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The Impacts of Career-Technical Education on High School Completion and Labor Market Success

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Abstract
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Keywords
Career, technical, education, high school, completion, labor, market, vocational, course

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High school career-technical education (CTE) is a massive enterprise. Last year high school students spent more than 1.5 billion hours in vocational courses of one kind or another. Of the twenty-six courses taken by the typical high school graduate, 4.2 are career-tech courses (NCES 2003a).

Courses in general labor market preparation (principles of technology, industrial arts, typing, keyboarding, etc) and family and consumer sciences are offered in almost every lower and upper-secondary school. High school graduates in the year 2000 took 1.2 full-year introductory CTE courses during upper-secondary school and probably almost as many during middle school (NCES 2003a).

Occupation-specific education is also available to most high school students. Nineteen out of twenty high school students attend comprehensive high schools. About 60 percent of public comprehensive high schools offer specific labor market preparation in at least one program area inside the school. Students who attend schools that do not offer occupation-specific education at the school or who want to pursue a field of study that is not offered at their local high school are typically able to spend part of the school day at an area or regional vocational-technical center. These regional centers account for 6.2 percent of upper-secondary schools. In many large urban school districts students are also able to choose to attend full day vocational high schools or career academies (schools of choice built around occupational themes). About 4.6 percent of the nation's high schools are of this type offering concentrated occupational studies and related academic coursework all in one building (Silverberg, et al 2003). The schools that specialize in CTE offer a greater range of occupational programs and their programs are generally of higher quality.

Participation in CTE courses is quite wide spread. Nearly every graduate takes at least one CTE course and 90.7 percent take at least one occupation specific course. Forty-four percent take three or more occupation specific courses and 25 percent take a sequence of three or more courses in a specific occupational field (referred to as an occupational concentration) (Lavesque 2003). The total number of occupational vocational credits earned has been remarkably stable: 3.00 for 1982 graduates and 3.03 for year 2000 graduates (Digest of Education Statistics: 2003, p. 163).

The Challenges presented by the Drive to Raise Academic Standards

The last two decades have been challenging for high school career-technical education. The payoff to college rose dramatically during the 1980s causing a 30 percent increase from 1982 to 1998 in the share of students who enter college right after graduating from high school (NCES 2001a). Occupation specific course taking is normally concentrated in the last few years of a student's time in school. As college attendance becomes more common, one might expect growing numbers of high school students to postpone occupation specific course taking until college.

The other major shock came from the National Commission on Excellence in Education's call for schools to turn back 'the rising tide of educational mediocrity' threatening American competitiveness and living standards (NCEE 1982). Their report, A *Nation at Risk,* recommended that all teachers expect more of their students and that all high school students take a New Basics curriculum of at least four credits in language arts, three credits in mathematics, science and social studies, and a half credit course in computers. Responding to the report, many states increased academic course graduation requirements and introduced a minimum competency test requirement for receiving the high school diploma.[a] Career technical education could no longer be an alternative to strong academic skills. CTE students were now being required to develop their occupational skills on a strong academic foundation.

[a] Declines in vocational course taking occurred in states that raised academic course graduation requirements during the 1990s (Levesque et al, 2001). States that require graduates to pass minimum competency tests in core academic subjects to graduate from high school also tend to have reduced levels of CTE course taking. (Bishop and Mane 2001).

High school CTE responded to employers' growing knowledge and skill demands by changing the types of CTE courses offered. Enrollments in traditional fields such as auto mechanics and materials production declined, while health-care courses tripled and computer related occupational courses sextupled from .16 credits in 1982 to .97 credits in 1998. Computer related courses now account for fully one-third of all occupational vocational courses (Lavesque, 2003, p. 48, 121). In addition, occupational concentrators have increased the number of academic courses they take by 27 percent and the share of concentrators completing the New Basics curriculum rose from about 8 percent in 1982, to 18.5 percent in 1990 to 46 percent in 1998. The proportion of high school graduates who complete both college prep and vocational concentrations in high school rose from 0.5 percent in 1982 to 7 percent in 1998. The greater emphasis on academics has produced results. The proportion of occupational concentrators going to college rose from 41.5 percent in 1982 to 54.7 percent in 1992. Reading scores of CTE concentrators increased by nearly a grade level equivalent on the National Assessment of Educational Progress between 1994 and 1998 (Silverberg et al. 2003, p. 261).

The increase in academic course taking was accomplished largely by increasing the total number of courses taken and secondarily by reducing the number of introductory vocational courses that students take in high school. The number of introductory career-technical education (CTE) courses taken by the typical high school graduates fell from 1.62 in 1982 to 1.3 in 1990 but has remained stable during the 1990s. Much of this decline in introductory CTE courses resulted from a 50 percent reduction in typing and keyboarding courses in high school (Lavesque 2003 p.118). Once a staple of the high school curriculum, typing and keyboarding are now largely learned in earlier grades.[1] Courses in specific occupation skills fell for a time in the early 1990s but by the year 2000 they had returned to the level prevailing in 1982 (Lavesque 2003).

While vocational course taking has been stable or declined slightly in high school, it has risen dramatically at the post secondary level. Occupational certificates and occupationally oriented AA and BA degrees rose 33 percent more rapidly than young adult population. When the tiny decline at the secondary level is subtracted from the increases at the post secondary level, young people are clearly now receiving considerably more school-based occupation specific education than they did ten or twenty years ago. This is exactly what one would expect to happen in a period of rapidly rising skill demands.

The past, however, may not be prolog for the future. Academic standards will continue to rise. Declines in tax revenue are forcing many schools to scale back CTE offerings, limiting student choice to just a few low cost programs. A few states are consolidating low incidence CTE programs at community colleges and requiring high school students who want to pursue these fields to spend substantial time commuting to a distant community college. Some of the reports calling for better schools express doubt about the economic benefits of the vocational education provided by secondary schools (Committee on Economic Development 1986). This suggests a need to reexamine the economic returns to career-technical education in high school in a post industrial society like the United States. This paper will assess the empirical evidence for the two major benefits claimed for occupation-specific education in high school:

A) *Giving students the option of choosing career-technical courses in high school will help retain some students in high school, raise the high school graduation rate and induce some to continue their occupational preparation in college.*
B) *Students who start preparing for an occupation in high school are more successful in the labor market both in the short and long run. They are more likely to find a job, more likely to enter the occupation of their choice and they end up earning more.*

We examine the effects of the CTE option on high school attendance and completion in Section 1. The labor market payoffs to high school CTE are examined in section 2. Rates of return are calculated in the final section where we also try to provide a balanced assessment of the arguments pro and con the continuing to provide high school students with the option of taking occupationally specific courses.

I. Are High School Completion Rates Higher When Students Can Take Career-Technical Education Courses?

CTE advocates argue that allowing students to start preparation for their chosen career in upper-secondary school increases the share of young people who choose to stay in school when they are no longer required to attend. People have diverse interests, diverse talents and diverse learning styles. The labor market is similarly diverse in the skills and talents that are sought. A "one size fits all" upper-secondary education is bound to fail many students. Students should not be forced to take CTE courses, but neither should they be forced to take only academic courses. The following quote from the Report of the Advisory Committee for the National Assessment of Vocational Education makes the case:

> Career and technical education empowers students by providing a range of learning opportunities that serve different learning styles. CTE relies on a powerful mode of teaching and learning that cognitive scientists call “contextual” or “situated” learning, both in classrooms and in workplaces. For many students, applying academic and technical skills to real-world activities, using computers and other tools, and being able to see how their learning is related to the world of work make CTE classes more interesting and motivating, and more educationally powerful than standard academic classes. A career focus often gives students a sense of direction and motivates them to achieve and to stay in school. Practically inclined students can be hooked on academic learning through CTE study. This is especially important for young people who learn best by doing, a group that includes disproportionate numbers of disadvantaged and special education students. Just having the option of being able to concentrate in CTE in high school results in more young people staying in school because more individually relevant choices are available to them. (Advisory Committee for the National Assessment of Vocational Education 2003. p. 2.)

A number of studies have attempted to measure the effect of CTE by comparing the dropout rates of vocational students and other students. But this approach mischaracterizes the claims made above. CTE advocates are not saying that randomly assigning a student to take a CTE course will lower their propensity to drop out. Indeed they would predict that forcing a student to take a particular course would increase the risk of their dropping out. They are saying that students differ in their preferences and goals and that creating more options will induce a larger share of them to stay in school.

Some students do not like academic courses or have been unsuccessful in them and are at high risk of dropping out. While predictable to some degree by grades and test scores in 8th grade, this "I dislike academics" (IDA) characteristic is unobservable. When the option of taking CTE courses is presented to all students, the "I dislike academics" (IDA) students will all take one or more CTE courses and will be significantly overrepresented among CTE course takers. Let us assume that taking a CTE course has no effect on the very high graduation rates of non-IDA students but a substantial positive effect on IDA students. Assume further that the graduation rates of IDA students remain low because they are still being required to take some academic courses. Now let's hire a statistician to compare the subsequent drop out rates of students who do and do not take CTE courses controlling for all available background characteristics. Taking a CTE course is still a marker for being an IDA student and the regression coefficient on the CTE variable will be biased in the negative direction. As in Willis and Rosen seminal paper on estimates of the return to college attendance, there is no way to completely control for the unobservable trait that makes CTE students more prone to drop out.[a]

A better way to assess the effect of the CTE option on high school completion rates is to study the history of education systems. In country after country, introducing CTE options at the secondary level helped spur expansions of secondary school attendance. A positive feedback cycle began. The CTE option induced students to stay in school longer. The flow of occupationally trained graduates into the labor force generated employer support for further expansion of secondary education.

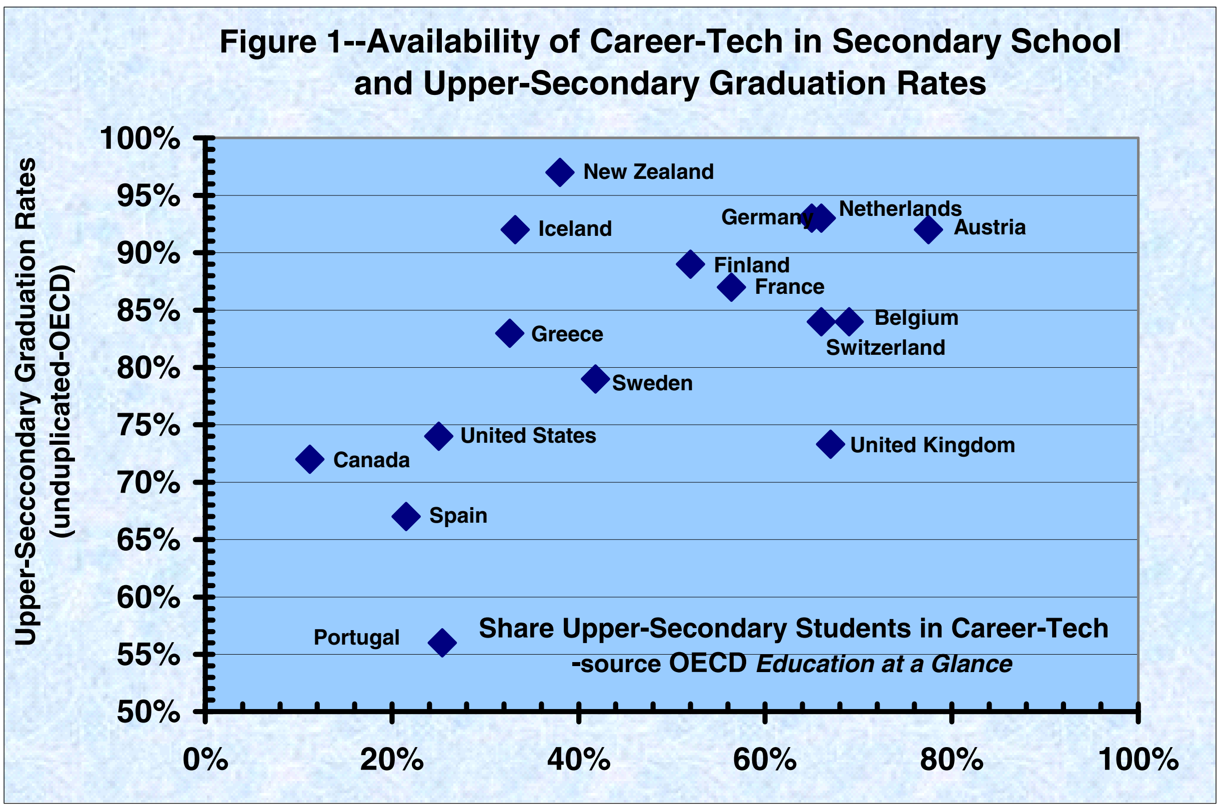
. At the beginning of the twentieth century, Latin was a required subject, vocational classes were unknown and only 6 percent of the age cohort got a diploma. By 1927/8 vocational courses were three times more popular than Latin and 27 percent of the age cohort

[a] The negative bias in standard econometric models of CTE effects is even stronger when planning to drop out causes students to take vocational courses. Some students probably make tentative decisions about whether to drop out a year or so prior to reaching the compulsory school leaving age. Students who plan to drop out will want to quickly take some vocational courses so they have some skills when they start looking for work. Students who plan to stay in school to get the diploma will postpone CTE courses until junior and senior year. The result, of course, is a positive association between dropping out and taking CTE courses early.

was graduating from high school. Many historians explain the growth of vocational education as a response to public pressure to open upper-secondary education to children from immigrant and working class families. Elite opinion believed that the traditional classical curriculum was inappropriate for these youth, so a less rigorous vocational option was created for them. The teachers of academic subjects were accommodated by introducing a tracking system in which the “top” track retained a classical focus and "high” standards. Absent the vocational option, the story goes, very few immigrant and working class children would have made it into and through high school. Vocational education, therefore, helped high schools grow; but did so by denying the masses access to the more “uplifting” (in some educational historians view) classical curriculum.

Recent work by two economic historians, Claudia Goldin and Lawrence Katz, proposes a different explanation. Rapid economic development at the beginning of the 20th century generated a need for workers who could handle clerical and skilled craft jobs. Private entrepreneurs had started schools to teach bookkeeping and typing skills. The payoff to this training was extremely high. In 1915 adult males in Iowa who had spent a year or so at proprietary business schools teaching typing, shorthand, bookkeeping, real estate and other commercial subjects earned 34 percent more than other adult males with the same amount of regular schooling. Unmarried females who had attended a business school earned 47 percent more (Goldin and Katz, 2000, p. 37-39, 43). Public schools saw an opportunity to attract more students and to gain political support in the business community by adding typing, stenography and bookkeeping to the public school curriculum.

However, the process got started, diversifying and modernizing the public high school curriculum expanded employer demand for graduates and prevented private returns to secondary education from falling precipitously as the supply of secondary school graduates grew. If high schools had remained purely academic, graduates would have soon had difficulty getting good jobs and secondary enrollment would have grown more slowly. These positive feedback mechanisms should produce a positive correlation between the size of high school vocational programs and national rates of school attendance. Figure 1 presents OECD data on graduation rates from upper-secondary school in Europe, Australia and North America and how they correlate with the vocational share of upper-secondary enrollments. Figure 2 presents comparable data on school enrollment rates of 15 to 19 year olds. Figure 3 and 4 present data on the relationship between career-tech programs and reading and mathematics achievement of 15 year olds in the PISA assessments in 2000 and 2001.



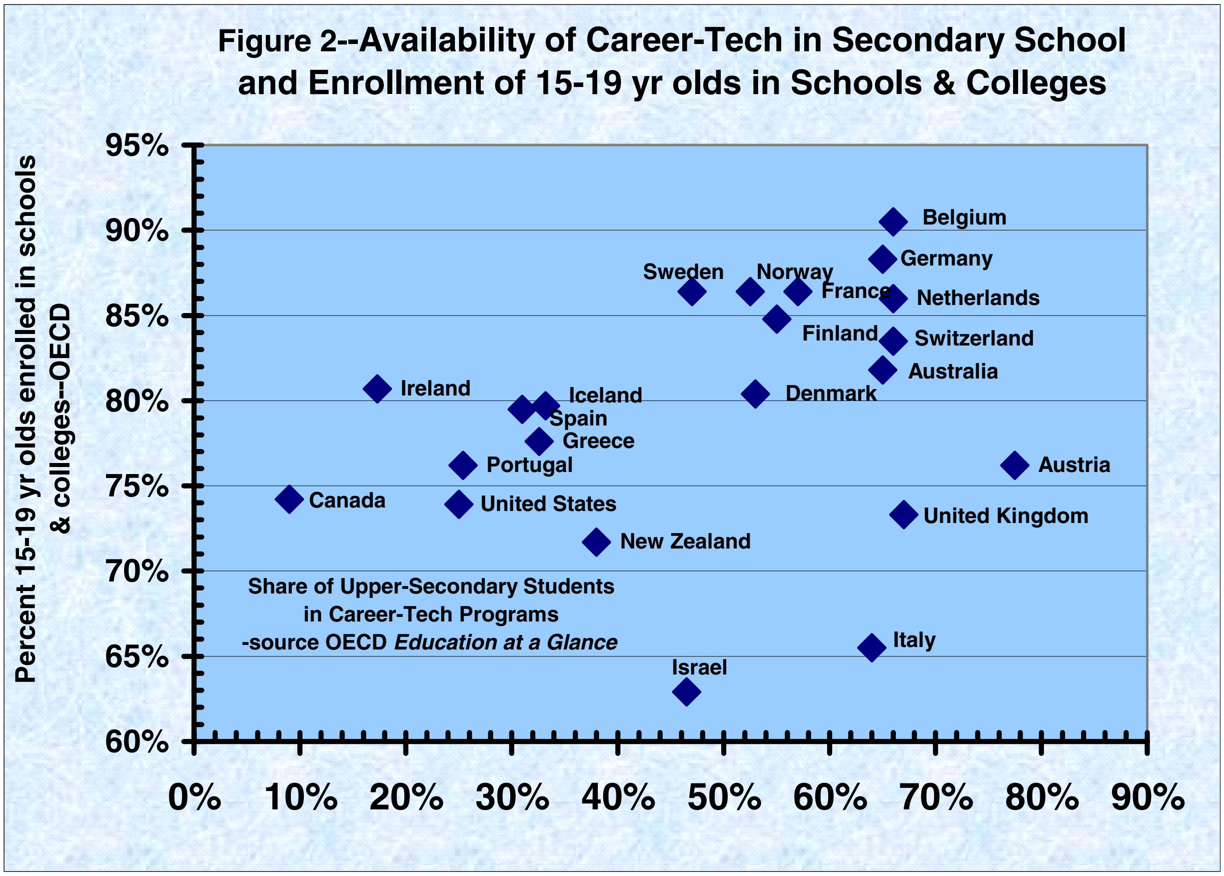


Figure 2--Availability of Career-Tech in Secondary School and Enrollment of 15-19 yr olds in Schools & Colleges
Percent 15-19 yr olds enrolled in schools & colleges--OECD
95%
90%
85%
80%
75%
70%
65%
60%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
Belgium
Germany
Sweden
Norway
France
Netherlands
Finland
Switzerland
Australia
Ireland
Iceland
Denmark
Spain
Greece
Portugal
Austria
Canada
United States
United Kingdom
New Zealand
Share of Upper-Secondary Students in Career-Tech Programs -source OECD Education at a Glance
Italy
Israel

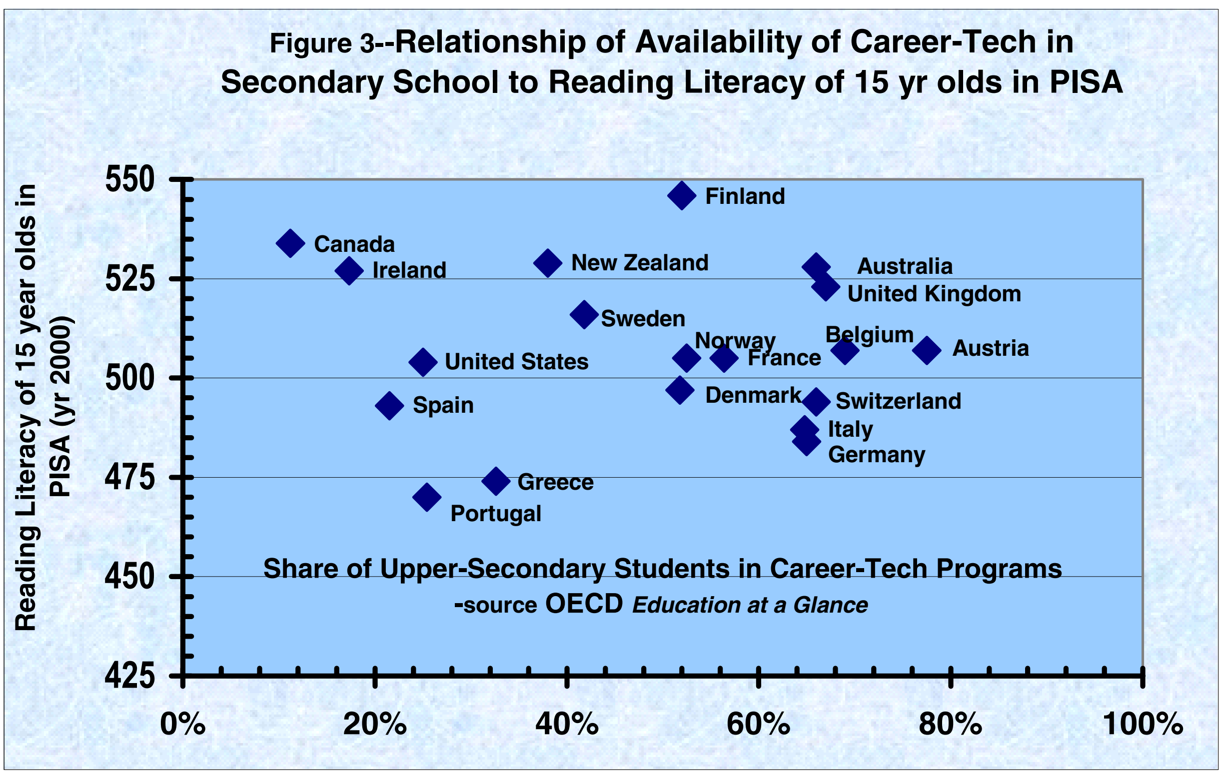
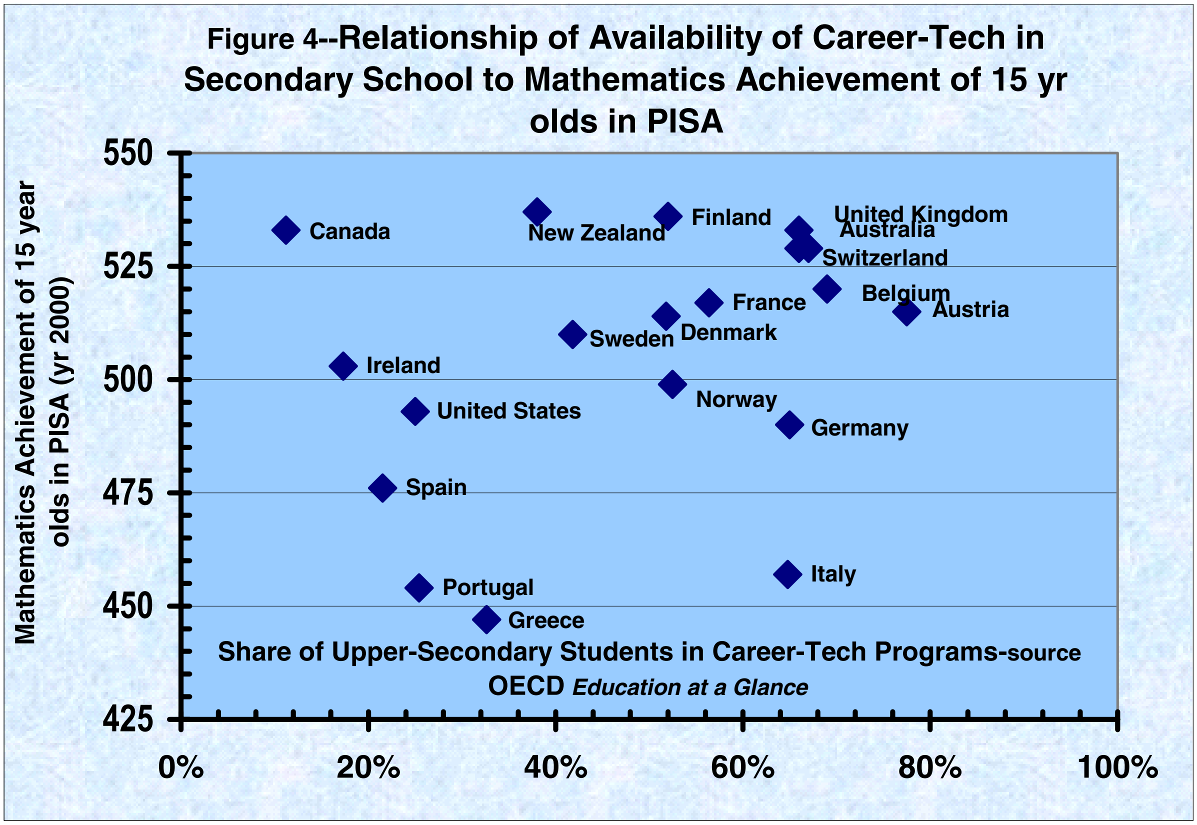


Figure 3--Relationship of Availability of Career-Tech in Secondary School to Reading Literacy of 15 yr olds in PISA
Reading Literacy of 15 year olds in PISA (yr 2000)
550
525
500
475
450
425
0%
20%
40%
60%
80%
100%
Finland
Canada
Ireland
New Zealand
Australia
United Kingdom
Sweden
Norway
Belgium
France
Austria
United States
Denmark
Switzerland
Spain
Italy
Germany
Greece
Portugal
Share of Upper-Secondary Students in Career-Tech Programs
-source OECD Education at a Glance



Just about all of the Western European members of the Organization of Economic Cooperation and Development (OECD) have higher upper-secondary school graduation rates and higher proportions of 15 to 19 year olds in school than the US and Canada. One of the possible reasons for higher school attendance rates in Northern Europe than in Canada, the United States, Spain and Portugal may be the low share of students in career-tech programs in these four countries. There appears to be a positive association between the share of students in Career-Tech programs and graduation rates.

Examining Figures 3 and 4, we see no apparent association between academic achievement at age 15 and the share of upper-secondary students in career-tech programs. This suggests that giving a career focus to a majority of a nation's upper-secondary schools does not inevitably result in lower levels of academic achievement at age 15.

While these graphs are consistent with the causal hypotheses advanced on page 6, other factors such as family background, productivity levels, graduation exams and unemployment rates also influence school enrollment, completion rates and test scores. These factors need to be statistically controlled before conclusions can be drawn. Regressions predicting high school graduation rates, school enrollment rates and PISA test scores that control for these other factors are presented in Table 1.

Table 1--Effects of Upper-Secondary Vocational Share on Enrollment Rates, Completion Rates and Literacy

	Upper-Secondary Graduation Rate (percent)	School/ College Enrollment of 15-19 yr olds (percent)	School-College Enrollment of 20-29 yr. Olds (percent)	Expected Full-time Equivalent Years of Schooling	Reading Literacy of 15 yr olds taking PISA test in home Language	Mathematical Literacy of 15 yr olds taking PISA test in home language
Percent Upper-Secondary Students in Vocational or Pre-Vocational Programs	.26* (.13)	.19* (.10)	.013 (.073)	.012 (.010)	-.04 (.26)	.43 (.35)
Adult Unemployment Rate	1.13 (.74)	1.27** (.56)	.61 (.40)	.123** (.057)	---	---
Log GDP per capita	27.3*** (6.3)	21.6*** (5.0)	10.4*** (3.5)	3.36*** (.49)	75.4*** (9.5)	90.7*** (13.3)
Curriculum- Based External Exit Exam	10.1 (6.2)	-3.6 (4.8)	1.8 (3.4)	.25 (.49)	33.6*** (11.2)	34.8** (14.8)
Adjusted R Square	.549	.460	.176	.652	.756	.729
Mean of Dependent Variable	78.0	77.2	21.2	16.05	489	483
Standard Deviation of Dependent Variable	20.1	14.3	7.6	1.95	35.7	49.7
Number of Nations	21	27	27	26	30	30

Source: OECD, Education at a Glance, Asian members of OECD not included in sample. The following 19 countries were included in all six regressions: Austria, Belgium, Canada, Czech Republic, Finland, France Germany, Greece, Iceland, Ireland, Mexico, Netherlands, New Zealand, Portugal, Spain, Switzerland, Sweden, and the United States. The model predicting the upper-secondary school graduation rate also included Hungary, Luxembourg and Turkey. The model predicting the share of 15-19 and 20-29 year olds in school also included: Australia, Denmark, Italy, Norway, Poland, Turkey and United Kingdom. The model predicting full-time equivalent years of schooling was the same set of countries with the exception of Luxembourg. The models predicting PISA scores for students who were taking the PISA test in the same language their parents usually spoke at home included six additional countries--Argentina Brazil, Peru, Chile, Russia and Luxembourg--but dropped Hungary and Turkey. Data on unemployment rates in OECD countries in the United Nations' Human Development Report 2001. Nearly a third of the people who work in the Duchy of Luxembourg commute from France, Belgium and Germany so the GDP per capita figure for Luxembourg overstates the wealth and productivity of Luxembourg residents. We, therefore, felt that Belgium's GDP per capita more accurately reflected the productivity and standard of living of Luxembourg and used that figure for Luxembourg.

Not surprisingly, the most important determinant of all of these outcomes is the productivity level of the country—per capita GDP. The adult unemployment rate has statistically significant positive relationships with both the expected number of years of full-time equivalent school attendance and the school enrollment rate of 15 to 19 year olds. Every one percentage point increase in a country's adult unemployment rate is associated with a 1.27 point increase in the proportion of 15 to 19 year olds who are attending school. Curriculum-based external exit exams had no significant association with school enrollment rates but did have large positive relationships with the PISA test scores of students who spoke the test language at home.[a]

The share of upper-secondary students in Career-Tech programs has a statistically significant (at the 10 percent level on a two-tail test) positive effect on rates of graduation from upper-secondary school and the proportion of 15-19 year olds in school or college. The relationship appears to be rather strong. A 10 percentage point increase in the share of upper-secondary students in vocational and prevocational programs is associated with a 2.6 percentage point increase in the high school graduation rate and a 1.9 percentage point increase in the proportion of 15-19 year olds in school. The career-tech share had no effect on academic achievement at age 15, school attendance rates of 20-29 year olds or on the expected number of years (full-time equivalent) spent in school between age 5 and 60. These results are consistent with the hypothesis that offering students a robust career-tech option increases upper-secondary enrollment and completion rates without lowering test scores at age 15 or college attendance rates after the age of 20.

[a] Students whose language at home is different from the language of instruction score between 35 and 110 points lower on the PISA reading assessment than students who speak the language of instruction at home. Since the proportion of students who are taught in a different language from the one spoken at home varies a great deal (reaching a high of 18 percent in Luxembourg), limiting the analysis to students who speak the language of instruction at home eliminates an important confounding source of variation in academic achievement across nations.

II. Labor Market Payoffs to Career-Tech Education

Literature Review: The Payoff during the 1970s

There have been a number of studies of the impact of high school vocational education on labor market success in the United States. The earliest studies used student reports of their participation in the vocational track to define participation in CTE (Grasso and Shea 1981, Gustman and Steinmeier 1981, Woods and Haney 1981). When, however, these student reports of track were cross checked against transcripts, it was found that some of the self-identified vocational students had only a few vocational courses on their transcript and many "general track" students had taken 3 or 4 vocational courses (Campbell, Orth and Seitz 1981). Since it is the number and types of courses taken which are influenced by school policy, studies of the impact of vocational education need to employ objective measures of participation and not self-assessments of track, which apparently measure the student's state of mind as much as they measure the courses actually taken.

The solution to this problem has been to use transcripts or reports of actual courses taken to measure participation in vocational education. Meyer's (1981) analysis of longitudinal data on 1972 high school graduates used school reports of the number of courses taken in vocational and non-vocational fields to define a continuous variable: the share of courses that were vocational. He found that females who devoted one-third of their high school course work to clerical training earned 16 percent more during the seven years following graduation than those who took no vocational courses. Those who specialized in home economics or other non-clerical vocational courses did not obtain higher earnings. Males who specialized in trade and industry earned 2.8 percent more than those in the general curriculum. Males in commercial or technical programs did not earn significantly more than those who pursued a general curriculum.

Rumberger and Daymont (1982) used transcripts to define variables for the share of course work during the 10th, 11th and 12th grades that was vocational and the share that was neither academic nor vocational. Analyzing 1979/80 data on 1161 recent high school graduates in the

National Longitudinal Survey (NLS79) who were not attending college full-time, they found that males who devoted one-third of their time to vocational studies instead of pursuing a predominantly academic curriculum spent about 12 percent more hours employed, but experienced slightly greater unemployment and received a 3 percent lower wage. Females who similarly devoted one-third of their time to vocational studies at the expense of academic course work were paid the same wage but spent about 8 percent more time employed and 1.6 percent less time unemployed.

The Payoff during the 1980s

Studies of vocational education using more recent data sets get more positive results. Kang and Bishop's (1986) study of 2485 men and women who graduated from high school in 1980 and did not attend college full-time used student reports [transcripts were not available] of courses taken in three different vocational areas--business and sales, trade and technical, and other--and five academic subjects--English, math, science, social science and foreign languages--as measures of curriculum. Males who took 4 courses (about 22 percent of their time during the final three years of high school) in trade and technical or other vocational subjects by cutting back on academic courses were paid a 7 to 8 percent higher wage, worked 10 to 12 percent more, and earned 21 to 35 percent more during 1981, the first calendar year following graduation. Males who took commercial courses did not have higher earnings or wage rates. Females who substituted 4 courses in office or distributive education for 4 academic courses were paid an 8 percent higher wage, worked 18 percent more, and earned 40 percent more during 1981.

Joseph Altonji's (1988) study of the NLS Class of 72 follow-up surveys for 1973 through 1986 found modest positive effects of vocational course work on hourly wage rates. Holding years of further education constant, four trade and technical courses substituted for a mix of academic courses (English, foreign language, social studies, science and mathematics) raised wage rates by 5 to 10.3 percent depending on specification. Substituting four commercial courses for a mix of academic courses had no effect on wages in OLS models but raised wage rates by 3 percent in instrumental variable models intended to correct for selection bias.

Studies by Paul Campbell and colleagues of young people graduating in the late 1970s and early 1980s also obtained positive findings. Controlling for test scores and past and present enrollment in higher education, their analysis of 1983 and 1985 National Longitudinal Survey data on 6953 young men and women between the ages of 19 and 28 found that graduates of vocational programs had 16.5 percent higher earnings than those who had specialized in academic courses [comparison is made with academic rather than general track students because most general track students take one or two vocational courses]. A parallel analysis of High School and Beyond data on 6098 students who graduated in 1982 (which also controlled for test scores and college attendance) found that the vocational graduates were 14.9 percent more likely to be in the labor force in 1983/84, were one percentage point less likely to be unemployed, and were paid about 9 percent more per month than the academic graduates. The overall earnings effect was 27 percent. The differential between vocational and general curriculum graduates [who generally took 1 to 2 vocational courses] was generally about half the size of the differential between vocational and academic graduates (Campbell et. al., 1986, 1987).

Gray and Huang (1992) found that high school vocational education had positive effects on yearly earnings and that these effects were not related to further attendance at technical or community college after high school. Gray et al., (1993), using data from the NLS-72 and defining the high school courses taken by students with the counselor-coded data, found positive long-term effects (fourteen years after graduation) of high school vocational education on earnings as high as the returns of college degree, both for males and females.

Ferran Mane's (2000) study is the most comprehensive study to date of the labor market impacts of career-technical education on students who do not go to college full-time. Employing almost identical variable definitions and specifications, he compared the short and medium-term effects of CTE courses for 1972 graduates, 1980 graduates and 1992 graduates. He concluded that both short and medium-term returns to CTE were a great deal higher for 1980 graduates than 1972 graduates. Short-term returns to CTE remained high for 1992 graduates.

Why did the Payoff Increase?

The payoff increased because skill needs of business were growing and shifting very rapidly during the 1980s and 90s. Career-technical education also became more responsive and more effective. During the 1970s, competency based instruction tied to competency profiles certifying the skills learned became common practice, career education courses preceding the selection of an occupational specialty were introduced, job search skills were added to the curriculum of most vocational programs, home economics was reoriented from a focus on home making to a focus on preparation for work, and the content of many individual programs was upgraded and updated. Change continued in the 1980s and 1990s. CTE students were required to take more demanding academic programs. Courses in computer skills and programming were introduced and have grown so much that they now account for one-third of occupational CTE courses.

Data has now become available on the medium-term payoffs to CTE for the class of 1992. We now turn to an analysis of these data.

2.1 Impacts of Career-Technical Education obtained at the beginning of the 1990s

Our study uses micro data from the National Educational Longitudinal Study (NELS-88), a longitudinal data set that followed a nationally representative sample of 8th graders in 1988 every two years through 1994 and then once more in 2000. We studied the subset of NELS:88 high school graduates who were in public schools in 10th grade and earned between 15 and 32 Carnegie units during high school and graduated in 1992 or 1993.

We aggregate high school courses into five subtotals. The first category: "Computer courses" included courses in keyboarding taught in high school, word processing, computer applications and programming. This variable had a mean of .57 credits and a standard deviation of .67. The second subtotal, all other advanced occupational vocational courses, included courses in agriculture, appliance repair, auto mechanics, business, construction, health occupations, metal working, etc. High school graduates in our data accumulated an average of

1.32 Carnegie units of advanced non-computer occupational courses. The standard deviation of this variable (1.7) was large relative to the mean indicating that some students took more than four courses while others took none. "Beginning vocational courses" included all home economics courses (including those referred to as vocational or occupational) and the introductory course in general business, agriculture, distributive education and health occupations). Students completed an average of .46 Carnegie units of these beginning vocational courses during high school. When students take these courses in middle school they do not show up in the high school transcript data.[a] The fourth subtotal, academic courses--English, foreign languages, mathematics, science and social studies—has a mean of 15.36 Carnegie units. The final subtotal, Personal Interest Courses--art, music, health, physical education, driver education—has a mean of 4.35 or roughly 20 percent of the total number of courses taken by graduates.[b]

Models were estimated predicting five indicators of early labor market outcomes: earnings in calendar 1993, the total number of months worked during the 21 month period from July 1992 to March 1994, the total number of months unemployed, the hourly wage rate and a one-zero dummy variable indicating that the job held in winter 1994 is a low skill job (that probably offers few promotion opportunities). The four indicators of medium-term labor market success were: annual earnings of the job occupied during the first quarter of the year 2000, the hours worked per week in that job, the number of months worked during 1999 and the hourly wage rate of that job.

[a] The "Beginning Vocational Courses" variable is the sum of F2RVGN_C and F2RVHO_C on the public use NELS:88 data CD. The 'NAEP' coding scheme employed by NORC does not count Typewriting 1 and traditional industrial arts courses as high school courses, so they do not appear as Carnegie units in any of our five categories of courses. This is the reason why the mean number of "Beginning vocational courses" reported in the previous sentence is substantially smaller than estimates of "General Labor Market Preparation" and "Family and Consumer Sciences" courses reported at the beginning of the paper and in the Digest of Education Statistics and other NCES publications (NCES, 1995, Appendix H.)

[b] The three largest groups of courses included in our "Personal Interest" category are visual and performing arts, health and physical education. The category also includes courses in interpersonal skills, leisure and recreation activities, citizenship/civic activities, military sciences and technologies, library sciences, theology and life skills taken from the detailed course codes available in the restricted data set. Our "Personal Interest" set of courses is larger than the "Personal Use" category that appears in NCES tables because NCES counts the visual and performing arts as academic courses. We excluded art and music from the academic category because we did not expect them to have any effect on gains on NELS:88's academic tests or on post high school wages. We, therefore, placed art and music with other nonacademic courses that we similarly expected to have no effect on wages or academic test score gains between 8th and 12th grade. Both NCES and NORC coding schemes count psychology and ethnic studies as social studies so they are included in our academic category (NCES, 1995, Appendix H.)

The wage rate and "Bad Job" variables are not defined for respondents who did not report a job sometime during 1993-94 or 2000. The other variables treated those who reported no work during the reference period as a zero (the variable was missing if the individual reported work but did not report earnings or hours worked). Thus, models predicting annual earnings assess the effect of coursework on both time employed and wage rates.

Since attending college reduces the time available for work, we included an extensive set of controls for current and past college attendance: the number of semesters of full-time college attendance during the period from fall 1992 to Spring 1994, number of semesters of part-time college attendance during that same period, the number semesters attending a two year institution full-time and the number of semesters of part-time attendance at a two year institution. We also included controls for "Attending college full-time in the first quarter of 2000", "Attending college part-time in the first quarter of 2000," "Ever dropped out of high school," "Obtained a GED," "graduated early" and, for late graduates, "the length of the delay in graduation." In the models predicting medium-term outcomes, we included dummy variables for some college, for 'ever attended a 4 year college', for earning a vocational certificate, for an associate degree, a bachelors degree, a masters degree and graduate or professional degrees. Family structure in 2000 was controlled by four indicator variables: married male, married female, male with children and female with children.

We also control for as many characteristics of the community and the student as possible in order to increase efficiency and reduce omitted variable bias. Our estimations include controls for grade point average in 8th grade, an average of 8th grade test scores in English, mathematics, science and social studies and other characteristics of the student in 8th grade. These included whether the student took remedial courses in 8th grade or earlier, whether she has taken advanced courses, has a computer at home, TV and homework hours, reading for pleasure, an indicator for being handicapped, socio-economic status of the student's family, logarithm of the number of books in the home, parent involvement index, family size, marital and parental status in 8^{th} grade, locus of control index, self esteem index and hours working for pay during 8^{th} grade (and it's square), an index for smoking in 8^{th} grade, dummies for race, ethnicity and religion and rural, suburban and urban residence and ten indicators describing the character and quality of the high school. From the principal's questionnaire we took the following indicators of quality of the student's secondary school: average teacher salary, the pupil-teacher ratio, percent free lunch, percent students that were white, school is a vocational high school, percentage of the school's full-time faculty who are vocational educators and average enrollment per high school grade (and its square). Two other measures of the quality of the school attended in 10^{th} grade—the average socio-economic status and 8^{th} grade test scores of students at the school—were calculated by averaging student responses for each high school in the NELS:88 data base. More detail on how variables are defined is available in Appendix A.

We used the restricted data set that identifies the state in which the student's high school was located. This allows us to merge information on state policies and characteristics into the data set. Control variables were included for: unemployment rate, mean weekly wage in retailing and manufacturing, state graduation requirements policies and dummies for 4 Census regions.[2]

Results for all students (both college bound and non-college bound) are reported in Table 2.

Table 2--The Effect of High School Courses on Employment Outcomes

	Mean (SD)	Computer Courses	Other Advanced CTE Courses	Intro-ductory CTE Courses	Academic Courses	Personal Interest Courses	1 Computer + 2 CTE Advanced	4 CTE Advanced – 2*Acad. -- Personal Interest	2 CTE Advanced + 2*Computer --2*Acad.	R2 # Obs.
Short Run	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1993 Annual Earnings	$5427 (5394)	- 14 (86)	248*** (47)	101 (87)	-52* (31)	- 42 (34)	482*** [.000]	1138*** [.000]	572*** [.005]	.2689 6,267
Total Months Worked in 92-94	14.15 (7.45)	-.108 (.125)	.129** (.057)	.089 (.096)	-.092** (..043)	- .023 (.044)	.151 [.402]	.723*** [.000]	.249 [.428]	.1396 7,339
Total Months Unemployed 92-94	1.47 (4.09)	.007 (.064)	-.041 (.035)	-.012 (.053)	-.019 (.022)	.019 (.024)	-.075 [.456]	-.145 [.258]	-.049 [.855]	.0389 7,339
Log Hrly Wage Rate in 93-94	1.292 (.557)	- .0045 (.0090)	.0217*** (.0045)	.0150 (.0076)	- .0052 (.0032)	.0015 (.0034)	.039*** [.004]	.096*** [.000]	.042** [.030]	.1003 7279
Logit for Bad Occupation	.294 (.456)	-.041 (.059)	-.114*** (.027)	-.044 (.040)	.002 (.022)	.025 (.022)	-.269*** [.002]	-.485*** [.000]	-.314** [.017]	.0686 2959
Medium Run										
Earnings in 2000	$26,535 ($18,953)	828** (358)	362** (160)	- 15 (246)	- 130 (100)	- 285*** (108)	1552*** [.002]	1993*** [.001]	2640*** [.001]	.2619 6,036
Months Worked-1999	10.49 (3.29)	080 (.053)	.123*** (.025)	.000 (.054)	.006 (.021)	.013 (.023)	.326*** [.000]	.467*** [.000]	.394*** [.001]	.1261 6,041
Hours Per Week in 2000	36.75 (15.33)	.227 (.225)	.386*** (.106)	. .280 (.202)	.096 (.077)	-.119 (.087)	.999*** [.003]	1.47*** [.000]	1.034** [.048]	.3345 6324
Log Hourly Wage Rate- 2000	2.543 (.436)	.0142* (.0073)	.0061+ (.0038)	-.0029 (.0066)	- .0036 (.0028)	-.0042 (.0031)	.0264** [.021]	.036*** [.001]	.0478*** [.006]	.1946 5331

Source: Analysis of NELS88. Sample is public high school graduates with 16 to 32 Carnegie units of course credit who were also interviewed in 1994 or 2000. Models contain controls for high school and college credentials, whether the respondent was in college full time (or part-time) during spring 1994 or 2000, the number of semesters spent attending college full-time and months spent attending part-time. Models also contain a full set of student background variables measured in the 8th grade including grades and test scores Numbers in parenthesis below the coefficient are Huber-White standard errors that correct for clustering by school. The numbers in brackets in the columns 7-9 are the p values for hypothesis tests of whether the total effect of adding three CTE courses is significantly different from zero. Column 7 tests the effect of a package of one computer course and 2 other advanced CTE courses. Column 8 and 9 test the effect of adding four advanced CTE courses by reducing two or three non-vocational courses. Models were not weighted.

+ Statistically significant at the 10% level one a one tail test   * Statistically significant at 5% level on a one tail test
** Statistically significant at 5% level on a 2 tail test   *** Statistically significant at 1 % level on a 2 tail test

The first column of the table gives the means and standard deviations of the dependent variables. The effects of vocational course taking are captured by three variables: the number of computer courses (column 2), the number of non-computer occupation specific CTE courses taken (column 3) and introductory vocational courses (column 4). The estimated effects of academic courses are reported in column 5. The effects of personal interest courses—physical education, health, fine arts, music, theatre, driver education, etc.—are reported in column 6. Below the coefficients we report Huber-White robust standard errors that account for the clustering of students within schools and deals with the problem of the correlation of errors generated by the cluster-based sampling frame. R square of the model and the number of observations with non-missing data are reported in column 10.

Effects of CTE Courses on All students: Advanced non-computer CTE courses had significant positive effects on earnings in 1993 and 2000, months worked in 1992-94 and in 1999, wage rates in 1994, job quality in 1994 and hours worked per week in 2000. Each additional non-computer CTE course was associated with 1993 earnings being $248 (4.6 percent) higher and year 2000 earnings being $362 (1.4 percent) higher. Computer courses had no effects on labor market outcomes immediately after graduation but large significant positive effects on earnings and wage rates in 2000. Eight years after graduating from high school, students who took one computer course earned $828 (3.1 percent) more annually and were paid 1.4 percent more per hour than students who took none. The incremental cost of delivering one CTE course in 1990/91 was only $1200 or $1500, so benefits of this magnitude imply very high rates of return. The large positive labor market effects of advanced CTE courses contrast with the negative (sometimes significantly negative) effects of academic and personal interest courses on labor market outcomes. Even though controls for college attendance were included, graduates who took extra academic courses in high school worked significantly less after high school and earned less in 1993. Art, music and personal interest courses had no effects on labor market outcomes in 1993 but were significantly associated with lower earnings in 2000. Introductory vocational courses had no significant effects on employment, unemployment, wage rates and earnings in either 1993-94 or 2000.[3]

Many students combine computer courses with other CTE courses. Effects of combining one computer course with two advanced non-computer occupation-specific CTE courses and no reduction in academic or personal interest courses are given in column 7. The numbers in brackets underneath these estimates of the effects of a CTE course package are the p values for a hypothesis test that the estimate of the effect of the package is not significantly different from zero. Students who took this package of CTE courses were 5.6 percentage points more likely to have a good job in 1994. They earned $482 (8.9 percent) more in calendar 1993 and $1552 (5.8 percent) more in the year 2000. Wage rates were also significantly higher in both years.

Students who do a CTE concentration take a larger total number of high school courses on average than other students. But they also typically take fewer academic and personal interest courses. What is the combined effect of increasing CTE courses and reducing non-CTE courses? Column 8 presents the estimated effects of taking four advanced non-computer CTE courses and taking two fewer academic courses and one fewer personal interest course. Our regressions indicate that these graduates spent more time in employment after high school and were 10 percentage points more likely to have a good job when they worked. They earned $1138 (21 percent) more in 1993 and $1993 (7.5 percent) more in 2000. They were paid 9.6 percent more per hour in 1994 and 3.6 percent more per hour in 2000.

Column 9 presents the estimated effects of taking 4 CTE courses--two advanced non-computer CTE courses and two computer courses--and giving up two academic courses while holding personal interest courses constant. These graduates spent more time in employment after high school and were 6.5 percentage points more likely to have a good job when they did work. They earned $572 (10.5 percent) more in 1993 and $2640 (10 percent) more in 2000. They were paid 4.2 percent more per hour in 1994 and 4.8 percent more per hour in 2000.

Are these estimates of the effects of CTE biased by selection effects? Students with low 8^{th} grade GPAs take many more CTE courses than students with high GPAs. Students taking advanced academic courses take fewer occupational courses. CTE course taking is more common at schools in poor communities. (Lavesque 2003a, Table 4 & 12). These contrasts suggest that students in CTE programs tend to be less able and less motivated than their more academically oriented peers and that their classmates are less likely to be planning to go to college. If these traits are not controlled for, estimates of the impact of CTE on labor market success will be biased in the negative direction. Our strategy for avoiding selection bias and omitted variable bias has been to include controls for as many personal and school characteristics as possible and to measure them in 8^{th} grade--before students start taking high school CTE courses. Our control variables are more extensive than in previous studies, so we feel we have kept any remaining selection bias to a minimum. If some selection bias remains, it probably generates a negative bias in our estimates of CTE's long-run effects.

Are the benefits of CTE smaller for students who go to college? Since the majority of CTE course takers go to college at least part-time, an evaluation of the economic payoffs to high school CTE needs to include its effects on college students and on those who complete postsecondary certificates and degrees. This is the reason why we did not drop full-time students and college degree holders from our baseline analysis as so many other studies have done. We included both groups in the analysis and controlled for their school attendance and the degrees they completed.

Because full-time students necessarily spend less time working, it seems inevitable that the earnings impacts of CTE courses will be smaller for students than for non-students. Going to school full-time also limits one's ability to get jobs in the occupational field studied in high school, so we would also expect wage rate effects to be smaller for college students. We tested these hypotheses by adding two interaction variables to the baseline model. The first variable was the number of years spent attending college full-time between fall 1992 and spring 1994 times the number of CTE courses taken (both computer and non-computer) in high school. The second variable was the years in college variable multiplied by the number of academic courses taken (deviated from 17). Results are presented in the top panel Tables 3 and 4.

Table 3--Effect of High School Courses on Employment Outcomes (interaction models)

	Computer Courses	Other Advanced CTE Courses	Intro-ductory CTE Courses	Academic Courses	Personal Interest Courses	CTE Courses *Yrs FT Student	Academic Courses * Yrs FT Student			R2 # Obs.
Short Run	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1993 Annual Earnings	149+ (106)	356*** (66)	115 (87)	-103* (56)	- 45 (34)	-151*** (46)	41 (31)			.2713 6,267
Total Months Worked in 92-94	.115 (.134)	.296*** (.064)	.117 (.096)	-.015 (.058)	- .020 (.044)	-.208*** (.059)	-.071* (.040)			.1413 7,339
Total Months Unemployed 92-94	-.068 (.077)	-.095** (.042)	-.022 (.054)	-.024 (.037)	.017 (.023)	.069** (.035)	.005 (.023)			.0395 7,339
Log Hrly Wage Rate in 93-94	.0064 (.0109)	.029*** (.0060)	.0163** (.0076)	- .0038 (.0049)	.0016 (.0034)	-.0092** (.0044)	-.0012 (.0029)			.1008 7279
Logit for Bad Occupation	-.040 (.061)	-.113*** (.029)	.046 (.040)	-.014 (.026)	.030+ (.021)	-.001 (.036)	.031 (.027)			.0677 2959
Year 2000						CTE Courses * BA+	Academic Courses * BA+	CTE Courses * LT BA	Academic Courses * LT BA	
Earnings in 2000	708** (345)	264+ (175)	- 47 (247)	- 226* (125)	- 286*** (108)	349 (385)	358* (214)	82 (355)	-116 (221)	.2619 6,036
Months Worked 1999	056 (.053)	.129*** (.029)	-.009 (.051)	.028 (.027)	-.015 (.020)	-.035 (.051)	-.066* (.033)	-.059 (.047)	.032 (.042)	.2849 6,041
Hours Per Week in 2000	.350+ (.247)	.483*** (.137)	.289+ (.202)	.142+ (.107)	-.121+ (.087)	-.257 (.247)	-.049 (.153)	-.245 (.225)	-.170 (.175)	.3349 6324
Log Hourly Wage Rate-2000	.0103+ (.0077)	.0021 (.0046)	-.0037 (.0066)	- .0079** (.0038)	-.0042 (.0031)	.0071 (.0080)	.0100* (.0053)	.0097 (.0081)	.0047 (.0064)	.1954 5331

Source: Analysis of NELS88. Sample is public high school graduates with 16 to 32 Carnegie units of course credit who were also interviewed in 1994 or 2000. Models control for educational credentials, the number of semesters in college full-time or part-time and a long list of student and school characteristics. Numbers in parenthesis below the coefficient are Huber-White standard errors that correct for clustering by school. Models were not weighted.

\+ Statistically significant at the 10% level one a one tail test
* Statistically significant at 5% level on a one tail test
** Statistically significant at 5% level on a 2 tail test
*** Statistically significant at 1 % level on a 2 tail test

Table 4--Effects of Career-Tech Study on Employment Outcomes

	1 Computer + 2 Advanced CTE			4 Advanced CTE - 2*Academic. -- Personal Interest			2 Advanced CTE + 2*Computer --2*Academic		
Short Run	**Non - student**	**Full time Student**		**Non - student**	**Full time Student**		**Non - student**	**Full time Student**	
1993 Annual Earnings	861*** [.000]	-45 [.794]		1675*** [.000]	301 [.201]		1217*** [.000]	-157 [.508]	
Total Months Worked in 92-94	.707*** [.001]	-.541* [.064]		1.23*** [.000]	-.15 [.692]		.850*** [.009]	-.53+ [.179]	
Total Months Unemployed 92-94	-.258* [.055]	.156 [.314]		-.349** [.025]	.183 [.399]		-.278+ [.166]	.254 [.206]	
Log Hrly Wage Rate in 93-94	.065*** [.004]	.010 [.573]		.124*** [.000]	.055** [.020]		.079** [.006]	.011 [.660]	
Logit for Bad Occupation	-.266*** [.005]	-.272+ [.163]		-.454*** [.000]	-.585** [.016]		-.279** [.052]	-.410+ [.104]	
Year 2000	**HS Grad**	**College Grad**	**Associate/ Certificate**	**HS Grad**	**College Grad**	**Associate/ Certificate**	**HS Grad**	**College Grad**	**Associate/ Certificate**
Earnings in 2000	1236** [.021]	2270** [.048]	1480+ [.130]	1793*** [.008]	2455* [.071]	2350* [.075]	2396** [.004]	3058** [.0647	2953** [.027]
Months Worked-1999	.308*** [.001	.203+ [.110]	.131 [.282]	.475*** [.000]	.467*** [.006]	.175 [.244]	.302*** [.021]	.294* [.078]	.001 [.932]
Hours Per Week in 2000	1.316*** [.002]	.545 [..387]	.58 [.437]	1.77*** [.001]	.84 [.324]	1.13+ [.103]	1.38** [.032]	.45 [.596]	.74 [.358]
Log Hourly Wage Rate- 2000	.0261 [.289]	.036*** [.100]	.044* [.051]	.028* [.083]	.037 [.202]	.058** [.033]	.040** [.037]	.049* [.098]	.070** [.019]

Source: Analysis of NELS88. Constructed from regression models with interactions with college attendance and credentials reported in table 2a. The numbers in brackets under the estimates of program effect are the p values for hypothesis tests of whether the total effect of the CTE study program is significantly different from zero. Columns 1-3 gives effect of a package of one computer course and 2 other advanced CTE courses. Columns 4-6 give the effect of adding four advanced CTE courses by reducing two academic and one personal interest courses. . Columns 7-9 give the effect of adding 2 computer and 2 other advanced CTE courses and reducing academic courses by two.

\+ F Statistic significant at the 20% level
* F Statistic significant at 10% level
** F Statistic significant at 5% level
*** F Statistic significant at 1 % level

The CTE interaction (in column 6) is highly significant and has the expected sign for earnings, months employed, months unemployed and hourly wage rate. The academic courses times full-time student interaction is significant only for months worked. Apparently students who take extra academic credits in high school subsequently spend less time in employment while attending college full-time. Columns 1 and 2 of Table 3 present our estimates of the effect of occupational CTE courses on non-college bound high school graduates. When we compare these estimates to columns 2 and 3 of Table 2 (where CTE effects on all graduates are reported), we see that the short-run impacts of CTE are much bigger for non-college bound graduates than for all graduates combined. Table 4 presents our estimates of the effects of the three different CTE study programs previously examined in Columns 7, 8 and 9 of Table 2. The one computer and two non-computer course CTE program raised the earnings of non-college bound students by $861.—a much larger figure than the $482 effect this package had on the full sample including both college students and non–students. The four non-computer CTE course scenario raised earnings of the non-college bound by $1675, college bound full-time students by $301, (not significant) and all groups combined by $1138. The four CTE course package containing two computer courses raised 1993 earnings of the non-college bound by $1217, full-time students by -$157, and all groups combined by $572. Clearly most (possibly all) of the short-run labor market benefits of high school CTE courses accrue to graduates who are not attending college full-time.

What about the medium-term effects of high school CTE on those who complete college degrees and certificates? Is the time in high school CTE courses wasted if the individual subsequently gets a voc-tech certificate, an associates degree or a bachelors degree? Do employers care only about the most recent credential and ignore high school coursework? Or does high school CTE help students make better choices about college major and help them achieve higher levels of skill? Our analysis of wage rates and earnings in 2000 addresses these questions by including interactions of dummy variables for obtaining a BA and for obtaining a vocational certificate or Associates degree with CTE courses and with academic courses. We tested the hypothesis that wage rate and earnings effects of high school CTE are smaller for students who have earned postsecondary degrees and certificates in the bottom panel of Tables 3 and 4. We found no support for the hypothesis. The coefficients on the CTE interaction variables are not statistically significant in the hypothesized direction. Indeed point estimates for the model predicting earnings and wage rates imply that CTE courses had larger effects when the individual later got licenses, certificates or degrees from post-secondary institutions. Furthermore, our estimates of the earnings and wage rate effects of the three packages of CTE courses are significantly positive despite the loss of power due to the small number of CTE concentrators who later obtained bachelors degrees in our data set (see the 1st and 4th row in the bottom panel of Table 4).

The medium-term effects of taking extra academic courses on wages and earnings were similar to the short-run effects? There were no statistically significant positive effects for any group. Indeed, for the two-thirds of our sample who have not earned a bachelors degree by the year 2000, taking extra academic courses during high school was associated with significantly lower wage rates and lower earnings. The conditional expectation function predicts that those who took four extra academic or personal interest courses in high school earned about a thousand dollars less. For the one-third of the sample who had obtained a bachelors degree, taking extra academic courses in high school were not associated with lower wages. The point estimate of the effect of academic courses on earnings is positive, but it is so small it is not even close to being statistically significant. There is considerable evidence that academic course taking in high school helps students go to and complete college (Adelman 2002). But conditional on postsecondary credentials and 8th grade test scores and grades, those who take extra academic courses in high school do not have better medium-run labor market outcomes. Maybe benefits will appear in the future. They had not appeared by the year 2000.[4]

III. Summary and Policy Implications

We conclude that offering students the option of starting preparation for their chosen occupation during upper-secondary school tends to increase school attendance of 15 to 19 year olds and improve labor market outcomes of high school graduates whether or not they enter and complete a postsecondary education. Nations that have a large share of their upper-secondary students in career-technical education have higher attendance rates and higher upper secondary completion rates. Test scores at age 15 and college attendance rates for young adults in their twenties are not reduced by a heavy emphasis on CTE in upper-secondary education.

Our analysis of longitudinal data on U.S. students in high school between 1988 and 1992 indicates that those who trained for specific occupations were more successful in the labor market. They spent more time in employment (both immediately after high school and eight years later), got better jobs and earned significantly more than students who did not take advanced CTE courses.

In Table 5 we present calculations of the earnings benefits of CTE cumulated over a student's entire working career and then compare them to the incremental costs of providing the CTE instruction.

Table 5--Comparison of High School Career Technical Education, Job Corps, Job Start and Job Training Partnership Act Training

(Costs and benefits in 2000 dollars)

	Extra Hours Occup. Train-ing	Extra Hours Acad. Instr.	Program Costs per Student	Increased Annual Earnings 1st & 2nd year after complet-ing	Increased Earnings Latest Date	Present Discount ed Value (4% real discount rate)	Benefit /Cost Ratio (4% real discount rate)	Internal Rate of Return
High School Career-Tech Education-1990-92					8th yr			
2 Advanced CTE plus 1 computer course	405	0	$5120	$ 570 8.9%	$ 1552 5.8%	$ 24,004	6.64	18.7%
4 Advanced CTE minus 2 Academic courses & 1 Personal Interest Course	540	-270	$3413	$ 1347 21 %	$ 1993 7.5 %	$ 32,951	11.84	36.6%
2-Advanced CTE plus 2 Computer Courses minus 2 Academic Courses	540	-270	$4567	$ 677 10.5%	$ 2640 10 %	$ 39,761	8.71	27.5%
Job Corps—1995-96					3rd yr			
Males & Females	645	395	$15,844	$ 820 (10%)	$ 1289 (11.6%)	$ 22,525	1.42	6.67%
Job Start—1986-88					3rd yr			
Male High School Dropouts	296	147	$ 7052	$ 27 (0.3%)	$ 685 (7.8%)	$11,510	1.63	7.65%
Female H.S. Dropouts	252	126	$ 7052	$ 244 (6.5%)	$ 523 (12%)	$9438	1.34	6.25%
Job Training Partnership Act –1988-89 Disadvantaged Youth under 22					2nd yr			
Classroom Training—Young Females	415	incl.	$ 2595	$ 783 (14%)	$926 (15.2)		pos	
Classroom Training—Young Male non-Arrestees	415	incl.	$ 2595	$ 4 (1 %)	-$756 (-6.4%)		neg	
On-Job Training—Young Female	276	0	$ 4050	- $ 933 (- 10%)	-$1252 (-14 %)		neg	
On-Job-Training—Young Male non-arrestees	276	0	$ 4050	- $ 1843 (-14%)	-$1669 (-12%)		neg	

The only benefits counted in this analysis were before tax earnings. Fringe benefits, reduced welfare receipt and reduced crime were not included in our calculations. Lost wages, stipends & OJT subsidies during training were not counted as costs or benefits. Real earnings effect of training in the final year of follow-up data is assumed to last until 35th post-training year.
Source: Job Corps---Peter Schochet et al. National Jobs Corps Study: 2001, Table IV.4
Job Start—George Cave et al, Job Start: Final report, 1993.. Estimates for participants were calculated from data for assignees by dividing by the participation rate---0.888. Tables 4.3, 5.2 & 7.2. The loss of earnings while being trained in the first year was $812 for men and $244 for women.
JTPA--Howard Bloom et al. The National JTPA Study-Overview, 1994, Exhibits 5, 13 & 15. The effects of enrollment in JTPA were calculated by dividing the effects per assignee by the proportion of assignees who enrolled in at least one kind of JTPA training. Many assignees participated in more than one form of training.

Graduates take an average of three advanced occupation specific CTE courses while in high school so we first present results for a scenario in which students take a package of three occupational CTE courses. In the first row of Table 5 we present our calculations of costs and benefits (in year 2000 dollars) of taking one computer course and two non-computer CTE courses without reducing the number of academic and personal interest courses (the scenario described in column 7 of Table 2). The instructional cost for this package is $5120.[5] The second row presents results for a scenario in which four extra CTE courses are offset by a reduction of three non-CTE courses. This costs approximately $3413. ($4*1797 - 3*$1138) in year 2000 dollars. The third row presents a scenario where four additional CTE courses (two of which are computer courses) are partially offset by reducing academic courses by two. This costs $4567 per student (4*$1797 - 2*$1138).

Column 6 of the table gives the present discounted value in year 2000 dollars (using a 4 percent interest rate) of this stream of benefits discounted back to 1991.[6] Column 7 presents the Benefit-Cost ratio obtained by dividing column 6 by column 3. Column 8 contains the internal rate-of-return for the CTE investment: the interest rate that makes the present discounted value of benefits for1992 through 2025 equal to the incremental cost of the package of CTE courses in 1990-91 (column 3).

Benefit-cost ratios and internal rates of return are remarkably high. Benefit-cost ratios exceed 6.0 and real internal rates of return all exceed 18 percent. These very high internal rates of return are not a consequence of our assumption that the earnings payoffs measured for the year 2000 will continue for another 25 years. If we assume, instead, that they last for only five more years to 2005, the internal rates of return for the three CTE packages described in table 3 are respectively 16%, 36% and 26%. If we make the completely unrealistic assumption that the benefits disappear in 2001, the internal rates of return become 10%, 33% and 21%. Rates of return and benefit-cost ratios are at their maximum when costs are kept low by substituting CTE courses for academic and personal interest courses. For those who did not go to college, rates of return for the three CTE program scenarios were 19.3%, 44% and 32% respectively. For those who earned a bachelors degree, rates of return were 18.6%, 27% and 23% respectively for the three scenarios.

Comparisons with 2nd Chance Training Programs: However calculated, these rates of return are substantially higher than those calculated for government training programs targeting high school dropouts. Rigorous random assignment evaluations have been conducted of three federally funded training programs targeted on youthful high school dropouts: the Job Corps, Job Start (a non-residential program otherwise similar to the Job Corps) and youth training funded by the Job Training Partnership Act (Peter Schochet et al 2001; George Cave et al 1993; Howard Bloom et al 1994). The benefit-cost reports for Job Corps and Job Start assumed that the estimated earnings impacts in the fourth and final year of the study would continue indefinitely and be constant in real terms. We maintained comparability across training programs by assuming that earnings impacts will last until 35 years after initiation of the training. The earnings impact of participating in the training program in the final year of the follow-up study is assumed to continue and be constant in real terms for the next 31 years in the case of Job Corp and Job Start and 25 years in the case of high school CTE. [7]

The results are presented in the second, third and fourth panel of table 5. The additional hours of classroom instruction associated with each program are reported in columns 1 and 2. The costs (in year 2000 dollars) of training are in column 3.[8] Job Corps' costs are substantially higher because it is a residential program. The extra services provided by Job Start probably account for its higher hourly costs of instruction. The earnings impacts (in year 2000 dollars) of the occupational training are presented in Column 4 and 5 and the present discounted value (at a 4 percent real interest rate) of 35 years of earnings gains are presented in column 6. The second chance programs have smaller medium-term earnings impacts than high school CTE.[9] With smaller benefits and higher costs, the 2nd chance programs end up having much lower benefit-cost ratios and rates of return (columns 7 and 8). Clearly, it is much better to prevent at-risk students from dropping out and to induce them to do occupation specific education at their local high school or a regional voc-tech center.

Comparisons with Associates Degree Programs: The earnings increments for postsecondary education are larger than the increments generated by four high school CTE courses (as simulated in table 2 and 4). But so are the costs. The 26 year olds in our sample with an Associates degree earned $5360 more than high school graduates; a premium that is three times the earnings benefit generated by three high school CTE courses and twice as large as the benefit of the four CTE course scenario split between computer and non-computer courses. An Associates degree, however, requires two years of full-time college attendance with associated reductions in earning power and instructional costs roughly equal to those for 12 high school courses. As a result, benefit–cost ratios and internal rates of return for high school CTE are likely to be higher than for most postsecondary CTE programs. This does not make postsecondary CTE a less attractive option than high school CTE. Students need not choose between them. They can do both and indeed they do not lose the benefits of their high school CTE when they do so. That, indeed, is what Tech-Prep programs are designed to foster. Students are encouraged to start an occupational specialization in high school and continue it in college. Many students in high school CTE programs are following this advice. They are significantly overrepresented in postsecondary CTE programs (Silverberg et al, 2003).

The second group that clearly needs to take CTE courses in high school is the students who do not plan to enter college immediately after graduating from high school or are uncertain about what they will do. The immediate benefits of CTE instruction in high school are much larger for these students than for those who go to college full-time. Four advanced non-computer CTE courses with an offsetting reduction of three non-CTE courses raises earning by 21 percent immediately after high school. They should be strongly advised to take CTE courses in the fields they are considering for a career while they are still in high school. This will help them pay for college if they choose to go and give them the skills to find a better job if they do not. The programs should be structured so as not to foreclose the student's changing their mind about college.

Once skills become standardized, schools have natural advantages as competitors in the occupational training market: (a) they offer students flexibility in scheduling and the choice of courses, (b) hourly costs of training are lower because teaching staff are specialized and economies result from spreading the cost of developing courses over many students, (c) school certification of skills makes them more portable, and (d) schools and students have access to public subsidies not available when training takes place at firms. Another advantage of school based occupational training is that they allow individuals to select the occupation for which they will prepare. When firms provide occupational training, competition to enter an occupation occurs before training rather than after. When schools become major training providers, barriers to entry into skilled occupations fall, the supply of skilled workers grows, the costs of employing people with the skill fall, and expanded use of new technology is facilitated.

Appendix A

Variables Used In The NELS-88 Regressions

Dependent Variables

Labor Market Outcomes immediately after High School:

Earns93: earnings in calendar year 1993 (Individuals who did not work in 1993 are included as zeros. Variable is missing if employment is reported but data on earnings is missing.).

Empltot: total number of months worked in the 21 month period from July 1992 to February 1994.

Unempltot: total number of months unemployed in the 21 month period from July 1992 to February 1994.

Logwages: hourly wage rate in the last job held.

BadJob: A zero-one dummy variable for job is as a laborer, food service or retail sales worker.

Labor Market Outcomes eight years after graduation from high school:

Inyes000: earnings in current / most recent job in 2000 (individuals who did not work in 2000 are included as zeros).

Months99: total number of months worked in the calendar year 1999 (individuals who did not work in 1999 are included as zeros).

Hour00b: total number of hours per week in current / most recent job in 2000 (individuals who did not work in 2000 are included as zeros).

Lnwag00b: hourly wage rate in current / most recent job in 2000 (individuals who did not work in 2000 are excluded).

Independent Variables

High school courses (information comes from Transcript data files):

computer: number of Carnegie units of computer courses (included keyboarding) taken in high school.

newvoca: number of Carnegie units of non-computer occupation specific courses taken in high school.

homeintr: number of Carnegie units of beginning vocational courses (including all home economics courses) taken during high school.

Academic: total number of Carnegie units taken in English, foreign languages, mathematics, science and social studies courses during high school.

othercor: total number of Carnegie units of personal interest courses taken during high school.

Control variables used in regression analysis

1. High School Completion and College Attendance Variables

Used for predicting short-run outcomes

Nodiplo: high school graduation status. Dummy variable indicating whether the student is in one of these situations (takes value = 1): enrolled in high school in 1994, working to get a equivalent high school diploma or not graduated and not working to obtain it.

Ged: high school graduation status. Dummy variable indicating whether (takes value=1) or not (takes value = 0) the student has received a GED or a certificate of attendance.

F2evdost: dummy variable indicating whether (takes value=1) or not (takes value = 0) the student ever dropped out over the whole period (1988-92).

Graderly: dummy variable indicating whether (takes value=1) or not (takes value = 0) the student graduated early from high school.

Whengrad: length of the delay in graduating from high school (in years)

Fulsem: sum of the percentages (ranging from 0 to 1) of months attending as a full-time student any postsecondary education institution in all semesters from fall 1992 to spring 1994. In every single semester 1 means that the student attended a college the whole period and 0 the opposite. Therefore, the maximum value is 4 and the minimum is 0.

Parsem: sum of the percentages (ranging from 0 to 1) of months attending as a part-time student any postsecondary education institution in all semesters from fall 1992 to spring 1994. In every single semester 1 means that the student attended a college the whole period and 0 the opposite. Therefore, the maximum value is 4 and the minimum is 0.

Tottwful: sum of four dummy variables indicating whether the student was enrolled as a full-time student in a two-years postsecondary degree over the period fall 1992 - spring 1994

Tottwpar: sum of four dummy variables indicating whether the student was enrolled as a part-time student in a two-years postsecondary degree over the period fall 1992 - spring 1994.

Variables used in models predicting outcomes in 1999 and 2000

Full2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) the respondent is, at the time of the interview, a full time student (not working).

Part2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) the respondent is, at the time of the interview, a part time student (working for pay).

Nodi2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) the respondent does not have a high school diploma or equivalent at the time of the interview.

Ged2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) the respondent has a GED certificate at the time of the interview.

Cert2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) the respondent has a Certificate of Attendance at the time of the interview.

Soco2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) the respondent has some post-secondary school experience but never obtained a degree.

Ev4y2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) respondents with some post-secondary school experience, ever attended a 4-year institution after high school.

Lice2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) respondent's highest PSE degree obtained is a certificate or license.

Asoc2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) respondent's highest PSE degree obtained is an associate's degree.

Bach2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) respondent's highest PSE degree obtained is a bachelor's degree.

Mast2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) respondent's highest PSE degree obtained is a master's degree.

Phd2000: dummy variable indicating whether (takes value=1) or not (takes value = 0) respondent's highest PSE degree obtained is a PH.D. or a professional degree.

2. Grades and test scores

Grades1: average of the self-reported grades in English, mathematics, science and social studies in 8th grade. Five points scale where mostly As is 4 and mostly below D is 0.5.

Remedial: mean of two dummies measuring whether the student is attending at least once a week remedial English or remedial mathematics in 8th grade. Missing values were replaced by the mean of the variable.

Dumyreme: dummy variable with value =1 when remedial was missing.

Advanced: mean of four dummies measuring whether the student is attending at least once a week advanced, enriched or accelerated courses in English, mathematics, sciences or social studies in 8th grade. Missing values were replaced by the mean of the variable.

Dumyadva: dummy variable with value =1 when advanced was missing.

MeanTeta: mean of mathematics, reading, science and social studies test scores in 8th grade. The IRT Theta "T" score was used because it has a normal distribution. Theta has a mean of 50 and a standard deviation of 10 where the standardization was carried out on the weighted panel sample.

3. Geographic Region during high school

Urban1: dummy variable for school located in a urban community. Information from first follow-up (tenth graders).

Rural1: dummy variable for school located in a rural community (default is suburban). Information from first follow-up (tenth graders).

West1: dummy variable for school located in the west region. Information from first follow-up (tenth graders).

South1: dummy variable for school located in the south region. Information from first follow-up (tenth graders).

Central1: dummy variable for school located in the west region (default is Northeast). Information from first follow-up (tenth graders).

4. Personal characteristics

Male: dummy variable for being male.

Black: dummy variable for being black, non Hispanic.

Asian: dummy variable for being Asian.

Hispanic: dummy variable for Hispanic.

NatAmer: dummy variable for being Native American (default is white, non hispanic).

Mishand: dummy variable measuring in 1988 current or past participation in a program for the orthopedically handicapped or learning disabled. Information comes from the parents and teachers questionnaires. Note that the eligibility criteria and participation patterns used in NELS-88 tended to eliminate most severely handicapped students from the sample.

dumyhand: dummy variable with value =1 when mishandi was missing.

langmino: dummy variable with value =1 when mishandi was missing.

5. Family Background (all variables measured in 8th grade)

Ses88: composite created by NELS measuring the family socieconomic status. They used father's and mother's education level and occupation and family income.

famsize: composite created by NELS estimating family size from both the parent and student questionnaires.

parinvol: variable measuring parents involvement in student school activities. It was created using two questions: how often student discuss with parents what is done in class and how often parents check on the student's homework. It runs from low values (checking often) to high values (not checking at all).

divor: household composition reported by the student. In this case the student lives with either the biological father or mother and, respectively, a female or male guardian.

Singfem: household composition reported by the student. In this case the student only lives with the biological mother.

Singmale: household composition reported by the student. In this case the student only lives with the biological father.

other: household composition reported by the student. In this case the student lives with a relative or non-relative other than his/her father or mother (default is living with student's father and mother).

Misbooks: number of books at home. Missing values were replaced by the mean of the variable.

Dumybook: dumy variable with value =1 when misbooks was missing.

Miscomp: dummy variable with value =1 when respondent's family have a computer at home. Missing values were replaced by the mean of the variable.

Household religious background (information comes from parents questionnaire):

Misbaptist: dummy variable for having a Baptist religious background.

Misprote: dummy variable for parents being in any of other [non Baptist] Protestant denominations (eg. Methodist, Lutheran, etc).

Miscatho: dummy variable for having a Catholic religious background.

Miscrist: dummy variable for having a eastern orthodox or other Christian religious background.

Misjewis: dummy variable for having a Jewish religious background.

Misother: dummy variable for having a Moslem, Buddhist, Hindu or other religious background.

misrelig: dummy variable which takes value = 1 when the answer is missing.

6. School Background (all variables measured in 1990 and provided by the principal)

Sallowte: salary paid to a first year full-time teacher.

Pupteara: pupil-teacher ratio in the school.

Intevoca: percentage of full time vocational education teachers among the total number of full time teachers in the school.

Whitsch: percentage of white (not of Hispanic origin) students among tenth graders.

Luncfree: percentage of students over the total student body that receives free or reduced-price school lunch program.

Gr10enro: tenth grade enrolment in hundreds.

Sq10enro: square of the tenth grade enrolment deviated from the mean.

Newtest: clustering students by 1990 high school, mean of the average (four items) test score obtained in 1988.

Newses: clustering students by 1990 high school, mean of the family socio-economic status in 1988.

7. Value Scores and Attitude Toward Work in 8th grade

Locus: psychological scale created by NELS measuring respondent's sense of locus of control.

Self: psychological scale created by NELS measuring respondent's self esteem.

Mistv: number of hours per day watching television. Missing values were replaced by the mean of the variable.

Dumytv: dummy variable with value =1 when mistv was missing.

Misread: number of hours per week the student read for fun. Missing values were replaced by the mean of the variable.

Dumyread: dummy variable with value =1 when misread was missing.

Missmoke: variable indicating student's smoking behaviour, where 0 means not smoking at all, 1 means smoking between one to five cigarettes per day and 2 means more than half a pack per day. Missing values were replaced by the mean of the variable.

Dumysmok: dummy variable with value =1 when missmoke was missing.

Mishomew: total number of hours spent on homework each week in all subjects. Missing values were replaced by the mean of the variable.

8. Work Experience in 8th grade

Workhour: number of hours working for pay per week in student's present or more recent job.

Worksq: square of the number of hours working per week deviated from the mean.

9. Variables describing state policies and local/regional labor markets

mcestate: a dummy variable for states where students must pass a minimum competency exam to receive a regular high school diploma. The states that required students to pass a minimum competency exam to graduate in 1992 were Alabama, Florida, Georgia, Hawaii, Louisiana, Maryland, Mississippi, Nevada, New Mexico, New Jersey, New York, North Carolina, South Carolina, Tennessee, and Texas. Thirty-six percent of our sample lived in states that mandate the MCE and set the graduation standard on the exam.

Nounit, statunit, acadunit: Three variables characterize course graduation requirements: a one-zero dummy variable identifying states without state-set minimum course graduation requirements, the minimum number of Carnegie units required to get a diploma, the number of core academic courses (English, math, science and social studies) required to get a diploma. States without statewide minimum course graduation requirements were assigned a value of 13—the lowest minimum total Carnegie unit requirement for the states with a requirement.

U93unemp, meanunem: unemployment rate in the local labor market—available in restricted data.

Logret93: Log of the state's weekly wage in retailing—available in restricted data.

Logman93: Log of the weekly wage in manufacturing—available in restricted data.

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Endnotes

[1] Data from 1948/49, 1960/61, 1972/73 and 1981/82 indicate that 20 to 23 percent of high school students took a typing course during that school year (Goldin 1999, p.59).

[2] We include separate measures of academic and total course requirements because they correlate only .22 with each other and are likely to have different effects on post high school outcomes.

[3] Other student characteristics that were associated with significantly lower monthly earnings or lower wage rates were: current attendance at college, female, African American, Asian, handicapped, rural location, Northeastern location, many siblings, and attending a school with a high incidence of free lunch. Monthly earnings were higher for students who had worked for pay in 8th grade, who had an internal locus of control and high self esteem and for students with parents who set tighter limits on behavior in 8th grade.

[4] The model also included a test of one final hypothesis: "The returns to college are greater for high school graduates with high 8th grade GPAs." Point estimates were positive as hypothesized but the magnitudes of the effect were never large enough to become statistically significant.

[5] In 1990/91 when these students were in school, school expenditure per pupil was $5421. Graduates in 1992 took 24 courses on average, so we divided by six to get an estimate of per student costs of mounting a typical one-year long course. Due to smaller class size, instructional costs per student are about 50 percent higher in advanced CTE classes, so our estimate of per student instructional cost for one full-year CTE course was $1355. in 1990/91 dollars and $1797. in year 2000 dollars. Non-vocational courses cost $1137 in 2000 dollars. Therefore, instruction cost of three CTE courses is $5120.

[6] Earnings benefits were calculated for each year by first translating the impact estimate for 1993 in row 1 of table 2 into year 2000 dollars and then by interpolating between the 1993 and 2000 figures. The 1992 earnings gain was assumed to be one-fourth of the 1993 estimate. Earnings benefits of CTE for years after 2000 were assumed equal to the 2000 figure in real terms and to last until 2025.

[7] The only benefits counted in this analysis were before tax earnings. Fringe benefits, reduced welfare receipt and reduced crime (that are were a part of the benefit-cost calculations for the second chance programs) not included in our calculations. Lost wages, stipends & OJT subsidies during training were not counted as costs or benefits.

[8] Since the control groups participated in other kinds of training, costs for second chance programs are calculated by measuring the extra training services received as a result of being assigned to the experimental group.

[9] Evaluations of other 2nd chance programs--Comprehensive Employment and Training Act and the Supported Work Demonstration—have also found earnings benefits for dropout youth are either negative or small. The smaller impacts of the 2nd chance programs might be due to less competent trainers, the more disadvantaged character of the students, the stigma of participating in a program intended solely for the poor or negative peer effects of being in a special program for dropouts from disadvantaged backgrounds. Alternatively, the difference might result from later measurement of earnings impacts (8 rather than 3 years after training ends) in our high school CTE study or selection biases that are avoided by using random assignment to measure the effects of the 2nd chance programs.