The Economic Contribution of America's Community and Technical Colleges

An Analysis of Investment Effectiveness and Economic Growth

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M. Henry Robison and Kjell A. Christophersen

CCbenefits Inc.
www.ccbenefits.com

1150 Alturas Dr, Suite 102
Moscow ID 83843
Phone: 208.882.3567
E-mail: ccbenefits@moscow.com

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CONCLUSIONS

This analysis of the economic impacts generated by technical and community colleges in the U.S. is based on a sample of 262 colleges in 14 states, representing roughly one-third of the current total enrollment in community and technical colleges in the country. The findings from the sample were used to generate results by inference for the some 1,200 colleges in the United States. Two major analyses are conducted: 1) investment analyses from the perspectives of the students and the taxpayers, and 2) economic growth analysis to determine the relative contribution to GDP by the community and technical colleges. The findings are as follows:

INVESTMENT RESULTS

1. **Students**: The analysis recognizes colleges as a wise investment on the part of students. Compared to their counterpart with only a high school diploma, the typical community or technical college graduate (Associate Degree) will see an increase in annual earnings of over $9,000, or approximately $325,000 over the course of a working lifetime. This figure does not capture a host of other well-documented personal benefits from education, including increased job satisfaction, improved health, and others.

2. **Taxpayers**: The analysis considers community and technical colleges as an investment on the part of state and local government taxpayers. Taxpayers bear roughly 58% of all college costs, and it is important to know what benefits they receive in return for their investment. The analysis translates the economic growth effect of community and technical colleges into increased state and local government revenues (via increased tax receipts). Added to these are an assortment of social savings, e.g., avoided costs stemming from reductions in incarceration, welfare, health care support, and others. Altogether, state and local government support of community and technical colleges proves an investor rate of return equal to 16.2%, well above the 4% opportunity cost of funds. The bottom line: colleges return more to taxpayers than they cost. They not only pay for themselves, but they also provide a surplus that helps support other government programs.

ECONOMIC GROWTH RESULTS

The macro-economic effects of U.S. community and technical colleges are measured using conservative assumptions in this study. Unlike many studies, we net-to-zero impacts stemming solely from college payment of wages and purchases of supplies. We recognize that moneys devoted to funding colleges are diverted from other uses – what the economy gains on one hand, it gives up on the other. The real economic impact of community and technical colleges relates to workforce development, i.e., as newly skilled college-trained workers deepen the national economy's human capital. The result is not just higher wages for students, but greater returns to other factors of production as well. There is increased investment and greater returns to property owners, increased tax revenues, and a host of increased incomes stemming from a collection of additional economy-wide multiplier effects.

1. **Economic growth**: The analysis of the nation's 1,200 community and technical colleges indicates that they annually contribute nearly $31 billion to U.S. economic growth – the figure amounts to roughly 7% of a typical year's national economic growth.

2. **GDP**: Based on historic data on college enrollments and achievements, as well as assumptions regarding worker attrition over time, we estimate that today's workforce actively embodies perhaps 2.2 billion hours of past community and technical college instruction. By applying a per-hour development value to this figure, we estimate that today's national economy owes nearly $621 billion, or some 5.6% of its current GDP to the past and present efforts of the nation's community and technical colleges. This figure is roughly equal to the gross state product of Florida or Illinois. Clearly it is not inaccurate to describe community and technical colleges as engines of economic growth.

CHAPTER 1
INTRODUCTION

OVERVIEW

The purpose of this study is to estimate the economic benefits generated by U.S. community and technical colleges. Of the approximately 1,200 such colleges, the authors of the present study have completed detailed studies on roughly a third of these, or some 400 individual colleges. For the purposes of this study, we used the results from a sub-sample of 262 colleges. The 140 or so colleges excluded from our sub-sample were mainly those completed in the early developmental phase of the project, or shortly thereafter, with results that were judged to be non-comparable with our more recent reports. The 262 colleges in our final sample represent community and technical colleges in 14 different states.

The report has four chapters and 10 appendices. **Chapter 1** is an overview of the benefits measured and the analytical approach. **Chapter 2** presents underlying data, mainly collected from individual colleges, and details on the major assumptions underlying the analysis. **Chapter 3** presents the results of the investment analysis—the returns to students and the taxpayers. In **Chapter 4** we consider the impact of U.S. community and technical colleges on national economic growth. **Appendix 1** is a simple glossary of terms. **Appendix 2** is an extended discussion of the differences between the broad and narrow taxpayer perspective results. **Appendix 3** provides a detailed technical/theoretical explanation of how benefits must be adjusted if the college can still stay open absent state and local government support. **Appendix 4** demonstrates the methods used to determine the alternative education variable—the extent to which the results are affected by the availability of alternative education opportunities. **Appendix 5** explains how the earnings related to higher education data were derived. **Appendix 6** is a short primer on the context and meaning of the investment analysis results—the net present values (NPV), rates of return (RR), benefit/cost ratios (B/C), and the payback period. **Appendix 7** provides the details on the input /output model used in generating the impact results. **Appendix 8** presents detail on the aggregate income effects of community and technical college education. **Appendix 9** presents details on the calculations of the earnings and social benefits. Finally, **Appendix 10** compares independent data sources with our inference from the sample colleges in this study to the total population.

BACKGROUND

The Association of College Trustees (ACCT) contracted with the authors in 1999 to create the model used in this study. The original vision was simple—to make available to community and technical colleges a generic and low cost yet comprehensive and academically defensible tool they could use to estimate the economic benefits generated by their institutions. It makes economic sense for the students to attend college only if their future earnings increase beyond their present investments of time and money. Likewise, taxpayers will only agree to fund colleges at the current levels or increase funding if it is demonstrated that the economic benefits gained from the education exceed the costs.

In response to ACCT's charge, CCbenefits developed the Community College Socio-Economic Impact Model, and in turn used the model to generate roughly 400 community college socioeconomic impact studies. The studies aim to bring to the attention of education stakeholders the economic roles played by community and technical colleges. The model addresses the fundamental student question: will the students be better off attending college or should they just forego additional education and stay employed where they are? And it addresses the fundamental taxpayer question: should taxpayers continue with their investments in the colleges at current levels, or is it in their economic interest to increase or decrease the funding? Along the way, the model addresses the regional economy effects (and in the present report, the national economy effects) of the colleges: to what extent do the colleges increase local and national income, and which sectors of the economy benefit the most?

Studies that aim to measure the economic impact of community colleges are not new, although they are common in scope. Most confine their analyses to the computation of the simple multiplier effects stemming from the annual operation expenditures of the colleges. Although multiplier effects are also a part of the CCbenefits model, they are only a relatively small part. The CCbenefits model also accounts for the economic impacts generated by the workforce effects of community college training, the future economic growth effects, and the effects of past students who are still active in the present day workforce. The CCbenefits model also accounts for a number of external social benefits, such as reduced crime, improved health, and reduced welfare and unemployment. These translate into avoided costs to the taxpayers, and, therefore, affect their decision to invest in the colleges.

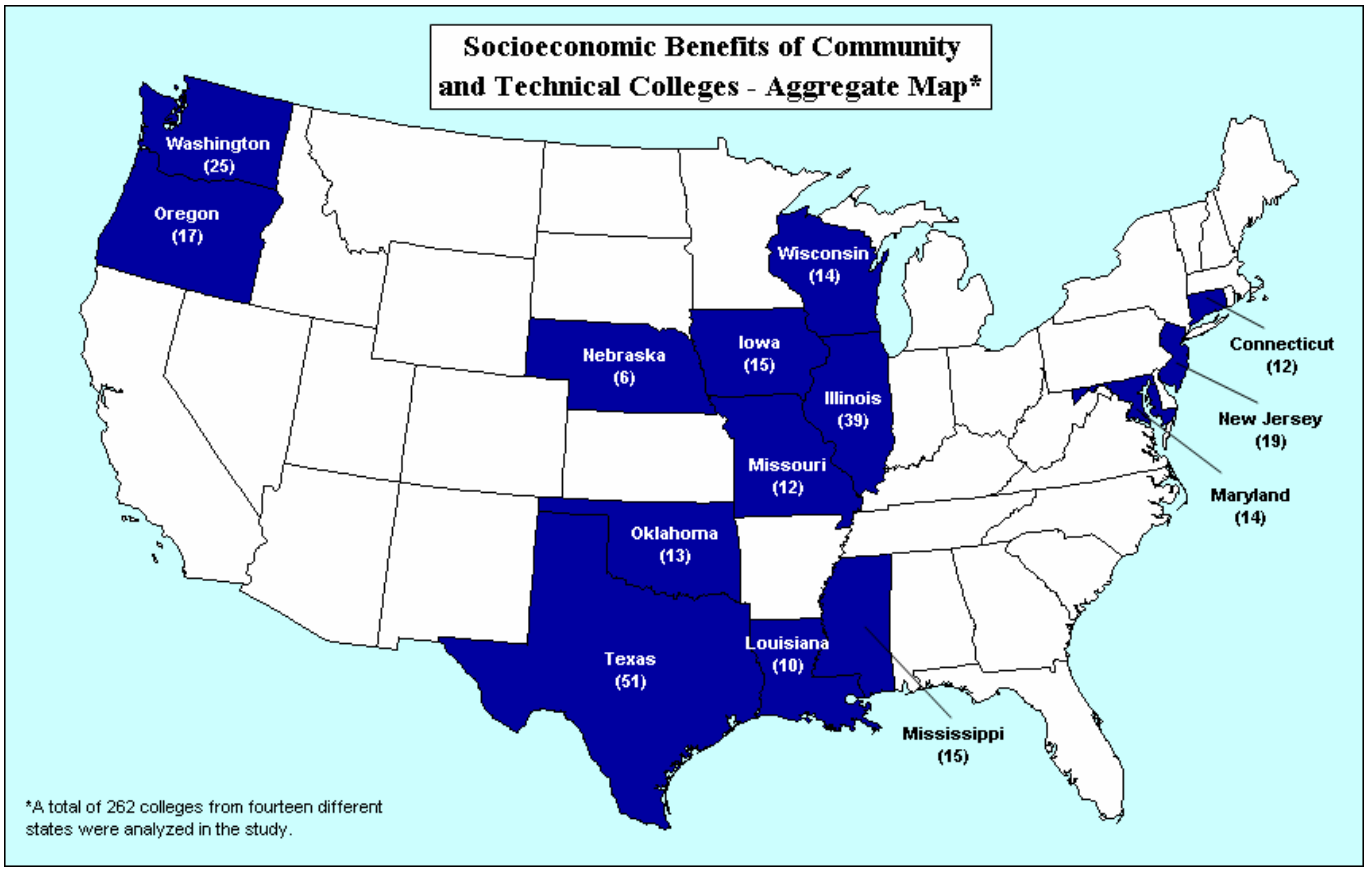
A final note: the analytical approach and results presented in this aggregate national study are discussed in less detail in this report than in the individual college or state aggregate reports we submitted to college and/or state association clients. If needed, the reader is encouraged to contact directly any of the participating colleges to obtain a

full set of reports where the data collection process, the assumptions, and the background data imbedded in the model are laid out in a fully transparent fashion. The list of references provided at the end of this report is the same list used in the individual college reports, although not all of the references may be cited in the present report.

METHODS

To date, CCbenefits has applied the community college socio-economic impact model to roughly 400 individual colleges in the U.S., and another 50 or so colleges in Canada. A college begins the process by assembling data in an electronic form we refer to as the "Starter kit." These data include information on student body characteristics, such as student headcounts, average coursework hours, the age, gender and ethnicity of students, the number of students who work while attending school, their level of education upon entering the college, their achievements during the analysis year, and so on. Also included is spending information, e.g., salaries paid, supplies purchased, whether the supplies are purchased locally or non-locally, and so on. Typically it requires a college three to five person-days of time to supply the data needed for the economic model. CCbenefits blends these individual college data with a myriad other published economic, social and educational data. Some of these are national, some state, and some county-level. The resulting studies present information specific to the participating colleges.

As stated above, the results reported in the present study are based on a 262 college sub-sample of the approximately 400 colleges in the CCbenefits' U.S. college data set. The results from the 262 college sample were used to infer results for the entire U.S. technical and community college system comprised of some 1,200 colleges. Data from the U.S. Department of Education's National Center for Education Statistics allowed us to judge the relative weights applied in inferring from the sample to the population. The map below shows the states included in the sample—most of the community and technical colleges in all of these states participated in the study: Washington, Oregon, Wisconsin, Nebraska, Oklahoma, Texas, Illinois, Iowa, Missouri, Louisiana, Mississippi, Maryland, New Jersey, and Connecticut.



Overview of Estimated Effects

Community and technical colleges in the United States generate a wide array of benefits. Students benefit directly from higher personal earnings, and society at large benefits from economic growth, and from cost savings (avoided costs) associated with reduced welfare and unemployment, improved health, and reduced crime. Higher education requires a substantial investment by students, and by taxpayers through their community and technical college support. All education stakeholders—taxpayers, legislators, employers, and students—want to know if they are getting their money's worth. In this study, results for the 262 colleges studied by CCbenefits are used to indicate the attractiveness of the returns community and technical colleges generate relative to alternative public investments. The benefits are presented in three ways: 1) annual benefits, 2) present values of future annual benefits (rates of return, benefit/cost ratios, etc.), and 3) national economy benefits in terms of economic growth and impact on particular industries.

Annual Private and Public Benefits

Private benefits are the higher earnings captured by the students; these are well-known and well-documented in economics literature (see for example Becker, 1964 and Mincer 1958, plus many others listed in the references at the end of this report). Less well-known and documented are the indirect benefits, or what economists call *positive externalities*, which are a collection of public benefits captured by society at large, such as improved health and lifestyle habits, lower crime, and lower incidences of welfare and unemployment. These stem from savings to society as taxpayer-provided services are reduced. We estimate dollar savings (or avoided costs) from reduced arrest, prosecution, jail, and reform expenditures based on published crime statistics arranged by education levels. Likewise, statistics that relate unemployment, welfare, and health habits to education levels are used to measure other savings. The annual economic impacts are presented in two ways: 1) per credit-hour equivalent (CHE), defined as a combination of credit and non-credit attendance,[1] and 2) in the aggregate (nationwide).

Present Values of Future Benefits

The annual impacts continue and accrue into the future and are quantified and counted as part of the economic return of investing in education. This lifetime perspective is summarized as *present values* – a standard approach of projecting benefits into the future and discounting them back to the present. The approach allows us to express the benefits occurring incrementally (every year) in the future in present value terms so that they can be compared with the costs incurred in the present. The present value analysis determines the economic feasibility of investing in college education—i.e., whether the present value of future benefits outweigh the costs. The time horizon over which future benefits are measured is the retirement age (65) less the average age of the students weighted by their total achievements (CHEs).[2]

The present values are also expressed in four ways: 1) net present value (NPV) total and per CHE, 2) rate of return (RR) where the results are expressed as a percent return on investment, 3) benefit/cost (B/C) ratio—the returns per dollar expended, and 4) the payback period—the number of years needed to fully recover the investments made (see **Appendices 1** and **6** for a more detailed explanation of the meaning of these terms).

[1] Instruction hours are not the same as credit hours. Colleges prepare people both for jobs and for degrees. Many attend for short periods and then leave to accept jobs without graduating. Others simply enroll in non-academic programs. Nonetheless, the CHEs earned will positively impact the students' lifetime earnings and social behavior.

[2] Retirement at age 65 is only our assumption. In some areas people retire earlier, in others later. Whether they retire at 62, 65, or 67, this will not change the magnitudes of the results by much. The assumption only affects the time horizon over which the analysis is conducted.

Economic Growth Effects

The benefits of a robust economy are many: jobs, increased business revenues, greater availability of public investment funds, and eased tax burdens. The educational activities of U.S. community and technical colleges benefit U.S. businesses directly by raising the skill level of the labor force. Trained employees are associated with a broad range of national economic externalities, including, in particular, a positive, well-recognized yet hard-to-track impact on new invention and innovation. Individual businesses benefit from increased efficiency and enhanced competitiveness. At the regional level, agglomeration and economic spread and linkage effects add still more to positive economic impact from the education produced by the colleges.

In this study we show the impact of U.S. community and technical colleges as a creator of earnings in the U.S. economy. Increased earnings are displayed by industrial sector (for the purposes of this report, we employ the major divisions of the Standard Industrial Classification system [SIC], which includes all industrial and service sectors). The role that U.S. community and technical colleges play in the U.S. economy is then indicated by the percentage of sector-by-sector earnings explained by the colleges. In general, these college-linked earnings fall under two categories: 1) earnings generated by the annual operating and capital expenditures of the colleges; and 2) earnings attributable to the college skills embodied in the workforce. At the national level, however, the first of these effects, the earnings generated by the annual operating and capital expenditures of the colleges, is netted out to zero. As explained in **Chapter 4**, the reason for this netting to zero is that the moneys to operate the colleges all come at the expense of some other use – in effect, what is gained on one hand is lost on the other. Our national economic effects are therefore, entirely generated by at the earnings attributable to the college skills embodied in the national workforce.

CHAPTER 2
DATA SOURCES AND ASSUMPTIONS

OVERALL PROFILE OF COLLEGES

To the extent possible our individual college models are outfitted with in-house (from the colleges themselves) or otherwise published data. In those cases where hard data are not available, college institutional researchers or financial officers are asked to apply best judgments on the basis of their intimate knowledge of the colleges and student bodies.

Faculty, Staff, and Operating Budgets

We estimate that community and technical colleges in the U.S. provide annual employment to approximately 278,000 full-time and 357,000 part-time faculty and staff. Their combined annual payrolls exceed $18 billion (see **Table 2.11** further below).

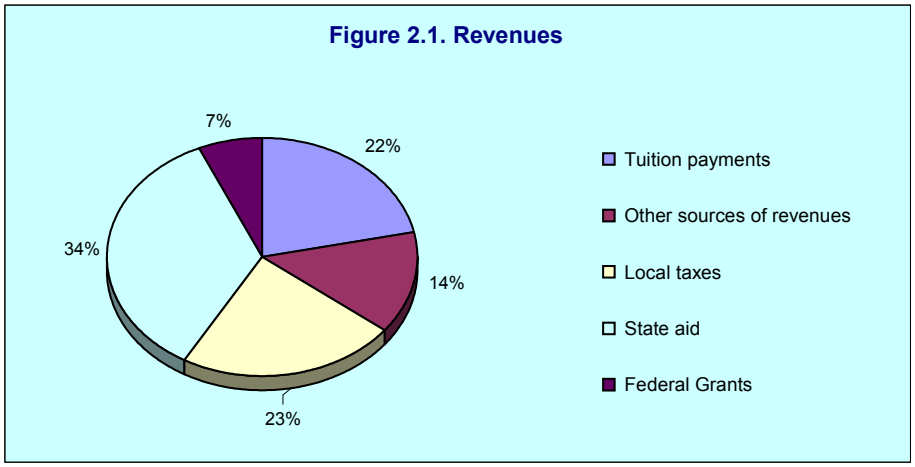
Table 2.1 shows the annual revenues by funding source: combined annual operating, capital and auxiliary budgets of roughly $32.2 billion.[3] Two main revenue sources—private and public—are indicated. Private sources include tuition and fees, 21.5%, plus 14.0% from other private sources (such as contract revenues, interest payments and the like). Public funding is comprised of local taxes, 22.7%, state aid, 35.1%, and federal grants, 6.7%. These budget data are critical in identifying the annual costs of educating the college student body from the perspectives of the students and the taxpayers alike. The same information is displayed in **Figure 2.1** in the form of a pie chart.

Table 2.1. Combined Annual Operating,Capital and Auxiliary Budgets ($ '000)

Sources	Revenues	Total	% of Total
Private Funding			
Tuition payments	$6,946,320		21.5%
Other sources of revenues	$4,504,969	$11,451,000	14.0%
Public Funding			
State & Local taxes			
Local taxes	$7,321,277		22.7%
State aid	$11,302,769	$18,624,046	35.1%
Federal grants	$2,170,745	$2,170,745	6.7%
Total		$32,245,791	100%

Source: Data supplied by the subsample of U.S. colleges, with inference to the overall U.S. community and technical college population.

[3] In assembling their input data sets, individual colleges are asked to "annualize" their capital spending, or otherwise provide an estimate indicative of a representative year.



The Students

Students attend community and technical colleges for different reasons: to prepare for transfer to four-year institutions, to obtain Associate Degrees or Certificates in professional/technical programs, to obtain basic skills, or perhaps to take refresher courses or participate in non-credit programs**.** Students also leave for various reasons—they may have achieved their educational goals or decided to interrupt their college career to work full-time**. Tables 2.2** and **2.3** provide a summary profile of U.S. community and technical college students. The estimated unduplicated student body headcount of credit students is roughly 8.6 million, while that of non-credit students is some 7.7 million.

Also shown in **Table 2.2** are the student employment patterns. Some students forego earnings entirely while attending college while others may hold full- or part-time jobs. Information about student employment plays a role in determining the *opportunity cost* of education incurred by the students while attending the colleges.[4] In **Table 2.2**, the rows labeled "Students employed while attending college (%)" and "Full-time earning potential (%)" provide the percentage estimates of the students who held jobs (53%) while attending college, and how much they earned (48%) relative to full-time employment (or what they would statistically be earning if they did not attend college). The former is a simple percent estimate of the portion of the student body working full- or part-time. The latter is a more complex estimate of their earnings relative to their earning power if they did not attend college (i.e., recognizing that several students may hold one or more part-time jobs that pay minimum wage).

[4] The opportunity cost is the measure of the earnings foregone; i.e., the earnings the individual would have collected had he or she been working instead of attending college.

The last five items in **Table 2.2** are *settling-in* factors—the time needed by students to settle into the careers that will characterize their working lives. These factors are adapted from Norton Grubb (see the source reference in the table). Settling-in factors have the effect of delaying the onset of the benefits to the students and to society at large. Thus, we assume that for transfer track students, the earnings benefits will be delayed for at least 2.5 years to account for the time spent subsequently at four-year colleges.

Table 2.3 shows the percentage breakdown of the student body by gender and ethnicity and entry level of education. Accordingly, we estimate that 3.6% of all U.S. community and technical college students were white males who entered college with less than a high school diploma or GED, while 0.9% of all students were minority females who entered with more than an Associate's Degree. Column sums show the percentage of all students by gender and ethnicity.

Table 2.2. Student Body Profile

		Values
Total headcount of unduplicated credit students		8,614,841
Total headcount of unduplicated non-credit students		7,654,192
Total unduplicated enrollment, all campuses		16,269,032
Enrollment on campus for which analysis is carried out	100%	16,269,032
Students employed while attending college (%)		53%
Full-time earning potential (%)		48%
Students remaining in the U.S. after leaving college		100%
Thirty-year attrition rate (leaving the U.S. workforce)		20%
"Settling In" factors (years):		
Completing Associate Degree		2.0
Completing Certificate		0.5
Non-completing transfer track		2.5
Non-completing workforce		0.0
ABE/ESL/GED		0.5

Sources: Student profile data supplied by the college subsample with inference to the entire U.S. community and technical college population. Settling-in factors adapted from Norton Grubb, *The Economic Benefits of Sub-Baccalaureate Education*, CCRC Brief No. 2, ISSN 1526-2049 (New York, NY: Community College Research Center, June 1999).

Table 2.3. Distribution of Students by Ethnicity, Gender and Entry-Level of Education

	Male		Female		
Education Level	White	Minority	White	Minority	Total
< HS/GED	3.6%	1.6%	3.7%	1.6%	10.5%
HS/GED equivalent	11.9%	5.8%	14.9%	7.5%	40.1%
One year post HS or less	6.5%	1.4%	7.9%	2.1%	17.9%
Two years post HS or less	5.8%	1.4%	7.8%	2.0%	17.0%
> Associate Degree	5.9%	0.7%	6.9%	0.9%	14.4%
Total	33.8%	11.0%	41.1%	14.1%	100.0%

Source: Computed internally by the analytical model based on data supplied by the subsample of U.S. community and technical colleges, with inference to the entire U.S. college population.

The Achievements

Table 2.4, along with **Figure 2.2,** shows the overall breakdown of U.S. community and technical college students in terms of academic pursuits and/or achievements during the analysis year. There are six student categories altogether: 1) retirees and/or court-required students, 2) Associate Degree completers, 3) Diploma and Certificate completers, 4) all transfer students, 5) workforce students plus all other non-credit students, and 6) ABE/ESL/GED students. An analytical submodel estimates the change in the distribution of the student body between the initial year and the beginning of the analysis year to account for stopouts and other such parameters that characterize how typical students progress over time in their college career.

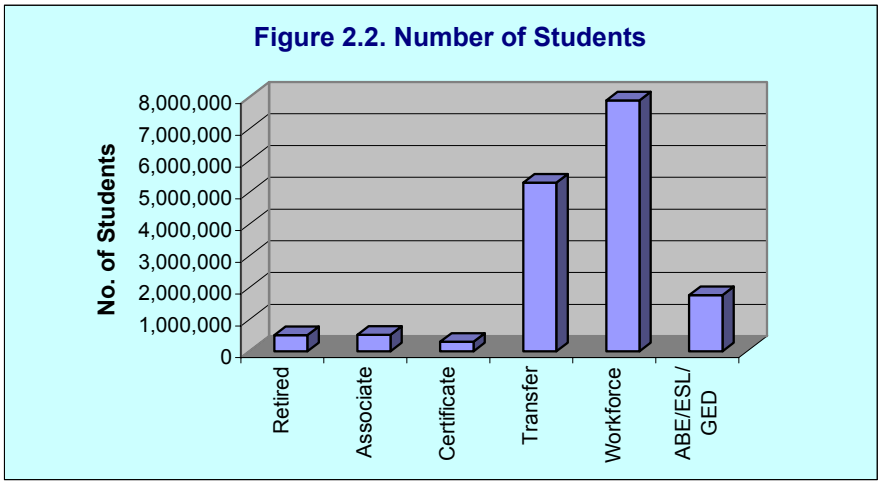
Table 2.4. Levels of Achievement

Student Body Category	Student Distribution	Headcount Credit and Non-Credit	Avg. Age*	CHEs This Year**	Total CHEs	# Years Attend.
Retired and court-required students	3.1%	501,940	66	5.6	2,825,019	0.2
Completing Associate Degree	3.1%	511,295	28	18.6	9,516,975	0.6
Completing Certificate	1.8%	295,377	31	17.2	5,067,841	0.6
Transfer track	32.6%	5,302,883	26	12.6	66,909,089	0.4
Workforce and all other non-credit students	48.5%	7,896,782	33	7.3	58,002,250	0.2
ABE/ESL/GED	10.8%	1,760,756	31	6.3	11,108,923	0.2
Total or weighted averages	100.0%	16,269,032	29.2	9.6	153,430,096	

** Note:* The weighted averages for student age and CHEs per year do not include the retired students.

*** Note:* A total of 30 credits is required for one full-time year equivalent of study.

Source: Computed internally by the analytical model based on data supplied by the subsample of U.S. colleges, with inference to the entire U.S. community and techincal college population.



As indicated in **Table 2.4**, students achieving their graduation goals would be those completing Associate Degrees or Certificates (3.1% and 1.8%, respectively). The majority of students complete college credits, and either fulfill their educational needs or return the following year to continue to work toward their goals (32.6% + 48.5% = 81.1% in the transfer track and workforce categories, respectively). The retired and leisure students (3.1%) and ABE/ESL/GED students (10.8%) complete the breakdown of the student

body. The retired students are simply backed out of the analysis altogether on the assumption that they do not attend college to acquire skills that will increase their earnings. ABE/ESL/GED students are assumed to have a lower percentage impact than other students, because the end product of their education is to arrive at the "starting gate" on an equal basis with others. This does not mean that ABE/ESL/GED education has lower value; it simply means that these students must complete an extra step before they can compete effectively in the job market and reap the benefits of higher earnings.[5]

The fourth column shows the average age of the students generating the benefits (excluding retirees). The time horizon for the analysis is 36 years, which is the difference between the average age (29.2 years) and retirement age (65 years). As indicated in Column 5, the average Associate Degree and Certificate student completed 18.6 and 17.2 CHEs of study, respectively, during the analysis year. The total number of CHEs completed during the analysis year for the entire U.S. community and technical college student body is 154.4 million. Finally, the last column shows the average time the students are actually in attendance during the analysis year. This information is needed to determine the opportunity cost of their education (or the time they would otherwise have been working and earning wages).

GROSS PRIVATE BENEFITS (INCREASED EARNINGS)

Table 2.5 and **Figure 2.3** are constructed from national data and point to the effect of schooling on employee earnings. The data become an important part of our basis for estimating the student earnings benefits reported below in **Chapters 3** and **4. Table 2.5** indicates that earnings are highly correlated with education. Correlation, however, does not necessarily mean causation. Higher education is not the only factor explaining the private and public benefits reported in the statistics. Other variables such as ability, family background, and socioeconomic status play significant roles. Not taking these other factors into account results in what is often termed an "ability bias" in benefit estimates. The *simple correlation* between higher earnings and education nonetheless defines the *upper limit* of the effect measured. Our estimates of higher education's impact on earnings are based on a survey of recent econometric studies. A literature review by Chris Molitor and Duane Leigh (March, 2001) indicates that the upper limit benefits defined by correlation should be discounted by 10%. Absent any similar research for the social variables (health, crime, and welfare and unemployment), we assume that the same discounting factor applies as well to the public benefits.

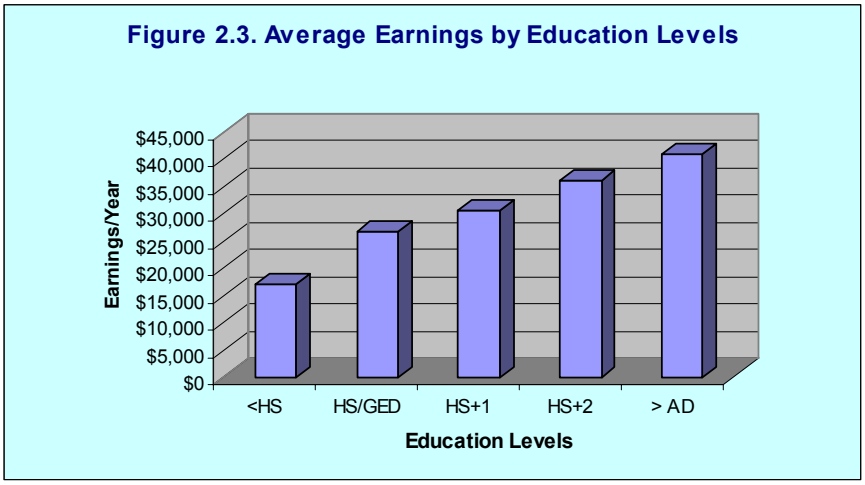
[5] The economic value attributable to the educational achievements of ABE/ESL/GED students is assumed to be roughly 39% (relative to a 100% attribution for other students), based on the case studies completed by CCbenefits, Inc. to date.

As education milestones are achieved, students move into higher levels of average earnings. **Table 2.5** shows average earnings by one-year education increments. The differences between the steps are indicated in the last column. We assume that *all* education has value, and therefore attribute value to students completing less than full steps as well. Specific detail on data sources and estimating procedures for **Table 2.5** is found in **Appendix 5**.

Table 2.5. Weighted Average Earnings

Entry Level	Average Earnings	Difference
One year short of HS/GED	$16,947	NA
HS/GED equivalent	$26,620	$9,673
One-year Certificate	$30,745	$4,125
Two-year Associate Degree	$35,979	$5,234
One year post Associate Degree	$41,061	$5,082

Source: Computed from data supplied by the U.S. Census Bureau, weighted to reflect the specific gender and ethnicity profile of the student body.



GROSS ANNUAL PUBLIC BENEFITS

As shown in **Table 2.5,** students benefit from community and technical college education through higher earnings. As will be shown in **Chapter 3** below, higher student earnings translate into higher gross domestic product (GDP), and the public benefits from the added tax revenues collected as a result.

Society benefits in other ways as well. Higher education is associated with a variety of lifestyle changes that generate savings (e.g., reduced welfare and unemployment, improved health, and reduced crime). Note that these are *external* or *incidental* benefits of education (see box). Colleges are created to provide education, not to improve health or reduce crime, welfare and unemployment. The fact that these incidental benefits occur

and can be measured, however, is a bonus that enhances the economic attractiveness of the college operations. It should not be taken to mean that taxpayers should channel more money to colleges on the strength of these external benefits. Our purpose is simply to bring to the attention of education stakeholders that the activities of the colleges impact society in many more ways than simply the education they provide. In so doing, we have identified and measured some social benefits obviously related to educational achievements and included them in the mix of impacts generated by the college.

Assuming state and local taxpayers represent the public, the public benefits of higher education can be gauged from two perspectives, 1) a *broad* perspective that tallies all benefits, and 2) a *narrow* perspective that considers only changes in the revenues and expenditures of the state and local government.

An adjustment to our gross benefit estimates must be made to account for three factors: 1) the ability bias discussed above,[6] 2) the alternative education variable (see the glossary in **Appendix 1** as well as **Appendix 4** for a more detailed explanation of what we mean by the alternative education variable), and, 3) the level at which a college may still operate absent all state and local government support (see **Appendix 3**).

The Beekeeper Analogy

The classic example of a positive externality (sometimes called "neighborhood effect") in economics is that of the private beekeeper. The beekeeper's only intention is to make money by selling honey. Like any other business, the beekeeper's receipts must at least cover his operating costs. If they don't, he will shut down.

But from society's standpoint there is more. Flower blossoms provide the raw input bees need for honey production, and smart beekeepers locate near flowering sources such as orchards. Nearby orchard owners, in turn, benefit as the bees spread the pollen necessary for orchard growth and fruit production. This is an uncompensated external benefit of beekeeping, and economists have long recognized that society might actually do well to subsidize positive externalities such as beekeeping.

Colleges are in some ways like the beekeepers. Strictly speaking, their business is in providing education and raising people's incomes. Along the way, however, external benefits are created. Students' health and lifestyles are improved, and society indirectly benefits from these just as orchard owners indirectly benefit from the location of beekeepers. Aiming at an optimal expenditure of public funds, the CCbenefits model tracks and accounts for many of these external benefits, and compares them to the public cost (what the taxpayers agree to pay) of college education.

Higher Incomes

Broad Perspective: Higher education accelerates general economic growth. The economy generates more income (both labor and property income) than it would without the college skills embodied in the labor force. From the broad taxpayer

[6] As indicated earlier, gross benefits are adjusted downward by 10% based on the work of Molitor and Leigh (March, 2001).

perspective, the total increase in national income is counted as a benefit of the community and technical college education – reduced to account for the several factors such as the ability bias discussed above.

Narrow Perspective: Higher national income translates into higher state and local *tax collections*. Under the narrow taxpayer perspective, we count only the estimated higher state and local taxes that will be collected from the increase in GDP.

Health Savings

The improved health of students generates savings in three measurable ways: 1) lower absenteeism from work, 2) reduced smoking, and 3) reduced alcohol abuse (see **Table 2.6** and **Figures 2.4** through **2.6** below). In general, statistics show a positive correlation between higher education and improved health habits. **Table 2.6** shows the calculated reductions in the incidences of smoking and alcohol abuse as a function of adding higher education – reduced to account for the several factors such as the ability bias discussed above.

Broad Perspective: The benefits from reduced absenteeism are equal to the average earnings per day multiplied by the number of days saved (less the students covered by the alternative education variable and other factors as discussed above). These are benefits that accrue largely to employers. Smoking and alcohol-related savings accrue mostly to the individuals who will *not* have to incur the health-related costs. In the broad taxpayer perspective, however, these benefits accrued to employers and individuals are also public benefits.

Narrow Perspective: Taxpayers benefit from reduced absenteeism to the extent that the state and local government is an employer. Accordingly, we assume a taxpayer's portion of absenteeism savings according to their portion of overall national employment.[7] As for smoking and alcohol-related savings, the taxpayers benefit to the extent that state and local health subsidies (to hospitals, for example) are reduced.

Table 2.6. Reduced Absenteeism, Smoking, and Alcohol Habits

	Absenteeism		Smoking		Alcohol Abuse	
Education Level	Days	%/Year	Average	Reduction	Average	Reduction
< HS/GED	8.7	3.3%	29.6%	NA	9.5%	NA
HS/GED equivalent	7.0	2.7%	27.2%	8.0%	8.9%	6.5%
One year post HS or less	6.1	2.3%	25.1%	7.9%	8.3%	6.5%
Two years post HS or less	4.8	1.9%	21.4%	14.5%	7.3%	11.9%
> Associate Degree	4.2	1.6%	19.2%	10.6%	6.7%	8.7%

Sources: Computed from data supplied by the Bureau of Labor Statistics, U.S. Department of Labor; National Center for Health Statistics, "Table 61: Age-adjusted prevalence of current cigarette smoking," in *Health, United States, 2001* (Hyattsville, MD, 2001)

[7] The ratio of state earnings over total earnings in the United States (Regional Economic Information System—REIS, Bureau of Economic Analysis, U.S. Department of Commerce, 1998).

Figure 2.4. Days of Absenteeism by Education Levels

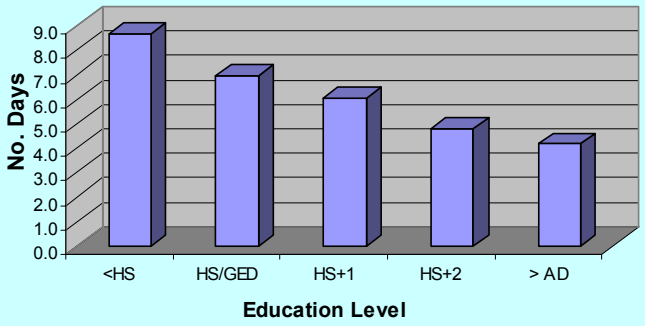


Figure 2.5. Average Incidence of Smoking by Education Levels

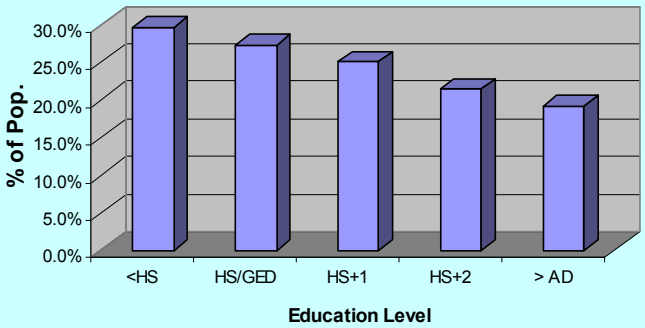
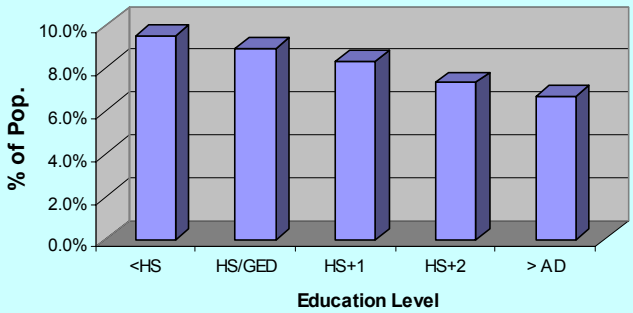


Figure 2.6. Average Incidence of Alcohol Abuse



Crime Reduction Benefits

Table 2.7 and **Figure 2.7** relate the probabilities of incarceration to education levels—incarceration drops on a sliding scale as education levels rise.[8] The implication is, as people achieve higher education levels, they are statistically less likely to commit crimes. The difference between before and after the education achievement (multiplied by the average cost per year) comprises the upper limit of the benefits attributable to education.

We identify three types of crime-related expenses: 1) the expense of incarceration, including prosecution, imprisonment, and reform, 2) victim costs, and 3) productivity lost as a result of time spent in jail or prison rather than working. As with our other social statistics, crime-related expenses are reduced to account for alternative education opportunities, ability bias, etc.

Broad Perspective: From the broad taxpayer perspective, all reductions in crime-related expenses are counted as a benefit (less reduction factors as above).

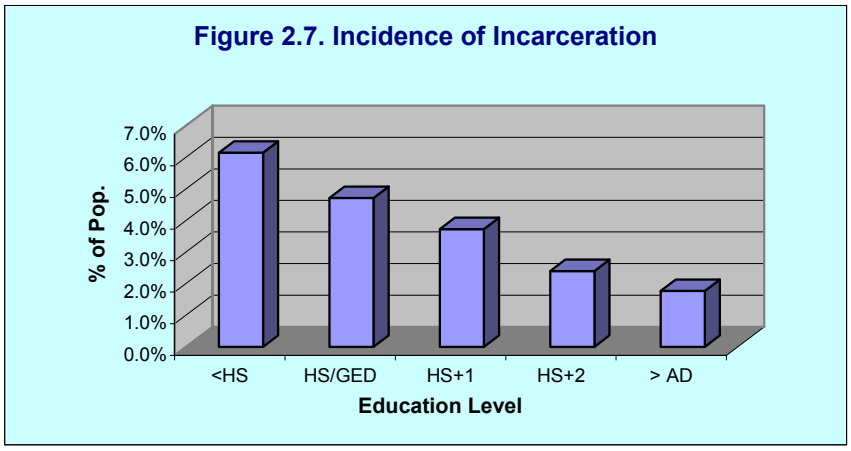
Narrow Perspective: We assume that nearly all of the incarceration savings accrue to the taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to the potential victims, not to the taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our "composite" state and local government average tax rate to the added productivity of persons *not* incarcerated to arrive at the taxpayer benefits.

Table 2.7. Incarceration Rates

Education Level	Average	Reduction
< HS/GED	6.1%	NA
HS/GED equivalent	4.7%	23.3%
One year post HS or less	3.7%	21.0%
Two years post HS or less	2.4%	35.6%
> Associate Degree	1.8%	26.2%

Sources: Computed from data supplied by the National Center for Education Statistics, *Literacy Behind Prison Walls* (Washington, D.C.: U.S. Department of Education, 1994); Thomas P. Bonczar and Alan J. Beck, *Lifetime Likelihood of Going to State or Federal Prison* (Washington D.C.: U.S. Department of Justice, 1997); Bureau of Justice Statistics, "Table 1: State (1) average annual pay for 2000 and 2001 and percent change in pay for all covered workers (2)" (Washington, D.C.: U.S. Department of Labor, Criminal Justice Expenditure and Employment Extracts Program, 2000).

[8] See also Beck and Harrison: http://www.ojp.usdoj.gov/bjs/abstract/p00.htm.



Welfare and Unemployment Reduction Benefits

Higher education is statistically associated with lower welfare and unemployment. **Table 2.8** and **Figure 2.8** relate the probabilities of individuals applying for welfare and/or unemployment assistance to education levels (linked to the gender and ethnicity profile of the aggregate student body). As above, all welfare and unemployment savings are reduced to account for alternative education opportunities, etc.

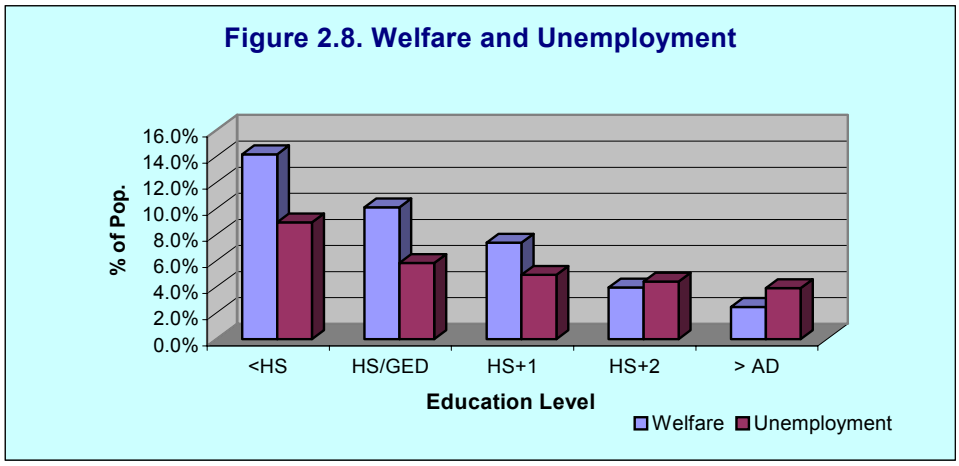
Broad Perspective: Reduced welfare and unemployment claims multiplied by the average cost per year are counted in full as benefits in the broad taxpayer perspective.

Narrow Perspective: Taxpayer benefits from reduced welfare are limited to the extent to which the state and local taxpayers subsidize the welfare system. None is claimed for unemployment, because none of these costs are borne by the state and local taxpayers.

Table 2.8. Welfare and Unemployment

	Welfare		Unemployment	
Education Level	Average	Reduction	Average	Reduction
< HS/GED	14.2%	NA	8.9%	NA
HS/GED equivalent	10.1%	28.7%	5.8%	34.8%
One year post HS or less	7.4%	26.8%	4.9%	15.6%
Two years post HS or less	3.9%	46.6%	4.4%	10.5%
> Associate Degree	2.5%	37.7%	3.9%	11.2%

Sources: Computed from data supplied by the Temporary Assistance for Needy Families (TANF) Program, "Table 12: Percent distribution of TANF adult recipients by race" and "Table 17: Percent distribution of TANF adult recipients by educational level" in *Characterisitics and Financial Circumstances of TANF Recipients* (Washington D.C.: U.S. Department of Health and Human Services, May 1999); Robert Rector, *Means-Tested Welfare Spending: Past and Future Growth* [database on-line] (Heritage Foundation, March 2001).



COSTS

There are two main cost components considered in the analytic framework: 1) the cost incurred by the student, including the expenses for tuition and books, and the opportunity cost of his or her time (represented by the earnings foregone while attending college) and, 2) the cost incurred by state and local government taxpayers, which is part of the colleges' operating, auxiliary activities and capital costs (see **Table 2.1**). These are briefly discussed below.

Opportunity Cost of Time

The opportunity cost of time is, by far, the largest cost. While attending college, most students forego some earnings, because they are not employed, employed only part-time, or, as is often the case, employed at jobs that pay less than would be possible if they were not attending school. For the non-working students, the opportunity cost is the full measure of the incomes not earned during their college attendance. For students working part-time, the opportunity cost is the difference between what they could make full-time less what they are making part-time, and the estimated dollar value of the leisure time given up. For students working full-time, the only opportunity cost of time charged is for the value of the leisure time given up.[9] The specific opportunity costs shown in **Table 2.9** are based on the particular profile of U.S. community and technical college students as displayed in **Table 2.4**, and the associated earnings potentials (by education levels) given in **Table 2.5**, although with some important modifications, as briefly described below:

[9] Elementary consumer theory presents a tradeoff between income and leisure (e.g., Henderson and Quandt, 1971). Students able to work full- or part-time while attending college maintain all or part of their incomes, but give up a significant amount of their leisure time. Failing to impute value to the leisure foregone would underestimate the cost of attending the college. We assume an hourly value of leisure time equal to one-third the hourly value of wages.

- The earnings in **Table 2.5** are averages based on trajectories of earnings for all ages, from 17 to 65 (roughly defining the time spent engaged in the workforce).
- The average earnings, therefore, define the midpoint of a working life trajectory that begins with low entry-level wages and culminates with a typical worker's highest wages around age 60.[10] The earnings data shown in **Table 2.5** are U.S. earnings, but weighted to reflect the specific gender and ethnicity makeup of the aggregate U.S. community and technical college student body. Details on earnings and education sources are found in **Appendix 5**.
- The opportunity cost of time is then conditioned by the average age of the student (29.2 years in **Table 2.4**).

Table 2.9. Opportunity Costs (Earnings Foregone), $ per Year

			Opp. Cost
Average statistical annual income of given gender and ethnicity profile		$31,055	
Annual income, given gender and ethnicity profile, at current age of students		$20,040	
CHEs per student (net of retired)	9.6		
% of full year in attendance and earnings foregone while attending	32%	$6,381	
Total number of students		16,269,032	
Less retired students, %	3.1%	501,940	
Remaining students subject to opportunity cost computation		15,767,092	
Students not working while attending college and opportunity cost	47%	7,414,200	$47,308,314,000
Number of working students	53%	8,352,892	
Earnings relative to statistical averages (%) and opportunity cost	48%	$3,301	$27,574,413,000
Value of Leisure time (at 1/3 working time)	20%	$1,276	
Value of Leisure time forgone			$10,659,578,000
Total opportunity cost (gross)			$85,542,305,000
Pell and other student aid		$3,701,019,102	
Restricted portion of student aid (tuition and fees)	56%	$2,067,591,228	($1,633,428,000)
NET TOTAL STUDENT OPPORTUNITY COST			$83,908,877,000

Sources: Computed from data supplied by the subsample of U.S. colleges with inference to the overall U.S. community and technical college population. See also the U.S. Census Bureau. See also James Henderson and Richard E. Quandt, *Microeconomic Theory: A Mathematical Approach* (New York: McGraw-Hill Book Company, 1971).

The Budget

Beyond the student perspective, our assessment of the community and technical colleges in the aggregate considers the benefits and costs from the state and local government taxpayer perspective. Accordingly, only the state and local government revenues in **Table 2.1** are included as costs in the investment and benefit/cost assessment. All else being equal, the larger the other revenue sources in **Table 2.1** are (i.e., federal grants, student tuition, and contract revenues) relative to state and local government revenues,

[10] This profile of lifetime earnings is well documented in labor economics literature. For example, see Willis (1986), which is supported by the well-respected theoretical and empirical work of Becker (1964) and Mincer (1958).

the larger the relative economic payback to state and local taxpayers will be. As described in **Appendix 3,** our analytic framework recognizes a level of college operations absent state and local government funding, and reduces benefits attributable to that amount of operations.

OTHER ASSUMPTIONS

Table 2.10 lists several other assumptions imbedded in the analytic model: 1) the discount rate and time horizon;[11] 2) crime-related costs (incarceration costs that are inclusive of the cost per prison year plus all costs associated with arrest, investigation, trial and incarceration); 3) welfare and unemployment costs per year;[12] and 4) health-related costs.[13] The alternative education opportunity assumption is discussed later in this chapter in association with the regional economic impacts. See also **Appendix 4**.

Table 2.10. Miscellaneous Variables

	Variables
Discount rate	4.0%
Time horizon, years to retirement	35.8
Average cost per prison year (arrest, trial, incarceration, rehab. etc.)	$77,178
Average length of incarceration (total years)	4.0
Average victim cost	$ 85,000
Average cost per welfare year	$ 75,138
Average duration on welfare (total years)	4.0
Average cost per unemployment year	$ 36,249
Average duration on unemployment (total years)	4.0
Smoking-related medical costs per year	$ 2,962
Alcohol-related medical costs per year	$ 7,946
Alternative education opportunities	14.0%

Sources: Bureau of Justice Statistics, "Table 1: State (1) average annual pay for 2000 and 2001 and percent change in pay for all covered workers (2)" (Washington, D.C.: U.S. Department of Labor, Criminal Justice Expenditure and Employment Extracts Program, 2000); Office of International Criminal Justice (OICJ), "The Extent and Costs of Victimization, Crime and Justice," *The Americas* (Dec-Jan 1995); Robert Rector, *Means-Tested Welfare Spending: Past and Future Growth* [database on-line] (Heritage Foundation, March 2001); U.S. Department of Treasury, *The Economic Costs of Smoking in the United States* , Report-3113 (Washington, D.C., 1998); National Center for Health Statistics, "Health Promotion and Disease Questionnaire of the 1990 National Health Interview Survey"; National Institute on Drug Abuse, *The Economic Costs of Alcohol and Drug Abuse in the United States* , (Bethesda, MD: National Institute of Health, 1998).

[11] See **Appendix 6** for a more in-depth discussion of the discount rate.
[12] As indicated in the table, we assume that the average duration on welfare and unemployment is 4.0 and 4.0 years, respectively. This means that, over the next thirty years or so, the cumulative incidence of welfare and/or unemployment will be spread evenly over the time horizon—it is not a consecutive period.
[13] The incarceration, health, welfare and unemployment probability, and cost variables are internal to the analytic model.

NATIONAL ECONOMIC GROWTH AND DEVELOPMENT BENEFITS

In general, the national economy is affected by the presence of the community and technical colleges in two ways: from their day-to-day operations (including capital spending), and from students who enter the workforce with increased skills. Day-to-day operations of the colleges provide the direct jobs and earnings of the faculty and staff, and additional indirect jobs and earnings through the action of regional multiplier effects. At the same time, the presence of college-trained past and present students in the national workforce deepens the economy's stock of human capital and generally increases incomes and output.

In the case of college operation and capital spending, it is important to deduct the impact of funds (both public and private) that are spent to support the college and are thus unavailable for other uses. In this national aggregate report, we ultimately reduce to zero the net economic effect of college operations and capital spending, thus leaving only human capital effects. The reason for such an adjustment is described in greater detail in **Chapter 4**.

Estimating the several national economic effects requires a number of interrelated models. Multiplier effects are obtained with a U.S. input-output (IO) model.[14] Estimating college operations effects requires an additional model that takes college expenditures and bridges these to the sectors of the IO model. The offsetting effect of moneys withdrawn from the national spending stream to support colleges is also estimated using the IO model.

Estimating the human capital, skill-enhancing effect of past students on the national economy entails five basic steps:

1. Estimate the number of past students still active in the workforce.
2. Adjust for alternative education opportunities, ability bias and the level of education possible absent state and local government support.

[14] The economic impact model is constructed using data purchased from Economic Modeling Specialists, Inc. and EMSI input-output (IO) modeling software (Moscow, ID: 2002). This software employs a standard regional-purchase-coefficient (RPC) non-survey IO modeling technique, similar to that used in constructing the Utah Multiregional IO (UMRIO) model (Governor's Office of Planning and Budget et al. [Salt Lake City, UT: Demographic and Economic Analysis, 1994]), the Idaho Economic Modeling Project (IDAEMP) (M. H. Robison, R. Coupal, N. Meyer, and eds [Moscow, ID: University of Idaho, College of Agriculture, 1991]), the Oregon Economic Modeling System (OREMS) (M. H. Robison, Proceeding at the 29th Annual Pacific Northwest Economic Conference [Missoula, MT: 1995]), models chronicled for small areas (see M. H. Robison, "Community Input-Output Models," *Annals of Regional Science* 31 no.3 [1997]: 325-351), IMPLAN models constructed using IMPLAN IO modeling software (Stillwater, MN: Minnesota IMPLAN Group, annual) and "Regional IO models" (RIO models) constructed by Rutgers University, Center for Urban Policy Research (New Brunswick, NJ: Rutgers University, 2002).

3. Estimate the increased earnings of the students still active in the national workforce.
4. Estimate the effect of college trained workers on the productivity of other factors (e.g., capital, land, unskilled workers, etc.), and account for associated income increases to those factors.
5. Allocate the direct increase in national income to affected economic sectors, and augment these to account for associated multiplier effects.

The end results include estimates of the impact of past student skills and increased productivity on: 1) the size of national industries, and 2) the size of the overall national economy.

This section is divided into a number of subsections. The first documents our estimation of day-to-day college operations effects, followed by sections that detail the steps necessary to estimate the effect of past student skills on the regional economy.

The Impact of College Operations

Estimating the gross impact of college operations and capital spending requires detailed information of the specific breakdown of that spending. In the course of assembling the data needed for our individual college economic impact studies, colleges are asked to supply data on their gross spending and then to break these down into local and non-local portions. For this national aggregate, we assume all spending occurs in the nation. The aggregate collection of college spending, i.e., our estimate of the specific spending by all U.S. community and technical colleges appears in **Table 2.11** – total spending comes to over $32 billion nationally.

The gross effect of offset spending, i.e., the moneys spent on colleges rather than elsewhere, is estimated by simply removing the like amount of total spending ($32 billion) from the household sector of the U.S. national IO model.

Table 2.11. Profile of Community and Technical College Spending ($ '000)

Spending Categories	Total Dollar Amount (1)	% of all Spending (2)
Salaries, Wages, and Benefits	$18,337,425	57%
Telephone	$165,622	1%
Electricity and Natural Gas	$582,513	2%
Water Supply and Sewerage Systems	$60,119	0%
General Merchandise Stores	$2,867,761	9%
Building Materials and Gardening Supplies	$580,865	2%
Maintenance and Repair Construction	$818,634	3%
New Construction	$1,502,131	5%
Services to Buildings	$219,553	1%
Travel	$298,255	1%
Eating and Drinking	$134,563	0%
Marketing	$165,210	1%
Shipping and Postal	$125,860	0%
Printing and Publishing	$321,298	1%
Accounting, Auditing and Bookkeeping	$49,470	0%
Banking and Credit Agencies	$735,806	2%
Legal Services	$62,430	0%
Insurance	$866,837	3%
Other Business Services	$1,932,604	6%
Rental Property	$444,690	1%
Unemployment Compensation	$33,201	0%
Household Income	$1,941,232	6%
Total	$32,246,080	

Source: Computed internally by the model based on data supplied by the subsample of U.S. community and technical colleges, with inference to the entire U.S. college population.

Estimating CHEs Embodied in the Present-Day Workforce

One of the more elaborate steps in assembling our individual college analyses is estimating their human capital effect on host regional economies. This section describes the submodel we use to collect the individual college data and estimate the ultimate effect of past college instruction embodied in the present-day workforce. **Table 2.12** shows the various steps in the calculation, outfitted with aggregate data for the entire collection of U.S. community and technical colleges.[15] Considering **Table 2.12** one column at a time reveals the steps involved in estimating embodied CHEs.

Column 1 provides an estimate of the enrollment history (unduplicated headcount) of all U.S. community and technical college students. Column 2 represents the non-retired students, in other words, the students who have the potential to go into the workforce. Column 3 is the same as Column 2, but net of students who leave the region immediately upon leaving the colleges. As shown in the table, for this national aggregate analysis we assume 100% of the students remain in the U.S. upon leaving the colleges.

[15] That is, aggregate data as collected from our sub-sample with inference to the entire 1,200 U.S. community and technical college population.

Table 2.12. Estimating CHEs of Instruction Embodied in the Workforce

Year	Student Enrollment Headcount 1	Subtract Retired Students 2	Subtract Students Migrating Immediately 3	Students Who Have Left College (Leavers) 4	Leavers Who Have Settled Into Jobs 5	# Settled Into Jobs - Active in the Workforce 6	Average CHEs 7	CHEs Embodied in the Workforce 8	Assumptions: % of Students in Workforce 9	Assumptions: "Settling-In" Factor 10	Assumptions: Active in Workforce 11
1974	5,227,293	5,066,018	5,066,018	5,066,018	5,066,018	4,052,815	9.6	38,712,000	100%	100%	80.0%
1975	6,129,693	5,940,576	5,940,576	5,940,576	5,940,576	4,787,942	9.6	45,734,000	100%	100%	80.6%
1976	6,022,189	5,836,389	5,836,389	5,836,389	5,836,389	4,739,090	9.6	45,267,000	100%	100%	81.2%
1977	6,294,286	6,100,091	6,100,091	6,100,091	6,100,091	4,990,193	9.6	47,666,000	100%	100%	81.8%
1978	6,282,968	6,089,123	6,089,123	6,089,123	6,089,123	5,018,409	9.6	47,935,000	100%	100%	82.4%
1979	6,618,864	6,414,655	6,414,655	6,414,655	6,414,655	5,326,169	9.6	50,875,000	100%	100%	83.0%
1980	7,107,976	6,888,677	6,888,677	6,888,677	6,888,677	5,762,459	9.6	55,042,000	100%	100%	83.7%
1981	7,408,872	7,180,289	7,180,289	7,180,289	7,180,289	6,051,239	9.6	57,801,000	100%	100%	84.3%
1982	7,530,133	7,297,810	7,297,810	7,297,810	7,297,810	6,196,197	9.6	59,185,000	100%	100%	84.9%
1983	7,491,214	7,260,091	7,260,091	7,260,091	7,260,091	6,210,193	9.6	59,319,000	100%	100%	85.5%
1984	7,253,396	7,029,611	7,029,611	7,029,611	7,029,611	6,057,935	9.6	57,865,000	100%	100%	86.2%
1985	7,308,874	7,083,377	7,083,377	7,083,377	7,083,377	6,149,843	9.6	58,742,000	100%	100%	86.8%
1986	7,636,636	7,401,026	7,401,026	7,401,026	7,401,026	6,473,601	9.6	61,835,000	100%	100%	87.5%
1987	7,949,458	7,704,197	7,704,197	7,704,197	7,704,197	6,789,093	9.6	64,848,000	100%	100%	88.1%
1988	8,183,801	7,931,310	7,931,310	7,931,310	7,931,310	7,041,409	9.6	67,259,000	100%	100%	88.8%
1989	8,781,468	8,510,538	8,510,538	8,510,538	8,510,538	7,612,057	9.6	72,709,000	100%	100%	89.4%
1990	9,123,382	8,841,903	8,841,903	8,841,903	8,841,903	7,967,482	9.6	76,104,000	100%	100%	90.1%
1991	10,036,828	9,727,167	9,727,167	9,727,167	9,727,167	8,830,637	9.6	84,349,000	100%	100%	90.8%
1992	10,375,534	10,055,423	10,055,423	10,055,423	10,055,423	9,196,791	9.6	87,846,000	100%	100%	91.5%
1993	10,305,397	9,987,450	9,987,450	9,987,450	9,987,450	9,202,820	9.6	87,904,000	100%	100%	92.1%
1994	10,483,418	10,159,979	10,159,979	10,159,979	10,159,979	9,431,689	9.6	90,090,000	100%	100%	92.8%
1995	10,686,199	10,356,504	10,356,504	10,356,504	10,356,504	9,685,904	9.6	92,518,000	100%	100%	93.5%
1996	10,997,333	10,658,038	10,658,038	10,658,038	10,658,038	10,042,332	9.6	95,923,000	100%	100%	94.2%
1997	11,401,976	11,050,197	11,050,197	11,050,197	11,050,197	10,489,570	9.6	100,195,000	100%	100%	94.9%
1998	11,547,945	11,191,662	11,191,662	11,191,662	11,191,662	10,703,174	9.6	102,235,000	100%	100%	95.6%
1999	12,214,969	11,838,107	11,838,107	11,838,107	11,838,107	11,405,927	9.6	108,948,000	100%	100%	96.3%
2000	13,610,857	13,190,928	13,190,928	13,190,928	13,190,928	12,804,246	9.6	122,304,000	100%	100%	97.1%
2001	14,070,062	13,635,965	13,635,965	13,629,062	12,266,156	11,995,476	9.6	114,579,000	100%	90%	97.8%
2002	14,983,087	14,520,822	14,520,822	14,194,103	10,645,577	10,488,383	9.6	100,184,000	98%	75%	98.5%
2003	16,269,032	15,767,092	15,767,092	13,402,028	6,701,014	6,701,014	9.6	64,007,000	85%	50%	100.0%
Embodied Total								2,217,980,000			

Sources: Computed from data supplied by the subsample of U.S. colleges, with inference to the entire U.S. community and technical college population. For Columns 7 and 11, see Tables 2.4 and 2.2, respectively.

A comparison of Columns 3 and 4 indicates that all past students have left the colleges except for the last three years (2000-2003) when students were still enrolled (the leaver assumptions are shown in Column 9) at the time of our original analyses. Column 5 further reduces leavers to focus only on those who have settled into a somewhat permanent occupation. As shown in Column 10 (the "settling factor"), it is assumed that all students settle into permanent occupations by their fourth year out of school.

Column 6 transitions further from leavers who have settled into jobs to leavers still active in the current workforce. Here we net off workers who, subsequent to leaving the colleges and settling into the local workforce, have either retired or died. We assume that 20% of current students will retire or die over the course of thirty years, and apply an appropriately calibrated "thirty-year attrition profile" following an assumed logarithmic decay function shown in Column 11.

Column 7 shows the average CHEs generated per year back to 1974. In general, colleges indicate a lack of historic information on this variable, and we resort to assuming the current year (i.e., the analysis year) estimate applies though time. There is good reason

to believe this assumption likely puts a downward bias on our estimates,[16] and our resulting workforce embodied CHE estimate might accordingly be viewed as conservative.

Column 8 shows the product of the year-by-year average CHEs, and the estimate of the number of past students active in the current workforce in Column 6. Looking to the total in Column 8, we estimate that the current U.S. workforce embodies some 2.2 billion CHEs of past community and technical college instruction.

SUMMARY

This chapter has presented the broader elements of our U.S. community and technical college database and some of the key assumptions needed to estimate that data. In general, our data come from 4 sources, 1) published national data, 2) published local data including data specific to the funding and operations of particular community and technical colleges, 3) data based on the best judgments of college institutional researchers and financial officers and 4), our own operating assumptions based on similar studies and common sense.

Our individual college studies include a chapter on the sensitivity of results to changes in key judgment variables that were determined either by us or by the institutional researchers and financial officers at the college. Our modeling framework can be judged robust since the results are not very sensitive to relatively large changes in the judgment variables.

Additional detail on data sources, assumptions, and the general methods underlying our analyses are conveyed in the remaining chapters and appendices. The core of our findings is presented in the next two chapters – **Chapter 3** looks at colleges as an investment, while **Chapter 4** considers their role in national economic growth. The appendices detail a collection of miscellaneous theory and data issues.

[16] The reason is that the role of U.S. community and technical colleges has changed over the years from primarily serving transfer students to a greater focus on workforce students. Inasmuch as transfer students are more likely than workforce students to be full-time, our estimated average CHEs per student will understate the actual historic average.

CHAPTER 3
INVESTING IN COMMUNITY COLLEGES: BENEFITS AND COSTS FROM A SINGLE YEAR'S OPERATIONS

INTRODUCTION

This chapter considers community and technical colleges as an investment from the perspectives of two important stakeholders: students and state and local government taxpayers. Five important measures of college performance are presented: 1) annual private and public benefits; 2) future benefits expressed as present values; 3) student and taxpayer investment benefit/cost ratios; 4) rates of return on student and taxpayer investments, and 5) payback periods on initial investments.

As described in **Chapter 1**, our approach in this study was to take the findings of a sample of 262 community and technical colleges studied by CCbenefits, and infer from these results to the entire population of approximately 1,200 colleges in the country. Data obtained from the U.S. Department of Education's National Center for Education Statistics indicates that enrollment at the community and technical colleges in our sample accounted for roughly one-third of overall enrollment at the 1,200 U.S. community and technical colleges. Our inferences for the entire collection of colleges are simply drawn by multiplying the findings from the 262 colleges by a factor of three. For measures involving relative amounts, e.g., average credits per student per year, we assume that the 262 college sample is representative of the entire 1,200 college population.

ANNUAL BENEFITS

Our investment analysis focuses on the effects of a single year of college operations.[17] We focus first on the annual benefits with the summary of our estimates presented in **Table 3.1**. The table has four columns: 1) higher student earnings; 2) the impact on the U.S. Gross Domestic Product (GDP) (See **Appendix 1**, Glossary of Terms); 3) the unit measures for the assortment of incidental social benefits (such as impact on health, crime, and welfare/unemployment benefits), and 4) associated social savings expressed in dollar terms.

[17] When we apply the CCbenefits model to a given community college we do so for a given "analysis year." The specific year is chosen by the college, and usually refers to the most recent year for which they have fully audited data. The analysis years represented in our 262 college sub-sample range from as early as 2001 to as recent as 2003. The analysis in the present report assumes that the results obtained from this mix of years are generally representative of present-day college operations.

Table 3.1. Summary of Estimated Average Annual Benefits ($'000)

	Student Benefits	Public Benefits		
	Earnings	US GDP	Units	Social Savings
Higher Earnings	$20,926,079	NA	NA	NA
Economic Growth	NA	$30,751,124	NA	NA
Health Benefits				
Absenteeism savings (days)	NA	NA	6,606,000	$724,281
Fewer smokers, medical savings (# persons)	NA	NA	31,400	$93,162
Fewer alcohol abusers (# persons)	NA	NA	50,900	$404,657
Crime Benefits				
Incarceration savings (# persons)	NA	NA	71,400	$755,688
Crime victim savings	NA	NA	NA	$832,277
Added productivity (fewer incarcerated)	NA	NA	NA	$334,112
Welfare/Unemployment Benefits				
Welfare savings (# persons)	NA	NA	188,000	$760,784
Unemployment savings (# persons)	NA	NA	66,300	$556,061
Total	$20,926,079	$30,751,124	NA	$4,461,022

Source: Computed from data supplied by Tables 1 through 15 in Appendix 9: Detailed Tables.

Higher Student Earnings

As indicated in **Table 3.1**, we estimate that each year community and technical colleges increase annual student earnings by an average aggregate amount of $21 billion.[18] Our estimates are based on the accumulated instruction provided by the colleges, as well as statistics showing the effect of education on earnings. Additional details on our estimating methods are found in **Appendix 5.**

Economic Growth (U.S. GDP)

Employers would not hire educated workers and pay higher wages if doing so were not profitable. Educated workers earn more because businesses earn more by hiring them. The students earn more because the skills learned at the community or technical college makes them more productive. Importantly, as they apply their new skills, capital (buildings, machinery and everything else) is also made more productive and profits and other property income increase.[19] Together, the combined labor and capital income effect might be considered the *direct income effect* of a skilled workforce.

[18] Students are rewarded for their education with higher incomes now and into the future, generally for as long as they remain active in the workforce. At the same time, research indicates that the gap between educated and non-educated workers grows through time and the income increment from schooling grows as well. The annual increase in student earnings shown in **Table 3.1** refers to the middle of a student's career. We would expect, therefore, a somewhat smaller figure in the years immediately following our single year of college operations, and a larger figure in the latter part of the students' careers.

[19] In the production process, skilled labor and capital complement each other (in technical language, they have a relatively low elasticity of substitution). Accordingly, an increase in skilled labor will increase the

There are also *indirect effects*. Educated workers have higher incomes and therefore more money to spend on consumer goods. At the same time the businesses that employ the higher skilled workers produce more, which in turn, requires an increase in inputs and input spending. The effect of these two spending items (consumer spending and business spending) is to increase overall income in the economy, which leads to still more spending and more income creation, and so on. The sum total of these several rounds of spending effects constitute the indirect income effects of a skilled workforce. Estimating these indirect effects requires a specialized economic model.[20]

The total economic growth effect of community and technical colleges is obtained as the sum of the direct and indirect income effects. As shown in **Table 3.1**, we estimate that a representative year of community and technical college operations annually adds nearly $31 billion to the U.S. Gross Domestic Product (GDP).

Social Savings

Statistics on the behavioral effects of education are relatively abundant and generally indicate positive changes as incidental (or external) effects of education. Also relatively abundant are data on the social costs of behaviors, e.g., the costs of treating alcoholism or dealing with crime. By combining these data sets we are able to measure a reduction in social costs as a by-product of education. The several items of social savings shown below are all calculated in this manner—relating incremental increases in education to improved social behavior. Additional details on our calculations and methods appear in **Appendix 9**.

Health-Related Savings

Table 3.1 shows annual savings from health-related issues. Health-related absenteeism from work will decline by approximately 6.6 million days per year, resulting in an annual average savings of otherwise lost productivity equal to nearly $725 million. There will also be roughly 31,000 fewer smokers, with an annual average savings to society of some $93 million. Finally, there will be nearly 51,000 fewer alcohol abusers, providing an annual average social savings of nearly $405 million.

productivity and income of existing capital, and encourage additional capital investment. Additional detail on the aggregate income effects of community and technical college education appears in **Appendix 8**.

[20] The indirect effects, sometimes called "multiplier effects," estimated in this study relied on an input-output model, the "EMSI-IO model," developed by Economic Modeling Specialists, Inc. of Moscow, Idaho. Details on the EMSI-IO model appear in **Appendix 7**.

Crime-Related Savings

Because of a single year of community and technical college operations, we estimate that there will be some 71,400 fewer people incarcerated at some point in their lives, resulting in average annual savings as follows: roughly $756 million in direct incarceration savings, $832 million in savings to otherwise would-be crime victims, and some $334 million in added productivity, i.e., persons working who would otherwise be incarcerated. As before, additional details on our calculations appear in **Appendix 9**.

Welfare and Unemployment Savings

As shown in **Table 3.1**, one year's operation of the nation's community and technical colleges results in an estimated average annual reduction in people on welfare and unemployment in the United States of approximately 188,000 and 66,000 respectively. The corresponding annual dollar savings amounts to nearly $761 million for welfare and over $556 million in unemployment savings. See **Appendix 9** for additional detail.

Total Social Savings

All told, we estimate that a year's operation of the nation's community and technical colleges annually generate nearly $4.5 billion in public savings (avoided costs)–the sum of all health, crime, and welfare/unemployment benefits.

ANNUAL BENEFITS PER CHE AND PER FULL-TIME STUDENT

To get a different perspective on the results, the aggregate benefits reported in **Table 3.1** are expressed in **Table 3.2** on per CHE and per full-time student bases. The upper two rows of the table refer to student benefits. The remainder of the table summarizes the public benefits, with the bottom row showing total public benefits.

Table 3.2. Annual Benefits Per CHE and Per Student*

	Per CHE	Per full-time Student
Increased Student Earnings, **gross**	$139	$4,168
Increased Student Earnings, **after tax**	$94	$2,835
Public Benefits		
National GDP Growth	$200	$6,013
Absenteeism Savings	$5	$140
Medical Cost Savings	$3	$100
Incarceration Savings	$5	$150
Crime Victim Savings	$6	$170
Added Productivity	$2	$70
Welfare Savings	$5	$150
Unemployment Savings	$4	$110
Total Public Benefits	$230	$6,903

* *Note:* The annualized values exclude benefits from retired students.

Source: Computed from data supplied by Table 2.4 and Tables 1 through 15 in Appendix 9: Detailed Tables.

As indicated in the first row, the annual average income of community and technical college students in the U.S. increases roughly $139 for every hour of credit or non-credit instruction they complete. The $139 figure is "gross earnings," e.g., the gross figure that might appear on a student's pay stub. The "after tax" figure is shown as $94, e.g., the figure that might appear on the student's actual paycheck.[21]

For the public benefits, **Table 3.2** indicates that an hour of instruction adds an average $200 per year to national GDP. The other "social benefits" shown are mainly avoided social costs. These range from $2 per CHE in added productivity from individuals who are gainfully employed and would have otherwise statistically been incarcerated, to roughly $6 per CHE from crime victim savings. All told, each hour of community and technical college instruction creates $230 in annual public benefits.

The second column in **Table 3.2** expresses the results on a full-time-equivalent (FTE) basis. We assume that an FTE student takes the equivalent of 30 credit hours of class work per year. On average, a full-time year of study rewards a student with $4,168 in higher annual income. It also increases national GDP by $6,013, and provides other social benefits as indicated in the table. The total of all social benefits, economic growth plus social savings, provides an annual figure of $6,903. These results are all annual averages of benefits that will accrue for years into the future, for at least as long as the students remain in the workforce.

WHO BENEFITS MOST FROM EDUCATION, THE STUDENTS OR THE PUBLIC?

A currently hotly debated question and obviously fundamental issue in higher education funding is this: Who benefits most from education, the students or the public? The view popular in many circles is that the students do, yet the results presented in **Table 3.2** would indicate otherwise. Because the money students pay in taxes does not benefit the student as such, but rather the taxpaying public, the appropriate figure for judging student benefits is increased earnings after-tax (shown in the second row in **Table 3.2**).

Total public benefits are shown in the bottom row of **Table 3.2**. The comparison can now be made: students benefit from one CHE of community and technical college attendance with a $94 annual increase in their after-tax earnings. At the same time, however, public benefits from that same hour of instruction sum to approximately $230 in added annual GDP growth and assorted social savings per CHE. The public benefits

[21] The federal tax adjustment is based on the nationwide federal rate on personal incomes. The state rate is based on a national average that includes state personal income taxes, as well as individuals' share of state sales taxes and state fees. The local rate is similarly computed, based on national averages that include individuals' share of local sales taxes, local property taxes, and local fees.

from community and technical college education are more than double the associated student benefits. Contrary to conventional wisdom, therefore, the public stands to benefit far more from the education produced by the colleges than the students.

THE INVESTMENT ANALYSIS: INCORPORATING FUTURE BENEFITS

The next step is to project the annual benefits into the future and discount them back to the present in accordance with standard investment analysis principles. The present values of the benefits are then compared to the college costs to derive our investment analysis results. The average annual benefits generated by the nation's 1,200 community and technical colleges estimated in **Tables 3.1** and **3.2** are instructive of college performance per year. To conduct the investment analysis, however, we also need the following: 1) data on the cost of instruction, both to the students and to the taxpayers, and 2) the benefits projected through time, as opposed to the single average annual figures shown above.

The investment analysis unfolds in five basic steps:

1. Annual benefits are projected into the future, normally for as long as the students remain in the workforce;
2. Future benefits are discounted to reflect the so-called time-value of money;[22]
3. The discounted stream of future benefits is summed to arrive at the present discounted value;
4. The present discounted value of benefits is then compared to costs; the investment is attractive if discounted future benefits exceed the costs.
5. We also use the stream of future benefits and present-day costs to compute the payback period and an annual percentage rate of return on the investment. Benefit-cost ratios, rates of return, and payback periods are simply alternative ways to assess the effectiveness of a given investment (see **Appendix 6** for a short primer on how to interpret these results).

[22] Future benefits are worth less than present benefits. The present value of $5,000 to be received thirty years from today is worth only $1,603 given a 4% discount rate ($5,000/$(1.04)^{30}$ = $1,603). If the same benefits occur each year for thirty years, each year's benefit must be discounted to the present, summed and collapsed into one value that represents the cumulative present value of all future benefits. Thus, the present value of 30-years' worth of $5,000 per year is $90,000. We use 4% as our discount rate, assuming that this equals the return of state and local governments on outside investments, or the rate at which state and local governments can borrow funds.

Accounting Stance and Key Definitions

Table 3.3 distinguishes between student and taxpayer costs and benefits. Students benefit from college attendance through increased future income; they invest in the form of tuition, books and foregone income while attending (the opportunity cost of their time).[23] Taxpayer costs (state and local) are straightforward; they include all direct aid to the colleges to fund operations and capital expenditures, plus financial aid to the students. The analysis focuses on state and local government support of community and technical colleges, so taxpayer costs only include state and local government expenditures.

Table 3.3. Key Definitions

Terms	Definitions
Student (Private) Benefits	Higher earnings captured by the students
Taxpayer Benefits: Broad	Additions to national GDP plus lower overall expenditures related to health, crime, welfare, and unemployment
Taxpayer Benefits: Narrow	Increased state and local government tax collections plus lower government expenditures related to health, crime, welfare, and unemployment
Student Costs	Tuition, books and fees plus the opportunity cost of time
Taxpayer Costs	State and local support, both current account and capital
Results:	
Student Perspective	Student Benefits / Student Costs
Taxpayer Perspective: Broad	Taxpayer Benefits (Broad) / Taxpayer Costs
Taxpayer Perspective: Narrow	Taxpayer Benefits (Narrow) / Taxpayer Costs

Taxpayer benefits require some additional elaboration. As indicated in **Table 3.3**, we view taxpayer benefits from two distinctly different perspectives, "broad" and "narrow." The aim of the broad taxpayer perspective is comprehensiveness. Under this perspective, all benefits are counted regardless of the ultimate beneficiary. Included under the broad perspective, for example, is the overall increase in national GDP, the total savings from improved health and reduced crime, reduced welfare payments, productivity gains from reduced absenteeism, and so on. Under the broad perspective, all of these otherwise varied results of community and technical college operations are lumped together and counted as a benefits of state and local college support.[24]

[23] For purposes of the investment analysis, we consider increased student earnings (a benefit) on a gross (before tax) basis. On the other side of the benefit-cost equation, the greatest part of a students' cost is the foregone wages while attending school (i.e., the opportunity cost of time). We consider this as well on a gross (before-tax) basis. The effect on final investment results of using gross rather than net income figures should therefore be negligible.

[24] Our analysis recognizes that in some cases a level of college operations may be possible without state and local government support. Accordingly, our larger analytic framework includes a sub-model that simulates a shifting of the funding burden from state and local taxpayers to the student body. Importantly, the sub-model takes into account the inverse relationship between tuition and college attendance. Where some level of college operations is possible absent state and local government

The "narrow taxpayer perspective" restricts the inclusion of benefits to those that would actually appear in the operating accounts of state and local governments. For example, whereas the broad perspective counts the total growth in national GDP, the narrow perspective counts only that portion of increased GDP measured by increased state and local tax payments. Similarly, federal crimes and prison expenses are excluded from the calculation of police, prosecution, incarceration and rehabilitation savings, while savings from reduced crime victims' costs are excluded altogether (since these strictly accrue to individuals). State and local government's portion of total welfare expenditures are used to compute their share of welfare savings, while savings from reduced unemployment payments are excluded altogether – these programs are strictly funded by the federal government. In general, the narrow taxpayer perspective counts only those items that actually result in a monetary gain (either added income or avoided cost) to state and local governments. For an extended discussion of the difference between the broad and the narrow taxpayer perspectives, see **Appendix 2**.

The lower part of **Table 3.3** summarizes our investment perspectives. The student perspective compares student benefits to student costs. The broad taxpayer perspective compares overall public benefits to state and local government costs, while the narrow taxpayer perspective compares strictly state and local government benefits to state and local government costs.

The Present Value of Future Benefits and Costs

Student Benefits

Table 3.4 shows the present discounted values of the annual benefits and the associated costs. The $139 added to a student's ***annual earnings*** per CHE completed (from **Table 3.2)** are projected across the working life of the students, and then discounted to the present. Thus, what appeared in **Table 3.2** as $139 (the increase in a student's annual earnings for every CHE), appears in **Table 3.4** as $2,407, the present value of all those future income increments.

Importantly, the present value of a benefit stream such as higher student income can be interpreted as the gross capital asset value of that income stream. Community and technical college students are accordingly rewarded for every CHE of coursework they take with a capital asset valued at $2,407. Considering all students together, the aggregate value for increased student earnings indicates that every year, as a result of their attendance at community and technical colleges, students acquire assets with a collective capital value of over $362 billion.

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support, then that portion of overall college benefits is excluded from our analysis. See **Appendix 3** below for a detailed discussion of these adjustments.

Table 3.4. Present Value of All Benefits and Costs, Private and Public

	Aggregate	Per CHE
PV of all benefits, private and public		
PV of student benefits (private benefits), increased earnings	$ 362,544,770,000	$ 2,407
PV of increased national GDP	$ 574,873,795,000	$3,817
Health benefits, captured by society		
PV of absenteeism savings	$ 11,136,280,000	$88
PV of tobacco and alcohol abuse medical savings	$ 7,378,491,000	$58
Crime		
PV of reduced incarceration	$ 10,771,434,000	$88
PV of reduced victim costs	$ 12,374,010,000	$97
PV of earnings (added productivity)	$ 5,167,543,000	$41
Unemployment and welfare		
PV of reduced welfare rolls	$ 11,217,672,000	$89
PV of reduced unemployment	$ 8,057,461,000	$63
Summed present value of all public benefits (broad perspective)	$ 640,976,686,000	$ 4,340
PV of all costs, private and public		
PV of opportunity cost of education plus tuition (private costs)	$ 94,465,824,000	$ 627
PV of state and local contribution to college budget (public costs)	$ 17,609,343,000	$ 117

Source: See Tables 1 through 15 in Appendix 9: Detailed Tables.

We now have an estimate of the students' reward for attending community and technical college. We need only compare this reward with the associated students' cost to judge whether attending school is a good investment. The cost figure is provided in the second to the last row of **Table 3.4**. The present value of the average cost of instruction per CHE is $627 – this figure includes tuition and fees, in addition to foregone income. Comparing costs with the present value of benefits yields a student benefit-cost (B/C) ratio equal to 3.8 (=$2,407/$627). We will consider this ratio and other measures of the students' investment below, but first let us consider the investment made by taxpayers.

Broad Taxpayer Perspective

Table 3.4 presents a collection of data on the present discounted value of public benefits. The present value of future additions to GDP growth, for example, sums to some $575 billion; the present value of absenteeism savings sums to $11 billion (the aggregate of workers who remain on the job rather than taking sick leave) and so on. Altogether, the present value of all the public benefits tracked in **Table 3.4** sum to roughly $641 billion.[25]

[25] We recognize in our individual college studies that some level of college operation might be possible absent state and local government support -- by raising tuition, for example. In arriving at the public benefits shown in **Table 3.4**, we estimate that level of operations, and reduce total benefits accordingly. We can, therefore, say that the benefits shown in **Table 3.4** would not occur absent state and local government support, and it is therefore proper to credit state and local government support with their creation. Specifics of the adjustment process appear in **Appendix 3**. In general, the adjustment works by reducing state and local government support by raising tuition. Studies indicate that community and technical college students are sensitive to the tuition level, so raising tuition reduces attendance. We

The estimate of state and local government support of community and technical colleges is roughly $17.6 billion per year as shown on the bottom row of **Table 3.4**.[26] Having now defined the present values of the costs and the benefits, we can form a benefit-cost ratio of roughly 36 to 1 (=$641 billion worth of benefits / $17.6 billion worth of state and local government support of the colleges).

This 36/1 ratio is not unexpected. It reflects the measure of all benefits generated regardless of to whom they may accrue. This is unlike the 3.8 benefit/cost ratio for the students, for example, where the B/C measure reflects benefits (higher earnings) accrued only to the students themselves divided by the student costs: tuition and fees and foregone income. For the broad taxpayer perspective, on the other hand, the benefits are received by widely dispersed publics, while the costs are born by the taxpayers. Students are the beneficiaries of higher earnings, would-be victims of crimes are the beneficiaries of lower crime rates, still others are beneficiaries of improved health, and so on. These are widely dispersed benefits and do not return to the state and local taxpayers who pay costs at full measure. In the broad taxpayer perspective, therefore, the B/C ratio simply aims at providing a ready comparison between all public benefits and taxpayer costs.[27]

Narrow Taxpayer Perspective

With the narrow taxpayer perspective the situation is different. Here we return to the standard investment analysis because the investors and the beneficiaries are one and the same. The pivotal step here is to limit the overall public benefits shown in **Table 3.4** to those that specifically accrue to state and local governments. These values are shown in **Table 3.5**. For example, **Table 3.4** shows increased GDP growth with a present value of some $575 billion. Increased GDP means higher incomes of all kinds (wages, salaries, proprietors' incomes, profits, rents and other) and from these will come higher taxes, whether federal, state and local. In **Table 3.5** we apply prevailing state and local government tax rates to the increased incomes shown in **Table 3.4**. The computation

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assume 25% of current enrollment as the minimum feasible scale for college operations. At enrollments less than 25%, colleges shut down. Where colleges shut down absent state and local government support, all benefits are counted. Where a level of college operations are possible absent state and local government support, the benefits associated with that level of attendance are subtracted from the overall total (i.e., excluded from the totals indicated in **Table 3.4**).

[26] The state and local government contribution to community and technical colleges is listed in the tables as a present value (PV). While this is technically correct, it is important to note that, unlike the streams of benefits that go on into the future, state and local government contributions are all made in the single analysis year. Their present value and nominal dollar value are thus the same.

[27] Because of those who benefit and those who bear the cost are not the same individuals or institutions, measures common to a standard investment analysis such as "rate of return," "payback period" "net present value" are not inappropriate in the broad taxpayer perspective.

yields a present value equal to approximately $52.8 billion in increased state and local tax receipts.[28] At the same time, **Table 3.5** repeats from **Table 3.4** the $17.6 billion annual contribution of state and local governments to the community and technical colleges. We can therefore say that in return for their $17.6 billion support of community and technical colleges, state and local governments are annually rewarded with a stream of increased future tax payments with an equivalent capital asset value of roughly $52.8 billion. This alone yields an investment benefit/cost ratio of 3.0 (=$52.8 billion/$17.6 billion), indicating a most profitable investment.

Table 3.5. Present Value of Net Benefits and Costs, Narrow Taxpayer Perspective

	Aggregate	Per CHE
PV of increased state and local govt. tax receipts	$ 52,821,066,000	$ 344
PV of state and local govt. savings from improved health		
PV of absenteeism savings	$ 1,101,912,000	$ 7
PV of tobacco and alcohol abuse medical savings	$ 383,691,000	$ 3
PV of state and local govt. savings from reduced crime	$ 7,765,892,000	$ 51
PV of reduced welfare rolls	$ 1,563,652,000	$ 10
PV of state and local government benefits	$ 63,636,213,000	$ 415
PV of state and local contribution to college budget (public costs)	$ 17,609,343,000	$ 117

With respect to the social savings, we showed in **Table 3.4** that employers would lose some $11.1 billion (present value of future loses) to health-related absenteeism were it not for our single year's state and local government support of community and technical colleges. Only a small fraction of these savings is counted in the narrow taxpayer perspective, however, reflecting only the portion of state and local government that benefit directly from this saving—the present value of their savings is estimated at roughly $1.1 billion (**Table 3.5**). State and local government savings from reduced tobacco and alcohol abuse are computed based on overall costs multiplied by an estimate of state and local governments' subsidy of general health care ($384 million).

Not surprisingly, state and local governments' greatest source of savings stems from the reductions in crime. **Table 3.4** shows total future savings from reduced incarceration with a present value of $28.3 billion (including victim costs and added productivity from people who would otherwise be incarcerated absent the education).[29] We arrive at the state and local government portion shown in **Table 3.5** by simply deducting the cost of federal crimes. Because of a single year of community and technical college support,

[28] Our individual college studies include region-specific data on state and local government tax rates and these are in turn applied to individual college GDP growth. The figures shown in **Table 3.5** are thus the sum of these individual college increments.

[29] Recall that incarceration is defined broadly to include costs associated with police, prosecution and incarceration.

state and local governments acquire an asset in the form of reduced future incarceration expenditures with a present value of roughly $7.8 billion.

Reduced future welfare expenditures, with a present value of nearly $1.6 billion, completes our estimation of state and local government savings from community and technical college support. Combining all of the items of increased income and avoided costs in **Table 3.5** provides the total overall asset value stemming from a year's support of U.S. community and technical colleges. As indicated in the table, this value is just under $64 billion, providing an overall narrow taxpayer perspective B/C ratio of 3.6 (=$63.6 billion/$17.6 billion).

Summary of Investment Analysis Results

In the previous section we examined the present value of community and technical college benefits, and characterized these in terms of various B/C ratios. In this investment analysis summary we consider these ratios again, and augment them with two other standard investment measures: the rate of return and payback period. These are simply alternative ways of assessing the effectiveness of given investments. The investment effectiveness measures appear in **Table 3.6.**

Table 3.6. Summary of Investment Analysis Results

RR, Student Perspective	15.3%
B/C Ratio, Student Perspective	3.8
Payback Period, Student Perspective (years)	9.0
B/C Ratio, Taxpayer Perspective: Broad	34.7
RR, Taxpayer Perspective: Narrow	16.2%
B/C Ratio, Taxpayer Perspective: Narrow	3.6
Payback Period, Taxpayer Perspective: Narrow (years)	8.1

Source: Computed from data supplied by Tables 2.4, 2.1, 3.4, and 3.5.

Investment Rate of Return

The rate of return is perhaps the most recognized indicator of investment effectiveness. Given the cost of college and the stream of associated future benefits, the rate of return indicates how much a bank would have to pay a depositor of like amount to yield an equally rewarding stream of future payments.[30] **Table 3.6** shows students of community and technical colleges earning average returns of 15.3% on their investment of time and money – this is indeed an impressive return, compared, for example, to perhaps 1% on a

[30] We compute our rates of return using the familiar "internal rate of return" calculation. Note that, with a bank deposit or stock market investment, the depositor puts up a principal, receives in return a stream of periodic payments, and then recovers the principal at the end. A college investor, on the other hand, receives a stream of periodic payments that include the recovery of the principal as part of the periodic payments, but there is no principal recovery at the end. These differences notwithstanding, comparable cash flows for both bank and college investors will yield the same internal rate of return.

standard bank passbook savings account, or approximately 8 to 10% on U.S. stocks and bonds (thirty-year average return).

At 16.2%, the rate of return to the state and local taxpayers is similarly impressive. Economists generally assume a 4% rate of return when dealing with government investments and public finance issues. This is the return governments are assumed to be able to earn on generally safe investments of unused funds, or alternatively the interest rate that governments, as relatively safe borrowers, can obtain funds for. A rate of return of 4.0% would mean that community and technical colleges would just pay their own way. In principle, governments could borrow the moneys used to support the colleges, and repay the loans out of the resulting added taxes generated from higher earnings and savings from avoided social costs. A rate of return of 16.2%, on the other hand, as indicated in **Table 3.6,** means that the average community or technical college not only pays its own way, but also generates a significant surplus that state and local governments can use to fund other programs. It is unlikely that other government programs could make such a claim.

Note that we refrain from calculating a rate of return for the broad taxpayer perspective. As discussed previously, the broad taxpayer perspective counts benefits to all recipients, of which state and local governments are but a part. Inasmuch as the benefits do not actually return to state and local governments, it would be misleading to compute an associated rate of return.

Payback Period

The payback period is simply defined as the number of years it takes to entirely recoup the initial investment. Having recovered the initial investment, returns beyond that are what economists would call "pure costless rent." As shown in **Table 3.6**, students at U.S. community and technical colleges on average see a payback period of 9.0 years on their foregone earnings and out-of-pocket costs, while state and local governments see a payback period of 8.1 years.[31]

CONCLUSIONS

This chapter has shown that U.S. community and technical colleges are attractive investments to their major stakeholders, students as well as state and local governments. The rates of return to students invariably exceed alternative investment opportunities. At the same time, state and local governments can take comfort in knowing that their expenditure of taxpayers funds

[31] A payback analysis is generally used by the business community to rank alternative investments when safety of investments is an issue. Its greatest drawback is that it takes no account of the time value of money.

creates a wide range of positive social benefits and, perhaps more importantly, actually returns more to government budgets than they cost. Absent the increased tax receipts and avoided costs provided by community and technical college education, state and local governments would have to raise taxes to make up for lost revenues and added costs.

CHAPTER 4
THE EFFECT OF COMMUNITY AND TECHNICAL COLLEGES ON NATIONAL ECONOMIC GROWTH

INTRODUCTION

The previous chapter considered community and technical colleges in the U.S. as an investment – first on the part of students, then on the part of state and local governments. In this chapter we focus on the U.S. economy and consider the impact of community and technical colleges on national economic growth. We report impact estimates in terms of national earnings (i.e., the sum of all wages, salaries and proprietors' incomes) and gross domestic product, or "GDP."[32]

In general, a college will affect its local economy in two ways: 1) through its local purchases, including the wages paid to its faculty and staff, and 2) through a human capital effect stemming from an increase in the skill-base of the local workforce. In our individual college studies, we have found that the second of these effects, the human capital effect, is by far the larger and more important. In this report, we omit the college spending effect altogether for reasons explained below.

WHY WE OMIT THE COLLEGE SPENDING EFFECT

Consider how college spending affects the *local* as opposed to the *national* economy. A college pays wages and these become part of overall local earnings. A portion of these direct earnings are, in turn, spent in the local economy to purchase consumer goods and services, make house and/or car payments, pay rent, and so on. At the same time, colleges purchase supplies and services of all kinds, and a portion of these direct expenditures are also made locally. Economic theory tells us that on top of any direct effect we must add an indirect effect, stemming from the action of a regional economic multiplier (see glossary in **Appendix 1**). Indirect effects capture the repeated spending and re-spending generated by the initial direct effect. The gross effect of college spending is obtained by adding together the direct and indirect effects.

To arrive at the net effect of college spending, we must first know where the revenues come from. For the most part, colleges are funded by the state taxpayers, either through local tax levies (property taxes), and/or state appropriations. In addition, some funding

[32] GDP equals the final value of all goods and services produced, final in the sense that otherwise double-counted inter-industry sales are netted out. Alternatively, GDP equals the combined incomes of all factors of production, i.e., labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents and other.

comes from federal sources (Pell Grants, direct federal aid and other), some comes from private sources, and, of course, some comes from the students themselves. The revenue breakdown in **Table 2.1** of **Chapter 2** reports U.S. federal support amounting to approximately 6.7% of overall college operating budgets. This means that the remaining 93.3% (=100% - 6.7%) of funds come from state and local sources (i.e., tuition and other private funding in addition to state and local government support). Devoting these funds to community and technical colleges means they are not available for other uses, e.g., consumer spending on the part of students, other government projects (or lower taxes) on the part of government. Moneys that are injected into the regional economy on one hand are withdrawn on the other. The net effect is obtained by estimating these two effects separately, and then subtracting the latter from the former.

In our individual college studies, we assume that moneys that support the college would otherwise remain in households and be spent on consumer goods. Students would spend the equivalent of their college expenses on consumer goods, and taxpayers would see their personal spending increase by an amount equal to their support of the college. Given these assumptions, college spending tends to have a positive net effect on regional economies, albeit considerably less than the unadjusted gross effect. There are two main reasons for the positive net effect: 1) Compared to spending by colleges, consumer spending tends to leak from the local region[33] and 2), federal funding of colleges and college students represents an outside injection to regional economies.

The present study focuses not on the individual college and region, but on the entire U.S. economy. Effects that leak from a given college region will generally be captured within the larger national economy. Federal support of community and technical colleges, while an injection to regional economies, is a transfer from other federal uses. From the national perspective, therefore, spending on one use can be expected to have approximately the same economic impact as spending on another use. For the above reasons we net to zero any would-be spending impact of U.S. community and technical colleges.

[33] In our individual college studies, we report impacts in terms of earnings (i.e., wages, salaries and proprietors' income). As shown in **Table 2.11,** the bulk of U.S. community and technical college spending goes directly to pay for wages and salaries of faculty and staff, and therefore directly to regional earnings. In contrast, the larger part of consumer spending goes for consumer durables (automobiles, appliances, etc.) and non-durables (chiefly food) that tend to be manufactured outside the regional economy. In contrast to college spending, the earnings effect of these latter items is felt elsewhere, i.e., it leaks out of the regional economy.

THE HUMAN CAPITAL EFFECT OF COMMUNITY AND TECHNICAL COLLEGES

Direct Effect

Students leave community and technical colleges and enter the workforce with newly acquired skills. They are more productive because of these skills, and their incomes go up accordingly. Moreover, skilled workers make capital more productive as well, which is why businesses are eager to hire them in the first place. The combination of these and other productivity effects constitutes the *direct economic growth effect* of community and technical college education.

Indirect Effect

The growth effect of a skilled workforce does not stop with the direct effects, i.e., with the higher incomes of skilled workers and their employers. Higher incomes mean greater consumer spending, and this generates a multiple of additional economic growth effects. Moreover, the businesses employing the skilled workers are more productive, meaning they produce a larger output - larger output means more inputs. In turn, this generates still another round of spending effects. The sum of these additional effects, i.e., the consumer-driven and output-driven effects, constitutes the *indirect economic growth effect* of community and technical college education.

Total Effect

The *total economic growth effect* of community and technical college education is simply the sum of the direct and indirect effects. As discussed in **Chapter 1**, the literature recognizes another effect that we omit altogether, namely, the effect of educated workers on innovation and technical progress. Because the larger part of this effect is general and spills beyond the businesses employing the skilled workers themselves, these innovation effects are generally labeled "external effects." The general uncertainty regarding the effect of education on innovation-led economic growth has prompted us to leave these out of our analysis altogether. To the extent there are such effects, and theory suggests there are, our overall results presented below can be considered conservative.

SUMMARY OF SPECIFIC ECONOMIC GROWTH RESULTS

Table 4.1 summarizes our economic growth results. The first row is for comparison purposes and shows total U.S. earnings and GDP. In 2002, our benchmark year, the U.S.

generated just under $7 trillion in earnings, and a GDP of roughly $10.5 trillion.[34] The remainder of the table is divided into two general parts, the first showing the aggregate economic effect of U.S. community and technical college operations spending, and the second showing the human capital effects of the community and technical colleges.

Community and Technical College Spending Effects

The section on the economic impact of community and technical college spending has several parts. The first row shows the total of faculty and staff wages and salaries. The figure shown there, roughly $18 billion, constitutes the direct effect of college spending on earnings – direct college earnings account for some 0.3% of all U.S. earnings. Note that the associated figure for GDP is the same as the figure for earnings. In contrast to private sector businesses, where profits and other property-type incomes must be considered, the direct contribution to GDP of government sectors is simply measured by the wages and salaries (i.e., earnings) they pay.

Indirect effects appear next, and amount to another $5.6 billion. These represent the earnings generated in other industries (i.e., off-campus effects) as a result of the direct college spending. Note that, at just over $9 billion, the indirect effect on GDP is greater than the associated effect on earnings: the difference measures the portion of these indirect effects represented by non-labor (i.e. property) income. The total effect of community and technical college spending is estimated at nearly $24 billion in national earnings (0.4% of the total). These are estimated using a national IO model.[35] The total impact of community and technical college spending is nearly $28 billion in national GDP.

The row labeled "Adjustment for alternative use of funds" accounts for moneys spent on education that are no longer available for spending elsewhere. The negative figure shown for this entry reflects the earnings and GDP foregone to fund education. Taking this adjustment into account, the net effect of college spending is zero.

The Human Capital Effect

Before we turn to the human capital effects in **Table 4.1**, it is necessary to consider the additional set of calculations shown in **Table 4.2.** The table starts with the just over 2 billion (from **Table 2.12)** estimate of total CHEs embodied in the current day workforce.

[34] The figures on earnings and GDP are from the U.S. Department of Commerce. Our individual college studies span a timeframe from 2000 to 2004 so in choosing a reference base-year we simply pick the midpoint year of 2002.

[35] Details on our national IO model appear in **Appendix 7.** As described there, we avoid an overstatement of actual multiplier effects by reducing the total effect indicated by the IO model by 80%. The reduction accounts for the shift of resources from next-best uses.

The next step is to reduce this figure 14% to account for alternative education opportunities. The approximately 1.9 billion CHEs left after this calculation can be viewed as strictly attributable to the existence of U.S. community and technical colleges.[36] Finally, we multiply the 1.9 billion CHEs by our estimate of the value in added earnings per CHE ($139 as shown in **Table 3.2**). The result, approximately $265 billion, is the estimated portion of current U.S. earnings that can be directly attributed to the community and technical college instruction embodied in the present-day workforce (i.e., the direct earnings impact of past community and technical college instruction).

The $265 billion direct earnings effect from **Table 4.2** reappears in **Table 4.1** where it is shown to account for some 3.9% of all U.S. earnings. The associated direct effect on U.S. GDP is over $487 billion, or 4.6% of all GDP.[37] Indirect effects are shown next. As described earlier, these occur as a result of the increased consumer and business input spending associated with the direct effects. As shown in the table, indirect effects of past students account for over $83 billion, or 1.2%, of all U.S. earnings, and just over $133 billion, or 1.3%, of all U.S. GDP. The bottom line: U.S. community and technical colleges account for over $348 billion, or 5.1%, of all U.S. earnings, and just over $620 billion, or 5.1% of GDP.

Table 4.1 Role of Community and Technical Colleges in the U.S. Economy

	Earnings ($ Millions)	% of Total	GDP ($ Millions)	% of Total
Total U.S. Earnings and GDP	$6,829,384	100%	$10,487,009	100%
Earnings and GDP Attributable to College Operations				
Direct Earnings and GDP of Faculty and Staff	$18,337	0.3%	$18,337	0.2%
Indirect Earnings and GDP	$5,641	0.1%	$9,339	0.1%
Gross Total	$23,978	0.4%	$27,676	0.3%
Adjustment for alternative use of funds	($23,978)	-0.4%	($27,676)	-0.3%
NET TOTAL	$0	0.0%	$0	0.0%
Earnings and GDP from Past Student Economic Growth Effects				
Direct Earnings and GDP	$265,071	3.9%	$487,230	4.6%
Indirect Earnings and GDP	$82,727	1.2%	$133,554	1.3%
TOTAL	$347,798	5.1%	$620,784	5.9%
GRAND TOTAL	$347,798	5.1%	$620,784	5.9%

Sources: Total earnings for the United States are assembled from the US Department of Commerce, Regional Economic Information System, CA and SA series; the U.S. Department of Commerce, County Business Patterns; and the U.S. Department of Commerce, Bureau of Labor Statistics ES-202 series. Direct earnings for faculty and staff are derived from data received from the subsample of U.S. community and technical colleges with inference to the entire U.S. college population. Indirect earnings are based on outputs from the EMSI IO Model (Moscow, ID: Economic Modeling Specialists, Inc., 2002).

[36] Details on our estimation of the alternative education opportunity value appear in **Appendix 4**.

[37] The fact that community and technical college-trained workers explain a relatively greater share of GDP than earnings indicates that they work in industries with greater than average capital-to-labor ratios. In the course of completing our individual college studies, we gather data on the approximate industries where past students work. Where this information is not available, we assume a pattern that favors higher development-stage industries. The direct GDP figure in **Table 4.1** is obtained by multiplying the earnings-by-industry of past students by the associated value added-to-earnings ratios.

Table 4.2. Estimating the Direct Human Capital Effect of Community and Technical College Instruction Embodied in the U.S. Workforce

	Variables
Total embodied CHEs	2,217,981,224
Alternative education opportunities, %	14.0%
CHEs net of alternative education opportunities	1,907,716,677
Value per CHE	$139
Net earnings attributable to U.S. community and technical colleges	$265,070,940,000

Sources: Derived from data provided by the subsample of U.S. community and technical colleges, with inference to the entire U.S. college population

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Appendix 1: Glossary of Terms

Alternative education	The alternative education variable is a "with" and "without" measure. It is a measure of the percent of students who would still be able to avail themselves of alternative education opportunities absent the community or technical colleges in the state. An estimate of 20%, for example, means that 20% of the students do not depend directly on the existence of the colleges in order to obtain their education. We then back 20% out the impact calculations.
Attrition rate	An attrition (decay) rate of students is applied to benefits occurring in the future. The rate refers to the fact that not all students remain in the local region once exiting the college, but some will out-migrate, retire, or die. This rate is either estimated by the college institutional researchers, or it is derived from the literature as a default value if the variable cannot be estimated by the college.
Benefit/cost ratio	The benefit/cost ratio separately discounts the flow of benefits and costs over time to the present and then divides the sum of the discounted benefits by the sum of the discounted costs. If the benefit/cost ratio is greater than one, then the benefits exceed costs and the investment is feasible. For every dollar expended we get more than one dollar back. This, however, does not necessarily mean that the investment is the best one. There are many feasible projects but only one optimal one. We must compare between investments—the higher the benefit/cost ratio, the more attractive the project.
Demand	The demand for education describes the relationship between the market price of education and the volume of education demanded (expressed in terms of enrollment). The law of the downward-sloping demand curve is related to the fact that enrollment increases only if the price (tuition and fees) is lowered, or conversely, enrollment decreases if the price (tuition and fees) increases.
Discounting	Discounting is the process of expressing future revenues and costs in present value terms. The discount rate converts future revenues

	into present values so they can be compared to costs incurred in the present.
Economics	Economics is the study of the allocation of scarce resources among alternative and competing ends. Economics is not normative (what *ought* to be done), but positive (describes *what is*, or how people are likely to behave in response to economic changes). Allocation of resources is the key focus of economics. Taxpayer dollars, for example, are scarce and there will be competing uses and pressures. Taxpayers vote to tax themselves to fund transportation, the health sector, education, and/or other priorities. They have choices and must allocate between them.
Elasticity of demand	In this report, the elasticity of demand refers to the degree of responsiveness of the quantity of education demanded (enrollment) to changes in market prices (tuition and fees). If a decrease in tuition increases total revenues, the demand is elastic. If it decreases total revenues, the demand is inelastic. If total revenues remain the same, the elasticity of demand is said to be unitary.
Externalities	Externalities (positive and negative) occur when impacts are generated for which there is no compensation. Hillside logging, for example, may create a negative externality because of erosion that lowers the productivity of downstream farms, but the logger does not compensate the farmers. For community and technical colleges, positive external benefits could be improved social behaviors manifested in lower crime, reduced welfare and unemployment, and improved health. Colleges cannot take direct credit, nor do they receive compensation for these manifestations, but the benefits still occur by virtue of the fact that the colleges exist and that the higher education they provide ultimately leads to improved social behaviors.
Gross Domestic Product	The gross domestic product (GDP) is a measure of the final value of all goods and services produced. Alternatively, GDP equals the combined incomes of all factors of production, i.e., labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents and other.
Input-output analysis	Input-output analysis is a branch of economics that addresses production relationships in an economy. In particular, it refers to

	the relation between a given set of demands for final goods and services, and the implied amounts of manufactured inputs, raw materials, and labor this requires. In an educational setting, as colleges pay wages and salaries and spend money for supplies in the local economic region, they also generate earnings in all of the sectors of the economy, thereby increasing the demand for goods and services and jobs. Moreover, as the students enter or rejoin the workforce with higher skills obtained at the colleges, they also earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy, subject to the familiar multiplier effect (see below).
Internal rate of return	The internal rate of return (IRR) is the rate of interest which, when used to discount the cash flows associated with investing in education, reduces its net present value to zero (i.e., where the present value of the revenues accruing from the investment are just equal to the present value of the costs incurred). This, in effect, is the breakeven rate of return on the investment since it shows the highest rate of interest at which the investment makes neither a profit nor a loss. IRR results are expressed as a percentage**.**
Multiplier	Multipliers are a measure of the overall regional earnings per dollar of earnings at the community or technical college (i.e., per dollar of college faculty and staff earnings). In our context, the multiplier can be defined as the total of on- and off-campus earnings divided by on-campus earnings. Multiplier effects are the result of in-area spending by the college on locally supplied goods and services, and of the local everyday spending of college faculty and staff. We also include in the off-campus portion of the multiplier the added regional earnings attributable to past-students still active in the local labor force. The regional economy is larger because of the skills of these past students, and because of the added spending associated with their higher incomes, and from spending associated with the enlarged output of the industries where these past students are employed.
Net cash flow	The net cash flow (NCF) is benefits minus costs, i.e., the sum of the revenues accruing from an investment minus the costs incurred.

Net present value	The net present value (NPV) is the net cash flow discounted to the present. All future cash flows are, in this way, collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure. If the net present value is positive, we have done better than alternative investment schemes, all else being equal.
Opportunity cost	The opportunity cost comprises the benefits foregone from alternative B once a decision is made to allocate resources to alternative A. Or, if an individual chooses not to attend college, he or she foregoes the higher future earnings associated with higher education. The benefit of higher education, therefore, is the "price tag" of choosing not to attend college.
Payback Period	This is a measure of the period of time required to recover an investment. The shorter the period, the more attractive is the investment. The formula for computing payback period is: Payback period = cost of investment/net return per period

Appendix 2: The Broad and Narrow Taxpayer Perspectives

The return on investment is considered from two taxpayer perspectives: broad and narrow. The CCbenefits model indicates that investment in the nation's community and technical colleges is very attractive for state and local governments. This finding is clearly indicated from the results of the analysis, also highlighted in this appendix. To better appreciate this finding, we develop these two perspectives more fully below.

BROAD INVESTMENT PERSPECTIVE

The effectiveness of government programs is often expressed through the use of a benefit/cost ratio. A ratio less than one indicates that a public project is not worthwhile, whereas a project with a benefit/cost ratio greater than one is considered to be an economically sound investment. Consider some examples. A transportation authority promotes a new road or bridge by demonstrating that savings in travel time and vehicle expenses greatly exceed the project's cost. Another example: the success of a government program aimed at revitalizing a depressed economy is said to be demonstrated when the incomes created by the program greatly exceed the program cost. In still a third example, expenditures on public parks are sometimes justified by showing that the value of the recreation, including scenic and other values that accrue to park users, exceeds the public outlay for park construction, operation, and the cost of extractive resources not used. In all these cases, note that overall benefits are counted and not just those that accrue back to state or local government. This is the hallmark of the broad benefit/cost (i.e., investment) perspective.

The broad investment perspective imbedded in the CCbenefits model measures a diverse collection of benefits generated by community and technical colleges, including the increased earnings of students plus external benefits associated with savings on health care, reduced expenditures on crime (e.g., prosecution, incarceration and victim costs), reduced welfare and unemployment expenditures, and costs associated with absenteeism from work. These benefits accrue to different publics such as students, employers, victims of crime, the federal government, and state and local taxpayers. The broad perspective tallies this varied collection of benefits and measures this against the outlays of state and local government. State and local government taxpayers can view a broad perspective benefit/cost ratio greater than 1.0 as a minimal indicator of a worthwhile public investment.

NARROW INVESTMENT PERSPECTIVE

Among the benefits tracked under the broad perspective is a subset that accrues to state and local governments. A portion of higher student earnings will be captured by state and local governments in the form of added tax receipts. Additionally, because state and local governments bear part of the cost of crime, their budgets benefit from education-induced crime reductions. The same holds in varying degrees for the other assorted benefits of an educated populace. The bottom line: while state and local governments spend money in support of the colleges, they receive benefits in the form of increased tax receipts and an assortment of reduced expenditures or avoided social costs. The narrow investment perspective counts only benefits that can be entered into the books of state and local governments.

Worthwhile public projects routinely generate negative narrow perspective returns. Generally, the role of government is to provide services that the public wants, but the business sector finds unprofitable. Considerable funds are spent on public parks, for example, yet except for entry fees and some concessionaire or special events receipts, no moneys directly return to the state or local taxpayers. From a narrow investment perspective, taxpayer returns are negative, and the park is justified by the benefits tracked under the broad perspective.

An important finding of the CCbenefits analysis is that the results are not only strong from the broad perspective but, unlike most government endeavors, the taxpayer investments generate strong results from the narrow investment perspective as well. Economists generally assume a 4.0% discount rate in analyzing government projects, assuming that governments can obtain unsecured loans at a rate of 4.0% or receive a return of 4.0% on any excess funds were they to be invested. Since the colleges generate a narrow taxpayer perspective rate of return of 16.2%, which is substantially greater than 4.0%, the state governments actually make money on the investment—the colleges put more money back into the state treasuries than they take out. By funding the colleges, therefore, other beneficiaries of state funding are actually subsidized through the revenues generated by the colleges.

Appendix 3: Adjusting for the Benefits Available Absent State and Local Government Support

INTRODUCTION

The investment analysis presented in the Main Report weighs the benefits of college enrollment (measured in terms of CHEs) against the support provided by state and local government. If, without state and local government support, a college would have to shut its doors, then it is entirely appropriate to credit all the benefits to that support. This brings up the question: is it in fact true that the college would have to close its doors absent state and local government support? Increased tuition could almost certainly make up for some of the lost funds, although this would result in reduced enrollment. Still, if the college could remain open and operate at this zero state and local government support level, then state and local government support can only be credited with the difference (i.e., the actual enrollment less the enrollment at zero state and local government support). This appendix documents our procedures for making these adjustments, which feed the broad and narrow taxpayer benefit/cost ratios, rates of return, and payback analyses estimates in the Main Report.

STATE AND LOCAL GOVERNMENT SUPPORT VERSUS TUITION

We start by exploring the issue with the aid of some graphics. **Figure 1** presents a simple model of student demand and state and local government support. The right side of the graph is a standard demand curve (D) showing student enrollment as a function of tuition and other student fees. Enrollment is measured in total CHEs and expressed as a percentage of current CHEs. The current tuition rate is p', and state and local government support covers C% of all costs. At this point in the analysis, we assume that the college has only two sources of revenues: student tuition payments and state and local government support.

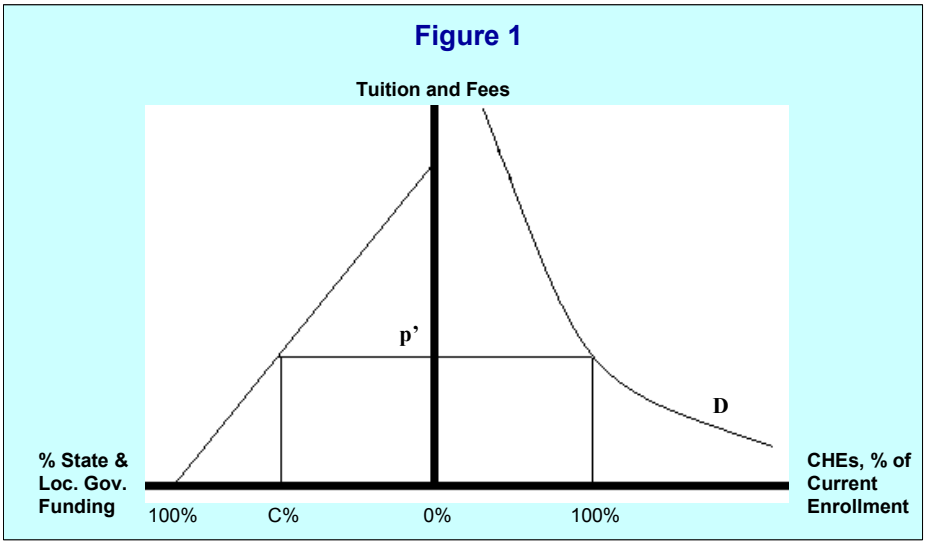
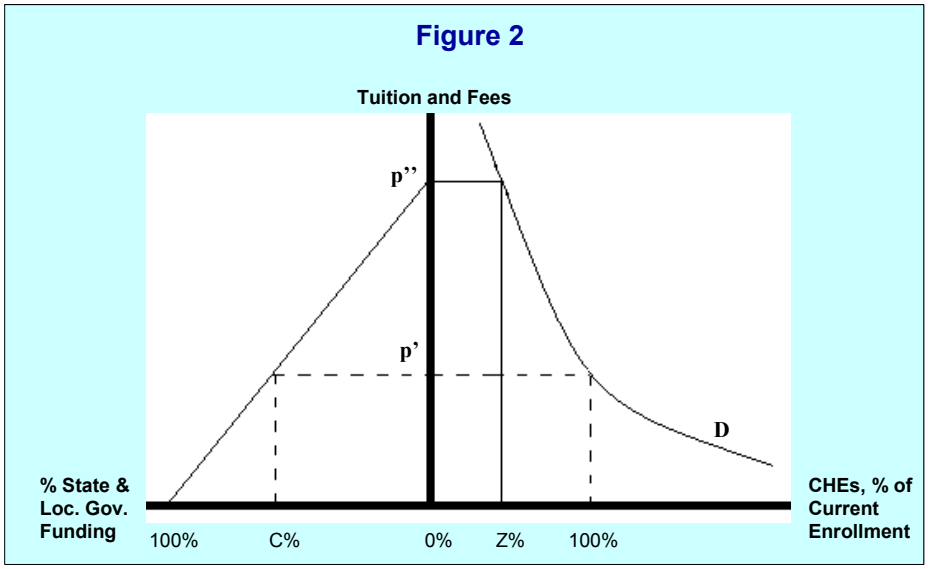


Figure 2 shows another important reference point in the model—where state and local government support is 0%, tuition rates are increased to p", and enrollment is Z% (less than 100%). The reduction in enrollment reflects price elasticity in the students' school vs. no-school decision. Neglecting for the moment those issues concerning the college's minimum operating scale (considered below in the section on "The College Shutdown Point"), the implication for our investment analysis is that the benefits of state and local government support for the college must be adjusted to net out the benefits associated with a level of enrollment at Z% (i.e., the school can provide these benefits absent state and local government support).



FROM ENROLLMENT TO BENEFITS

This appendix is mainly focused on the size of college enrollment (i.e., the production of CHEs) and its relationship to student versus state and local government funding. However, to clarify the argument it is useful to briefly consider the role of enrollment in our larger benefit/cost model.

Let B equal the benefits attributable to state and local government support. B might be understood as applying to either our broad or narrow taxpayer perspectives. The analysis in the Main Report derives all benefits as a function of student enrollments (i.e., CHEs). For consistency with the graphical exposition elsewhere in this appendix, B will be expressed as a function of the percent of current enrollment (i.e., percent of current CHEs). Accordingly, the equation

(1) $B = B(100\%)$

reflects the total benefits generated by enrollments at their current levels, measured in **Chapter 3** of our Main Report.

Consider benefits now with reference to **Figure 2**. The point where state and local government support is zero nonetheless provides for Z% (less than 100%) of the current enrollment, and benefits are symbolically indicated by:

(2) $B = B(Z\%)$

Inasmuch as the benefits in (2) occur with or without state and local government support, the benefits appropriately attributed to state and local government support is given by:

(3) $B = B(100\%) - B(Z\%)$

THE COLLEGE SHUTDOWN POINT

College operations will cease when fixed costs can no longer be covered. The shutdown point is introduced graphically in **Figure 3** as S%. The location of point S% indicates that this particular college can operate at an even lower enrollment level than Z% (the point of zero state and local funding). At point S%, state and local government support is still zero, and the tuition rate has been raised to p'''. At tuition rates still higher than p''', the college would not be able to attract enough students the keep the doors open, and it would shut down. In **Figure 3**, point S% illustrates the college shutdown point

but otherwise plays no role in the estimation of state and local government benefits. These remain as shown in equation (3).

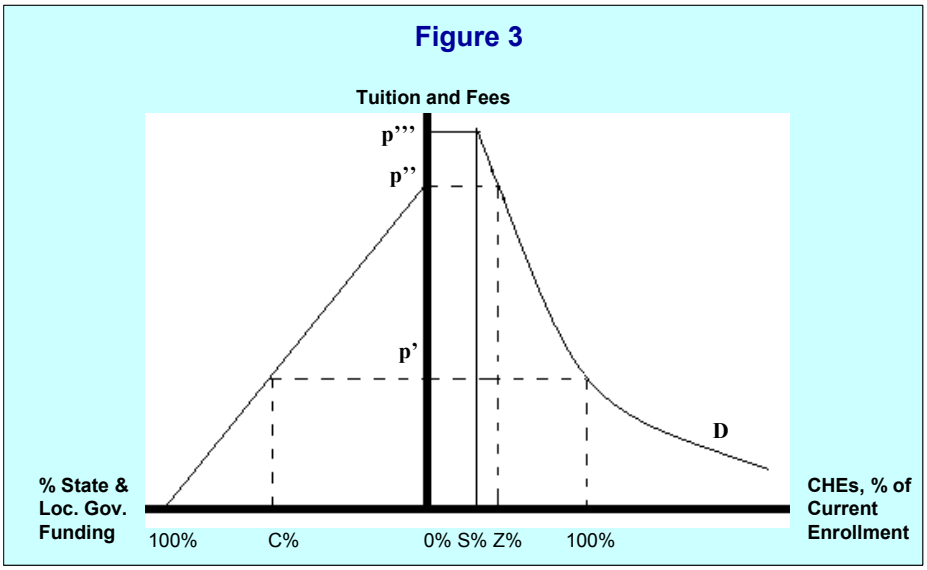
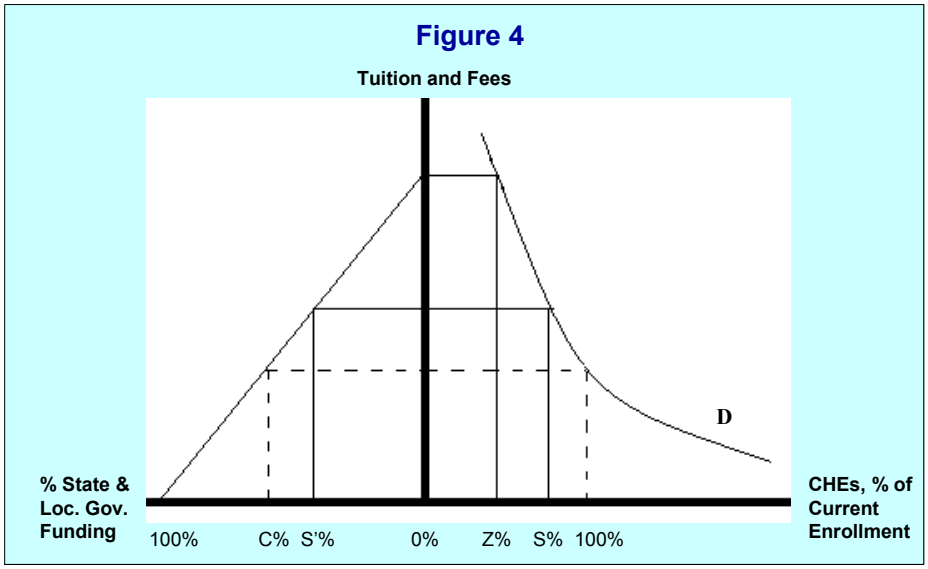


Figure 4 illustrates yet another scenario. Here the college shutdown point occurs at an enrollment level greater than Z% (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the school to operate at all. This minimum portion of overall funding is indicated by S'% on the left side of the chart, and as before, the shutdown point is indicated by S% on the right side of chart. In this case, state and local government support is appropriately credited all the benefits generated by college enrollment, or B=B(100%).



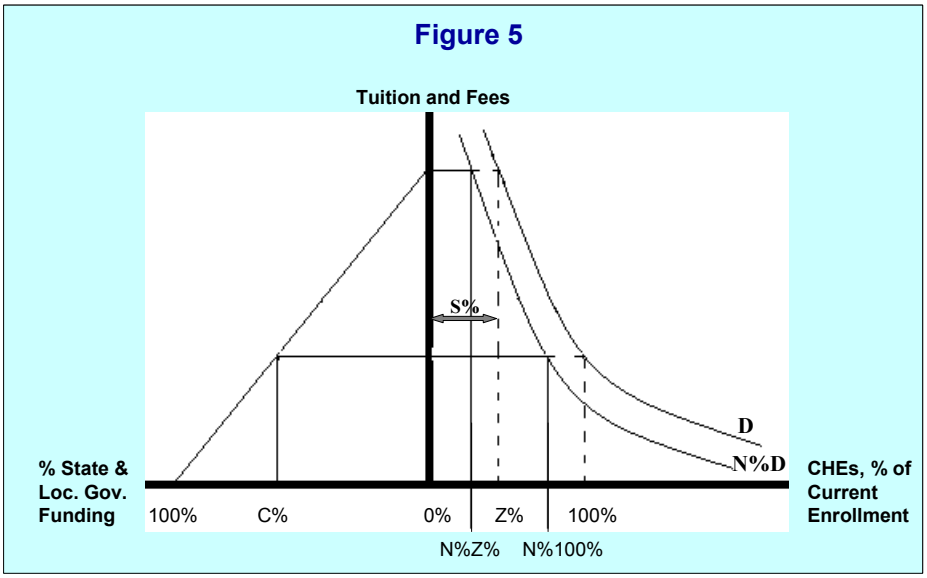
ADJUSTING FOR ALTERNATIVE EDUCATION OPPORTUNITIES

Because there may be education alternatives to the two-year colleges in the state, we must make yet another adjustment. The question asked is: "Absent the community and technical colleges, what percentage of the students would be able to obtain their education elsewhere?" The benefits associated with the college education of these students are deducted from the overall benefit estimates.

The adjustment for alternative education is easily incorporated into our simple graphic model. For simplicity, let A% equal the percent of students with alternative education opportunities, and N% equal the percent of students without an alternative. Note that: N% + A% = 100%. **Figure 5** presents the case where the college could operate absent state and local government support (i.e., Z% occurs at an enrollment level greater than the college shutdown level S%). In this case, the benefits generated by enrollments absent state and local government support must be subtracted from total benefits. This case is parallel to that indicated in equation (3), and the net benefits attributable to state and local government support is given by:

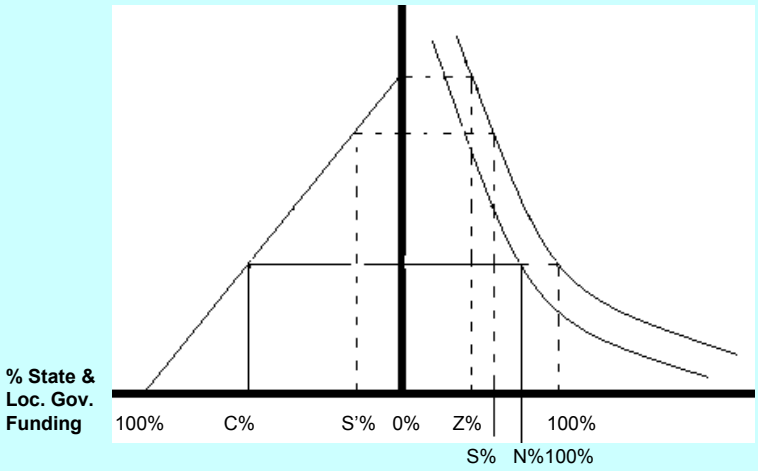
(4) $B = B(N\%100\%) - B(N\%Z\%)$

Figure 5



Finally, **Figure 6** presents the case where the college cannot remain open absent some minimum S'% level of state and local government support. In this case the state and local government is credited with all benefits generated by current enrollment, less only the percent of students with alternative education opportunities. These benefits are represented symbolically as B(N%100%).

Figure 6


Tuition and Fees
% State & Loc. Gov. Funding
CHE's, % of Current Enrollment
100%
C%
S'%
0%
Z%
100%
S%
N%
100%

Appendix 4: Estimating the Alternative Education Opportunity

INTRODUCTION

The alternative education is simply the percent of students who would still be able to avail themselves of alternative education opportunities absent all publicly funded educational institutions in the state.[38] In the earlier versions of the economic impact model we asked the researchers at the individual colleges to provide an estimate of this variable, but not without considerable effort on their part to, first, fully understand why we were asking for this information and, second, determine what the numerical estimate should be. Because this process proved to be very cumbersome, we decided to internalize it in the model through the application of a regression analysis based on estimates already received from 117 colleges previously analyzed. The purpose of this appendix is to lay out the theoretical framework for determining the alternative education opportunity variable and the data used to make this determination.

ALTERNATIVE EDUCATION VARIABLE IN FUNCTIONAL FORM

The alternative education variable is the dependent variable, expressed in functional form as:

(1) $Y = b_1X_1 + b_2X_2 + b_3X_3 + e$

Where:

Y = Dependent variable, alternative education opportunity expressed as percentage of students who would be able to avail themselves of alternative education elsewhere from private institutions

b_i = partial regression coefficients

e = standard error

[38] The question we ask in determining the alternative education variable is: What percentage of students would still be able to receive higher education if all publicly funded institutions in the state (community colleges, technical colleges, state universities, etc.) were shut down? If state and local taxpayers decided to stop their financial support of colleges and universities, students would no longer be able to avail themselves of such funds to pursue their education. They still have the option, however, of attending a private institution.

INDEPENDENT VARIABLES

The three independent variables reflect the explanatory parameters explained to institutional researchers and fiscal officers when asked to derive their own estimates. These parameters now form the theoretical backdrop to the internal estimation of the dependent variable based on 117 observations. The three independent variables include the following:

X_1: Population per square mile in the college service region

This variable defines the population density of the college service area. A positive coefficient (b) is expected; i.e., the more densely populated the area, the more numerous will be the alternative education opportunities.[39]

X_2: Number of private school employees per 1,000 population per square mile in the college service region

This variable is a proxy for the availability of private educational institutions providing alternative education opportunities in the college service area. A positive coefficient (b) is expected; i.e., the more private school employees, the more alternative education opportunities there are in the area.[40]

X_3: Personal income

The average personal income of the residents in the service area serves as a measure of the relative economic well-being of the area. A positive coefficient (b) is expected; i.e., the higher the average earnings in the area, the more the students will be able to afford avail themselves of the alternative education opportunities. This number is expressed in thousands.[41]

EXAMPLE OF ANALYSIS AND RESULTS

Ordinary least squares (OLS) was the procedure used to estimate the parameters. Fitting the equation by OLS yielded the following results:

(2) $Y = 3.43E\text{-}05X_1 + 0.023565X_2 + 0.005748X_3 + 0.064722$
(2.723) (1.4765) (3.1326)

$R^2 =$ .458 (coefficient of determination)

F = 31.84 (Fischer test statistic)

[39] This information may be found at the U.S. Census Bureau, 2002 Population Estimates [database on-line], available from http://eire.census.gov/popest/data/counties/files/county_dataset.csv.
[40] Available from the U.S. Department of Commerce, 2001 County Business Patterns.
[41] Available from the U.S. Department of Commerce, Bureau of Economic Analysis, 2001 REIS Employment and Earnings Reports.

The numbers in parentheses below the coefficients are the "t" values (all statistically significant). The R^2 measures the degree to which the independent variables explain the variation in the dependent variable. The maximum R^2 attainable (1.00) is the case in which all observations fall on the regression line and all variability is explained. The .458 R^2 obtained in equation (2) indicates that nearly 46% of the variation in the alternative education opportunity is explained by the variables. The F-ratio indicates that the equation can be considered a good predictor of the alternative education opportunity.

The positive signs of the regression coefficients agree with expected relationships. As population density, the number of private school employees, and personal income increase, so does the provision of alternative education opportunities.

For example, suppose a community or technical college has a service region of five counties. The total population of the five counties is 188,341, while the size of the region is 3754 square miles; the average population per square mile is therefore a little over 50. Within this region, there is about 1 higher education private school employee for every 3,000 residents. Finally, the average income per person within the region is $21,869 per year. Using this data, we produce the following results:

(3) Y = (3.43E-05 * 50.2) + (0.023565 * .3318) + (0.005748 * 21.869)

(4) Y = 13.5%

Appendix 5: Methodology for Creating Income Gains by Levels of Education

The U.S. Bureau of the Census reports income in two ways:

1) Mean income by race and Hispanic origin and by sex.

2) Mean income by educational attainment and sex.

The first and second data sets can be found at the following sources:

U.S. Census Bureau and U.S. Department of Commerce. Table P-3: Race and Hispanic Origin of People by Mean Income and Sex: 1947 to 2000, and Table P-18: Educational Attainment--People 25 Years Old and Over by Mean Income and Sex: 1991 to 2000.

Also consult:

http://www.census.gov/ftp/pub/hhes/income/histinc/histinctb.html

Further contact information:

1) Income Surveys Branch

2) Housing and Household Economic Statistics Division

3) U.S. Census Bureau

4) U.S. Department of Commerce.

The data needed for this analysis is mean income by educational attainment reported by race/ethnic origin and by sex. A model was developed to translate these two data sets into the data needed for the analysis. This was accomplished in the following way:

Mean income by race and sex was calculated as a percent of all races.

This percent was then applied to mean income by educational attainment. For example, African-American males make an average income of $28,392 versus $40,293 for all males, or 70% of the average income of all males.

This percent (70%) was then applied to the income levels by educational attainment for all males to estimate the income levels by educational attainment for African-American males.

To simplify the analysis, all minority males were averaged together as were all minority females. The same process was repeated for white males and white females.

The educational levels of attainment were aggregated together in some categories to model the educational system of community and technical colleges. These numbers were then adjusted for inflation to current year dollars.

The final step is to adjust these income levels by state. The *Four Person Median Family Income by State* from the Bureau of the Census was used to make state level adjustments. Each state's median family income is taken as a percentage of the national average. These percentages are then applied to the income levels by educational attainment by race, ethnicity, and sex, as calculated earlier.

Appendix 6: Explaining the Results—a Primer

The purpose of this appendix is to provide some context and meaning to investment analysis results in general, using the simple hypothetical example summarized in **Table 1** below. The table shows the projected (assumed) benefits and costs over time for one student and the associated investment analysis results.[42]

Table 1. Costs and Benefits

Year	Tuition	Opportunity Cost	Total Cost	Higher Earnings	NCF
1	2	3	4	5	6
1	$1,500	$20,000	$21,500	$0	($21,500)
2	$0	$0	$0	$5,000	$5,000
3	$0	$0	$0	$5,000	$5,000
4	$0	$0	$0	$5,000	$5,000
5	$0	$0	$0	$5,000	$5,000
6	$0	$0	$0	$5,000	$5,000
7	$0	$0	$0	$5,000	$5,000
8	$0	$0	$0	$5,000	$5,000
9	$0	$0	$0	$5,000	$5,000
10	$0	$0	$0	$5,000	$5,000
NPV			$20,673	$35,747	$15,074
IRR					18%
B/C Ratio					1.7
Payback Period					4.2 years

The assumptions are as follows:

1) The time horizon is 10 years—i.e., we project the benefits and costs out 10 years into the future (Column 1). Once the higher education has been earned, the benefits of higher earnings remain with the student into the future. Our objective is to measure these future benefits and compare them to the costs of the education.

2) The student attends the community or technical college for one year for which he or she pays a tuition of $1,500 (Column 2).

3) The opportunity cost of time (the earnings foregone while attending the community or technical college for one year) for this student is estimated at $20,000 (Column 3).

4) Together, these two cost elements ($21,500 total) represent the out-of-pocket investment made by the student (Column 4).

[42] Note that this is a hypothetical example. The numbers used are not based on data collected from any community or technical college.

5) In return, we assume that the student, having completed the one year of study, will earn $5,000 more per year than he would have without the education (Column 5).

6) Finally, the net cash flow column (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).

7) We assume a "going rate" of interest of 4%, the rate of return from alternative investment schemes, for the use of the $21,500.

Now the "mechanics"—we express the results in standard investment analysis terms: the net present value (NPV), the internal rate of return (IRR—or, as referred to in the Main Report, simply the rate of return—RR), the benefit/cost ratio (B/C), and the payback period. Each of these is briefly explained below in the context of the cash flow numbers in **Table 1**.

THE NET PRESENT VALUE (NPV)

"A bird in hand is worth two in the bush." This simple folk wisdom lies at the heart of any economic analysis of investments lasting more than one year. The student we are tracking in **Table 1** has choices: 1) to attend a community or technical college, or 2) forget about higher education and hold on to the present employment. If he or she decides to enroll, certain economic implications unfold: the tuition must be paid and earnings will cease for one year. In exchange, the student calculates that, with the higher education, his or her income will increase by at least the $5,000 per year as indicated in the table.

The question is simple: will the prospective student be economically better off by choosing to enroll? If we add up the higher earnings of $5,000 per year for the remaining nine years in **Table 1**, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different—the benefits are far lower than $45,000 because future money is worth less than present money. The costs (tuition plus foregone earnings) are felt immediately because they are incurred today—in the present. The benefits (higher earnings), on the other hand, occur in the future. They are not yet available. We must discount all future benefits by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[43] A brief example: at 4%, the present value of $5,000 to be received one year from today is $4,807. If the $5,000 were to be received in year ten, the present

[43] Technically, the interest rate is applied to compounding—the process of looking at deposits today and determining how much they will be worth in the future. The same interest rate is called a discount rate when we reverse the process—determining the present value of future earnings.

value would reduce to $3,377. Or put another way, $4,807 deposited in the bank today earning 4% interest will grow to $5,000 in one year; and $3,377 deposited today would grow to $5,000 in ten years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 ten years from today given the going rate of interest of 4%. The process of discounting—finding the present value of future higher earnings—allows us to express values on an equal basis in future or present value terms.

Our goal is to express all future higher earnings in present value terms so that we can compare them to the investments incurred today—the tuition and foregone earnings. As indicated in **Table 1**, the cumulative present value of the flow of $5,000 worth of higher earnings between years 2 and 10 is $35,747 given the 4% interest rate, far lower than the undiscounted $45,000 discussed above.

The measure we are looking for is the net present value of $15,074. It is simply the present value of the benefits less the present value of the costs, or $35,747 - $20,673 = $15,074. In other words, the present value of benefits exceeds the present value of costs by as much as $15,074. The criterion for an economically worthwhile investment is that the net present value is equal to or greater than zero. Given this result, it can be concluded that, *in this case*, and given these assumptions, this particular investment in college education is very strong.

THE INTERNAL RATE OF RETURN (IRR)

The internal rate of return is another way of measuring the worth of the investment in education using the same cash flows shown in **Table 1**. In technical terms—the internal rate of return is a measure of the average earning power of the money used over the life of the investment. It is simply the interest rate that makes the net present value equal to zero. In the NPV example above we applied the "going rate" of interest of 4% and computed a positive net present value of $15,074. The question now is: what would the interest rate have to be in order to reduce the net present value to zero? Obviously it would have to be higher—18% in fact, as indicated in **Table 1**. Or, if we applied 18% to the NPV calculations instead of the 4%, then the net present value would reduce to zero.

What does this mean? The internal rate of return of 18% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the net present value equals zero. Or, at 18%, the higher incomes of $5,000 per year for the next nine years will earn back all the investments of $21,500 made plus pay 18% for the use of that money (the $21,500) in the meantime. Is this a good return? Indeed it is—first, if we compare it to the 4% "going rate" of interest we applied to the net present value calculations, 18% is far higher than 4%. We can conclude, therefore,

that the investment in this case is solid. Alternatively, we can compare the rate to the long-term 7% rate or so obtained from investments in stocks and bonds. Again, the 18% is far higher, indicating that the investment in community or technical education is strong relative to the stock market returns (on average).

A word of caution—the IRR approach can sometimes generate "wild" or "unbelievable" results—percentages that defy the imagination. Technically, the approach requires at least one negative cash flow (tuition plus opportunity cost of time) to offset all subsequent positive flows. For example, if the student works full-time while attending college, the opportunity cost of time would be much lower—the only out-of-pocket cost would be the $1,500 paid for tuition. In this case, it is still possible to compute the internal rate of return, but it would be a staggering 333% because only a negative $1,500 cash flow will be offsetting nine subsequent years of $5,000 worth of higher earnings. The 333% return is technically correct, but not consistent with conventional understanding of returns expressed as percentages. For purposes of this report, therefore, we express all results in the Main Report exceeding 100% simply as "NA," or we leave them out altogether.

THE BENEFIT/COST RATIO (B/C)

The benefit/cost ratio is simply the present value of benefits divided by present value of costs, or $35,747 / $21,500 = 1.7 (based on the 4% discount rate). Of course, any change in the discount rate will also change the benefit/cost ratio. If we applied the 18% internal rate of return discussed above, the benefit/cost ratio would reduce to 1.0—or the breakeven solution where benefits just equal the costs. Applying a discount rate higher than the 18% would reduce the ratio to less than one and the investment would not be feasible. The 1.7 ratio means that a dollar invested today will return a cumulative $1.70 over the ten year time period.

THE PAYBACK PERIOD

This is the length of time from the beginning of the investment (consisting of the tuition plus the earnings foregone) until the higher future earnings return the investments made. In **Table 1**, it will take roughly 4.2 years of $5,000 worth of higher earnings to recapture the student's investment of $1,500 in tuition and the $20,000 earnings he or she foregoes while attending the community or technical college. The higher earnings occurring *beyond* the 4.2 years are the returns (the "gravy") that make the investment in education *in this example* economically worthwhile. The payback period is a fairly rough, albeit common, means of choosing between investments. The shorter the payback period is, the stronger the investment will be.

Appendix 7: Overview of the Input/Output Model

OVERVIEW

Input-output (IO) models are based on a double entry accounting system that shows the interconnection of industries, government and households. IO theory has been around since the 1930s and has won the Nobel Prize in economics for its inventor, Wassily Leontief. Textbooks on IO theory and practice are numerous, although we recommend Miller and Blair (1985).

The model employed in the present study is obtained from the U.S. Department of Commerce (the U.S. national IO model), and managed by software developed by Economic Modeling Specialists, Inc. (EMSI) of Moscow, Idaho. Models employed at the individual college level are likewise developed using the EMSI IO modeling system and software. EMSI regional IO multipliers are produced using common "data-reduction" techniques, and produce multipliers of similar magnitude as those generated by other popular regional IO modeling products, such as the IMPLAN model (Minnesota IMPLAN Group, Stillwater, MN) and RIO Model (Rutgers University, Center for Urban Policy Research, New Brunswick, NJ).

EMSI regional IO modeling software was used to develop the Utah Multiregional IO (UMRIO) model (Governor's Office of Planning and Budget, et al. [Salt Lake City, UT: Demographic and Economic Analysis, 1994]), the Idaho Economic Modeling Project (IDAEMP) (M. H. Robison, R. Coupal, N. Meyer, and eds [Moscow, ID: University of Idaho, College of Agriculture, 1991]), and the Oregon Economic Modeling System (OREMS) (M. H. Robison, Proceeding at the 29th Annual Pacific Northwest Economic Conference [Missoula, MT: 1995]).[44]

REDUCING MULTIPLIER IMPACTS

IO models track the so-called "ripple" or "multiplier" effects of a given direct economic event. In the case of the analyses reported in our main report, the ripple effects stem from the increased incomes of community and technical college students. With added incomes, students have more money to spend which subsequently affects earnings in other industries through multiplier effects. Similarly, the businesses that hire these workers are more productive, purchasing additional inputs and rewarding business owners with greater incomes. This generates further multiplier effects. At the national

[44] The approach is also chronicled in M.H. Robison, "Community Input-Output Models for Rural Area Analysis: With an Example from Central Idaho," (Annals of Regional Science 31 no. 3 (1997): 325-331.

level, multiplier effects can amount to as much as 150% of direct effects.[45] An important function of models is the estimation of multiplier effects.

It has been argued that overall multiplier effects like the ones just described overstate net effects by as much as 80%.[46] The reason is that while the economy is stimulated and incomes increase, the factors of production (land, labor and capital) receiving these increased incomes abandon lower paying next-best opportunities. At some level the jobs and uses of capital that are left behind are simply left undone, or perhaps outsourced overseas. The result is that gross multiplier effects need to be reduced to reflect this opportunity cost of taking a newly created job.

Few IO analysts bother to make the correction just described. In contrast, and to provide impact results that might be described as "conservative," we apply the maximum downward adjustment suggested by the literature. Thus, in the main report we estimate gross multiplier effects using an EMSI IO model, then discard all but 20% of the indicated indirect impact.

[45] Multipliers are generally defined as the total effect divided by the direct effect – or the direct and indirect effects divided by the direct effect. An impact effect described as 150% of the direct effect would be associated with a multiplier of 2.5 (direct effect = 1.0; indirect effect = 1.5).
[46] See J.R. Hamilton, N.K. Whittlesey, M.H. Robison and J. Ellis, "Economic Impacts, Value Added and Benefits in Regional Project Analysis" (*American Journal of Agricultural Economics* 31 no. 2 (1991): 334-344).

Appendix 8: Aggregate Production Function

Our assessment of the economic growth effect of community and technical college education is guided by a familiar model drawn from standard neo-classical production and distribution theory (e.g., Ferguson, 1964; Heckman and Klenow, 1997). Following this model, we view the national economy's overall output of goods and services (i.e., its GDP) as a function of the following three inputs: simple labor, human capital, and physical capital. We will define "simple labor" more fully below.

Our analysis of education earnings differentials and the achievements of community and technical college students provides an estimate of increased earnings as a result of college attendance (**Chapter 3** above). Viewed another way, this same dollar value can be considered the aggregate annual return to the increment of added human capital as a result of community and technical college education. This appendix examines the impact of increased human capital on the return to the other two factors of production, i.e., simple labor and physical capital. Added to our estimate of increased human capital returns is the change in returns to the other two factors – this equals the overall economic growth impact of community and technical college education.

A Rough Estimate of Relative Factor Shares

Simple Labor

In our capital-labor view of the production process, "simple labor" serves as an analytic fiction permitting us to separate "human capital" from some unskilled foundation everyone is assumed to possess prior to acquiring experience, training or formal education of any kind. An individual's income is then seen as a return to two factors: 1) their allotment of "simple labor" and, 2) their accumulated "human capital."

Return to Factors

Figure 1 further below provides a rough estimate of the relative factor shares in U.S. National GDP. The figures are highly rounded approximates obtained from the U.S. Department of Commerce's *National Product and Income Accounts*. Current U.S. national GDP is approximately $11 trillion. At the same time, the economy provides roughly 167 million jobs, and some $7 trillion in total labor income. A minimum wage job, paying $7 to $8 per hour, yields an annual income of roughly $15 thousand. If we assume this value equals the annual return to a worker's complement of simple labor, then the *aggregate* economy-wide return to simple labor is roughly $2.5 trillion (167 million jobs x $15 thousand per job).

Subtracting the $2.5 trillion simple labor component from $7 trillion in total labor income provides our estimate of aggregate return to human capital in the U.S. economy, $4.5 trillion. What remains, $4.0 trillion, is the aggregate return to physical capital.[47]

A THREE-INPUT AGGREGATE PRODUCTION FUNCTION

Since first introduced in the 1950's, the so-called "constant elasticity of substitution production function," or CES production function, has been used to examine a wide range of both micro- and macro-economic issues. For the purpose of addressing our macro-economic growth issue, we employ the following three input variation (e.g., Heckman and Klenow, 1997):

$$(1)\quad Q = \gamma\left[\alpha L^{u} + (1-\alpha)\left[\beta K^{\rho} + (1-\beta)H^{\rho}\right]^{u/\rho}\right]^{1/u}$$

where:

Q = aggregate output (in our case GDP)

L = simple labor

H = human capital

K = physical capital

$0 < \rho < 1$
$0 < \mu < 1$

and other terms are assorted constant model parameters.

Two other terms, most important to our analysis can be defined:

$\sigma = \frac{1}{1-\mu}$ is the elasticity of substitution, simple labor and capital

$\delta = \frac{1}{1-\rho}$ is the elasticity of substitution, human capital and physical capital

Marginal products are derived with the help of the following simplifications of (1)

$$Q = \gamma G^{1/u}$$

[47] Inasmuch as GDP includes depreciation of physical capital, our estimated $4.0 trillion capital return includes the so-called "return of capital" depreciation, as well as the "return on capital."

$$Q = \gamma\left[\alpha L^{u} + (1-\alpha)M^{u/\rho}\right]^{1/u}$$

Marginal products are now given by:

$$(2)\quad Q_L = \gamma G^{\frac{1-u}{u}}\alpha L^{u-1}$$

$$(3)\quad Q_H = \gamma G^{\frac{1-u}{u}}(1-\alpha)M^{\frac{u-\rho}{\rho}}(1-\beta)H^{\rho-1}$$

$$(4)\quad Q_K = \gamma G^{\frac{1-u}{u}}(1-\alpha)M^{\frac{u-\rho}{\rho}}\beta K^{\rho-1}$$

Since (1) is homogenous of degree 1, Euler's theorem holds and the sum of factor incomes exhausts the economy's output:

$$(5)\quad Q = Q_L L + Q_K K + Q_H H$$

ELASTICITY OF SUBSTITUTION MAGNITUDES

It is generally recognized that currently emerging technologies favor the skilled worker. At the same time, the new technologies require considerable capital inputs as well, generally computers or related electronic equipment. Skilled labor (human capital) and physical capital are thus highly complementary in the production process.

Input complementarity is reflected in a low elasticity of substitution, i.e., by relative inelasticity. When the elasticity of substitution is low, an increase in one input will raise the marginal product of other inputs. With factors of production rewarded according to their marginal products, an increase in marginal product means an increase in factor returns, which encourages a greater application of these factors. In the case of physical capital, an increase in return encourages additional investment.

Figure 1 below presents simulations using the aggregate production function (1) and three alternative assumptions regarding the magnitude of the elasticities of substitution. Inputs are everywhere expressed in trillions of current dollars. Thus, and with reference to our discussion above regarding factor returns and current U.S. GDP, the input of simple labor is $2.5 (trillion); physical capital, $4.0 (trillion); and human capital, $4.5 (trillion). With model parameters as indicated in the table, the economy produces current output of $11.0 (trillion). The purpose of our simulations is to examine the impact an increase in human capital has on the marginal products of simple labor and human capital. For the purposes of our simulations, we arbitrarily choose a 10% increase.

Two Plausible Simulations

As discussed above, there are good reasons to suppose that human and physical capital are complementary inputs. With simple labor, as described in our model, things are likely different. As reflected in the widely differing levels of education and experience among people, education and experience (the wellsprings of human capital) can obviously be expanded to a considerable degree without adding new persons – this indicating a high elasticity of substitution between these two inputs. At the same time, and again as discussed above, much of the physical capital seen in the modern economy can be viewed as complementary of human capital as opposed to simple labor, i.e., what is needed to exploit the new capital is not additional workers per se, but rather more trained workers. This would again indicate a relatively high elasticity of substitution, this time between physical capital and simple labor.

The simulations shown in Columns 1 and 2 of **Figure 1** reflect relative complementarity of physical and human capital, and relative substitutability of simple labor and the other two inputs. Accordingly, both columns show a relatively low elasticity of substitution (0.111) for physical capital and human capital, and differ only in the elasticity of substitution for simple labor and the other two inputs: the first assumes highly elastic substitution (5.0), while the second assumes a unitary elasticity of substitution (1.0).[48] Elasticities of substitution are shown on the table's first two rows.

Figure 1. Simulations with Alternative Elasticity of Substitution Assumptions

	Simulation 1	Simulation 2	Simulation 3
σ	5.000	1	10,000
δ	0.111	0.111	10,000
γ	2.9	2.9	3
α	0.3	0.24	0.35
β	0.25	0.25	0.5
μ	0.8	0.000000009	0.9999
ρ	-8	-8	0.9999
L	$2.5	$2.5	$2.5
H	$4.5	$4.5	$4.5
K	$4.0	$4.0	$4.0
Q	$11.0	$11.0	$11.0
Q_K change	46.2%	45.0%	0.0%
Q_L change	0.7%	3.3%	0.0%

[48] We approximate unitary elasticity in the substitutions above, i.e., with a value only approaching 1.0. With the CES production function, an exactly unitary elasticity of substitution is not possible.

The response in the marginal products of physical capital and simple labor to a 10% increase in human capital is shown on the bottom two rows of **Figure 1**. Note the considerable increase in the marginal product of physical capital. The more complementary two factors are, the greater the effect on the marginal product of the unchanged factor. As for the process of market adjustment to these changes, standard neoclassical economic theory would suggest that, absent the needed complements of physical capital, the additions to human capital at first appear somewhat redundant – competition for the existing stocks of physical capital puts upward pressure on their price (i.e., upward pressure on the returns to physical capital). This spawns an increase in physical capital investments until market equilibrium is restored. Barring some interim change in technologies, equilibrium returns when physical capital has increased by 10%, restoring the original ratio of physical capital to human capital.

Note the relatively small change in the marginal product of simple labor, a reflection of the assumed high elasticity of substitution. If we had assumed an infinite elasticity of substitution, then simple labor's marginal product response would have been zero. We will assume that the impact on the returns to simple labor are not particularly great, and direct most of our focus on the impact to the returns of physical capital.

The conclusion we draw from the analyses indicated by the simulations in **Figure 1**'s first two columns is this: Given the considerable complementarity exhibited in today's economy between human and physical capital, it is relatively safe to assume that an increase in the aggregate returns to human capital (indicating increased quantities of human capital) will be accompanied by increased investments in physical capital, followed by a roughly proportionate increase in aggregate returns to physical capital.

A Third Simulation

Figure 1's third column presents an implausible but nonetheless instructive simulation: a case where elasticities of substitution are infinite in all directions,[49] i.e., where inputs are all infinitely substitutable. Note that compared to simulations 1 and 2, the assumption here is only slightly more extreme with regard to simple labor and human capital: the elasticities of substitution there ranged from highly elastic to unitary, where here it is infinitely elastic. The real difference with this simulation is with regard to the elasticity of substitution of human capital and physical capital. Where before it was assumed to be highly inelastic (.1111), here it is assumed to be infinitely elastic. With elasticities of substitution infinite in all directions, an increase in one input, in our case human capital, is accompanied by no change in the marginal products of the other inputs (change in marginal products are indicated on the bottom two rows of the table).

[49] As shown in the table, we approximate infinite with an elasticity of substitution equal to 10,000.

Accordingly, an increase in human capital, e.g., stemming from an increase in community and technical college education, brings forth no additional investment in physical capital, and therefore no change in the aggregate returns to physical capital.

The implausible case offered by our third simulation is most important in assigning a value to the change in non-human capital returns in response to a change in human capital. It would appear that the appropriate course is to assume that returns to physical capital increase in the same proportion as an increase in human capital, i.e., if returns to human capital show, say, a 10% increase, then returns to physical capital will likewise increase by 10%. The assumption is tantamount to specifying that the ratio in aggregate production of physical to human capital tends toward constancy. Only in the highly implausible case where the elasticity of substitution among factors is everywhere infinitely elastic is it appropriate to assume that an increase in the returns to human capital equals the overall impact of a change in the magnitude of human capital.

ESTIMATING PHYSICAL CAPITAL RETURNS TO EDUCATION

In **Chapter 3** of this report we estimate the direct increase in earnings due to community and technical college instruction. In the course of completing our individual college studies, we gather data on the approximate industries where leaving students find employment. Where this information is not provided, we assume a pattern that favors higher development-stage industries (e.g., Parr, 1999). The final pattern emerging from this data-collection and estimation process is shown in Column 1 of **Figure 2**.

Column 2 of **Figure 2** shows the ratio of value added to earnings from the U.S. national input-output model. GDP is roughly the sum of all value added in the economy. Our estimate of the impact of increased student earnings is obtained by multiplying the direct earnings impact by the value added to earnings ratios in Column 2.

Figure 2. Table Industries Employing Community and Technical College Students, and Industry Ratios of Value Added to Earnings

Industries	Percent of all CC & TC Students 1	Ratio of GDP to Earnings 2
Agriculture and Agricultural Services	1.0%	1.56
Mining, Sand, and Gravel	0.5%	3.80
Construction	1.4%	0.88
Manufacturing: Food, Wood, Paper, and Textiles	2.6%	1.79
Manufacturing: Chemicals, Petroleum, Stone, and Glass	4.6%	1.69
Manufacturing: Computer and Electronic Equipment	1.7%	1.20
Manufacturing: Other	3.1%	1.25
Transportation	2.9%	1.24
Public Utilities	2.1%	3.43
Publishing and Communications	2.9%	3.14
Trade	15.6%	1.74
Finance, Insurance, and Real Estate	12.9%	4.52
Motels, Eating/Drinking, and Amusement/Recreation	2.4%	1.34
Consumer Services	4.9%	0.97
Business Services	12.7%	0.97
Medical/Educational/Social Services	14.2%	1.00
Federal Government	2.7%	1.00
State and Local Government	12.0%	1.00
Total	100.0%	1.54

Sources: Data in Column 1 are assembled from U.S. Department of Commerce, Regional Economic Information System, CA and SA series; the U.S. Department of Commerce, *County Business Patterns*; and the U.S. Department of Commerce, Bureau of Labor Statistics ES-202 series.

Appendix 9: Detailed Tables

The purpose of this appendix is to present the results of the economic impact analysis in detail by gender, ethnicity, and entry level of education. It is kept as a separate appendix intended for limited distribution only, however, because this effort is not about gender and ethnicity differences *per se*. The study is about the overall economic impacts generated by community and technical colleges. As such, the main text presents the results without reference to gender and ethnicity differences.

We feel, nevertheless, that it is important to present *all* of the results for the sake of completeness, not just the consolidated ones, so long as the users of the detailed information remain prudent in its use and distribution. The results should not be used, for example, to further any political agendas. Other studies about gender and ethnicity differences address such questions better and in greater detail. Our intent is simply to provide pertinent information should specific questions arise.

On the data entry side, gender and ethnicity are important variables that help characterize the student body profile. We collect the profile data and link it to national statistical databases which are already broken out by gender and ethnic differences. The student body profile, to a large extent, drives the magnitudes of the results which are presented in detail in this volume and in a consolidated fashion in the main report.

Note that the tabular results presented in this appendix are calculated values based on the data inputs provided by the colleges in combination with the various national databases and other parameters invoked to generate the results. The literature references for these databases and parameters are listed in the main report text, and the major sources are also presented in conjunction with the summary tables in this appendix.

Table 1. Higher Annual Earnings Based on Achievements During Analysis Year, Aggregate

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	$1,445,990,532	$314,984,238	$734,787,122	$209,121,349	$2,704,883,240
HS/GED equivalent	$500,833,472	$109,071,856	$254,783,420	$72,494,206	$937,182,954
One year post HS or less	$3,298,786,547	$766,635,076	$2,488,391,692	$778,047,561	$7,331,860,875
Two years post HS or less	$4,469,378,987	$747,145,968	$3,427,168,216	$816,923,860	$9,460,617,032
> Associate Degree	$237,261,985	$28,471,122	$192,859,321	$32,942,178	$491,534,607
Total	$9,952,251,523	$1,966,308,260	$7,097,989,771	$1,909,529,154	$20,926,078,709

Sources: Computed from data supplied by the U.S. Census Bureau, Housing and Household Economic Statistics Division; U.S. Census Bureau, Income Surveys Branch/HHES Division, "Median for 4-Person Families, by State" (October 2003); U.S. Census Bureau, "Table P-3. Race and Hispanic Origin of People by Mean Income and Sex: 1947 to 2000" (September 2002); U.S. Census Bureau, "Table P-18. Educational Attainment—People 25 Years Old and Over by Mean Income and Sex: 1991 to 2000" (September 2002).

Table 2. Number of Days Reduced Absenteeism per Year

	Male		Female		Reduce
	White	Minority	White	Minority	Absent.
< HS/GED	254,404	117,123	333,801	252,313	957,642
HS/GED equivalent	14,381	6,618	18,871	14,258	54,129
One year post HS or less	716,645	353,791	1,145,533	957,152	3,173,121
Two years post HS or less	464,919	164,561	743,967	474,672	1,848,118
> Associate Degree	154,305	39,126	261,025	118,394	572,851
Total	1,604,654	681,219	2,503,198	1,816,790	6,605,860

Sources: Computed from data supplied by the Labor Market Reporter, "U.S. Employee Absences by Industry: 1997" [database on-line] (*The Public Purpose* : accessed September 2001); Labor Market Reporter, "U.S. Employee Absences by Industry Ranked: 1997" [database on-line] (*The Public Purpose* : accessed September 2001).

Table 3. Employer Savings from Reduced Absenteeism, $ per Year

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	$23,611,264	$6,613,847	$17,621,012	$10,584,438	$58,430,560
HS/GED equivalent	$2,133,821	$597,459	$1,527,034	$916,857	$5,175,171
One year post HS or less	$122,029,804	$36,654,223	$108,024,687	$71,726,702	$338,435,416
Two years post HS or less	$92,004,352	$19,814,022	$82,893,177	$42,028,418	$236,739,969
> Associate Degree	$34,659,518	$5,347,241	$33,440,141	$12,053,153	$85,500,053
Total	$274,438,759	$69,026,792	$243,506,051	$137,309,568	$724,281,169

Sources: Computed from data supplied by the Labor Market Reporter; see also Table 2.

Table 4. Fewer Smokers

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	304	17	160	13	494
HS/GED equivalent	674	39	356	30	1,099
One year post HS or less	1,476	100	965	96	2,637
Two years post HS or less	1,267	73	849	74	2,262
> Associate Degree	13,762	632	9,895	668	24,957
Total	17,483	861	12,225	880	31,449

Sources: Computed from data supplied by the National Center for Chronic Disease Prevention and Health Promotion, Behavioral Risk Factor Surveillance System [database on-line] (accessed March 2001); National Center for Health Statistics, "Table 60. Current cigarette smoking by persons 18 years of age and over" in *Health, United States, 2001* (Hyattsville, MD, 2001); National Center for Health Statistics, "Table 61: Age-adjusted prevalence of current cigarette smoking," in *Health, United States, 2001* (Hyattsville, MD, 2001); U.S. Census Bureau, "Table 1. Educational Attainment of the Population 15 Years and Over" in *Educational Attainment in the United States, March 2000* (December 2000).

Table 5. Medical Savings from Reduced Smoking, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$900,358	$50,239	$473,165	$38,238	$1,462,000
HS/GED equivalent	$1,996,910	$115,490	$1,055,206	$87,816	$3,255,421
One year post HS or less	$4,372,415	$297,017	$2,859,535	$283,440	$7,812,407
Two years post HS or less	$3,751,999	$216,693	$2,514,512	$218,826	$6,702,030
> Associate Degree	$40,767,955	$1,872,198	$29,312,437	$1,977,949	$73,930,539
Total	$51,789,637	$2,551,636	$36,214,855	$2,606,269	$93,162,397

Sources: Computed from data supplied by the U.S. Department of Treasury, *The Economic Costs of Smoking in the United States and the Benefits of Comprehensive Tobacco Legislation* , Report-3113 (Washington, D.C., 1998); see also Table 4.

Table 6. Fewer Alcohol Abusers

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	1,719	622	1,190	339	3,870
HS/GED equivalent	130	47	87	25	290
One year post HS or less	9,088	3,497	6,892	2,282	21,759
Two years post HS or less	8,703	2,388	5,739	1,555	18,386
> Associate Degree	3,375	660	2,156	434	6,625
Total	23,015	7,214	16,064	4,635	50,929

Sources: Computed from data supplied by the National Institute of Alcohol Abuse and Alcoholism, "Percent reporting alcohol use in the past year by age group and demographic characteristics: NHSDA, 1994-97" (August 1999); National Institute on Drug Abuse, *The Economic Costs of Alcohol and Drug Abuse in the United States – 1992* (Bethesda, MD: National Institute of Health, 1998); Thomas Nephew and others, eds., *Surveillance Report #55: Apparent Per Capita Alcohol Consumption: National, State and Regional Trends, 1977-98* (Rockville, MD: National Institute on Alcohol Abuse and Alcoholism, 2000).

Table 7. Medical Savings from Reduced Alcohol Abuse, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$13,654,943	$4,945,731	$9,453,954	$2,694,080	$30,748,707
HS/GED equivalent	$1,033,842	$373,683	$694,410	$200,789	$2,302,723
One year post HS or less	$72,205,422	$27,786,894	$54,760,693	$18,131,955	$172,884,963
Two years post HS or less	$69,153,441	$18,971,120	$45,601,918	$12,358,197	$146,084,676
> Associate Degree	$26,815,443	$5,245,334	$17,129,166	$3,446,206	$52,636,150
Total	$182,863,090	$57,322,761	$127,640,141	$36,831,227	$404,657,219

Sources: Computed from data supplied by the National Institute of Alcohol Abuse and Alcoholism and the National Institute on Drug Abuse; see also Table 6.

Table 8. Fewer Incarcerated, Aggregate for Student Body

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	6,165	2,959	70	502	9,696
HS/GED equivalent	400	214	5	35	654
One year post HS or less	19,575	14,333	269	2,776	36,954
Two years post HS or less	9,653	8,059	133	1,466	19,310
> Associate Degree	2,445	1,974	36	347	4,802
Total	38,238	27,540	512	5,127	71,416

Sources: Computed from data supplied by Allen J. Beck and Paige M. Harrison, *Prisoners in 2000* (Washington, D.C.: U.S. Department of Justice, August 2001); National Center for Education Statistics, *Literacy Behind Prison Walls* (Washington, D.C.: U.S. Department of Education, October 1994); National Institute for Literacy, Correctionall Educational Facts [home page on-line] (accessed March 2001); Sandra Kerka, "Prison Literacy Programs. ERIC Digest No. 159" [database on-line] (1995); Stephen J. Steurer, Linda Smith, and Alice Tracy, "Three State Recidivism Study" (Lanham, MD: Correctional Education Association, September 2001); Thomas P. Bonczar and Alan J. Beck, *Lifetime Likelihood of Going to State or Federal Prison* (Washington, D.C.: U.S. Department of Justice, March 1997); US Census Bureau, "Table 1. Educational Attainment of the Population 15 Years and Over, by Age, Sex, Race, and Hispanic Origin" in *Educational Attainment in the United States March 2000* (December 2000).

Table 9. Savings from Reduced Incarceration, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$65,230,053	$31,312,395	$738,049	$5,313,479	$102,593,976
HS/GED equivalent	$4,235,985	$2,267,626	$47,917	$373,944	$6,925,472
One year post HS or less	$207,137,074	$151,663,492	$2,850,462	$29,377,078	$391,028,106
Two years post HS or less	$102,140,440	$85,278,277	$1,404,421	$15,507,428	$204,330,566
> Associate Degree	$25,868,122	$20,888,969	$376,207	$3,676,744	$50,810,042
Total	$404,611,674	$291,410,759	$5,417,056	$54,248,674	$755,688,163

Sources: Computed from data supplied by the Correctional Education Association, the National Center for Education Statistics, the U.S. Census Bureau, and the U.S. Department of Justice; see also Table 8.

Table 10. Crime Victim Savings, Aggregate for Student Body, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$71,841,127	$34,485,910	$812,850	$5,852,001	$112,991,889
HS/GED equivalent	$4,665,303	$2,497,450	$52,773	$411,844	$7,627,370
One year post HS or less	$228,130,442	$167,034,607	$3,139,356	$32,354,449	$430,658,854
Two years post HS or less	$112,492,387	$93,921,241	$1,546,760	$17,079,108	$225,039,495
> Associate Degree	$28,489,859	$23,006,068	$414,336	$4,049,383	$55,959,646
Total	$445,619,118	$320,945,276	$5,966,075	$59,746,784	$832,277,253

Sources: Computed from data supplied by D. A. Anderson, "The Aggregate Burden of Crime" (*Journal of Law and Economics* XLII 2, October 1999): 611-642; Ted R. Miller, Mark A. Cohen, and Brian Wiersema, *Victim Costs and Consequences: A New Look* (Washington, D.C.: U.S. Department of Justice, National Institute of Justice, January 1996); see also Table 8.

Table 11. Productivity Gained (Fewer Incarcerated), $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$25,313,402	$7,393,241	$159,630	$913,255	$33,779,527
HS/GED equivalent	$2,117,361	$689,649	$13,062	$81,007	$2,901,079
One year post HS or less	$111,259,835	$49,565,263	$841,800	$6,894,248	$168,561,147
Two years post HS or less	$62,990,553	$31,998,668	$483,584	$4,243,250	$99,716,055
> Associate Degree	$18,409,939	$9,413,429	$151,789	$1,178,854	$29,154,011
Total	$220,091,090	$99,060,250	$1,649,865	$13,310,614	$334,111,819

Sources: Computed from data supplied by the Correctional Education Association, the National Center for Education Statistics, the U.S. Census Bureau, and the U.S. Department of Justice; see also Table 8.

Table 12. Fewer People on Welfare

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	3154	2542	10401	7733	23831
HS/GED equivalent	211	170	695	517	1592
One year post HS or less	10942	9459	43953	36139	100494
Two years post HS or less	6060	3757	24349	15308	49473
> Associate Degree	1657	736	7046	3144	12583
Total	22,024	16,664	86,444	62,841	187,973

Sources: Computed from data supplied by the Committee on Ways and Means, *2000 Ways and Means Green Book*, 17th ed. (Washington D.C.: U.S. House of Representatives, October 2000); Health Care Financing Administration, *A Profile of Medicaid: Chartbook 2000* (Washington, D.C.: U.S. Department of Health and Human Services, September 2000); Robert Rector, *Means-Tested Welfare Spending: Past and Future Growth* [database on-line] (Heritage Foundation, March 2001); Social Security Bulletin, *Annual Statistical Supplement, 2000* [database on-line] (December 2002);Temporary Assistance for Needy Families (TANF) Program, "Table 12: Percent distribution of TANF adult recipients by race" and "Table 17: Percent distribution of TANF adult recipients by educational level" in *Characterisitics and Financial Circumstances of TANF Recipients* (Washington D.C.: U.S. Department of Health and Human Services, May 1999); U.S. Census Bureau, Population Division, "Table ST-EST2002-01 - State Population Estimates" [database on-line] (December 2002).

Table 13. Community Welfare Savings, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$12,765,459	$10,287,817	$42,096,475	$31,299,655	$96,449,406
HS/GED equivalent	$852,975	$687,195	$2,813,027	$2,090,863	$6,444,061
One year post HS or less	$44,286,723	$38,285,405	$177,892,169	$146,264,279	$406,728,577
Two years post HS or less	$24,526,723	$15,205,257	$98,545,860	$61,955,740	$200,233,581
> Associate Degree	$6,707,795	$2,977,700	$28,518,045	$12,724,799	$50,928,340
Total	$89,139,675	$67,443,375	$349,865,577	$254,335,337	$760,783,964

Sources: Computed from data supplied by the Health Care Financing Administration, the Heritage Foundation, the Social Security Bulletin, the Temporary Assistance for Needy Families (TANF) Program, and the U.S. Census Bureau; see also Table 12.

Table 14. Fewer People on Unemployment

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	5,060	3,304	6,505	4,249	19,117
HS/GED equivalent	408	266	525	343	1,541
One year post HS or less	4,786	6,759	7,382	10,783	29,710
Two years post HS or less	2,086	2,083	3,288	3,580	11,037
> Associate Degree	1,045	748	1,732	1,351	4,876
Total	13,385	13,160	19,432	20,305	66,282

Sources: Computed from data supplied by the Health Care Financing Administration, the Heritage Foundation, the Social Security Bulletin, the Temporary Assistance for Needy Families (TANF) Program, and the U.S. Census Bureau; see also Table 12.

Table 15. Unemployment Savings, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$42,448,814	$27,716,498	$54,572,042	$35,644,021	$160,381,375
HS/GED equivalent	$3,422,827	$2,234,415	$4,400,564	$2,873,633	$12,931,439
One year post HS or less	$40,149,981	$56,701,076	$61,933,291	$90,461,013	$249,245,362
Two years post HS or less	$17,498,536	$17,476,799	$27,582,255	$30,037,017	$92,594,607
> Associate Degree	$8,769,430	$6,273,256	$14,534,394	$11,331,440	$40,908,520
Total	$112,289,587	$110,402,044	$163,022,546	$170,347,125	$556,061,302

Sources: Computed from data supplied by the Health Care Financing Administration, the Heritage Foundation, the Social Security Bulletin, the Temporary Assistance for Needy Families (TANF) Program, and the U.S. Census Bureau; see also Table 12.

Appendix 10: CHE Production and the Nationwide Workforce

This study estimates that a total of 2.2 billion CHEs earned at community and technical colleges entered the nationwide workforce between 1974 and 2003. To determine whether or not such a number is reasonable, it must be compared with an independent data source.

The first step is to calculate the average number of CHEs earned per worker over the course of the past thirty years. In 1974, the average number of CHEs earned per student in a lifetime was 57.0, largely due to the high percentage of students in Associate Degree and transfer-track programs. In 2003, the high number of students enrolled in non-credit courses and/or one-year certificate programs caused the average CHEs to drop from 57.0 to 45.4. The average for the entire thirty-year period was 51.2 CHEs.

Figure 1. Average CHEs Earned per Worker Over Thirty-Year Period

Student Category	Average CHEs	1974 %	1974 CHEs	2003 %	2003 CHEs
Category 1: Retired Students	15	0%	0.0	3%	0.4
Category 2: Associate Degree	65	25%	16.3	3%	2.0
Category 3: Certificate	35	0%	0.0	2%	0.6
Category 4: Transfer Track	55	47%	25.9	33%	17.9
Category 5: Workforce	55	26%	14.3	35%	19.1
Category 6: Court-Required	10	0%	0.0	0%	0.0
Category 7: ABE/ESL/GED	10	0%	0.0	11%	1.1
Category 8: Non-Credit	30	2%	0.6	14%	4.1
Averages			57.0		45.4
Thirty-Year Average					51.2

As shown in **Figure 2**, there are an estimated 43.3 million workers in the workforce who attended a community or technical college. This translates to around 2.2 billion CHEs (43.3 million x 51.2 CHEs). Altogether, the number of workers with community college experience comprises 26.5% of the nationwide workforce.

Figure 2. Percent of Workforce Attributable to Community and Technical Colleges - Data Set 1

Total CHEs	2,217,981,224
Workers attributable to U.S. community and technical colleges	43,326,085
% of workers with two or more jobs	2.0%
Jobs attributable to U.S. community and technical colleges	44,192,607
Total U.S. workforce	166,990,400
% of workforce attributable to community and technical colleges	26.5%

Source: U.S. Department of Commerce, Bureau of Economic Analysis. 2003 Annual State Personal Income, "SA25N Total full-time and part-time employment by industry."

The number of workers with community college experience must now be determined using independent data sources. Educational attainment and national historical enrollment statistics are provided in **Figure 3**. As shown in the bottom row of the table, the percentage of the total population 16 years and older who attended community college is 22.6%.

Figure 3. Percent of Population 16 Years and Older Who Attended Community or Technical College

Education Attainment	% of Population	% of Education Attrib. to CCs	% of Population Attended CC
Some College, No Degree	14.8%	37.7%	5.6%
Associate Degree	7.2%	100.0%	7.2%
Bachelor or Higher	22.9%	30.0%	6.9%
		Subtotal	19.6%
		Workforce Education	3.0%
		TOTAL	22.6%

Sources: U.S. Department of Education, National Center for Education Statistics. Digest of Education Statistics, 2002, "Table 173: Total fall enrollment in degree-granting institutions, by control and type of institution: 1965 to 2000."; U.S. Census Bureau. March 2001 and March 2002 Current Population Survey, "Table C-1. Comparison of Educational Attainment: 2001 and 2002."; U.S. Census Bureau. Census 2000 Special EEO Tabulation, "Educational Attainment by Geography, Sex and Age for Total U.S."

Figure 4 provides statistics for the total population who are currently active in the workforce. The number of people with community college experience comes to around 49.1 million (217.3 million x 22.6%). Of this number, a total of 41.8 million people are active in the nationwide workforce, as compared to the 43.3 million of **Figure 2**. Thus an estimated 25.5% of the total workforce is attributable to community colleges. When compared to the 26.5% figure from **Figure 2**, the two sets of results are found close enough to be reasonable.

Figure 4. Percent of Workforce Attributable to Community and Technical Colleges - Data Set 2

Population 16 years of age and older	217,312,000
% with community or technical college experience	22.6%
Population with community or technical college experience	49,142,424
% active in workforce	85.0%
Persons in workforce with community or technical college exp.	41,771,061
% of workers with two or more jobs	2.0%
Jobs attributable to community and technical colleges	42,606,482
Total U.S. workforce	166,990,400
% of workforce attributable to community and technical colleges	25.5%

Sources: U.S. Census Bureau. March 2001 and March 2002 Current Population Survey, "Table C-1. Comparison of Educational Attainment: 2001 and 2002."; U.S. Census Bureau. Census 2000 Special EEO Tabulation, "Educational Attainment by Geography, Sex and Age for Total U.S."