Information Systems	2003, 2004
	Intro to the Web/Web Certification/ Internet	2002, 2003, 2004
	Job Skills/Job Search	1999, 2000, 2001, 2002
	Landscaping	1999, 2000, 2001, 2002, 2003, 2004
	Medical Test Technician	2003
	Microsoft Certification	2002, 2004

School	Courses	Years Offered
Lincoln, cont'd	Natural Resources	2003, 2004
	Plumbing	1999, 2000
	Printing	1999
	Restaurant Management	1999
	Software	1999, 2000, 2002, 2004
	Technology	2002
	Transportation	1999
	Web Design	2002, 2003, 2004
	Work Experience	1999, 2000, 2001, 2002
Northeast HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Business Law	2000
	Carpentry	2003, 2004
	Child Lab/Child Care	1999, 2000, 2001, 2002, 2003, 2004
	CISCO	2000, 2001, 2002
	Communication Technology	2003
	Computer Programming	2003, 2004
	Computer Skills	2000
	Computer Network	2003, 2004
	Culinary Arts	1999, 2000, 2001, 2002, 2003, 2004
	Drafting	1999, 2000
	Employment Principles	1999, 2000
	Engineering/Drawing	2001, 2002
	Graphic Communication	2002
	Graphic Design	2003, 2004
	Health Technology	2004
	Info Processing/Keyboarding/ Word Processing/Data Processing	1999, 2000, 2001, 2002, 2003, 2004
	International Foods	2002
	OJT/Work Experience	1999, 2000, 2001, 2002
	Radio & TV	2003, 2004
	Tech Publishing	1999, 2000, 2001, 2002
	Web Design	2003, 2004
	Word Perfect	1999, 2000
George Washington HS	Accounting	1999, 2000, 2001, 2002, 2003, 2004
	Advanced Technology	1999, 2000, 2001
	Building Maintenance	1999
	Business Law	1999, 2000, 2001
	Business Technology	2004
	C++	2000, 2002
	CISCO	2001, 2002
	Computer Applications	1999, 2000, 2001, 2002
	Computer Drafting	1999, 2000
	Computer Programming	2003, 2004
	Computer R & Science	1999, 2000, 2003, 2004
	Computers	2000, 2001, 2002
	Culinary Arts	2000, 2001, 2002, 2003, 2004
	Entrepreneurship	1999, 2000, 2001, 2002, 2003, 2004
	Financial Management	1999
	Graphic Arts	1999, 2000, 2001, 2002, 2003, 2004
	Hospitality	1999, 2000, 2001, 2002, 2003, 2004
	Home Economics	1999
	Info Processing/Keyboarding/	

School	Courses	Years Offered
Wash, cont'd	Word Processing	1999, 2000, 2001, 2002
	Information Systems	2003
	OJT/Work Experience	1999, 2000, 2001, 2002
	Oracle	2002
	Systems Networking	2003
	VIS Basic	1999, 2001
	Vocational Skills	2001
	Web Design	2004
Swenson	A+	2001, 2002
	Auto Collision/Auto Body	2001, 2002, 2003, 2004
	Auto Mechanics	2000, 2003, 2004
	Auto Repair	2000, 2001, 2002
	Auto Special	2001
	Auto Technology	2000
	Baking/Bakery-Pastry	2000, 2001, 2002, 2003, 2004
	Carpentry	2000, 2001, 2003, 2004
	CISCO	2000, 2001, 2002
	Computer Service	2001
	Computer Technology	2000, 2001, 2002
	Computers	2002, 2003, 2004
	Construction	2001, 2002
	Culinary Arts	2000, 2003, 2004
	Desktop Publishing	2000, 2001
	Electrician	2000, 2001, 2002, 2003, 2004
	Electronics	2000
	Engineering Technology	2002, 2003, 2004
	Food Prep	2000, 2001, 2002
	Graphics/Graphic Design	2004
	Health Occupations/Health Care	2002, 2003, 2004
	Health Technologies	2000, 2001, 2002
	Home Management	2000, 2001, 2002
	Hotel Management	2003, 2004
	Plumbing	2000, 2001, 2002, 2003, 2004
	Printing	2000, 2001, 2002, 2003
	Restaurant Management	2000, 2001, 2002
	Web Design/Web-Info	2002, 2003, 2004

SOURCE: School District of Philadelphia Office of Secondary Education

Table B.2: Percentage of Vocational Concentrators, by Cohort and Concentration Area Using Two Course Criteria for Vocational Concentrator

	Class of 2003	Class of 2004	Class of 2005
Total Concentrators in Any Area	**12.9%**	**13.1%**	**15.8%**
Agriculture & Natural Resources	1.1	1.1	1.3
Science, Technology, Engineering, & Mathematics	0.7	0.4	0.5
Architecture and Construction	0.6	0.7	1.0
Business	3.9	4.0	4.4
Computer and Information Sciences	1.1	1.5	2.2
Health Sciences	0.5	0.5	0.8
Manufacturing, Repair, and Transportation	1.5	1.4	1.6
Communications and Design	1.4	1.3	1.7
Personal Services and Culinary Arts	2.7	2.9	3.1
Public Services	0.0	0.0	0.0
Total Students	16,926	18,701	18,808

SOURCE: Analysis of student data from the School District of Philadelphia.

Table B.3: Mean Number of CTE Courses Taken by Year, For Students with at Least One CTE Course Taken Using Two Course Criteria for Vocational Concentrator

	Class of 2003	Class of 2004	Class of 2005
One Area of Concentration	95.3%	95.1%	94.5
Two Areas of Concentration	4.5	4.8	5.4
Three Areas of Concentration	0.1	0.2	0.1
Total	100.0	100.0	100.0
Total Students	2,189	2,443	2,971

SOURCE: Analysis of student data from the School District of Philadelphia.

APPENDIX C

Table C.1: Description of Dependent Variables

Variable	Description	Mean	Standard Deviation	N of students (2003-2005)
Enrolled, Year 1	Binary variable (0-1). Student attends any district school.	.86	.35	22,877
Enrolled, Year 2		.78	.41	22,877
Enrolled, Year 3		.72	.45	22,877
Enrolled, Year 4		.63	.48	22,877
On-time promotion to 10th grade	Binary variable (0-1). Students were coded as "1" if they appeared as tenth graders in their second year of high school. Students who were no longer in the district were coded as 0.	.69	.46	22,877
On-time promotion to 11th grade	Same as above, except that students were coded as "1" if they appeared as 11th graders in their third year of high school. Students who were no longer in the district were coded as 0.	.55	.50	22,877
On-time promotion to 12th grade	Same as above, except that students were coded as "1" if they appeared as 12th graders in their fourth year of high school. Students who were no longer in the district were coded as 0.	.59	.49	22,877
Attendance, 1st year	Number of days attended divided by the number of days enrolled.	.83	.17	19,581
Attendance, 2nd year		.80	.19	17,958
Attendance, 3rd year		.79	.19	16,437
Attendance, 4th year		.82	.16	14,305
GPA, 1st year	Average course grade (unweighted). Students for whom grades are not recorded in a given year (e.g. dropouts) are not included in that year's data.	1.75	.95	19,985
GPA, 2nd year		1.77	.96	18,046
GPA, 3rd year		1.72	.93	15,617
GPA, 4th year		1.74	.89	13,885
Total GPA, years 1-4		1.62	.84	20,699

CTE credits earned, Year 1	Number of credits earned in CTE courses, regardless of they were taken in a single CTE area or were sequential. CTE courses included: family and consumer sciences education; general labor market preparation; occupational preparation courses.	.32	.60	22,877
CTE credits earned, Year 2		.56	.78	22,877
CTE credits earned, Year 3		.52	.73	22,877
CTE credits earned, Year 4		.44	.70	22,877
Total CTE credits earned		1.92	1.99	20,681
Credits earned, Year 1	Number of credits earned in all courses	5.46	2.30	20,039
Credits earned, Year 2		5.44	2.42	18,696
Credits earned, Year 3		5.56	2.54	17,241
Credits earned, Year 4		5.90	2.55	15,611
Total credits earned		19.19	9.63	21,892
Completed college prep math sequence	Binary variable (0-1). Earned passing grades in Algebra 1, Algebra 2, and Geometry, or equivalent courses	.33	.47	19,800
Completed college prep science sequence	Binary variable (0-1). Earned passing grades in chemistry and physics.	.18	.39	19,800
Completed foreign language sequence	Binary variable (0-1). Earned passing grades in at least two years of the same foreign language.	.75	.43	19,800
8th to 11th grade growth, mathematics	Growth variable created by subtracting the 8th grade Normal Curve Equivalent (NCE) score from the 11th grade NCE score on the state-mandated test (PSSA)	1.11	12.60	12,189
8th to 11th grade growth, reading		-.39	12.05	12,146
On-time graduation, including unknowns	Binary variable (0-1). Students are coded as "1" if they graduated within 4 years of starting high school; they are coded as "0" if they did not graduate. Students who left the district but have no code indicating their destination (e.g. a transfer) are coded as "0".	.49	.50	22,877
On-time graduation, excluding unknowns	Binary variable (0-1). Same as above graduation variable, except that students with unknown destinations are excluded from the analysis.	.54	.50	20,722

5-year graduation, including unknowns (ONLY CLASSES OF 2003 AND 2004)	Binary variable (0-1). Students are coded as "1" if the graduated within 5 years of starting high school; they are coded as "0" if they did not graduate. Students who left the district but have no code indicating their destination (e.g. a transfer) are coded as "0".	.54	.50	17,283
5-year graduation, excluding unknowns (ONLY CLASSES OF 2003 AND 2004)	Binary variable (0-1). Same as above 5-year graduation variable, except that students with unknown destinations are excluded from the analysis.	.59	.49	15,812
6-year graduation, including unknowns (ONLY FOR CLASS OF 2003)	Binary variable (0-1). Students are coded as "1" if the graduated within 6 years of starting high school; they are coded as "0" if they did not graduate. Students who left the district but have no code indicating their destination (e.g. a transfer) are coded as "0".	.53	.5	11,308
6-year graduation, excluding unknowns (ONLY FOR CLASS OF 2003)	Binary variable (0-1). Same as above 6-year graduation variable, except that students with unknown destinations are excluded from the analysis.	.58	.49	10,295

SOURCE: Analysis of student data from the School District of Philadelphia.

Table C.2: Description of Independent Variables

Variable	Description	Mean	Standard Deviation	N of students (2003-2005)
Offered admission at the CTE school	Binary variable (0-1). Student is coded as "1" if accepted to the CTE school.	.37	.48	22,877
Ranking of the school	Range: 1-17, with 1 indicating the most preferred school.	3.36	2.47	22,877
Number of CTE schools applied to	Range: 1-5.	1.99	.93	22,877
Attended CTE school, Year 1	Binary variable (0-1). Student is coded as "1" if attended a CTE school during a given year.	.30	.46	22,877
Attended CTE school, Year 2		.29	.45	22,877
Attended CTE school Year 3		.28	.44	22,877
Attended CTE school, Year 4		.28	.44	22,877
Receipt of special education services	Binary variable (0-1). Student is coded as "1" if received special education services in 8th grade	.13	.34	22,877
Receipt of English Language Learner services	Binary variable (0-1). Student is coded as "1" if received ELL services in 8th grade	.03	.16	22,877
Mathematics test score	Normal Curve Equivalent (NCE) score on the 8th grade state standardized test (PSSA)	31.59	16.37	20,875
Reading test score		32.7	16.53	20,571
Overage for grade	Binary variable (0-1). Student is coded as "1" if 15 years or older on the first day of ninth grade.	.15	.36	20,765
Female	Student is coded as "1" if female.	.55	.50	22,750
African American	Binary variables (0-1). "1" if a student is of the racial/ethnic heritage.	.75	.44	22,750
Asian		.04	.20	22,750
Latino		.10	.30	22,750
White		.11	.31	22,750
Biracial/Multiracial		.00	.06	22,750

SOURCE: Analysis of student data from the School District of Philadelphia.

Table C.3: Summary of Effects of CTE Schools for Imputed Outcomes, All Cohorts

Outcome	ITT	LATE	DOSAGE
Class of 2003			
Total GPA	0.10 (.220)	0.24 (.220)	0.20 (.000*)
Math PSSA 11th Grade	-0.21 (.795)	-0.50 (.795)	-2.09 (.000*)
Read PSSA 11th Grade	0.04 (.972)	0.10 (.972)	-1.17 (.002*)
Class of 2004			
Total GPA	0.02 (.474)	0.06 (.474)	0.10 (.000*)
Math PSSA 11th Grade	3.01 (.025*)	9.12 (.025*)	-1.78 (.000*)
Read PSSA 11th Grade	2.84 (.011*)	8.61 (.011*)	-1.49 (.010*)
Class of 2005			
Total GPA	-0.04 (.045*)	-0.16 (.045*)	0.06 (.110)
Math PSSA 11th Grade	1.47 (.258)	5.88 (.258)	-1.13 (.128)
Read PSSA 11th Grade	0.74 (.423)	2.96 (.423)	-1.58 (.005*)

Table C.4: Summary of Ninth Grade Effects of CTE Schools, for the Classes of 2003, 2004, and 2005*

	Class of 2003			Class of 2004			Class of 2005		
	ITT	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**
Enrolled in a district school	**1.46 (.003)**	**2.48 (.003)**	n/a	**2.36 (.000)**	**2.61 (.000)**	**6.54 (.000)**	1.11 (.451)	1.59 (.451)	1.17 (.459)
Attendance	**.05 (.000)**	**.12 (.000)**	**.06 (.000)**	**.02 (.000)**	**.06 (.000)**	**.03 (.000)**	.00 (.912)	.00 (.912)	.00 (.912)
GPA	**.12 (.000)**	**.29 (.000)**	**.07 (.001)**	**.07 (.011)**	**.21 (.011)**	-.03 (.336)	.01 (.791)	.04 (.791)	**-.29 (.000)**
Number of CTE Courses Taken	**-.06 (.000)**	**-.14 (.000)**	**-.19 (.000)**	**.02 (.375)**	**.06 (.375)**	**.20 (.000)**	**-.10 (.000)**	**-.40 (.000)**	**.14 (.000)**
Number of Credits Earned	**.48 (.000)**	**1.14 (.000)**	**.68 (.000)**	**.24 (.000)**	**.73 (.000)**	**.81 (.000)**	-.10 (.111)	-.40 (.111)	-.01 (.907)
On-time promotion to 10th grade	**1.41 (.000)**	**2.25 (.000)**	**1.81 (.000)**	**1.30 (.000)**	**2.20 (.000)**	**1.42 (.000)**	1.05 (.504)	1.22 (.504)	.83 (.082)

SOURCE: Analysis of student data from the School District of Philadelphia.

*Statistical significance levels in parentheses. Estimates with p<.05 in bold.

** Intent to Treat (ITT) compares outcomes for students who were accepted to the CTE school to outcomes for those who were not accepted to the CTE school. ITT estimates include controls for race/ethnicity and the student's ranking of the school on the application form. Dosage compares outcomes for CTE school attenders versus non-attenders, controlling for the number of years the student attended a CTE school and a number of pre-high school characteristics specified in equations in Chapter 4.

*** All students attending a CTE school in Year 1 remained enrolled by the end of the school year. Therefore, the odds ratio cannot be calculated.

Table C.5: Summary of Year Two Effects of CTE Schools, for the Classes of 2003, 2004, and 2005*

	Class of 2003			Class of 2004			Class of 2005		
	ITT	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**
Enrolled in a district school	**1.45 (.000)**	**2.41 (.000)**	**3.45 (.000)**	**1.42 (.003)**	**2.89 (.003)**	**2.64 (.000)**	1.11 (.149)	1.86 (.149)	**2.30 (.000)**
Attendance	**.03 (.000)**	**.07 (.000)**	**.05 (.000)**	**.01 (.044)**	**.03 (.044)**	**.03 (.000)**	-.01 (.192)	-.04 (.192)	**-.02 (.026)**
GPA	**.10 (.000)**	**.24 (.000)**	**.00 (.987)**	**.09 (.002)**	**.27 (.002)**	-.05 (.086)	.04 (.173)	.16 (.173)	**-.29 (.000)**
Number of CTE Courses Taken	**.29 (.000)**	**.69 (.000)**	**.70 (.000)**	-.01 (.539)	-.03 (.539)	**.46 (.000)**	**-.09 (.002)**	**-.36 (.002)**	**.86 (.000)**
Number of Credits Earned	**.48 (.000)**	**1.14 (.000)**	**.75 (.000)**	-.009 (.904)	-.03 (.904)	**.22 (.012)**	-.05 (.497)	-.20 (.497)	-.07 (.539)
On-time promotion to 11th grade	**1.22 (.000)**	**1.60 (.000)**	**1.27 (.000)**	**1.17 (.020)**	**1.63 (.020)**	1.05 (.589)	1.04 (.587)	1.16 (.587)	.91 (.430)

SOURCE: Analysis of student data from the School District of Philadelphia.

*Statistical significance levels in parentheses. Estimates with p<.05 in bold.

** Intent to Treat (ITT) compares outcomes for students who were accepted to the CTE school to outcomes for those who were not accepted to the CTE school. ITT estimates include controls for race/ethnicity and the student's ranking of the school on the application form. Dosage compares outcomes for CTE school attenders versus non-attenders, controlling for the number of years the student attended a CTE school and a number of pre-high school characteristics specified in equations in Chapter 4.

Table C.6: Summary of Year Three Effects of CTE Schools*

	Class of 2003			Class of 2004			Class of 2005		
	ITT	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**
Enrolled in a district school	**1.28 (.000)**	1.86 (.149)	**1.95 (.000)**	1.18 (.052)	1.64 (.052)	**1.91 (.000)**	1.01 (.877)	1.06 (.877)	**1.90 (.001)**
Attendance	.03 (.000)	-.04 (.192)	**.03 (.000)**	.02 (.008)	.06 (.008)	**.04 (.000)**	.00 (.990)	.00 (.990)	-.02 (.165)
GPA	**.06 (.024)**	.16 (.173)	-.04 (.102)	**.08 (.012)**	**.24 (.012)**	-.03 (.462)	.05 (.057)	.20 (.057)	**-.54 (.000)**
Number of CTE Courses Taken	**.23 (.000)**	**-.36 (.002)**	**.63 (.000)**	.03 (.162)	.09 (.162)	**.71 (.000)**	**.09 (.002)**	**.36 (.002)**	**1.15 (.000)**
Number of Credits Earned	**.32 (.000)**	-.20 (.497)	**.53 (.000)**	.02 (.799)	.06 (.799)	**.35 (.001)**	-.04 (.592)	-.16 (.592)	-.06 (.711)
On-time promotion to 12th grade	**1.41 (.000)**	1.16 (.587)	**2.25 (.000)**	**1.19 (.010)**	**1.70 (.010)**	**2.00 (.000)**	1.06 (.370)	1.28 (.370)	1.05 (.687)

SOURCE: Analysis of student data from the School District of Philadelphia.

*Statistical significance levels in parentheses. Estimates with p<.05 in bold.

** Intent to Treat (ITT) compares outcomes for students who were accepted to the CTE school to outcomes for those who were not accepted to the CTE school. ITT estimates include controls for race/ethnicity and the student's ranking of the school on the application form. Dosage compares outcomes for CTE school attenders versus non-attenders, controlling for the number of years the student attended a CTE school and a number of pre-high school characteristics specified in equations in Chapter 4.

Table C.7: Summary of Year Four Effects of CTE Schools*

	Class of 2003			Class of 2004			Class of 2005		
	ITT	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**	**ITT**	**LATE**	**Dosage**
Enrolled in a district school	**1.35 (.000)**	**2.06 (.000)**	**2.67 (.000)**	1.14 (.077)	1.49 (.077)	**2.94 (.000)**	0.99 (.844)	0.94 (.844)	**1.45 (.025)**
Attendance	**.02 (.000)**	**.05 (.000)**	**.03 (.000)**	**.01 (.003)**	**.03 (.003)**	**.03 (.000)**	.01 (.053)	.04 (.053)	-.01 (.342)
GPA	.04 (.128)	.10 (.128)	**.08 (.004)**	**.15 (.000)**	**.45 (.000)**	**-.29 (.000)**	.04 (.158)	.16 (.158)	**-.60 (.000)**
Number of CTE Courses Taken	**.22 (.000)**	**.52 (.000)**	**.70 (.000)**	**.06 (.013)**	**.18 (.013)**	**.68 (.000)**	.02 (.386)	.08 (.386)	**.85 (.000)**
Number of Credits Earned	**.21 (.007)**	**.50 (.007)**	**.75 (.000)**	**.29 (.001)**	**.88 (.001)**	**1.05 (.000)**	**.19 (.009)**	**.76 (.009)**	.27 (.092)
On-time graduation	**1.33 (.000)**	**1.97 (.000)**	**2.28 (.000)**	**1.36 (.000)**	**2.55 (.000)**	**2.63 (.000)**	1.09 (.168)	1.42 (.168)	1.19 (.241)

SOURCE: Analysis of student data from the School District of Philadelphia.

*Statistical significance levels in parentheses. Estimates with p<.05 in bold.

** Intent to Treat (ITT) compares outcomes for students who were accepted to the CTE school to outcomes for those who were not accepted to the CTE school. ITT estimates include controls for race/ethnicity and the student's ranking of the school on the application form. Dosage compares outcomes for CTE school attenders versus non-attenders, controlling for the number of years the student attended a CTE school and a number of pre-high school characteristics specified in equations in Chapter 4.

Table C.8: On-Time Graduation Rates for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	40%	42%	-2
	B	48	43	+5
	C	47	41	+6
	D	59	44	+15
	Total	*48*	*42*	*+6*
2004	A	53%	49%	+4
	B	59	54	+5
	C	53	52	+1
	D	66	58	+8
	Total	*57*	*52*	*+5*
2005	A	55%	50%	+5
	B	56	58	-2
	C	54	57	-3
	D	52	56	-4
	E	51	48	+3
	Total	*54*	*54*	*0*
TOTAL	A	49%	45%	+4
	B	54	47	+7
	C	51	46	+5
	D	59	47	+12
	E	51	48	+3
	Total	*53*	*46*	*+7*

Table C.9: Five-Year Graduation Rates for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	47%	50%	-3
	B	56	51	+5
	C	54	48	+6
	D	63	51	+12
	Total	*55*	*50*	*+5*
2004	A	59%	57%	+2
	B	64	61	+3
	C	57	60	-3
	D	72	64	+8
	Total	*63*	*59*	*+4*
TOTAL	A	53%	52%	+1
	B	60	53	+7
	C	56	52	+4
	D	68	53	+15
	Total	*59*	*52*	*+7*

Table C.10: Six-Year Graduation Rates for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	48%	53%	-5
	B	60	53	+7
	C	56	50	+6
	D	64	52	+12
	Total	*57*	*52*	*+5*

Table C.11: Mean High School GPA for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	1.34	1.53	-.19
	B	1.68	1.48	+.20
	C	1.72	1.53	+.19
	D	1.86	1.68	+.18
	Total	*1.65*	*1.54*	*+.11*
2004	A	1.62	1.58	+.04
	B	1.66	1.66	.00
	C	1.68	1.71	-.03
	D	2.08	1.96	+.12
	Total	*1.73*	*1.68*	*+.05*
2005	A	1.52	1.57	-.05
	B	1.57	1.66	-.09
	C	1.67	1.65	+.02
	D	1.92	1.91	+.01
	E	1.60	1.67	-.07
	Total	*1.64*	*1.65*	*-.01*
TOTAL	A	1.49	1.55	-.06
	B	1.64	1.54	+.10
	C	1.69	1.59	+.10
	D	1.96	1.74	+.22
	E	1.60	1.67	-.07
	Total	*1.67*	*1.59*	*+.08*

Table C.12: Mean Credits Earned for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	16.34	17.42	-1.08
	B	20.45	17.28	+3.17
	C	18.80	16.97	+1.84
	D	20.76	17.91	+2.85
	Total	*19.15*	*17.34*	*+1.81*
2004	A	19.36	19.09	+.27
	B	21.14	20.09	+1.05
	C	19.44	20.24	-.80
	D	22.51	21.51	+1.01
	Total	*20.55*	*19.95*	*+.60*
2005	A	19.69	20.30	-.61
	B	21.82	21.44	+.39
	C	20.10	22.00	-1.90
	D	22.39	22.58	-.18
	E	20.89	20.10	+.79
	Total	*21.01*	*21.04*	*-.03*
TOTAL	A	18.46	18.46	-.00
	B	21.15	18.40	+2.75
	C	19.45	18.43	+1.02
	D	21.96	18.86	+3.10
	E	20.89	20.10	+.79
	Total	*20.29*	*18.53*	*+1.76*

Table C.13: Mean CTE Courses Taken for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	1.58	1.47	+0.11
	B	2.33	1.58	+0.75
	C	2.20	1.51	+0.69
	D	2.33	1.38	+0.95
	Total	*2.13*	*1.50*	*+0.63*
2004	A	1.63	1.78	-0.15
	B	2.74	1.89	+0.85
	C	2.08	2.10	-0.02
	D	1.89	1.94	-0.05
	Total	*2.17*	*1.93*	*+0.24*
2005	A	1.68	2.01	-0.33
	B	2.39	2.32	+0.07
	C	1.99	2.92	-0.93
	D	2.69	2.32	+0.37
	E	4.47	2.05	+2.42
	Total	*2.47*	*2.27*	*+0.20*
TOTAL	A	1.63	1.66	-0.03
	B	2.48	1.74	+0.74
	C	2.09	1.83	+0.26
	D	2.29	1.55	+0.74
	E	4.47	2.05	+2.42
	Total	*2.27*	*1.72*	*+0.55*

Table C.14: Percentage of Students Who Completed Algebra 1, Algebra 2, and Geometry, for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	26%	25%	+1
	B	36	25	+11
	C	32	26	+6
	D	48	26	+22
	Total	*35*	*25*	*+10*
2004	A	34%	31%	+3
	B	43	30	+13
	C	35	36	-1
	D	51	35	+16
	Total	*40*	*33*	*+7*
2005	A	32%	38%	-6
	B	47	41	+6
	C	37	44	-7
	D	55	46	+9
	E	39	35	+4
	Total	*42*	*40*	*+2*
TOTAL	A	31%	29%	+2
	B	42	28	+14
	C	35	31	+4
	D	51	29	+22
	E	39	35	+4
	Total	*39*	*30*	*+9*

Table C.15: Percentage of Students Who Completed Chemistry and Physics, for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	11%	17%	-6
	B	11	19	-8
	C	17	15	+2
	D	42	17	+25
	Total	*18*	*17*	*+1*
2004	A	7%	18%	-11
	B	8	14	-6
	C	9	15	-6
	D	39	20	+19
	Total	*14*	*16*	*-2*
2005	A	13%	22%	-9
	B	13	30	-17
	C	24	26	-2
	D	44	28	+16
	E	41	25	+16
	Total	*24*	*25*	*-1*
TOTAL	A	10%	18%	-8
	B	11	20	-9
	C	16	16	0
	D	42	19	+23
	E	41	25	+16
	Total	*19*	*18*	*+1*

Table C.16: Percentage of Students Who Completed Two or More Years of a Foreign Language, for Accepted and Non-Accepted Students, by School and Cohort

Cohort	School	Accepted	Not Accepted	Difference
2003	A	67%	66%	+1
	B	78	67	+11
	C	65	70	-5
	D	82	74	+8
	Total	*73*	*69*	*+4*
2004	A	75%	73%	+2
	B	80	78	+2
	C	70	81	-11
	D	88	84	+4
	Total	*78*	*78*	*0*
2005	A	76%	80%	-4
	B	82	83	-1
	C	79	86	-7
	D	92	89	+3
	E	80	79	+1
	Total	*81*	*82*	*-1*
TOTAL	A	73%	71%	+2
	B	80	71	+9
	C	72	75	-3
	D	87	77	+10
	E	80	79	+1
	Total	*78*	*73*	*+5*