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 especially 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.

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. These programs may not lead to a traditional college degree, but a certificate. 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 training which prepares students for a variety of careers (Becker, 1964).

There are a number of ways to evaluate workforce and technical skill programs. One of the most compelling 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.

Numerous studies have attempted to evaluate workforce and technical skill programs using workforce outcomes, specifically, wage data. The studies have primarily used descriptive data, but as this chapter will highlight, it is difficult to render a clear assessment of programs with those metrics. This chapter offers a handful of 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) internal rate of return.

Theoretical Link between Wages and Education

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 2009, students with a Bachelor's degree earned $1,025 a week, Associate's recipients earned $761 a week, high school graduates earned $626, and those with less than a high school diploma earned $454 a week (Bureau of Labor Services, 2010). Moreover, obtaining more education is associated with lower unemployment rates. The yearly unemployment rate in 2009 was 7.9% in the United States, college graduates was only 5.2%, compared to 9.7% for high school graduates and 14.6% for those without a high school diploma.

Human capital theory—on which describes the link between education and earnings—predicts educated individuals will earn higher wages (see Becker, 1964). 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. Consequently, educated farmers could respond better to changing conditions and had higher productivity than less educated farmers.

In other industries, 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.

Data Sets

A significant difficulty of assessment based on workforce outcomes is collecting and organizing the data. Fortunately, assessments utilizing wage data have grown tremendously due to an increasing availability of individual-specific wage data through state administrative records (see Sanchez & Laanan, 1999). 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 architecture to viticulture. 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. As opposed to CIP program areas, the sixteen career clusters is succinct so results can be easily displayed, but broad enough to be descriptive. The State's Career Cluster Initiative website (www.careerclusters.org) contains a crosswalk from CIPs to the sixteen clusters.

Researchers may be quite familiar with various taxonomies for majors, but less familiar with occupational classification schemes. 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. UI records provide earnings for individuals for each quarter Additional elements of UI records contain social security number, 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 (e.g., SOC) 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, which should be noted. 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 (see Porter, 2002). 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? A compelling method to answer this question is to compare a cohort of completers to a cohort of leavers. Suppose a student, who completed some postsecondary schooling, 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. Ideally, students will remain in school and be rewarded over the long-term.

An Example: Assessing CTE Programs at Iowa Community Colleges

All of Iowa's community colleges offer one- and two-year career and technical education (CTE) programs for students. Almost a third of all Iowa community college students are enrolled in CTE programs (Iowa Department of Education, 2011). These programs encourage students to obtain employment in a field related to their study after graduation. Most CTE students are available to enter the workforce after graduation since only 15 percent of CTE completers transferring to a four-year university after graduation. State law even goes so far as to require CTE programs to provide wages that are greater than the cost of the programs themselves. The remainder of this chapter will provide an assessment of these CTE programs using workforce outcomes

[FIGURE 2 ABOUT HERE]

Figure 2 shows the inflation-adjusted median wages between 2002 and 2008 by career cluster—the preferred method of aggregation. Median wages are shown on an *n*-tuple line plot. This style of plot, however, allows an easy comparison when each graph is set on a grid with the same vertical and horizontal axis with minimal clutter.[2]

Wages were obtained from Iowa's UI records. Median wages are shown for completers and leavers. Completers were enrolled in community college in 2002, leavers were enrolled in community college 2001, but entered the workforce in 2002 without completing a degree. Thus, completers spent 2002 in school, but finished at least one degree by the end of the year.

[2] This process is also described as faceting (Wilkinson, 2005) and is available in several advanced statistical software packages. Faceting or *n*-tuple charts can also be manually created with other software such as Excel or Adobe Illustrator.

Meanwhile, leavers had foregone a college degree in favor of entering the workforce early. Ultimately, the analysis will reveal if leaving early was worthwhile or if graduates eventually earn more.

Students—either completers or leavers—were omitted from the data if they continue to enroll in higher education after 2002. Unfortunately, UI records only reveal if students were working in the state. Missing students could have moved outside the state, worked in an industry not covered by the UI database[3], or were not working. Students were omitted if they showed no earnings within an entire year. One exception, though, are completers in 2002 since currently enrolled students may opt not to work, but are known to be enrolled in community college.

Wages are then adjusted for inflation to 2008 levels using the Consumer Price Index-Urban from the Bureau of Labor Statistics. It is important to adjust for inflation[4] since wages will often at least grow with the changes in price levels. Thus, changes in wages over time will resemble the changes in real income.

A number of similar studies have analyzed median wages of leavers and completers (Friedlander, 1993a, 1993b, 1996; Laanan, 1998; Seppenen, 1998). Median wages is the preferred statistic since it is not sensitive to extreme outliers which can be prevalent in wage data.

Median wages were highest for science, technology, engineering, and mathematics (STEM) completers.[5] Most career clusters had higher median wages for completers by 2008, but

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[3] UI records systematically exclude several industries: federal employees, members of the armed forces, the self-employed, proprietors, unpaid family workers, church employees, railroad workers covered by the railroad unemployment insurance, and students employed in a college or university as part of a financial aid package.
[4] Current wages in year *t* are adjusted for inflation from each current year, *t*, to 2008 using:

[5] Government leavers had higher median wages, but the entire group consisted of less than 10 students.

notable exceptions were education, government, human services, and marketing majors. Clearly, the assessment for the latter programs is troubling.

Researchers can also analyze the *gap* between completers and leavers. In this case, health completers had median earnings over seven thousand dollars more than leavers. Law, public safety, corrections, and security had a gap of six thousand, followed by architecture and construction, finance, and arts, A/V, and communications.

But higher median wages for completers is not *sufficient* for a positive assessment. Some programs—business, finance, and IT—only saw higher median wages for completers in the sixth year after graduation. Additionally, it is unclear what constitutes of "good" wage. One could compare median wages for each career cluster to the respective state median wage--$49,007 for Iowa in 2008 (U.S. Census Bureau, 2010). But this comparison is problematic since the state median income includes all ages and education levels. "Sufficient" wages, such as poverty levels are intractably tied to household size—data typically unavailable in administrative records.

Another set of metrics is cumulative and annual change in wages. Both are shown in Figure 2 for completers and leavers.[6] The cumulative and average change was typically higher for completers than leavers in each program. There was also a notable decline in wages between 2007 and 2008 due to the beginning of the 2008-09 recession—justifiably called the Great Recession. Still, these results are inconclusive for assessment since it is difficult to distinguish a "good" from "bad" results. Finance majors, for instance, had higher median wages and a large wage gap, but only saw mediocre wage growth.

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[6] Average annual changes in wages were calculated using the average geometric rate of growth. As opposed to the traditional algebraic rate of growth, the geometric mean is less sensitive to outliers. Specifically, the average growth in wages, *w*, over *t* years until the final year *T* is:

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Descriptive measures often found in the literature often succumb to these basic issues in assessment: clearly identifying satisfactory results. A significant strand of economics literature as eschewed descriptive statistics in favor of calculating the returns to education (e.g., Grubb, 1993; Heckman, Lochner, & Todd, 2005; Kane & Rouse, 1995). This style of research interprets education as a type of investment (e.g., tuition) which provides economic returns (e.g., wages). Insofar as education is a type of investment, the normative claim is the returns from education *should* at least cover the cost of education. This is also practical in the current policy environment where rising tuitions have been heavily critiqued.

But tuition only represents on type of cost—*direct* cost of schooling. The largest cost for students is typically *opportunity* costs, the earnings students forego to continue school. This is commonly represented by the difference in earnings between compelters and leavers.

A third cost of schooling, *time* costs, includes the psychic discounting of earnings over time. Thus, programs are less desirable if they only provide a relative return in later years. Time costs, interestingly, is a natural process that occurs in the brain where short-term rewards are compared with long-term benefits (Camerer, Loewenstein & Prelec, 2005; McClure, Ericson, Laibson, Loewenstein & Cohen, 2007).

Schenk & Matsuyama (2009) describe a method to calculate returns relative to the cost of education using administrative datasets. Two measures, net present value and internal rate of return, provide the net benefit of education by comparing wages earned to direct, opportunity, and time costs.[7] Table 3 shows the results of this analysis for the previously mentioned Iowa CTE wage data.

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[7] Both net present value and internal rate of return are calculated using a similar function for wages, *w*, in each year, *t*, until the final year *T* for completers, *m*, and leavers, *l* with tuition costs *C*

[TABLE 3 ABOUT HERE]

Net present value provides a dollar value, which is the *net* benefit of education over six years by major. We have been able to simplify the stream of earnings between 2002 and 2008 into a single number for each major. Moreover, positive values indicate the wages for completing the program exceeds the costs. Negative values mean the cost of education has not been recouped yet. This simple delineation provides a clear system for accountability.

The net present value itself—besides being positive or negative—can be interpreted as the profit from the investment in education. In this data set, health majors would lose $21,860 in net income by choosing to leave community college before completing a degree. 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.

Net present values are dollar amounts that are easily familiar to most readers. However, even after adjusting for inflation, it can be difficult to compare dollar amounts within nations, states, or providences. The internal rate of return provides essentially the same information as net present value, but expresses it as percentages which can be compared across regions with

Net present value is calculated by assuming an interest rate, *i* and solving. Internal rate of return is found by leaving *i* unknown and finding the root of the resulting polynomial through a multiple iteration technique.

different costs of living. That is, internal rate of returns presents the value of education in a similar fashion a stock portfolio would be described.

The measure is interpreted as the percentage return for each dollar invested. For example, the 49.1% return for STEM programs means a $1 investment returns $0.49 in profit (the original $1 investment would also be returned). The internal rate of return also has the same demarcation between positive and negative values—the former indicates a positive assessment, the latter indicating a negative assessment.

Some internal rate of returns, however, cannot be calculated. Some programs have very few completers who ever earn more than leavers. These students, consequently, never earned enough to cover their costs—not even for a single year. This scenario leads to an infinitely negative internal rate of return. While the exact rate of return is not calculatedly, it is a negative return by definition. In fact, these “infinitely negative” returns are the most troubling result.

Summary

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. Fortunately, this method of analysis has become possible with the emergence of administrative datasets like unemployment insurance records. This chapter explored several methods to assess workforce programs using these data.

Descriptive data has been highly utilized and is relatively simple to calculate. However, it is difficult to assess programs because the criteria in which to assess these programs are unclear. Two other measures of workforce outcomes, net present value and internal rate of return, provides a better set of metrics since it is easier to distinguish between a good outcome versus a negative outcome.

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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

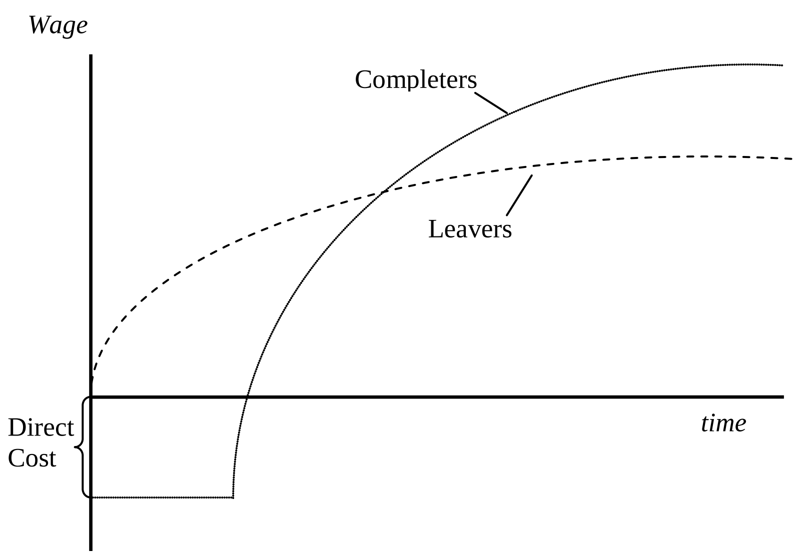

Figure 2: Iowa Community Colleges Median Wages for Completers & Leavers by Career Cluster: 2002-2008

Note: Average annual change is calculated using the geometric average rate of growth formulation. Source: Iowa Department of Education & Iowa Workforce Development (2010).

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

Career Cluster	Net Present Value	Rate of Return
Agriculture & Natural Resources	-$913	4.6%
Architecture & Construction	24,563	30.8%
Arts, A/V & Communications	-20,702	[1]
Business Management & Administration	-23,407	[1]
Education	-22,168	[1]
Finance	35,450	46.0%
Government	-13,315	-17.6%
Health Science	21,860	32.9%
Hospitality	-33,237	[1]
Human Services	-50,902	[1]
Information Technology	22,391	26.7%
Law, Public Safety, Corrections & Security	29,763	53.0%
Manufacturing	35,364	37.8%
Marketing	4,883	12.9%
Science, Technology, Engineering & Mathematics	53,578	49.1%
Transportation	5,947	12.9%

Note: Net present values were calculated using a 3 percent discount rate. [1] denotes rate of return calculations did not converge. In all cases, returns were "infinity negative." Source: Schenk & Matsuyama (2009).