Economic Contribution of Austin Community College

Analysis of Investment Effectiveness and Economic Growth

Volume 1: Main Report

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EMSI
Economic Modeling Specialists Inc.

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EMSI

EMSI is a leading provider of socioeconomic impact and strategic planning tools to community and technical colleges. To date the model developed by EMSI has been successfully applied to generate more than 800 studies in the United States, Canada, and the UK. Questions concerning the approach, assumptions, and/or results should be directed to EMSI, c/o Drs. Kjell Christophersen and Hank Robison, PO Box 9008, Moscow, ID 83843; phone: 866-999-3674; fax: 208-882-3317; e-mail: info@economicmodeling.com.

ACRONYMS

ACC	Austin Community College
B/C	Benefit/Cost Ratio
CHE	Credit Hour Equivalent
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 Austin Community College in its service region and in the state. The study presents two analyses: 1) an investment analysis from the perspectives of students and taxpayers, and 2) an economic growth analysis to determine the relative contribution of ACC to regional income. Major findings are as follows:

INVESTMENT ANALYSIS

1. **Students:** The analysis recognizes Austin Community 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 income of approximately $481,000 over the course of a working lifetime, equal to about $13,000 per year. This figure does not capture personal incidental benefits from education, including increased job satisfaction, improved health, and others. All in all, it is estimated that students will receive a 22.2% annual rate of return on their education investment.

2. **Taxpayers:** The analysis considers ACC as an investment on the part of state and local government taxpayers. The economic growth effect of ACC 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 ACC yields an investor rate of return equal to 13.5%, exceeding the assumed 4.0% opportunity cost of funds. This means that ACC 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 wages, salaries, and benefits of ACC faculty and staff plus college operations spending increase regional income in the ACC Service Area economy by $110.3 million. This is a conservative estimate discounted to account for monies withdrawn from the local economy to support the college.

2. **Student Spending Effect:** Some of ACC's students come from outside the region to attend college in the ACC Service Area, bringing in monies which would not otherwise have entered the region.

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 ACC's past students annually contribute $2.2 billion to economic growth in the ACC Service Area.

4. **Total Effect:** Adding college operations, student spending, and past student productivity effects together, ACC accounts for approximately $2.3 billion of labor and non-labor income in the ACC Service Area. This is equal to about 3.0% of total income in the regional economy.

Chapter 1
INTRODUCTION

OVERVIEW

ACC generates a wide array of benefits. Students benefit from higher personal income, 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, Austin Community College (ACC) 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 income 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, the model projects benefits into the future, discounts them back to the present, and compares 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 ACC 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 ACC operating expenditures; 2) income generated by spending of ACC students; and, 3) income generated by ACC skills embodied in the workforce.

A note of importance: although the reports generated for ACC 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 or using the data to rank colleges is strongly discouraged.

The report has five chapters and four appendices. **Chapter 1** is an overview of benefits measured. **Chapter 2** presents data and assumptions underlying the analysis. **Chapter 3** presents investment analysis results from the student and taxpayer perspectives. **Chapter 4** considers the impact of ACC on regional economic growth. **Chapter 5** provides sensitivity analyses of softer variables. **Appendix 1** is a glossary of terms. **Appendices 2** and **3** provide detailed explanations of two adjustment factors used to discount benefits. Finally, **Appendix 4** is a short primer on the investment analysis results.

Chapter 2
DATA SOURCES AND ASSUMPTIONS

INTRODUCTION

Estimating the benefits and costs of higher education requires three types of information: (1) the profile of the college and its student body, (2) the economic profile of the region, and (3) statistics relating higher education to improved social behavior. For the purposes of this study, information on the college and its students was obtained from ACC, data on the regional and state economy were drawn from public databases, and statistics on social behavior were provided by national studies and surveys.

COLLEGE PROFILE

Revenues and Expenditures

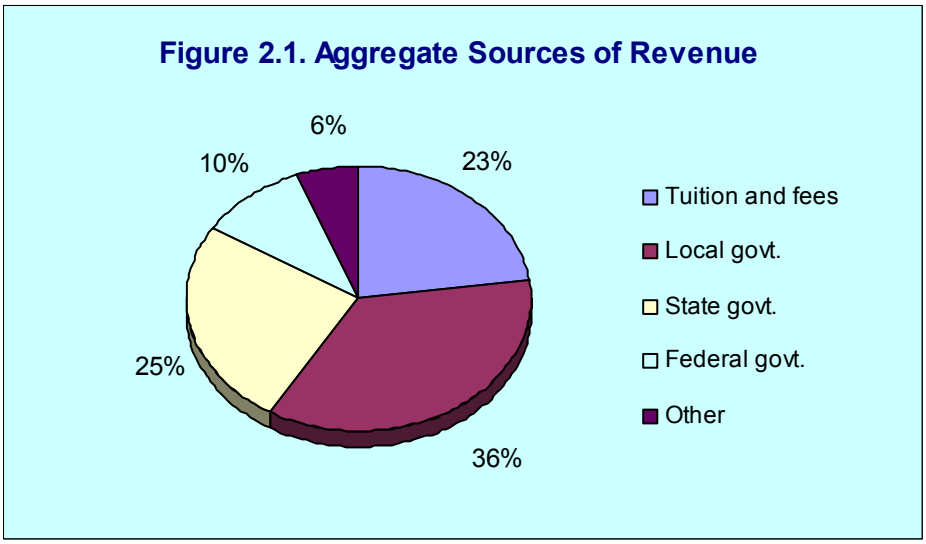
Table 2.1 and **Figure 2.1** show ACC's annual revenues by funding source: a total of $200.4 million. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (22.8%) plus 5.7% from other private sources such as contract revenues, interest payments and the like. Public funding is comprised of state and local taxes (61.0%) and federal grants (10.4%). These data are critical in identifying annual costs of educating the student body from the perspectives of students and taxpayers alike.

Table 2.1: Revenues by Source (FY 2006-07)

SOURCE	AMOUNT	TOTAL	%
Private Funding			
Tuition and fee payments[1]	$45,748,936		22.8%
Other sources of revenue	$11,521,488	$57,270,424	5.7%
Public Funding			
Local govt. funding	$71,458,676		35.7%
State govt. funding	$50,895,394		25.4%
Federal govt. funding	$20,795,707	$143,149,777	10.4%
TOTAL REVENUES		**$200,420,201**	**100.0%**

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

Source: Data supplied by ACC.



ACC employed 1,543 full and 3,310 part-time faculty and staff in fiscal year 2007. Their combined payroll amounted to $130.2 million. Other operating expenditures, including purchases of supplies and services, made up $57.3 million. These budget data appear in Column 1 of **Table 2.2**. Column 2 apportions that spending to local (i.e., in-region) vendors.[1] 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 86% of all college expenditures benefit local vendors ($160.4 million / $187.5 million = 86%).

Table 2.2: Profile of ACC Spending In and Out of Regional Economy

SPENDING CATEGORIES	TOTAL DOLLAR AMOUNT (1)	% LOCAL (2)	NET LOCAL SPENDING (3)
Salaries, wages, and benefits	$130,198,163	100%	$130,198,163
Other non-pay expenditures[1]	$57,292,263	53%	$30,178,713
TOTAL EXPENSES	**$187,490,426**	**86%**	**$160,376,876**

1. Includes capital expenditures.

Source: Total dollar amounts provided by ACC. Estimated percent of spending that occurs locally calculated internally in the model based on data provided by a sample of 200 colleges analyzed to date.

[1] EMSI collected data from a sample of some 200 colleges on the breakdown of their spending between local and non-local vendors and regressed these on total earnings by place of work in the region.

Student Demographics

ACC served 57,227 credit students and 8,797 non-credit students during the 2006-07 academic year, a total of 66,024 students (unduplicated). Of these students, 43% were males and 57% were females. The percent breakdown of the student body by ethnicity was 59% Whites and 41% Non-Whites (**Figure 2.2**).[2] The average age of the student body was 28.

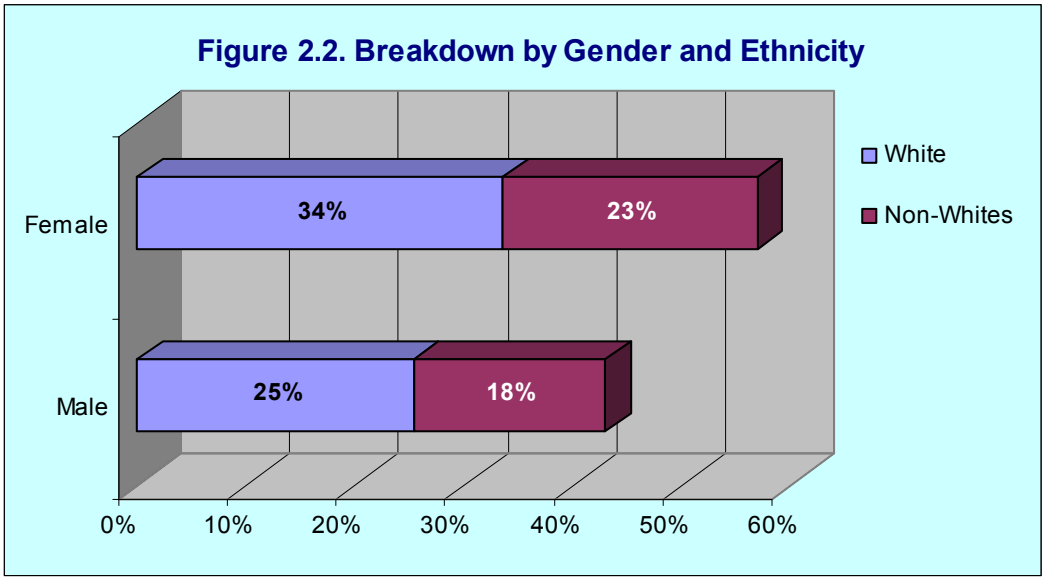


Table 2.3 provides information on the students' entry level of education by broad education category ranging from less than high school to a graduate or professional degree. However, not all students currently studying at ACC are in their first year of college – some may have enrolled two or more years ago and furthered their education beyond the level reflected in their enrollment applications. Because of this, the breakdown of the student body by entry level of education may be different from the students' education level at the start of the analysis year, so a new distribution of students is needed. To do this the model applies a utility that begins with the students' level of education at entry, then moves them through their college career all the way up to the start of the analysis year. Results appear in **Table 2.3**.

[2] Non-whites include White Hispanic, Non-White Hispanic, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, and two or more races.

Table 2.3: Redistribution of Students by Level of Education

EDUCATION LEVEL	ENTRY LEVEL[1]	% OF TOTAL	ANALYSIS YEAR[2]	% OF TOTAL
< HS/GED	4,622	7%	3,429	5%
HS/GED equivalent	31,692	48%	8,221	12%
One year post HS or less	12,086	18%	24,919	38%
Two years post HS or less	13,664	21%	25,313	38%
> Associate Degree	3,961	6%	4,142	6%
TOTAL	**66,024**	**100%**	**66,024**	**100%**

1. Refers to the level of education of the student body upon entry.

2. Refers to the redistribution of students by education level at the start of the analysis year.

Source: Adapted from data supplied by ACC based on parameters internal to the model.

Note that the "Entry Level" and "Analysis Year" columns in **Table 2.3** add to the same total. Differences between the columns reflect the new breakdown of students as they move from one education level to the next, based on a bell curve distribution with a mean value equal to the average number of steps completed per student. The redistribution is measured and analyzed separately for four main demographic groups (white males, white females, non-white males, and non-white females), although only weighted averages are shown here.

An important component of the analysis is an estimation of the number of credit hour equivalents, or CHEs, achieved by the student body during the single academic year. CHEs are defined as 15 contact hours of education if on a semester system or 10 contact hours if on a quarter system. **Table 2.4** shows the breakdown of the student body by educational achievement, along with the corresponding average number of CHEs completed per student during the analysis year.

As indicated, students who achieved their goals during the analysis year included Associate Degree and Certificate graduates (total 2%). Transfer students and/or credit-bearing students who did not complete their programs during the analysis year comprised 51% of the student body. Other students fulfilled credits to improve their skills or to meet their educational needs (47%).

In sum, ACC students generated 522,040 CHEs during the 2006-07 academic year, for an average of 8 CHEs per student. The last column of the table shows the average time students are actually in attendance relative to a full year. This is calculated by dividing

average CHEs by 30, the number of CHEs required to complete a full-time equivalent, or FTE.

Table 2.4: Levels of Achievement

STUDENT CATEGORY	STUDENT DISTRIBUTION	HEAD COUNT	AVG CHEs	TOTAL CHEs	% FTE[3]
Cat. 1 - Associate's Degree graduates	1%	974	16	15,440	53%
Cat. 2 - Certificate graduates	1%	345	17	5,814	56%
Cat. 3 - Transfer track and continuing[1]	51%	33,543	8	280,108	28%
Cat. 4 - Workforce students[2]	47%	31,162	7	220,678	24%
TOTAL/WGHTD AVG	**100%**	**66,024**	**8**	**522,040**	**26%**

1. Includes students enrolled in college transfer programs, as well as first or second year students who will be returning the following year to complete their programs.
2. Includes career-oriented students enrolled in apprenticeship programs, career/vocational training, or upgrading courses.
3. Calculated by dividing average CHEs by 30, the assumed number of CHEs required to complete an FTE.

Source: Adapted from data supplied by ACC.

Opportunity Cost

Opportunity cost refers to the value of time and earnings foregone by students who choose to attend college rather than work full-time. It is derived by establishing the full earning potential of students, then comparing this to what they are actually earning while attending college. Full earning potential is assumed to be the equivalent of the expected income of students given their current age, gender, ethnicity, and level of education. Average statistical income at the midpoint of the students' career appears in **Table 2.5**. These figures are derived from national data on earnings by gender, ethnicity, and level of education, regionalized to the ACC Service Area by applying a ratio of income by place of work divided by the number of workers, then finally weighted to reflect the specific gender and ethnicity profile of the ACC student body. Note that wage rates in the EMSI model combine state and federal sources to provide earnings that reflect proprietors, self-employed workers, and others not typically included in state data, as well as benefits and all forms of employer contributions. As such, EMSI industry earnings per worker numbers are generally higher than average salaries by industry from other sources.

Table 2.5: Expected Income at Midpoint of Individual's Working Career (Weighted Average)[1]

EDUCATION LEVEL	AVERAGE INCOME	DIFFERENCE
One year short of HS/GED	$21,600	-
HS/GED equivalent	$33,700	$12,100
Certificate	$39,400	$5,700
Associate Degree	$46,700	$7,300
One year post Associate Degree	$53,900	$7,200
AVERAGE INCOME	**$38,900**	**-**

1. Reflects average income (i.e., wages, salaries, and benefits) 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 to the ACC Service Area using a ratio of income by place of work divided by the number of workers.

The bottom row of the table presents the overall average annual income of students, weighted according to gender and ethnicity ($38,900). This defines the midpoint of a working life trajectory that begins with low entry-level wages, culminates with a typical worker's highest wages somewhere after the midpoint of his or her career, then tapers off again as the worker approaches retirement around age 65.[3] To accurately determine the full earning potential of the ACC student body, the $38,900 must be conditioned to the age of the students (28) using a scalar defined by the well-known and tested Mincer equation. The result – $23,740 – is assumed to be the full earning potential of the student body while enrolled, assuming full-time employment.

Students do not forego the entire $23,740, however. Many of them work full or part-time when class is not in session, thus making up some of their foregone earnings. The model estimates that students attend, on average, 26% relative to a full-time year of study, equal to the average CHEs per student (8) divided by 30, the number of CHEs required to achieve an FTE (see last column of **Table 2.4**). Accordingly, the model discounts the $23,740 by all but 26%, assuming that students are free to work the rest of the year and

[3] 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* (NewYork: 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.

thus do not accrue any opportunity cost when they are not actually attending ACC. The resulting figure, $6,257, serves as the gross annual opportunity cost per student (see **Table 2.6**).

Table 2.6: Total Opportunity Cost by Employment Status

EMPLOYMENT STATUS	HEAD-COUNT	OPP. COST	%ADJUST-MENT[1]	TOTAL
Non-working	10,564	$6,257	100%	$66,096,095
Working	55,460	$6,257	55%	$190,418,760
			Subtotal	$256,514,856
		Net of unrestricted grants and scholarships[2]		($2,040,198)
			TOTAL	**$254,474,658**

1. Includes the percent of earnings foregone relative to full earning potential, plus the value of leisure time given up (for working students only).
2. An assumed 40% of total grants and scholarships awarded during the analysis year were paid out directly to students to cover their living expenses.

Source: Adapted from data supplied by ACC. See also Table 2.5.

Student opportunity cost is further adjusted to match the employment patterns of the ACC student body. For example, some students are not working at all and are thus giving up all (100%) of their full earning potential; other students are employed, but many of them hold jobs that pay less than statistical averages because they can only find work that accommodates their college schedule. The model estimates that working students are giving up, on average, 35% of their full earning potential.[4] Working students also forego a substantial amount of their leisure time to attend college, which has an assumed value equal to 20% of the students' gross opportunity cost.[5] All of these adjustments are tallied up and applied to the $6,257 in gross opportunity cost for the ACC student body.

Table 2.6 displays the grand total opportunity cost of education from the student perspective. Included are earnings foregone by employment status, equal to $256.5 million. Also included is a reduction to account for grants and scholarships given

[4] Earnings foregone by working students relative to their full earning potential is calculated internally in the model based on regression analyses conducted for a sample of some 200 colleges analyzed by EMSI.
[5] 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).

directly to students after all tuition and fees have been paid. Such funds represent a net gain to students and are thus discounted from the cost calculations. In sum, it is estimated that the costs of education for the ACC student population amounted to $254.5 million in the 2006-07 analysis year.

Origin and Settlement Patterns

Some of ACC students either commute or relocate to the ACC Service Area from outside the region. These students spend money while in the area, whether for textbooks, food, rent, transportation, and so on. Their annual expenditures create jobs and incomes for local businesses, thereby contributing to economic growth in the region. A study commissioned by the Illinois Board of Higher Education estimates that full-time students spend, on average, $5,701 each year while attending college, including expenses for books and supplies, room and board, transportation, and other personal expenses. To arrive at the net spend per FTE, the model discounts the gross expenditures of students to account for the estimated portion that leaks from the economy.[6] This adjustment appears in the "% After Leakage" column of **Table 2.7**.

The next step is to discount the cost of books and supplies to account for the fact that not all students are attending full-time. This adjustment is derived from the percent of an FTE that the typical ACC student earns in the course of the year, as shown in **Table 2.4**. For the other budget items (room and board, transportation, etc.), it is assumed that full and part-time students spend the same amount.

Of course, the cost per FTE only applies to students who actually relocate to the area. Those who commute to ACC do not incur living expenses in the region while attending, so their costs for rent, food, and other personal expenses do not impact the economy. As such, the model assumes that the impacts of in-commuters are restricted to their purchase of books and supplies, while the rest of their expenditures are excluded. Expenses incurred by long distance or on-line students are also excluded.

The net aggregate expenditure of ACC's out-of-region students, both those who relocate and those who commute, comes to $10,000, shown in the bottom row of **Table 2.7**. This

[6] In arranging data for inclusion in the impact model, only the trade margin is allocated to the trade sector. Modelers customarily assume a 25% mark-up. Accordingly, an item with a retail selling price of $100 but costing the retailer $80 will enter the economic model as $20 (= $80 x 25%) to the retail trade sector, and $80 to the manufacturer of the item. If the manufacturer is located outside the region, only the $20 trade margin is added: in this case the $80 is spending that is said to "leak" from the regional economy.

figure represents net sales generated in the economy, not income. Sales serve as the basis from which the model calculates the impact of student spending on the creation of regional income, as discussed in **Chapter 4**.

Table 2.7: Student Spending by Major Item, AY 2006-07

BUDGET ITEM	GROSS SPEND PER FTE	% AFTER LEAKAGE	NET SPEND PER FTE	TIMES FTEs ACHIEVED
Books and supplies	$613	40%	$245	$65
Room and board	$2,525	80%	$2,020	$2,020
Personal expenses	$1,495	55%	$822	$822
Transportation	$1,069	55%	$588	$588
TOTAL	**$5,701**	**64%**	**$3,675**	**$3,494**
			Students from outside region	155
			Net spending	$541,603
			Net of living expenses of in-commuters	($531,588)
			TOTAL SPENDING	**$10,015**

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

Students who remain in the area upon exiting college also contribute to the economic growth of the region, while students who settle in the state (whether inside or outside of regional boundaries) benefit state and local taxpayers through their higher incomes and improved lifestyles. **Table 2.8** presents the settlement patterns of ACC's students by region and by state. As shown in the table, 80% of students stay in the region upon exiting college, while 98% stay in the state (inclusive of students who remain in-region). The retention rates only apply to the first year, however. The model also assumes that 35% 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). For the state, the assumed thirty-year attrition rate is 25%.

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 and continuing students it is assumed that the onset of benefits will be delayed by 2.5 years to account for time spent at other institutions. These factors are derived from Norton Grubb (1999).

Table 2.8: Student Settlement Patterns

	VALUES
Students remaining in region after leaving college	80%
Students remaining in State after leaving college	98%
Thirty-year attrition rate (leaving region)	35%
Thirty-year attrition rate (leaving State)	25%
"Settling-in" factors (years):	
Associate Degree graduates	2.0
Certificate graduates	0.5
Transfer track/continuing	2.5
Workforce students	0.0

Source: Student retention variables supplied by the college. Thirty-year attrition internal to the 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).

REGIONAL PROFILE

ACC serves the whole counties of Gillespie, Blanco, Hays, Travis, Caldwell and Bastrop, plus portions of Williamson and Gonzales Counties (see map). For the purpose of this analysis, the regional backdrop comprises all eight counties in the college's service area. ACC serves the local region by creating jobs and income, providing area residents with easy access to higher education opportunities, and preparing students for highly-skilled, technical professions. The availability of quality education and training in the ACC Service Area also attracts new industry to the region, thereby generating new businesses and expanding the availability of public investment funds.

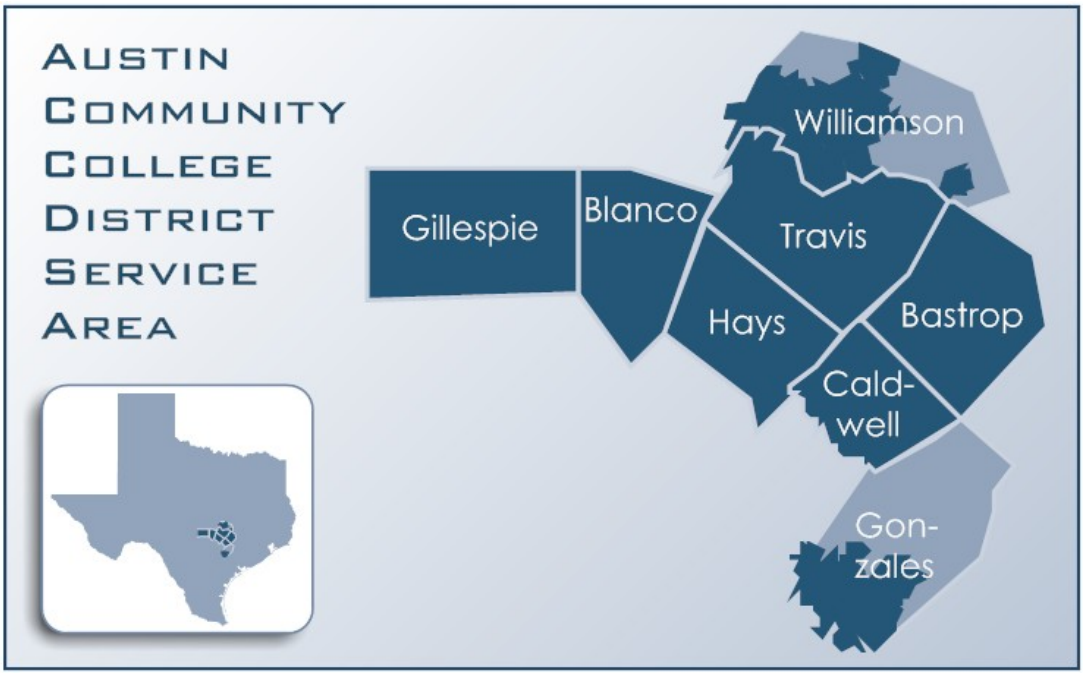


Table 2.9 presents labor and non-labor income estimates by major industrial sector in the ACC Service Area. These figures serve as the regional backdrop against which the relative impacts of ACC and its students are measured, discussed more fully in the economic growth analysis presented in **Chapter 4**. Economic growth analysis is a measure of the increase in value of goods and services produced in an economy. It is traditionally reported in terms of added regional income or gross domestic product (GDP), which reflects all factors of production, i.e,. labor, land and capital, net of otherwise double-counted inter-industry sales. Included are wages, salaries and proprietors' income (labor income) and profits, rents and other (non-labor income). The U.S. Department of Commerce annually publishes these estimates for counties and states in its Survey of Current Business. Data are also readily available in electronic form.

Table 2.9: Labor and Non-Labor Income by Industrial Sector in Regional Economy, 2006

INDUSTRIAL SECTORS	LABOR INCOME[1] ($ Millions)	NON-LABOR INCOME[2] ($ Millions)	TOTAL INCOME ($ Millions)	% OF TOTAL
Agriculture and Agricultural Services	$133	$150	$282	0%
Mining, Sand, and Gravel	$890	$1,915	$2,805	4%
Construction	$3,598	$658	$4,256	5%
Manufacturing: Food, Wood, Paper, and Textiles	$391	$149	$540	1%
Manufacturing: Chemicals, Petroleum, Stone, and Glass	$1,164	$857	$2,021	3%
Manufacturing: Computer and Electronic Equipment	$4,735	$984	$5,719	7%
Manufacturing: Other	$372	$135	$507	1%
Transportation	$956	$326	$1,283	2%
Public Utilities	$234	$625	$859	1%
Publishing and Communications	$2,140	$2,914	$5,053	7%
Trade: Wholesale and Retail	$6,895	$5,267	$12,162	16%
Finance, Insurance, and Real Estate	$5,093	$7,462	$12,555	16%
Motels, Eating/Drinking, and Amusement/Recreation	$1,766	$1,014	$2,780	4%
Consumer Services	$1,252	$501	$1,754	2%
Business Services	$8,191	$1,875	$10,066	13%
Medical/Educational/Social Services	$4,551	$895	$5,447	7%
Federal Government	$908	$209	$1,117	1%
State and Local Government[3]	$7,448	$1,034	$8,481	11%
TOTAL	**$50,716**	**$26,970**	**$77,687**	**100%**

1. Wages, salaries, and benefits

2. Dividends, interests, and rents; Does not include transfers

3. Includes ACC faculty and staff wages and salaries

Source: U.S. Department of Commerce Regional Economic Information System (REIS), CA and SA series; U.S. Department of Commerce, County Business Patterns; Bureau of Labor Statistics ES-202 series.

SOCIAL BENEFITS

Higher education is statistically correlated with a variety of lifestyle changes that generate social savings, also known as *external* or *incidental* benefits of education (see "Beekeeper Analogy" box). These social savings represent avoided costs that would have otherwise accrued to state and local government and drained public resources absent the education provided by ACC. Data relating higher education to improved social comportment are available from a variety of sources, including the U.S. Census Bureau, U.S. Department of Labor, and studies and surveys analyzing the impacts of substance abuse, crime, and unemployment on society.

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.

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.

Tables 2.10 through **2.12** present calculated reductions in the probability that an individual will incur social costs related to health, crime, or welfare and unemployment with each year of higher education. Costs per individual per year are also shown. The 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, then adjusting downward to net out benefits that are statistically correlated with other factors besides higher education (such as socioeconomic status and family background).[7] 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.

[7] This adjustment, also known as the "ability bias" is described more fully in **Chapter 3**.

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 2.10** 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 ACC student body.

Table 2.10: Absenteeism, Tobacco and Alcohol Abuse by Level of Education

	ABSENTEEISM		TOBACCO		ALCOHOL	
EDUCATION LEVEL	DAYS[1]	%/YEAR[2]	PROB.[3]	% REDUCT.[4]	PROB.[3]	% REDUCT.[4]
< HS/GED	6.4	2.5%	24.0%	-	9.6%	-
HS/GED equivalent	5.0	1.9%	21.5%	10.3%	9.0%	6.5%
One year post HS or less	4.6	1.8%	19.3%	10.2%	8.4%	6.5%
Two years post HS or less	3.9	1.5%	15.7%	18.8%	7.4%	12.0%
> Associate Degree	3.5	1.3%	11.5%	26.4%	6.7%	8.8%
Annual costs per alcohol abuser		**$7,000**				
Annual costs per tobacco abuser		**$3,000**				
State and local govt. health subsidy		**6%**				

1. Shows the average number of days of absenteeism by education level, weighted according to the specific gender and ethnicity profile of the student body.
2. Calculated by dividing absenteeism days by the number of working days per year (260).
3. Shows the probability that an individual will be a smoker or an alcoholic, weighted according to the specific gender and ethnicity profile of the student body.
4. Shows the calculated reduction in the probability that an individual will abuse tobacco or alcohol.

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

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. 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, the model assumes a taxpayer's portion of absenteeism savings at 14.7%, equal to the estimated public portion

of employment in the region.[8] As for smoking and alcohol-related savings, taxpayers benefit to the extent that state and local health subsidies (to hospitals, for example) are reduced. The model assumes that 6.0% of total benefits can be counted as taxpayer savings.

Crime Savings

Table 2.11 shows rates of incarceration by education level. As indicated, incarceration drops on a sliding scale as education levels rise.[9] 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 ACC student body. The analysis identifies 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.

Table 2.11: Incarceration Rates by Level of Education

EDUCATION LEVEL	PROBABILITY[1]	% REDUCTION[2]
< HS/GED	11.7%	-
HS/GED equivalent	9.4%	20.2%
One year post HS or less	7.6%	18.4%
Two years post HS or less	5.2%	31.8%
> Associate Degree	4.0%	23.5%
Annual cost per inmate		**$66,250**
Annual cost per victim		**$85,000**
State & local govt. justice expenditures (%)[3]		**80%**

1. Shows the probability that an individual will be incarcerated by education level, weighted according to the specific gender and ethnicity profile of the student body.
2. Shows the calculated reduction that an individual will be incarcerated.
3. Refers to the percent of total justice expenditures covered by state and local govt.

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

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. Savings

[8] Ratio of state and local government earnings over total state earnings (U.S. Department of Commerce, Bureau of Economic Analysis, REIS, annual).
[9] 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.

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: The model assumes 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, none of these are claimed as taxpayer savings. Finally, the "composite" state and local government average tax rate (11.5%) is applied to the added productivity of persons *not* incarcerated to arrive at narrow taxpayer benefits.

Welfare and Unemployment Savings

Table 2.12 relates the probabilities of individuals applying for welfare and/or unemployment assistance to education levels (linked to the gender and ethnicity profile of the ACC student body).[10]

Table 2.12: Welfare and Unemployment by Level of Education

	WELFARE		UNEMPLOYMENT	
EDUCATION LEVEL	PROBABILITY[1]	% REDUCTION[2]	PROBABILITY[1]	% REDUCTION[2]
< HS/GED	14.4%	NA	7.3%	NA
HS/GED equivalent	10.3%	28.7%	6.4%	12.4%
One year post HS or less	7.5%	26.8%	5.6%	12.4%
Two years post HS or less	4.0%	46.6%	4.4%	21.2%
> Associate Degree	2.5%	37.7%	3.2%	27.1%
Average cost per welfare year		**$12,410**		
State and local govt. welfare subsidy		**16%**		
Average cost per unemployment year		**$10,400**		

1. Shows the probability that an individual will go on welfare or claim unemployment by education level, weighted according to the specific gender and ethnicity profile of the student body.
2. Shows the calculated reduction that an individual will be go on welfare or claim unemployment.

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

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.

[10] The model assumes 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.

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.

SUMMARY

This chapter presents the broader elements of the database and some key assumptions needed to determine the results. In general, data are drawn from four sources: 1) the institutional research and financial departments at the college, 2) public databases, 3) studies and surveys, and 4) the economic literature. Additional detail on data sources, assumptions, and general methods underlying the analyses are conveyed in the remaining chapters and appendices. The core of the findings is presented in the next two chapters – **Chapter 3** looks at ACC as an investment, while **Chapter 4** considers ACC's role in regional economic growth. The appendices detail a collection of miscellaneous theory and data issues.

Chapter 3
INVESTMENT ANALYSIS

INTRODUCTION

Investment analysis is the process of evaluating total costs and measuring these against total benefits to determine whether or not a proposed venture will be profitable. If benefits outweigh costs, then the investment is worthwhile. If costs outweigh benefits, then the investment will lose money and is thus considered infeasible.

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

STUDENT PERSPECTIVE

Analyzing the benefits of higher education from the perspective of students is most obvious – they give up time and money to go to college in return for a lifetime of higher income. The benefit component of the analysis thus focuses on the extent to which student income increases as a result of their education, while costs comprise the monies they put up.

Table 3.1 displays the total cost of education from the student perspective. Included are tuition and fees from **Table 2.1** ($45.7 million), the cost of books and supplies, and student opportunity cost from **Table 2.6** ($254.5 million). In sum, it is estimated that the costs of education amounted to $310.9 million in the 2006-07 analysis year.

Table 3.1: Student Costs

COST COMPONENT	TOTAL
Tuition and fees	$45,748,936
Books and supplies[1]	$10,667,017
Opportunity cost	$254,474,658
TOTAL	**$310,890,611**

1. Calculated by multiplying the average annual cost of books and supplies (from Table 2.7) times the number of students, times the average number of FTEs earned per student (from Table 2.4).

Source: See Tables 2.1, 2.4, and 2.6.

Estimating benefits from the student perspective requires information on the value of each CHE they achieve during the single analysis year. Determining this value makes use of another utility that takes average income by education level from **Table 2.5** and allocates the differences to the CHEs completed within each level. For example, students who move from a high school diploma to a Certificate may expect $5,700 in higher annual income, equal to the difference between average income of someone with a Certificate and that of a high school graduate. This defines the marginal value of moving from one education level to the next, which is spread out and allocated to the individual CHEs required to complete the award.[11]

Other factors come into play when calculating the value per CHE. For example, ability, family background, and socioeconomic status are proven to correlate with higher earnings, and failure to take these into account when estimating the benefits of higher education results in what is known as an "ability bias." Nevertheless, 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%.[12]As such, the gross value per CHE is adjusted downward by 10%.

Net values are displayed in **Table 3.2**. Note that the individual CHEs required to achieve each education level have their own unique value in the model, but only the weighted averages are shown here.

Table 3.2: Aggregate Higher Income at Midpoint, by Education Level

EDUCATION LEVEL	NET CHEs	VALUE PER CHE	AGGREGATE HIGHER INCOME
HS/GED equivalent or less	24,638	$425	$10,463,297
One year post HS or less	268,115	$170	$45,553,632
Two years post HS or less	220,537	$231	$50,976,220
> Associate Degree	8,750	$215	$1,882,980
TOTAL	**522,040**	**$209**	**$108,876,129**

Source: See Tables 2.3, 2.4, and 2.5.

[11] Students who obtain a certificate or degree during the analysis year are granted a "ceremonial boost" in recognition of the fact that an award has greater value than the individual steps required to achieve it.
[12] 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.

Multiplying the value per CHE times the corresponding number of CHEs completed yields the aggregate higher income that accrues to ACC students. This figure reflects income at the midpoint of the students' careers, not immediately upon exiting college. The general expectation is that earnings will be lower at the start of an individual's career, peak somewhere after the midpoint, then taper off again near retirement, so earnings at the midpoint serve as a reasonable average.[13] Altogether, it is estimated that the aggregate ACC student body enjoys, on average, $108.9 million in higher income each year as a direct result of their education.

The $108.9 million in higher income does not occur in one year alone, however. Higher income accrues for years out into the future, long after students make their initial investment of time and money. For this reason, benefits must be projected out into the future before they can be compared to costs to ascertain the feasibility of the investment. The time horizon for the analysis is defined by the students' working career, from the time they enter (or re-enter) the workforce at age 28 all the way up until they retire at age 65. Each year within this timeframe is assigned to a specific scalar derived from the well-known and tested Mincer equation, where average income (i.e., $108.9 million) is scaled down for the years prior to the midpoint, then scaled up for the years beyond the midpoint, resulting in a projected array of higher student income that gradually increases each year that students remain active in the workforce, with a slight dampening near retirement age.[14]

The next step is to discount the projected array of higher student income back to the present to reflect the so-called time value of money. For this analysis the assumed discount rate is 4.0% (see "Discount Rate" box). Present values of benefits are then collapsed down to one number and compared to student costs to derive investment analysis results, expressed in terms of benefit/cost ratios, rates of return and payback periods. The investment is feasible if returns match or exceed the minimum threshold values, i.e., a benefit/cost ratio greater than one, a rate of return that exceeds the discount rate, and a reasonably low payback period. Results appear in **Table 3.3**.

[13] 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 3.2** refers to the middle of students' careers. A somewhat smaller figure is therefore expected in years immediately following the single year of college operations, and a larger figure in the latter part of students' careers.

[14] The Mincer equation is computed based on estimated coefficients presented in Willis, 1986. These are adjusted to current year dollars in the usual fashion by applying the GDP implicit price deflator.

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. All future values must therefore be expressed 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 this 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.

As shown in the table, the $108.9 million in higher student income is projected across the working life of students, discounted to the present, and summed together to yield a cumulative of $2.2 billion, the present value of all those future income increments. This may also be interpreted as the gross capital asset value of the students' higher income stream. Accordingly, the aggregate student body is rewarded a capital asset valued at $2.2 billion as a result of their attendance at ACC.

Table 3.3: Present Value of Benefits and Costs, Student Perspective

	RESULTS
Present value of future benefit stream[1]	$2,230,679,063
Present value of costs	$310,890,611
Net present value	**$1,919,788,452**
Benefit/cost ratio	**7.2**
Internal rate of return	**22.2%**
Payback period (no. of years)	**6.6**

1. Calculated by projecting average annual higher student income from Table 3.2 over the established time horizon, discounting the future benefit stream to the present using an assumed rate of 4.0%, then summing final discounted values together.

Source: See Tables 3.1 and 3.2.

Having estimated the students' reward for attending ACC, the model compares this to associated costs to judge whether attending college is a good investment. Costs are provided in the second row of **Table 3.3**, equal to $310.9 million. Note that costs only occur in the single analysis year and are thus already in current year dollars, so their present value equals what is reported in **Table 3.1**. Comparing costs with the present value of benefits yields a student benefit/cost ratio of 7.2 (equal to $2.2 billion in benefits divided by $310.9 million in costs).

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.[15] **Table 3.3** shows ACC students earning average returns of 22.2% 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).

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[16] Beyond that point, returns are what economists would call "pure costless rent." As indicated in **Table 3.3**, students at ACC see, on average, a payback period of 6.6 years on their foregone earnings and out-of-pocket costs.

TAXPAYER PERSPECTIVE

Benefits from the taxpayer perspective are further subdivided into two main components: broad and narrow. The broad taxpayer perspective focuses on society as a whole, whether employers, homeowners, students or whoever else stands to benefit from the educational activities of ACC. Under the broad perspective *all* benefits generated by the college are counted, regardless of beneficiary. The narrow taxpayer perspective, on the other hand, restricts benefits to those that result in actual monetary gain to state and local government, whether in the form of added tax revenue or reduced government expenditures. In both cases (broad and narrow), costs comprise state and local government support of the college.

Broad Taxpayer Perspective

Benefits from the broad or "social" perspective consist of added income and avoided social costs. Income growth refers to the increase in economic activity as higher earnings and added skills of ACC students stimulate the production of income in the state. Avoided social costs comprise reductions in both private and public expenditures as

[15] Rates of return are computed 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.

[16] 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.

ACC students manifest improved lifestyles in the form of reduced health care costs, lower crime, and reduced welfare and unemployment.

Students earn more because of the skills they learned while attending college, and businesses earn more because student skills make capital more productive (i.e., buildings, machinery and everything else).[17] This in turn raises profits and other business property income. Together, increases in labor and capital income are considered the *direct effect* of a skilled workforce. *Indirect effects* occur when the higher incomes of educated workers enable them to spend more money on consumer goods, while the increased output of businesses that employ them also creates a demand for more inputs and, consequently, input spending. The effect of these two spending items (consumer and business spending) leads to still more spending and more income creation, and so on. The sum total of these several rounds of spending effects constitutes the indirect income effects of a skilled workforce.

Estimating the direct effect of ACC on income growth in the state begins with the present value of projected higher student income from **Table 3.3**. This must be adjusted downward to account for students who leave the state, in accordance with the out-migration and attrition variables shown in **Table 2.8**. The model then calculates the indirect effect of higher student earnings on labor income using a multiplier derived from a specialized input-output (IO) model described more fully in **Chapter 4**. Total labor income growth attributable to ACC is then inflated by a ratio of gross state product to total state earnings to factor out the growth of non-labor income in the state (i.e., dividends, interest, and rent).

The next step is to apply a reduction factor that takes into account alternative education opportunities such as private trade schools and colleges, correspondence schools, and so on.[18] The alternative education variable is derived through the application of a regression analysis based on estimates supplied by colleges previously analyzed by EMSI (see **Appendix 3**). For ACC, this variable is set at 24%, meaning that 24% of the student body could have obtained an education elsewhere absent ACC and other publicly-funded colleges and universities in the state. The model assumes that benefits

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

generated by such students are not directly attributable to ACC and discounts results accordingly.

Another adjustment called the "shutdown point" accounts for the fact that a certain portion of benefits generated by the college may not be directly linked to the state and local government costs of supporting it. The overall approach includes a sub-model that simulates the students' demand curve for ACC 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 ACC, the analysis shows that without state and local government support the college would have to cease its operations, so the reduction is zero.

Applying these adjustment factors yields the net effect of ACC on income growth in the state economy. Results appear with labor and non-labor income detail in the top rows of **Table 3.4**. Altogether, it is estimated that a representative year of ACC operations annually adds about $146.4 million in income to the state economy.

Table 3.4: Aggregate Annual Benefits, Broad Taxpayer Perspective

BENEFIT COMPONENT	UNITS	TOTAL
Income Growth		
Labor income	-	$93,455,400
Non-labor income	-	$52,920,300
Subtotal, Income Growth		$146,375,700
Social Savings		
Health Benefits		
Absenteeism savings (no. days)	12,800	$1,677,400
Fewer smokers (no. persons)	770	$2,316,600
Fewer alcohol abusers (no. persons)	170	$1,204,500
Crime Benefits		
Incarceration savings (no. persons)	430	$3,103,300
Crime victim savings	-	$995,400
Added productivity	-	$2,083,300
Welfare/Unemployment Benefits		
Welfare savings (no. persons)	640	$864,600
Unemployment savings (no. persons)	250	$279,500
Subtotal, Social Savings		$12,524,600
TOTAL PUBLIC BENEFITS		**$158,900,300**

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

The next section of **Table 3.4** outlines the social savings stemming from the activities of ACC and its students. Statistics generally indicate positive behavioral changes as individuals reach higher levels of education, while data on the social costs of behavior are also relatively abundant (see **Tables 2.10** through **2.12**). By combining these data sets the model measures a reduction in social costs as a by-product of education. The several items of social savings shown in **Table 3.4** are all calculated in this manner—relating incremental increases in education to improved social behavior, then adjusting downward to account for out-migration and the ability bias.[19] Additional detail appears in **Chapter 2** and in **Volume 2: Detailed Results**.

As indicated in the table, one year's worth of ACC operations reduces health-related absenteeism from work by approximately 12,800 days per year, resulting in an annual average savings of otherwise lost productivity equal to roughly $1.7 million. There are also about 770 fewer smokers incurring average smoking-related costs, with an annual average savings to society of some $2.3 million. Finally, there are 170 fewer alcohol abusers per year, providing an annual average savings of $1.2 million.

ACC operations also result in an estimated 430 fewer people incarcerated at some point in their lives, with corresponding annual of $3.1 million in direct incarceration savings, $995,400 in savings to otherwise would-be crime victims, and some $2.1 million in added productivity, i.e., persons working who would otherwise be incarcerated. Estimated average annual reduction of people on welfare and unemployment is approximately 640 and 250 respectively. The corresponding annual dollar savings amount to roughly $864,600 for welfare and about $279,500 in unemployment savings.

All told, a year's operation of ACC annually generates around $12.5 million in avoided social costs, equal to the sum of all health, crime, and welfare and unemployment savings. Added to this are income growth benefits, for a grand total of $158.9 million. This sum represents the average annual benefits that accrue to the state and local community as a result of ACC.

As with the student perspective, annual benefits in **Table 3.4** must be projected out into the future before they can be compared to costs. The time horizon for the analysis is again defined by the students' working career, equal to the assumed retirement age of 65 minus the average age of the student body. The present value of benefits and costs are displayed in **Table 3.5**, using an assumed discount rate of 4.0%. As shown, the present

[19] The ability bias specifically relates to higher earnings. Absent any similar research for the social variables, the model assumes that the same discounting factor applies as well to the public benefits. See the text surrounding **Table 3.2** for more information about the ability bias.

value of future additions to income growth sums to $3.0 billion, while the present value of future social savings sums to $162.3 million. Altogether, the present value of all public benefits equals roughly $3.2 billion.

Table 3.5: Present Value of Benefits and Costs, Broad Perspective

	RESULTS
Present value of future added income	$2,999,154,900
Present value of future avoided social costs	$162,328,600
Total benefits, present value	$3,161,483,500
Total costs, present value	$122,354,100
Benefit/cost ratio	**25.8**

Source: See Tables 2.1 and 3.4.

State and local government support of ACC also appears in **Table 3.5**, listed as the present value of total costs. While this is technically correct, it is important to note that, unlike streams of benefits that go on into the future, the state and local government contribution of $122.4 million was made in the single analysis year alone. Its present value and nominal dollar value are thus the same.

Having now defined present values of costs and benefits, the model forms a benefit/cost ratio of roughly 25.8 (= $3.2 billion worth of benefits / $122.4 million worth of state and local government support). Recall that this ratio reflects the measure of *all* benefits generated regardless of to whom they may accrue. Students are the beneficiaries of higher income, employers are beneficiaries of lower absenteeism, 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. Since investors and beneficiaries are not the same individuals, measures common to standard investment analyses such as rate of return, payback period, and net present value no longer apply. From the broad taxpayer perspective, therefore, the benefit/cost ratio should be viewed strictly as a comparison between public benefits and taxpayer costs.

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, benefits resulting from 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 received strictly by

state and local government, while benefits to private residents, local businesses or the federal government are excluded altogether.

Table 3.6 presents annual benefits that accrue to state and local taxpayers in terms of added tax revenue and reduced government expenditures. E.g., **Table 3.4** shows annual income growth in the state equal to some $146.4 million. **Table 3.6** applies prevailing state and local government tax rates to this figure to compute annual higher tax revenues associated with growth: approximately $16.9 million. Reduced government expenditures related to absenteeism and substance abuse are also shown. Absenteeism savings are restricted to the portion that accrues to state and local government employers, while savings from reduced tobacco and alcohol abuse are computed based on state and local government's subsidy of general health care. This yields savings of $168,300 and $139,700, respectively, to state and local government each year.

The state and local government portion of crime savings shown in **Table 3.4** is computed by deducting victim costs and the cost of federal crimes, as 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, 11.5%. All told, state and local government sees reduced incarceration expenditures and increased revenue due to added productivity equal to $1.9 million each year. Reduced welfare expenditures of $91,500 complete the estimation of annual state and local government savings from ACC support.

Table 3.6: Aggregate Annual Benefits, Narrow Taxpayer Perspective

BENEFIT COMPONENT	TOTAL
Added Tax Revenue	$16,882,300
Reduced Government Expenditures	
Health Benefits	
Absenteeism savings	$168,300
Substance abuse savings[1]	$139,700
Crime Benefits	
Incarceration savings	$1,641,600
Added productivity	$257,200
Welfare/Unemployment Benefits	
Welfare savings	$91,500
Subtotal, Reduced Government Expenditures	$2,298,300
TOTAL GOVERNMENT BENEFITS	**$19,180,600**

1. Inclusive of reduced government expenditures related to reduced tobacco and alcohol abuse.

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

Projecting annual benefits in **Table 3.6** out to the future and then discounting them back to the present gives the time value of all future benefit increments that accrue strictly to state and local government. Results appear in **Table 3.7**. As indicated, the future stream of benefits provides an overall asset value of $390.5 million stemming from a year's support of ACC. Costs, on the other hand, come to only $122.4 million, equal to the annual contribution of state and local government to ACC (note that this number is repeated from **Table 3.5**). In return for their support, therefore, state and local government is rewarded with an investment benefit/cost ratio of 3.2 (= $390.5 million / $122.4 million), indicating a most profitable investment.

At 13.5%, 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 of the resulting added taxes and reduced government expenditures. A rate of return of 13.5%, on the other hand, means that ACC 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.

Table 3.7: Present Value of Benefits and Costs, Narrow Perspective

	RESULTS
Present value of increased state and local government tax revenue	$345,908,800
Present value of reduced state and local government expenditures	$44,597,800
Total benefits, present value	$390,506,600
Total costs, present value	$122,354,100
Net present value	**$268,152,400**
Benefit/cost ratio	**3.2**
Internal rate of return	**13.5%**
Payback period (no. of years)	**9.7**

Source: See Tables 2.1 and 3.6.

Note that returns reported in **Table 3.7** are real returns, not nominal. When a bank promises to pay a certain rate of interest on a 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 3.7**, the 13.5% taxpayer 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 17.0%, substantially higher than what is reported in this analysis.

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 benefits, i.e., higher income, should be counted. **Tables 3.5** and **3.7** are inclusive of social benefits reported here as attributable to the college. Recognizing the other point of view, **Table 3.8** 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 ACC.

Table 3.8: Taxpayer Perspectives Without Social Externalities ($ Thousands)

	BROAD PERSPECTIVE With Social Savings…		NARROW PERSPECTIVE With Social Savings…	
	Included	Excluded	Included	Excluded
Net present value	$3,161,484	$2,999,155	$390,507	$345,909
Internal rate of return	-	-	13.5%	11.6%
Benefit/cost ratio	25.8	24.5	3.2	2.8
Payback period (years)	-	-	9.7	11.2

Source: See Tables 3.5 through 3.7.

ANNUAL PRIVATE AND PUBLIC BENEFITS COMPARED

To get a different perspective on the results, aggregate annual benefits reported in **Tables 3.2** and **3.4** are expressed in **Table 3.9** 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 3.9: Annual Benefits Per CHE and Per FTE Student

	PER CHE[1]	PER FTE STUDENT[1]
STUDENT BENEFITS		
Increased student income, **gross**	$209	$6,257
Increased student income, **after tax**	$150	$4,492
PUBLIC BENEFITS		
Income growth	$280	$8,412
Health-related savings[2]	$10	$299
Crime savings[3]	$12	$355
Welfare/unempl. savings[4]	$2	$66
TOTAL	**$304**	**$9,132**

1. Annualized values exclude benefits from retired/leisure 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 w elfare and unemployment claims.

Source: See Table 3.2 and 3.4.

As indicated in the first row, the annual average income of ACC students increases roughly $209 for every hour of credit or non-credit instruction they complete. The $209 figure is "gross income," e.g., the gross figure that might appear on a student's pay stub. The "after tax" figure is shown as $150 – this is the figure that might appear on the student's actual paycheck.[20]

For public benefits, **Table 3.9** indicates that an hour of instruction adds an average of $280 per year to state income. The other "social benefits" shown are mainly avoided social costs. These range from $2 per CHE in welfare/unemployment savings, to roughly $12 per CHE from crime savings. All told, each hour of ACC instruction creates $304 in annual public benefits.

The last column in **Table 3.9** expresses results on a full time equivalent (FTE) basis. The model assumes 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 ACC student with $6,257 in higher annual income (before tax). It also increases state income by $8,412 and provides other social benefits as indicated in the table. The total of all social benefits, economic growth plus social savings, provides $9,132 to the public annually.

[20] The federal tax adjustment is based on the IRS 2006 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=150856,00.html; internet; accessed September 2007). 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.

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 3.9** 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 income after tax (shown in the second row of **Table 3.9**).

Total public benefits are shown in the bottom row of **Table 3.9**. The comparison can now be made: students benefit from one CHE of ACC attendance with a $150 annual increase in their after-tax income. At the same time, public benefits from that same hour of instruction sum to about $304 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 ACC than students do.

CONCLUSIONS

This chapter has shown that ACC 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 ACC 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 ACC as an investment, first on the part of students, then on the part of state and local government. This chapter focuses on the ACC Service Area and considers the impact of ACC on regional economic growth. Impact estimates are reported in terms of labor income (i.e., wages, salaries, and benefits) and non-labor income (i.e., sum of all dividends, interests, and rents).

Estimating the impacts of ACC requires use of a specialized input-output (IO) model that shows the interconnection of industries, government and households in the area. 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 the most widely known is 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, which uses common "data-reduction" techniques to generate regional multipliers that are similar in magnitude to those of other popular regional IO modeling products, such as the IMPLAN and RIO models. 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).[21]

IO models track so-called "ripple" or "multiplier" effects of a given direct economic event, in this case, the ripple effects stemming from the daily activities of ACC and the increased incomes of students. For example, students with higher incomes have more money to spend, while businesses that hire them are more productive, purchasing

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

additional inputs and rewarding business owners with greater incomes. All of this affects earnings in other industries, thereby generating multiplier effects and expanding the size of the economy.[22]

It has been argued that multiplier effects such as those described overstate net effects.[23] The reason is that while the economy is stimulated and incomes increase, factors of production 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. Accordingly, the model applies a downward adjustment suggested by the literature and discards all but 33% of the indicated indirect impact. This adjustment is unique to the analysis and enhances the conservative nature of the results.

In general, ACC impacts the economy in three ways: (1) from its day-to-day operations, (2) from the spending of students who come from outside the region to attend college, and (3) from students who enter the workforce with increased skills. The *college operations effect* includes direct wages, salaries, and benefits of faculty and staff plus additional earnings and income generated through the action of regional multiplier effects. The *student spending effect* focuses on new monies entering the economy as ACC attracts students from outside the region. Finally, the *past student productivity effect* comprises income growth that occurs as ACC 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 ACC pays wages and salaries to its employees, which become part of overall local earnings. At the same time, ACC 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 net effect of college spending is obtained by adding direct and indirect (i.e., multiplier) effects together, then applying a reduction factor to account for local monies

[22] 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).
[23] 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.

withdrawn from the economy to support the college. Such monies would have been spent in the region anyway and are thus not credited to ACC.

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 the relative impacts of college operations are measured. As shown, the ACC Service Area generated about $50.7 billion in labor income and another $27.0 billion in non-labor income – a total $77.7 billion altogether (see **Table 2.9**). The next item in the table is the direct effect of faculty and staff wages and salaries, equal to $130.2 million (see **Table 2.2**). 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 ACC Service Area	$50,716,388	100%	$26,970,409	100%	$77,686,798	100%
Direct effect of faculty and staff	$130,198	0.3%	$0	<0.1%	$130,198	0.2%
Indirect effect	$15,474	<0.1%	$8,851	<0.1%	$24,325	<0.1%
Gross total	$145,672	0.3%	$8,851	<0.1%	$154,523	0.2%
Adjustment for alternative use of funds[2]	($28,301)	<0.1%	($15,905)	<0.1%	($44,206)	<0.1%
TOTAL	**$117,370**	**0.2%**	**($7,054)**	**<0.1%**	**$110,317**	**0.1%**

1. Includes all dividends, interest, and rents generated in the ACC Service Area. Does not include wages, salaries, and benefits.

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

Source: Adapted from data supplied by ACC 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 $15.5 million in labor income and $8.9 million in non-labor income. These represent income generated in other industries (i.e., off-campus effects) as a result of direct college spending.[24] 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 the input-output (IO) model constructed for the ACC Service Area. Adding these effects to direct effects gives the gross (i.e., unadjusted) effect of college operations spending, equal to approximately $154.5 million.

[24] As described earlier, actual multiplier effects indicated by the IO model are discounted by all but 33% to account for the shift of resources from next-best uses.

Here a qualification must be made. ACC receives about 63% of its funding from local sources, whether from students, private businesses,[25] property owners, and the estimated portion of state appropriations originating from local taxpayers.[26] Devoting these funds to ACC 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 ACC'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 ACC 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 ACC, this comes to about $44.2 million, shown as a negative number in **Table 4.1**. These represent monies that would have been generated in the region even without ACC, and are thus subtracted from the gross effect of college operations. The net effect is $110.3 million in added regional income attributable to the operations of ACC.

STUDENT SPENDING EFFECT

ACC students who commute from outside the region spend monies that would not have otherwise entered the regional economy absent the college, which means increased revenue for local business. To determine the effect of these expenditures, the model begins with total dollar amounts listed in **Table 2.7** (net of leakage and household income) and converts these to direct added income through the action of earnings-to-sales and value added-to-sales ratios. Indirect effects are derived by bridging the increase in regional sales to the industrial sectors of the IO model, running them through an indirect multiplier matrix and then discounting results by all but 33% to avoid overstatement of multiplier impacts. Summing direct and indirect effects together yields

[25] The wide variety of private sources of revenue makes it difficult to determine whether they come from within or outside the region. For this reason, the model assumes a strict 50% breakdown, where 50% comes from outside the region, and the remaining 50% comes from within the region.
[26] 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. This portion is derived 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).

a total of $6,600 in added regional income attributable to the spending of in ACC's out-of-region students, as shown in the bottom row of **Table 4.2**.

Note that the student spending effect is an insignificant number relative to the college operations effect presented in **Table 4.1** and the past student productivity effect discussed in the next section. Although the student spending effect depends upon the number of out-of-region students whom the college attracts, its relatively small size demonstrates that the college's greatest impact is not in the monies that it brings in from outside, but rather in the income building effects it creates through its own daily activities and those of its past and present students who live and work in the region.

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 ACC Service Area	$50,716,388	100%	$26,970,409	100%	$77,686,798	100%
Direct effect of student spending	$3	<0.1%	$3	<0.1%	$5	<0.1%
Indirect effect	$1	<0.1%	$0	<0.1%	$1	<0.1%
TOTAL	**$3**	**<0.1%**	**$3**	**<0.1%**	**$7**	**<0.1%**

1. Includes all dividends, interest, and rents generated in the ACC Service Area. Does not include w ages, salaries, and benefits.

Source: Adapted from data supplied by the EMSI regional IO model. See also Tables 2.9 and 2.7.

PAST STUDENT PRODUCTIVITY EFFECT

ACC's impact on the economy is most prevalent in its capacity to provide skills training and career enhancement opportunities to area residents for high demand, high paying occupations in the region. Since ACC was established students have studied at ACC 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. This sparks a chain reaction wherein higher student incomes generate additional rounds of consumer spending, while new skills and training translate to 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 past student productivity effects is to estimate the number of ACC skills currently active in the workforce, measured in terms of CHEs. Data and assumptions appear in **Table 4.3**. The analysis begins with the historical enrollment of the college from AY 1977-78 to AY 2006-07, as provided by ACC.

Table 4.3: Estimating CHEs of Instruction Embodied in the Workforce[1,3]

Year	Student headcount[2] 1	Students remaining in region (%) 2	Students who have left college (%) 3	Students settled into jobs (%) 4	Attrition (%) 5	Students active in workforce 6	Average CHEs 7	CHEs active in workforce 8
1978	17,135	80%	100%	100%	65%	8,910	7.9	70,451
1979	20,105	80%	100%	100%	66%	10,606	7.9	83,859
1980	24,200	80%	100%	100%	67%	12,951	7.9	102,400
1981	27,464	80%	100%	100%	68%	14,910	7.9	117,891
1982	28,868	80%	100%	100%	69%	15,899	7.9	125,708
1983	33,659	80%	100%	100%	70%	18,805	7.9	148,691
1984	36,527	80%	100%	100%	71%	20,703	7.9	163,697
1985	39,045	80%	100%	100%	72%	22,450	7.9	177,511
1986	38,622	80%	100%	100%	73%	22,528	7.9	178,129
1987	40,440	80%	100%	100%	74%	23,930	7.9	189,208
1988	43,913	80%	100%	100%	75%	26,361	7.9	208,429
1989	47,206	80%	100%	100%	76%	28,748	7.9	227,303
1990	50,973	80%	100%	100%	77%	31,490	7.9	248,989
1991	53,174	80%	100%	100%	78%	33,325	7.9	263,499
1992	51,357	80%	100%	100%	79%	32,652	7.9	258,174
1993	56,329	80%	100%	100%	81%	36,331	7.9	287,265
1994	54,392	80%	100%	100%	82%	35,589	7.9	281,399
1995	56,895	80%	100%	100%	83%	37,765	7.9	298,605
1996	57,946	80%	100%	100%	84%	39,019	7.9	308,519
1997	57,118	80%	100%	100%	85%	39,018	7.9	308,510
1998	58,614	80%	100%	100%	87%	40,619	7.9	321,168
1999	58,296	80%	100%	100%	88%	40,983	7.9	324,044
2000	56,987	80%	100%	100%	89%	40,642	7.9	321,350
2001	59,293	80%	100%	100%	90%	42,898	7.9	339,189
2002	61,406	80%	100%	100%	92%	45,070	7.9	356,357
2003	61,047	80%	100%	100%	93%	45,454	7.9	359,398
2004	61,701	80%	100%	100%	94%	46,606	7.9	368,501
2005	62,067	80%	100%	100%	96%	47,529	7.9	375,802
2006	63,620	80%	97%	49%	97%	23,707	7.9	187,447
2007	66,024	80%	84%	48%	100%	21,173	7.9	167,409
						Subtotal		7,168,899
						Net of alternative education variable	24%	(1,694,911)
						NET CHEs IN WORKFORCE		**5,473,988**

1. Numbers may not add due to rounding.

2. Column 1 shows the combined unduplicated headcount of credit and non-credit students. For the years 1978 to 1999, the enrolment figures are calculated based on the ratio of unduplicated to duplicated students.

3. In the absence of better data, the model assumes that the same data and assumptions for the current year also apply to the other years in the timeframe.

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

Column 2 nets out students who leave the region upon exiting ACC, reducing the headcount to include only those who settle in the area (80% from **Table 2.8**). Again, a constant reduction factor is assumed for all years within the timeframe. Column 3 accounts for students who have not yet entered the workforce. As shown, it is assumed that all past students have left ACC and found employment except for the last two to three years, based on the estimated percent of students who are already employed while attending college (84%).

Settling-in factors come into play in Column 4, though only for the last two years of the analysis. By the end of the third year it is assumed that all ACC students have settled into their jobs. Adjustments are weighted according the breakdown of the student body from **Table 2.4** and their corresponding settling-in factors from **Table 2.8**. Column 5 subtracts students who have out-migrated, retired, or died over time, using a logarithmic decay function based on the thirty-year attrition variable from **Table 2.8** (35%). The net number of students who are active in the workforce appears in Column 6.

Column 7 displays the average number of CHEs generated per student per year back to AY 1977-78. Historic information on this variable is generally unavailable, so it is assumed that average CHEs for the analysis year apply though time. These figures are multiplied times the number of students active in the workforce from Column 6 and summed together, yielding a total of 7.2 million CHEs currently embodied by students in the region. This is then reduced by 24% to account for alternative education opportunities (i.e., the percent of students who would have still been able to obtain an education even without ACC). The approximately 5.5 million CHEs remaining after this calculation are strictly attributed to the existence of ACC.

The next step is to convert the 5.5 million CHEs embodied in the workforce to direct regional earnings. The net value per CHE – $209 – comes from **Table 3.2** and represents the higher income received by students for each CHE of instruction received at ACC during the current analysis year.[27] Multiplying this figure times the 5.5 million net CHEs results in approximately $1.1 billion in regional labor income that is directly due to the ACC skills currently active in the workforce. This figure reappears in **Table 4.4** as the direct effect of past student productivity on labor income.

[27] 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**), adjusted downward to account for the ability bias and other factors discussed in **Chapter 2**.

Added to this is another $610.5 million in non-labor income, representing the higher property values and increased investment income stemming from the direct income of students and enhanced productivity of the businesses that employ them. Non-labor income attributable to past student skills is obtained by disaggregating higher student income to the industrial sectors of the IO model and multiplying them times their associated value added-to-earnings ratios.[28] Summing labor and non-labor income together gives a direct effect of past student productivity equal to approximately $1.8 billion.

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 ACC Service Area	$50,716,388	100%	$26,970,409	100%	$77,686,798	100%
Direct effect of past student productivity	$1,141,649	2.3%	$610,487	2.3%	$1,752,136	2.3%
Indirect effect	$298,668	0.6%	$167,829	0.6%	$466,497	0.6%
TOTAL	**$1,440,318**	**2.8%**	**$778,316**	**2.9%**	**$2,218,633**	**2.9%**

1. Includes all dividends, interest, and rents generated in the ACC Service Area. Does not include wages, salaries, and benefits.

Source: Adapted from outputs supplied by EMSI regional IO model. See also Tables 2.9 and 4.3.

Economic growth stemming from a skilled workforce does not stop with the direct effect. To calculate the indirect effect the model allocates increases in regional income to specific industrial sectors and augments these to account for both demand and supply-side multiplier effects. Demand-side effects refer to the increased demand for consumer goods and services as the higher incomes of skilled workers and their employers are spent in the local economy. For example, the increased output of businesses is associated with an increased demand for inputs, which in turn produces a set of regional economic multiplier effects that are all captured as part of demand-side indirect effects. In the model these are estimated by converting higher student income into direct increased industry sales, running these through an indirect multiplier matrix, and converting them

[28] Direct earnings effects of past students initially appear with no industry detail, thus requiring an aggregation that would reduce all industries to a single aggregate. By any measure, use of such an aggregated multiplier would court an unacceptable aggregation error. This occurs whenever 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). At the same time, however, the EMSI IO modeling system conveys industry detail at roughly the NAICS 4-digit level, and disaggregating the direct earnings effects at this fine level of detail is not realistic. To resolve these problems, the model disaggregates past student earnings effects to the eighteen sectors appearing in **Table 2.9**, which avoids aggregation error while still maintaining a level of detail that is within reasonable limits.

to regional income by applying earnings-sales and value added-sales ratios supplied by the regional IO model.

Supply-side effects occur through a process of "cumulative causation," or "agglomeration," whereby growth becomes in some degree self-perpetuating. The presence of one industry, for example, attracts other industries that use the first industry's outputs as inputs, which produces subsequent rounds of industry growth, and so on.[29] To estimate agglomeration effects, the model converts direct income of past students to industry value added and applies this to a set of supply-driven multipliers provided by the regional IO model. To increase the plausibility of this assumption, the model applies only direct effects associated with industries in the highest stages of development.[30]

Summing demand and supply-side effects together constitutes the indirect effect of ACC education, equal to $298.7 million of all labor income and approximately $167.8 million of all non-labor income (**Table 4.4**). Adding these to the direct effects of past student productivity yields a grand total of $2.2 billion in added income attributable to the accumulation of ACC skills in the regional workforce. Note that this figure 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 it is excluded from the analysis. To the extent there are such effects, and theory suggests that there are, overall results can be considered conservative.

TOTAL EFFECT

Table 4.5 displays the grand total of ACC's impact on the ACC Service Area, including the college operations effect, student spending effect, and past student productivity effect. These results depend on, first, the number of ACC employees working in the

[29] 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).

[30] Parr (1999) describes four stages of economic development: primary production, process manufacturing, fabricative manufacturing, and producer services and capital export. The model applies a "development score" to Parr's stages: low scores for lower stage sectors and higher scores for higher development sectors. Only those industries with the highest scores are applied to the supply-driven multipliers of the IO model. For additional detail on the use of this approach for classifying industries by industrial stage, see Rutgers et al, 2002.

region, second, the percent of ACC students coming from outside the region, and third, the accumulation of skills (or CHEs) currently active in the regional workforce.

Table 4.5: Total Effect

	TOTAL INCOME ($ Thousands)	% OF TOTAL
Total income in ACC Service Area	$77,686,798	100%
College operations effect	$110,317	0.1%
Student spending effect	$7	<0.1%
Past student productivity effect	$2,218,633	2.9%
TOTAL	**$2,328,956**	**3.0%**

Source: See Tables 4.1 through 4.4.

As shown, ACC accounts for $2.3 billion, or 3.0%, of all regional income in the ACC Service Area. These results demonstrate several important points. First, ACC 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 ACC, stemming from higher incomes of students and their employers. And third, regional income in the ACC Service Area would be substantially lower without the educational activities of ACC.

Chapter 5
SENSITIVITY ANALYSIS

INTRODUCTION

This study concludes 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 the 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.

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 ACC. 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 ACC 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 84% of the current student body is employed. This variable is tested 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 ACC it is estimated that students working while attending classes earn only 65%, on average, of earnings they would have statistically received if not attending ACC. This suggests that many students hold part-time jobs that accommodate their ACC 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, this variable is tested 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—84% for the portion of students employed, and 65% for their earnings relative to statistical averages. These base case assumptions are held constant in the 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 84% to 100% first (holding all other assumptions constant), the rate of return, benefit/cost ratio, and payback period results improves to 24.6%, 8.2, and 6.0 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 65% 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 33.9%,

12.4, and 4.6 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 45.5%, 17.7, and 3.7 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	84%	22.2%	7.2	6.6
Employed	100%	24.6%	8.2	6.0
2. Percent of	65%	22.2%	7.2	6.6
Earnings	100%	33.9%	12.4	4.6
1 = 100%, 2 = 100%		45.5%	17.7	3.7

A final note to this section—it is strongly emphasized 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 ACC 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. The approach is to estimate regional economic impacts of ACC based on college operations and capital spending, spending effects of ACC's out-of-region students, and increased productivity effects of past ACC students in the regional workforce. Impacts are expressed in terms of regional *labor income* (i.e., wages, salaries, and benefits) 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. This issue is addressed 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 ACC impacts in terms of gross sales rather than income. Gross sales measures are estimated by the economic model to be $146.7 billion, obtained by multiplying sector-specific regional earnings by a national estimate of sales-to-earnings. Note that direct local expenditures of the college and students from outside the region reflect their total spending, reduced by the estimated portion that leaks out-of-region to purchase goods produced elsewhere.[31] 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 ACC is estimated to explain some $4.5 billion in regional gross sales, a number substantially larger than the $2.3 billion explained by the college in regional income shown in **Table 4.5**.

While gross sales impacts shown in **Table 5.2** are not incorrect, this analysis reports college impacts in terms of income (**Table 4.5**) rather than gross sales, because this reflects economic realities in the local community much more accurately. Advocacy studies, on the other hand, often opt to express results in terms of sales because numbers

[31] 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.

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 ACC on Sales in Regional Economy

	GROSS SALES ($ Thousands)	% OF TOTAL
Total gross sales in ACC Service Area	$146,693,735	100%
Gross sales attributable to college operations		
Direct local spending of ACC	$30,179	<0.1%
Indirect spending effect	$33,639	<0.1%
Subtotal	$63,818	<0.1%
Gross sales attributable to student spending		
Direct local spending by students	$10	<0.1%
Indirect spending effect	$2	<0.1%
Subtotal	$12	<0.1%
Gross sales attributable to past student economic development effects		
Direct gross sales	$3,557,783	2.4%
Indirect gross sales	$863,467	0.6%
Subtotal	$4,421,250	3.0%
GRAND TOTAL	**$4,485,081**	**3.1%**

Source: Adapted from data supplied by ACC and outputs of the EMSI regional IO model. See also Tables 2.2 and 2.7.

VARIABLES REQUIRING "JUDGMENT"

This section tests the sensitivity of the attrition rate and alternative education opportunity variables. Recall that the attrition rate (35% 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 (24%) is characterized as a "negative benefit" used to account for students who can obtain a similar education elsewhere absent the publicly funded colleges and universities in the state (see **Appendix 3**). 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)

	-50%	-33%	-17%	BASE CASE	17%	33%	50%
Alternative Education Variable	11.8%	15.8%	19.7%	23.6%	27.6%	31.5%	35.5%
Narrow Taxpayer Perspective							
Net present value	$328,609	$308,457	$288,305	$268,152	$248,000	$227,848	$207,696
Rate of return	15.2%	14.6%	14.0%	13.5%	12.9%	12.3%	11.7%
Benefit/cost ratio	3.7	3.5	3.4	3.2	3.0	2.9	2.7
Payback period (years)	8.7	9.0	9.4	9.7	10.1	10.5	10.9
	-50%	**-33%**	**-17%**	**BASE CASE**	**17%**	**33%**	**50%**
Attrition Rate Variable	17.5%	23.3%	29.2%	35%	40.8%	46.7%	52.5%
Regional Economic Development							
Added income	$2,572,455	$2,493,900	$2,412,843	$2,328,956	$2,241,836	$2,150,970	$2,055,698
% of total income	3.3%	3.2%	3.1%	3.0%	2.9%	2.8%	2.6%
CHEs embodied in workforce	6,074,766	5,880,949	5,680,959	5,473,988	5,259,038	5,034,847	4,799,784

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, the model brackets the base case assumption on either side with plus or minus 17%, 33% and 50% variation in assumptions. Analyses are then redone introducing one change at a time, holding all other variables constant. For example, an increase of 17% in the Alternative Education assumption (from 23.6% to 27.6%) reduces the narrow taxpayer perspective rate of return from 13.5% to 12.9%. Likewise, a decrease of 17% (from 23.6% to 19.7%) in the assumption increases in the rate of return from 13.5% to 14.0%.

Based on this sensitivity analysis, the conclusion can be drawn that ACC 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 50% (from 23.6% to 35.5%). 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, the assumption increases and decreases relative to the base case of 35% (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 $2.6 billion at -50% to a low of $2.1 billion at a 50% 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, income attributable to the college decreases accordingly.

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APPENDIX 1: GLOSSARY OF TERMS

Alternative education	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.
Asset value	Capitalized value of a stream of future returns. Asset value measures what someone would have to pay today for an instrument that provides the same stream of future revenues.
Attrition rate	Rate at which students leave the local region after exiting college due to out-migration, retirement, or death.
Benefit/cost ratio	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.
Credit hour equivalent	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.
Demand	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.
Discounting	Expressing future revenues and costs in present value terms.
Economics	Study of the allocation of scarce resources among alternative and competing ends. Economics is not normative (what *ought* to be done), but positive (describes *what is*, or how people are likely to behave in response to economic changes).

Elasticity of demand	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.
Externalities	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.
Gross State Product	Measure of the final value of all goods and services produced. Alternatively, GSP equals the combined incomes of all factors of production, i.e., labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents and other.
Input-output analysis	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.
Internal rate of return	Rate of interest which, when used to discount cash flows associated with investing in education, reduces its net present value to zero (i.e., where the present value of revenues accruing from the investment are just equal to the present value of costs incurred). This, in effect, is the breakeven rate of return on investment since it shows the highest rate of interest at which the investment makes neither a profit nor a loss.

Multiplier	Measure of overall regional earnings per dollar of faculty and staff earnings (i.e., on- and off-campus earnings divided by on-campus earnings). Multiplier effects are the result of in-area spending for goods and services and of everyday spending by faculty and staff. The analysis also includes added regional earnings attributable to past students still active in the workforce. The regional economy is larger because of student skills, added spending associated with higher student incomes, and enlarged output of industries where past students are employed.
Net cash flow	Benefits minus costs, i.e., the sum of revenues accruing from an investment minus costs incurred.
Net present value	Net cash flow discounted to the present. All future cash flows are, in this way, collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure.
Opportunity cost	Benefits foregone from alternative B once a decision is made to allocate resources to alternative A. Or, if an individual chooses not to attend college, he or she foregoes higher future earnings associated with higher education. The benefit of higher education, therefore, is the "price tag" of choosing not to attend college.
Payback Period	Length of time required to recover an investment – the shorter the period, the more attractive the investment. The formula for computing payback period is: Payback period = cost of investment/net return per period

APPENDIX 2: 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 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.[32] The 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 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 the procedure for making these adjustments.

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, it is assumed that the college has only two sources of revenues: student tuition payments and state and local government support.

[32] Of course, as a community college, ACC 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 ACC in standard investment analysis terms by netting out any benefits it may be able to generate that are not directly linked to the costs of supporting it.

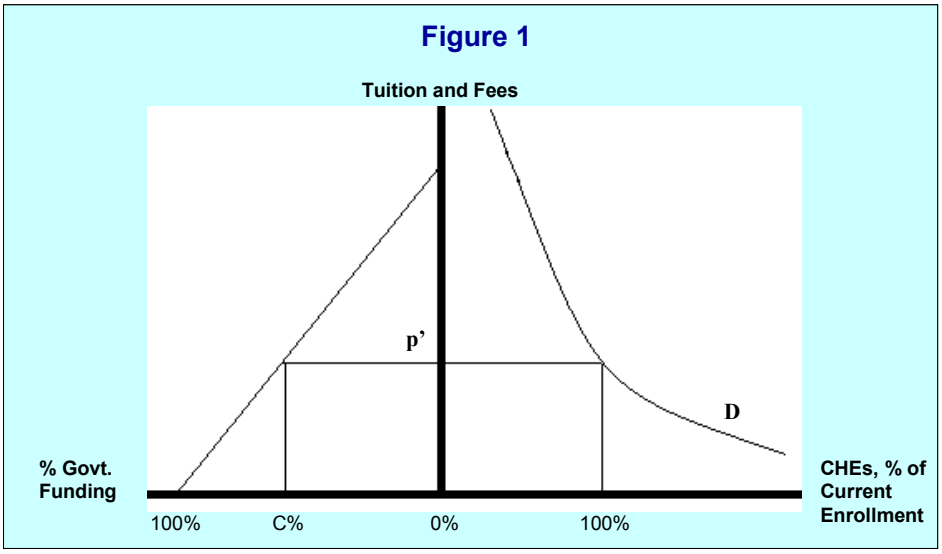
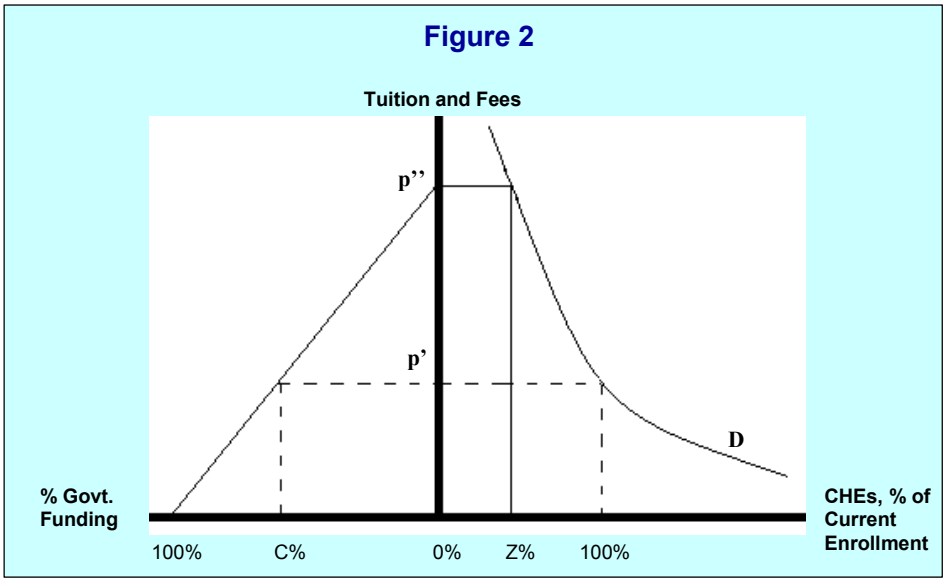


Figure 2 shows another important reference point in the model—where state and local government support is 0%, tuition rates are increased to p", and enrollment is Z% (less than 100%). The reduction in enrollment reflects price elasticity in the students' school vs. no-school decision. Neglecting for the moment those issues concerning the college's minimum operating scale (considered below in the section on "College Shutdown Point"), the implication for the 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 the larger benefit/cost model.

Let B equal the benefits attributable to state and local government support. B might be understood as applying to either the 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) $B = B(100\%)$

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

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

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

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

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

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 3

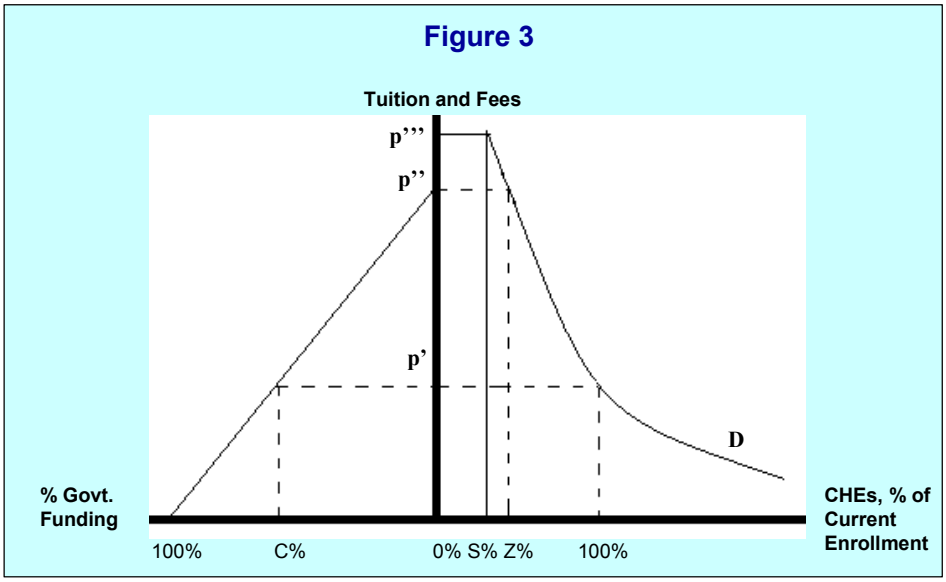
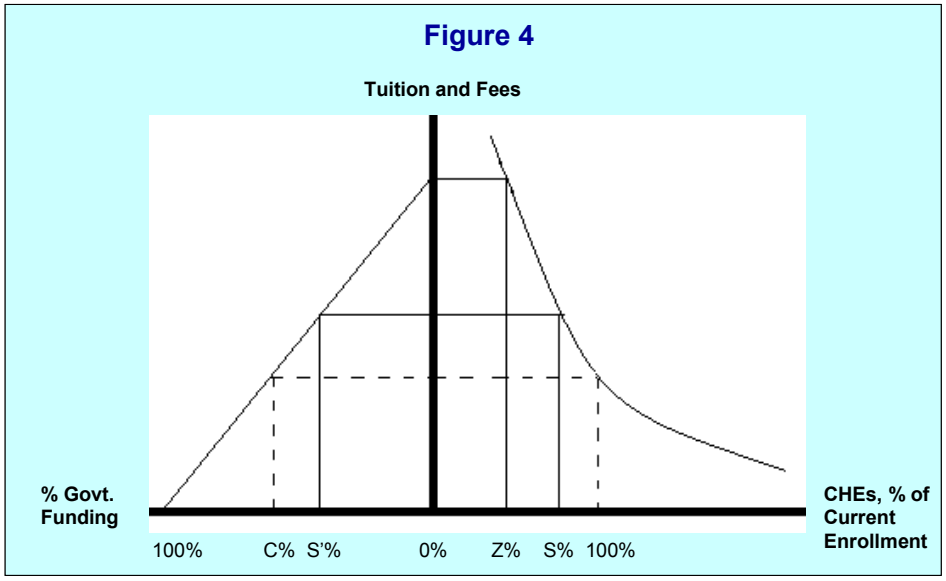


Figure 4 illustrates yet another scenario. Here the shutdown point occurs at an enrollment level greater than Z% (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the school to operate at all. This minimum portion of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



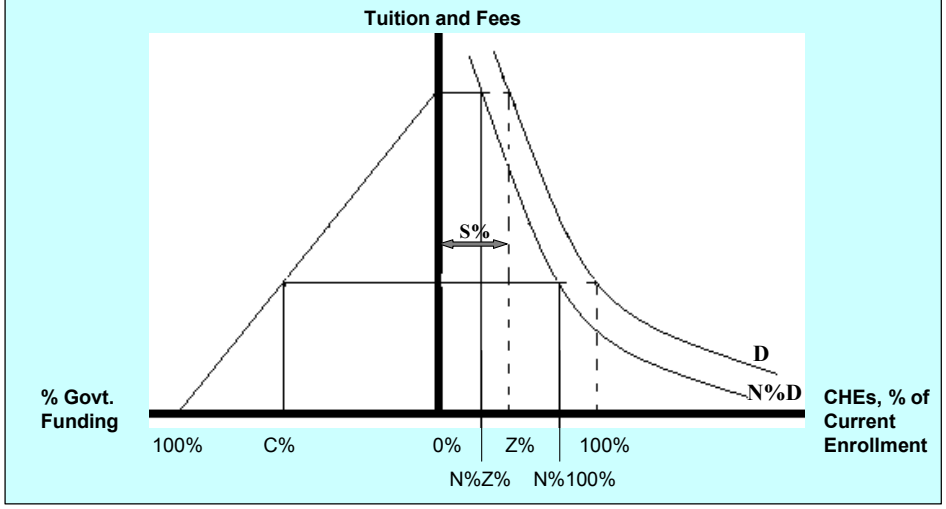
ADJUSTING FOR ALTERNATIVE EDUCATION OPPORTUNITIES

Because there may be education alternatives to the two-year colleges in the state, yet another adjustment is necessary. 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 the 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:

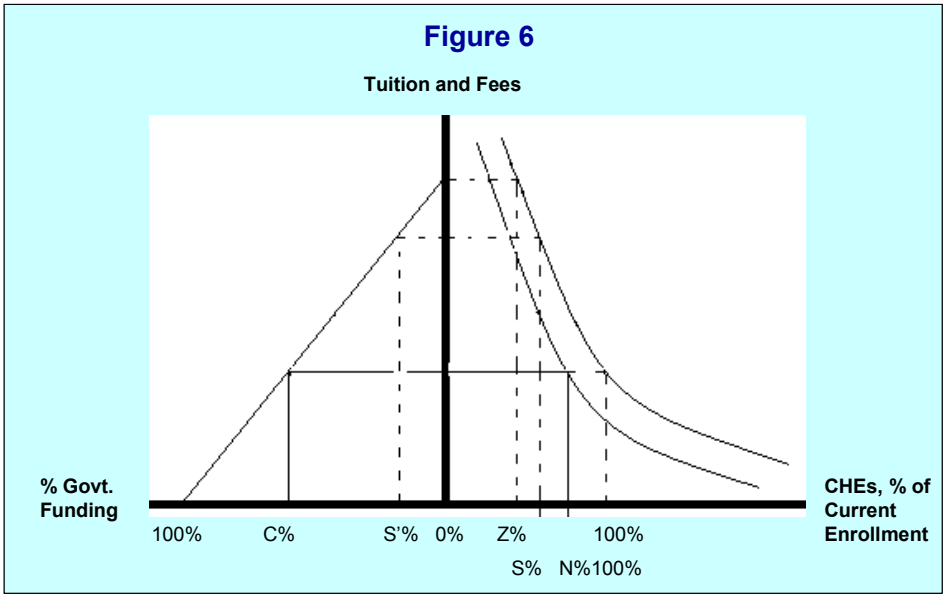
(4) $B = B(N\%100\%) - B(N\%Z\%)$

Figure 5



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

Figure 6



APPENDIX 3: 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 researchers at the individual colleges were asked to provide an estimate of this variable, but not without considerable effort on their part to, first, fully understand why this information was requested and, second, determine what the numerical estimate should be. Because this process proved to be very cumbersome, it was internalized in the model through the application of a regression analysis based on estimates already received from 117 colleges previously analyzed. The purpose of this appendix is to lay out the theoretical framework for determining the alternative education opportunity variable and the data used to make this determination.

ALTERNATIVE EDUCATION VARIABLE IN FUNCTIONAL FORM

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

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

Where:

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

b_i = partial regression coefficients

e = standard error

INDEPENDENT VARIABLES

The three independent variables reflect the explanatory parameters explained to institutional researchers and fiscal officers when asked to derive their own estimates. These parameters now form the theoretical backdrop to the internal estimation of the

dependent variable based on 117 observations. The three independent variables include the following:

X_1: Population per square mile in the 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.[33]

X_2: 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.[34]

X_3: 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.[35]

EXAMPLE OF ANALYSIS AND RESULTS

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

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

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

F = 31.84 (Fischer test statistic)

[33] Available from U.S. Census Bureau, Current Population Survey (available from http://www.bls.census.gov/cps; internet).
[34] Available from U.S. Department of Commerce, County Business Patterns, annual.
[35] 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 R^2 measures the degree to which the independent variables explain the variation in the dependent variable. The maximum R^2 attainable (1.00) is the case in which all observations fall on the regression line and all variability is explained. The .458 R^2 obtained in equation (2) indicates that nearly 46% of the variation in the alternative education opportunity is explained by the variables. The F-ratio indicates that the equation can be considered a good predictor of the alternative education opportunity.

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

For example, suppose 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, the following results are produced:

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

(4) $Y = 13.5\%$

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.[36]

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., benefits and costs are projected 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. The 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).

[36] 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, it is assumed 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) The assumed "going rate" of interest is 4%, the rate of return from alternative investment schemes, for the use of the $21,500.

Now the "mechanics"—results are expressed 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 in **Table 1** has choices: 1) attend college, or 2) forego higher education and maintain 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 he/she adds 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. All future benefits must be discounted by the going rate of interest (referred to as the discount rate) to be able to express them in

present value terms.[37] 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 the model to express values on an equal basis in future or present value terms.

The goal is to express all future higher earnings in present value terms so that they can be compared to 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 net present value of the investment is $14,247. This 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 the model applies 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 a discount rate of

[37] 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 the process is reversed—determining the present value of future earnings.

18% were applied to the NPV calculations instead of the 4%, then the net present value would reduce to zero.

What does this mean? The internal rate of return of 18% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the net present value equals zero. Or, at 18%, 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 it is compared to the 4% "going rate" of interest applied to the net present value calculations, 18% is far higher than 4%. It may be concluded, therefore, that the investment in this case is solid. Alternatively, comparing the 18% rate of return to the long-term 7% rate or so obtained from investments in stocks and bonds also indicates 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, all results exceeding 100% are expressed 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. Applying the 18% internal rate of return discussed above would reduce the benefit/cost ratio to 1.0—or 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.