THE ECONOMIC CONTRIBUTION OF THE COMMUNITY COLLEGES OF OREGON

An Analysis of Investment Effectiveness

And Economic Growth

Volume 1: Main Report

State of Oregon

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ACRONYMS

ABE	Adult Basic Education
ACCT	Association of Community College Trustees
B/C	Benefit/Cost Ratio
CHE	Credit Hour Equivalent
ESL	English as a Second Language
GED	General Equivalency Diploma (also Education Development Certificate)
HS	High School
IO	Input-Output Analysis
NCF	Net Cash Flow
NPV	Net Present Value
REIS	Regional Economic Information System
RR	Rate of Return

PREFACE

The CCbenefits SEIM model left the development stage late in 2000 after passing peer review and field tests with 8 "pilot schools." With a product such as this, however, peer and other reviews never stop. We have now applied the SEIM to roughly 500 colleges in the U.S. and Canada, and along the way routinely received valuable insights, questions and suggestions from institutional researchers, financial officers and others. As a result of these, relatively minor revisions are more or less continuous.

With the release of the present version of the SEIM and accompanying reports, a somewhat more dramatic set of revisions are introduced. Most of these are stylistic. For example, the chapters are restructured, and much of the text is streamlined for easier reading. Other changes add new features and therefore value to the reports, including the following:

- Data updates in the SEIM model, specifically to the earnings and income data, state and local tax information, and the social variables;
- The inclusion of the value of leisure time in the student opportunity cost of time;
- The internalization of the alternative education variable;
- The application of out-of-state attrition variables to the investment analysis;
- The addition of the "Who Benefits the Most" piece in **Chapter 3** of this report.

At least two changes not listed above reflect more significant analytic improvements. The first of these changes reflects our approach to deriving regional economic growth from changes in student earnings. Our original version relied on an international education and economic growth literature. However, additional review and research, including comments from peer reviewers, convinced us that our approach was predictably underestimating the actual economic growth effect of community and technical college education. Accordingly, we replaced our earlier international growth literature approach with one based on neo-classical production theory.

A second adjustment has to do with our estimation of community college operations and spending effects. As observed by several reviewers, these effects might overstate the actual community college economic impact because at least some of the monies that fund colleges come from within the state, and thus are withdrawn from the economy.

Our new approach estimates this withdrawal effect, and subtracts it from the positive college operations and expenditure effects.

We thus have two major changes in the estimation of college economic impacts. First, in the way we estimate economic growth resulting from higher student earnings, and, secondly, in the way we estimate the impact of college operations and spending. The first of these changes increased the overall impact of the college, while the second decreased it. All in all, we feel that these changes have not only substantially strengthened the theoretical underpinnings of the analysis, but they have also increased the accuracy and transparency of the study as a whole.

CONCLUSIONS

This report presents the economic impacts generated by the Oregon community colleges in the state. The study presents two major analyses: 1) investment analyses from the perspectives of the students and the taxpayers, and 2) economic growth analysis to determine the relative contribution of the colleges to labor and non-labor income in the state. The major findings are as follows:

INVESTMENT RESULTS

1. **Students:** The analysis recognizes the Oregon community colleges as a wise investment on the part of students. Compared to their counterpart with only a high school diploma, the typical Associate Degree graduate will see an increase in annual earnings of $11,000 (rounded), or approximately $374,400 over the course of a working lifetime. This figure does not capture a host of other well-documented personal incidental benefits from education, including increased job satisfaction, improved health, and others.

2. **Taxpayers:** The analysis considers the Oregon community colleges as an investment on the part of state and local government taxpayers. Taxpayers bear roughly 48% 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 the Oregon community colleges into increased state and local government revenues (via increased tax receipts). Added to these is 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 the Oregon community colleges yields an investor rate of return equal to 19%, well above the 4% opportunity cost of funds. The bottom line: the Oregon community colleges return more to taxpayers than they cost. The colleges 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 the Oregon community colleges are measured using conservative assumptions in this study. Unlike many impact studies, we discount the impacts stemming solely from college operations by the estimated portion of funding that comes from within the state. This is in recognition of the fact that monies devoted to

funding colleges are diverted from other uses – what the economy gains on one hand, it gives up on the other. In the case of the Oregon community colleges, for example, the colleges receive about 74% of their funding from sources within the state. These are monies that would have been spent in the state anyway and are not attributable to the actions of the colleges. We thus discount the total impact of college operations accordingly. Given these adjustments, it is estimated that college operations explain roughly $344.5 million in labor and non-labor income in the Oregon economy.

By far the greatest impact of the Oregon community colleges relates to workforce development, i.e., as newly skilled college-trained workers deepen the state and local 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 labor and non-labor incomes stemming from a collection of additional economy-wide multiplier effects. The analysis of the Oregon community colleges indicates that the past students annually contribute about $10.1 billion to economic growth in the State of Oregon.

In sum, college operations and past student productivity effects account for approximately $10.4 billion of labor and non-labor income in the State of Oregon – this figure amounts to roughly 8.9% of a typical year's statewide income. Clearly it is not inaccurate to describe the colleges as engines of economic growth.

Chapter 1
INTRODUCTION

OVERVIEW

Colleges generate a wide array of benefits. Students benefit directly from higher personal earnings, and society at large benefits indirectly from cost savings (avoided costs) associated with reduced welfare and unemployment, improved health, and reduced crime. Higher education, however, requires a substantial investment on the parts of the students and the taxpayers. Therefore, all education stakeholders—taxpayers, legislators, employers, and students—want to know if they are getting their money's worth. In this study, the Oregon community colleges investigate the attractiveness of their returns 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 and benefit/cost ratios, etc.), and 3) regional economic benefits, including income formation and returns to the business community.

The report has five chapters and six appendices. **Chapter 1** is an overview of the benefits measured and the analytical approach. **Chapter 2** presents underlying data, mainly collected from the Oregon community 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 the Oregon community colleges on economic growth in the state. Finally, **Chapter 5** provides sensitivity analyses of some of the softer variables used in the study. **Appendix 1** is a simple glossary of terms. **Appendix 2** provides a detailed technical/theoretical explanation of how benefits must be adjusted if colleges can still stay open absent state and local government support. **Appendix 3** 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 4** 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 5** provides the details on the input/output model used in generating the regional impact results. **Appendix 6** explains the variances in the results between the present study and the one that was previously conducted for the Oregon community colleges in 2002.

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 Socioeconomic Impact (SEIM) model, and in turn used the model to generate more than 500 community college socioeconomic impact studies to date. 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 investment 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 economic effects of the colleges: To what extent do the colleges increase local and state income, and which sectors of the economy benefit the most?

Studies that aim to measure the economic impact of community colleges are not new. Most studies, however, cover a rather narrow scope, confining their analyses to the computation of the simple multiplier effects stemming from the annual operation expenditures of the colleges. While 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: Although the written reports generated for the Oregon community colleges are similar in text to the reports prepared for other colleges, the results differ widely.

These differences, however, do not necessarily indicate that some colleges are doing a better job than others. Differences among colleges are a reflection of the student profiles, particularly whether or not the students are able to maintain their jobs while attending, and the extent to which state and local taxpayers fund the colleges. Therefore, if the average student rate of return for College A is 15%, and that of College B is 20%, that does not necessarily mean that B is doing a better job than A. Rather, it may simply be attributable to the employment opportunities in the region, or that one college may enroll more women than men, or more minorities, and/or different kinds of students such as transfer or workforce. In turn, the student body profiles are associated with their own distinct earnings functions reflecting these employment, gender and ethnicity differences. The location of the college, therefore, dictates the student body profile, which, to a large extent, translates into the magnitudes of the results. Thus, College A with a 15% student rate of return may actually be a better or more efficiently managed school than College B with a 20% student rate of return. Any difference in management efficiency is not equal to the difference between the two returns.

METHODS

To date, CCbenefits has applied the SEIM model to roughly 450 individual colleges in the United States, 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 of 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 college under analysis.

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 three ways: 1) in the aggregate (covering the entire student body), 2) per credit-hour equivalent (CHE), defined as a combination of credit and non-credit attendance,[1] and 3) per full-time equivalent student.

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 **4** 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.

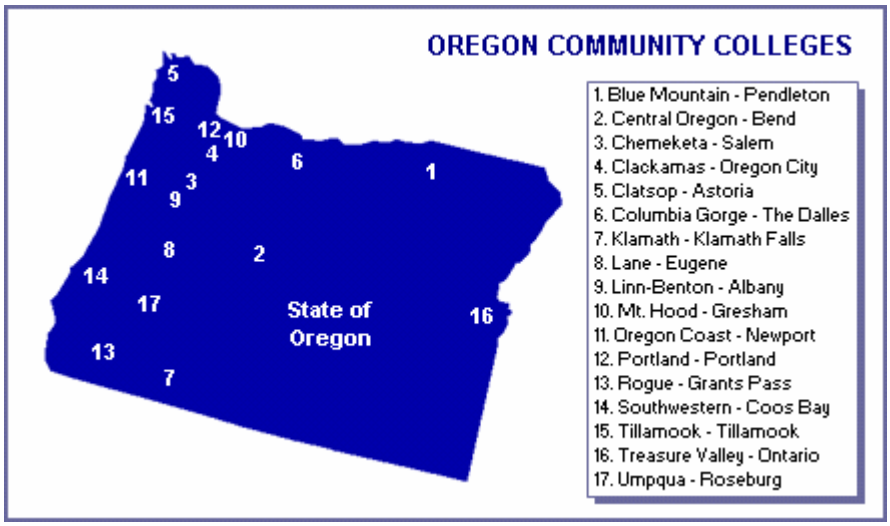
[2] Retirement at age 65 is only our assumption. In some areas people retire earlier, in others later. Whether they retire at 62, 65, or 67, this will not change the magnitudes of the results by much. The assumption only affects the time horizon over which the analysis is conducted.

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 the Oregon community colleges benefit local businesses directly by raising the skill level of the labor force. Trained employees are associated with a broad range of regional 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 state level, agglomeration and economic spread and linkage effects add still more to the positive economic impact generated by the education produced by the colleges.

In this study we show the impact of the Oregon community colleges as creators of income in the state economy. Increased earnings are displayed by industrial sector (for the purposes of this report, we employ the major divisions of the North American Industry Classification System [NAICS], which includes all industrial and service sectors). The role that the Oregon community colleges play in the state economy is then indicated by the percentage of sector-by-sector income explained by the colleges. In general, these college-linked incomes fall under two categories: 1) income generated by the annual operating and capital expenditures of the colleges; and, 2) income attributable to the skills embodied in the workforce.

The participating colleges are shown in the map below. The entire State of Oregon comprises the backdrop for the calculation of the economic impacts presented in this report.



Chapter 2
DATA SOURCES AND ASSUMPTIONS

INTRODUCTION

To the extent possible, documented statistics obtained from several databases and from the colleges were used to craft the assumptions on which the results are based. In the cases where hard data were not available, the college institutional researchers on the scene applied well-informed judgments and estimations on the basis of their intimate knowledge of the colleges and student bodies.

This chapter contains six sections documenting our data sources and assumptions: 1) college profile; 2) gross private benefits by education levels; 3) the social benefit assumptions (health, crime, and welfare/unemployment); 4) education costs; 5) other assumptions (the discount rate used, health, crime, and welfare cost statistics, etc.); and 6) assumptions pertaining to regional economic effects.

COLLEGE PROFILE

Faculty, Staff, and Operating Budget

A total of 5,538 full and 6,813 part-time faculty and staff were employed by the Oregon community colleges in fiscal year 2005. Their combined payroll amounted to a total of some $467.6 million (see **Table 2.11** below).

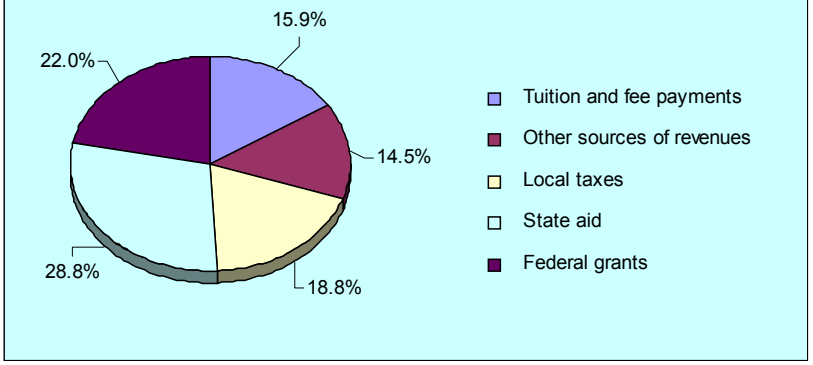
Table 2.1 shows the colleges' annual revenues by funding source: combined annual revenue, capital and auxiliary budgets of roughly $764.6 million. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (15.9%) plus 14.5% from other private sources (such as contract revenues, interest payments and the like). Public funding is comprised of local taxes (18.8%), state aid (28.8%), and federal grants (22.0%). These budget data are critical in identifying the annual costs of educating the 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. Aggregate Revenues

Sources	Revenues	Total	% of Total
Private Funding			
Tuition and fee payments	$121,496,248		15.9%
Other sources of revenues	$110,992,341	$232,488,589	14.5%
Public Funding			
Local taxes	$143,390,594		18.8%
State aid	$220,355,104		28.8%
Federal grants	$168,323,817	$532,069,515	22.0%
Total		$764,558,104	100%

Source: Data supplied by the colleges. Note that the tuition and fee revenue is inclusive of student loans, since these are considered a cost to the student.

Figure 2.1. Revenues



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** through **2.4** summarize the student body profile. The unduplicated student body headcount of the Oregon community colleges is 346,206 (fiscal 2005 enrollment). This total consists of both credit and non-credit students.

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 Oregon community colleges.[3] In **Table 2.2**, the rows labeled "Students employed while attending college (%)" and

[3] 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.

"Full-time earning potential (%)" provide the percentage estimates of the students who held jobs (80%) while attending college, and how much they earned (64%) 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.[4]

Table 2.2. Student Body Profile

		Values
Total headcount of unduplicated credit students		149,747
Total headcount of unduplicated non-credit students		196,459
Total unduplicated enrollment, all campuses		346,206
Enrollment on campus for which analysis is carried out	100%	346,206
Students employed while attending colleges (%)		80%
Full-time earning potential (%)*		64%
Students remaining in state after leaving colleges		93%
Thirty-year attrition rate (leaving state)**		5%
"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

*Note: This is calculated through the application of regression analyses based on estimates provided by some 200 colleges analyzed to date.

**Note: This assumption is internal to the analytical model.

Sources: Student headcount and employment variables supplied by the colleges. 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).

As indicated in the table, it is estimated that 93% of the students remain in the state and thereby generate state benefits. The remaining 7% leave the state and are not counted as contributing to statewide economic development. The 93% local retention rate applies only to the first year, however. The analytical model also assumes that 5% of the students, and thus associated benefits, will leave the state over the next thirty years due to attrition (e.g., retirement, out-migration, or death).

[4] For example, students might make $20 an hour working full-time in a factory, yet only $10 an hour in a service sector job that accommodates their school attendance. Thus their annual earnings while attending college fall short of what they would *potentially* be earning had they chosen to work full-time. These "lost" earnings are precisely what the earnings variables aim to capture. In the model, full-time earnings foregone reflect the age, gender and ethnicity of the student body, all localized to reflect wages prevailing in the State of Oregon. Additional detail on these earnings and their derivation appear in the text accompanying **Table 2.5** and **Table 2.9** below.

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 table references). 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.

Entry-Level Education, Gender, and Ethnicity

Table 2.3 and **Figure 2.2** show the education level, gender, and ethnicity of the student body. This breakdown is used only to add precision to the analysis, not for purposes of comparing between different groups.[5] Five education entry levels are indicated in approximate one-year increments, ranging from less than High School to post Associate Degree. These provide the platform upon which the economic benefits are computed.

The *entry level* characterizes the education level of the students when they first enter the colleges; this is consistent with the way most colleges keep their records. The analysis in this report, however, is based on the educational achievements of the students during the current year. As not all students reported in the enrollment figures for the fiscal year are in their first year of college, an adjustment was made to account for students who had accumulated credits during their college experience and moved up from the "<HS/GED" category. For this reason, the education levels of the student body must also be estimated for the beginning of the analysis year. Thus, of the 64,610 white males who first entered with a high school diploma or GED, it is estimated that only 18,632 still remain in that category at the beginning of the analysis year, meaning that 45,979 students have actually moved up from the "HS/GED equivalent" category to the "One year post HS or less" category or beyond since they first entered college.[6]

Note that the "Entry Level" and "Begin Year" columns always add to the same total. Differences between the two columns reflect a redistribution of students from entry level to where they are estimated to be at the beginning of the analysis year. The assumptions underlying the process of redistributing the students from the "Entry Level" to "Begin

[5] In this volume we present the gender and ethnicity breakdown only in **Table 2.3**. Otherwise, the breakdown is presented as weighted averages for the remainder of the report. Please refer to the separate companion volume, **Volume 2: Detailed Results**, to see the breakdown by gender, ethnicity and level of education.

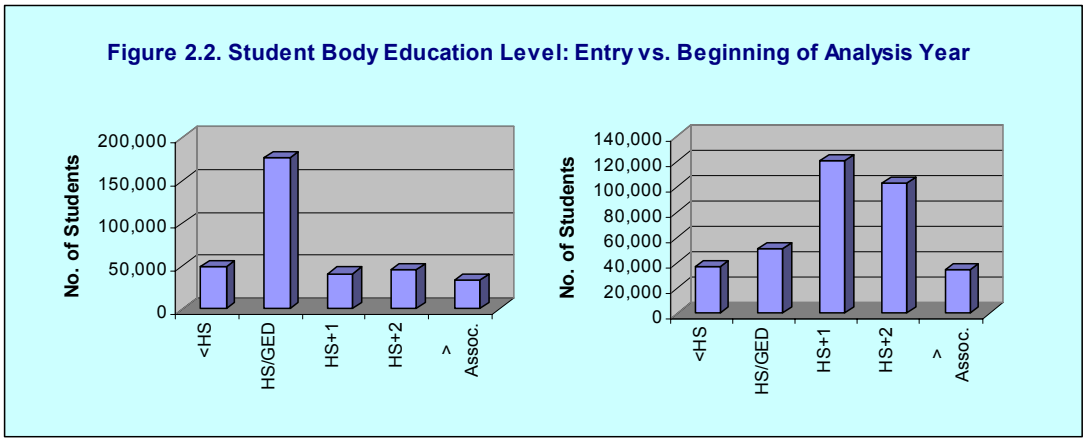
[6] These calculations are based on parameters (such as the frequency of "stopouts") that characterize how typical college students progress over time in their college career from when they first started up to the analysis year.

Year" columns are internal to the economic model—they are designed to capture the dynamics of the educational progress as the students move up the educational ladder beyond their entry level.

Table 2.3. Student Body Education Level: Entry vs. Beginning of Analysis Year

	White Male		Minority Male		White Female		Minority Female		Total	
Education Level	Entry Level	Begin Year	Entry Level	Begin Year	Entry Level	Begin Year	Entry Level	Begin Year	Entry Level	Begin Year
< HS/GED	16,219	12,176	7,116	5,342	19,045	14,298	6,820	5,120	49,200	36,936
HS/GED equivalent	64,610	18,632	11,991	3,531	84,196	24,243	15,468	4,513	176,266	50,918
One year post HS or less	13,350	43,164	2,731	8,852	21,542	57,837	3,781	11,170	41,405	121,024
Two years post HS or less	15,476	35,523	2,850	6,930	23,190	51,360	4,115	9,336	45,631	103,149
> Associate Degree	10,683	10,843	1,659	1,692	18,443	18,678	2,920	2,967	33,705	34,180
Total	120,338	120,338	26,347	26,347	166,416	166,416	33,105	33,105	346,206	346,206

Source: The colleges provided data on the breakdown of the student body by gender, ethnicity and level of education (e.g., less than HS, HS/GED equivalent, some college, etc.). These data are broken down into the five education levels shown in Table 2.3 based on parameters internal to the analytical model.



The Achievements

Table 2.4, along with **Figures 2.3** and **2.4**, shows the student breakdown in terms of analysis year academic pursuits and/or achievements, allocated according to seven basic categories: 1) retired and/or leisure students, 2) Associate Degree completers, 3) Certificate completers, 4) transfer students and/or degree non-completers, 5) workforce students, 6) ABE/ESL/GED students, and finally, 7) all other students.

As indicated in the table, students who achieved their graduation goals during the analysis year would be those completing Associate Degrees (1.8%) or Certificates (0.4%). Transfer students and/or degree-bound students who did not complete during the analysis year comprised 36.4% of the student body. Other students completed college credits to improve their skills or to fulfill their educational needs (21.0% + 18.6% = 39.6% in the workforce and all other student categories, respectively).

Retired students (13.4%) 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 (8.5%) 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.[7]

The fourth column of **Table 2.4** shows the average age of the students generating the benefits (excluding retired and leisure students). The time horizon for the analysis is 34 years, which is the difference between the average age (31 years) and retirement age (65 years). The total number of CHEs completed during the year of analysis for the entire student body is 4.6 million. The last column of the table 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).

Table 2.4. Levels of Achievement

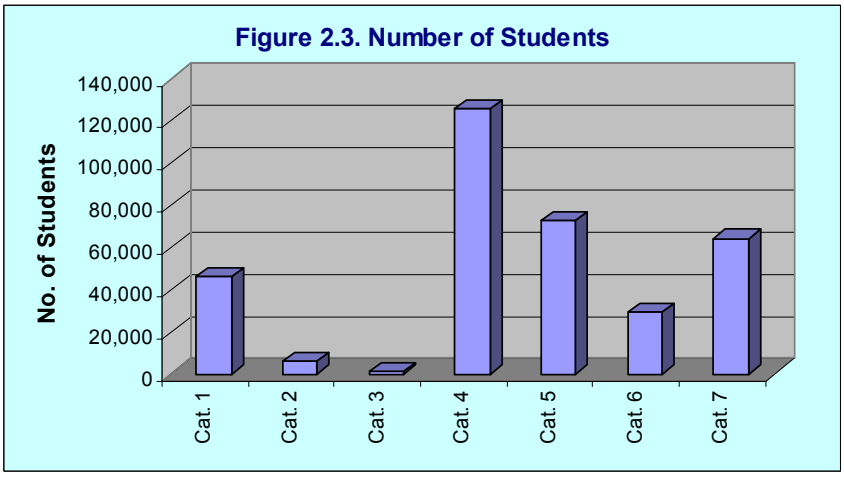
Student Body Category	Student Distribution	Student Headcount	Average Age*	CHEs This Year	Total CHEs	CHEs/ FTE**
Cat. 1 - Retired and/or leisure students	13%	46,298	50	3	122,748	0.1
Cat. 2 - Associate's Degree completers	2%	6,245	30	49	303,970	1.1
Cat. 3 - Certificate completers	0%	1,256	34	61	76,802	1.4
Cat. 4 - Transfer track and non-completing	36%	125,941	29	24	3,017,235	0.5
Cat. 5 - Workforce students	21%	72,641	40	3	213,643	0.1
Cat. 6 - ABE/ESL/GED	8%	29,366	30	14	409,468	0.3
Cat. 7 - All other students	19%	64,459	35	8	494,783	0.2
Total or weighted averages	100%	346,206	31	15	4,638,649	0.3

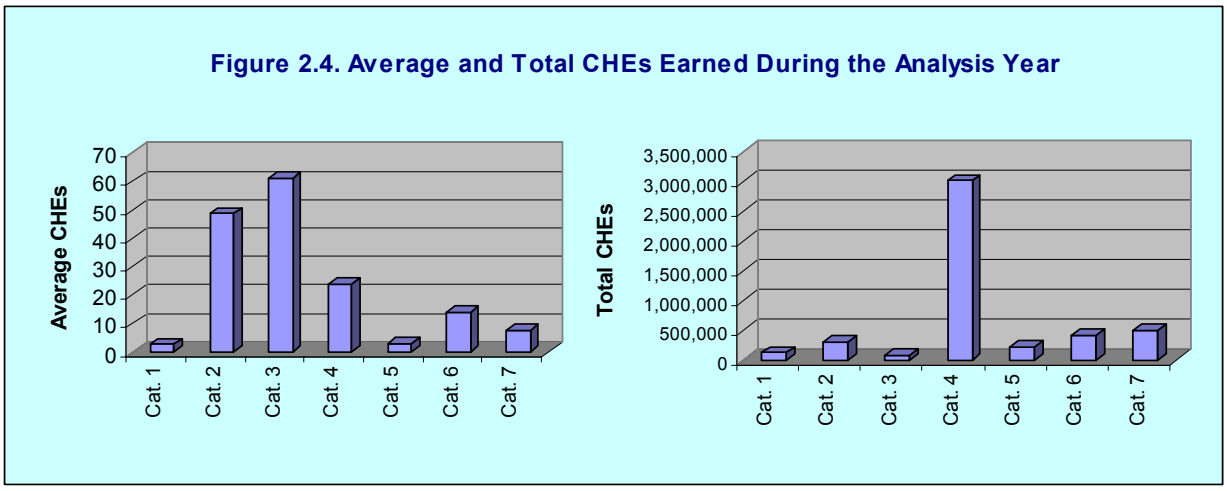
*Note: The average age and the average CHEs of the entire student body (shown in the bottom row of the table) do not include retired, leisure or court-required students, as these students are backed out of the study altogether. Their total CHEs, however, are included in the impact calculations, because, as paying students, they comprise a portion of the total number of CHEs produced by the colleges. As a result, multiplying student headcount (Column 3) times the average CHEs of the entire student body may not agree with the total number of CHEs shown at the bottom of Column 6.

**Note: A total of 45 CHEs is required to achieve one full-time year equivalent of study, or FTE.

Source: Computed internally by the model based on data supplied by the colleges.

[7] 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. The economic value attributable to the educational achievements of ABE/ESL/GED students is assumed to be roughly 45.8% (relative to a 100% attribution for other students), based on previous studies completed by CCbenefits, Inc.





GROSS PRIVATE BENEFITS (INCREASED EARNINGS)

The numbers shown in **Table 2.5** are constructed from national data and point to the effect of schooling on employee earnings. These data become an important part of our basis for estimating the student earnings benefits reported below in **Chapters 3** and **4** below.

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 education 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.

As education milestones are achieved, students move into higher levels of average earnings. **Table 2.5** shows average earnings by one-year education increments, linked to the gender and ethnicity profile of the student body. We assume that *all* education has value, and thus attribute value to students completing full steps as well as those completing less than full steps. The differences between the steps are indicated in the last column.

Table 2.5. Weighted Average Earnings

Entry Level	Average Earnings*	Difference
One year short of HS/GED	$18,799	NA
HS/GED equivalent	$29,781	$10,982
One-year Certificate	$34,602	$4,820
Two-year Associate Degree	$40,771	$6,169
One year post Associate Degree	$46,788	$6,016

* Note: The data in this table reflect earnings at the midpoint of the individual's working career, not immediately upon exiting college.

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

GROSS ANNUAL PUBLIC BENEFITS

As shown in **Table 2.5,** students benefit from higher education through higher earnings, and society benefits from higher student earnings as well. As will be shown in **Chapter 3** below, higher earnings translate into additions in Gross State Product (GSP), which basically adds non-labor income to the students' added labor income (i.e., higher earnings). The public benefits from added tax revenues collected from both labor and non-labor income.

Higher education is also 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 the "Beekeeper Analogy" 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 Oregon community 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 colleges.

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.

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.

Adjustment Factors

Before continuing, it is important to note that all of our gross benefit estimates are adjusted to account for the following three factors: 1) the ability bias discussed above,[8] 2) the alternative education variable, and 3) the level at which a college may still operate absent all state and local government support (also called the "Shutdown Point"). Detail on these variables and how they are estimated may be found in **Appendices 2** and **3** at the end of this report.

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

Higher Incomes

Broad Perspective: Higher education accelerates general economic growth. The economy generates more income (both labor and non-labor income) than it would without the college skills embodied in the labor force. From the broad taxpayer perspective, the total increase in state income is counted as a benefit of college education, reduced to account for the several factors such as the ability bias discussed above.

Narrow Perspective: Higher state income translates into higher state and local *tax collections*. In the narrow taxpayer perspective we count only the estimated higher state and local taxes that will be collected from the increase in state income.[9]

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 2.5** through **2.7** 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, also linked to the gender and ethnicity profile of the student body. Recall from above, these savings are 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 reduction factors, as 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, all health-related benefits, including those that accrue solely to employers and individuals, are considered 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 at 15.2%, equal to the estimated public portion of

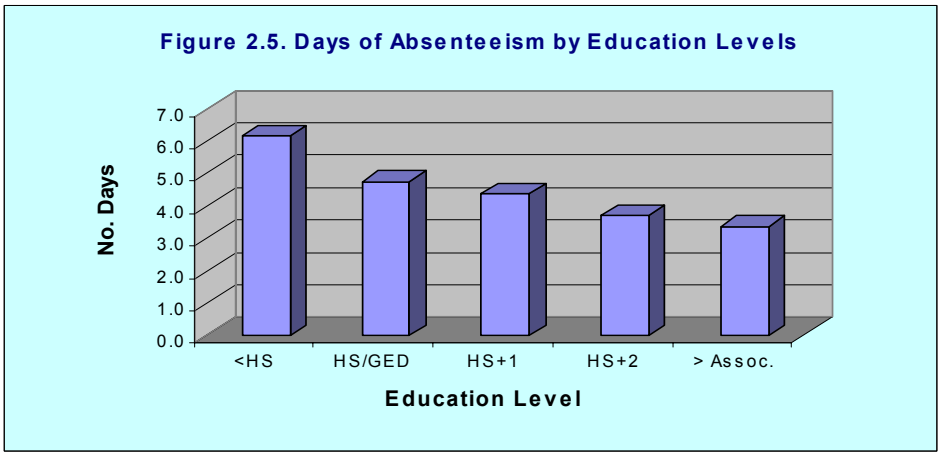
[9] Tax data are obtained from the U.S. Census Bureau and the U.S. Department of Commerce.

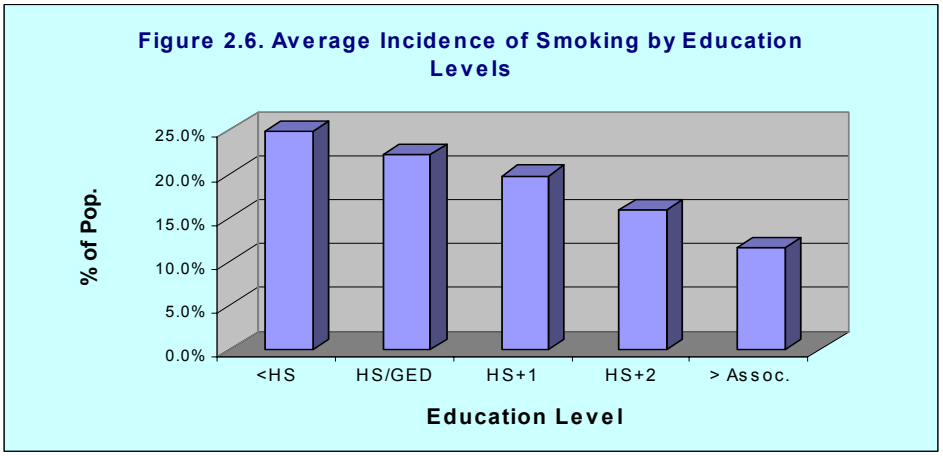
employment in the state.[10] As for smoking and alcohol-related savings, the taxpayers benefit to the extent that state and local health subsidies (to hospitals, for example) are reduced. We assume that 6.0% of the total benefits can be counted as taxpayer savings.

Table 2.6. Reduced Absenteeism, Smoking, and Alcohol Habits

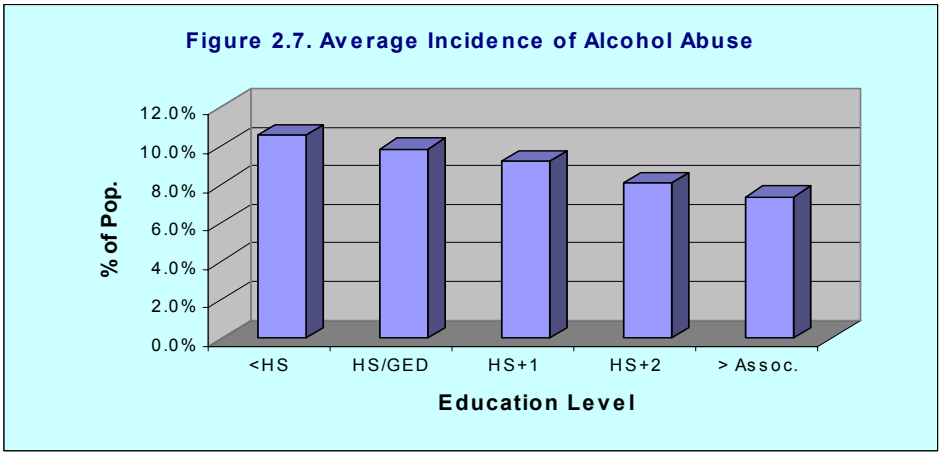
	Absenteeism		Smoking		Alcohol Abuse	
Education Level	Days	%/Year	Average	Reduction	Average	Reduction
< HS/GED	6.1	2.4%	24.8%	NA	10.5%	NA
HS/GED equivalent	4.7	1.8%	22.1%	10.7%	9.8%	6.7%
One year post HS or less	4.4	1.7%	19.8%	10.6%	9.2%	6.6%
Two years post HS or less	3.7	1.4%	15.9%	19.5%	8.1%	12.2%
> Associate Degree	3.4	1.3%	11.5%	27.5%	7.4%	8.9%

Sources: See Volume 2: Detailed Results, Tables 2 through 7.





[10] The ratio of state and local government earnings over total state earnings (Regional Economic Information System—REIS, Bureau of Economic Analysis, U.S. Department of Commerce, 1998).



Crime Reduction Benefits

Table 2.7 and **Figure 2.8** show the rates of incarceration by education levels – incarceration drops on a sliding scale as education levels rise.[11] These statistical patterns are calibrated to the gender and ethnicity profile of the student body. 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 incarceration 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.

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

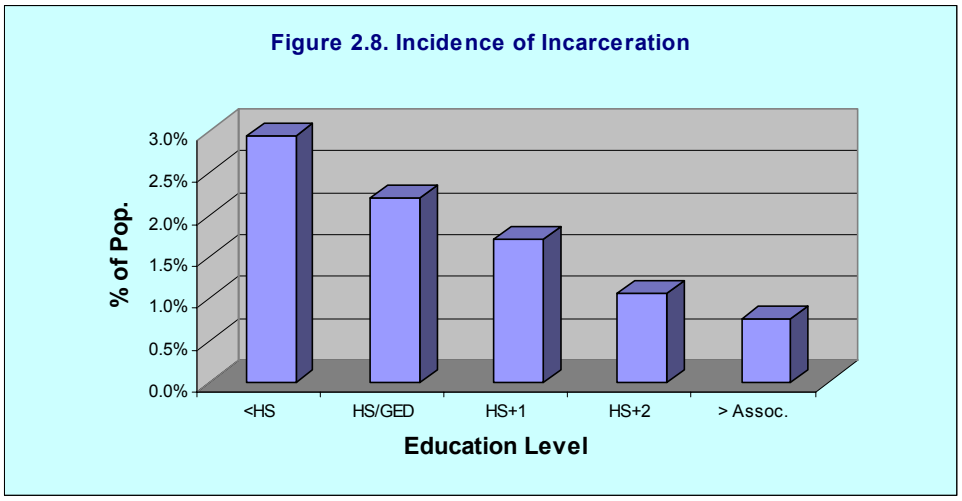
Narrow Perspective: We assume that nearly all of the incarceration savings accrue to the state and local taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to the potential victims, not to the taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our "composite" state and local government average tax rate (14.4%) to the added productivity of persons *not* incarcerated to arrive at the taxpayer benefits.

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

Table 2.7. Incarceration Rates

Education Level	Average	Reduction
< HS/GED	2.9%	NA
HS/GED equivalent	2.2%	25.1%
One year post HS or less	1.7%	22.5%
Two years post HS or less	1.1%	38.1%
> Associate Degree	0.8%	28.1%

Sources: See Volume 2: Detailed Results, Tables 8 through 11.



Welfare and Unemployment Reduction Benefits

Lower welfare and unemployment are statistically associated with higher education. **Table 2.8** and **Figure 2.9** relate the probabilities of individuals applying for welfare and/or unemployment assistance to education levels (linked to the gender and ethnicity profile of the student body). As above, all welfare and unemployment savings are reduced to account for alternative education opportunities, ability bias, and other reduction factors discussed above.

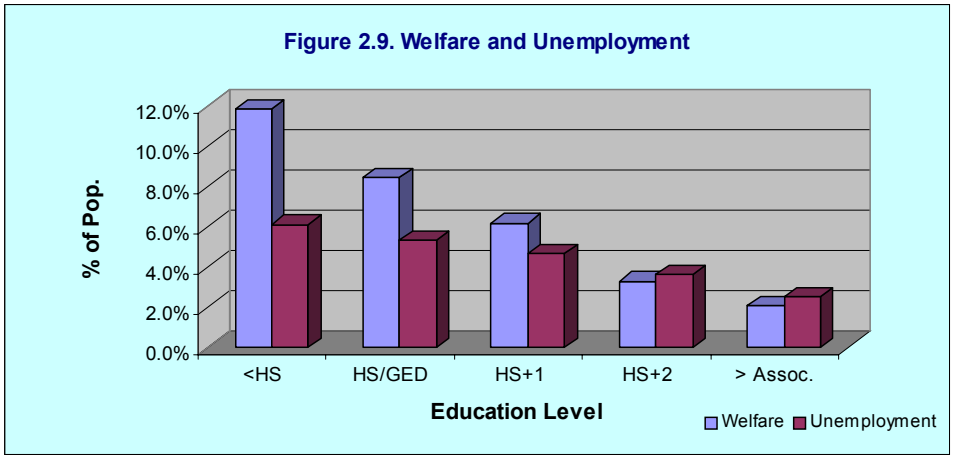
Broad Perspective: Reduced welfare and unemployment claims multiplied by the average cost per year are counted in full as benefits in the broad taxpayer perspective.

Narrow Perspective: Taxpayer benefits from reduced welfare are limited to 16.0%—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 taxpayers.

Table 2.8. Welfare and Unemployment

	Welfare		Unemployment	
Education Level	Average	Reduction	Average	Reduction
< HS/GED	11.8%	NA	6.1%	NA
HS/GED equivalent	8.4%	28.7%	5.3%	12.7%
One year post HS or less	6.2%	26.8%	4.6%	12.7%
Two years post HS or less	3.3%	46.6%	3.6%	22.4%
> Associate Degree	2.1%	37.7%	2.5%	30.0%

Sources: See Volume 2: Detailed Results, Tables 12 through 15.



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 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 what would be possible if they were not attending school.

The opportunity cost (earnings foregone) incurred by the student body in the aggregate is estimated in **Table 2.9**. The first number in the table - $33,599 - is the overall average annual income of the student body (given gender and ethnicity characteristics). This

number is derived from the earnings categories by education entry levels given in **Table 2.5**, although with some important modifications, as briefly described below:

- Earnings data in **Table 2.5** are derived using national census data, adjusted by a ratio of state earnings to national earnings per worker. These data are averages based on trajectories of earnings for all ages, from 17 to 65 (the time typically spent engaged in the workforce).

- Average earnings of $33,599 thus 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.[12] However, what we actually need are the earnings of the students while enrolled (which are expected to be less than earnings at the midpoint).

- To calculate the average earnings of the student body, we condition earnings at the midpoint by the student body's entry level of education and average age (31 years in **Table 2.4**), as specified by the well-known and tested Mincer equation. The result, $22,899 per year, is the average earnings of the student body, assuming full-time employment. This is the second number shown in the table.

Once we have determined the average annual income of the students, we deduct the retired/leisure student body (13.4%) to arrive at the net number of students subject to opportunity cost calculations—299,908 students. (Retired and leisure students typically do not expect to receive higher earnings as a result of their college attendance, so their opportunity cost is set at $0.) It is estimated that the average student spends at least 33% of the year at college, time which he or she could have otherwise spent working. This translates to a total of $7,662 in earnings foregone per student per year.

For the 61,383 non-working students, the opportunity cost is the full measure of the incomes not earned during their college attendance. This comes to a total of $470.3 million for the entire student body (= 61,383 students x $7,662 in earnings). The 238,525 working students, on the other hand, are charged only a fraction of the full opportunity cost, plus the value of the leisure time given up. It is estimated that the working students are earning, on average, about 64% relative to full earning potential (i.e., because the

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

student is going to college, he is only able to hold a job that pays about 64% of what he would be statistically earning had he been working full-time). The total opportunity cost for such students thus comes to around $661.9 million (= 238,525 * $7,662 * 36%), plus an additional $365.5 million to account for the leisure time given up.[13]

Finally, we adjust the opportunity cost downward by the unrestricted portion of Pell and other student aid grants. Such funds are paid out directly to the students to use as they so choose, and are thus excluded from the student opportunity cost calculations. Altogether, the combined opportunity cost for all of the students comes to around $1.5 billion.

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

		Opp. Cost
Average statistical annual income of given gender and ethnicity profile	$33,599	
Annual income given age, gender and ethnicity profile of students	$22,899	
Total number of students (net of retired/leisure students)	299,908	
CHEs per student (net of retired/leisure students)	15.1	
Percent (%) of full year in attendance	33%	
Earnings foregone while attending, per student per year	$7,662	
Students not working while attending (net of retired/leisure students)	61,383	
Total opportunity cost for non-working students		$470,336,462
Students working while attending college (net of retired/leisure students)	238,525	
Earnings relative to statistical averages (%)*	64%	
Total opportunity cost for working students		$661,901,804
Value of leisure time, per working student per year (at 1/3 working time)	$1,532	
Total value of leisure time foregone		$365,531,088
Pell and other student aid	$87,379,974	
Unrestricted portion of student aid**		($34,951,990)
GRAND TOTAL STUDENT OPPORTUNITY COST		$1,462,817,365

*Note: This variable takes into account what students are earning relative to what they would statistically be earning had they chosen to work full-time instead of attend college. It is calculated internally in the analytical model based on data collected from nearly 200 colleges analyzed to date.

**Note: The colleges provided data on the total grants and scholarships awarded to students during the analysis year. For the purposes of this report, we assume that 60% of these funds were restricted to tuition and fees, while the remaining 40% was paid out directly to the student to use as he or she so chooses. We thus discount total student opportunity cost by the estimated portion of student aid that was unrestricted.

Sources: Computed from data supplied by the colleges and by 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 Oregon community colleges considers the benefits and costs from the state and local government taxpayer

[13] 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 college.

perspective. Accordingly, only the state and local government revenues in **Table 2.1** are included as costs in the investment and benefit/cost assessment. As indicated in the text below, our analysis includes an estimate of the level at which the colleges can operate absent all state and local government support. No state and local taxpayer benefits are counted for this level of college operations.

OTHER ASSUMPTIONS

Table 2.10 lists several other assumptions imbedded in the analytic model: 1) the discount rate and time horizon;[14] 2) crime-related costs (incarceration costs that are inclusive of the cost per prison year plus all costs associated with arrest, investigation, trial and finally incarceration); 3) welfare and unemployment costs per year;[15] and 4) health-related costs.[16] The alternative education opportunity assumption is discussed later in this chapter in association with the state economic impacts. See also **Appendix 3**.

Table 2.10. Miscellaneous Variables

	Variables
Discount rate	4.0%
Time horizon, years to retirement	34.1
Average cost per prison year (arrest, trial, incarceration, rehab. etc.)	$66,000
Average length of incarceration (total years)	4.0
Average victim cost	$ 85,000
Average cost per welfare year	$ 12,000
Average duration on welfare (total years)	4.0
Average cost per unemployment year	$ 10,000
Average duration on unemployment (total years)	4.0
Smoking-related medical costs per year	$ 3,000
Alcohol-related medical costs per year	$ 7,000
Alternative education opportunities	22.1%

Sources: The time horizon applies an assumed retirement age of 65, minus the average of the student body from Table 2.4. Sources for the social variables may be found in Volume 2: Detailed Results, Tables 5 through 15. For details on the alternative education variable, see Appendix 3.

[14] See **Chapter 3** for a more in-depth discussion of the discount rate.
[15] 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.
[16] The incarceration, health, welfare and unemployment probability, and cost variables are internal to the analytic model.

REGIONAL ECONOMIC GROWTH AND DEVELOPMENT BENEFITS

In general, the state economy is affected by the presence of the Oregon community 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 workforce deepens the economy's stock of human capital, which attracts new industry and makes existing industry more productive.

In the case of college operation and capital spending, it is important to deduct the impact of funds (both public and private) that are diverted from other uses to support the colleges. In this report, we show only the net economic effect of college operations and capital spending, leaving human capital effects as by far the greater economic effect of the colleges. These adjustments are described in greater detail in **Chapter 4**.

Estimating the regional economic effects requires a number of interrelated models. Multiplier effects are obtained with an input-output (IO) model constructed for the state.[17] Estimating college operations effects requires an additional model that takes college expenditures, deducts spending that leaks from the economy, and bridges what is left to the sectors of the IO model.

Estimating the skill-enhancing effect of past students on the state economy entails five basic steps:

1. Estimate the number of past students still active in the state workforce.

[17] 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).

2. Adjust for alternative education opportunities, ability bias, and the level of education possible absent state and local government support.

3. Estimate the increased earnings of the students still active in the state 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 these factors (i.e., effects on non-labor income).

5. Allocate the direct increase in state income to affected economic sectors, and augment these to account for a collection of demand- and supply-side multiplier effects.

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

The Impact of College Operations

The first step in estimating the gross impact of college operations is to assemble data on its combined operating and capital expenditures. These data are assembled from college budgets and collected into the categories of **Table 2.11**. Column 1 simply shows the total dollar amount of spending. Column 2 apportions that spending to state vendors. The net in-state portion is derived in Column 3.

Table 2.11, by itself, might provide useful information to local audiences—Chambers of Commerce, local business establishments, Rotary clubs, and the like. The table indicates that the colleges are a "good neighbor" in the state, evidenced by the fact that an estimated 94% of all college expenditures benefit state vendors ($709.6 million / $754.9 million = 94%).

Table 2.11. Profile of College Spending In and Out of State Economy

Spending Categories	Total Dollar Amount (1)	% In-State (2)	Net In-State Spending (3)
Salaries, Wages, and Benefits	$467,565,491	99%	$461,427,880
Other Operating Expenditures	$287,294,892	86%	$248,136,509
TOTAL	$754,860,383	94%	$709,564,389

Source: Total dollar amounts provided by the colleges. Estimated percent of spending that occurs locally calculated internally in the analytical model.

Estimating CHEs Embodied in the Present-Day Workforce

This section describes the submodel for estimating the CHEs of past instruction embodied in the present-day state workforce. The process is documented in **Table 2.12** below.

Column 1 provides an estimate of the enrollment history (unduplicated headcount) of the 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 state immediately upon exiting (not necessarily graduating from) college. As shown in the table, 93% of the students remain in the state, and 7% leave.

A comparison of Columns 3 and 4 indicates that all past students have left the Oregon community colleges except for the last three years (2002-2005) where students are still enrolled (the leaver assumptions are shown in Column 9). 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. Settling-in assumptions are specified in **Table 2.2** above.

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 Oregon community colleges and settling into the state workforce, have out-migrated, retired, or died. As shown in **Table 2.2**, 5% of the past students will out-migrate, retire or die over the course of the next thirty years. This "thirty-year attrition" follows an assumed logarithmic decay function shown in Column 11.

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 Colleges (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
1976	200,630	176,162	167,354	167,354	167,354	158,986	12	1,888,745	100%	100%	95%
1977	206,605	181,408	172,337	172,337	172,337	164,001	12	1,967,891	100%	100%	95%
1978	235,950	207,174	196,815	196,815	196,815	187,615	12	2,240,987	100%	100%	95%
1979	258,240	226,746	215,408	215,408	215,408	205,690	12	2,478,648	100%	100%	95%
1980	299,377	262,866	249,722	249,722	249,722	238,864	12	2,850,851	100%	100%	96%
1981	289,897	254,542	241,815	241,815	241,815	231,696	12	2,762,964	100%	100%	96%
1982	242,886	213,264	202,601	202,601	202,601	194,456	12	2,315,697	100%	100%	96%
1983	231,995	203,701	193,516	193,516	193,516	186,054	12	2,222,934	100%	100%	96%
1984	234,329	205,751	195,463	195,463	195,463	188,247	12	2,242,467	100%	100%	96%
1985	238,306	209,243	198,781	198,781	198,781	191,770	12	2,289,596	100%	100%	96%
1986	242,372	212,813	202,172	202,172	202,172	195,376	12	2,317,564	100%	100%	97%
1987	262,489	230,476	218,953	218,953	218,953	211,954	12	2,577,392	100%	100%	97%
1988	280,680	246,449	234,126	234,126	234,126	227,031	12	2,678,845	100%	100%	97%
1989	304,459	267,328	253,961	253,961	253,961	246,686	12	2,896,252	100%	100%	97%
1990	316,695	278,072	264,168	264,168	264,168	257,039	12	3,011,044	100%	100%	97%
1991	324,016	284,500	270,275	270,275	270,275	263,431	12	3,098,022	100%	100%	97%
1992	323,228	283,808	269,617	269,617	269,617	263,240	12	3,097,985	100%	100%	98%
1993	321,248	282,069	267,966	267,966	267,966	262,075	12	3,091,797	100%	100%	98%
1994	314,428	276,081	262,277	262,277	262,277	256,951	12	3,030,932	100%	100%	98%
1995	320,834	281,706	267,620	267,620	267,620	262,634	12	3,098,303	100%	100%	98%
1996	335,441	294,531	279,805	279,805	279,805	275,061	12	3,232,496	100%	100%	98%
1997	348,480	305,980	290,681	290,681	290,681	286,242	12	3,363,241	100%	100%	98%
1998	355,516	312,158	296,550	296,550	296,550	292,521	12	3,425,993	100%	100%	99%
1999	373,982	328,372	311,953	311,953	311,953	308,242	12	3,616,982	100%	100%	99%
2000	392,510	344,640	327,408	327,408	327,408	324,067	12	3,804,870	100%	100%	99%
2001	403,783	349,786	324,488	324,488	324,488	321,726	15	4,821,591	100%	100%	99%
2002	405,487	351,262	325,857	325,857	325,857	323,636	15	4,858,538	100%	100%	99%
2003	377,533	327,046	303,393	303,239	272,915	271,519	15	4,062,042	100%	90%	99%
2004	330,945	286,688	265,954	259,970	194,977	194,312	15	2,896,085	98%	75%	100%
2005	346,206	299,908	278,218	236,485	118,243	118,243	15	1,759,750	85%	50%	100%
Embodied Total								88,000,506			

*Note: Column 1 shows the combined total of credit and non-credit students. In the case that enrollment data as far back as 1976 is unavailable, the missing information is calculated internally in the analytical model.

**Note: CCbenefits conducted an impact study for the State of Oregon in 2002 reflecting academic year 1999-2000. For this reason, we apply the same average CHEs per student from the previous study to AY 2000 and any years prior to that. Beyond 2000, the average CHEs for the current year of study apply.

Sources: Computed from data supplied by the colleges. See also Tables 2.4 and 2.2.

Column 7 shows the average CHEs generated per year back to 1976. In general, colleges indicate a lack of historic information on this variable, and we resort to assuming that the CHE estimate for the current year (i.e., the analysis year) applies though time.[18] There is good reason to believe this assumption likely puts a downward bias on our estimates, and our resulting workforce embodied CHE estimate might accordingly be viewed as conservative.[19]

[18] We used the current year estimate of CHEs (see **Table 2.4**), adjusted for the retired students, as a proxy for the average achievement per student in all prior years before FY 2005. In the case where a different number is supplied, the colleges provided us with a more accurate CHE estimate for that particular year.
[19] The reason is that the role of community and technical colleges has changed over the years from primarily serving transfer students to a greater focus on workforce students. Inasmuch as transfer

Column 8 shows the product of the year-by-year average CHEs in Column 7, 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 workforce of the State of Oregon embodies some 88.0 million CHEs of past instruction received at the Oregon community colleges.

From Embodied CHEs to Direct State Income Effects

The next step in calculating the direct and indirect effect of past student productivity is to convert the 88.0 million embodied CHEs (shown in **Table 2.12**) to state income. In the standard model, state income is expressed as a function of physical and human capital. Human capital is increased by adding new workers or by enhancing the skills of existing workers – the former adds the productivity of the new workers, the latter increases the productivity of existing workers.

A key part of the CCbenefits SEIM model is the "engine" that estimates the value per CHE of instruction.[20] The product of per-CHE added earnings, and the total of embodied past instruction (88.0 million CHEs, **Table 2.12**) provides the dollar estimate of how much more students are earning as a result of their college coursework.

Before turning to the income calculation, however, it is fair to ask to what degree past students would have been able to obtain schooling (and therefore skills) absent the publicly funded colleges and universities in the state. This is the common "with and without condition" in applied economic analysis.

The alternative education opportunity variable (22.1%) is internal to the analytical model and is derived through the application of a regression analysis based on estimates received from colleges previously analyzed by CCbenefits, Inc (see **Appendix 3**). It is designed to take into account opportunities such as private trade schools and colleges, correspondence schools, and so on.[21] Accordingly, when calculating the net increase in

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students are more likely than workforce students to be full-time, our estimated average CHEs per student will understate the actual historic average.

[20] Briefly, the engine that estimates the value per CHE does so by combining earnings/education data from **Table 2.5** with information on aggregate student achievements during the analysis year (from **Table 2.4**). These calculations are discussed more fully in **Chapter 4**.

[21] As indicated in **Chapter 1** of this report, our analysis is not intended as a vehicle for comparing one college with others—it examines colleges as members of the community and technical college system, and not as a competitor with other two-year colleges in the state.

state income attributable to the Oregon community colleges, the historic CHEs indicated in **Table 2.12** should be reduced by 22.1%.

We further reduce the 88.0 million embodied CHEs to account for the fact that the colleges might still be able to operate at some level of enrollment absent state and local government support. Our overall modeling approach includes a sub-model with the students' demand curve for education. The sub-model simulates a reduction to zero state and local support by progressively increasing tuition. As tuition increases, enrollment declines as indicated by the demand curve (see **Appendix 2** for technical details). Below some minimum level of enrollment, the colleges would have to shut down. In the case of the Oregon community colleges, the reduction applied to account for the college "shutdown point" is assumed to be 0%.

Once we have discounted the number of embodied CHEs by the factors described above, we can determine both the direct and indirect effect of increased human capital on state income. The direct effect is conveyed in the higher earnings of the newly-skilled workers themselves. This is calculated by multiplying the total number of CHEs embodied in the workforce (in this case, 88.0 million CHEs) times the estimated value (i.e., added earnings) per CHE.

Calculating the indirect effect is somewhat more complicated and requires the use of the regional IO model as described above. The IO model is designed to capture the way a dollar turns over in the economy, generating a set of regional IO multipliers that are later applied to the direct effects attributable to past student productivity.

The Industries Where Past Students Work

The use of IO multipliers in this way requires that the direct effects be disaggregated into specific industrial sectors. Disaggregating direct impacts avoids IO aggregation error,[22] and it facilitates an analysis of the colleges' contribution to the business sector – an analysis that appears in **Chapter 4**.

[22] Aggregation error occurs when a model with many industrial sectors is reduced through industry combination to a model with many fewer "aggregated industries" (see Miller and Blair, 1985, Chapter 5). Our initial estimate of past-student direct earnings effects appears with no industry detail, and would thus require aggregating all industries to a single aggregate. By any measure, use of such an aggregated multiplier would court an unacceptable aggregation error. At the same time, the EMSI IO modeling system conveys industry detail at roughly the SIC 4-digit level. An assembly of data on direct past student effects at this fine level of detail is not realistic. Our solution is to disaggregate past student direct effects to the eighteen sectors appearing in **Table 2.13**.

Table 2.13 provides information on the sectoral distribution of earnings in the state economy. The table provides a draft-stage vehicle for collecting information from the Oregon community colleges on the sectoral breakdown of their past students, and it documents the information provided by the colleges. **Table 2.13** appears with three columns briefly described below.

Column 1 appears for reference and simply shows the current distribution of all earnings in the state economy by sector. For example, 3.2% of all earnings are in the Agriculture and Agricultural Services sector, 7.8% of all earnings are in the Finance, Insurance, and Real Estate sector, and so on. Column 2 shows the distribution by sector of past student earnings, i.e., an estimate of the industries where they currently work. For example, while 3.2% of all state earnings are in the Agriculture and Agricultural Services sector, only 1.2% of past student earnings are estimated to be in that sector. In contrast, while 7.8% of all earnings are in the Finance, Insurance, and Real Estate sector, 4.8% of past student earnings are estimated to be in that sector.

There is a long-standing theory of regional development known as *stage theory*. The notion is that regional economies develop by progressing from "low stage industries" (agriculture, mining, logging, etc.), to "higher stage industries" (process manufacturing, fabricative manufacturing, etc.), and finally to specialized industries such as finance, engineering, and so on. The distribution of past student earnings appears in Column 2. In general, it is assumed that past students tend to find jobs in the higher development stage industries.[23]

Column 3 applies the distribution of student percentages in Column 2 to the total historic CHEs embodied in the workforce. This latter total is obtained from **Table 2.12**, and reappears at the bottom of Column 3. In **Chapter 3**, we estimate the contribution to student earnings per CHE of instruction. This product provides our estimate of the direct effect of past college operations on state earnings by industry.

[23] Parr (1999) describes four stages of economic development: primary production, process manufacturing, fabricative manufacturing, and producer services and capital export. We apply a "development score" to Parr's stages: low scores for lower stage sectors and higher scores for higher development sectors. The scores are applied to employment in each sector, then normalized to form weights for distributing past students. The end result is that past students favor higher stage industries. For additional detail on the use of this approach for classifying industries by industrial stage, see Rutgers et al, 2002.

The Indirect Economic Development Effects of Students

The previous section described how we estimated the increment of state earnings directly attributable to the college skills embodied in the current state workforce. Next, we turn to the indirect effects on both the demand- and supply-sides.

First, consider demand-side effects. Earnings in the state are larger because of the skills embodied in past students still active in the workforce. As earnings increase, so do industry outputs and industry purchases of inputs.[24] These in turn generate subsequent rounds of increased earnings, which are measured with the familiar multiplier effects. These indirect effects on the demand-side are estimated in the regional IO model by converting the embodied CHEs shown in **Table 2.13** into direct increased industry sales.

Second, consider the supply-side indirect effect. Economic development theory describes a process of "cumulative causation," or "agglomeration," whereby growth becomes in some degree self-perpetuating. The location of a new industry (A) in the region attracts other industries (B, C, and D) that use industry A's outputs as inputs. This, in turn, produces subsequent rounds of industry growth, and so on.[25]

To estimate agglomeration effects, we configure our economic region IO model to provide a set of so-called supply-driven multipliers (see for example Miller and Blair, 1985). We estimate the supply-side effects by converting the embodied CHEs shown in **Table 2.13** into direct increased industry value added, and then apply these to the multipliers of the supply-driven regional IO model. In order to increase the plausibility of this assumption, we apply only the direct effects associated with the industries in the highest stages of development.

[24] For example, associated with the increased output and earnings is an increased demand for both consumer goods and services, and goods and services purchased by businesses as inputs. These in turn produce a set of regional economic multiplier effects. These are all captured and included as part of the demand-side indirect effects.

[25] For a more complete discussion of agglomeration and cumulative causation, see Fujita, Krugman, and Venables, 1999.

Table 2.13. Distribution of Past Student Earnings by Industrial Sectors of the State Economy

Industries	Distribution of All Earnings 1	Distribution of Past Student Earnings 2	Distribution of Historic CHEs Embodied in Current Workforce 3
Agriculture and Agricultural Services	3.2%	1.2%	1,639,589
Mining, Sand, and Gravel	0.3%	0.1%	64,259
Construction	6.2%	6.3%	4,866,163
Manufacturing: Food, Wood, Paper, and Textiles	4.3%	4.1%	2,999,218
Manufacturing: Chemicals, Petroleum, Stone, and Glass	3.6%	3.5%	2,082,161
Manufacturing: Computer and Electronic Equipment	5.0%	3.9%	1,431,213
Manufacturing: Other	2.1%	1.9%	1,278,730
Transportation	3.6%	2.0%	1,592,601
Public Utilities	0.8%	1.1%	733,353
Publishing and Communications	2.7%	2.6%	1,538,754
Trade: Wholesale and Retail	13.4%	13.8%	13,308,531
Finance, Insurance, and Real Estate	7.8%	4.8%	3,699,289
Motels, Eating/Drinking, and Amusement/Recreation	4.2%	6.3%	11,605,346
Consumer Services	2.8%	1.4%	1,968,303
Business Services	11.7%	12.3%	10,197,088
Medical/Educational/Social Services	15.7%	22.6%	22,520,723
Federal Government	2.7%	3.4%	1,772,083
State and Local Government	9.8%	8.5%	4,703,100
Total	100%	100%	88,000,506

Sources: Column 1 shows the percentage breakdown of all earnings in the state across the industrial sectors shown in the table. Data on overall earnings by industry are obtained from the 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. Data in Column 2 were calculated based on data provided by college personnel. Data in Column 3 are historic CHEs reported in Table 2.12, distributed according to the proportions shown in Column 2.

SUMMARY

This chapter has presented the broader elements of our database and some of the key assumptions needed to estimate that data. In general, our data come from four sources, 1) published national data, 2) published local data, including data specific to the funding and operations of the Oregon community 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.

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 the Oregon community colleges as an investment, while **Chapter 4** considers the colleges' role in statewide economic growth. The appendices detail a collection of miscellaneous theory and data issues.

Chapter 3
INVESTMENT ANALYSIS – BENEFITS AND COSTS FROM A SINGLE YEAR'S OPERATIONS

INTRODUCTION

This chapter considers the Oregon community colleges as an investment from the perspectives of two important stakeholders: students and 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.

ANNUAL BENEFITS

Our investment analysis focuses on the effects of a single year of college operations. We focus first on the annual benefits with the summary of our estimates presented in **Table 3.1**. The table has three sections: 1) student benefits (i.e., higher student earnings); 2) the economic growth benefits (i.e., labor and non-labor income), and; 3) an assortment of incidental social benefits (such as impact on health, crime, and welfare/unemployment benefits).

Higher Student Earnings

As indicated in **Table 3.1**, we estimate that each year the Oregon community colleges increase annual student earnings by an average aggregate amount of $382.1 million.[26] Our estimates are based on the accumulated instruction provided by the Oregon community colleges, as well as statistics showing the effect of education on earnings. See also **Table 2.5** for additional details.

[26] 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.

Table 3.1. Summary of Annual Benefits

	Units	Total
STUDENT BENEFITS, ANNUAL		
Higher student earnings	NA	$382,130,000
TOTAL STUDENT BENEFITS		$382,130,000
ECONOMIC GROWTH BENEFITS, ANNUAL*		
Labor income	NA	$318,353,000
Non-labor income	NA	$156,810,000
TOTAL INCOME GROWTH		$475,163,000
SOCIAL BENEFITS, ANNUAL		
Health Benefits		
Absenteeism savings (days)	60,700	$6,690,000
Fewer smokers, medical savings (# persons)	3,900	$11,697,000
Fewer alcohol abusers (# persons)	930	$6,497,000
Crime Benefits		
Incarceration savings (# persons)	600	$4,704,000
Crime victim savings	NA	$1,509,000
Added productivity (fewer incarcerated)	NA	$2,788,000
Welfare/Unemployment Benefits		
Welfare savings (# persons)	2,700	$3,854,000
Unemployment savings (# persons)	1,050	$1,256,000
TOTAL SOCIAL BENEFITS		$38,995,000

* Note: These figures are calculated using higher student earnings as the gross figure, net of student attrition and other reduction factors such as the alternative education variable and the shutdown point (see Appendices 2 and 3 for more information). Higher student earnings have already been adjusted to account for the ability bias discussed in Chapter 2.

Source: Computed from data supplied by Tables 19 and 20 in Volume 2: Detailed Results.

Economic Growth Benefits

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 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.[27] Together, the combined labor and capital income effect might be considered the *direct income effect* of a skilled workforce.

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

[27] 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 productivity and income of existing capital, while encouraging additional capital investment.

rounds of spending effects constitutes the indirect income effects of a skilled workforce. Estimating these indirect effects requires a specialized economic model.[28]

The total economic growth effect of the Oregon community 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 college operations annually adds about $475.2 million in labor and non-labor income to the state economy.

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.[29] Additional details on our calculations and methods appear in **Volume 2: Detailed Results**.

Health-Related Savings

Table 3.1 shows annual savings from health-related issues. Health-related absenteeism from work will decline by approximately 60,700 days per year, resulting in an annual average savings of otherwise lost productivity equal to roughly $6.7 million. There will also be roughly 3,900 fewer smokers incurring average smoking-related costs, with an annual average savings to society of some $11.7 million. Finally, there will be about 930 fewer alcohol abusers, providing an annual average social savings of around $6.5 million.

Crime-Related Savings

Because of a single year of college operations, we estimate that there will be some 600 fewer people incarcerated at some point in their lives, resulting in average annual

[28] The indirect effects, sometimes called "multiplier effects," estimated in this study rely 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 5**.

[29] The social savings presented in this portion of the report are annual figures and do not account for out-of-state attrition that occurs over time (due to retirement, out-migration or even death). Attrition is applied in the investment analysis, which is discussed in greater detail later in this chapter. See also Table 19 in **Volume 2: Detailed Results**.

savings as follows: roughly $4.7 million in direct incarceration savings, $1.5 million in savings to otherwise would-be crime victims, and some $2.8 million in added productivity, i.e., persons working who would otherwise be incarcerated. As before, additional details on our calculations appear in **Volume 2: Detailed Results**.

Welfare and Unemployment Savings

As shown in **Table 3.1**, one year's operation of the Oregon community colleges results in an estimated average annual reduction in people on welfare and unemployment in the State of Oregon of approximately 2,700 and 1,050 respectively. The corresponding annual dollar savings amounts to roughly $3.9 million for welfare and about $1.3 million in unemployment savings. See **Volume 2: Detailed Results** for additional detail.

Total Social Savings

All told, we estimate that a year's operation of the Oregon community colleges annually generates around $39.0 million 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 equivalent 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 FTE Student

	Per CHE	Per FTE Student
Increased Student Earnings, **gross**	$85	$3,808
Increased Student Earnings, **after tax**	$51	$2,309
PUBLIC BENEFITS		
Income Growth	$105	$4,735
Absenteeism Savings	$1	$67
Medical Cost Savings	$4	$181
Incarceration Savings	$1	$47
Crime Victim Savings	$0	$15
Added Productivity	$1	$28
Welfare Savings	$1	$38
Unemployment Savings	$0	$13
Total	$114	$5,123

Note: The annualized values exclude benefits from retired students.

Source: Computed from data supplied by Table 2.3, 2.4, 3.1 and Tables 17-18 in Volume 2: Detailed Results.

As indicated in the first row, the annual average income of students increases roughly $85 for every hour of credit or non-credit instruction they complete. The $85 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 $51 – this is the figure that might appear on the student's actual paycheck.[30]

For the public benefits, **Table 3.2** indicates that an hour of instruction adds an average $105 per year to state income. The other "social benefits" shown are mainly avoided social costs. These range from $0 per CHE in unemployment savings, to roughly $4 per CHE from medical cost savings. All told, each hour of college instruction creates $114 in annual public benefits.

The last 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 if on a semester system and 45 credit hours of class work per year if on a quarter system. On average, a full-time year of study rewards the average student with $3,808 in higher annual income (before tax). It also increases state income by $4,735 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 $5,123 as shown in the bottom row of the table. 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?

Who benefits most from education, the students or the public? This is a currently hotly debated question and is an obviously fundamental issue in higher education funding. The popular view in many circles is that the students benefit most, 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 college attendance with a $51 annual

[30] The federal tax adjustment is based on the IRS 2005 Tax Rate Schedules. See the Internal Revenue Service, Department of the Treasury, Schedule X- Single (Available from http://www.irs.gov/formspubs/article/0,,id=133517,00.html; Internet; accessed 26 July 2005). The state and local share of taxes is determined using a ratio of state and local taxes divided by total earnings by place of residence.

increase in their after-tax earnings. At the same time, however, public benefits from that same hour of instruction sum to approximately $105 in added annual income growth and assorted social savings per CHE. Contrary to conventional wisdom, therefore, the public stands to benefit far more from the education produced by the Oregon community colleges than the students do.

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 costs to derive our investment analysis results. The average annual benefits generated by the Oregon community colleges (as shown in **Tables 3.1** and **3.2**) are indicative 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. This time horizon is equal to the assumed retirement age of 65, minus the average age of the student body.

2. Future benefits are discounted to reflect the so-called time-value of money.[31]

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.

[31] 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.

Benefit/cost ratios, rates of return, and payback periods are simply alternative ways to assess the effectiveness of a given investment (see **Appendix 4** for a short primer on how to interpret these results).

Expressing the Investment Analysis Results

Economists and financial experts have different ways of expressing investment analysis results. The standard and most familiar ones are those we present here: the **net present value** (NPV) is a dollar measure of future values discounted to the present; the **internal rate of return** (IRR) is expressed as a percentage return on investment; the **benefit/cost ratio** (B/C) is a ratio of how many dollars worth of benefits are received per cost dollar; and the **payback period** is a simple calculation of how many years' worth of benefits are required to fully recover all of the investments made. The criteria for feasibility is as follows: 1) the net present value must be positive or equal to zero; 2) the rate of return must be equal to or greater than the returns from other similar risk investments; and 3) the benefit/cost ratio must be equal to or greater than 1.

The net present values, rates of return, benefit/cost ratios and payback periods are all derived from the same data shown later in this chapter in **Table 3.6**. Readers unfamiliar with the interpretation of these standard investment analysis results are encouraged to consult the short layman's guide provided in **Appendix 4** of this report: "Explaining the Results—a Primer." A glossary of terms is also provided in **Appendix 1**.

Accounting Stance and Key Definitions

Table 3.3 distinguishes between student and taxpayer costs and benefits. Students benefit from their college attendance through increased future income. They invest in the form of tuition, books and foregone income while attending (i.e., the opportunity cost of their time).[32] Taxpayer costs (state and local) are straightforward; they include all direct aid to the Oregon community colleges to fund operations and capital expenditures, plus financial aid to the students. The analysis focuses on state and local government support of the colleges, so taxpayer costs only include state and local government expenditures.

[32] 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.

Table 3.3. Some Definitions

Terms	Definitions
Student (Private) Benefits	Higher earnings captured by the students
Taxpayer Benefits: Broad	Additions to GSP 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 (see **Table 2.1**) plus the opportunity cost of time
Taxpayer Costs	State and local taxes (see **Table 2.1**), including financial aid to students
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 state income, 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 college operations are lumped together and counted as a benefit of state and local college support.[33]

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 state income, the narrow perspective counts only that portion of increased state income 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 is 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

[33] 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 support, then that portion of overall college benefits is excluded from our analysis. See **Appendix 2** below for a detailed discussion of these adjustments.

only those items that actually result in a monetary gain (either added income or avoided cost) to state and local governments.

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 $85 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 $85 (the increase in a student's annual earnings for every CHE), appears in **Table 3.4** as $1,900 – the present value of all those future income increments.

It is important to note that 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. The students are accordingly rewarded a capital asset valued at $1,900 for every CHE of coursework they take. Considering all students together, the aggregate value for increased student earnings indicates that every year, as a result of their attendance at the Oregon community colleges, students acquire assets with a collective capital value of around $8.5 billion.

We now have an estimate of the students' reward for attending the Oregon community colleges. We need only compare this reward with the associated students' cost incurred today 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 $370 – 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 5.1 (equal to $1,900 in benefits divided by $370 in costs). We will consider this ratio and other measures of the students' investment below, but first let us consider the investment made by taxpayers.

Table 3.4. Summary of Investment Analysis Results - Present Values

	Aggregate	Per CHE
PRIVATE BENEFITS		
PV of student benefits, increased earnings	$ 8,539,520,000	$ 1,900
Sum of all private benefits, present value	$ 8,539,520,000	$1,900
PUBLIC BENEFITS		
PV of increased GSP	$ 10,997,036,000	$2,440
Health benefits, captured by society		
PV of absenteeism savings	$ 102,775,000	$20
PV of tobacco and alcohol abuse medical savings	$ 268,200,000	$60
Crime		
PV of reduced incarceration	$ 69,343,000	$20
PV of reduced victim costs	$ 22,242,000	$0
PV of earnings (added productivity)	$ 42,828,000	$10
Unemployment and welfare		
PV of reduced welfare rolls	$ 56,816,000	$10
PV of reduced unemployment	$ 18,022,000	$0
Sum of all public benefits, present value	$ 11,577,262,000	$ 2,560
COSTS, PRIVATE AND PUBLIC		
PV of opportunity cost of education plus tuition (private)	$ 1,685,842,000	$ 370
PV of state and local contribution to college budget (public)	$ 363,746,000	$ 80

Source: Computed from data supplied by Tables 2.1, 2.4, and Tables 19 and 20 in Volume 2: Detailed Results.

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 income growth, for example, sums to some $11.0 billion. The present value of absenteeism savings sums to $102.8 million (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 $11.6 billion.[34]

[34] We recognize 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 what that level of operation might be 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 2**. 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 assume 35% of current enrollment as the minimum feasible scale for college operations. At enrollments less than 35%, 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**).

The estimate of state and local government support of the Oregon community colleges is roughly $363.7 million per year as shown on the bottom row of **Table 3.4**.[35] Having now defined the present values of the costs and the benefits, we can form a benefit/cost ratio of roughly 31.7 (=$11.6 billion worth of benefits / $363.7 million worth of state and local government support).

This 31.7 ratio is not unexpected. It reflects the measure of all benefits generated regardless of to whom they may accrue. This is unlike the benefit/cost ratio of 5.1 for the students, for example, where the benefit/cost measure reflects benefits (higher earnings) accrued only to the students themselves divided by the student costs: tuition, 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 borne 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 benefit/cost ratio simply aims at providing a ready comparison between all public benefits and taxpayer costs.[36]

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 government. These values are shown in **Table 3.5**. For example, **Table 3.4** shows increased state income growth with a present value of some $11.0 billion. Increased growth means higher incomes of all kinds (wages, salaries, proprietors' incomes, profits, rents and other) and from these will come higher taxes, whether federal, state or 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 yields a present value equal to approximately $1.6 billion in increased state and local tax

[35] The state and local government contribution to the Oregon community 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.
[36] Because 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 inappropriate in the broad taxpayer perspective.

receipts. Note also that **Table 3.5** repeats from **Table 3.4** the $363.7 million annual contribution of state and local government to the Oregon community colleges.

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	$ 1,588,215,000	$350
PV of state and local govt. savings from improved health		
PV of absenteeism savings	$ 15,582,000	$0
PV of tobacco and alcohol abuse medical savings	$ 16,092,000	$0
PV of state and local govt. savings from reduced crime	$ 61,660,000	$10
PV of reduced welfare rolls	$ 9,091,000	$0
PV of state and local government benefits	$ 1,690,640,000	$ 370
PV of state and local contribution to college budget (public costs)	$ 363,746,000	$ 80

Source: Computed from data supplied by Tables 2.4, 2.1, and Tables 19 and 20 in Volume 2: Detailed Results.

With respect to the social savings, we showed in **Table 3.4** that employers would lose some $102.8 million (present value of future loses) to health-related absenteeism were it not for our single year's state and local government support of the Oregon community 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 benefits directly from this saving—the present value of their savings is estimated at roughly $15.6 million (**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 government's subsidy of general health care, for a net present value of $16.1 million.

Not surprisingly, state and local government's 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 $134.4 million (including victim costs and added productivity from people who would otherwise be incarcerated absent the education).[37] We arrive at the state and local government portion of this figure by deducting the cost of federal crimes from the incarceration savings. Added to this is the added productivity of persons not incarcerated, adjusted to include only the portion that accrues to state and local government (in this case, 14.4%, equal to the composite state and local tax rate). Victim cost savings are not counted as taxpayer benefits, since none of these accrue to the taxpayer. All told, state and local government acquires an asset in the form of reduced future incarceration expenditures and added productivity with a present value of roughly $61.7 million.

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

Reduced future welfare expenditures, with a present value of about $9.1 million, completes our estimation of state and local government savings from 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 the Oregon community colleges. As indicated in the table, this value is roughly $1.7 billion.

We can therefore say that in return for their $363.7 million support of the Oregon community colleges, state and local governments are annually rewarded with a stream of increased future tax payments with an equivalent capital asset value of roughly $1.7 billion. This alone yields an investment benefit/cost ratio of 4.6 (=$1.7 billion/$363.7 million), indicating a most profitable investment.

Summary of Investment Analysis Results

In the previous section we examined the present value of benefits attributable to the Oregon community colleges, and characterized these in terms of various benefit/cost 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	19.2%
B/C Ratio, Student Perspective	5.1
Payback Period, Student Perspective (years)	7.3
B/C Ratio, Taxpayer Perspective: Broad	31.7
RR, Taxpayer Perspective: Narrow	18.7%
B/C Ratio, Taxpayer Perspective: Narrow	4.6
Payback Period, Taxpayer Perspective: Narrow (years)	7.4

Source: Computed from data supplied by Tables 2.1, 2.4, 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.[38] **Table 3.6** shows students earning

[38] 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,

average returns of 19.2% on their investment of time and money. This is indeed an impressive return, compared, for example, to perhaps 1% on a standard bank passbook savings account, or approximately 8 to 10% on U.S. stocks and bonds (thirty-year average return).

At 18.7%, the rate of return to the state and local taxpayers is similarly impressive. Economists generally assume a 4.0% 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 the colleges would just pay their own way. In principle, governments could borrow the monies 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 18.7%, on the other hand, as indicated in **Table 3.6,** means that the Oregon community colleges not only pay their own way, but also generate 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.

Discount Rate

The **discount rate** is a rate of interest that converts future costs and benefits to present values. For example, a $1,000 higher earnings benefit to be realized 30 years in the future is worth much less than $1,000 in the present. We must therefore express all future values in present value terms in order to compare them with the investments (i.e., the costs) made today. The selection of an appropriate discount rate, however, can become an arbitrary and controversial undertaking. As suggested in economic theory, the discount rate should reflect the investor's opportunity cost of capital, i.e., the rate of return one could reasonably expect to obtain from alternative investment schemes. If the desired end is to portray the investment as feasible and attractive, the discount rate selected is typically low. On the other hand, if the desired end is to portray the proposed investment as poor and unattractive, then the selected discount rate is high. The **4.0%** discount rate used in the CCbenefits impact study is a typical and relatively low rate often applied in public investment projects, since governments are large and can therefore spread their risks over a larger and more diverse investment portfolio than the private sector can.

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.

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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.

One additional note of importance: It must be understood that the returns reported in **Table 3.6** are real returns, not nominal. When a bank promises to pay a certain rate of interest on passbook savings account, it employs an implicitly nominal rate. Bonds also operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, then money is lost in real terms. In contrast, a real rate of return is on top of inflation. For example, if inflation is running at 3.0% and a nominal percent of 5.0% is paid, then the real rate of return on the investment is only 2.0%. In **Table 3.6**, the 19.2% student rate of return is a real rate. With an inflation rate of 3.1% (the average rate reported over the past 20 years as per the U.S. Department of Commerce, Consumer Price Index), the corresponding nominal rate of return is 22.9%, substantially higher than what we report.

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 the Oregon community colleges on average see a payback period of 7.3 years on their foregone earnings and out-of-pocket costs, while state and local governments see a payback period of 7.4 years.[39]

WITH AND WITHOUT SOCIAL BENEFITS

In **Chapter 2** the social benefits attributable to college education (reduced crime, welfare and unemployment, and improved health) were defined as *external benefits*, incidental to the operations of the colleges. Colleges do not directly aim at creating these benefits. Some would question the legitimacy of including these benefits in the calculation of the rates of return to higher education, arguing that only the direct benefits—the higher earnings—should be counted. **Table 3.6** is inclusive of the social benefits reported here as attributable to the colleges. Recognizing the other point of view, **Table 3.7** shows the rates of return for both the broad and narrow perspectives exclusive of the social benefits. As indicated, the returns are still well above the threshold values (a benefit/cost ratio greater than 1 and a rate of return greater than 4.0%) confirming that the taxpayers receive great value from investing in the Oregon community colleges.

[39] 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.

Table 3.7. Taxpayer Perspective ($ Thousands)

	Broad Perspective With Social Savings		Narrow Perspective With Social Savings	
	Included	Excluded	Included	Excluded
NPV	$11,537,857	$10,842,837	$1,684,883	$1,560,857
IRR	-	-	18.7%	16.9%
B/C ratio	31.7	29.8	4.6	4.3
Payback (years)	-	-	7.4	8.2

Source: See Tables 3.4 through 3.6.

CONCLUSIONS

This chapter has shown that the Oregon community colleges are an attractive investment 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 taxpayer funds creates a wide range of positive social benefits and, perhaps more importantly, actually returns more to government budgets than it costs. Absent the increased tax receipts and avoided costs provided by higher education, state and local governments would have to raise taxes to make up for lost revenues and added costs.

Chapter 4
THE EFFECT ON ECONOMIC GROWTH

INTRODUCTION

The previous chapter considered the Oregon community colleges as an investment – first on the part of students, then on the part of state and local government. In this chapter we focus on the State of Oregon and consider the impact of the colleges on economic growth in the state. We report impact estimates in terms of labor income (i.e., earnings) and non-labor income (i.e., the sum of all dividends, interests, and rents).[40]

In general, a college will affect the state economy in two ways: 1) through its in-state 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 state 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 adjust the college spending effect to account for taxes and other monies withdrawn from the state in support of the Oregon community colleges. Reasons for this adjustment are explained more fully below.

THE EFFECT OF COLLEGE OPERATIONS

Consider how college spending affects the state economy. A college pays wages and these become part of overall state earnings. A portion of these direct earnings is, in turn, spent in the state 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 is 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.

[40] The sum of labor and non-labor income 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, regional income reflects all factors of production, i.e., labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents and other.

To arrive at the net effect of college spending, we must first know where the revenues come from. Notice that about 26% of college funding comes from sources located outside of the State of Oregon, e.g., the Federal government and any private revenue from outside the state.[41]

The remaining 74% of college funding comes from state sources, whether in the form of student tuition and fees, state and local taxes, etc. Devoting these funds to the Oregon community 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 the state and local government. Monies that are injected into the state economy on one hand are thus withdrawn on the other. The net effect is obtained by estimating these two effects separately, and then subtracting the latter from the former.

For the purposes of this report, we assume that any funding from state sources is withdrawn from the state economy, and thus the benefits generated in return for that funding should not be counted. In the case of the Oregon community colleges, the total impact of college operations is discounted by $228.7 million, equal to the estimated income that would have been generated in the state anyway should the monies used to support the colleges had instead been used for consumer spending.

THE HUMAN CAPITAL EFFECT

Direct Effect

Students leave the Oregon community 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 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

[41] Private sources of revenue vary widely, from a scholarship sponsored by a local resident to contract revenue received from a national company that sends its employees to the colleges in order to attend training seminars. The wide variety of these sources of revenues makes it difficult to determine whether they come from within or outside the state. For this reason, we assume a strict 25/75 breakdown, where 25% comes from outside the state, and the remaining 75% comes from within the state.

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. This, in turn, creates the need for more inputs, which 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 education.

Total Effect

The *total economic growth effect* of 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 that 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. As shown in the first row of the table, the State of Oregon generated approximately $80.4 billion in labor income, and another $36.5 billion in non-labor income.[42] Altogether, the State of Oregon generated approximately $116.9 billion in regional labor and non-labor income. The remainder of the table is divided into two general parts, the first showing the aggregate economic effect of college operations spending, and the second showing the human capital effects of past students.

Spending Effects

The section on the impact of college spending has several parts. The first row shows the total of faculty and staff wages and salaries. The figure shown there, roughly $467.6 million, constitutes the direct effect of college spending on earnings. Note that the associated figure for non-labor income is $0. This is because, in contrast to private sector businesses where profits and other property-type incomes must be considered, the direct contribution of government sectors is only measured in terms of labor income.

[42] The figures on labor and non-labor income are from the U.S. Department of Commerce.

Indirect effects amount to another $71.6 million. These represent the earnings generated in other industries (i.e., off-campus effects) as a result of direct college spending. The indirect effect on non-labor income is $34.1 million.[43] The total effect of college spending is thus estimated at $573.2 million in regional labor and non-labor income.

The row labeled "Adjustment for alternative use of funds" accounts for local monies spent on education that are no longer available for spending elsewhere. The negative figure shown for this entry reflects the labor and non-labor income foregone to fund education (see section labeled "The Effect of College Operations" above). Taking this adjustment into account, the net effect of college spending is $344.5 million.

Table 4.1. Impact of Colleges on Labor and Non-Labor Income in the State Economy

	Labor Income ($ Thousands)	% of Total	Non-Labor Income* ($ Thousands)	% of Total	TOTAL INCOME ($ Thousands)	% of Total	Multi-pliers
Total Income in State	$80,413,994	100%	$36,477,306	100%	$116,891,300	100%	
Income Attributable to College Operations							
Direct Effect of Faculty and Staff	$467,565	0.6%	$0	0.0%	$467,565	0.4%	
Indirect Effect	$71,557	0.1%	$34,085	0.1%	$105,641	0.1%	
Gross Total	$539,122	0.7%	$34,085	0.1%	$573,207	0.5%	1.23
Adjustment for alternative use of funds	($158,757)	-0.2%	($69,961)	-0.2%	($228,718)	-0.2%	
TOTAL**	$380,365	0.5%	($35,876)	-0.1%	$344,489	0.3%	
Income Attributable to Past Student Economic Development Effects							
Direct Effect	$5,794,393	7.2%	$2,282,386	6.3%	$8,076,780	6.9%	
Indirect Effect	$1,357,353	1.7%	$668,427	1.8%	$2,025,780	1.7%	
TOTAL	$7,151,746	8.9%	$2,950,813	8.1%	$10,102,559	8.6%	1.25
GRAND TOTAL	$7,532,111	9.4%	$2,914,937	8.0%	$10,447,048	8.9%	

*Note: This column includes all dividends, interest, and rents generated in the State of Oregon. It does not include earnings.

**Note: Negative income means that the monies spent on college support would have otherwise raised consumer spending and generated more income in the state than the colleges do now. The total impact of college operations is discounted accordingly.

Sources: Total income for the state is assembled from the 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. Income attributable to college operations and to past students, in addition to the associated multiplier effects, are calculated in the model based on data supplied by the colleges. The indirect effect is based on data from Table 2.13 and outputs from the EMSI Regional IO Model for state (Moscow, ID: Economic Modeling Specialists, Inc., 2002).

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 88.0 million estimate of total CHEs (from **Table 2.12)** embodied in the current day workforce. The next step is to reduce this figure 22.1% to account for alternative education opportunities, plus a further reduction to account for the benefits generated by the

[43] Details on our regional IO model appear in **Appendix 5.** As described there, we avoid an overstatement of actual multiplier effects by discarding all but 20% of the total effect indicated by the IO model. The reduction accounts for the shift of resources from next-best uses.

Oregon community colleges should the colleges still be able to operate absent state and local government support (in the case of the Oregon community colleges this reduction is 0%). The approximately 68.5 million CHEs left after this calculation can be viewed as strictly attributable to the existence of the Oregon community colleges. Finally, we multiply the 68.5 million CHEs by our estimate of the net value in added earnings per CHE ($85 as shown in **Table 3.2**). The result, approximately $5.8 billion, is the estimated portion of current state earnings that can be directly attributed to the college instruction embodied in the present-day workforce.

The $5.8 billion direct earnings effect from **Table 4.2** reappears in **Table 4.1** where it is shown to account for some 7.2% of all labor income (i.e., earnings). The associated direct effect on non-labor income is about $2.3 billion, or 6.3% of all non-labor income.[44] 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 around $1.4 billion, or 1.7%, of all labor income, and approximately $668.4 million, or 1.8%, of all non-labor income. The bottom line: the Oregon community colleges account for $10.4 billion, or 8.9%, of all income in the State of Oregon.

Table 4.2. Estimating the Net Statewide Income Effect of Embodied CHEs

Total embodied CHEs	88,000,506
Alternative education opportunities, %	22%
Level of education possible absent state and local govt. funding, %	0%
Total CHEs, net of reduction factors	68,476,452
Gross value per CHE	$94
Ability bias, %	10%
Net value per CHE	$85
Gross earnings of past students	$8,273,883,335
Net earnings of past students	$5,794,393,452

Sources: Computed internally by model based on data supplied by the colleges. See also Table 2.13. The gross value per CHE is derived from Table 3.2, without the 10% adjustment used to account for correlation-causation factors.

[44] In the course of completing this study, we gather data on the approximate industries where past students work (see **Table 2.13**). Where this information is not available, we assume a pattern that favors higher development-stage industries. The non-labor income figures in **Table 4.1** are obtained by multiplying the earnings-by-industry of past students by the associated value added-to-earnings ratios.

Chapter 5
SENSITIVITY ANALYSIS OF KEY VARIABLES

INTRODUCTION

We conclude this study with a sensitivity analysis of some key variables on both the investment and regional economic development sides. The purpose of the sensitivity analysis is twofold:

1. *To set our approach apart from "advocacy" education impact analyses that promote community and technical college education.* These studies may lack uniformity and use assumptions that will not stand up to rigorous peer scrutiny, and they often generate results that grossly overstate benefits. The approach taken here is to account for all relevant variables on both the benefit and cost sides as reflected in the conservatively estimated base case assumptions laid out in **Chapter 2**. The sensitivity tests include: a) the impacts associated with changes in the student employment variables for the investment analysis, and b) the addition of student spending and sales (as opposed to earnings only) to the regional economic development analysis.

2. *To test the sensitivity of the results associated with the assumptions for which researchers have applied judgment and innovative thinking rather than hard data.* Some may even refer to these variables as educated guesswork. They include the "Alternative Education" and "Attrition Rate" variables discussed in **Chapter 2**.

THE STUDENT EMPLOYMENT VARIABLES

Probably the most difficult data to collect are the two employment variables, because colleges generally do not collect this kind of information as a matter of formal routine. These variables include: 1) the percent of the students employed, and 2) of those employed, the earnings received by the students relative to the full earnings they would have received if not attending the Oregon community colleges. Both employment variables relate to the earnings foregone by the students—the opportunity cost of time—and they affect the investment analysis results (net present value, rate of return, benefit/cost ratio, and payback period).

Percent of Students Employed

The students incur substantial expense by attending the Oregon community colleges because of the time they spend not gainfully employed. Some of that cost is recaptured if the student remains partially (or fully) employed while attending. It is estimated that 80% of the current student body is employed. We test this variable in the sensitivity analysis by changing this assumption to 100%. This change would mean that *all* of the students are employed, reducing the average opportunity cost of time accordingly.

Percent of Earnings Relative to Full Earnings

The second opportunity cost variable is more difficult to estimate. For the Oregon community colleges it is estimated that the students working while attending classes earn only 64%, on average, of the earnings they would have statistically received if not attending college. This suggests that many of the students hold part-time jobs that accommodate their college attendance, but at an additional cost in terms of receiving a wage that is less than what they might otherwise make. The model captures these differences and counts them as a part of the opportunity cost of time. As above, we test this variable in the sensitivity analysis by changing the assumption to 100%. This would mean that the students are fully employed, and the average opportunity cost of time would be reduced accordingly.

Results

The changed assumptions (both of which would be consistent with advocacy analyses) generate the results summarized in **Table 5.1**. Here, the base case assumptions taken from **Table 2.2** are reflected in the two shaded rows for the variables tested—80% for the portion of students employed, and 64% for their earnings relative to the statistical averages. These base case assumptions are held constant in the shaded rows for the student perspective. The sensitivity analysis results are shown in the non-shaded rows—the extent to which the investment analysis results would change if the two base case variables were increased to 100%, first separately, and second, together. Changing both assumptions to 100% (all students fully employed) would automatically increase the benefits because the opportunity cost of time would reduce to zero.

1. Increasing the students employed assumption from 64% to 100% first (holding all of the other assumptions constant), the rate of return, benefit/cost ratio, and payback period results would improve to 21.2%, 5.7, and 6.7 years, respectively,

relative to the base case results. The improved results are attributable to a lower opportunity cost of time—all students would be employed in this case.

2. Increasing the earnings relative to the statistical averages from 64% to 100% second (holding the second employment assumption constant at the base case level), the rate of return, benefit/cost ratio, and payback period results would improve to 28.4%, 8.3, and 5.2 years, respectively, relative to the base case results—a strong improvement over the base case results, again attributable to a lower opportunity cost of time.

3. Finally, increasing both of the above assumptions to 100% simultaneously, the rate of return, benefit/cost ratio, and payback period results would improve yet further to 41.9%, 13.1, and 3.8 years, respectively, relative to the base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to the statistical averages) while attending classes. These results are unrealistic, albeit not uncommon for advocacy analyses.

Table 5.1. Sensitivity Analysis of Student Perspective

Variables	Assumptions	RR	B/C	Payback
1. Percent	80%	19.2%	5.1	7.3
Employed	100%	21.2%	5.7	6.7
2. Percent of	64%	19.2%	5.1	7.3
Earnings	100%	28.4%	8.3	5.2
1 = 100%, 2 = 100%		41.9%	13.1	3.8

A final note to this section—we strongly emphasize that the base case results are very attractive—the results are all well above their threshold levels, and the payback periods are short. As clearly demonstrated here, advocacy results *appear* much more attractive, although they would overstate the benefits. The results presented in **Chapter 3** are *realistic,* indicating that investments in the Oregon community colleges will generate excellent returns, well above the long-term average percent rates of return of roughly 7% in the stock and bond markets.

REGIONAL ECONOMIC DEVELOPMENT

The economic impacts of higher education can be calculated in different ways. Our approach was to estimate the regional economic impacts of the Oregon community colleges based on college operations and capital spending and the increased

productivity effects of past students in the state workforce. The impacts are expressed in terms of *labor income* (i.e., earnings) and in terms of *non-labor income* (i.e., dividends, interests, and rent).[45] Others often add student spending to the impacts and express the results in terms of sales instead of income—both will substantially inflate the numerical measures of the impacts so that they appear larger than they really are. In the present section we address these two issues: 1) the addition of student spending effects to impact estimates, and 2) the expression of economic impacts in terms of gross sales rather than income.

The Economic Impact of Student Spending

Students spend money while attending college: they buy books and supplies, rent rooms, purchase food, pay for transportation, attend sports events, go to movies, and so on. These expenditures create jobs and incomes for local businesses, which, as argued by some, should be counted among the regional economic impacts attributable to the colleges.

In our analysis, however, we exclude student spending because most of the students already reside in the state. Student expenditures, therefore, do not represent new monies in the state, but rather a redirection of monies that would have been spent anyway. The other side of the argument is that, even though the college-related spending of a resident student does not constitute new money, some students would leave the state to obtain an education elsewhere if the colleges and universities in the state were not present. Thus, the state loses the spending and related jobs and incomes. Both cases have merit, although we believe the former is more reasonable than the latter. This is because only a few students will actually be able to avail themselves of an education elsewhere (see discussion of the alternative education variable in **Chapter 2** and in **Appendix 3**). Our approach, therefore, is to exclude student spending, recognizing at the same time, that the regional impact estimates may err on the conservative side.

In **Table 5.2** we show the potential magnitude of student spending effects in the state economy. The table parallels **Table 4.1** in the previous chapter, but adds the section "Income Attributable to Student Spending,"[46] creating some $365.9 million in additional

[45] U.S. Department of Commerce, Regional Economic Information System (REIS) data includes labor and non-labor income estimates for counties and states, and is published annually in the ***Department's Survey of Current Business***. It is also readily available in electronic form.

[46] We estimated student spending effects by borrowing average college student information from a study conducted for higher education economic impacts in Illinois (University of Illinois, 2000). Student spending by broad expenditure category was bridged to the sectors of the state economy input-output

labor income for the local businesses patronized by students (the direct effects), plus another $109.5 million in labor income stemming from related multiplier effects (indirect effects). The corresponding numbers for non-labor income are $165.5 million for the direct effect, and $52.4 million for the indirect effect. As shown in the bottom row of the table, these additional measures increase the colleges' overall impact on income in the State of Oregon from 8.9% in **Table 4.1** to 9.7% in **Table 5.2**.

Table 5.2. Impact of Colleges on Labor and Non-Labor Income in the State Economy

	Labor Income ($ Thousands)	% of Total	Non-Labor Income ($ Thousands)	% of Total	TOTAL Income ($ Thousands)	% of Total
Total Income in State	$80,413,994	100%	$36,477,306	100%	$116,891,300	100%
Income Attributable to Student Spending						
Direct Effect	$365,922	0.5%	$165,543	0.5%	$531,465	0.5%
Indirect Effect	$109,481	0.1%	$52,428	0.1%	$161,909	0.1%
TOTAL	$475,403	0.6%	$217,971	0.6%	$693,374	0.6%
Income Attributable to College Operations						
Direct Effect of Faculty and Staff	$467,565	0.6%	$0	0.0%	$467,565	0.4%
Indirect Effect	$71,557	0.1%	$34,085	0.1%	$105,641	0.1%
Gross Total	$539,122	0.7%	$34,085	0.1%	$573,207	0.5%
Adjustment for tax payment effects	($263,522)	-0.3%	($122,386)	-0.3%	($385,908)	-0.3%
TOTAL	$275,600	0.3%	($88,301)	-0.2%	$187,299	0.2%
Income Attributable to Past Student Economic Development Effects						
Direct Effect	$5,794,393	7.2%	$2,282,386	6.3%	$8,076,780	6.9%
Indirect Effect	$1,357,353	1.7%	$668,427	1.8%	$2,025,780	1.7%
TOTAL	$7,151,746	8.9%	$2,950,813	8.1%	$10,102,559	8.6%
GRAND TOTAL	$8,166,272	10.2%	$3,080,482	8.8%	$10,983,232	9.7%

Sources: Data for student spending are obtained by multiplying spending data shown in Table 5.3 by earnings-sales and value added-sales ratios determined by the EMSI Regional IO Model for the state (Moscow, ID: Economic Modeling Specialists, Inc., 2002). Data on the impact of college operations and past student productivity effects obtained from Table 4.1.

Economic Impacts Reported as Gross Sales

Advocates sometimes favor gross sales over earnings as an impact measure, because sales are always larger than the earnings. Using this as an impact measure has notable drawbacks, however. An immediate drawback is that, unlike earnings, there is generally no published total against which a sales impact can be measured. More importantly though, the most troublesome aspect of gross sales impact measures is captured in the following example:

> Two visitors spend $50,000 each in the economic region. One visits a local auto dealer and purchases a new luxury automobile. The other undergoes a medical procedure at the local hospital. In terms of direct economic impact, both have spent $50,000. However, the

model. Adjustments were made consistent with the model's regional accounts to allow for spending leakages.

expenditures will likely have very different meanings to the local economy. Of the $50,000 spent for the luxury automobile, perhaps $10,000 remains in the county as salesperson commissions and auto dealer income (part of the economic region's overall earnings), while the other $40,000 leaves the area for Detroit or somewhere else as wholesale payment for the new automobile. Contrast this to the hospital expenditure. Here perhaps $40,000 appears as physician, nurse, and assorted hospital employee wages (part of the county's overall earnings), while only $10,000 leaves the area, to pay for hospital supplies, or to help amortize building and equipment loans. In terms of sales, both have the same impact, while in terms of earnings, the former has one-fourth the impact of the latter.

Table 5.3 expresses the impacts of the Oregon community colleges in terms of gross sales rather than income. Note that gross sales measures are everywhere larger than income. The economy-wide measure of total gross sales estimated by the economic model is $251.1 billion.[47] Direct local spending by students reflects their total spending, reduced by the estimated portion that leaks out-of-state to purchase goods produced elsewhere.[48] In the usual fashion, indirect effects reflect the action of local economic multiplier effects, also estimated by the economic model.

Direct local expenditures include all spending by the colleges (i.e., for consumer items), excluding faculty and staff wages and salaries. Both items are reduced to reflect purchases from outside the state. All told, the operation of the Oregon community colleges is estimated to explain some $22.9 billion in gross sales, a number substantially larger than the $11.0 billion explained by the colleges in state income shown in **Table 5.2**.

While the gross sales impacts shown in **Table 5.3** are not incorrect, we prefer to report college impacts in terms of income (**Table 4.1**) rather than gross sales, because they reflect the economic realities in the local community much more accurately. Advocacy studies, on the other hand, will often opt to express the results in terms of sales because the numbers are much more impressive. Such results, however, will likely not stand up to rigorous peer scrutiny in the economics profession.

[47] Simply stated, economy-wide gross sales are obtained by multiplying sector-specific regional earnings by a national estimate of sales-to-earnings.

[48] Students purchase gasoline for their cars, for example, and while the trade margin stays in the area, in most cases the producer price of gasoline itself will leak out to the oil-producing region.

Table 5.3. Impact of Colleges on Sales in the State Economy

	Gross Sales ($ Thousands)	% of Total
Total Gross Sales in State	$251,128,228	100%
Gross Sales Attributable to Student Spending		
Direct Local Spending by Students	$922,616	0.4%
Indirect Spending Effect	$318,780	0.1%
TOTAL	$1,241,396	0.5%
Gross Sales Attributable to College Operations		
Direct Local Spending of Colleges	$248,137	0.1%
Indirect Spending Effect	$149,482	0.1%
TOTAL	$397,619	0.2%
Gross Sales Attributable to Past Student Economic Development Effects		
Direct Gross Sales	$17,170,952	6.8%
Indirect Gross Sales	$4,089,509	1.6%
TOTAL	$21,260,461	8.5%
GRAND TOTAL	$22,899,476	9.1%

Sources: Data shown for student spending are based on spending information appearing in Robert Resek, David Merriman, Susan Hartter, and eds, Illinois Higher Education (Springfield, IL: IBHE, University of Illinois, 2000), applied to the EMSI Regional IO Model for the state (Moscow, ID: Economic Modeling Specialists, Inc., 2002). Data for the direct effect of college operations on sales are obtained from the colleges, while the indirect effect is calculated through the application of multipliers determined by the regional IO model. Direct and indirect past student effects are derived using earnings data from Table 4.1, multiplied by sales-earnings ratios from the EMSI IO model.

VARIABLES REQUIRING "JUDGMENT"

The sensitivity analysis is a simple tool often used to determine "switching" values, which occur when the investment results turn from positive to negative, or from attractive to non-attractive as the assumptions are varied up and down. If the results change dramatically with only a small variation in the assumption, then that assumption is sensitive. If the results do not change much, the assumption is not sensitive, and minute accuracy in its specification is less important. The sensitivity analysis is also used to demonstrate how some results become unrealistic when advocacy assumptions are invoked.

Two variables have consistently raised concerns among institutional researchers, since neither can be specified on the basis of hard data collected regularly by the colleges. These are the "Attrition Rate" and the "Alternative Education Opportunity" variables, discussed in detail in **Tables 2.2** and **2.10,** respectively. Recall from **Chapter 2** that the attrition rate (5% in **Table 2.2)** characterizes the mobility of the exiting students out of the state over the next thirty years or so through retirement, out-migration and/or death. The alternative education opportunity variable (22.1% in **Table 2.10**) is characterized as a "negative benefit"—the taxpayer benefits are reduced by the percent indicated to account for the portion of the current student body who could obtain a

similar education elsewhere, absent the publicly funded colleges and universities in the state. In earlier studies that we conducted, we regularly asked the institutional researchers at the individual colleges to provide an estimate of this variable, but due to the cumbersome nature of the process involved, we later internalized the alternative education variable to the analytical model. **Appendix 3** provides a detailed explanation of the method used to derive this variable.

Given the nature of the "Attrition Rate" and the "Alternative Education Opportunity" variables and the difficulty in accurately specifying them, the obvious question is: how great a role do they play in the magnitudes of the results? The results are presented in the sensitivity analysis in **Table 5.4**.

Table 5.4. Sensitivity Analysis of Alternative Education and Attrition Rate Variables ($ Thousands)

		-75%	-50%	-25%	Base Case	25%	50%	75%
Alternative Education Variable		5.5%	11.1%	16.6%	22.1%	27.7%	33.2%	38.7%
Narrow Taxpayer Perspective								
Investment results	NPV	$1,679,910	$1,560,319	$1,440,728	$1,321,137	$1,201,546	$1,081,956	$962,365
	RR	21.9%	20.8%	19.7%	18.7%	17.6%	16.5%	15.4%
	B/C ratio	5.6	5.3	5.0	4.6	4.3	4.0	3.6
	Pay Back	8.4	8.7	9.0	7.4	9.8	10.2	10.7
		-75%	**-50%**	**-25%**	**Base Case**	**25%**	**50%**	**75%**
Attrition Rate Variable		1.3%	2.5%	3.8%	5.0%	6.3%	7.5%	8.8%
Regional Economic Development								
Earnings Attributable to Colleges		$10,631,813	$10,570,511	$10,508,925	$10,447,048	$10,384,874	$10,322,398	$10,259,612
% of Total Earnings in State		9.1%	9.0%	9.0%	8.9%	8.9%	8.8%	8.8%
Credits Embodied in the Workforce		89,609,939	89,075,961	88,539,499	88,000,506	87,458,928	86,914,714	86,367,808

Alternative Education Opportunity

Variations in the Alternative Education assumption are calculated around the base case assumptions listed in the middle column of **Table 5.4** for the taxpayer perspective results (the variable does not affect the student investment analysis results). The net present value, rate of return, benefit/cost ratio, and payback results listed in the base case column were all presented and discussed in **Chapter 3**. Next, we bracket the base case assumption on either side with plus or minus 25%, 50% and 75% variation in the assumptions. The analyses are then redone introducing one change at a time, holding all the other variables constant. For example, an increase of 25% in the Alternative Education assumption (from 22.1% to 27.7%) will reduce the narrow taxpayer perspective rate of return from 18.7% to 17.6%. Likewise, a decrease of 25% (from 22.1% to 16.6%) in the assumption will generate an increase in the rate of return from 18.7% to 19.7%.

Based on this sensitivity analysis, the conclusion can be drawn that the investment analysis results from the narrow taxpayer perspective are not very sensitive to relatively large variations in the Alternative Education variable. As indicated, the results are still well above their threshold levels (net present value greater than 0, benefit/cost ratio greater than 1, and rate of return greater than the discount rate of 4.0%) even when the Alternative Education assumption is increased by as much as 75% (from 22.1% to 38.7%). The conclusion is simply that, although the assumption is difficult to specify, its impact on the overall investment analysis results for the narrow taxpayer perspective is not very sensitive.

Attrition Variable

The attrition rate variable only affects the regional economic development results (**Table 4.1**). As above, we increase and decrease the assumption relative to the base case assumption of 5% (from **Table 2.2**) by the increments indicated in the table. The impacts on the results are more pronounced, as indicated in **Table 5.4**. Labor income attributable to the colleges, for example, ranges from a high of $10.6 billion at -75% to a low of $10.3 billion at a 75% variation from the base case assumption for this variable. This means that if the attrition of the ex-students over time increases, the number of CHEs embodied in the current state workforce decreases; hence, the labor income attributable to the colleges decreases accordingly.

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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 publicly funded colleges and universities in the state. An estimate of 20%, for example, means that 20% of the students do not depend directly on the existence of the college in order to obtain their education. We then back 20% out of the impact calculations.
Asset Value	The asset value is the capitalized value of a stream of future returns. It is the measure of what you would have to pay today for an instrument that provides the same stream of future revenues.
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 in order 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 State Product The gross state product (GSP) is a measure of the final value of all goods and services produced. Alternatively, GSP 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 the investment. The formula for computing payback period is: Payback period = cost of investment/net return per period

APPENDIX 2: 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 school 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 period 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.[49]

[49] Obviously, colleges need at least some measure of support in order to stay open. For smaller schools, the loss of 35% of the student body would be felt far more acutely than if a larger college were to lose the same percentage of its students. For this reason, the analytical model allocates a higher shutdown point, no greater than 50%, for colleges with fewer than 6,000 students, based on an internalized formula.

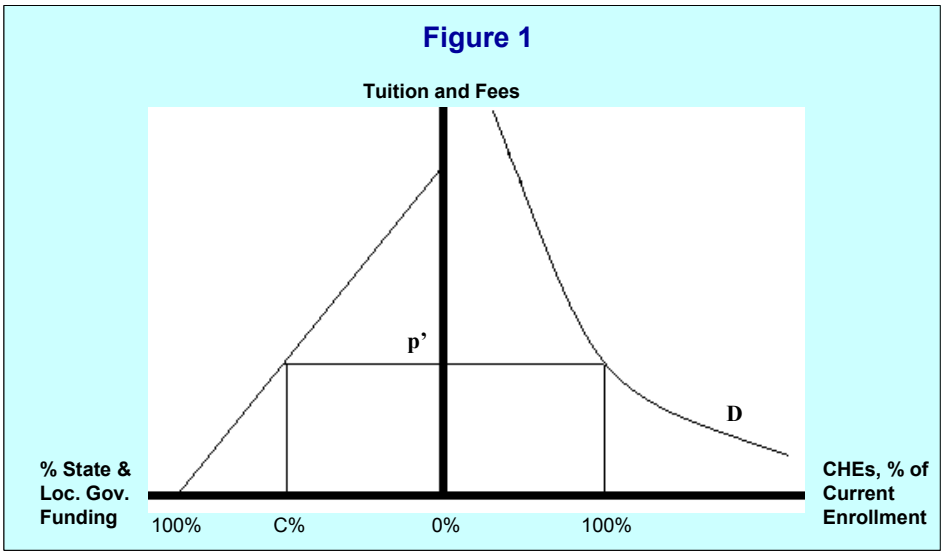
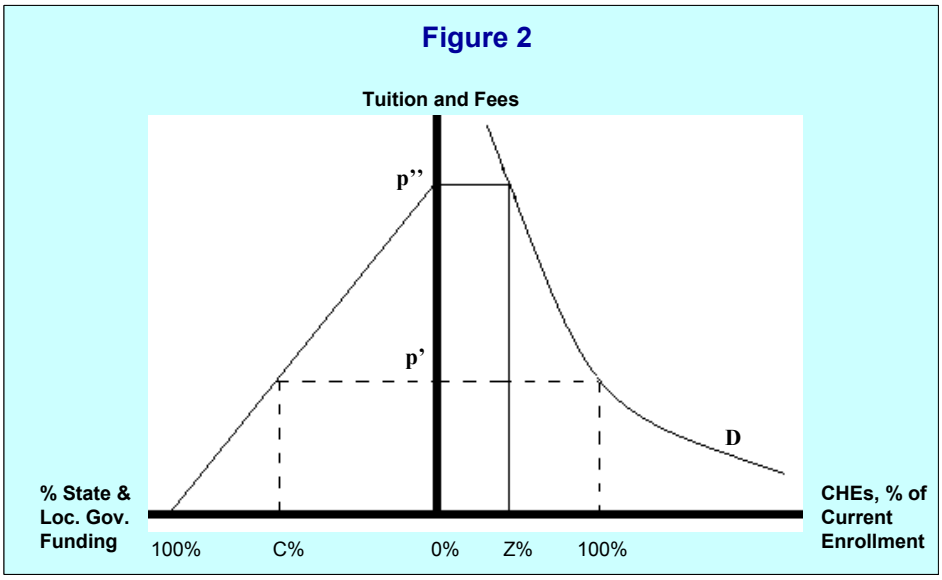


Figure 2 shows another important reference point in the model—where state and local government support is 0%, tuition rates are increased to p", and enrollment is Z% (less than 100%). The reduction in enrollment reflects price elasticity in the students' school vs. no-school decision. Neglecting for 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 our Main Report and shown in **Table 3.6** for the broad and narrow taxpayer perspectives.

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 are 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 3

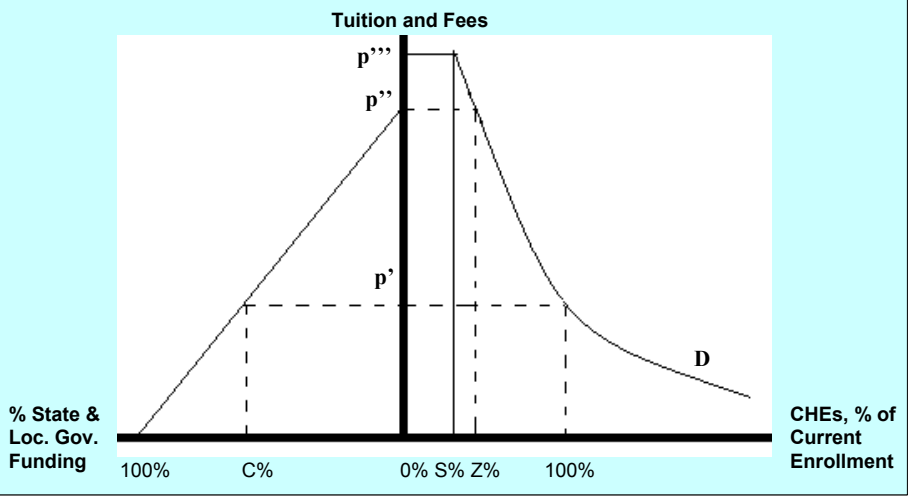
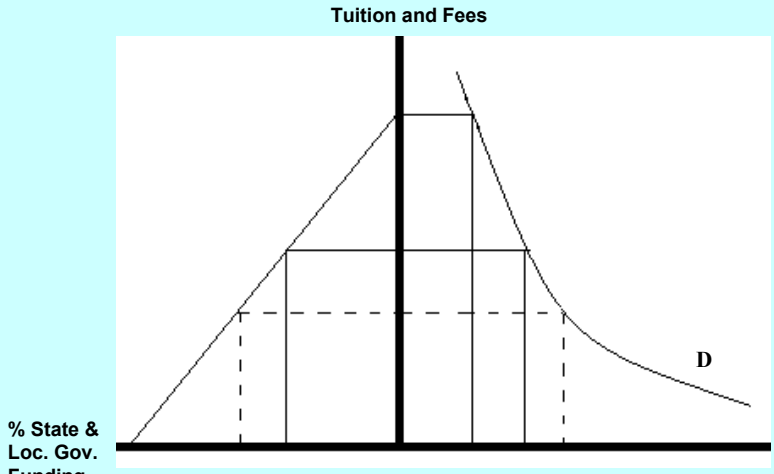


Figure 4 illustrates yet another scenario. Here the college shutdown point occurs at an enrollment level greater than Z% (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the school to operate at all. This minimum portion 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%).

Figure 4



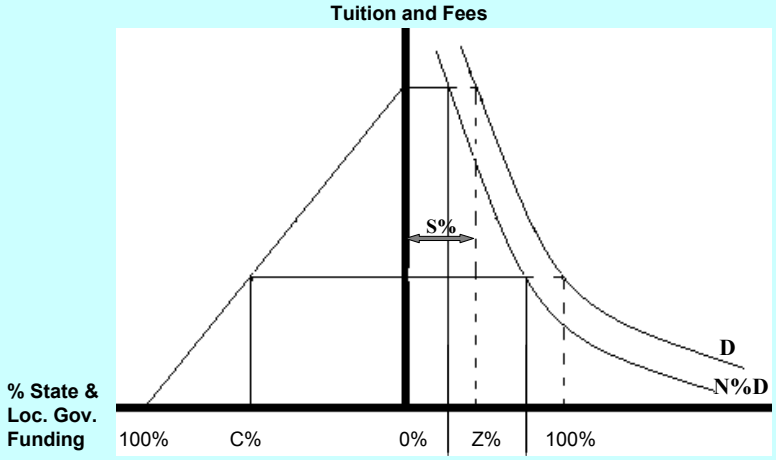
ADJUSTING FOR ALTERNATIVE EDUCATION OPPORTUNITIES

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 publicly funded colleges and universities in the state, 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:

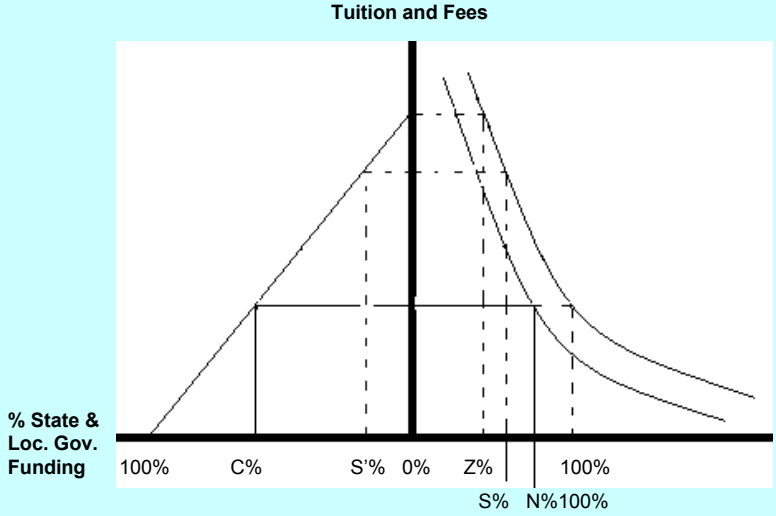
(4) $B = B(N\%100\%) - B(N\%Z\%)$

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



APPENDIX 3: 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 the publicly funded colleges and universities in the state.[50] 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

[50] The question we ask in determining the alternative education variable is as follows: 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.[51]

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.[52]

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 avail themselves of the alternative education opportunities. This number is expressed in thousands.[53]

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:

[51] 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.
[52] Available from the U.S. Department of Commerce, 2001 County Business Patterns.
[53] Available from the U.S. Department of Commerce, Bureau of Economic Analysis, 2001 REIS Employment and Earnings Reports.

(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)

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) $Y = (3.43E\text{-}05 * 50.2) + (0.023565 * .3318) + (0.005748 * 21.869)$

(4) $Y = 13.5\%$

APPENDIX 4: 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.[54]

Table 1. Costs and Benefits

Year	Tuition	Opportunity Cost	Total Cost	Higher Earnings	Net Cash Flow
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			$21,500	$35,747	$14,247
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).

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

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).

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) 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.[55] 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 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 $14,247. It is simply the present value of the benefits less the present value of the costs, or $35,747 - $21,500 = $14,247. In other words, the present value of benefits exceeds the present value of costs by as much as $14,247. 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

[55] 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.

computed a positive net present value of $14,247. 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. 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 "> 100%."

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 5: 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 regional IO model), and managed by software developed by Economic Modeling Specialists, Inc. (EMSI) of Moscow, Idaho. 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]).[56]

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 the students. With added incomes, students have more money to spend which subsequently affects earnings in other industries through

[56] 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.

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.[57] 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%.[58] 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.

[57] 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).
[58] 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 6: EXPLANATION OF VARIANCES IN RESULTS

INTRODUCTION

CCbenefits, Inc. completed a Socioeconomic Impact (SEIM) study for the Oregon community colleges in 2002. The present report is an updated study applying data from both the 2002 Starter Kits and the Refresher Starter Kits from 2006. Ratios derived from the 2006 Refresher Kits were applied to the 2002 Starter Kits to update the data for the present study.[59]

The purpose of this appendix is to outline the changes and/or updates that were made to the data provided by the Oregon community colleges and to the CCbenefits, Inc. Socioeconomic Impact Model between the time that the first study was conducted and the present study. Each revision is linked to specific tables in the present report, with references made to the original 2002 study. For more information, the reader is encouraged to review the original set of reports produced for the Oregon community colleges in 2002.

Changes are broken down into three basic categories:

1. Data Updates in the CCbenefits, Inc. Socioeconomic Impact Model
2. Improved Methodology and Application of New Theory
3. Revised Data from the Oregon community colleges

DATA UPDATES IN THE CCBENEFITS, INC. SOCIOECONOMIC IMPACT MODEL

Income and Earnings Data

Average earnings by education level reported in **Table 2.5** are calculated using national averages from the U.S. Census Bureau, which are regionalized by applying a ratio of

[59] The Starter Kit is an Excel spreadsheet which compiles together all of the necessary variables for the study. The Refresher Kit is a condensed version of the Starter Kit employed only by those colleges that request an updated set of reports. Only the most crucial variables (i.e., student headcount, college revenue, faculty and staff wages and salaries, etc.) are requested in the Refresher Kit.

regional earnings to national earnings. These data were updated in March 2006 in the CCbenefits SEIM model. Regional income data reported in **Table 4.1** of the present report were also updated.

State and Local Tax Data

State and local tax data from the U.S. Census Bureau were updated in the SEIM model in March 2006, thereby adjusting the estimated amount of added taxes in the state as a result of higher student earnings and added income. Added taxes plus the avoided social costs figure directly into the calculation of the return on investment from the narrow taxpayer perspective.

Social Variables

Data on the statistical correlation between improved lifestyles and higher education were updated in June of 2005. In most cases the updated data generated results that were slightly more conservative than previously reported, particularly for reduced absenteeism, reduced welfare and unemployment, and reduced incarceration costs.

IMPROVED METHODOLOGY AND APPLICATION OF NEW THEORY

CHE Engine

The methodology used to move students through their education between the time they entered the colleged and the beginning of the analysis year was refined and updated in the CCbenefits SEIM model in March 2006 (see **Table 2.3**). These changes allowed for a more accurate representation of the typical student's college career as he or she works to complete his/her education.

Alternative Education Opportunity

In the 2002 study, college staff members were requested to provide CCbenefits with an estimate of the percent of students who would be able to obtain education elsewhere absent the publicly funded colleges and universities in the state. This variable – the alternative education variable – was later internalized in the CCbenefits SEIM model. For more information regarding the reasons and methodology behind the calculation of the Alternative Education Variable for the Oregon community colleges, please refer to **Appendix 3**.

Labor Versus Non-Labor Income

The present analysis includes an analysis of the colleges' impact on both labor and non-labor income in the State of Oregon (see **Table 4.1** in the present report). Impacts were expressed only in terms of labor income in the 2002 study. The primary reason for including the impact of the colleges on non-labor income is in recognition of the fact that past student productivity affects *all* factors of production, i.e., labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents and other. The direct and indirect effect of the Oregon community colleges on non-labor income is derived using value-added ratios estimated by the EMSI regional IO model.

Hamilton Reduction Factor

The indirect effects generated by past students and by college operations in the State of Oregon are discounted by all but 20% in accordance with recent theory arguing that overall multiplier effects overstate net effects by as much as 80%.[60] See **Appendix 5** for more details.

REVISED DATA FROM THE OREGON COMMUNITY COLLEGES

College Revenues

The colleges provided data on their aggregate revenues for both the 2002 and 2006 studies. In 2006, a smaller percentage of the total college budget was covered by state and local grants and appropriations (48% in 2006 as opposed to 58% in 2002). The portion of college revenue provided by state and local taxpayers is directly used to calculate the taxpayer return on investment and benefit/cost ratios.

College Expenditures

College operation spending generates additional earnings in the State of Oregon, due to the well-known multiplier (i.e., ripple) effects. A comparison of **Table 2.10** from the 2002 study and **Table 2.11** in the present report shows that college spending increased by roughly $99.7 million between 2002 and 2006 ($754.9 million in 2006 minus $655.1

[60] 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.

million in 2002). These figures are used to calculate both the direct and indirect earnings effect of college operations in the state.

Student Achievements

The estimated number of CHEs embodied in the state workforce was higher in 2006 than in 2002 (see **Table 2.12** in the 2002 study, which reports 65.8 million embodied CHEs, as opposed to the **Table 2.12** in the present report, which reports a total of 88.0 million embodied CHEs). The number of CHEs embodied in the workforce is used to calculate the increased skills and added income in the State of Oregon due to the productivity effects of past students. See also **Table 4.2** in the present report.