WORKFORCE AND TECHNICAL SKILL EDUCATION AND ITS ASSESSMENT

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Introduction

Education is all, to some extent, workforce development. Whether students major in engineering or English, successful outcomes tend to be those where students find a successful career. Yet, there are programs which are targeted for the workforce that can be assessed differently than traditional college programs. Workforce and technical skill programs are focused programs with the intent of program graduates immediately transitioning to related occupations. For example, career and technical education (CTE) are career-oriented programs that are typically offered by two-year colleges. Graduates are not expected to continue their education elsewhere, but to obtain employment in their career area.

Workforce programs can be remarkably distinct in a number of ways. First, the main driver of these programs is workforce development with programs often responding to the local labor market. Second, some programs are not offered as credit courses, instead, as non-credit courses. In a non-credit setting, grades are not the primary criterion and the structure of classes differs greatly compared to a traditional credit course. Moreover, training may not be offered on college classrooms or laboratories, but on job sites. For this reason, much of the literature refers to workforce and technical skill training as "specific" training as opposed to general taining which prepares students for a variety of careers (Becker, 1964). When the instruction takes place on work sites, it is referred to as "on-the-job" training.

There are a number of ways to evaluate workforce and technical skill programs. One of the most popular methods is to evaluate the workforce outcomes of participants. These assessments are based on the well-known link between education and wages established by human capital theory. Additionally, the growing availability of longitudinal data systems has permitted researchers to obtain alumni's salary, industrial sector and employers of graduates.

Researchers can use a variety of wage-related metrics to measure outcomes, including: (1) wage levels of graduates; (2) annual change in wages; (3) cumulative change in wages; (4) net present value; and (5) rate of return.

Data Sets

Assessments utilizing wage data have grown tremendously due to an increasing availability of individual-specific wage data. In particular, unemployment insurance records are maintained in each state to administer unemployment benefits. Since the early 1990s, this data has been matched with educational records and is the primary basis for this chapter.. The presumption is researchers can find program participants using the institutions data set. Yet, the researcher will still need to categorize the workforce programs, obtain wage data, and use the appropriate methodology. Workforce programs contain a diverse set of programs that range from graphic design to tool and die repair. Thus, it's important for researchers to be able to categorize programs that can be easily presented while being able to group similar programs based on content. One plausible solution is to use the Classification of Instructional Programs (CIP) numbers to group similar programs.

CIP numbers are six-digit numbers developed in 1985 to classify postsecondary majors. The list is updated regularly and a revised catalog was released in 2010. Each pair of digits conveys some information about the major. The first two digits describes the program area, for instance, 01 denotes agriculture and agriculture operations programs. The next two digits—the third and fourth digit—denotes sub-program areas with more specific, but still general description. The CIP 01.02 are agriculture mechanization programs. The final two digits denote the specific program. The CIP 01.0204 denotes agriculture power machinery operation programs.

[TABLE 1 ABOUT HERE]

Grouping by the first two digits is a natural form of group similar programs. CIP numbers are widely used in postsecondary education, so results could be easily communicated within and between postsecondary institutions. However, there are over 50 program areas defined by the two-digit CIP. Unfortunately, this may be too many if researchers were to summarize data for all program areas at once.

An alternative solution is to use the State Career Clusters. Career clusters consist of 16 program areas grouped by occupational skill. Researchers can reasonably display data for all 16 clusters in a single table or graph, which is an advantage compared to CIPs. The State's Career Cluster Initiative website (www.careerclusters.org) contains a crosswalk from CIPs to the sixteen clusters.

Some researchers may be asked to assess programs based on occupation outcomes. For instance, a researcher may be asked to assess workforce and technical programs that lead to occupations in wind energy. Like college programs, occupations have multiple systems classifying various occupations. The Standard Occupational Classification (SOC—pronounced "sock") system is one such taxonomy supported by the U.S. Bureau of Labor Services. The Occupational Information Network (O*Net) also provides a standardized list of occupations. Fortunately, there are crosswalks between CIP, SOC, O*Net, and career clusters provided by the National Crosswalk Center (www.xwalkcenter.org). Table 1 shows the major categories used in the CIP, career cluster, and SOC/O*Net system.

[TABLE 2 ABOUT HERE]

Unemployment insurance (UI) records, despite the name, contain employment and wage information for most employed workers within a state. These records are becoming increasingly available to researchers in order to match education and wage records. The basic elements of UI records contain social security number, the individual's wage for a given quarter in a year, the employer, employers address, industrial sector, quarter and year. Some states have access to more information, such as the individual's occupation or the number of hours worked. Table 2 shows the list of states and their respective state agencies which maintain unemployment insurance records.

There are some necessary caveats with UI records. First, they contain wage information of the individual for every employer. That is, an individual with multiple jobs will be reflected in the same manner. Second, the employers address reflects the company's payroll office—which is not necessarily the location where the individual is located. Finally, UI records do not contain information on federal employees, members of the armed forces, the self-employed, proprietors, unpaid family workers, church employees, and railroad workers covered by the railroad unemployment insurance system, as well as students employed in a college or university as part of a financial aid package.

Data on federal employees (e.g., postal workers) and the military can be obtained from the Federal Employment Data Exchange System (FEDES). FEDES contains employment records from Office of Personnel Management, U.S. Postal Service, and Department of Defense (Stevens, 2008). Unlike most UI records, data returned from FEDES includes occupational information for individuals in each agency.

Even though workforce and technical skill programs are meant to immediately lead to direct employment, some students will inevitably transfer or remain in higher education. Transfer or retention may be outcomes of interest, but most of the literature eliminates those students from the analysis. Researchers typically use the National Student Clearinghouse to match program participants after they left the institution. The National Student Clearinghouse is a subscription-based database containing enrollment records of over 92% (over 3,200 postsecondary institutions) of postsecondary enrollment. Researchers can match with the National Student Clearinghouse to see what, if any, institutions former program participants enrolled in after leaving.

A fundamental consideration in all education research is whether a program is better than some alternative path. For instance, is completing a workforce program more valuable than dropping out early? Typically the literature defines these as treatment and control groups—or participants and nonparticipants. Under ideal circumstances, researchers could make copies of the same student—one participating in a workforce program while the other does not. Since that is not feasible, researcher must come up with an alternative method to assess these programs.

A popular method is to compare a cohort of completers to a cohort of leavers. Imagine a student who completed some postsecondary schooling and is on the verge of registering for his final year of courses. But there is a choice, does the student go to the college's website and register for a final year of courses or does he search for jobs online? While researchers are not able to see students experience both options, they can get an idea by comparing a cohort of students who chose to register and complete a degree to those that decided to leave.

Theory

Workforce and technical programs are premised on a well-known fact: education improves workforce performance, increases earnings, and lowers the chance for unemployment. Years of Census Bureau data has continually shown that individuals with higher education earn more in the workforce. In 2008, students with a Bachelor's degree earned $1,012 a week, Associate's recipients earned $757 a week, high school graduates earned $618, and those with less than a high school diploma earned $453 a week (Census Bureau, 2008). Moreover, obtaining more education is associated with lower unemployment rates. The yearly unemployment rate ending September 2009 was 8.6% in the United States, college graduates was only 4.5%, compared to 9.1% for high school graduates and 17.5% for those without a high school diploma. Becker's (1964) seminal work on the economics of education presents a theoretical and empirically testable model of the relationship between education and workforce outcomes.

Human capital theory—on which describes the link between education and earnings—predicts educated individuals will earn higher wages. Educated individuals will be more productive since they will be trained to use technology, work more intelligently, and will be able to adapt. For instance, Huffman (1979) showed educated farmers were more adaptive to changes in soil conditions at their farms.

Higher productivity will mean higher wages. More productive workers will make more money for the firm, thus, the firm will be able to pay productive workers more. Human capital theory also predicts participants of workforce and technical skill programs will receive an even higher premium for their education. That is because these programs fall within a category of education called "specific" and "on-the-job" training.

Figure 1 shows the theoretical relationship between a student completing a job training program (completers) and a student leaving early (leavers). At first, completers will need to pay for education while leavers enjoy a reasonable wage. After graduation, completers will see a large increase in wages, hopefully overtaking earnings of leavers. Eventually, earnings will begin to flatten for both groups as the impact of education diminishes.

Workforce and technical skill programs, at the very least, offer training in specific occupations. Many graduates will be highly prepared for these specific occupations, but they are limited in their choices. Thus, as the theory states, these students will require higher wages in order to compensate for their limited set of choices. Firms, meanwhile, will be willing to pay more. Graduates from workforce programs will be less mobile and less likely to change jobs. This longevity is valued by firms who will not need to continually seek replacements.

Training that takes place on job sites are also lucrative for students and employers. So-called "on-the-job" training often teaches students to use highly specialized requirement on job sites. Typically, this equipment is only used by a limited number of companies, thus, students who are familiar with specialized equipment are valuable to these firms. Consequently, firms will be willing to pay a premium to these employees and will hope to retain them in order to reduce the cost of turnover and training. Students, meanwhile, will demand a premium since their technical skills have limited portability.

Research

Most studies utilizing UI records have used descriptive statistics—such as means or medians—as the primary analytical method. Three descriptive statistics have been used in particular: median wage, cumulative change in wages, and annual change in wages. Friedlander (1993a, 1993b) was one of the first to use UI records to match with educational records and report descriptive statistics. Friedlander (1993a) assessed the outcomes of CTE students after they left Santa Barbara City College. The findings showed each major occupational category grew in that timeframe by an average of 24 percent, or otherwise 7.4 percent a year. Those gains, however, differ substantially by major. Wages for graphical arts students grew 40 percent between the first year and third year after graduation.

Friedlander (1996) conducted a similar study of 18 California community colleges. That paper analyzed the difference in earnings for a completer compared to a student who left early. Friedlander showed students completing a degree earned higher wages by the third year after graduation compared to a leaver. Similarly, Laanan (1998) found wages grew quickly after graduation, which varied depending on the program.

Wage growth, however, is only one dimension of workforce outcomes. Multiple studies in California have shown graphic arts/communication students have the largest increase in wages, but mostly because the initial wage was one of the lowest—$14,000. Seppenen (1998) compares the wages levels of completers and leavers to determine which program is most valuable. She finds earnings for students that finished an Associate's degree in Nursing paid 49% more than students who left the program. Meanwhile, the difference in wages for other programs is very small.

Descriptive measures have several advantages. First, they are relatively easy to compute and generally understood by researchers and non-researchers alike. Computing averages and medians are relatively simply, so the task can be quickly completed. Second, some state workforce agencies do not permit individual records to be seen by researchers outside the agency—this depends on the structure within the state and data sharing agreements. These agencies, however, will often return data that is aggregated to show averages and medians.

There are also disadvantages for descriptive statistics. In particular, dollar amounts differ across the country in relationship with cost-of-living. Consequently, it can be difficult to assess the success of programs without being able to compare with similar programs across the nation.

Second, descriptive measures do not incorporate the cost of education. How much more does a completer need to make to justify the education? This information is not readily available in means and medians.

Net Present Value

An ideal measure will incorporate the costs and benefits related to a training program. Recall the scenario of a student deciding whether to register for class or search for jobs. What does the student incur when deciding to finish the degree? Student will face three types of costs: direct costs, time costs, and opportunity costs.

Direct costs are the cash payments required to continue schooling, such as tuition, fees, books, or any other costs directly related to education. It is important to only account for the costs actually paid by the student. For this reason, it's inappropriate to estimate direct costs as the listed tuition prices, since many students may have scholarships or awards which lower the actual direct cost. The actual cost paid by the student may be in a college's financial database. Another alternative is to simply divide total revenues from tuition and fees and divide by the number of students.

Time costs include the psychic nature of delaying an increase in wages. Studies in neuroeconomics suggest that human brains naturally discount money over time (Camerer, Loewenstein, & Prelec, 2005; McClure, Ericson, Laibson, Loewenstein, & Cohen, 2007).

Finally, students leaving early will be able to dedicate themselves toward employment, while students remaining in school must balance both work and school. Therefore, students remaining in school earn less, forgoing higher earnings in the present in order to obtain higher earnings in the future. This notion is referred to as opportunity costs.

Net present value calculates the value of education by accounting for the benfits and cost of completing a degree. Direct costs are simply the average tuition and fees per student. Opportunity costs are the difference in the wages between a completer in his last year and a leaver who is already in the workforce. Time cost is the discount rate (e.g., interest) rate compounded over time. Becker (1964), Levin & McEwan (2001), and Schenk & Matsuyama (2009) provide a fuller discussion of the formula and calculation.

Table 3 shows the net present value calculations from Schenk & Matsuyama (2009), who studied the value of completing a CTE program at Iowa community colleges. The analysis was conducted by aggregating CTE majors into the sixteen career clusters—permitting a robust but succinct analysis.

The net present value for completing a CTE program varied tremendously. The most valuable programs were in science, technology, engineering, and mathematics (STEM) cluster. Completing the program was worth $53,578 for students over the six year period analyzed in the study. Recall, net present value is the excess money the student earns *after* accounting for costs, so STEM programs are worth fifty thousand dollars in profit. Completing programs oriented toward manufacturing, finance, law, construction, and health were also valuable.

Meanwhile, some programs had a negative net present value. For instance, completing a human services program cost students $50,902 over six years. In that instance, wages for completers rarely exceeded the wage for leavers in the program. The high opportunity cost of completing the program and the additional direct and time costs means students do not recoup all of their expenses by completing the program.

Net present value is a more complete measure of outcomes for participants in workforce programs. It provides the dollar value of completing a program after account for the student's costs. At the same time, it can be used to marketing. Health CTE programs in Iowa could promote programs by claiming programs are worth $21,860 to students who decide to complete a degree.

But it can also help researchers and deans determine tuition levels. Note that Iowa's government program graduates lost—on average—$13,315 over six years. What is the motivation for these students to complete a program? They could be incentivized to stay and complete a degree through scholarships or tuition reductions. But how much should those scholarships be worth? Conveniently, the net present value provides that answer. Government CTE students will be fairly compensated by paying $13,315 less a year or be given an equivalent scholarship. Thus, net present value can be called the *compensation differential*—the dollar value that can compensate for changes in behavior.

However, net present value has some disadvantages. Namely, the formula is more complex and takes longer to compute. It is also harder to understand for non-researchers, especially the nuanced interpretation of the compensation differential. Finally, net present value is expressed as a dollar amount, which, as stated before, is difficult to compare between regions and states.

Rate of Return

Rate of return uses a similar formulation to net present value to express the value of completing a workforce program as a percent. The advantage of this, of course, is being able to directly compare returns between various institutions. In addition, early studies exploring the link between education and workforce outcomes expressed the value of education as a percentage—known as the rate of return. These studies have been replicated hundreds of times, which has provided a wealth of comparison across the United States and abroad. The literature has generally found each year of education returns 10 percent to the student (Card, 1999). That is, for every $1 invested, the student receives 10 cents in profit after covering costs.

These figures have also been applied to career and technical programs. Schenk and Matsuyama (2009) found the rate of return for CTE programs fluctuated between -10 percent to +54 percent. Law, STEM, finance, manufacturing, health, and construction programs had the highest rate of return (Table 3). For instance, STEM programs had a 49.1 percent rate of return, indicating each dollar invested in completing a degree returned 49 cents.

Government programs, meanwhile, had a negative rate of return of -17.6 percent. That is, for every dollar invested, a completer will lose 18 cents. Other programs also had negative rates of return, but the precise amount is not calculable. Technically, completers must make more than leavers for at least one year to calculate the rate of return; otherwise, the rate of return is "infinitely" negative. Human services, for instance, has an infinitely negative rate of return, which is consistent with the findings from net present value.

Conclusion

Workforce and technical skill programs are meant to meet workforce needs, so the most sensible approach to assessment is to measure wages after completing the program. Human capital theory has shown and explained the link between education and earnings after graduation. Fortunately, the increased availability of wage data through UI records has permitted a thorough analysis by a number of researchers.

A variety of studies utilizing UI records to study CTE programs has shown most programs lead to higher wage levels, a faster wage growth, higher net present value, and higher rate of return.

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Table 1: Major Classifications of Workforce Programs

Classification of Instructional Programs (2000)	Career Clusters	SOC/O*Net
Agriculture, agricultural operations, and related sciences	Agriculture, food, and natural resources	Architecture and Engineering Occupations
Architecture and related services	Architecture and construction	Arts, Design, Entertainment, Sports, and Media Occupations
Area, ethnic, cultural, and gender studies	Arts, A/V technology, and communication	Building and Grounds Cleaning and Maintenance Occupations
Basic skills	Business, management, and administration	Business and Financial Operations Occupations
Biological and biomedical sciences	Education and training	Community and Social Service Occupations
Business, management, marketing, and related services	Finance	Computer and Mathematical Occupations
Citizenship activities	Government and public administrative	Construction and Extraction Occupations
Communications technologies and support services	Health science	Education, Training, and Library Occupations
Communications, journalism, and related programs.	Hospitality and tourism	Farming, Fishing, and Forestry Occupations
Computer and information sciences and support services	Human services	Food Preparation and Serving Related Occupations
Construction trades	Information technology	Healthcare Practitioners and Technical Occupations
Dental, medical and veterinary residency programs	Law, public safety, corrections, and security	Healthcare Support Occupations
Education	Manufacturing	Installation, Maintenance, and Repair Occupations
Engineering	Marketing, sales, and service	Legal Occupations
Engineering technology	Science, technology, engineering, and mathematics	Life, Physical, and Social Science Occupations
English language and literature/letters.	Transportation, distribution, and logistics	Management Occupations
Family and consumer sciences/human sciences		Military Specific Occupations
Foreign languages, literatures, and linguistics		Office and Administrative Support Occupations
Health professions and related clinical sciences		Personal Care and Service Occupations
Health-related knowledge and skills		Production Occupations
High school/secondary diplomas and certificate programs		Protective Service Occupations
History		Sales and Related Occupations
Interpersonal and social skills		Transportation and Material Moving Occupations
Law, legal services, and legal studies		
Leisure and recreational activities		
Liberal arts and sciences, general studies, and		

humanities
Library science
Mathematics and statistics
Mechanic and repair technology
Military technologies
Multi/interdisciplinary studies
Natural resources and conservation
Parks, recreation, leisure and fitness studies
Personal and culinary services
Personal awareness and self-improvement
Philosophy and religion
Physical sciences
Precision production trades
Protective services
Psychology
Public administration and services
Science technologies/technicians
Social sciences
Theological studies and religious vocations
Transportation and materials moving services
Visual and performing arts

Source: National Center of Education Statistics, Classification of Instructional Programs 2000; State's Career Cluster Initiative; U.S. Department of Labor, Bureau of Labor Services.

Table 2: List of State Agencies Maintain Unemployment Insurance Records

State	Agency
Alabama	Department of Industrial Relations
Alaska	Department of Labor and Workforce Development
Arizona	Department of Economic Security
Arkansas	Department of Workforce Services
California	Employment Development Department
Colorado	Department of Labor and Employment
Connecticut	Department of Labor
Delaware	Department of Labor
District of Columbia	Department of Employment Services
Florida	Agency for Workforce Innovation
Georgia	Department of Labor
Hawaii	Department of Labor and Industrial Relations
Idaho	Department of Labor
Illinois	Department of Employment Security
Indiana	Department of Workforce Development
Iowa	Workforce Development
Kansas	Department of Labor
Kentucky	Office of Employment and Training
Louisiana	Workforce Commission
Maine	Department of Labor
Maryland	Department of Labor, Licensing, and Regulation
Massachusetts	Labor and Workforce Development
Michigan	Department of Energy, Labor, and Economic Growth
Minnesota	Department of Employment and Economic Development
Mississippi	Department of Employment Security
Missouri	Department of Labor and Industrial Relations
Montana	Department of Labor and Industry
Nebraska	Department of Labor
Nevada	Department of Employment, Training and Rehabilitation
New Hampshire	Department of Employment Security
New Jersey	Department of Labor and Workforce Development
New Mexico	Department of Workforce Solutions
New York	Department of Labor
North Carolina	Employment Security Commission
North Dakota	Job Service
Ohio	Department of Job and Family Services
Oklahoma	Employment Security Commission
Oregon	Employment Department
Pennsylvania	Department of Labor and Industry
Rhode Island	Department of Labor and Training

South Carolina	Department of Employment and Workforce
South Dakota	Department of Labor
Tennessee	Department of Labor and Workforce Development
Texas	Workforce Commission
Utah	Department of Workforce Services
Vermont	Department of Labor
Virginia	Employment Commission
Washington	Employment Security Department
West Virginia	Workforce
Wisconsin	Department of Workforce Development
Wyoming	Department of Employment

Source: Career OneStop, www.servicelocator.org/OWSLinks.asp.

Figure 1: Theoretical Wages of Higher Education Leavers and Completers

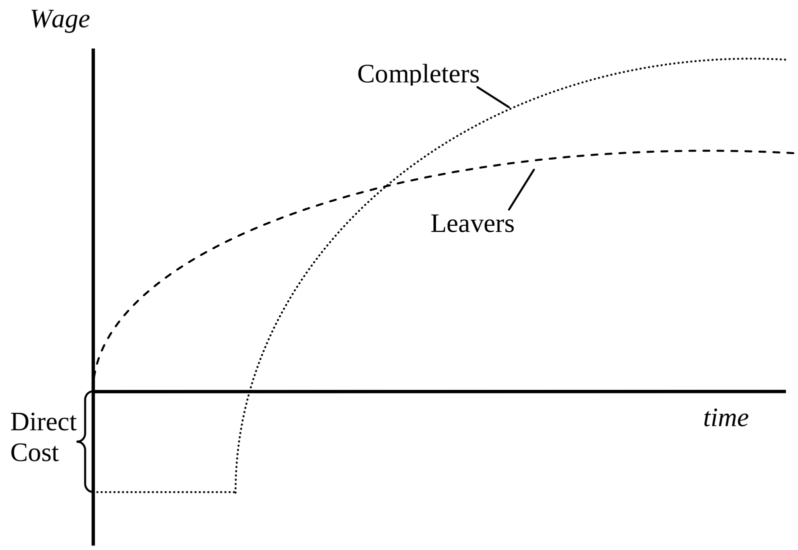

Table 3: Net Present Value and Rate of Return by Career Cluster

Career Cluster	Net Present Value	Rate of Return
Agriculture	-$913	4.6%
Construction	24,563	30.8%
Arts/Comm	-20,702	[1]
Business	-23,407	[1]
Education	-22,168	[1]
Finance	35,450	46.0%
Government	-13,315	-17.6%
Health	21,860	32.9%
Hospitality	-33,237	[1]
Human Services	-50,902	[1]
IT	22,391	26.7%
Law	29,763	53.0%
Manufacturing	35,364	37.8%
Marketing	4,883	12.9%
STEM	53,578	49.1%
Transportation	5,947	12.9%

Note: [1] denotes rate of return calculations did not converge. In all cases, returns were "infinity negative." Source: Schenk & Matsuyama (2009).