



Economic Contribution of Contra Costa Community College District

***Analysis of Investment Effectiveness
and Economic Growth***

Volume 1: Main Report

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CCbenefits Inc. is a leading provider of socioeconomic impact and strategic planning tools to community and technical colleges. To date the model developed by CCbenefits has been successfully applied to more than 500 colleges in the United States and Canada. Questions concerning the approach, assumptions, and/or results should be directed to CCbenefits, c/o Drs. Kjell Christophersen and Hank Robison, PO Box 9008, Moscow, ID 83843; phone: 208-882-3567; fax: 208-882-3317; e-mail: ccbenefts@moscow.com.

ACRONYMS

ABE	Adult Basic Education
B/C	Benefit/Cost Ratio
CCCCD	Contra Costa Community College District
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

SUMMARY

This report presents the economic impacts generated by Contra Costa Community College District in its service region and in the state. The study presents two analyses: 1) investment analysis from the perspectives of students and taxpayers, and 2) economic growth analysis to determine the relative contribution of CCCCDC to regional income. Major findings are as follows:

INVESTMENT ANALYSIS

1. **Students:** The analysis recognizes Contra Costa Community College District as an investment on the part of students. Compared to someone with a high school diploma, the Associate Degree graduate will see an increase in earnings of approximately \$570,800 over the course of a working lifetime, equal to about \$15,000 per year. This figure does not capture personal incidental benefits from education, including increased job satisfaction, improved health, and others. All in all, it is estimated that students will receive a 20.9% annual rate of return on their education investment.
2. **Taxpayers:** The analysis considers CCCCDC as an investment on the part of state and local government taxpayers. The economic growth effect of CCCCDC translates into increased state and local government revenues, plus an assortment of social savings stemming from reductions in incarceration, welfare, health care support, and others. Altogether, state and local government support of CCCCDC yields an investor rate of return equal to 10%, exceeding the assumed 4% opportunity cost of funds. This means that CCCCDC returns more to taxpayers than it costs. The district not only pays for itself but also provides a surplus that supports other government programs.

ECONOMIC GROWTH ANALYSIS

1. **District Operations Effect:** Direct earnings of CCCCDC faculty and staff plus district operations spending increase regional income in the Contra Costa County economy by \$112.9 million. This is a conservative estimate discounted to account for monies withdrawn from the local economy to support the district.

2. **Student Spending Effect:** About 14% of CCCCD's students come from outside the region. The spending effects of these out-of-region students account for about \$14.9 million in added regional income in the Contra Costa County economy.
3. **Past Student Productivity Effect:** Newly skilled college-trained workers deepen the state and local economy's human capital. This results in higher wages for students, greater returns to property owners, increased tax revenues, and added incomes due to economy-wide multiplier effects. Altogether it is estimated that the productivity effects of CCCCD's past students annually contribute \$3.4 billion to economic growth in Contra Costa County.
4. **Total Effect:** Adding district operations, student spending, and past student productivity effects together, CCCCD accounts for approximately \$3.5 billion of labor and non-labor income in the Contra Costa County economy. This is equal to about 8.9% of a typical year's economic growth.

Chapter 1

INTRODUCTION

OVERVIEW

CCCCD generates a wide array of benefits. Students benefit from higher personal earnings, and society benefits from cost savings associated with reduced welfare and unemployment, improved health, and reduced crime. Higher education, however, requires a substantial investment on the part of students and taxpayers. All education stakeholders, therefore, want to know if they are getting their money's worth. In this study, Contra Costa Community College District (CCCCD) investigates the attractiveness of its returns relative to alternative public investments. Two main analyses are presented: 1) investment analysis, and 2) economic growth analysis.

The investment analysis captures private and public benefits that accrue to students and taxpayers in return for their educational support. Private benefits include higher earnings of students, while public benefits include growth in income plus an assortment of positive externalities such as improved health and lifestyle habits, lower crime, and lower incidences of welfare and unemployment. All of these annual benefits continue and accrue into the future, for as long as students are in the workforce. To determine the feasibility of the investment, we project benefits into the future, discount them back to the present, and compare them with present costs. Results are displayed in four ways: 1) net present value, 2) rate of return, 3) benefit/cost ratio, and 4) payback period.

The economic growth analysis focuses on the contribution of CCCCCD to economic development by increasing consumer spending and raising the skill level of the labor force. This in turn leads to more jobs, increased business efficiency, greater availability of public investment funds, and eased tax burdens. In general, college-linked income falls under three categories: 1) income generated by annual CCCCCD operating expenditures; 2) income generated by spending of CCCCCD students; and, 3) income generated by CCCCCD skills embodied in the workforce.

A note of importance: although the reports generated for CCCCCD are similar to those 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.** Results are a reflection of location, student body profile, and other factors that have little or

nothing to do with the relative efficiency of the colleges. For this reason, comparing results between colleges is strongly discouraged.

METHODS

The process begins by assembling data in an Excel file called the “Starter Kit” requesting information on headcount, student demographics, average coursework hours, etc. Also included is information on revenues and expenditures, as well as faculty and staff wages and salaries. Typically it requires three to five person-days to supply the data needed for the economic model. CCBenefits blends these data with other published economic, social and educational data at the national, state, and county level.

The report has five chapters and five appendices. **Chapter 1** is an overview of benefits measured and analytical approach. **Chapter 2** presents data and assumptions underlying the analysis. **Chapter 3** presents investment analysis results, i.e., returns to students and taxpayers. **Chapter 4** considers the impact of CCCCD on regional economic growth. **Chapter 5** provides sensitivity analyses of softer variables. **Appendix 1** is a glossary of terms. **Appendix 2** demonstrates methods used to determine benefits generated by students who can avail themselves of alternative education opportunities. **Appendix 3** is a short primer on the investment analysis results. Finally, **Appendix 4** provides detail on the input/output model used in the study.

Chapter 2

DATA SOURCES AND ASSUMPTIONS

INTRODUCTION

To the extent possible, documented statistics obtained from public databases and from the district were used to craft assumptions on which results are based. In cases where hard data were not available, college researchers used, where appropriate, CCbenefits default values.

This chapter contains three sections documenting data sources and assumptions: 1) district profile; 2) student profile; and 3) social benefits.

DISTRICT PROFILE

District Revenues

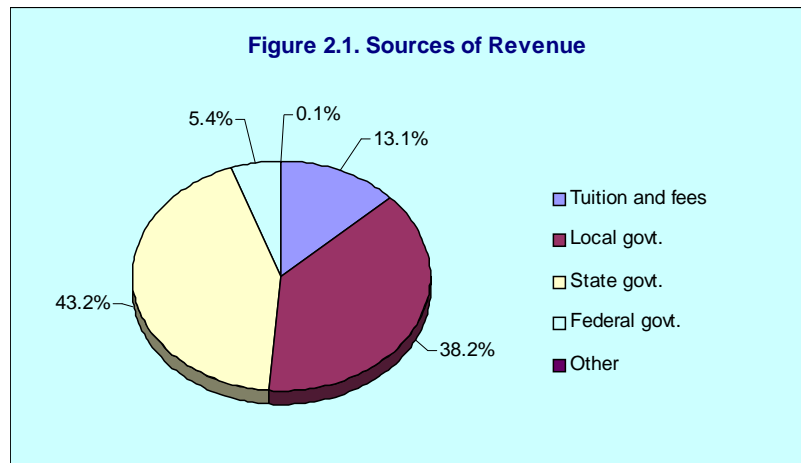
Table 2.1 and **Figure 2.1** show CCCC'D's annual revenues by funding source: a total of \$248.5 million. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (13.1%) plus 0.1% from other private sources such as contract revenues, interest payments and the like. Public funding is comprised of state and local taxes (81.4%) and federal grants (5.4%). These data are critical in identifying annual costs of educating the student body from the perspectives of students and taxpayers alike.

Table 2.1. Aggregate Revenues

Sources	Revenues	Total	% of Total
Private Funding			
Tuition and fee payments ¹	\$32,637,784		13.1%
Other sources of revenues	\$202,174	\$32,839,957	0.1%
Public Funding			
Local taxes	\$95,001,439		38.2%
State aid	\$107,359,182		43.2%
Federal grants	\$13,334,382	\$215,695,003	5.4%
Total		\$248,534,960	100%

1. Includes student loans; excludes student grants, scholarships, discounts, and allowances.

Source: Data supplied by CCCC'D.



District Expenditures

CCCCD employed 513 full and 1,947 part-time faculty and staff in fiscal year 2006. Their combined payroll amounted to \$131.3 million. Other operating expenditures, including purchases of supplies and services, made up \$117.2 million. These budget data appear in Column 1 of **Table 2.2**. Column 2 apportions that spending to local (i.e., in-region) vendors. The net local portion is derived in Column 3.

Table 2.2, 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 district is a “good neighbor” in the region, evidenced by the fact that 68% of all district expenditures benefit local vendors (\$168.9 million / \$248.5 million = 68%).

Table 2.2. Profile of CCCCDC Spending In and Out of Regional Economy

Spending Categories	Total Dollar Amount (1)	% Local (2)	Net Local Spending (3)
Salaries, wages, and benefits	\$131,304,890	84%	\$110,857,894
Other operating expenditures	\$117,230,071	50%	\$58,045,766
TOTAL	\$248,534,961	68%	\$168,903,661

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

District Service Region

Contra Costa County is shown in the map below. The whole counties included in the economic region comprise the backdrop for calculating the economic impacts presented in this report.



STUDENT PROFILE

Demographics

The CCCCD unduplicated student body headcount for AY 2006 was 58,505 credit students and 4,404 non-credit students, for a total of 62,909 students altogether. Of these students, 44% were males and 56% were females (**Figure 2.2**). The percent breakdown of the student body by ethnicity was 40% White and 60% Non-White, including African-American (13%), Asian/Pacific Islander (18%), Hispanic (17%), Native American (1%), other Non-White (3%), and unknown (9%). For the purposes of this report, we present gender and ethnicity breakdowns according to four main groups: White Male, Non-White Male, White Female, and Non-White Female.

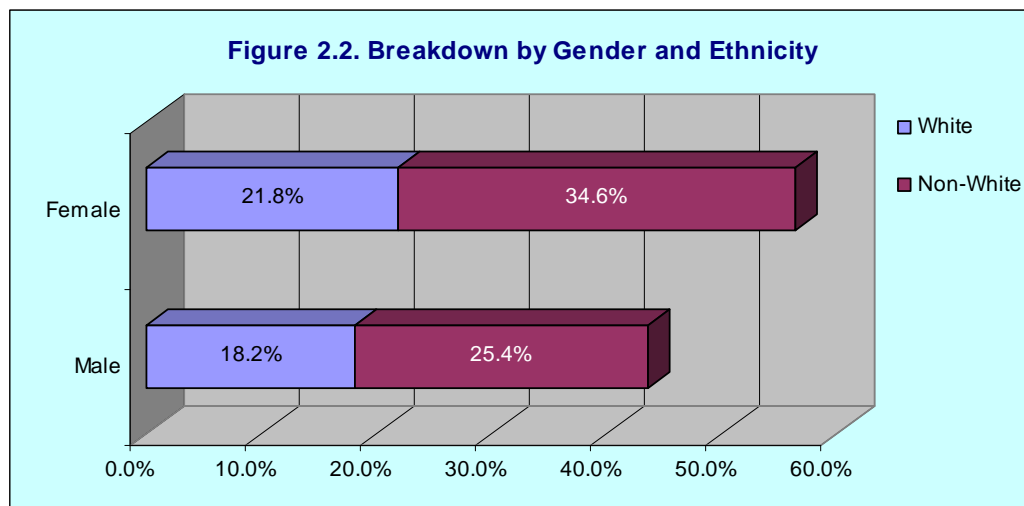


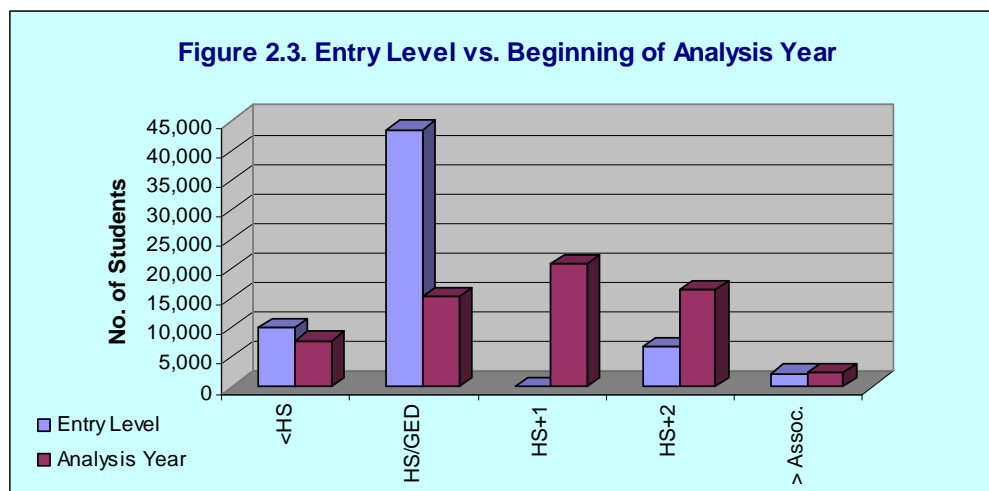
Table 2.3 and **Figure 2.3** show the students’ entry level of education by gender and ethnicity. Entry level characterizes the students’ education level when they first enrolled, indicated in approximate one-year increments ranging from less than High School to post Associate Degree. However, education levels must also be estimated for students at the beginning of the analysis year, since this is the platform upon which the economic benefits are computed. Thus, of the 8,727 white males who first entered college with a high school diploma, it is estimated that only 3,055 still remain in that category at the beginning of the analysis year. This means that 5,673 students have moved up from the “HS/GED equivalent” category to the “One year post HS or less” category or beyond since they first entered CCCC.¹ Note that differences between the “Entry Level” and “Analysis Year” columns reflect the redistribution of students as they move from one category to the next, although the columns always add to the same total.²

Table 2.3. Student Body Education Level: Entry vs. Beginning of Analysis Year¹

Education Level	White Male		Non-White Male		White Female		Non-White Female		Total	
	Entry Level	Analysis Year	Entry Level	Analysis Year	Entry Level	Analysis Year	Entry Level	Analysis Year	Entry Level	Analysis Year
< HS/GED	1,763	1,372	2,871	2,234	1,832	1,426	3,577	2,783	10,044	7,815
HS/GED equivalent	8,727	3,055	10,679	3,748	10,106	3,534	14,055	4,930	43,568	15,267
One year post HS or less	1	4,144	46	5,210	17	4,776	67	6,828	131	20,957
Two years post HS or less	624	2,543	1,884	4,286	1,181	3,400	3,148	6,302	6,837	16,532
> Associate Degree	484	485	346	349	787	789	712	715	2,329	2,338
Total	11,600	11,600	15,827	15,827	13,924	13,924	21,558	21,558	62,909	62,909

1. "Non-White" includes African-American, Asian/Pacific Islander, Hispanic, Native American, other Non-White, and unknown ethnic groups.

Source: Adapted from data supplied by CCCC.



¹ These calculations are based on parameters (such as the frequency of “stopouts”) that characterize how typical college students progress over time from when they first enrolled up to the analysis year.

² In this volume we present gender and ethnicity breakdowns only in **Table 2.3** and **Figure 2.2**. Otherwise, breakdowns are presented as weighted averages. Please refer to **Volume 2: Detailed Results** for the breakdown by gender, ethnicity and level of education.

Achievements

Table 2.4 shows the student body allocated to seven basic categories: 1) Associate Degree completers, 2) Certificate completers, 3) transfer students and/or degree non-completers, 4) workforce students, 5) ABE/ESL/GED students, 6) retired and leisure 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 (2%) or Certificates (1%). Transfer students and/or degree-bound students who did not complete during the analysis year comprised 34% of the student body. Other students fulfilled credits to improve their skills or to meet their educational needs (23% + 25% = 48% in workforce and all other student categories, respectively).

Retired and leisure students (5%) are simply backed out of the analysis altogether on the assumption that they do not attend CCCC to acquire skills that will increase their earnings. ABE/ESL/GED students (10%) 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.³

The fourth column of **Table 2.4** shows the average age of students (excluding retired and leisure students). The time horizon for the analysis is 38 years, which is the difference between the average age (27 years) and retirement age (65). Average CHEs per student category appear in the fifth column, while total CHEs generated by the entire student body (735,113) appear in Column 6.⁴ The last column of the table shows the average time students are actually in attendance relative to a full-time year, or FTE. This information is needed to determine the opportunity cost of education (see next section).

³ 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 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.

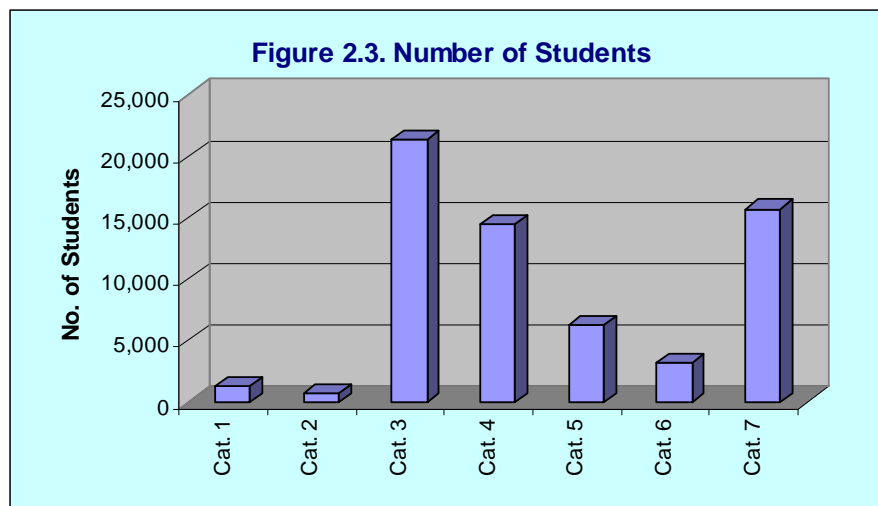
⁴ CHEs, or credit hour equivalents, are defined as 15 contact hours of education if on a semester system and 10 contact hours if on a quarter system. The analytical model is based on the implicit assumption that it requires 30 CHEs, or 450 contact hours, to complete one full year of study. In California student achievements are measured in terms of units, where one full year (or FTE) requires at least 525 contact hours of education. For the purposes of this report, student achievement data submitted by the CCCC Office of Institutional Research were converted from units to CHEs to accommodate the methodology and assumptions embedded in the analytical model.

Table 2.4. Levels of Achievement

Student Body Category	Student Distribution	Student Headcount	Average Age ²	CHEs This Year ²	Total CHEs ²	CHEs/FTE ³
Cat. 1 - Associate's Degree completers	2%	1,258	27	27	34,306	0.9
Cat. 2 - Certificate completers	1%	629	33	24	14,847	0.8
Cat. 3 - Transfer track and non-completing	34%	21,389	24	17	360,762	0.6
Cat. 4 - Workforce students ¹	23%	14,469	34	10	147,585	0.3
Cat. 5 - ABE/ESL/GED	10%	6,291	25	7	44,456	0.2
Cat. 6 - Retired and/or leisure students	5%	3,145	70	4	11,533	0.1
Cat. 7 - All other students	25%	15,727	28	8	121,624	0.3
Total or weighted averages	100%	62,909	27	12	735,113	0.4

1. Includes students attending courses for reasons of career enhancement or professional development.
2. Average age and average CHEs do not include retired/leisure students as these are backed out of the study altogether. Their total CHEs, however, are included because, as paying students, they comprise a portion of the total number of CHEs produced by CCCCD. As a result, multiplying student headcount times average CHEs per student may not agree with total CHEs in Column 6.
3. CHEs, or credit hour equivalents, are defined as 15 contact hours of education. All student achievements data submitted by the CCCCD Office of Institutional Research were converted from units to CHEs.

Source: Adapted from data supplied by CCCCD.



Opportunity Cost

Some students forego earnings entirely while attending college, while others are employed full or part-time. Earnings foregone by students while attending CCCCD comprise the *opportunity cost* of education.

Determining student opportunity cost requires an estimate of average earnings by education level. This information appears in **Table 2.5**. Numbers are constructed from national data, regionalized to Contra Costa County, and weighted to reflect the specific

gender and ethnicity profile of the CCCCD student body. Differences between steps are shown in the last column.

Table 2.5. Expected Earnings at Midpoint of Individual's Working Career (Weighted Average)¹

Entry Level	Average Earnings	Difference
One year short of HS/GED	\$25,700	NA
HS/GED equivalent	\$40,700	\$15,000
Certificate	\$47,300	\$6,600
Associate Degree	\$55,700	\$8,400
One year post Associate Degree	\$63,900	\$8,200

1. Reflects earnings at the midpoint of the individual's working career, not immediately upon exiting college; Results are weighted to reflect the specific gender and ethnicity profile of the CCCCD student body.

Source: Adapted from national percentages of earnings by gender, ethnicity, and level of education, as supplied by the U.S. Census Bureau, then regionalized according to a ratio of earnings by place of work in Contra Costa County to the number of workers.

Opportunity cost incurred by the aggregate student body is estimated in **Table 2.6**. The first number in the table - \$44,135 - is the overall average annual income of the student body as derived from **Table 2.5**, weighted according to gender and ethnicity. This defines 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 65.⁵

The second number in the table - \$23,833 - is the average earnings of the CCCCD student body while enrolled (assuming full-time employment). This is calculated by conditioning earnings at the midpoint by the average age of the student body (27 from **Table 2.4**), as specified by the well-known and tested Mincer equation.

The average CCCCD student spends 40% of the year at college, time which he or she could have otherwise spent working. This translates to \$9,618 in earnings foregone per student per year ($=40\% \times \$23,833$). Retired and leisure students do not forego earnings and are thus charged zero opportunity cost. The 12,582 non-working students are charged full opportunity cost, equal to \$121.0 million ($=12,582 \times \$9,618$ in foregone

⁵ This profile of lifetime earnings is well documented in labor economics literature. For example, see Robert J. Willis, "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Function" in *Handbook of Labor Economics*, Vol. 1 (Amsterdam: Elsevier Science Publishers, 1986): 525-602; Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education* (New York: Columbia University Press for NBER, 1964); and Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," *Journal of Political Economy* 66 no. 4 (August 1958): 281-302.

earnings). The remaining 47,182 students are all employed and earn 60% relative to full earning potential, meaning that they give up about 40% of earnings they would have received had they chosen to work instead of attend college.⁶ Opportunity cost for such students comes to \$181.4 million (= 47,182 * \$9,618 * 40%), plus \$90.8 million to account for leisure time given up.⁷

Table 2.6. Opportunity Costs (Earnings Foregone)

		Opp. Cost
Average statistical annual income, given gender and ethnicity profile	\$44,135	
Annual annual income of students, adjusted for age	\$23,833	
Total number of students	62,909	
Percent (%) of full year in attendance	40%	
Earnings foregone per student per year	\$9,618	
Retired/leisure students	3,145	
Total opportunity cost		\$0
Non-working students (net of retired/leisure students)	12,582	
Total opportunity cost		\$121,016,956
Working students (net of retired/leisure students)	47,182	
Earnings relative to statistical averages (%) ¹	60%	
Total opportunity cost		\$181,432,628
Value of leisure time per working student	\$1,924	
Total value of leisure time foregone		\$90,762,717
Pell and other student aid	\$17,521,493	
Unrestricted portion of student aid ²		(\$7,008,597)
GRAND TOTAL STUDENT OPPORTUNITY COST		\$386,203,703

1. Calculated internally in the model based on data collected from nearly 200 colleges analyzed to date.

2. An assumed 60% of grants and scholarships are restricted to tuition and fees, while the unrestricted portion (40%) is paid out directly to students.

Source: Adapted from data supplied by CCCCD and by 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 last step in computing opportunity cost is to adjust it downward by the unrestricted portion of Pell and other student aid grants. Such funds are paid out directly to students and thus comprise a net gain to students. With this adjustment, combined opportunity cost for the aggregate student body comes to \$386.2 million.

⁶ For example, students might make \$20 an hour working full-time in a factory, but only \$10 an hour in a service sector job that accommodates their school attendance. Annual earnings while attending college thus fall short of what they would *potentially* be earning had they chosen to work full-time. These “lost” earnings are what the employment variables aim to capture.

⁷ Elementary consumer theory presents a tradeoff between income and leisure. Students able to work 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 leisure foregone underestimates the cost of education. See James M. Henderson and Richard E. Quandt, *Microeconomic Theory: A Mathematical Approach* (New York: McGraw-Hill Book Company, 1971).

Student Spending

Students spend money while attending college, whether for books and supplies, rent, food, transportation, and so on. These expenditures create jobs and incomes for local businesses. In this analysis we focus solely on the spending of students who come from outside the region, equal to 14% of the CCCCD student body. **Table 2.7** shows the estimated spending of CCCCD's out-of-region students broken down into four primary categories: "books and supplies," "room and board," "personal expenses," and "transportation." Actual dollar amounts appear in the middle column, with the percent breakdown in the last column.

Table 2.7. Student Spending by Major Items

Budget Item	Spending	% of Total
Books and supplies	\$2,523,250	11%
Room and board	\$10,393,485	44%
Personal expenses	\$6,153,767	26%
Transportation	\$4,400,252	19%
TOTAL	\$23,470,754	100%

Source: Adapted from data supplied by CCCCD and Robert Resek, "Illinois Higher Education: Building the Economy, Shaping Society" (Springfield, IL: Illinois Board of Higher Education, University Board of Higher Education, 2000).

Settlement Patterns

Table 2.8 presents the settlement patterns of CCCCD's students. As shown in the table, 75% of students stay in the region upon exiting college, and 25% leave. The 75% local retention rate only applies to the first year, however. The analytical model also assumes that 33% of students, and thus associated benefits, will leave the region over the next thirty years due to attrition (e.g., retirement, out-migration, or death). The last five items in **Table 2.8** are *settling-in* factors, the time needed by students to settle into their careers and start accruing benefits. For example, for transfer track students it is assumed that the onset of benefits will be delayed by 2.5 years to account for time spent at other institutions.

Table 2.8. Student Settlement Patterns

	Values
Students remaining in region after leaving college	75%
Thirty-year attrition rate (leaving region)	33%
"Settling In" factors (years):	
Associate Degree graduates	2.0
Certificate graduates	0.5
Transfer track students	2.5
Workforce students	0.0
ABE/ESL/GED students	0.5

Source: Student retention variables supplied by the district. Thirty-year attrition calculated internally in analytical model. 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).

Students who settle into careers within the area contribute to economic growth through their skills. **Table 2.9** estimates the number of CCCCDC skills currently active in the workforce, measured in terms of CHEs. Column 1 of the table presents the enrollment history of CCCCDC (credit and non-credit students). Column 2 nets off retired students. Column 3 further reduces student headcount by the percent of students who leave the region upon exiting CCCCDC (25% from **Table 2.8**).

Column 4 subtracts students from Column 3 who are still enrolled at CCCCDC and have not yet entered the workforce. In general, it is assumed that all past CCCCDC students have left CCCCDC except for the last three years (leaver assumptions appear in Column 9). Column 5 nets off students who have not yet settled into permanent occupations, as specified by the "settling-in" factors from Column 10 (see also **Table 2.8**). As shown, it is estimated that all students who have left CCCCDC settle into their occupations by their fourth year out of college.

Column 6 subtracts students who have out-migrated, retired, or died over the past thirty years. The thirty-year attrition variable (33% from **Table 2.8**) follows the logarithmic decay function shown in Column 11. Column 7 displays average CHEs generated per year back to 1977. Historic information on this variable is generally unavailable, so it is assumed that average CHEs for the analysis year apply through time.⁸ Column 8 shows the product of Columns 6 and 7. Altogether, it is estimated that there are 12.7 million CHEs of past CCCCDC instruction currently active in the regional workforce.

⁸ The assumption is that students earn, on average, about the same number of CHEs from year to year, so we use the average CHEs per student during AY 2006 as a reasonable proxy for student achievements in past years. In the case of CCCCDC, average CHEs per student in AY 2006 was around 12 (see **Table 2.4**), which, as shown in **Table 2.9**, is applied backward through time for all the years prior to 2006.

Table 2.9. Estimating CHEs of Instruction Embodied in the Workforce¹

Year	Student enrollment headcount ²	Subtract retired students	Subtract students out-migrating	Students who have left college	Leavers who have settled into jobs	Students active in workforce	Average CHEs ³	CHEs active in workforce	% students in work-force	Assumptions "Settling-in" Factor	Active in workforce
	1	2	3	4	5	6	7	8	9	10	11
1977	47,800	45,410	34,057	34,057	34,057	22,818	12	276,270	100%	100%	67%
1978	48,504	46,079	34,559	34,559	34,559	23,466	12	284,107	100%	100%	68%
1979	49,208	46,748	35,061	35,061	35,061	24,126	12	292,105	100%	100%	69%
1980	49,912	47,416	35,562	35,562	35,562	24,800	12	300,267	100%	100%	70%
1981	50,616	48,085	36,064	36,064	36,064	25,488	12	308,595	100%	100%	71%
1982	51,320	48,754	36,566	36,566	36,566	26,190	12	317,093	100%	100%	72%
1983	52,025	49,423	37,067	37,067	37,067	26,906	12	325,764	100%	100%	73%
1984	52,729	50,092	37,569	37,569	37,569	27,637	12	334,610	100%	100%	74%
1985	53,433	50,761	38,071	38,071	38,071	28,382	12	343,635	100%	100%	75%
1986	54,137	51,430	38,573	38,573	38,573	29,143	12	352,843	100%	100%	76%
1987	64,246	61,034	45,775	45,775	45,775	35,049	12	424,356	100%	100%	77%
1988	65,779	62,490	46,868	46,868	46,868	36,368	12	440,321	100%	100%	78%
1989	67,738	64,351	48,263	48,263	48,263	37,954	12	459,528	100%	100%	79%
1990	70,040	66,538	49,904	49,904	49,904	39,772	12	481,530	100%	100%	80%
1991	69,731	66,244	49,683	49,683	49,683	40,128	12	485,848	100%	100%	81%
1992	68,228	64,817	48,612	48,612	48,612	39,791	12	481,764	100%	100%	82%
1993	64,369	61,151	45,863	45,863	45,863	38,045	12	460,624	100%	100%	83%
1994	60,542	57,515	43,136	43,136	43,136	36,264	12	439,060	100%	100%	84%
1995	59,579	56,600	42,450	42,450	42,450	36,167	12	437,883	100%	100%	85%
1996	62,912	59,766	44,825	44,825	44,825	38,703	12	468,593	100%	100%	86%
1997	65,271	62,007	46,506	46,506	46,506	40,694	12	492,697	100%	100%	88%
1998	67,898	64,503	48,377	48,377	48,377	42,901	12	519,414	100%	100%	89%
1999	68,927	65,481	49,110	49,110	49,110	44,136	12	534,372	100%	100%	90%
2000	71,098	67,543	50,657	50,657	50,657	46,138	12	558,611	100%	100%	91%
2001	70,696	67,161	50,371	50,371	50,371	46,494	12	562,917	100%	100%	92%
2002	75,792	72,002	54,002	54,002	54,002	50,515	12	611,604	100%	100%	94%
2003	76,674	72,840	54,630	54,630	54,630	51,790	12	627,036	100%	100%	95%
2004	66,186	62,877	47,158	47,134	42,420	40,755	12	493,436	100%	90%	96%
2005	64,578	61,349	46,012	44,977	33,732	32,844	12	397,651	98%	75%	97%
2006	62,909	59,764	44,823	38,099	19,050	19,050	12	230,641	85%	50%	100%
Embodied Total								12,743,177			

- Numbers in this table are truncated such that only the figures prior to the decimal point appear. This may generate a rounding error when making calculations between columns.
- Column 1 shows the combined total of credit and non-credit students. In the case that enrollment data as far back as 1977 is unavailable, the missing information is calculated internally in the analytical model.
- In the absence of better data, the model assumes that average CHEs from the current year also apply to past years.

Source: Adapted from data supplied by CCCC. See also Tables 2.4 and 2.8.

Each of the 12.7 million CHEs generated by past CCCC students has a value that contributes to income growth in the industries where students are employed. **Table 2.10** allocates past student CHEs to the different industries of the regional economy based on the sectoral location of past student earnings. In general, it is assumed that past student earnings occur in sectors that are in the highest stages of development, since these are the industries where students tend to find employment.⁹

⁹ Parr describes four stages of economic development: primary production, process manufacturing, fabricative manufacturing, and producer services and capital export. The notion is that regional economies develop by progressing from low stage industries (agriculture, mining, logging, etc.), to higher

Table 2.10. Distribution of Historic CHEs by Industrial Sector

Industries	Distribution of all regional earnings	Distribution of past student earnings	Distribution of historic CHEs in workforce
	1	2	3
Agriculture and Agricultural Services	0.3%	0.0%	3,391
Mining, Sand, and Gravel	0.6%	0.1%	6,054
Construction	9.8%	0.9%	102,909
Manufacturing: Food, Wood, Paper, and Textiles	1.0%	0.5%	54,703
Manufacturing: Chemicals, Petroleum, Stone, and Glass	6.0%	8.7%	632,922
Manufacturing: Computer and Electronic Equipment	0.9%	2.2%	190,862
Manufacturing: Other	0.5%	0.4%	56,953
Transportation	2.8%	1.0%	147,148
Public Utilities	1.0%	0.5%	53,959
Publishing and Communications	5.4%	12.8%	1,134,183
Trade: Wholesale and Retail	10.6%	5.8%	1,115,245
Finance, Insurance, and Real Estate	16.6%	31.3%	3,483,416
Motels, Eating/Drinking, and Amusement/Recreation	3.1%	0.4%	161,375
Consumer Services	3.6%	0.7%	188,478
Business Services	14.7%	9.8%	1,543,744
Medical/Educational/Social Services	14.6%	17.9%	3,061,229
Federal Government	1.3%	1.2%	139,139
State and Local Government	6.9%	5.7%	667,468
Total	100%	100%	12,743,177

Source: Adapted from data supplied by U.S. Department of Commerce, Regional Economic Information System, CA and SA series; U.S. Department of Commerce, County Business Patterns; and U.S. Department of Commerce, Bureau of Labor Statistics ES-202 series. See also Table 2.9.

Column 1 shows the current distribution of all regional earnings in the Contra Costa County economy. Column 2 presents the distribution by sector of past CCCCDC student earnings based on where students are employed. Column 3 applies the distribution in Column 2 to CCCCDC CHEs currently active in the workforce, with an additional adjustment to accommodate the prevalent wage rates by industrial sector in the Contra Costa County. This latter total is obtained from **Table 2.9** and reappears at the bottom of Column 3.

stage industries (process manufacturing, fabricative manufacturing, etc.), and finally to specialized industries such as finance, engineering, and so on. 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 CCCCDC students. The end result is that past students favor higher stage industries. See J. B. Parr, “Regional Economic Development: An Export-Stages Framework,” *Land Economics* 77 no. 1 (1999): 94-114. For additional detail, see Rutgers State University of New Jersey et al, “The Impact of EDA RLF Loans on Economic Restructuring” (New Brunswick: Rutgers State University of New Jersey, 2002).

SOCIAL BENEFITS

Higher education is statistically correlated with a variety of lifestyle changes that generate social savings. These are *external* or *incidental* benefits of education (see “Beekeeper Analogy” box). In this analysis social benefits break down into three main categories: 1) health savings, 2) crime savings, and 3) welfare and unemployment savings. Health savings include avoided medical costs associated with reduced absenteeism and fewer incidents of alcohol and tobacco abuse. Crime savings comprise the sum total of avoided police, incarceration, prosecution, and victim costs, as well as benefits stemming from the added productivity of individuals who would have otherwise been incarcerated. Welfare and unemployment benefits include avoided costs due to the reduced number of social assistance and unemployment insurance claims.

Beekeeper Analogy

A classic example of positive externalities (sometimes called “neighborhood effects”) in economics is the private beekeeper. The beekeeper’s 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, his business 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 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 enjoys these benefits just as orchard owners indirectly enjoy benefits generated by beekeepers. Aiming at an optimal expenditure of public funds, the analytical model tracks and accounts for many of these external benefits and compares them to public costs (what taxpayers agree to pay) of college education.

Costs and assumptions associated with health, crime, and welfare and unemployment appear in **Table 2.11**. As shown, each year that an individual is incarcerated, claims welfare or unemployment, or abuses tobacco and alcohol results in increased public expenditures. The analytical model translates these expenditures into avoided costs to the public by applying cost data to the number of incidents where individuals manifest improved social behavior as a result of their education. Results of the analysis are gauged from two perspectives, 1) a *broad* perspective that tallies all benefits, and 2) a *narrow* perspective that tallies only benefits to state and local government. These are described more fully in the following sections.

Table 2.11. Social Variables

	Variables
Average cost per prison year (arrest, trial, incarceration, rehab. etc.)	\$66,000
Average length of incarceration (total years) ¹	4.0
Average victim cost	\$ 85,000
Average cost per welfare year	\$ 16,000
Average duration on welfare (total years) ¹	4.0
Average cost per unemployment year	\$ 12,000
Average duration on unemployment (total years) ¹	4.0
Smoking-related medical costs per year	\$ 3,000
Alcohol-related medical costs per year	\$ 7,000

1. Average length of incarceration and average duration on welfare or unemployment is spread evenly over the established time horizon—it is not necessarily a consecutive period.

Source: See Volume 2: Detailed Results, Tables 5 through 15.

Health Savings

In general, statistics show a positive correlation between higher education and improved health habits, which means reduced health-related expenditures to the public. **Table 2.12** presents calculated reductions in worker absenteeism, smoking, and alcohol abuse as a function of higher education. These data are linked to the gender and ethnicity profile of the CCCC student body.

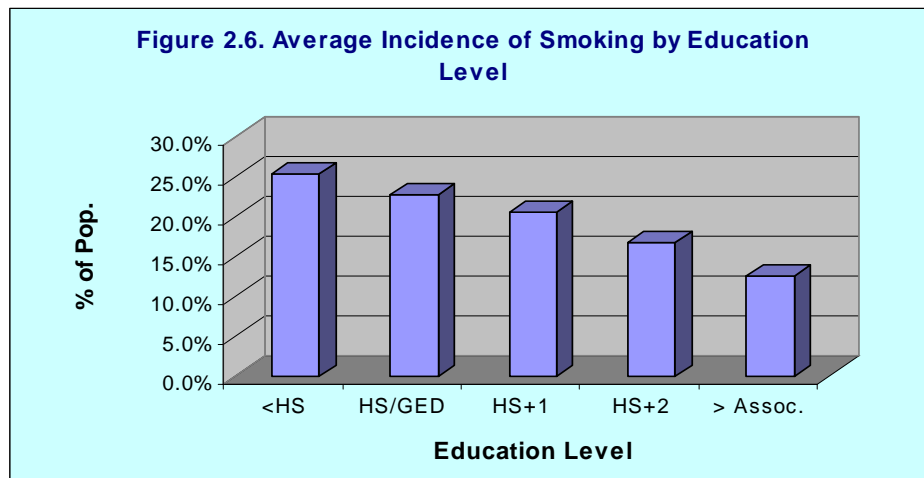
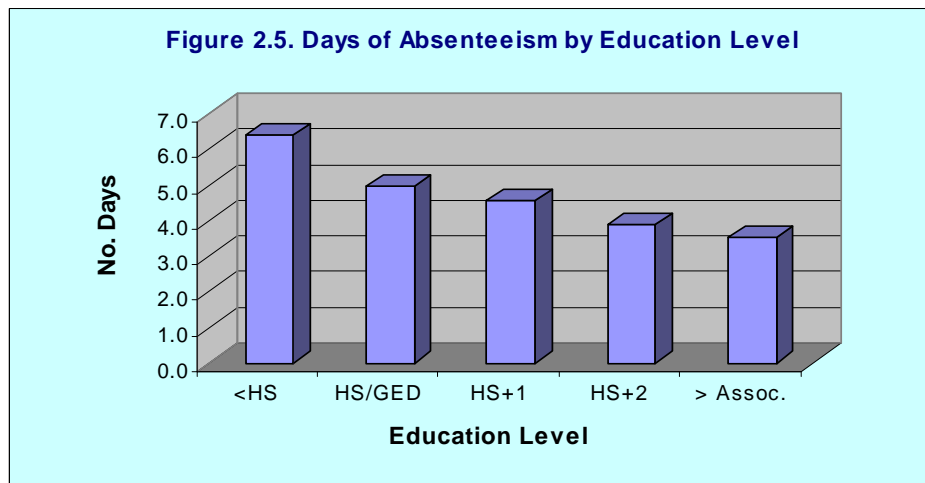
Broad Perspective: Benefits from reduced absenteeism are equal to average earnings per day multiplied by number of days saved. Smoking and alcohol-related savings are calculated by multiplying the number of individuals who will *not* have to incur health-related costs times associated costs of smoking and alcohol abuse per year (cost assumptions appear in **Table 2.11**). 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 state and local government is an employer. Accordingly, we assume a taxpayer's portion of absenteeism savings at 9.1%, equal to the estimated public portion of employment in the region.¹⁰ As for smoking and alcohol-related savings, taxpayers benefit to the extent that state and local health subsidies (to hospitals, for example) are reduced. We assume that 6.0% of total benefits can be counted as taxpayer savings.

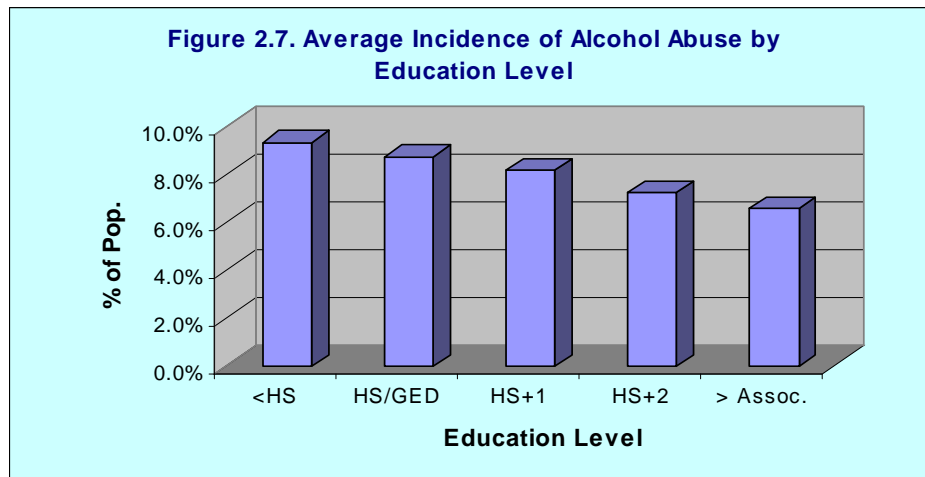
Table 2.12. Reduced Absenteeism, Smoking, and Alcohol Habits

Education Level	Absenteeism		Smoking		Alcohol Abuse	
	Days	%/Year	Average	Reduction	Average	Reduction
< HS/GED	6.4	2.5%	25.2%	NA	9.3%	NA
HS/GED equivalent	4.9	1.9%	22.7%	10.0%	8.7%	6.4%
One year post HS or less	4.6	1.8%	20.5%	9.9%	8.2%	6.4%
Two years post HS or less	3.9	1.5%	16.8%	18.2%	7.2%	11.8%
> Associate Degree	3.5	1.4%	12.5%	25.6%	6.6%	8.7%

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



¹⁰ Ratio of state and local government earnings over total state earnings (U.S. Department of Commerce, Bureau of Economic Analysis, REIS, annual).



Crime Savings

Table 2.13 and **Figure 2.8** show rates of incarceration by education levels. As indicated, incarceration drops on a sliding scale as education levels rise.¹¹ The implication is, as people achieve higher education levels, they are statistically less likely to commit crimes. These statistical patterns are calibrated to the gender and ethnicity profile of the CCCCD student body. In this analysis we identify three types of crime-related expenses: 1) 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: Incarceration savings are determined first by multiplying the number of individuals who will *not* be incarcerated times the average cost per prison year, then again times the average number of years one spends in incarceration (see variables in **Table 2.11**). Savings to victims and savings due to added productivity are calculated in a similar fashion. From the broad taxpayer perspective, all reductions in crime-related expenses are counted as a benefit.

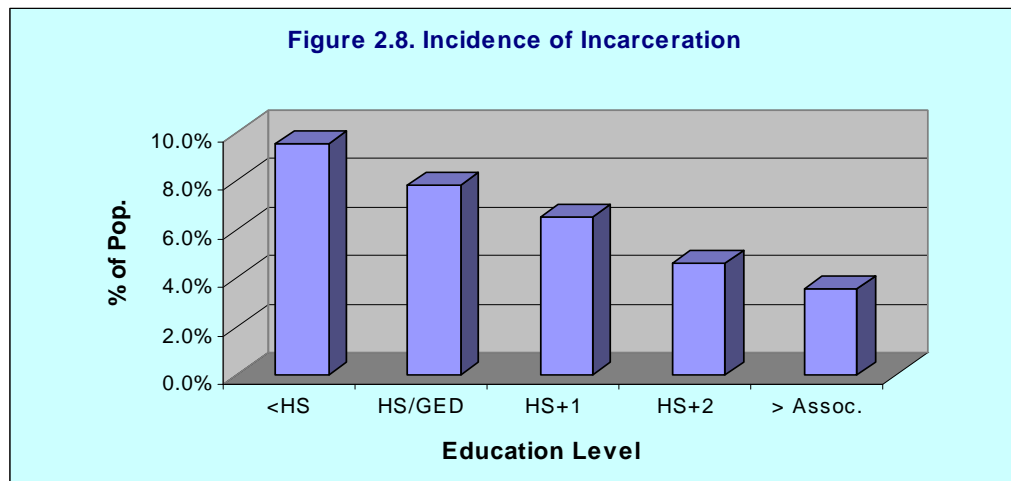
Narrow Perspective: We assume that nearly all incarceration savings accrue to state and local taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to potential victims, not to taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our “composite” state and local government average tax rate (14.6%) to the added productivity of persons *not* incarcerated to arrive at narrow taxpayer benefits.

¹¹ See also Allen J. Beck and Paige M. Harrison, “Prisoners in 2000” (U.S. Department of Justice, Bureau of Justice Statistics, August 2001): NCJ 188207.

Table 2.13. Incarceration Rates

Education Level	Average	Reduction
< HS/GED	9.5%	NA
HS/GED equivalent	7.8%	18.0%
One year post HS or less	6.5%	16.8%
Two years post HS or less	4.6%	29.5%
> Associate Degree	3.6%	22.0%

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



Welfare and Unemployment Savings

Table 2.14 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 CCCC student body).¹²

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. Cost assumptions are found in Table 2.11.

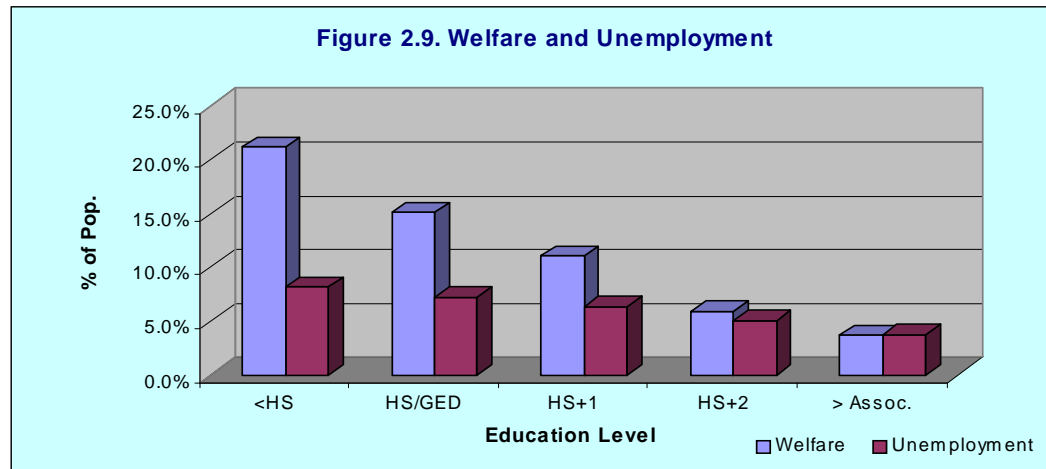
Narrow Perspective: Taxpayer benefits from reduced welfare are limited to 16.0%—the extent to which state and local taxpayers subsidize the welfare system. None is claimed for unemployment, because none of these costs are borne by state taxpayers.

¹² As indicated, we assume that 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.

Table 2.14. Welfare and Unemployment

Education Level	Welfare		Unemployment	
	Average	Reduction	Average	Reduction
< HS/GED	21.2%	NA	8.2%	NA
HS/GED equivalent	15.1%	28.7%	7.2%	12.3%
One year post HS or less	11.1%	26.8%	6.3%	12.2%
Two years post HS or less	5.9%	46.6%	5.0%	20.5%
> Associate Degree	3.7%	37.7%	3.7%	25.5%

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



Adjustment Factors

All external benefits discussed above are adjusted to account for two reduction factors: 1) ability bias, and 2) alternative education variable.

Ability Bias: Higher earnings and lifestyle changes are highly correlated with education. Correlation does not necessarily mean causation, however. Ability, family background, and socioeconomic status are also statistically linked to earnings and healthier lifestyles. Failure to take these other factors into account results in an “ability bias” in education benefit estimates. Nonetheless, the simple correlation between benefits and education defines the *upper limit* of the effect measured. A literature review by Chris Molitor and Duane Leigh indicates that upper limit benefits defined by correlation should be discounted by 10%.¹³

¹³ Chris Molitor and Duane Leigh, “Estimating the Returns to Schooling: Calculating the Difference Between Correlation and Causation” (Pullman, WA: by the authors, March 2001). Report available upon request.

Alternative Education Variable: The alternative education opportunity variable is derived through the application of a regression analysis based on estimates from colleges previously analyzed by CCBenefits (see **Appendix 2**). It is designed to take into account opportunities such as private trade schools and colleges, correspondence schools, and so on.¹⁴ For CCCCD, this variable is set at 34.7%, meaning that 34.7% of the student body can obtain an education elsewhere absent CCCCD and other publicly-funded colleges and universities. We assume that benefits generated by such students are not directly attributable to CCCCD and thus discount results accordingly.

SUMMARY

This chapter presents the broader elements of our database and some key assumptions needed to determine the results. 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 CCCCD, 3) data based on the best judgments of 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 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 CCCCD as an investment, while **Chapter 4** considers CCCCD's role in regional economic growth. The appendices detail a collection of miscellaneous theory and data issues.

¹⁴ As indicated in **Chapter 1** of this report, our analysis is not intended as a vehicle for comparing one college with others—it examines CCCCD as a member of the community and technical college system, not as a competitor with other two-year colleges in the state.

Chapter 3

INVESTMENT ANALYSIS

INTRODUCTION

This chapter considers CCCCD as an investment from the perspectives of students and taxpayers. Two important measures are presented: 1) annual benefits, and 2) future benefits expressed in present value terms. The backdrop for this analysis is the entire State of California.

ANNUAL BENEFITS

Private and Public Benefits

Our investment analysis concentrates on the effects of a single year of district operations. We focus first on annual benefits shown in **Table 3.1**. The table has three sections: 1) student benefits (i.e., higher student earnings); 2) economic growth benefits (i.e., labor and non-labor income), and; 3) incidental social benefits (e.g., health, crime, and welfare/unemployment savings).

Higher Student Earnings

As indicated in **Table 3.1**, we estimate that each year CCCCD increases annual student earnings by an average aggregate amount of \$143.3 million.¹⁵ This estimate is based on the accumulated instruction provided by CCCCD during the single analysis year (from **Table 2.4**), in conjunction with statistics on the effect of education on earnings (from **Table 2.5**). Additional detail on higher student earnings is found in **Volume 2: Detailed Results**.

¹⁵ 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 that the income increment from schooling grows as well. The annual increase in student earnings shown in **Table 3.1** refers to the middle of students' careers. We would expect, therefore, a somewhat smaller figure in years immediately following our single year of district operations, and a larger figure in the latter part of students' careers.

Table 3.1. Summary of Annual Benefits

	Units	Total
STUDENT BENEFITS, ANNUAL		
TOTAL STUDENT BENEFITS		\$143,273,000
ECONOMIC GROWTH BENEFITS, ANNUAL¹		
Labor income	NA	\$101,060,000
Non-labor income	NA	\$51,177,000
TOTAL INCOME GROWTH		\$152,237,000
SOCIAL BENEFITS, ANNUAL		
Health Benefits		
Absenteeism savings (days)	17,400	\$2,596,000
Fewer smokers, medical savings (# persons)	1,040	\$3,126,000
Fewer alcohol abusers (# persons)	220	\$1,536,000
Crime Benefits		
Incarceration savings (# persons)	480	\$3,350,000
Crime victim savings	NA	\$1,075,000
Added productivity (fewer incarcerated)	NA	\$2,555,000
Welfare/Unemployment Benefits		
Welfare savings (# persons)	1,420	\$2,433,000
Unemployment savings (# persons)	370	\$454,000
TOTAL SOCIAL BENEFITS		\$17,125,000

1. Net of student attrition and other reduction factors such as the alternative education variable (see Appendix 2 for more information). Higher student earnings have already been adjusted to account for the ability bias discussed in Chapter 2.

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

Economic Growth Benefits

Students earn more because of skills learned while attending college, and businesses earn more because student skills make capital more productive (i.e., buildings, machinery and everything else). This in turn raises profits and other business property income.¹⁶ Together, increases in labor and capital income are considered the *direct effect* of a skilled workforce.

There are also *indirect effects*. Educated workers have higher incomes and therefore more money to spend on consumer goods. Businesses that employ higher skilled workers also produce more, requiring an increase in inputs and input spending. The effect of these two spending items (consumer spending and business spending) is an increase in income in the overall economy, which leads to still more spending and more income creation, and so on. The sum total of these several rounds of spending effects constitutes

¹⁶In the production process, skilled labor and capital complement each other (i.e., they have a relatively low elasticity of substitution). Accordingly, an increase in skilled labor increases the productivity and income of existing capital, while encouraging additional capital investment.

the indirect income effects of a skilled workforce. Estimating indirect effects requires a specialized economic model described more fully in **Chapter 4** and **Appendix 4**.¹⁷

Total economic growth effect of CCCCCD is obtained as the sum of direct and indirect income effects. As shown in **Table 3.1**, we estimate that a representative year of CCCCCD operations annually adds about \$152.2 million in labor and non-labor income to the Contra Costa County economy.

Social Savings

Statistics on the behavioral effects of education generally indicate positive changes as incidental (or external) effects of education (see **Tables 2.12** through **2.14**). Data on social costs of behavior are also relatively abundant (see **Table 2.11**). By combining these data sets we measure a reduction in social costs as a by-product of education. The several items of social savings shown in **Table 3.1** are all calculated in this manner—relating incremental increases in education to improved social behavior.¹⁸ Additional detail appears in **Chapter 2** and in **Volume 2: Detailed Results**.

As indicated in the table, one year's worth of CCCCCD operations reduces health-related absenteeism from work by approximately 17,400 days per year, resulting in an annual average savings of otherwise lost productivity equal to roughly \$2.6 million. There are also about 1,040 fewer smokers incurring average smoking-related costs, with an annual average savings to society of some \$3.1 million. Finally, there are 220 fewer alcohol abusers per year, providing an annual average savings of \$1.5 million.

CCCCCD operations also results in an estimated 480 fewer people incarcerated at some point in their lives, with corresponding annual of \$3.4 million in direct incarceration savings, \$1.1 million in savings to otherwise would-be crime victims, and some \$2.6 million in added productivity, i.e., persons working who would otherwise be incarcerated.

Estimated average annual reduction of people on welfare and unemployment is approximately 1,420 and 370 respectively. The corresponding annual dollar savings

¹⁷ Indirect effects, sometimes called “multiplier effects,” rely on an input-output model developed by Economic Modeling Specialists, Inc. of Moscow, Idaho (available from www.economicmodeling.com). Details on the EMSI IO model appear in **Appendix 4**.

¹⁸ 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, discussed in greater detail later in this chapter. See also **Table 19** in **Volume 2: Detailed Results**.

amount to roughly \$2.4 million for welfare and about \$454,000 in unemployment savings.

All told, a year's operation of CCCCDCD annually generates around \$17.1 million in public savings (avoided costs), equal to the sum of all health, crime, and welfare and unemployment benefits.

Annual Benefits Per CHE and Per Full-Time Student

To get a different perspective on the results, aggregate benefits reported in **Table 3.1** are expressed in **Table 3.2** on per CHE and per full time equivalent (FTE) student bases. The upper two rows of the table refer to student benefits. The remainder of the table summarizes 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 ¹
STUDENT BENEFITS		
Increased student earnings, gross	\$198	\$5,940
Increased student earnings, after tax	\$119	\$3,584
PUBLIC BENEFITS		
Income growth	\$210	\$6,312
Health-related savings ²	\$10	\$301
Crime savings ³	\$10	\$289
Welfare/unempl. savings ⁴	\$4	\$120
Total	\$234	\$7,022

1. Results based on the assumption that one full-time equivalent, or FTE, is equal to 30 CHEs of education; Retired and leisure students excluded from analysis.

2. Inclusive of savings due to reduced absenteeism and tobacco and alcohol abuse.

3. Inclusive of savings due to reduced incarceration and victim costs.

4. Inclusive of savings due to reduced welfare and unemployment claims.

Source: See 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 CCCCDCD students increases roughly \$198 for every hour of credit or non-credit instruction they complete. The \$198 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 \$119 – this is the figure that might appear on the student's actual paycheck.¹⁹

¹⁹ 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.

For public benefits, **Table 3.2** indicates that an hour of instruction adds an average \$234 per year to regional income. The other “social benefits” shown are mainly avoided social costs. These range from \$4 per CHE in welfare/unemployment savings, to roughly \$10 per CHE from health-related savings. All told, each hour of CCCC CD instruction creates \$234 in annual public benefits.

The last column in **Table 3.2** expresses 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 CCCC CD student with \$5,940 in higher annual income (before tax). It also increases regional income by \$6,312 and provides other social benefits as indicated in the table. The total of all social benefits, economic growth plus social savings, provides \$7,022 to the public annually. These results are all annual averages of benefits that will accrue for years into the future, for at least as long as students remain in the workforce.

Who Benefits Most from Education?

Who benefits most from education, 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 students benefit most, yet the results presented in **Table 3.2** indicate otherwise. Because the money students pay in taxes does not benefit students as such, but rather the taxpaying public, the appropriate figure for judging student benefits is increased earnings after tax (shown in the second row of **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 CCCC CD attendance with a \$119 annual increase in their after-tax earnings. At the same time, public benefits from that same hour of instruction sum to about \$234 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 provided by CCCC CD than students do.

FUTURE BENEFITS EXPRESSED IN PRESENT VALUE TERMS

The next step is to project annual benefits from **Tables 3.1** and **3.2** out into the future and discount them back to the present. Present values of benefits are then compared to CCCC CD costs to derive investment analysis results. This is done in three basic steps:

1. First, we project average annual benefits from **Table 3.1** into the future for as long as students remain in the workforce. The time horizon equals the assumed retirement age of 65 minus the average age of the student body.
2. Next, we sum the stream of future benefits and discount it to the present to reflect the so-called time-value of money. For this analysis we assume a discount rate of 4.0% (see “Discount Rate” box).
3. Finally, we compare present discounted value of future benefits to costs. The investment is attractive if discounted future benefits exceed costs.

Discount Rate

The discount rate is a rate of interest that converts future costs and benefits to present values. For example, \$1,000 in higher earnings 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 investments (i.e., 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.

Results are expressed in terms of benefit/cost ratios, rates of return and payback periods. The benefit/cost ratio is a measure of how many dollars of benefits are received per dollar of costs. This ratio must be greater than or equal to 1 in order for the investment to be considered feasible. The rate of return is expressed as a percent return on investment. If the return matches or exceeds those of similar risk investments, it is considered feasible. The payback period is the length of time needed to recover all investments made. **Appendix 3** provides more information on the different ways of expressing investment analysis results.

Accounting Stance and Key Definitions

In this analysis we present investment analysis results from two perspectives: students and taxpayers. Students benefit from their CCCC attendance through increased future income. They invest in the form of tuition and foregone income while attending (see **Tables 2.1** and **2.6**).

Benefits from the taxpayer perspective are further subdivided into two main components: broad and narrow. The broad taxpayer perspective counts *all* benefits of CCCCDC operations, regardless of beneficiary. These include higher regional income plus social savings resulting from improved health, fewer incidences of crime, and reductions in welfare and unemployment. Costs comprise state and local government support of the district, as shown in **Table 2.1**.

The narrow taxpayer perspective restricts benefits to those that result in actual monetary gain to state and local government. For example, benefits resulting from regional income growth are limited to higher state and local tax payments. Similarly, savings related to improved health, reduced crime and fewer welfare/unemployment claims are limited to those that accrue strictly to state and local government, while benefits to private residents, local businesses or the federal government are excluded altogether. As with the broad taxpayer perspective, costs comprise state and local government support of the district from **Table 2.1**.

Table 3.3 summarizes student and taxpayer 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.

Table 3.3. Some Definitions

Terms	Definitions
Student (private) benefits	Higher earnings captured by 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 (Table 2.1) plus opportunity cost of time (Table 2.6)
Taxpayer costs	State and local taxes (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

Student Perspective

Table 3.4 shows present discounted values of annual benefits and associated costs. The \$198 added to a student’s *annual* earnings per CHE (from **Table 3.2**) are projected across the working life of students and then discounted to the present. Thus, what appears in **Table 3.2** as \$198 (the increase in a student’s annual earnings for every CHE) appears in **Table 3.4** as \$4,100 – the present value of all those future income increments.

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. CCCC students are accordingly rewarded a capital asset valued at \$4,100 for every CHE they take. Considering all students together, the aggregate value of increased student earnings indicates that every year, as a result of their attendance at CCCC, students acquire assets with a collective capital value of \$3.0 billion.

Having estimated the students' reward for attending CCCC, we compare this to associated costs to judge whether attending college is a good investment. Costs are provided in the second to the last row of **Table 3.4**. The present value of the average cost of instruction per CHE is \$580 – this figure includes tuition, fees, and foregone income. Comparing costs with the present value of benefits yields a student benefit/cost ratio of 7.1 (equal to \$4,100 in benefits divided by \$580 in costs).

Table 3.4. Summary of Investment Analysis Results - Present Values

	Aggregate	Per CHE
PRIVATE BENEFITS		
PV of student benefits, increased earnings	\$ 2,962,447,000	\$ 4,100
Sum of all private benefits, present value	\$ 2,962,447,000	\$4,100
PUBLIC BENEFITS		
PV of increased GSP	\$ 3,112,918,000	\$4,300
Health benefits, captured by society		
PV of absenteeism savings	\$ 33,139,000	\$50
PV of tobacco and alcohol abuse medical savings	\$ 57,144,000	\$80
Crime		
PV of reduced incarceration	\$ 41,059,000	\$60
PV of reduced victim costs	\$ 13,170,000	\$20
PV of earnings (added productivity)	\$ 32,611,000	\$50
Unemployment and welfare		
PV of reduced welfare rolls	\$ 29,813,000	\$40
PV of reduced unemployment	\$ 5,422,000	\$10
Sum of all public benefits, present value	\$ 3,325,276,000	\$ 4,610
COSTS, PRIVATE AND PUBLIC		
PV of opportunity cost of education plus tuition (private)	\$ 418,532,000	\$ 580
PV of state and local contribution to district budget (public)	\$ 202,361,000	\$ 280

Source: See 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 \$3.1 billion. The present value of absenteeism savings sums to \$33.1 million (the aggregate of workers who remain on the job rather than taking sick leave) and so on. Altogether, the present value of all public benefits tracked in **Table 3.4** sum to roughly \$3.3 billion.

The estimate of state and local government support of CCCCDC is roughly \$202.4 million per year as shown on the bottom row of **Table 3.4**.²⁰ Having now defined present values of costs and benefits, we form a benefit/cost ratio of roughly 16.4 (=\$3.3 billion worth of benefits / \$202.4 million worth of state and local government support).

Recall that the benefit/cost ratio from the broad taxpayer perspective reflects the measure of all benefits generated regardless of to whom they may accrue. Students are the beneficiaries of higher earnings, would-be victims of crimes are beneficiaries of lower crime rates, still others are beneficiaries of improved health, and so on. These are widely dispersed benefits that do not necessarily return to state and local taxpayers who pay costs at full measure. From the broad taxpayer perspective, therefore, the benefit/cost ratio simply aims at providing a ready comparison between all public benefits and taxpayer costs.²¹

Narrow Taxpayer Perspective

With the narrow taxpayer perspective the situation is different, since investors and beneficiaries are one and the same. The pivotal step here is to limit overall public benefits shown in **Table 3.4** to those that specifically accrue to state and local government. For example, **Table 3.4** shows regional income growth with a present value of some \$3.1 billion. In **Table 3.5** we apply prevailing state and local government tax rates to increased income in **Table 3.4** to compute higher tax revenues associated with growth. The computation yields a present value equal to approximately \$454.4 million in increased state and local tax receipts.

Table 3.4 also shows that employers would lose some \$33.1 million to health-related absenteeism were it not for the district. Only the portion that accrues to state and local government employers is counted as a benefit from the narrow perspective, an estimated \$3.0 million as shown in **Table 3.5**. State and local government savings from reduced tobacco and alcohol abuse are computed based on overall costs multiplied by state and local government's subsidy of general health care. This gives us a net present value of \$3.4 million in tobacco and alcohol abuse savings to the public.

²⁰ State and local government contribution to CCCCDC is listed in the tables as a present value. While this is technically correct, it is important to note that, unlike 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.

²¹ 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, and net present value are inappropriate in the broad taxpayer perspective.

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	\$ 454,424,000	\$630
PV of state and local govt. savings from improved health		
PV of absenteeism savings	\$ 3,016,000	\$0
PV of tobacco and alcohol abuse medical savings	\$ 3,429,000	\$0
PV of state and local govt. savings from reduced crime	\$ 40,019,000	\$60
PV of reduced welfare rolls	\$ 4,770,000	\$10
PV of state and local government benefits	\$ 505,658,000	\$ 700
PV of state and local contribution to district budget (public costs)	\$ 202,361,000	\$ 280

Source: See Tables 2.4, 2.1, and Tables 19 and 20 in Volume 2: Detailed Results.

Total future savings from reduced crime has a present value of \$86.8 million in **Table 3.4**.²² The state and local government portion of this figure is computed by deducting victim costs as well as the cost of federal crimes (none of these accrue to taxpayers). Benefits resulting from added productivity of persons not incarcerated are also adjusted according to the composite state and local tax rate, in this case, 14.6%. 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 \$40.0 million. Reduced future welfare expenditures, with a present value of about \$4.8 million, complete our estimation of state and local government savings from CCCCD support.

Combining increased income and avoided costs in **Table 3.5** provides an overall asset value of \$505.7 million stemming from a year's support of CCCCD. Costs, on the other hand, come to only \$202.4 million, equal to the annual contribution of state and local government to CCCCD (note that this number is repeated from the bottom row of **Table 3.4**). In return for their support, therefore, state and local government is rewarded with an investment benefit/cost ratio of 2.5 ($=\$505.7 \text{ million}/\202.4 million), indicating a most profitable investment.

Summary of Investment Analysis Results

In the previous section we examine the present value of benefits and costs attributable to CCCCD, and characterize these in terms of benefit/cost ratios. In this 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.

²² Recall that crime costs are defined broadly to include costs associated with police, prosecution, incarceration, victim costs, and added productivity.

Table 3.6. Summary of Investment Analysis Results

Rate of return, student perspective	20.9%
Benefit/cost ratio, student perspective	7.1
Payback period, student perspective (years)	7.1
Benefit/cost ratio, taxpayer perspective: broad	16.4
Rate of return, taxpayer perspective: narrow	10.2%
Benefit/cost ratio, taxpayer perspective: narrow	2.5
Payback period, taxpayer perspective: narrow (years)	12.9

Source: See 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.²³ **Table 3.6** shows CCCC students earning average returns of 20.9% on their investment of time and money. This is indeed an impressive return compared, for example, to 1% on a standard bank savings account, or approximately 8 to 10% on U.S. stocks and bonds (thirty-year average return).

At 10.2%, the rate of return to state and local taxpayers is similarly impressive. Economists typically 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 for which governments, as relatively safe borrowers, can obtain funds. A rate of return of 4.0% would mean that the district just pays its own way. In principle, governments could borrow monies used to support the district and repay the loans out of the resulting added taxes and avoided social costs. A rate of return of 10.2%, on the other hand, as indicated in **Table 3.6**, means that CCCC not only pays its own way, but also generates a significant surplus that state and local government can use to fund other programs. It is unlikely that other government programs could make such a claim.

Note that we refrain from calculating a rate of return for the broad taxpayer perspective. As discussed previously, the broad taxpayer perspective counts benefits to all recipients,

²³ We compute our rates of return using the familiar “internal rate of return” calculation. Note that, with a bank deposit or stock market investment, the depositor puts up a principal, receives in return a stream of periodic payments, and then recovers the principal at the end. A college investor, on the other hand, receives a stream of periodic payments that include the recovery of the principal as part of the periodic payments, but there is no principal recovery at the end. These differences notwithstanding, comparable cash flows for both bank and college investors yield the same internal rate of return.

of which state and local government is but a part. Inasmuch as benefits do not actually return to state and local government, it is misleading to compute a rate of return.

Note that 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 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 20.9% 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 24.7%, substantially higher than what we report.

Payback Period

The payback period is defined as the length of time it takes to entirely recoup the initial investment.²⁴ Having recovered the initial investment, returns beyond that are what economists would call “pure costless rent.” As shown in **Table 3.6**, students at CCCCDC on average see a payback period of 7.1 years on their foregone earnings and out-of-pocket costs, while state and local government sees a payback period of 12.9 years.

With and Without Social Benefits

In **Chapter 2** social benefits attributable to college education (reduced crime, welfare and unemployment, and improved health) are defined as *external benefits*, incidental to the operations of the district. Some would question the legitimacy of including these benefits in the calculation of rates of return to higher education, arguing that only direct benefits, i.e., higher earnings, should be counted. **Table 3.6** is inclusive of social benefits reported here as attributable to the district. Recognizing the other point of view, **Table 3.7** shows rates of return for both broad and narrow perspectives exclusive of social benefits. As indicated, returns are still well above threshold values (a benefit/cost ratio greater than 1 and a rate of return greater than 4.0%) confirming that taxpayers receive great value from investing in CCCCDC.

²⁴ 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	\$3,325,276	\$3,112,918	\$505,657	\$454,424
IRR	-	-	10.2%	9.0%
B/C ratio	16.4	15.4	2.5	2.2
Payback	-	-	12.9	14.5

Source: See Tables 3.4 through 3.6.

CONCLUSIONS

This chapter has shown that CCCCDC is an attractive investment to its major stakeholders, students as well as state and local government. Rates of return to students invariably exceed alternative investment opportunities. At the same time, state and local government can take comfort in knowing that its 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 increased tax receipts and avoided costs provided by CCCCDC education, state and local government would have to raise taxes to make up for lost revenues and added costs.

Chapter 4

ECONOMIC GROWTH ANALYSIS

INTRODUCTION

The previous chapter considers CCCCD as an investment – first on the part of students, then on the part of state and local government. In this chapter we focus on Contra Costa County and consider the impact of CCCCD on regional economic growth. We report impact estimates in terms of regional labor income (i.e., earnings) and non-labor income (i.e., sum of all dividends, interests, and rents).²⁵

In general, CCCCD impacts the economy in three ways: from its day-to-day operations, from the spending of its students, and from students who enter the workforce with increased skills. The *district operations effect* includes direct earnings of faculty and staff plus additional earnings through the action of regional multiplier effects. The *student spending effect* focuses on new monies entering the economy as CCCCD attracts students from outside the region. Finally, the *past student productivity effect* comprises income growth that occurs as CCCCD students in the local workforce deepen the economy's stock of human capital, attract new industry to the region, and make existing industry more productive.

DISTRICT OPERATIONS EFFECT

Each year CCCCD pays wages and salaries to its employees, which become part of overall local earnings. At the same time, CCCCD purchases supplies and services, and a portion of this spending is also made locally. These expenditures create a ripple effect that generates additional income and business revenue throughout the regional economy. The gross effect of district spending is obtained by adding direct and indirect (i.e., multiplier) effects together. A reduction factor is then applied to account for local monies withdrawn from the economy to support the district. Such monies would have been spent in the region anyway and are thus not credited to CCCCD.

²⁵ 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.

Table 4.1 summarizes the effect of district operations spending in the regional economy. Total county income appears in the top row and provides the backdrop against which we measure the relative impact of district operations. As shown, Contra Costa County generated about \$24.8 billion in labor income and another \$14.8 billion in non-labor income – a total \$39.6 billion altogether.²⁶ The next item in the table is the direct effect of faculty and staff wages and salaries, equal to \$131.3 million. Note that the associated figure for non-labor income is \$0. This is because, in contrast to private sector businesses, the direct contribution of government sectors is only measured in terms of labor income.

Table 4.1. District Operations Effect

	Labor Income (\$ Thousands)	% of Total	Non-Labor Income ¹ (\$ Thousands)	% of Total	TOTAL INCOME (\$ Thousands)	% of Total
Total income in Contra Costa County	\$24,842,329	100%	\$14,753,232	100%	\$39,595,561	100%
Direct effect of faculty and staff	\$131,305	0.5%	\$0	<0.1%	\$131,305	0.3%
Indirect effect	\$9,710	<0.1%	\$4,826	<0.1%	\$14,536	<0.1%
Gross total	\$141,015	0.6%	\$4,826	<0.1%	\$145,841	0.4%
Adjustment for alternative use of funds ²	(\$22,727)	<0.1%	(\$10,229)	<0.1%	(\$32,956)	<0.1%
TOTAL	\$118,288	0.5%	(\$5,403)	<0.1%	\$112,885	0.3%

1. Includes all dividends, interest, and rents generated in Contra Costa County. Does not include earnings.

2. Negative numbers represent income that would have been generated in the county had monies used to fund district operations been instead used for consumer spending.

Source: Adapted from data supplied by CCCCD and U.S. Department of Commerce REIS, CA and SA series; U.S. Department of Commerce County Business Patterns; Bureau of Labor Statistics ES-202 series; and outputs of the EMSI regional IO model.

Indirect effects appear next and amount to another \$9.7 million in labor income and \$4.8 million in non-labor income. These represent income generated in other industries (i.e., off-campus effects) as a result of direct district spending.²⁷ Estimating indirect effects requires a model that takes district expenditures, deducts spending that leaks from the economy, and bridges what is left to the sectors of an input-output (IO) model constructed for Contra Costa County.²⁸ Adding indirect effects to direct effects gives us

²⁶ REIS data from the U.S. Department of Commerce 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.

²⁷ Details on the EMSI IO model appear in **Appendix 4**. 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.

²⁸ The CCCCD economic impact model is constructed using data purchased from Economic Modeling Specialists, Inc. and EMSI input-output (IO) modeling software. This software employs a standard regional-purchase-coefficient (RPC) non-survey IO modeling technique, similar to that used in

the gross (i.e., unadjusted) effect of district operations spending. This comes to \$145.8 million.

Here a qualification must be made. CCCCD receives about 52% of its funding from local sources, whether from students, private businesses,²⁹ property owners, and the estimated portion of state appropriations originating from local taxpayers.³⁰ Devoting these funds to CCCCD means they are not available for other uses, e.g., consumer spending on the part of students, public projects on the part of government. Monies that are injected into the regional economy on one hand are thus withdrawn on the other. Because of this, a portion of CCCCD's spending effect cannot be considered as new monies brought to the region, since much of this spending was funded by local sources.

To determine the amount by which the gross effect should be reduced, the model analyzes what would have been the effect on regional income had the funding received by CCCCD from local sources been redirected elsewhere and used instead for purposes of consumer spending. To measure this effect, any local funding, whether from students, private residents, or taxpayers, is bridged to the sectors of the IO model and converted to income. In the case of CCCCD, this comes to about \$33.0 million, shown as a negative number in **Table 4.1**. These monies would have been generated in the region anyway even without CCCCD, and should thus be subtracted from the gross effect of district operations. This gives us a net effect of approximately \$112.9 million in regional income attributable to the operations of CCCCD.

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).

²⁹ Private sources of revenue vary widely, from a scholarship sponsored by a local resident to contract revenue received from companies that send employees to the district to attend training seminars. The wide variety of these revenues makes it difficult to determine whether they come from within or outside the region. For this reason, we assume a strict 50% breakdown, where 50% comes from outside the region, and the remaining 50% comes from within the region.

³⁰ Local taxpayers must pay state taxes as well, so it is fair to assume that a certain portion of state appropriations received by the district comes from local sources. We derive this portion by applying a ratio of state taxes paid by local residents to total taxes in the state. Tax information is supplied by the U.S. Department of Commerce, Regional Economic Information System (REIS).

STUDENT SPENDING EFFECT

CCCCD draws about 14% of its student body from outside the region. These students spend money while attending CCCC, whether for books and supplies, food, rent, transportation, or whatever. Such expenditures represent new monies that would not have entered the regional economy absent the district, which means added income in the region and increased revenue for local businesses.

To determine the effect of student spending, we begin with total dollar amounts listed in **Table 2.7**, bridge these to the industrial sectors in the regional IO model, and adjust downward to account for leakage from the Contra Costa County economy. Results appear in **Table 4.2**. As shown, the spending of CCCC's out-of-region students has a direct effect equal to \$12.9 million and an indirect effect equal to \$1.9 million, for a sum total of \$14.9 million in the Contra Costa County economy each year.

Table 4.2. Student Spending Effect

	Labor Income (\$ Thousands)	% of Total	Non-Labor Income ¹ (\$ Thousands)	% of Total	TOTAL INCOME (\$ Thousands)	% of Total
Total income in Contra Costa County	\$24,842,329	100%	\$14,753,232	100%	\$39,595,561	100%
Direct effect of student spending	\$8,677	<0.1%	\$4,264	<0.1%	\$12,941	<0.1%
Indirect effect	\$1,266	<0.1%	\$651	<0.1%	\$1,917	<0.1%
TOTAL	\$9,943	<0.1%	\$4,915	<0.1%	\$14,858	<0.1%

1. Includes all dividends, interest, and rents generated in Contra Costa County. Does not include earnings.

Source: Adapted from data supplied by the EMSI regional IO model. See also Tables 4.1 and 2.7.

PAST STUDENT PRODUCTIVITY EFFECT

CCCCD's main contribution to the Contra Costa County economy is the productivity effect of its past students. Since CCCC was established students have studied at CCCC and entered the regional workforce, bringing with them skills they acquired while in attendance. Over time these skills have built up and accumulated, steadily increasing the training level and experience of the workforce.

As skills of past CCCC students stockpile, a chain reaction occurs in which higher student earnings generate additional rounds of consumer spending. New skills and training also mean increased business output and higher property income, causing still more consumer purchases and regional multiplier spending. The sum of all these direct and indirect effects comprises the total impact of past student productivity on labor and non-labor income in the economy.

The first step in calculating the effect of past student productivity is to estimate the number of CCCC CD CHEs (i.e., skills) currently active in the regional workforce. This number, 12.7 million, is provided in **Table 2.9**. We adjust this figure downward to account for the alternative education variable, as discussed in **Chapter 2**. Results of the analysis appear in **Table 4.3**.

Table 4.3. Estimating Net Regional Income Effect of Embodied CHEs

Total embodied CHEs	12,743,177
Alternative education opportunities, %	35%
Total CHEs, net of reduction factor	8,325,478
Gross value per CHE ¹	\$220
Ability bias, %	10%
Net value per CHE	\$198
Gross earnings of past CCCC CD students	\$2,803,584,346
Net earnings of past CCCC CD students	\$1,648,494,931

1. Derived from Table 3.2 without 10% adjustment used to account for correlation-causation factors.

Source: Adapted from data supplied by CCCC CD. See also Table 2.9.

As shown, the table starts with the 12.7 million CHEs from **Table 2.9**, then nets off 34.7% to account for alternative education opportunities. The approximately 8.3 million CHEs remaining after this calculation are strictly attributed to the existence of CCCC CD. Next we convert the 8.3 million CHEs to regional earnings by attaching a dollar value to each CHE of instruction, adjusted downward to account for the ability bias described in **Chapter 2**.³¹ The net value per CHE – \$198 – comes from **Table 3.2** and represents the higher earnings received by students for each CHE of instruction received at CCCC CD. Multiplying this figure times the 8.3 million net CHEs gives us approximately \$1.6 billion in regional earnings that is directly attributable to the CCCC CD skills currently active in the workforce.

The \$1.6 billion in regional earnings reappears in **Table 4.4** as the direct effect of past student productivity on labor income. Added to this is another \$1.4 billion in non-labor income, representing added regional income and higher property values stemming from direct earnings of the students.³² Altogether, the direct effect of past student productivity comes to about \$3.1 billion.

³¹ Briefly, the engine that estimates 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**).

³² In the course of completing this study, we gather data on the approximate industries where past students work (see **Table 2.10**). Non-labor income figures in **Table 4.4** are obtained by multiplying earnings-by-industry of past students by associated value added-to-earnings ratios.

Table 4.4. Past Student Productivity Effect

	Labor Income (\$ Thousands)	% of Total	Non-Labor Income ¹ (\$ Thousands)	% of Total	TOTAL INCOME (\$ Thousands)	% of Total
Total income in Contra Costa County	\$24,842,329	100%	\$14,753,232	100%	\$39,595,561	100%
Direct effect of past student productivity	\$1,648,495	6.6%	\$1,401,923	9.5%	\$3,050,418	7.7%
Indirect effect	\$232,241	0.9%	\$131,293	0.9%	\$363,535	0.9%
TOTAL	\$1,880,736	7.6%	\$1,533,217	10.4%	\$3,413,953	8.6%

1. Includes all dividends, interest, and rents generated in Contra Costa County. Does not include earnings.

Source: Adapted from outputs supplied by EMSI regional IO model. See also Tables 2.10, 4.1, and 4.3.

Economic growth stemming from a skilled workforce does not stop with the direct effect. To calculate the indirect effect we allocate increases in regional income to specific industrial sectors and augment these to account for demand and supply-side multiplier effects.³³ Demand-side effects refer to the increase in consumer and business spending as higher incomes of skilled workers and their employers are spent in the local economy.³⁴ We estimate these by converting net CHEs in **Table 4.3** into direct increased industry sales, running these through an indirect multiplier matrix, and converting to regional income by applying earnings-sales and value added-sales ratios supplied by the regional IO model.

Supply-side effects occur through a process of “cumulative causation,” or “agglomeration,” whereby growth becomes in some degree self-perpetuating. The presence of one industry, for example, may attract other industries that use the first industry’s outputs as inputs. This, in turn, produces subsequent rounds of industry

³³ Disaggregating direct effects to industrial sectors of the economy avoids aggregation error. This occurs when a model with many industrial sectors is reduced through industry combination to a model with many fewer “aggregated industries” (see chapter 5 in Ron Miller and Peter Blair, *Input-Output Analysis: Foundations and Extensions* [Englewood Cliffs, NJ: Prentice Hall, 1985]). 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 2.10**.

³⁴ For example, associated with 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, which are all captured as part of demand-side indirect effects.

growth, and so on.³⁵ To estimate agglomeration effects, we configure our regional IO model to provide a set of supply-driven multipliers.³⁶ Next we convert net CHEs from **Table 4.3** to direct increased industry value added, and apply these to multipliers of the supply-driven regional IO model. To increase the plausibility of this assumption, we apply only direct effects associated with industries in the highest stages of development.

Summing demand and supply-side effects together constitutes the indirect effect of CCCCDC education. As shown in **Table 4.4**, indirect effects amount to \$232.2 million, or 0.9%, of all regional labor income, and approximately \$131.3 million, or 0.9%, of all non-labor income. Adding these to the direct effects of past student productivity, we come up with a grand total of \$3.4 billion in added income attributable to the accumulation of CCCCDC skills in the regional workforce.

Note that our analysis omits altogether the effect of educated workers on innovation and technical progress. This effect is generally labeled as “external” because it is uncertain in nature and spills beyond businesses employing skilled workers. For this reason we exclude it from our analysis altogether. To the extent there are such effects, and theory suggests that there are, our overall results can be considered conservative.

TOTAL EFFECT

Table 4.5 displays the grand total of CCCCDC’s impact on Contra Costa County, including the district operations effect, student spending effect, and past student productivity effect. These results depend on, first, the number of CCCCDC employees working in the region, second, the percent of CCCCDC students coming from outside the region, and third, the accumulation of skills (or CHEs) currently active in the regional workforce.

³⁵ For a more complete discussion of agglomeration and cumulative causation, see Masahisa Fujita, Paul Krugman, and Anthony Venables, *The Spatial Economy: Cities, Regions, and International Trade* (Cambridge: Massachusetts Institute of Technology, 1999).

³⁶ See for example Miller and Blair, 1985.

Table 4.5. Total Effect

	TOTAL INCOME (\$ Thousands)	% of Total
Total income in Contra Costa County	\$39,595,561	100%
Income attributable to district operations		
Direct effect	\$131,305	0.3%
Indirect effect	\$14,536	<0.1%
Gross total	\$145,841	0.4%
Adjustment for alternative use of funds	(\$32,956)	<0.1%
TOTAL	\$112,885	0.3%
Income attributable to student spending		
Direct effect	\$12,941	<0.1%
Indirect effect	\$1,917	<0.1%
TOTAL	\$14,858	<0.1%
Income attributable to past student productivity		
Direct effect	\$3,050,418	7.7%
Indirect effect	\$363,535	0.9%
TOTAL	\$3,413,953	8.6%
GRAND TOTAL	\$3,541,696	8.9%

Source: See Tables 4.1 through 4.4.

As shown, CCCCDC accounts for \$3.5 billion, or 8.9%, of all regional income in Contra Costa County. These results demonstrate several important points. First, we see that CCCCDC promotes regional economic growth through its own operations spending, through the spending of its out-of-region students, and through the increase in productivity as past students remain active in the regional workforce. Second, the past student productivity effect is by far the largest and most important impact of CCCCDC, stemming from higher incomes of students and their employers. And third, regional income in Contra Costa County would be substantially lower without the educational activities of CCCCDC.

Chapter 5

SENSITIVITY ANALYSIS

INTRODUCTION

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

1. *To set our approach apart from “advocacy” education impact analyses that promote higher education.* These studies often use assumptions that do not stand up to rigorous peer scrutiny and generate results that grossly overstate benefits. The approach 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 sales (as opposed to income only) to the regional economic development analysis.
2. *To test the sensitivity of results associated with assumptions internal to the analytical model.* The two assumptions analyzed in this chapter include the alternative education and attrition rate variables discussed in **Chapter 2**.

STUDENT EMPLOYMENT VARIABLES

Student employment variables are difficult to estimate because colleges generally do not collect this kind of information. These variables include: 1) percent of students employed, and 2) of those employed, what percent they earn relative to earnings they would have received if not attending CCCC. Both employment variables relate to earnings foregone by 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

Students incur substantial expense by attending CCCC because of 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 75% of the current student body is employed. We test this variable in the sensitivity analysis by changing it to 100%. This change means that *all* 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 CCCCDC it is estimated that students working while attending classes earn only 60%, on average, of earnings they would have statistically received if not attending CCCCDC. This suggests that many students hold part-time jobs that accommodate their CCCCDC 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 part of opportunity cost of time. As above, we test this variable in the sensitivity analysis by changing the assumption to 100%. This means that students are fully employed, and the average opportunity cost of time reduces accordingly.

Results

The changed assumptions generate results summarized in **Table 5.1**. Here, base case assumptions taken appear in the two shaded rows—75% for the portion of students employed, and 60% for their earnings relative to statistical averages. These base case assumptions are held constant in shaded rows for the student perspective. Sensitivity analysis results are shown in non-shaded rows—the extent to which 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) automatically increases benefits because the opportunity cost of time reduces to zero.

1. Increasing students employed assumption from 75% to 100% first (holding all other assumptions constant), the rate of return, benefit/cost ratio, and payback period results improves to 22.9%, 8.0, and 6.5 years, respectively, relative to base case results. Improved results are attributable to a lower opportunity cost of time—all students are employed in this case.
2. Increasing earnings relative to statistical averages from 60% 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 improves to 32.2%,

12.5, and 4.8 years, respectively, relative to the base case results—a strong improvement, again attributable to a lower opportunity cost of time.

3. Finally, increasing both assumptions to 100% simultaneously, rate of return, benefit/cost ratio, and payback period results improves yet further to 50.9%, 21.1, and 3.4 years, respectively, relative to base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to statistical averages) while attending classes.

Table 5.1. Sensitivity Analysis of Student Perspective

Variables	Assumptions	Rate of Return	Benefit/Cost	Payback
1. Percent Employed	75%	20.9%	7.1	7.1
	100%	22.9%	8.0	6.5
2. Percent of Earnings	60%	20.9%	7.1	7.1
	100%	32.2%	12.5	4.8
1 = 100%, 2 = 100%		50.9%	21.1	3.4

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

REGIONAL ECONOMIC DEVELOPMENT

Economic impacts of higher education can be calculated in different ways. Our approach is to estimate regional economic impacts of CCCCDC based on district operations and capital spending, spending effects of CCCCDC's out-of-region students, and increased productivity effects of past CCCCDC students in the regional workforce. Impacts are expressed in terms of regional *labor income* (i.e., earnings) and in terms of *non-labor income* (i.e., dividends, interests, and rent). Others often express results in terms of sales instead of income, which tends to inflate impacts so that they appear larger than they really are. We address this issue in the next section.

Economic Impacts Reported as Gross Sales

Advocates sometimes favor gross sales as an impact measure because sales are always larger than income. This method 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. 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 expenditures 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 5.2 expresses the CCCCDC impacts 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 \$96.8 billion.³⁷ Direct local spending by students reflects their total spending, reduced by the estimated portion that leaks out-of-region to purchase goods produced elsewhere.³⁸ 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 district (i.e., for consumer items), excluding faculty and staff wages and salaries. Both items are reduced to reflect purchases from outside the region. All told, the operation of CCCCDC is estimated to explain some \$8.5 billion in regional gross sales, a number substantially larger than the \$3.5 billion explained by the district in regional income shown in **Table 4.5**.

³⁷ Simply stated, economy-wide gross sales are obtained by multiplying sector-specific regional earnings by place of work times a national ratio of sales-to-earnings.

³⁸ 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.

While gross sales impacts shown in **Table 5.2** are not incorrect, we prefer to report district impacts in terms of income (**Table 4.5**) rather than gross sales, because they reflect economic realities in the local community much more accurately. Advocacy studies, on the other hand, often opt to express the results in terms of sales because numbers are much more impressive. Such results, however, are not likely to stand up to rigorous peer scrutiny in the economics profession.

Table 5.2. Impact of CCCCD on Sales in Regional Economy

	Gross Sales (\$ Thousands)	% of Total
Total gross sales in Contra Costa County	\$96,793,609	100%
Gross sales attributable to district operations		
Direct local spending of CCCCD	\$58,046	<0.1%
Indirect spending effect	\$15,512	<0.1%
TOTAL	\$73,558	<0.1%
Gross sales attributable to student spending		
Direct local spending by students	\$23,471	<0.1%
Indirect spending effect	\$3,928	<0.1%
TOTAL	\$27,399	<0.1%
Gross sales attributable to past student economic development effects		
Direct gross sales	\$7,593,287	7.8%
Indirect gross sales	\$780,827	0.8%
TOTAL	\$8,374,114	8.7%
GRAND TOTAL	\$8,475,071	8.8%

Source: Adapted from data supplied by CCCCD and outputs of the EMSI regional IO model. See also Table 2.7 and Tables 4.1 through 4.5.

VARIABLES REQUIRING “JUDGMENT”

In this section we test the sensitivity of the attrition rate and alternative education opportunity variables, both discussed in detail in **Chapter 2**. Recall that the attrition rate (33% in **Table 2.8**) characterizes the mobility of exiting students out of the region over the next thirty years or so through retirement, out-migration and/or death. The alternative education opportunity variable (34.7%) is characterized as a “negative benefit” used to account for students who can obtain a similar education elsewhere absent publicly funded colleges and universities in the state. **Appendix 2** provides a detailed explanation of the method used to derive this variable.

Given the difficulty in accurately specifying the attrition rate and alternative education opportunity variables, the obvious question is: how great a role do they play in the magnitudes of the results? Results appear in **Table 5.3**.

Table 5.3. Sensitivity Analysis of Alternative Education and Attrition Rate Variables (\$ Thousands)

	-75%	-50%	-25%	Base Case	25%	50%	75%	
Alternative Education Variable	8.7%	17.3%	26.0%	34.7%	43.3%	52.0%	60.7%	
<i>Narrow Taxpayer Perspective</i>								
Investment results	NPV	\$504,532	\$437,454	\$370,375	\$303,297	\$236,218	\$169,140	\$102,061
	RR	13.3%	12.3%	11.2%	10.2%	9.0%	7.8%	6.4%
	B/C ratio	3.5	3.2	2.8	2.5	2.2	1.8	1.5
	Payback	10.3	11.1	11.9	12.9	14.2	15.8	17.8
	-75%	-50%	-25%	Base Case	25%	50%	75%	
Attrition Rate Variable	8.3%	16.5%	24.8%	33%	41.3%	49.5%	57.8%	
<i>Regional Economic Development</i>								
Labor income attributable to CCCCCD	\$4,099,464	\$3,920,859	\$3,735,763	\$3,541,696	\$3,341,242	\$3,128,275	\$2,901,189	
% of total labor income in region	10.4%	9.9%	9.4%	8.9%	8.4%	7.9%	7.3%	
CHEs embodied in workforce	14,820,076	14,153,402	13,462,497	12,743,177	11,989,879	11,194,944	10,347,304	

Alternative Education Opportunity

Variations in the alternative education assumption are calculated around base case results listed in the middle column of **Table 5.3**. Next, we bracket the base case assumption on either side with plus or minus 25%, 50% and 75% variation in assumptions. Analyses are then redone introducing one change at a time, holding all other variables constant. For example, an increase of 25% in the Alternative Education assumption (from 34.7% to 43.3%) reduces the narrow taxpayer perspective rate of return from 10.2% to 9.0%. Likewise, a decrease of 25% (from 34.7% to 26.0%) in the assumption increases in the rate of return from 10.2% to 11.2%.

Based on this sensitivity analysis, the conclusion can be drawn that CCCCCD investment analysis results from the narrow taxpayer perspective are not very sensitive to relatively large variations in the alternative education variable. As indicated, 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 34.7% to 60.7%). The conclusion is that, although the assumption is difficult to specify, its impact on 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 4.5**). As above, we increase and decrease the assumption relative to the base case assumption of 33% (from **Table 2.8**) by increments indicated in the table. Impacts on the results are more pronounced, as indicated in **Table 5.3**. Labor income attributable to the district, for example, ranges from a high of \$4.1 billion at -75% to a low of \$2.9 billion at a 75% variation from the base case assumption for this variable. This means that if attrition of ex-students increases over time, the number of CHEs embodied in the current local workforce decreases; hence, labor income attributable to the district decreases accordingly.

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APPENDIX 1: GLOSSARY OF TERMS

<i>Alternative education</i>	A “with” and “without” measure of the percent of students who would still be able to avail themselves of education absent the publicly funded colleges and universities in the state. An estimate of 20%, for example, means that 20% of students do not depend directly on the existence of the college in order to obtain their education.
<i>Asset value</i>	Capitalized value of a stream of future returns. Asset value measures what you would have to pay today for an instrument that provides the same stream of future revenues.
<i>Attrition rate</i>	Rate at which students leave the local region after exiting college due to out-migration, retirement, or death.
<i>Benefit/cost ratio</i>	Present value of benefits divided by present value of costs. If the benefit/cost ratio is greater than one, then benefits exceed costs and the investment is feasible.
<i>Credit hour equivalent</i>	Credit hour equivalent, or CHE, is defined as 15 contact hours of education if on a semester system, and 10 contact hours if on a quarter system. In general, it requires 450 contact hours to complete one full time equivalent, or FTE, although in some cases a student may need as many as 525 contact hours to achieve an FTE. For the purposes of this study, all student achievement data submitted by the district were converted to CHEs on the basis of the assumption that a CHE is equal to 15 contact hours.
<i>Demand</i>	Relationship between market price of education and 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 price increases.
<i>Discounting</i>	Expressing future revenues and costs in present value terms.

APPENDIX 1: GLOSSARY OF TERMS

<i>Economics</i>	Study of the allocation of scarce resources among alternative and competing ends. Economics is not normative (what <i>ought</i> to be done), but positive (describes <i>what is</i> , or how people are likely to behave in response to economic changes).
<i>Elasticity of demand</i>	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, demand is elastic. If it decreases total revenues, demand is inelastic. If total revenues remain the same, elasticity of demand is unitary.
<i>Externalities</i>	Impacts (positive and negative) for which there is no compensation. Positive externalities of education include improved social behaviors such as lower crime, reduced welfare and unemployment, and improved health. Colleges do not receive compensation for these benefits, but benefits still occur because education ultimately leads to improved social behaviors.
<i>Gross State Product</i>	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.
<i>Input-output analysis</i>	Relationship 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 sectors of the economy, thereby increasing the demand for goods and services and jobs. Moreover, as students enter or rejoin the workforce with higher skills, they earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy.
<i>Internal rate of return</i>	Rate of interest which, when used to discount cash flows associated with investing in education, reduces its net present value to zero (i.e., where the present value of revenues accruing from the investment are just equal to the present value of costs

incurred). This, in effect, is the breakeven rate of return on investment since it shows the highest rate of interest at which the investment makes neither a profit nor a loss.

Multiplier

Measure of overall regional earnings per dollar of faculty and staff earnings (i.e., on- and off-campus earnings divided by on-campus earnings). Multiplier effects are the result of in-area spending for goods and services and of everyday spending by faculty and staff. We also include added regional earnings attributable to past students still active in the workforce. The regional economy is larger because of student skills, added spending associated with higher student incomes, and enlarged output of industries where past students are employed.

Net cash flow

Benefits minus costs, i.e., the sum of revenues accruing from an investment minus costs incurred.

Net present value

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.

Opportunity cost

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 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

Length 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: ALTERNATIVE EDUCATION OPPORTUNITY

INTRODUCTION

The alternative education variable is the percent of students who would still be able to avail themselves of education absent the publicly funded colleges and universities in the state. In earlier versions of the model we asked 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:

$$(1) \quad Y = b_1 X_1 + b_2 X_2 + b_3 X_3 + e$$

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

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:

X₁: Population per square mile in the service region

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

X₂: Number of private school employees per 1,000 population per square mile in the service region

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

X₃: Personal income

The average personal income of residents in the service region 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.⁴¹

EXAMPLE OF ANALYSIS AND RESULTS

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

$$(2) \quad Y = 3.43E-05X_1 + 0.023565X_2 + 0.005748X_3 + 0.064722$$

(2.723) (1.4765) (3.1326)

$$R^2 = .458 \text{ (coefficient of determination)}$$

$$F = 31.84 \text{ (Fischer test statistic)}$$

³⁹ Available from U.S. Census Bureau, Current Population Survey (available from <http://www.bls.census.gov/cps>; internet).

⁴⁰ Available from U.S. Department of Commerce, County Business Patterns, annual.

⁴¹ Available from U.S. Department of Commerce, Bureau of Economic Analysis, 2001 REIS Employment and Earnings Reports.

The numbers in parentheses below the coefficients are the “t” values (all statistically significant). The R² measures the degree to which the independent variables explain the variation in the dependent variable. The maximum R² attainable (1.00) is the case in which all observations fall on the regression line and all variability is explained. The .458 R² 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 the district 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:

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

$$(4) \quad Y = 13.5\%$$

APPENDIX 3: INVESTMENT ANALYSIS 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 associated investment analysis results.⁴²

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

Assumptions are as follows:

- 1) The time horizon is 10 years—i.e., we project benefits and costs out 10 years into the future (Column 1). Once higher education has been earned, benefits of higher earnings remain with the student into the future. Our objective is to measure these future benefits and compare them to costs of education.
- 2) The student attends college for one year for which he or she pays a tuition of \$1,500 (Column 2).
- 3) The opportunity cost of time (earnings foregone while attending college for one year) for this student is estimated at \$20,000 (Column 3).

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

- 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 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**.

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 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: tuition must be paid and earnings will cease for one year. In exchange, the student calculates that, with 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 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—benefits are far lower than \$45,000 because future money is worth less than present money. Costs (tuition plus foregone earnings) are felt immediately because they are incurred today—in the present. Benefits (higher earnings), on the other hand, occur in the future. They are not yet available. We must discount all future benefits by the going rate of interest (referred to as the discount rate) to be able to express them in present

value terms.⁴³ A brief example: at 4%, the present value of \$5,000 to be received one year from today is \$4,807. If the \$5,000 were to be received in year ten, the present 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—tuition and foregone earnings. As indicated in **Table 1**, the cumulative present value 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 education is very strong.

INTERNAL RATE OF RETURN (IRR)

The internal rate of return is another way of measuring the worth of investing 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 money used over the life of the investment. It is simply the interest rate that makes the net present value equal to zero. In the NPV example above we applied the “going rate” of interest of 4% and computed a positive net present value of \$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.

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

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%, higher incomes of \$5,000 per year for the next nine years will earn back all investments of \$21,500 made plus pay 18% for the use of that money (\$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 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 exceeding 100% simply as: “NA” or “> 100%.”

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—the breakeven solution where benefits just equal 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.

PAYBACK PERIOD

This is the length of time from the beginning of the investment (consisting of the tuition plus earnings foregone) until higher future earnings return 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 college. Higher earnings occurring *beyond* 4.2 years are the returns 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.

APPENDIX 4: OVERVIEW OF 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 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 are similar in magnitude to those generated by other popular regional IO modeling products, such as the IMPLAN model and RIO Model. EMSI regional IO modeling software was used to develop the Utah Multiregional IO (UMRIO) model, the Idaho Economic Modeling Project (IDAEMP), and the Oregon Economic Modeling System (OREMS).⁴⁴

REDUCING MULTIPLIER IMPACTS

IO models track so-called “ripple” or “multiplier” effects of a given direct economic event. In this analysis, the ripple effects stem from increased incomes of CCCC students. With added incomes, students have more money to spend which subsequently affects earnings in other industries through multiplier effects. Similarly, businesses that hire these workers are more productive, purchasing additional inputs and rewarding business owners with greater incomes. This generates further multiplier effects.⁴⁵ An important function of models is the estimation of multiplier effects.

⁴⁴ The approach is also chronicled in Robison, 1997.

⁴⁵ Multipliers are generally defined as the total effect divided by the direct effect – or the direct and indirect effects divided by the direct effect. An impact effect described as 150% of the direct effect would be associated with a multiplier of 2.5 (direct effect = 1.0; indirect effect = 1.5).

It has been argued that overall multiplier effects like the ones just described overstate net effects by as much as 80%.⁴⁶ The reason is that while the economy is stimulated and incomes increase, factors of production (land, labor and capital) receiving these increased incomes abandon lower paying next-best opportunities. At some level 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.

⁴⁶ See J.R. Hamilton, N.K. Whittlesey, M.H. Robison and J. Ellis, "Economic Impacts, Value Added and Benefits in Regional Project Analysis," *American Journal of Agricultural Economics* 31 no. 2 (1991): 334-344.