

Economic Contribution of Central Arizona College

*Analysis of Investment Effectiveness
and Economic Growth*

Volume 1: Main Report

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ACKNOWLEDGMENTS

The successful completion of this case study is largely due to excellent support from the institutional research staff of Central Arizona College (CAC). We would like to express our appreciation to Dr. Terry A. Calaway, President, who approved the study, and to Mr. Russell Banta, Executive Director of Accounting Services/Comptroller, Mr. William Brown, Executive Director/Institutional Planning, Research and Knowledge Systems, Mr. Darius Brumand, Programmer, Dr. Ed Harter, Executive Director/Chief Information Officer, and Ms. Sue Romero, Research Assistant/Institutional Planning, Research and Knowledge Systems, who collected and organized much of the data we requested. In addition, Annike Christophersen and Deacon James of our own staff contributed invaluable modeling and data collection expertise throughout the study period. Any errors in the report are the responsibility of the authors and not of any of the above-mentioned institutions or individuals.

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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 generate more than 600 studies 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: ccbenefits@moscow.com.

ACRONYMS

ABE	Adult Basic Education
B/C	Benefit/Cost Ratio
CAC	Central Arizona College
CHE	Credit Hour Equivalent
ESL	English as a Second Language
GED	General Equivalency Diploma
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 Central Arizona College 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 CAC to regional income. Major findings are as follows:

INVESTMENT ANALYSIS

1. **Students:** The analysis recognizes Central Arizona College 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 \$290,900 over the course of a working lifetime, equal to about \$9,200 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 19.3% annual rate of return on their education investment.
2. **Taxpayers:** The analysis considers CAC as an investment on the part of state and local government taxpayers. The economic growth effect of CAC 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 CAC yields an investor rate of return equal to 11%, exceeding the assumed 4% opportunity cost of funds. This means that CAC returns more to taxpayers than it costs. The college not only pays for itself but also provides a surplus that supports other government programs.

ECONOMIC GROWTH ANALYSIS

1. **College Operations Effect:** Direct earnings of CAC faculty and staff plus college operations spending increase regional income in the Pinal County economy by \$21.9 million. This is a conservative estimate discounted to account for monies withdrawn from the local economy to support the college.
2. **Student Spending Effect:** About 24% of CAC's students come from outside the region to attend college in Pinal County. The spending effects of these out-of-region

- students account for about \$5.0 million in added regional income in the Pinal 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 CAC's past students annually contribute \$391.8 million to economic growth in Pinal County.
 4. **Total Effect:** Adding college operations, student spending, and past student productivity effects together, CAC accounts for approximately \$418.7 million of labor and non-labor income in the Pinal County economy. This is equal to about 17.2% of the total economy.

Chapter 1

INTRODUCTION

OVERVIEW

CAC 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, Central Arizona College (CAC) 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 CAC 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 CAC operating expenditures; 2) income generated by spending of CAC students; and, 3) income generated by CAC skills embodied in the workforce.

A note of importance: although the reports generated for CAC 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 the 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 CAC on regional economic growth. **Chapter 5** provides sensitivity analyses of softer variables. **Appendix 1** is a glossary of terms. **Appendix 2** provides a detailed explanation of why benefits must be adjusted if the college can still stay open absent state and local government support. **Appendix 3** demonstrates methods used to determine benefits generated by students who can avail themselves of alternative education opportunities. **Appendix 4** is a short primer on the investment analysis results. Finally, **Appendix 5** 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 college 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) college profile; 2) student profile; and 3) social benefits.

COLLEGE PROFILE

College Revenues

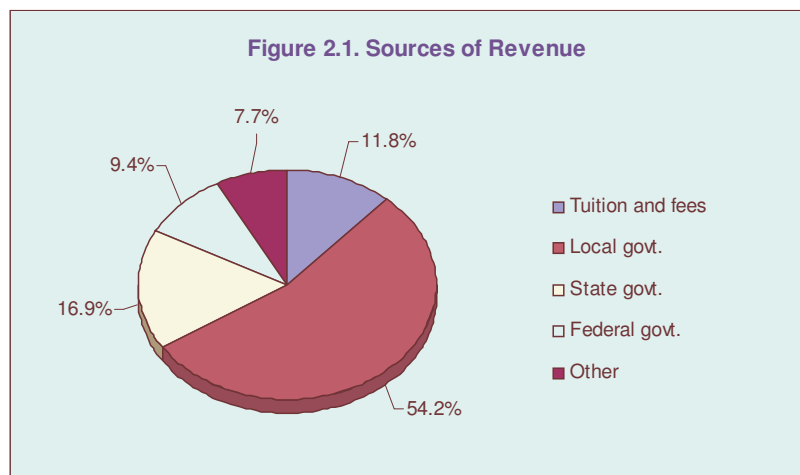
Table 2.1 and **Figure 2.1** show CAC's annual revenues by funding source: a total of \$54.5 million. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (11.8%) plus 7.7% from other private sources such as contract revenues, interest payments and the like. Public funding is comprised of state and local taxes (71.1%) and federal grants (9.4%). 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	\$6,423,319		11.8%
Other sources of revenues	\$4,194,963	\$10,618,282	7.7%
Public Funding			
Local taxes	\$29,553,940		54.2%
State aid	\$9,232,976		16.9%
Federal grants	\$5,129,592	\$43,916,508	9.4%
Total		\$54,534,790	100%

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

Source: Data supplied by CAC.



College Expenditures

CAC employed 369 full and 1,219 part-time faculty and staff in fiscal year 2006. Their combined payroll amounted to \$26.4 million. Other operating expenditures, including purchases of supplies and services, made up \$19.9 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 college is a “good neighbor” in the region, evidenced by the fact that 68% of all college expenditures benefit local vendors (\$31.5 million / \$46.3 million = 68%).

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

Spending Categories	Total Dollar Amount (1)	% Local (2)	Net Local Spending (3)
Salaries, wages, and benefits	\$26,439,767	84%	\$22,196,642
Other operating expenditures	\$19,869,421	47%	\$9,330,023
TOTAL	\$46,309,188	68%	\$31,526,665

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

College Service Region

The map below shows Pinal County. The whole counties included in the economic region comprise the backdrop for calculating the economic impacts presented in this report.



STUDENT PROFILE

Demographics

The CAC unduplicated student headcount for AY 2006 was 11,751 credit students and 0 non-credit students, for a total of 11,751 students. Of these students, 47% were males and 53% were females. The percent breakdown of the student body by ethnicity was 52% Whites and 48% Non-Whites (**Figure 2.2**). The average age of the student body was 33 (net of retired students).

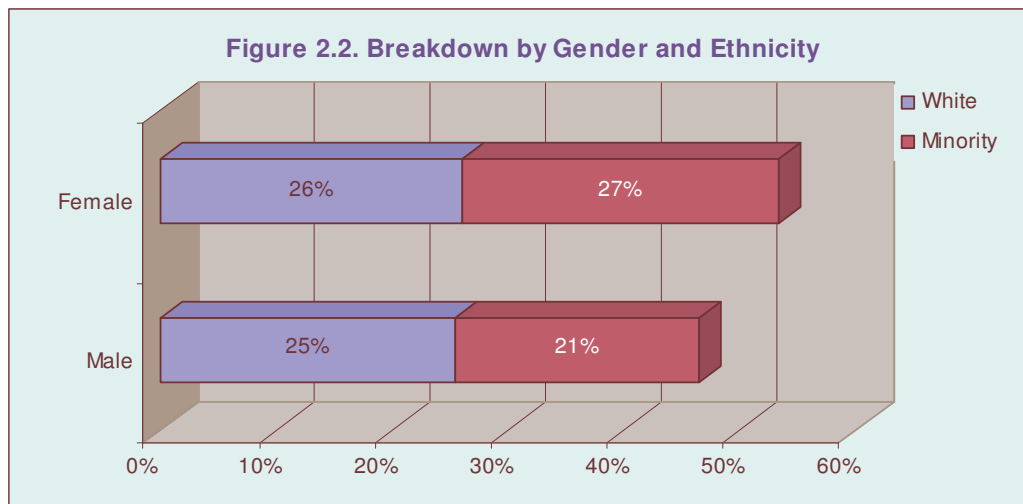


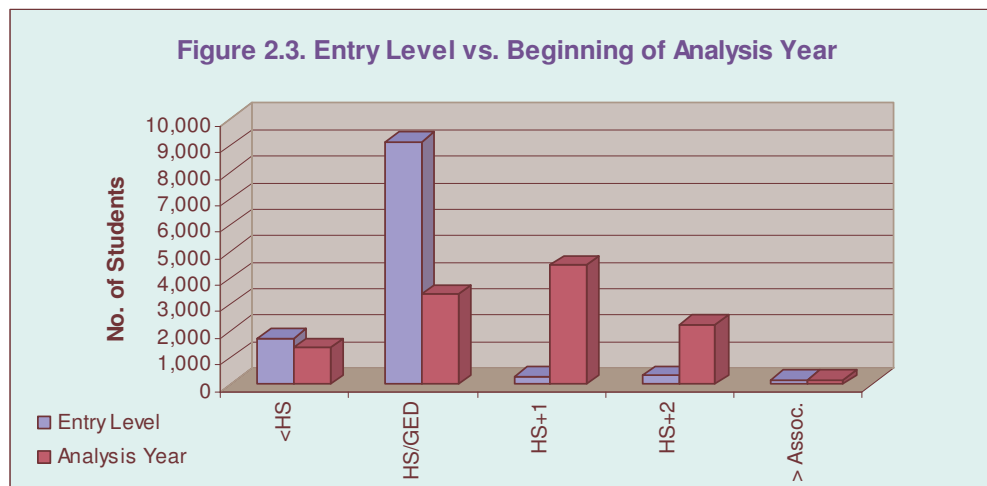
Table 2.3 and **Figure 2.3** show the students' entry level of education by gender and ethnicity. Entry level characterizes the students' education level when they first enrolled,

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 2,484 white males who first entered college with a high school diploma, it is estimated that only 924 still remain in that category at the beginning of the analysis year. This means that 1,561 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 CAC.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 Year

Education Level	White Male		Minority Male		White Female		Minority Female		Total	
	Entry Level	Analysis Year	Entry Level	Analysis Year	Entry Level	Analysis Year	Entry Level	Analysis Year	Entry Level	Analysis Year
< HS/GED	306	240	353	277	495	387	589	461	1,743	1,365
HS/GED equivalent	2,484	924	2,049	763	2,214	826	2,426	905	9,172	3,418
One year post HS or less	72	1,194	36	986	120	1,132	78	1,215	305	4,527
Two years post HS or less	81	585	46	458	139	621	87	596	354	2,260
> Associate Degree	47	48	0	1	106	108	24	25	177	181
Total	2,991	2,991	2,484	2,484	3,073	3,073	3,203	3,203	11,751	11,751

Source: Adapted from data supplied by CAC.



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 goals during the analysis year were those who completed Associate Degrees (2%) or Certificates (7%). Transfer students and/or degree-bound students who did not complete during the analysis year comprised 50% of the student body. Other students fulfilled credits to improve their skills or to meet their educational needs (2% + 30% = 32% in workforce and all other student categories, respectively).

Retired and leisure students are simply backed out of the analysis altogether on the assumption that they do not attend CAC to acquire skills that will increase their earnings. ABE/ESL/GED students (8%) 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 average CHEs per student category, while total CHEs generated by the entire student body (144,132) appear in Column 5.⁴ 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 450 contact hours to complete one full year of study (also known as an FTE).

Table 2.4. Levels of Achievement

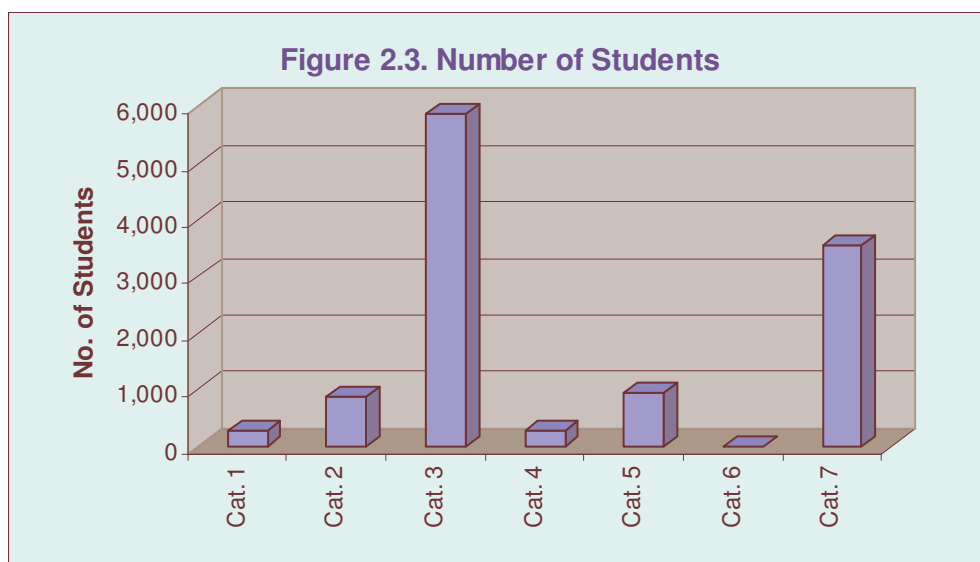
Student Body Category	Student Distribution	Student Headcount	CHEs This Year ²	Total CHEs ²	CHEs/FTE ³
Cat. 1 - Associate's Degree completers	2%	259	22	5,699	0.7
Cat. 2 - Certificate completers	7%	860	23	19,769	0.8
Cat. 3 - Transfer track and non-completing	50%	5,887	12	70,647	0.4
Cat. 4 - Workforce students ¹	2%	271	6	1,625	0.2
Cat. 5 - ABE/ESL/GED	8%	942	8	7,536	0.3
Cat. 6 - Retired and/or leisure students	0%	0	0	0	0.0
Cat. 7 - All other students	30%	3,532	11	38,856	0.4
Total or weighted averages	100%	11,751	12	144,132	0.4

1. Includes students attending courses for reasons of career enhancement or professional development.

2. 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 CAC.

3. CHEs, or credit hour equivalents, are defined as 15 contact hours of education.

Source: Adapted from data supplied by CAC.



Opportunity Cost

Some students forego earnings entirely while attending college, while others are employed full or part-time. Earnings foregone by students while attending CAC 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 Pinal County, and weighted to reflect the specific gender and ethnicity profile of the CAC 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

Education Level	Average Earnings	Difference
One year short of HS/GED	\$15,800	NA
HS/GED equivalent	\$25,000	\$9,200
Certificate	\$29,100	\$4,100
Associate Degree	\$34,200	\$5,100
One year post Associate Degree	\$39,200	\$5,000

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 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 a ratio of earnings by place of work in Pinal 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 - \$26,593 - 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 - \$21,045 - is the average earnings of the CAC 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 (33 from **Table 2.4**), as specified by the well-known and tested Mincer equation.

The average CAC student spends 41% of the year at college, time which he or she could have otherwise spent working. This translates to \$8,604 in earnings foregone per student per year ($=\$21,045 \times 41\%$). Retired and leisure students do not forego earnings and are thus charged zero opportunity cost. The 2,938 non-working students are charged full opportunity cost, equal to \$25.3 million ($=2,938 \times \$8,604$ in foregone earnings). The remaining 8,813 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

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.

had they chosen to work instead of attend college.⁶ Opportunity cost for such students comes to \$30.4 million (= 8,813 * \$8,604 * 40%), plus \$15.2 million to account for leisure time given up.⁷

Table 2.6. Student Opportunity Cost (Earnings Foregone)

		Opp. Cost
Average statistical annual income, given gender and ethnicity profile	\$26,593	
Annual annual income of students, adjusted for age	\$21,045	
Total number of students	11,751	
Percent (%) of full year in attendance	41%	
Earnings foregone per student per year	\$8,604	
Retired/leisure students	-	
Total opportunity cost		\$0
Non-working students (net of retired/leisure students)	2,938	
Total opportunity cost		\$25,276,949
Working students (net of retired/leisure students)	8,813	
Earnings relative to statistical averages (%) ¹	60%	
Total opportunity cost		\$30,434,738
Value of leisure time per working student	\$1,721	
Total value of leisure time foregone		\$15,166,170
Pell and other student aid	\$4,924,495	
Unrestricted portion of student aid ²		(\$1,969,798)
TOTAL STUDENT OPPORTUNITY COST		\$68,908,059

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 CAC 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 \$68.9 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 24% of the CAC student body.⁸ **Table 2.7** shows the estimated spending of CAC'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	\$814,722	11%
Room and board	\$3,355,912	44%
Personal expenses	\$1,986,966	26%
Transportation	\$1,420,780	19%
TOTAL	\$7,578,381	100%

Source: Adapted from data supplied by CAC 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 CAC'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.

⁸This figure accounts for long distance and other students who are not physically present in the region while attending college.

Table 2.8. Student Settlement Patterns

	Values
Students remaining in region after leaving college	75%
Students remaining in state after leaving college	95%
Thirty-year attrition rate (leaving region)	33%
Thirty-year attrition rate (leaving state)	5%
"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 college. Thirty-year attrition internal to 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 CAC skills currently active in the workforce, measured in terms of CHEs. Column 1 of the table presents the enrollment history of CAC (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 CAC (25% from **Table 2.8**).

Column 4 subtracts students from Column 3 who are still enrolled at CAC and have not yet entered the workforce. In general, it is assumed that all past CAC students have left CAC 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 CAC 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 though time.⁹ Column 8 shows the product of Columns 6 and 7. Altogether, it is estimated that there are 2.9 million CHEs of past CAC instruction currently active in the regional workforce.

⁹ We used the current year estimate of CHEs (see **Table 2.4**), adjusted for retired students, as a proxy for the average achievement per student in years prior to FY 2006. In the case where a different number is supplied, the college provided us with a more accurate CHE estimate for that particular year.

Table 2.9. Estimating CHEs of Instruction Embodied in the Workforce¹

Year	Student 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	13,204	13,204	9,903	9,903	9,903	6,635	12	81,381	100%	100%	67%
1978	13,192	13,192	9,894	9,894	9,894	6,718	12	82,399	100%	100%	68%
1979	13,180	13,180	9,885	9,885	9,885	6,802	12	83,429	100%	100%	69%
1980	13,167	13,167	9,876	9,876	9,876	6,887	12	84,473	100%	100%	70%
1981	13,155	13,155	9,866	9,866	9,866	6,973	12	85,529	100%	100%	71%
1982	13,143	13,143	9,857	9,857	9,857	7,060	12	86,598	100%	100%	72%
1983	13,131	13,131	9,848	9,848	9,848	7,149	12	87,681	100%	100%	73%
1984	13,119	13,119	9,839	9,839	9,839	7,238	12	88,777	100%	100%	74%
1985	13,107	13,107	9,830	9,830	9,830	7,328	12	89,886	100%	100%	75%
1986	13,094	13,094	9,821	9,821	9,821	7,420	12	91,010	100%	100%	76%
1987	13,082	13,082	9,812	9,812	9,812	7,513	12	92,147	100%	100%	77%
1988	13,070	13,070	9,803	9,803	9,803	7,607	12	93,299	100%	100%	78%
1989	13,058	13,058	9,794	9,794	9,794	7,702	12	94,465	100%	100%	79%
1990	15,342	15,342	11,507	11,507	11,507	9,170	12	112,479	100%	100%	80%
1991	14,369	14,369	10,777	10,777	10,777	8,704	12	106,761	100%	100%	81%
1992	14,724	14,724	11,043	11,043	11,043	9,039	12	110,869	100%	100%	82%
1993	14,466	14,466	10,850	10,850	10,850	9,000	12	110,390	100%	100%	83%
1994	13,724	13,724	10,293	10,293	10,293	8,653	12	106,136	100%	100%	84%
1995	14,157	14,157	10,618	10,618	10,618	9,046	12	110,955	100%	100%	85%
1996	14,111	14,111	10,583	10,583	10,583	9,138	12	112,081	100%	100%	86%
1997	13,292	13,292	9,969	9,969	9,969	8,723	12	106,995	100%	100%	88%
1998	12,765	12,765	9,574	9,574	9,574	8,490	12	104,134	100%	100%	89%
1999	13,073	13,073	9,805	9,805	9,805	8,812	12	108,079	100%	100%	90%
2000	13,385	13,385	10,039	10,039	10,039	9,143	12	112,146	100%	100%	91%
2001	13,941	13,941	10,456	10,456	10,456	9,651	12	118,374	100%	100%	92%
2002	12,501	12,501	9,376	9,376	9,376	8,770	12	107,573	100%	100%	94%
2003	11,204	11,204	8,403	8,403	8,403	7,966	12	97,708	100%	100%	95%
2004	11,535	11,535	8,651	8,647	7,782	7,477	12	91,705	100%	90%	96%
2005	11,156	11,156	8,367	8,179	6,134	5,972	12	73,255	98%	75%	97%
2006	11,751	11,751	8,813	7,491	3,746	3,746	12	45,942	85%	50%	100%
Embodied Total								2,876,657			

- Numbers may not add due to rounding.
- 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 CAC. See also Tables 2.4 and 2.8.

Each of the 2.9 million CHEs generated by past CAC 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.¹⁰

¹⁰ 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 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

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	4.5%	0.3%	12,516
Mining, Sand, and Gravel	3.1%	0.5%	8,665
Construction	3.7%	0.3%	10,399
Manufacturing: Food, Wood, Paper, and Textiles	3.5%	2.0%	47,871
Manufacturing: Chemicals, Petroleum, Stone, and Glass	2.2%	2.3%	60,926
Manufacturing: Computer and Electronic Equipment	0.4%	1.2%	21,243
Manufacturing: Other	0.7%	0.7%	18,799
Transportation	2.9%	1.8%	40,114
Public Utilities	0.7%	0.5%	10,169
Publishing and Communications	0.7%	1.2%	37,439
Trade: Wholesale and Retail	11.6%	8.4%	323,028
Finance, Insurance, and Real Estate	3.6%	5.6%	202,308
Motels, Eating/Drinking, and Amusement/Recreation	2.7%	0.5%	37,333
Consumer Services	2.9%	0.9%	40,330
Business Services	8.7%	7.9%	242,095
Medical/Educational/Social Services	17.1%	28.3%	946,533
Federal Government	4.7%	8.7%	129,597
State and Local Government	26.3%	28.8%	687,293
Total	100%	100%	2,876,657

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

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 CAC 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	\$ 11,000
Average duration on welfare (total years) ¹	4.0
Average cost per unemployment year	\$ 7,000
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 CAC 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.

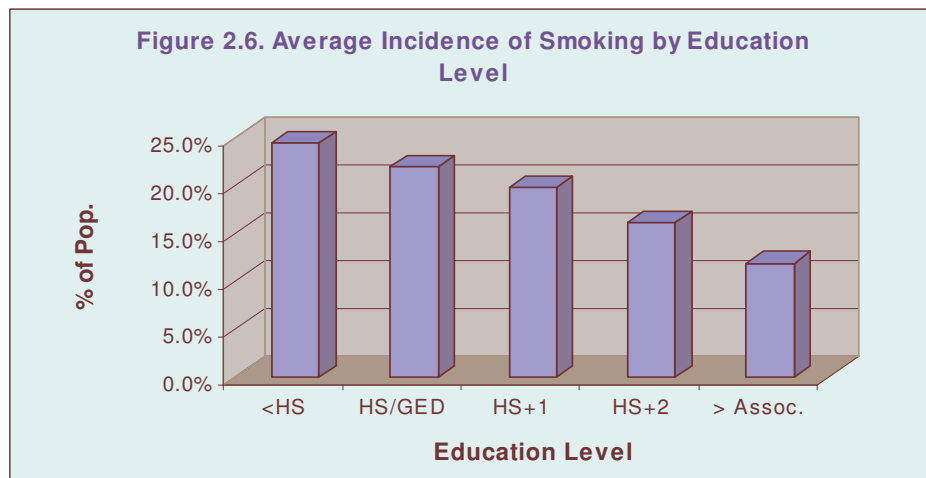
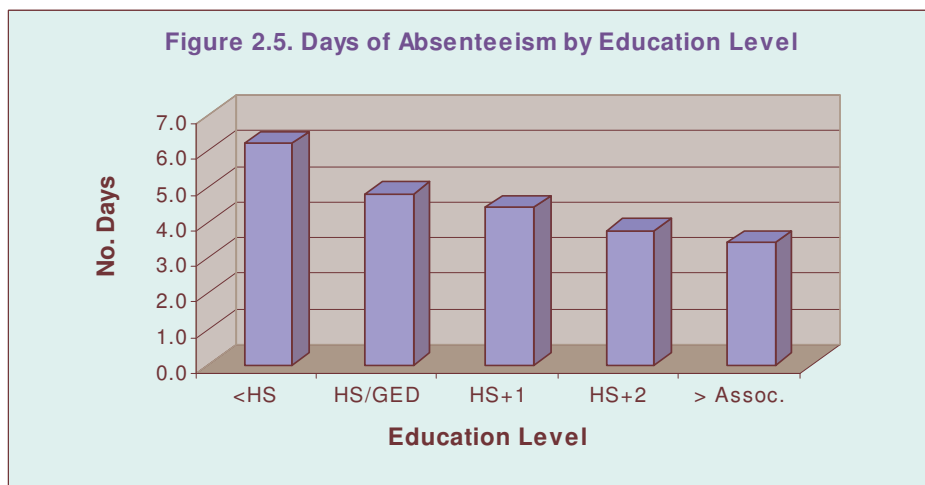
Narrow Perspective: Taxpayers benefit from reduced absenteeism to the extent that state and local government is an employer. Accordingly, we assume a taxpayer's portion of absenteeism savings at 33.3%, equal to the estimated public portion of employment in the region.¹¹ As for smoking and alcohol-related 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.

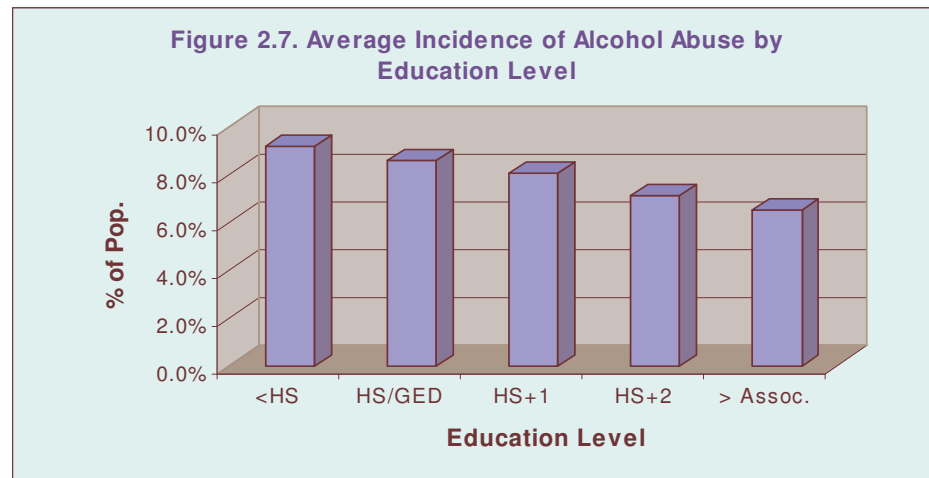
¹¹ Ratio of state and local government earnings over total state earnings (U.S. Department of Commerce, Bureau of Economic Analysis, REIS, annual).

Table 2.12. Reduced Absenteeism, Smoking, and Alcohol Habits

Education Level	Absenteeism		Smoking		Alcohol Abuse	
	Days	%/Year	Average	Reduction	Average	Reduction
< HS/GED	6.2	2.4%	24.4%	NA	9.1%	NA
HS/GED equivalent	4.8	1.8%	21.9%	10.2%	8.6%	6.3%
One year post HS or less	4.4	1.7%	19.7%	10.1%	8.0%	6.3%
Two years post HS or less	3.8	1.4%	16.0%	18.6%	7.1%	11.6%
> Associate Degree	3.4	1.3%	11.8%	26.2%	6.5%	8.6%

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





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.¹² 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 CAC 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.

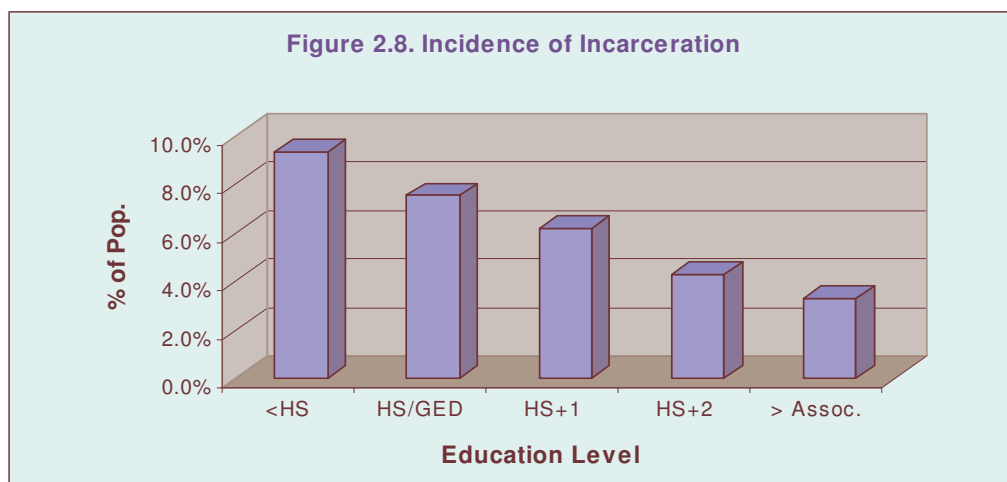
Narrow Perspective: We assume that nearly all incarceration savings accrue to state and local taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to potential victims, not to taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our “composite” state and local government average tax rate (13.6%) to the added productivity of persons *not* incarcerated to arrive at narrow taxpayer benefits.

¹² 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	9.3%	NA
HS/GED equivalent	7.5%	19.5%
One year post HS or less	6.2%	17.9%
Two years post HS or less	4.3%	31.0%
> Associate Degree	3.3%	23.0%

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 CAC student body).¹³

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.

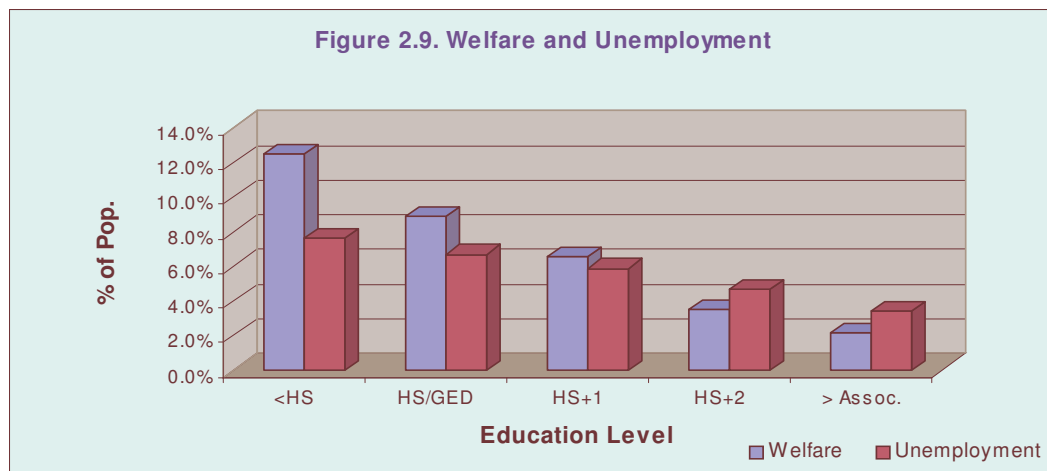
Narrow Perspective: Taxpayer benefits from reduced welfare are limited to 16.0%—the extent to which state and local taxpayers subsidize the welfare system. None is claimed for unemployment, because none of these costs are borne by state taxpayers.

¹³ 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	12.5%	NA	7.6%	NA
HS/GED equivalent	8.9%	28.7%	6.7%	12.3%
One year post HS or less	6.5%	26.8%	5.9%	12.2%
Two years post HS or less	3.5%	46.6%	4.7%	20.8%
> Associate Degree	2.2%	37.7%	3.4%	26.4%

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



Adjustment Factors

All external benefits discussed above are adjusted to account for three reduction factors: 1) ability bias, 2) alternative education variable, and 3) shutdown point. Further detail on these adjustments is provided in **Appendices 2 and 3**.

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%.¹⁴

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 3**). It is designed to take into account opportunities such as private trade schools and colleges, correspondence schools, and so on.¹⁵ For CAC, this variable is set at 11.7%, meaning that 11.7% of the student body can obtain an education elsewhere absent CAC and other publicly-funded colleges and universities in the state. We assume that benefits generated by such students are not directly attributable to CAC and thus discount results accordingly.

Shutdown Point: The shutdown point accounts for the fact that a portion of benefits generated by the college may not be directly linked to state and local government costs of supporting it. Our overall approach includes a sub-model that simulates the students' demand curve for CAC education by reducing state and local support to zero and progressively increasing tuition. As tuition increases, enrollment declines (see **Appendix 2**). Below some minimum level of enrollment (35%), it is assumed that the college would have to shut down. In the case of CAC, the analysis shows that, without state and local government support, the college would have to cease its operations, so the reduction is zero.

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 CAC, 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.

¹⁴ 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.

¹⁵ As indicated in **Chapter 1** of this report, our analysis is not intended as a vehicle for comparing one college with others—it examines CAC as a member of the community and technical college system, not as a competitor with other two-year colleges in the state.

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 CAC as an investment, while **Chapter 4** considers CAC’s role in regional economic growth. The appendices detail a collection of miscellaneous theory and data issues.

Chapter 3

INVESTMENT ANALYSIS

INTRODUCTION

This chapter considers CAC 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 Arizona.

ANNUAL BENEFITS

Private and Public Benefits

Our investment analysis concentrates on the effects of a single year of college 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 CAC increases annual student earnings by an average aggregate amount of \$15.4 million.¹⁶ This estimate is based on the accumulated instruction provided by CAC 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**.

¹⁶ 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 college 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		\$15,423,300
ECONOMIC GROWTH BENEFITS, ANNUAL¹		
Labor income	NA	\$14,443,500
Non-labor income	NA	\$7,591,700
TOTAL INCOME GROWTH		\$22,035,200
SOCIAL BENEFITS, ANNUAL		
Health Benefits		
Absenteeism savings (no. days)	3,400	\$308,900
Fewer smokers, medical savings (no. persons)	180	\$527,700
Fewer alcohol abusers (no. persons)	40	\$291,000
Crime Benefits		
Incarceration savings (no. persons)	100	\$803,900
Crime victim savings	NA	\$257,900
Added productivity	NA	\$375,900
Welfare/Unemployment Benefits		
Welfare savings (no. persons)	170	\$223,200
Unemployment savings (no. persons)	60	\$56,500
TOTAL SOCIAL BENEFITS		\$2,845,000

1. Net of student attrition and other reduction factors such as the alternative education variable and the shutdown point (see Appendices 2 and 3 for more information). Higher student earnings have already been adjusted to account for the ability bias discussed in Chapter 2.

Source: 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.¹⁷ 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

¹⁷ In 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 5**.¹⁸

Total economic growth effect of CAC is obtained as the sum of direct and indirect income effects. As shown in **Table 3.1**, we estimate that a representative year of CAC operations annually adds about \$22.0 million in labor and non-labor income to the Pinal 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.¹⁹ Additional detail appears in **Chapter 2** and in **Volume 2: Detailed Results**.

As indicated in the table, one year's worth of CAC operations reduces health-related absenteeism from work by approximately 3,400 days per year, resulting in an annual average savings of otherwise lost productivity equal to roughly \$308,900. There are also about 180 fewer smokers incurring average smoking-related costs, with an annual average savings to society of some \$527,700. Finally, there are 40 fewer alcohol abusers per year, providing an annual average savings of \$291,000.

CAC operations also results in an estimated 100 fewer people incarcerated at some point in their lives, with corresponding annual of \$803,900 in direct incarceration savings, \$257,900 in savings to otherwise would-be crime victims, and some \$375,900 in added productivity, i.e., persons working who would otherwise be incarcerated.

Estimated average annual reduction of people on welfare and unemployment is approximately 170 and 60 respectively. The corresponding annual dollar savings amount to roughly \$223,200 for welfare and about \$56,500 in unemployment savings.

¹⁸ 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 5**.

¹⁹ 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**.

All told, a year's operation of CAC annually generates around \$2.8 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	\$107	\$3,210
Increased student earnings, after tax	\$76	\$2,285
PUBLIC BENEFITS		
Income growth	\$153	\$4,586
Health-related savings ²	\$8	\$235
Crime savings ³	\$10	\$299
Welfare/unempl. savings ⁴	\$2	\$58
Total	\$173	\$5,179

1. Annualized values exclude benefits from retired students.

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 CAC students increases roughly \$107 for every hour of credit or non-credit instruction they complete. The \$107 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 \$76 – this is the figure that might appear on the student's actual paycheck.²⁰

For public benefits, **Table 3.2** indicates that an hour of instruction adds an average \$173 per year to regional income. The other "social benefits" shown are mainly avoided

²⁰ 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 work.

social costs. These range from \$2 per CHE in welfare/unemployment savings, to roughly \$10 per CHE from crime savings. All told, each hour of CAC instruction creates \$173 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 CAC student with \$3,210 in higher annual income (before tax). It also increases regional income by \$4,586 and provides other social benefits as indicated in the table. The total of all social benefits, economic growth plus social savings, provides \$5,179 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 CAC attendance with a \$76 annual increase in their after-tax earnings. At the same time, public benefits from that same hour of instruction sum to about \$173 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 CAC 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 CAC 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 the 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 4** 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 CAC 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 CAC 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 college, 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 college 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 \$107 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 \$107 (the increase in a student's annual earnings for every CHE) appears in **Table 3.4** as \$2,500 – 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. CAC students are accordingly rewarded a capital asset valued at \$2,500 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 CAC, students acquire assets with a collective capital value of \$359.1 million.

Having estimated the students' reward for attending CAC, 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 \$550 – this figure includes tuition, fees, and foregone income. Comparing costs with the present value of benefits yields a student benefit/cost ratio of 4.5 (equal to \$2,500 in benefits divided by \$550 in costs).

Table 3.4. Summary of Investment Analysis Results - Present Values

	Aggregate	Per CHE
PRIVATE BENEFITS		
PV of student benefits, increased earnings	\$ 359,147,000	\$ 2,500
Sum of all private benefits, present value	\$ 359,147,000	\$2,500
PUBLIC BENEFITS		
PV of increased GSP	\$ 505,158,000	\$3,500
Health benefits, captured by society		
PV of absenteeism savings	\$ 4,863,000	\$30
PV of tobacco and alcohol abuse medical savings	\$ 12,447,000	\$90
Crime		
PV of reduced incarceration	\$ 12,221,000	\$80
PV of reduced victim costs	\$ 3,920,000	\$30
PV of earnings (added productivity)	\$ 5,918,000	\$40
Unemployment and welfare		
PV of reduced welfare rolls	\$ 3,393,000	\$20
PV of reduced unemployment	\$ 840,000	\$10
Sum of all public benefits, present value	\$ 548,760,000	\$ 3,800
COSTS, PRIVATE AND PUBLIC		
PV of opportunity cost of education plus tuition (private)	\$ 79,526,000	\$ 550
PV of state and local contribution to college budget (public)	\$ 38,787,000	\$ 270

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 \$505.2 million. The present value of absenteeism savings sums to \$4.9 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 \$548.8 million.²¹

The estimate of state and local government support of CAC is roughly \$38.8 million per year as shown on the bottom row of **Table 3.4**.²² Having now defined present values of costs and benefits, we form a benefit/cost ratio of roughly 14.1 (= \$548.8 million worth of benefits / \$38.8 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.²³

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 \$505.2 million. 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 \$68.6 million in increased state and local tax receipts.

²¹ Our analysis recognizes that in some cases a level of college operations may be possible without state and local government support. Accordingly, our larger analytic framework includes a sub-model that simulates a shifting of the funding burden from state and local taxpayers to the student body. Importantly, the sub-model takes into account the inverse relationship between tuition and college attendance. Where some level of college operations is possible absent state and local government support, that portion of overall benefits is excluded from our analysis. See **Appendix 2** for a detailed discussion of these adjustments.

²² State and local government contribution to CAC 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.

²³ 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	\$ 68,644,000	\$480
PV of state and local govt. savings from improved health		
PV of absenteeism savings	\$ 1,621,000	\$10
PV of tobacco and alcohol abuse medical savings	\$ 747,000	\$10
PV of state and local govt. savings from reduced crime	\$ 11,004,000	\$80
PV of reduced welfare rolls	\$ 543,000	\$0
PV of state and local government benefits	\$ 82,559,000	\$ 570
PV of state and local contribution to college budget (public costs)	\$ 38,787,000	\$ 270

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

Table 3.4 also shows that employers would lose some \$4.9 million to health-related absenteeism were it not for the college. Only the portion that accrues to state and local government employers is counted as a benefit from the narrow perspective, an estimated \$1.6 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 \$747,000 in tobacco and alcohol abuse savings to the public.

Total future savings from reduced crime has a present value of \$22.1 million in **Table 3.4**.²⁴ 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, 13.6%. 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 \$11.0 million. Reduced future welfare expenditures, with a present value of about \$543,000, complete our estimation of state and local government savings from CAC support.

Combining increased income and avoided costs in **Table 3.5** provides an overall asset value of \$82.6 million stemming from a year's support of CAC. Costs, on the other hand, come to only \$38.8 million, equal to the annual contribution of state and local government to CAC (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 2.1 ($=\$82.6 \text{ million}/\38.8 million), indicating a most profitable investment.

²⁴ Recall that crime costs are defined broadly to include costs associated with police, prosecution, incarceration, victim costs, and added productivity.

Summary of Investment Analysis Results

In the previous section we examine the present value of benefits and costs attributable to CAC, 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.

Table 3.6. Summary of Investment Analysis Results

Rate of return, student perspective	19.3%
Benefit/cost ratio, student perspective	4.5
Payback period, student perspective (years)	7.1
Benefit/cost ratio, taxpayer perspective: broad	14.1
Rate of return, taxpayer perspective: narrow	10.5%
Benefit/cost ratio, taxpayer perspective: narrow	2.1
Payback period, taxpayer perspective: narrow (years)	11.3

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.²⁵ **Table 3.6** shows CAC students earning average returns of 19.3% 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 10.5%, 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 college just pays its own way. In principle, governments could borrow monies used to support the college and repay the loans out

²⁵ 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 the resulting added taxes and avoided social costs. A rate of return of 10.5%, on the other hand, as indicated in **Table 3.6**, means that CAC 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, 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 an associated 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 19.3% 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 23.0%, 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.²⁶ Having recovered the initial investment, returns beyond that are what economists would call “pure costless rent.” As shown in **Table 3.6**, students at CAC 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 11.3 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 college. Some would question the legitimacy of including these benefits in the calculation of rates of return to higher education, arguing that only direct

²⁶ 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.

benefits, i.e., higher earnings, should be counted. **Table 3.6** is inclusive of social benefits reported here as attributable to the college. 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 CAC.

Table 3.7. Taxpayer Perspective (\$ Thousands)

	Broad Perspective With Social Savings		Narrow Perspective With Social Savings	
	Included	Excluded	Included	Excluded
NPV	\$548,760	\$505,158	\$82,558	\$68,644
IRR	-	-	10.5%	8.4%
B/C ratio	14.1	13.0	2.1	1.8
Payback	-	-	11.3	13.4

Source: See Tables 3.4 through 3.6.

CONCLUSIONS

This chapter has shown that CAC 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 CAC 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 CAC as an investment – first on the part of students, then on the part of state and local government. In this chapter we focus on Pinal County and consider the impact of CAC 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).²⁷

In general, CAC 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 *college 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 CAC attracts students from outside the region. Finally, the *past student productivity effect* comprises income growth that occurs as CAC 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.

COLLEGE OPERATIONS EFFECT

Each year CAC pays wages and salaries to its employees, which become part of overall local earnings. At the same time, CAC 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 college 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 college. Such monies would have been spent in the region anyway and are thus not credited to CAC.

²⁷ 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 college 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 college operations. As shown, Pinal County generated about \$1.8 billion in labor income and another \$635.1 million in non-labor income – a total \$2.4 billion altogether.²⁸ The next item in the table is the direct effect of faculty and staff wages and salaries, equal to \$26.4 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. College Operations Effect

	Labor Income (\$ Thousands)	% of Total	Non-Labor Income ¹ (\$ Thousands)	% of Total	TOTAL INCOME (\$ Thousands)	% of Total
Total income in Pinal County	\$1,794,958	100%	\$635,125	100%	\$2,430,083	100%
Direct effect of faculty and staff	\$26,440	1.5%	\$0	<0.1%	\$26,440	1.1%
Indirect effect	\$1,531	<0.1%	\$661	0.1%	\$2,192	<0.1%
Gross total	\$27,971	1.6%	\$661	0.1%	\$28,632	1.2%
Adjustment for alternative use of funds ²	(\$4,952)	<0.1%	(\$1,814)	<0.1%	(\$6,765)	<0.1%
TOTAL	\$23,019	1.3%	(\$1,153)	<0.1%	\$21,866	0.9%

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

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

Source: Adapted from data supplied by CAC 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 \$1.5 million in labor income and \$660,600 in non-labor income. These represent income generated in other industries (i.e., off-campus effects) as a result of direct college spending.²⁹ Estimating indirect effects requires a model that takes college expenditures, deducts spending that leaks from the economy, and bridges what is left to the sectors of an input-output (IO) model constructed for Pinal County.³⁰ Adding indirect effects to direct effects gives us the gross (i.e., unadjusted) effect of college operations spending. This comes to \$28.6 million.

²⁸ 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.

²⁹ Details on the EMSI IO model appear in **Appendix 5**. As described there, we avoid an overstatement of actual multiplier effects by discarding all but 20% of the total effect indicated by the IO model. The reduction accounts for the shift of resources from next-best uses.

³⁰ The CAC 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

Here a qualification must be made. CAC receives about 70% of its funding from local sources, whether from students, private businesses,³¹ property owners, and the estimated portion of state appropriations originating from local taxpayers.³² Devoting these funds to CAC 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 CAC'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 CAC 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 CAC, this comes to about \$6.8 million, shown as a negative number in **Table 4.1**. These monies would have been generated in the region anyway even without CAC, and should thus be subtracted from the gross effect of college operations. This gives us a net effect of approximately \$21.9 million in regional income attributable to the operations of CAC.

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).

³¹ 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 college 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.

³² Local taxpayers must pay state taxes as well, so it is fair to assume that a certain portion of state appropriations received by the college 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

About 24% of the students come from outside the region to attend CAC (net of long distance students who are not physically present in the region while attending). These students spend money while in the area, 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 college, 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 Pinal County economy. Results appear in **Table 4.2**. As shown, the spending of CAC's out-of-region students has a direct effect equal to \$4.4 million and an indirect effect equal to \$556,800, for a sum total of \$5.0 million in the Pinal 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 Pinal County	\$1,794,958	100%	\$635,125	100%	\$2,430,083	100%
Direct effect of student spending	\$2,990	0.2%	\$1,419	0.2%	\$4,409	0.2%
Indirect effect	\$417	<0.1%	\$140	<0.1%	\$557	<0.1%
TOTAL	\$3,406	0.2%	\$1,559	0.2%	\$4,966	0.2%

1. Includes all dividends, interest, and rents generated in Pinal 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

CAC's main contribution to the Pinal County economy is the productivity effect of its past students. Since CAC was established students have studied at CAC 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 CAC 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 CAC CHEs (i.e., skills) currently active in the regional workforce. This number, 2.9 million, is provided in **Table 2.9**. We adjust this figure downward to account for the alternative education variable and shutdown point, 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	2,876,657
Alternative education opportunities, %	12%
Level of education possible absent state and local govt. funding, %	0%
Total CHEs, net of reduction factors	2,541,453
Gross value per CHE ¹	\$119
Ability bias, %	10%
Net value per CHE	\$107
Gross earnings of past CAC students	\$342,027,294
Net earnings of past CAC students	\$271,955,143

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

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

As shown, the table starts with the 2.9 million CHEs from **Table 2.9**, nets off 11.7% to account for alternative education opportunities, then applies a further reduction to account for the benefits generated by CAC should the college still be able to operate absent state and local government support (in the case of CAC this reduction is 0%). The approximately 2.5 million CHEs remaining after this calculation are strictly attributed to the existence of CAC.

Next we convert the 2.5 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**.³³ The net value per CHE – \$107 – comes from **Table 3.2** and represents the higher earnings received by students for each CHE of instruction received at CAC. Multiplying this figure times the 2.5 million net CHEs gives us approximately \$272.0 million in regional earnings that is directly attributable to the CAC skills currently active in the workforce.

³³ 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**).

The \$272.0 million in regional earnings reappears in **Table 4.4** as the direct effect of past student productivity on labor income. Added to this is another \$79.4 million in non-labor income, representing added regional income and higher property values stemming from direct earnings of the students.³⁴ Altogether, the direct effect of past student productivity comes to about \$351.3 million.

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 Pinal County	\$1,794,958	100%	\$635,125	100%	\$2,430,083	100%
Direct effect of past student productivity	\$271,955	15.2%	\$79,372	12.5%	\$351,327	14.5%
Indirect effect	\$30,100	1.7%	\$10,391	1.6%	\$40,491	1.7%
TOTAL	\$302,055	16.8%	\$89,763	14.1%	\$391,818	16.1%

1. Includes all dividends, interest, and rents generated in Pinal 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.³⁵ 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.³⁶ 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

³⁴ 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.

³⁵ 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**.

³⁶ 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.

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 growth, and so on.³⁷ To estimate agglomeration effects, we configure our regional IO model to provide a set of supply-driven multipliers.³⁸ 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 CAC education. As shown in **Table 4.4**, indirect effects amount to \$30.1 million, or 1.7%, of all regional labor income, and approximately \$10.4 million, or 1.6%, of all non-labor income. Adding these to the direct effects of past student productivity, we come up with a grand total of \$391.8 million in added income attributable to the accumulation of CAC 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 CAC’s impact on Pinal County, including the college operations effect, student spending effect, and past student productivity effect. These results depend on, first, the number of CAC employees working in the region, second, the percent of CAC students coming from outside the region, and third, the accumulation of skills (or CHEs) currently active in the regional workforce.

³⁷ 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).

³⁸ See for example Miller and Blair, 1985.

Table 4.5. Total Effect

	TOTAL INCOME (\$ Thousands)	% of Total
Total income in Pinal County	\$2,430,083	100%
Income attributable to college operations		
Direct effect	\$26,440	1.1%
Indirect effect	\$2,192	<0.1%
Gross total	\$28,632	1.2%
Adjustment for alternative use of funds	(\$6,765)	<0.1%
TOTAL	\$21,866	0.9%
Income attributable to student spending		
Direct effect	\$4,409	0.2%
Indirect effect	\$557	<0.1%
TOTAL	\$4,966	0.2%
Income attributable to past student productivity		
Direct effect	\$351,327	14.5%
Indirect effect	\$40,491	1.7%
TOTAL	\$391,818	16.1%
GRAND TOTAL	\$418,650	17.2%

Source: See Tables 4.1 through 4.4.

As shown, CAC accounts for \$418.7 million, or 17.2%, of all regional income in Pinal County. These results demonstrate several important points. First, we see that CAC 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 CAC, stemming from higher incomes of students and their employers. And third, regional income in Pinal County would be substantially lower without the educational activities of CAC.

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 CAC. 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 CAC 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 CAC it is estimated that students working while attending classes earn only 60%, on average, of earnings they would have statistically received if not attending CAC. This suggests that many students hold part-time jobs that accommodate their CAC 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 21.6%, 5.2, 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 28.7%,

7.3, and 5.1 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 45.8%, 12.4, and 3.6 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%	19.3%	4.5	7.1
	100%	21.6%	5.2	6.5
2. Percent of Earnings	60%	19.3%	4.5	7.1
	100%	28.7%	7.3	5.1
1 = 100%, 2 = 100%		45.8%	12.4	3.6

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 CAC 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 CAC based on college operations and capital spending, spending effects of CAC's out-of-region students, and increased productivity effects of past CAC 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 CAC 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 \$6.5 billion.³⁹ Note that direct local expenditures of the college and its students reflect their total spending, reduced by the estimated portion that leaks out-of-region to purchase goods produced elsewhere.⁴⁰ In the usual fashion, indirect effects reflect the action of local economic multiplier effects, also estimated by the economic model. All told, the operation of CAC is estimated to explain some \$1.1 billion in regional gross sales, a number substantially larger than the \$418.7 million explained by the college in regional income shown in **Table 4.5**.

While gross sales impacts shown in **Table 5.2** are not incorrect, we prefer to report college 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

³⁹ Simply stated, economy-wide gross sales are obtained by multiplying sector-specific regional earnings by a national estimate of sales-to-earnings.

⁴⁰ 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.

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 CAC on Sales in Regional Economy

	Gross Sales (\$ Thousands)	% of Total
Total gross sales in Pinal County	\$6,497,478	100%
Gross sales attributable to college operations		
Direct local spending of CAC	\$9,330	0.1%
Indirect spending effect	\$2,599	<0.1%
TOTAL	\$11,929	0.2%
Gross sales attributable to student spending		
Direct local spending by students	\$7,578	0.1%
Indirect spending effect	\$1,454	<0.1%
TOTAL	\$9,032	0.1%
Gross sales attributable to past student economic development effects		
Direct gross sales	\$972,122	15.0%
Indirect gross sales	\$110,192	1.7%
TOTAL	\$1,082,314	16.7%
GRAND TOTAL	\$1,103,275	17.0%

Source: Adapted from data supplied by CAC 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 (11.7%) 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 3** 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	2.9%	5.8%	8.7%	11.7%	14.6%	17.5%	20.4%	
<i>Narrow Taxpayer Perspective</i>								
Investment results	NPV	\$51,938	\$49,216	\$46,494	\$43,771	\$41,049	\$38,327	\$35,605
	RR	11.5%	11.2%	10.9%	10.5%	10.2%	9.8%	9.5%
	B/C ratio	2.3	2.3	2.2	2.1	2.1	2.0	1.9
	Payback	10.5	10.7	11.0	11.3	11.5	11.8	12.2
	-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 CAC	\$487,949	\$465,637	\$442,580	\$418,650	\$393,679	\$367,436	\$339,587	
% of total labor income in region	20.1%	19.2%	18.2%	17.2%	16.2%	15.1%	14.0%	
CHEs embodied in workforce	3,385,431	3,221,627	3,052,347	2,876,657	2,693,323	2,500,649	2,296,188	

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 11.7% to 14.6%) reduces the narrow taxpayer perspective rate of return from 10.5% to 10.2%. Likewise, a decrease of 25% (from 11.7% to 8.7%) in the assumption increases in the rate of return from 10.5% to 10.9%.

Based on this sensitivity analysis, the conclusion can be drawn that CAC 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 11.7% to 20.4%). 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 college, for example, ranges from a high of \$487.9 million at -75% to a low of \$339.6

million 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 college decreases accordingly.

RESOURCES AND REFERENCES

- Anderson, D.A. "The Aggregate Burden of Crime." *Journal of Law and Economics* XLII 2 (October 1999): 611-642.
- Beck, Allen J. and Paige M. Harrison. "Prisoners in 2000." Washington, D.C.: U.S. Department of Justice, Bureau of Justice Statistics, August 2001. NCJ 188207.
- Becker, Gary S. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. New York: Columbia University Press for NBER, 1964.
- Bils, M. and P.J. Klenow. "Does Schooling Cause Growth?" *American Economic Review* 90 no. 5 (2000): 1160-1183.
- Bonczar, Thomas P. and Alan J. Beck. *Lifetime Likelihood of Going to State or Federal Prison*. Washington, D.C.: U.S. Department of Justice, Bureau of Justice Statistics, March 1997. NCJ 160092.
- Borts, G. H. and J. L. Stein. *Economic Growth in a Free Market*. New York: Columbia University Press, 1964.
- Bureau of Justice Statistics. "Table 1: State (1) average annual pay for 2000 and 2001 and percent change in pay for all covered workers (2)." Criminal Justice Expenditure and Employment Extracts Program (CJEE). Washington D.C.: U.S. Department of Labor, 2000.
- _____. Survey of Inmates in Local Jails, 2002. "Length of sentence and time expected to be served of inmates sentenced to jail, by offense, 2002." *BJS On-line*. Home page on-line. Available from <http://www.ojp.usdoj.gov/bjs>; Internet; accessed 5 July 2004.
- Centers for Disease Control and Prevention. "Table 2. Annual smoking-attributable economic costs for adults and infants – United States, 1995 – 1999" in "Annual Smoking-Attributable Mortality, Years of Potential Life Lost, and Economic Costs – United States, 1995 – 1999." *MMWR Weekly* 51, no. 4 (April 12, 2002): 300-303.
- CCH Incorporated. "Employee absenteeism rises slightly, while employers still struggle with high cost of 'sick time.'" *CCH Online*. Home page on-line. Available from <http://www.cch.com/press/news/2001/20011023h.asp>; Internet; accessed April 2004.
- Christaller, Walter. *Central Places in Southern Germany*. Translated by C.W. Baskins. Englewood Cliffs, NJ: Prentice-Hall, 1966.

RESOURCES AND REFERENCES

- Christophersen, Kjell A. and M. Henry Robison. "The Socioeconomic Benefits of Community Colleges, Illustrated with Case Studies of Everett Community College and Walla Walla Community College in Washington State." Volume 1: Summary Report. EMSI, Consulting Economists. Moscow, ID: by the authors, 2000.
- Committee on Ways and Means. *2000 Ways and Means Green Book*, 17th ed. Washington D.C.: U.S. House of Representatives, October 2000.
- Drake, R. L. "A Shortcut to Estimates of Regional Input-Output Multipliers: Methodology and Evaluation." *International Regional Science Review* 1 no. 2 (Fall 1976).
- Economic Modeling Specialists, Inc. Regional Input-Output Modeling System (data and software). Moscow, ID: annual. Database on-line. Available from <http://www.economicmodeling.com>; Internet.
- Fujita, Masahisa, Paul Krugman, and Anthony J. Venables. *The Spatial Economy: Cities, Regions, and International Trade*. Cambridge: Massachusetts Institute of Technology, 1999.
- Governor's Office of Planning and Budget, Demographic and Economic Analysis Section, and Consulting Economists. "The Base Period 1992 Utah Multiregional Input-Output (UMRIO-92) Model: Overview, Data Sources, and Methods." Utah State and Local Government Fiscal Impact Model, Working Paper Series 94-1. Salt Lake City, UT: Demographic and Economic Analysis (DEA), June 1994.
- Grubb, W. Norton. *The Economic Benefits of Sub-Baccalaureate Education: Results from National Studies*. CCRC Brief No. 2, ISSN 1526-2049. New York, NY: Community College Research Center, June 1999.
- Hamilton, J. R., 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.
- Harrison, Paige M. and Allan J. Beck. "Number of persons held in state or federal prison or in local jails, 1995-2004." Bureau of Justice Statistics, National Prisoner Statistics. *BJS On-line*. Homepage on-line. Available from <http://www.ojp.usdoj.gov/bjs>; Internet; accessed 24 April 2005.
- Health Care Financing Administration. *A Profile of Medicaid: Chartbook 2000*. Washington, D.C.: U.S. Department of Health and Human Services, September 2000.
- Henderson, James M. and Richard E. Quandt. *Microeconomic Theory: A Mathematical Approach*. New York: McGraw-Hill Book Company, 1971.

RESOURCES AND REFERENCES

- Hughes, Timothy, et al. "State prison admissions 2001: Sentence length by offense and admission type." Bureau of Justice Statistics, National Corrections Reporting Program, 2001.
- Internal Revenue Service, Department of the Treasury. Schedule X- Single. Home page on-line. Available from <http://www.irs.gov/formspubs/article/0,,id=133517,00.html>; Internet; accessed 26 July 2005.
- Kerka, Sandra. "Prison Literacy Programs. ERIC Digest No. 159." 1995. Database on-line. Available from ERIC, ED383859.
- Labor Market Reporter. "U.S. Employee Absences by Industry: 1997." *The Public Purpose*. Home page on-line. Available from <http://www.publicpurpose.com/lm-97abs.htm>; Internet; accessed 30 September 2001.
- _____. "U.S. Employee Absences by Industry Ranked: 1997," *The Public Purpose*. Home page on-line. Available from <http://www.publicpurpose.com/lm-97absr.htm>; Internet; accessed 30 September 2001.
- Losch, August. *The Economics of Location*. Translated by W. H. Woglom and W. F. Stolper. New Haven: Yale University Press, 1954.
- Miller, Ron and Peter Blair. *Input-Output Analysis: Foundations and Extensions*. Englewood Cliffs, NJ: Prentice Hall, 1985.
- Miller, Ted R., Mark A. Cohen, and Brian Wiersema. *Victim Costs and Consequences: A New Look*. National Institute of Justice Research Report. Washington, D.C.: U.S. Department of Justice, National Institute of Justice, January 1996. NCJ 155282.
- Mincer, Jacob. "Investment in Human Capital and Personal Income Distribution." *Journal of Political Economy* 66 no. 4 (August 1958): 281-302.
- Mincer, Jacob. *Schooling, Experience and Earnings*. New York: National Bureau of Economic Research, 1974.
- Minnesota IMPLAN Group, Inc. IMPLAN System (data and software). Stillwater, MN, annual. Database on-line. Available from <http://www.implan.com>; Internet.
- Molitor, Chris and Duane Leigh. "Estimating the Returns to Schooling: Calculating the Difference Between Correlation and Causation." Pullman, WA: by the authors, March 2001.

RESOURCES AND REFERENCES

National Center for Chronic Disease Prevention and Health Promotion. Behavioral Risk Factor Surveillance System, *CDC Online*. Home page on-line. Available from <http://www.cdc.gov/brfss/>; Internet; accessed 30 September 2001.

_____. Office on Smoking and Health. CDC Online. Home page on-line. Available from <http://www.cdc.gov/tobacco/mission.htm>; Internet; accessed September 2003.

National Center for Education Statistics. *Digest of Education Statistics, 2000*. Washington D.C, U.S. Department of Education, 2000. Database on-line. Available from <http://nces.ed.gov/pubs2001/digest/foreword.asp>; Internet.

_____. *Literacy Behind Prison Walls*. Washington, D.C.: U.S. Department of Education, October 1994.

National Center for Health Statistics. Centers for Disease Control and Prevention, Division of Data Services. Hyattsville, MD, 2000. Database on-line. Available from <http://www.cdc.gov/nchs/>; Internet.

_____. "1990 National Health Interview Survey." *ICPSR Online*. Home page on-line. Available from <http://www.icpsr.umich.edu:8080/ICPSR-STUDY/09839.xml>; Internet; accessed February 2001. ICPSR No. 9839.

_____. "Table 60. Current cigarette smoking by persons 18 years of age and over according to sex, race, and age: United States, selected years 1965-1999." in *Health, United States, 2004*. Hyattsville, MD, 2004.

_____. "Table 61. Age-adjusted prevalence of current cigarette smoking by persons 25 years of age and older, according to sex, race, and education: United States, selected years 1974-1999." in *Health, United States, 2004*. Hyattsville, MD, 2004.

National Clearinghouse for Alcohol and Drug Information. *Prevention Online*. Home page on-line. Available from <http://www.health.org>; Internet.

National Institute for Literacy. "Correctional Education Facts." *NIFL Online*. Home page on-line. Available from http://www.nifl.gov/nifl/facts/facts_overview.html; Internet; accessed 18 March 2001.

National Institute of Alcohol Abuse and Alcoholism. "Percent reporting alcohol use in the past year by age group and demographic characteristics: NHSDA, 1994-97." August 1999. Database on-line. Available from <http://www.niaaa.nih.gov/databases/dkpat3.htm>; Internet.

RESOURCES AND REFERENCES

- National Institute on Drug Abuse. *The Economic Costs of Alcohol and Drug Abuse in the United States – 1992*. Bethesda, MD: National Institute of Health, 1998. NIH Publication Number 98-4327.
- Nephew, Thomas M., Gerald D. Williams, and Frederick Stinson, eds. *Surveillance Report #55: Apparent Per Capita Alcohol Consumption: National, State and Regional Trends, 1977-98*. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism, Division of Biometry and Epidemiology, December 2000.
- Office of International Criminal Justice (OICJ). "The Extent and Costs of Victimization, Crime and Justice," *The Americas* 8 no.6 (Dec-Jan 1995).
- Parr, J.B. "Regional Economic Development: An Export-Stages Framework," *Land Economics* 77 no. 1 (1999): 94-114.
- Rector, Robert. *Means-Tested Welfare Spending: Past and Future Growth*. Heritage Foundation, Policy Research and Analysis, March 2001. Database on-line. Available from <http://www.heritage.org/Research/Welfare/Test030701b.cfm>; Internet.
- Resek, Robert W., David F. Merriman, Susan R. Hartter, and eds. *Illinois Higher Education: Building the Economy, Shaping Society*. Springfield, IL: Illinois Board of Higher Education, University of Illinois, 2000.
- Robison, M. H. "Community Input-Output Models for Rural Area Analysis: With an Example from Central Idaho." *Annals of Regional Science* 31 no. 3 (1997): 325-351.
- _____, R. Coupal, N. Meyer, and C. C. Harris. *The Role of Natural-Resource-Based Industries in Idaho's Economy*. University of Idaho, College of Agriculture Bulletin 731. Moscow, ID: University of Idaho, College of Agriculture, 1991.
- _____. "The Oregon Economic Modeling System (OREMS): A Tool for Analyzing Changes in Jobs, Incomes, and the Spatial Structure of the Oregon Economy." Missoula, MT: 29th Annual Pacific Northwest Economic Conference, May 1995.
- Rutgers, State University of New Jersey, et al. "The Impact of EDA RLF Loans on Economic Restructuring." Paper prepared for U.S. Department of Commerce, Economic Development Administration. New Brunswick: Rutgers State University of New Jersey, 2002.
- Social Security Bulletin. "Table 9.G2: Average monthly number of families and recipients of Temporary Assistance for Needy Families and total amount of assistance, by state or other area, 2003" in "Annual Statistical Supplement, 2004." *Social Security Bulletin*

RESOURCES AND REFERENCES

- Online*. Database on-line. Available from <http://www.ssa.gov/policy/docs/statcomps/supplement/2004/>; Internet; accessed 1 June 2005.
- Steurer, Stephen J. , Linda Smith, and Alice Tracy. "Three State Recidivism Study." Paper submitted to the Office of Correctional Education, United States Department of Education. Lanham, MD: Correctional Education Association, September 2001.
- Stevens, B. H., G. I. Treyz, D. J. Ehrlich, and J. R. Bower. "A New Technique for the Construction of Non-Survey Regional Input-Output Models." *International Regional Science Review* 8 no. 3 (1983): 271-186.
- Tanner, Michael, Stephen Moore, and David Hartman. *The Work Versus Welfare Trade-Off: An Analysis of the Total Level of Welfare Benefits by State*. Policy Analysis No. 240. Washington D.C.: Cato Institute, September 1995. Database on-line. Available from <http://www.cato.org/pubs/pas/pa240es.html>; Internet.
- Temporary Assistance for Needy Families (TANF) Program. "Table 12: Percent distribution of TANF adult recipients by race, October 1997 – September 1998" in *Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 1998*. Washington D.C.: U.S. Department of Health and Human Services, May 1999.
- _____. "Table 17: Percent distribution of TANF adult recipients by educational level, October 1997 – September 1998" in *Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 1998*. Washington D.C.: U.S. Department of Health and Human Services, May 1999.
- Tobacco Institute. *The Tax Burden on Tobacco*. Historical Compilation Volume 32, 1997. Home page on-line. Available at <http://www.tobaccoinstitute.com/getallimg.asp?if=avtidx&DOCID=TCAL0404218/4236>; Internet; last accessed April 2004.
- U.S. Census Bureau and Bureau of Labor Statistics. Current Population Survey. Database on-line. Available from <http://www.bls.census.gov/cps/>; Internet.
- _____. "Fact Sheet." *American FactFinder*. Home page on-line. Available from http://factfinder.census.gov/servlet/SAFFFacts?geo_id=&_geoContext=&_street=&_county=&_cityTown=&_state=&_zip=&_lang=en&_sse=on; Internet; accessed April 2004.
- _____. Historical Income Data. Database on-line. Available from <http://www.census.gov/hhes/income/histinc/histinctb.html>; Internet.
- _____. Housing and Household Economic Statistics Division. Database on-line. Available from <http://www.census.gov/hhes/www/>; Internet.

RESOURCES AND REFERENCES

- _____. Income Surveys Branch/HHES Division. "Median for 4-Person Families, by State." October 2003. Database on-line. Available from <http://www.census.gov/hhes/income/4person.html>; Internet.
- _____. *Money Income in the United States 1998*. Current Population Reports. Washington, D.C.: U.S. Department of Commerce, Economics and Statistics Administration, 1999.
- _____, Population Division. "Table ST-EST2002-01 - State Population Estimates: April 1, 2000 to July 1, 2002." December 2002. Database on-line. Available from <http://eire.census.gov/popest/data/states/tables/ST-EST2002-01.php>; Internet.
- _____. "Table 1. Educational Attainment of the Population 15 Years and Over, by Age, Sex, Race, and Hispanic Origin" in *Educational Attainment in the United States, March 2000*. December 2000. Database on-line. Available from <http://www.census.gov/population/www/socdemo/education/p20-536.html>; Internet.
- _____. "Table P-3. Race and Hispanic Origin of People by Mean Income and Sex: 1947 to 2000." September 2002. Database on-line. Available from <http://www.census.gov/hhes/income/histinc/p03.html>; Internet.
- _____. "Table P-18. Educational Attainment—People 25 Years Old and Over by Mean Income and Sex: 1991 to 2000." September 2002. Database on-line. Available from <http://www.census.gov/hhes/income/histinc/p18.html>; Internet.
- U.S. Department of Commerce. County Business Patterns. [CD-ROM], annual.
- _____. Bureau of Economic Analysis: REIS, County data. [CD-ROM], annual.
- _____. Bureau of Economic Analysis: REIS, Employment and Earnings Reports, 2001.
- _____. Bureau of Economic Analysis: REIS, Zip Code Business Patterns. [CD-ROM], annual.
- _____. Statistical Abstract of the United States. [CD-ROM], annual.
- U.S. Department of Health and Human Services. Centers for Medicare and Medicaid Services, 2003 Data Compendium. *HHS On-line*. Database on-line. Available from <http://www.cms.hhs.gov/researchers/pubs/datacompendium/current/>; Internet; accessed 1 June 2005.

RESOURCES AND REFERENCES

- _____. Appendix A in "Indicators of Welfare Dependence: Annual Report to Congress, 2003." *HHS On-line*. Database on-line. Available from <http://aspe.hhs.gov/hsp/indicators03/index.htm>; Internet; accessed 1 June 2005.
- U.S. Department of Justice, Office of Justice Programs. Bureau of Justice Statistics Bulletin. Table 1 in "Justice Expenditures and Employment in the United States, 2001." May 2004.
- U.S. Department of Labor. Bureau of Labor Statistics. *BLS Online*. Home page on-line. Available from <http://www.bls.gov/>; Internet; accessed April 2004.
- _____. Bureau of Labor Statistics. Current Population Survey. *BLS On-line*. Database on-line. Available from <http://www.bls.gov/cps>; Internet.
- _____. Bureau of Labor Statistics. Employment and Training Administration, Unemployment Insurance Data Summary. *DOL On-line*. Database on-line. Available from <http://workforcesecurity.doleta.gov/unemploy/content/data.asp>; Internet; accessed 1 June 2005.
- _____. Bureau of Labor Statistics. ES-202 series (Covered Employment and Wages program).
- _____. Bureau of Labor Statistics. Office of Employment and Unemployment, *BLS Online*. Home page on-line. Available from <http://www.bls.gov/bls/proghome.htm#OEUS>; Internet.
- _____. Bureau of Labor Statistics. "Table 1. State (1) average annual pay for 2000 and 2001 and percent change in pay for all covered workers (2)." Washington, D.C.: U.S. Department of Labor, 2001. Database on-line. Available from <http://www.bls.gov/news.release/annpay.t01.htm>; Internet.
- _____. Bureau of Labor Statistics. "Table 46. Absences from work of employed full-time wage and salary workers by age and sex" in the Current Population Survey. *BLS On-line*. Database on-line. Available from <http://www.bls.gov/cps>; Internet; accessed 20 June 2005.
- U.S. Department of Treasury. "The Economic Costs of Smoking in the United States and the Benefits of Comprehensive Tobacco Legislation." Database on-line. Available from <http://www.treas.gov/press/releases/report3113.htm>; Internet; accessed April 2004. Report-3113.
- Willis, Robert J. "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions." In *Handbook of Labor Economics, Vol. 1*. Edited by Kenneth J. Arrow and Michael D. Intriligator. Amsterdam: Elsevier Science Publishers, 1986: 525-602.

RESOURCES AND REFERENCES

Woods and Poole Economics, Inc. W&P System (data and CD-ROM). Washington, D.C., 2000. Database on-line. Available from <http://woodsandpoole.com>; Internet.

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.
<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.
<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.

<i>Multiplier</i>	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.
<i>Net cash flow</i>	Benefits minus costs, i.e., the sum of revenues accruing from an investment minus costs incurred.
<i>Net present value</i>	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.
<i>Opportunity cost</i>	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.
<i>Payback Period</i>	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: SHUTDOWN POINT

INTRODUCTION

The investment analysis weighs benefits of enrollment (measured in terms of CHEs) against the support provided by state and local government. This adjustment factor is unique to the CCBenefits analysis and is used to establish a direct link between the costs of supporting the college and the benefits it generates in return. If benefits accrue without taxpayer support, then it wouldn't be a true investment.⁴¹ Our overall approach includes a sub-model that simulates the effect on student enrollment should the college lose its state and local funding and have to raise tuition in order to stay open. If the college can still operate without state and local support, then any benefits it generates at that level are discounted from our total benefit estimates. If the simulation indicates that the college cannot stay open, however, then benefits are directly linked to costs and no discounting applies. This appendix documents our procedure for making these adjustments which feed the broad and narrow taxpayer perspective results.

STATE AND LOCAL GOVERNMENT SUPPORT VERSUS TUITION

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

⁴¹ Of course, as a community college, CAC would not be permitted to continue without public funding, so the situation in which it would lose all state and local support is entirely hypothetical. The purpose of the adjustment factor is to examine CAC in terms of standard investment analyses by netting out any benefits it may be able to generate that are not directly linked to the costs of supporting it.

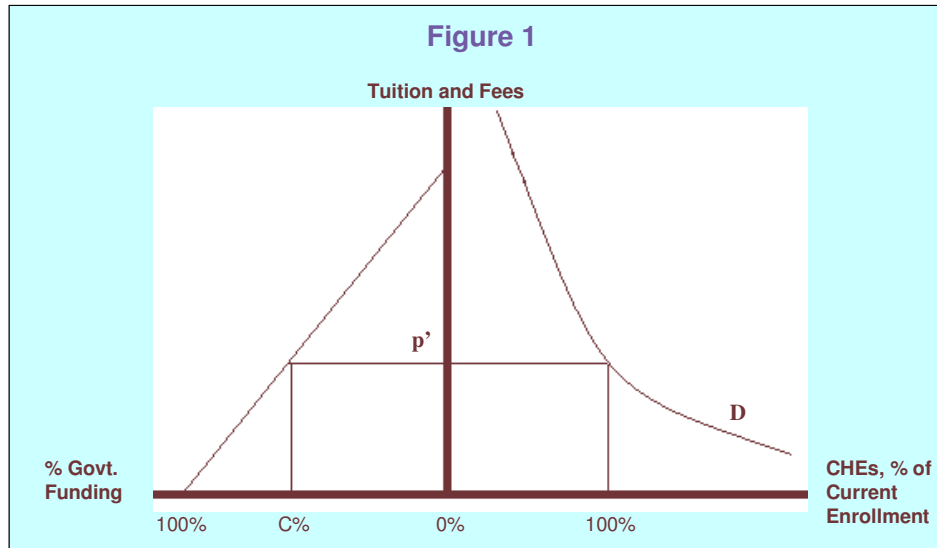
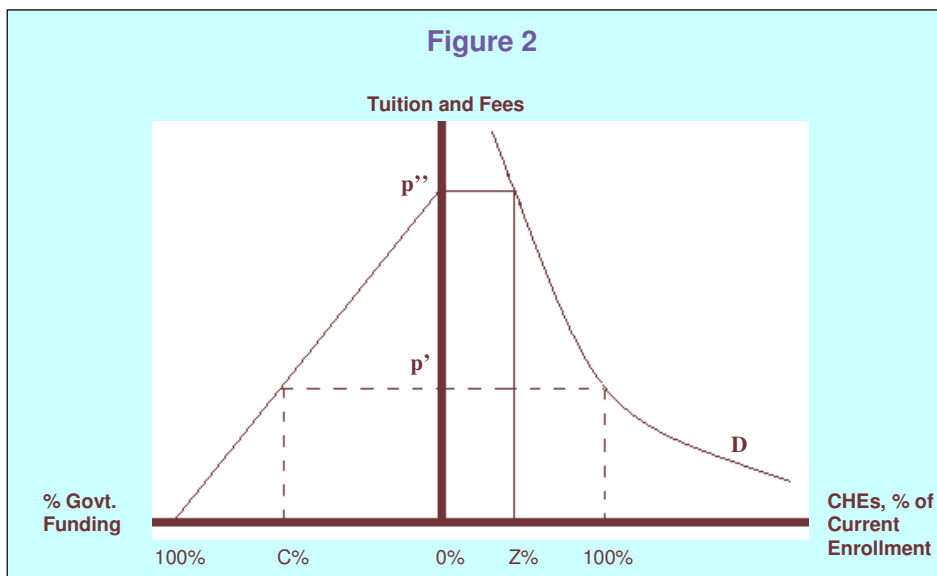


Figure 2 shows another important reference point in the model—where state and local government support is 0%, tuition rates are increased to p'' , and enrollment is $Z\%$ (less than 100%). The reduction in enrollment reflects price elasticity in the students' school vs. no-school decision. Neglecting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



FROM ENROLLMENT TO BENEFITS

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

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

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

reflects the total benefits generated by enrollments at their current levels, measured in our Main Report and shown in **Table 3.6** for the broad and narrow taxpayer perspectives.

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

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

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

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

COLLEGE SHUTDOWN POINT

College operations cease when fixed costs can no longer be covered. The shutdown point is introduced graphically in **Figure 3** as S%. The location of point S% indicates that the college can operate at an even lower enrollment level than Z% (the point of zero

state and local funding). At point $S\%$, state and local government support is still zero, and the tuition rate has been raised to p''' . At tuition rates still higher than p''' , the college would not be able to attract enough students to keep the doors open, and it would shut down. In **Figure 3**, point $S\%$ illustrates the shutdown point but otherwise plays no role in the estimation of state and local government benefits. These remain as shown in equation (3).

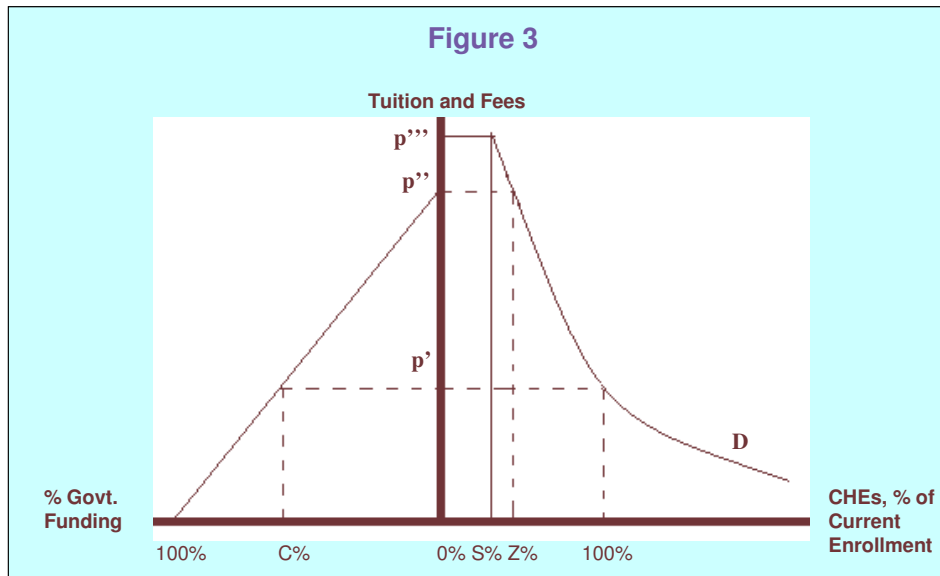
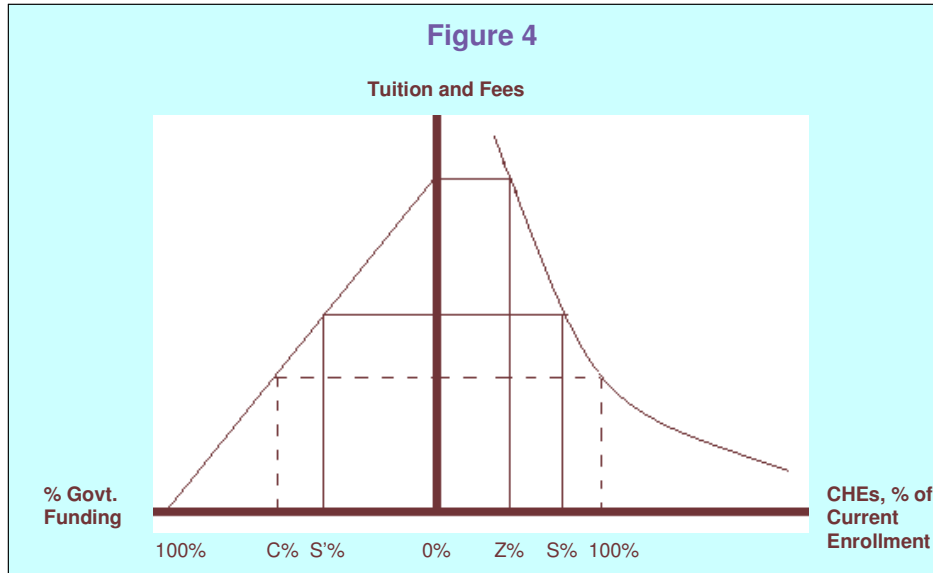


Figure 4 illustrates yet another scenario. Here the shutdown point occurs at an enrollment level greater than $Z\%$ (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the school to operate at all. This minimum portion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

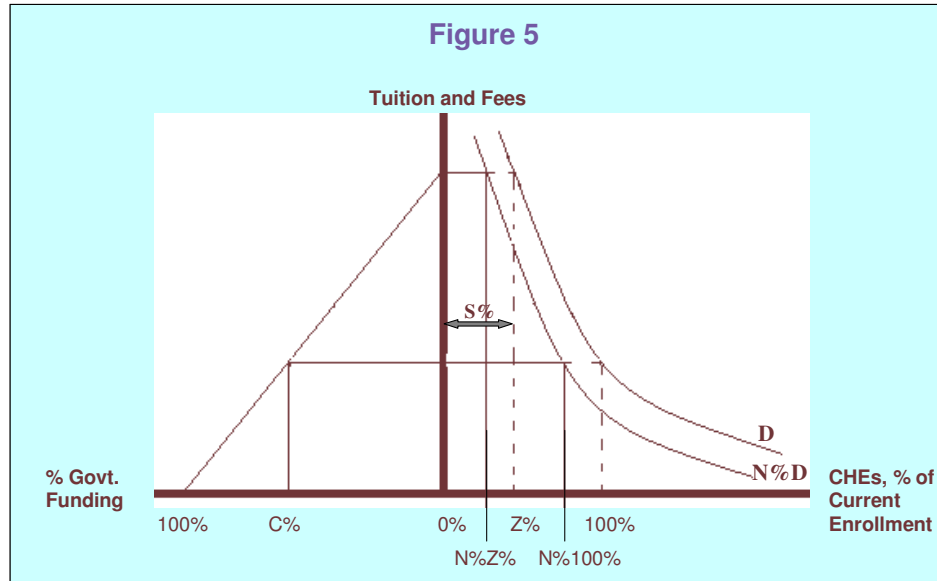


ADJUSTING FOR ALTERNATIVE EDUCATION OPPORTUNITIES

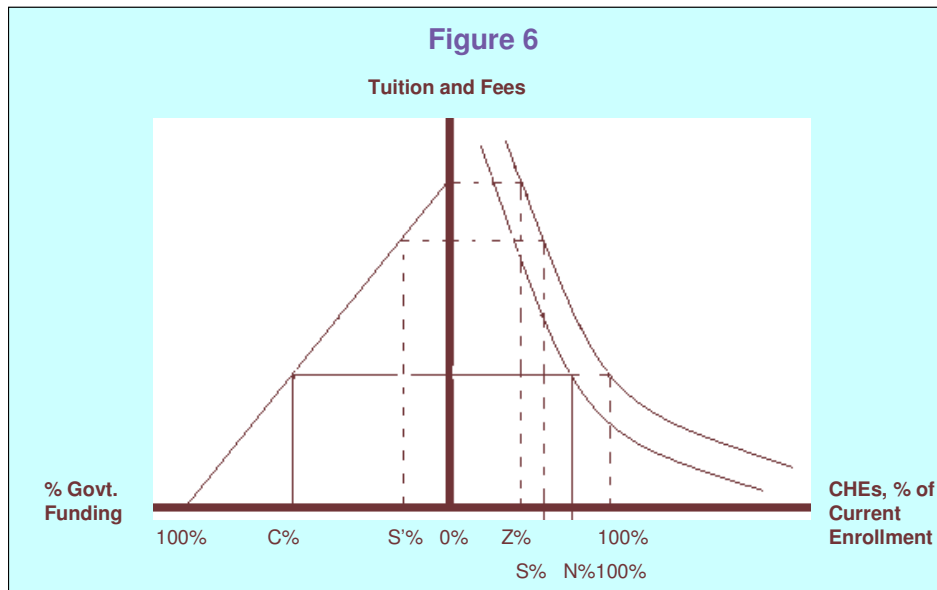
Because there may be education alternatives to the two-year colleges in the state, we must make yet another adjustment. The question asked is: “Absent the publicly funded colleges and universities in the state, what percentage of the students would be able to obtain their education elsewhere?” Benefits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

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

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



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



APPENDIX 3: 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:

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

Where:

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

b_i = partial regression coefficients

e = standard error

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.⁴²

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.⁴³

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.⁴⁴

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)

$$R^2 = .458 \text{ (coefficient of determination)}$$
$$F = 31.84 \text{ (Fischer test statistic)}$$

⁴² Available from U.S. Census Bureau, Current Population Survey (available from <http://www.bls.census.gov/cps>; internet).

⁴³ Available from U.S. Department of Commerce, County Business Patterns, annual.

⁴⁴ 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 college has a service region of five counties. The total population of the five counties is 188,341, while the size of the region is 3754 square miles; the average population per square mile is therefore a little over 50. Within this region, there is about 1 higher education private school employee for every 3,000 residents. Finally, the average income per person within the region is \$21,869 per year. Using this data, we produce the following results:

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

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

APPENDIX 4: 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.⁴⁵

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).

⁴⁵ 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.⁴⁶ 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.

⁴⁶ 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 5: 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).⁴⁷

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 CAC 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.⁴⁸ An important function of models is the estimation of multiplier effects.

⁴⁷ The approach is also chronicled in Robison, 1997.

⁴⁸ 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%.⁴⁹ 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.

⁴⁹ 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.