The Socioeconomic Benefits Generated by 14 Community College Districts in Oklahoma

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CCbenefits Inc. is a company created in collaboration with the Association of Community College Trustees (ACCT) to provide economic analysis services to community and 2-year community colleges. Questions of a technical nature concerning the approach, assumptions, and/or results should be directed to CCbenefits, Inc., c/o Drs. Kjell Christophersen and Hank Robison, 1150 Alturas Dr., Suite 102, Moscow ID 83843, phone: 208-882-3567, fax: 208-882-3317, e-mail: ccbenefits@moscow.com.

ACRONYMS

AD	Associate Degree
ABE	Adult basic education
ACCT	Association of Community College Trustees
B/C	Benefit–cost ratio
CC	Community College
CHE	Credit hour equivalent
ESL	English as a second language
GED	General Equivalency Diploma (also Education Development Certificate)
HS	High school
IO	Input–output analysis
NCF	Net cash flow
NPV	Net present value
REIS	Regional Economic Information System
RR	Rate of return
TC	Technical College
TD	Technical Diploma

Preface

The Association of Community College Trustees (ACCT) contracted with the authors in 1999 to create the model used in this study. The original vision was simple—to make available to colleges a generic and low cost yet comprehensive tool that would allow them to estimate the economic benefits accrued by students and taxpayers as a result of the higher education achieved. In short, it only makes economic sense for the students to attend college if their future earnings increase beyond their present investments of time and money; likewise, taxpayers will only agree to fund colleges at the current levels or increase funding if the economic benefits exceed the costs.

An important requirement of the ACCT vision was that the model reach far beyond the "standard" study—the computation of the simple multiplier effects stemming from the annual operations of the colleges. Although the standard study was part and parcel of the model ultimately developed, it was only a relatively small part. The current model also accounts for the economic impacts generated by past students who are still applying their skills in the workforce; and it accounts for a number of external social benefits such as reduced crime, improved health, and reduced welfare and unemployment, which translate into avoided costs to the taxpayers. All of these benefits are computed for each college and analyzed. The analysis is based on regional data adjusted to state situations to the greatest extent possible.

Although the written reports generated for each college are similar in text, the results differ widely. This, however, should not be taken as an indication that some colleges are doing a better job than others in educating the students. Differences among colleges are a reflection of the student profiles, particularly whether or not the students are able to maintain their jobs while attending, and the extent to which state and local taxpayers fund the colleges. Some students give up substantial earnings while attending college because employment opportunities are few and far between. In other cases they are able to work while attending because the area has an abundance of opportunities. Therefore, if the average student rate of return for College A is 15%, and the rate of return for College B is 20%, that does not mean that B is doing a better job than A. Rather, it is attributable to the employment opportunities in the region, and to the fact that one college may cater more to women than to men, or to minorities, and/or to different kinds of students such as transfer, workforce or retired, etc. In turn, the student body profiles are associated with their own distinct earnings functions reflecting these

employment, gender and ethnicity differences. The location of the college, therefore, dictates the profile of the student body, which, to a large extent, translates into the magnitudes of the results. In this sense, it could be that College A, which has a 15% student rate of return, is actually a better or more efficiently managed school than College B, which has a 20% student rate of return. The qualitative difference in management efficiency is not equal to the difference between the two returns.

Chapter 1
INTRODUCTION

OVERVIEW

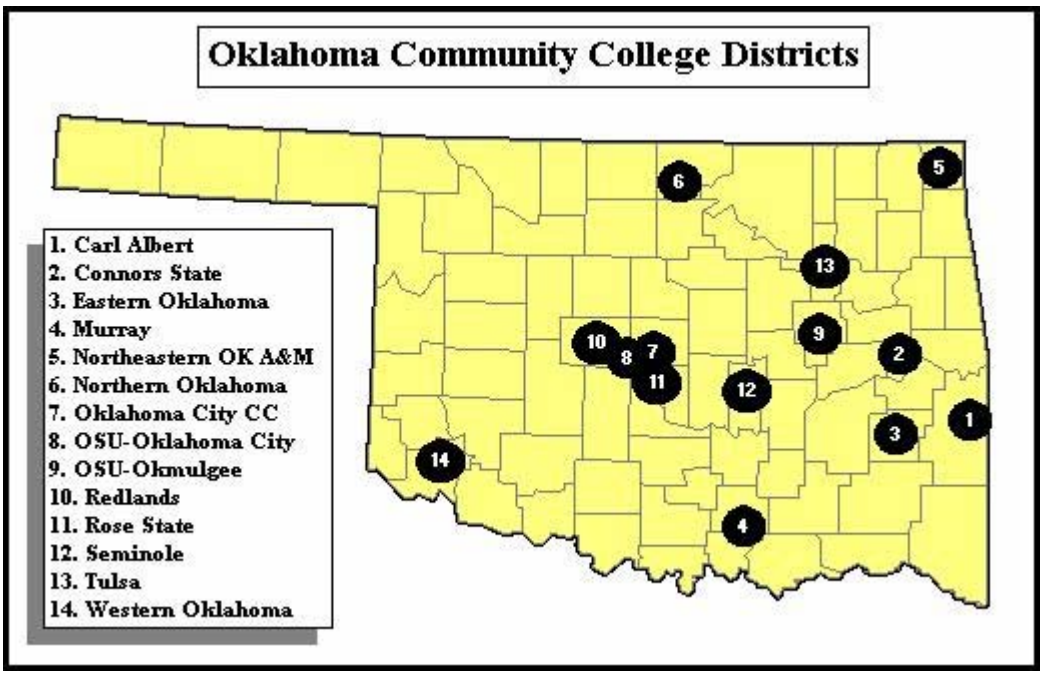
Oklahoma's 14 community college districts (CCs) generate a wide array of benefits. Students benefit directly from higher personal earnings, and society at large benefits indirectly from cost savings (avoided costs) associated with reduced welfare and unemployment, improved health, and reduced crime. Higher education requires a substantial investment on the parts of the student and society as a whole, however. All education stakeholders—taxpayers, legislators, employers, and students—want to know if they are getting their money's worth. In this study, the Oklahoma Community College Districts investigate the attractiveness of the returns generated by the 14 community colleges in the state (**Table 1.1** and **Figure 1.1**) relative to alternative public investments. The benefits are presented in three ways: 1) annual benefits, 2) present values of future annual benefits (rates of return and benefit-cost ratios, etc.), and 3) statewide economic benefits, including returns to the business community.

The study has four chapters and three appendices. **Chapter 1** is an overview of the benefits measured. **Chapter 2** details the major assumptions underlying the analysis. **Chapter 3** presents the main socioeconomic, business, and statewide economic results. Finally, **Chapter 4** presents a sensitivity analysis of some key assumptions—tracking the changes in the results as assumptions are changed. **Appendix 1** is a short primer on the context and meaning of the investment analysis results—the net present values (NPV), rates of return (RR), benefit/cost ratios (B/C), and the payback period. **Appendix 2** explains how the earnings related to higher education data were derived. **Appendix 3** provides a detailed technical/theoretical explanation of how benefits must be adjusted if the college can still stay open absent state and local government support.

Table 1.1. Oklahoma Participating CCs and '01-02 Credit Enrollment

Name of College	Abbreviation	Credit Enrollment
Carl Albert State College	CASC	2,870
Connors State College	CSC	2,756
Eastern Oklahoma State College	EOSC	2,607
Murray State College	MSC	1,958
Northeastern Oklahoma A&M College	NEO	2,896
Northern Oklahoma College	NOC	4,002
Oklahoma City Community College	OKCCC	17,793
OSU-Oklahoma City	OSU-Oklahoma City	7,237
Oklahoma State University-Okmulgee	OSU-Okmulgee	4,197
Redlands Community College	Redlands	3,049
Rose State College	RSC	11,558
Seminole State College	SSC	2,779
Tulsa Community College	TCC	27,293
Western Oklahoma State College	WOSC	5,313
Total		96,308

Figure 1.1. Geographical Distribution of Participating CCs



ANNUAL PRIVATE AND PUBLIC BENEFITS

Private benefits are the higher earnings captured by the students; these are well known and well documented in economics literature (see for example Becker, 1964 and Mincer 1958, plus many others listed in the references at the end of this report). Less well known and documented are the indirect benefits, or what economists call *positive externalities*, which are a collection of public benefits captured by society at large, such as improved health and lifestyle habits, lower crime, and lower incidences of welfare and unemployment. These stem from savings to society as taxpayer-provided services are reduced. We estimate dollar savings (or avoided costs) from reduced arrest, prosecution, jail, and reform expenditures based on published crime statistics arranged by education levels. Likewise, statistics that relate unemployment, welfare, and health habits to education levels are used to measure other savings. The annual economic impacts are presented in three ways: 1) per credit-hour equivalent (CHE), defined as a combination of credit and non-credit attendance[1], 2) per student, and 3) in the aggregate (statewide).

PRESENT VALUES OF FUTURE BENEFITS

The annual impacts continue and accrue into the future and are quantified and counted as part of the economic return of investing in education. This lifetime perspective is summarized as *present values*–a standard approach of projecting benefits into the future and discounting them back to the present. The present value analysis determines the economic feasibility of investing in CC education—i.e., whether the benefits outweigh the costs. The time horizon over which future benefits are measured is the retirement age (65) less the average age of the students. [2]

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

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

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

STATEWIDE ECONOMIC AND BUSINESS COMMUNITY BENEFITS

The benefits of a robust economy are many: jobs for the young, increased business revenues, greater availability of public investment funds, and eased tax burdens. The activities of the 14 Oklahoma Community College Districts benefit state businesses directly by raising the skill level of the state labor force and providing opportunities for direct contract training of employees. State businesses benefit as well as the presence of a trained labor force works to attract new industry and increase the efficiency, competitiveness and output of existing industry. All these together spell a more effective and robust state economy.

In this study we show the impact of the 14 Oklahoma Community College Districts as a creator of earnings in the state economy. Increased earnings are displayed by industrial sector, and the role of Oklahoma's CC Districts in the state economy is then indicated by the percentage of sector-by-sector earnings explained by the college. The geographic boundaries of the regional economy used in this report are shown in **Figure 1.1.** In general, these CC-linked earnings fall under two categories: 1) earnings generated by the annual operating expenditures of the colleges; and 2) earnings attributable to the CC skills embodied in the workforce.

Chapter 2
DATA SOURCES AND ASSUMPTIONS

INTRODUCTION

To the extent possible, documented statistics were used to estimate model parameters. In the few cases where hard data were scarce, however, the institutional researchers on the scene applied well-informed judgments and estimations on the basis of their intimate knowledge of their colleges and the student bodies.

This chapter contains six assumption sections, all based on various data imbedded in the analytic model: 1) the aggregate profiles of the 14 CCs; 2) annual earnings by education levels; 3) the social benefit assumptions (health, crime, and welfare/unemployment); 4) education costs; 5) other assumptions (the discount rate used, health, crime, and welfare cost statistics, etc.); and 6) assumptions pertaining to statewide economic effects.

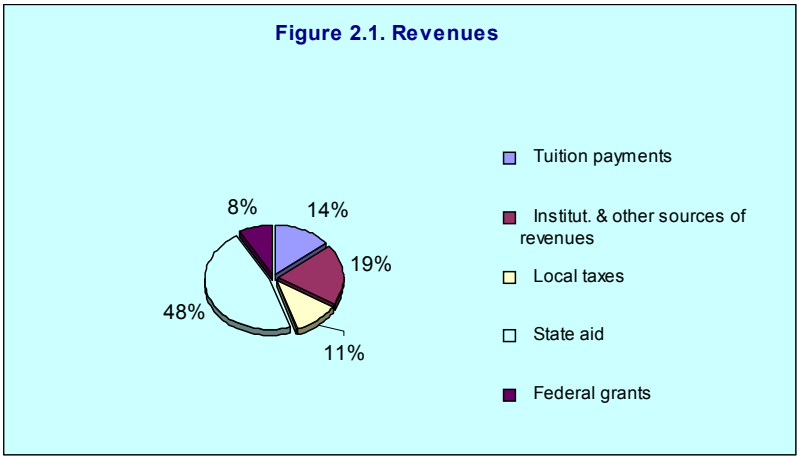
PROFILE

Faculty, Staff, and Operating Budgets

The Oklahoma community colleges employed 3,601 full- and 4,171 part-time faculty and staff in fiscal year 2002 amounting to a total annual payroll of some $200.4 million. **Table 2.1** shows the aggregate annual revenues by funding source: a total of $310.8 million. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (14.3%) plus 19.2% from other private sources (such as contract revenues, interest payments and the like). Public funding is comprised of local taxes (11.4%), state aid (46.8%), and federal grants (8.3%). These budget data are critical in identifying the annual costs of educating the CC student body from the perspectives of the students and the taxpayers alike. The same information is displayed in **Figure 2.1** in the form of a pie chart.

Table 2.1. Aggregate Revenues

Sources	Revenues	Total	% of Total
Private Funding			
Tuition payments	$44,376,298		14.3%
Institut. & other sources of revenues	$59,676,954	$104,053,252	19.2%
Public Funding			
Local taxes	$35,401,694		11.4%
State aid	$145,426,676		46.8%
Federal grants	$25,938,740	$206,767,110	8.3%
Total		$310,820,362	100%



The Students

Students attend community colleges for different reasons: to prepare for transfer to four-year institutions, to obtain Associate Degrees or Certificates in professional/technical programs, to obtain basic skills, for retraining purposes, or perhaps to take refresher courses in non-credit programs—workforce students, for example**.** Students also leave for various reasons -- they may have achieved their educational goals or decided to interrupt their college career to work full-time**. Tables 2.2 – 2.4** summarize the student body profiles for the 14 CCs in the State of Oklahoma. The unduplicated student body (headcount) is 106,201 (fiscal 2002 enrollment).

Some students forego earnings entirely while attending college while others may hold full or part-time jobs. Information about student employment plays a role in

determining the *opportunity cost* of education incurred by the students while attending the Oklahoma community college system[3]. **Table 2.2** rows labeled "% of students employed while attending college" and "% of full-time earning potential" provide the percentage estimates of the students who held jobs (75%) while attending college, and how much they earned (62%) relative to full-time employment (or what they would statistically be earning if they did not attend college). The former is a simple percent estimate of the portion of the student body working full or part-time. The latter is a more complex estimate of their earnings relative to their earning power if they did not attend college (i.e., recognizing that several students may hold one or more part-time jobs paying minimum wage while attending college).

Table 2.2. Student Body Profile

	Values
Total headcount of unduplicated credit students	90,995
Total headcount of unduplicated non-credit students	15,206
Total unduplicated enrollment, all campuses	106,201
% of students employed while attending college	75%
% of full-time earning potential	62%
Students remaining in state after leaving college	95%
Attrition rate over time (leaving state)	20%
"Settling In" factors (years):	
Completing Associate Degree	2.0
Completing Certificate	0.5
Non-completing transfer track	2.5
Non-completing workforce	0.0
ABE/ESL/GED	0.5

As indicated in the table, it is estimated that 95% of the students remain in the state (as defined in **Figure 1.1**) and thereby generate statewide benefits. The remaining 5% leave the state altogether and are not counted as part of the economic development benefits. The 95% retention rate applies only to the first year, however. We assume that 20% of the students, and thus associated benefits, will leave the state over the next 30 years due to attrition (e.g., retirement, out-migration, or death).

The last five items in **Table 2.2** are *settling-in* factors—the time needed by students to settle into the careers that will characterize their working lives. These factors are

[3] The opportunity cost is the measure of the earnings foregone; i.e., the earnings the individual would have collected had he or she been working instead of attending any of the 14 Oklahoma community college districts.

adapted from Norton Grubb (June 1999). Settling-in factors have the effect of delaying the onset of the benefits to the students and to society at large.

Entry-Level Education, Gender, and Ethnicity

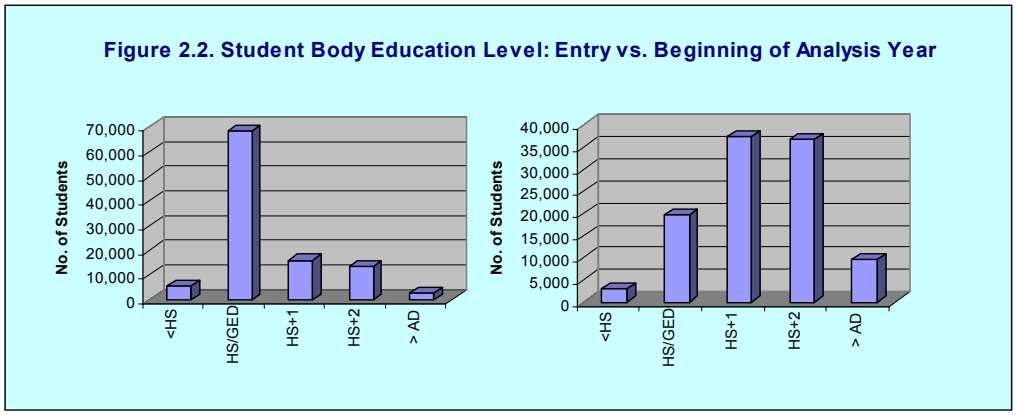
Table 2.3 and **Figure 2.2** show the education level, gender, and ethnicity of the aggregate student body. This breakdown is used only to add precision to the analysis, not for purposes of comparing between different groups. Five education entry levels are indicated in approximate one-year increments,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

The *entry level* characterizes the education level of the students when they first enter the colleges; this is consistent with the way most colleges keep their records. The analysis in this report, however, is based on the educational achievements of the students during the current year. As not all students reported in the enrollment figures for the fiscal year are in their first year of college, an adjustment was made to account for upper class students who had accumulated credits during their community college experience and moved up from the HS/GED equivalent category. For this reason, the education levels of the student body must also be estimated for the beginning of the analysis year. Thus, of the 20,171 white males who first entered with HS/GED equivalent, it is estimated that only 5,772 still remain in that category at the beginning of the analysis year, meaning that 14,399 students have actually moved up from the "HS/GED equivalent" category to the "1 year post HS or less" category or beyond since they first entered the colleges.[4] (Note that the "Entry Level" and "Begin Year" columns always add to the same total.) Differences between the two columns reflect a redistribution of students from entry level to where they are at the beginning of the analysis year. The assumptions underlying the process of redistributing the students from the "Entry Level" to "Begin Year" columns are internal to the economic model—they are designed to capture the dynamics of the educational progress as the students move up the educational ladder beyond their initial entry level.

[4] These calculations are internal to the model, based on parameters such as the frequency of "stop outs" and other parameters that characterize how typical CC students progress over time in their college career from when they first started up to the analysis year.

Table 2.3. Education Entry Level of Student Body

	White Male		Minority Male		White Female		Minority Female		Total	
Entry Level	Entry Level	Begin Year	Entry Level	Begin Year	Entry Level	Begin Year	Entry Level	Begin Year	Entry Level	Begin Year
< HS/GED	1,463	807	705	389	2,458	1,356	956	527	5,582	3,078
HS/GED equivalent	20,171	5,772	8,248	2,380	28,739	8,292	11,292	3,256	68,450	19,700
1 year post HS or less	5,069	11,086	2,030	4,536	6,334	15,469	2,601	6,128	16,033	37,218
2 years post HS or less	4,244	11,159	1,661	4,478	5,400	15,035	2,146	5,956	13,450	36,629
> AD	1,030	3,153	179	1,041	1,201	3,981	274	1,401	2,686	9,576
Total	31,977	31,977	12,823	12,823	44,132	44,132	17,269	17,269	106,201	106,201



The Achievements

Table 2.4, along with **Figures 2.3** and **2.4**, shows the student breakdown in terms of analysis year academic pursuits and/or achievements according to six categories: 1) retirees plus those attending (non-reimbursable) hobby and recreation courses, 2) Associate Degree completers, 3) Diploma and Certificate completers, 4) all transfer students, 5) all workforce students, and 6) ABE/ESL students.[5]

As indicated in the table, students achieving their graduation goals would be those completing Associate Degrees or Certificates (11.4% and 0.8%, respectively). The majority of students complete college credits, and either fulfill their educational needs, or return the following year to continue to work toward their goals (50.9% + 32.6% = 83.5% in the transfer track and workforce categories, respectively). The retired and leisure students (2.4%) and ABE/ESL/GED students (2.0%) complete the breakdown of the student body. The retired students are simply backed out of the analysis altogether on the assumption that they do not attend the community colleges to acquire skills that

[5] ABE/ESL = Adult basic education and English as a second language

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

The fifth column shows the average age of the students generating the benefits (excluding retirees). The time horizon for the analysis is 37.4 years, which is the difference between the average age (28.4 years) and retirement age (65 years).

As indicated in Column 6, the average Associate Degree and Certificate student completed 18.0 and 15.9 CHEs of study, respectively, during the analysis year. The total number of CHEs completed during the year of analysis for the entire system student body is 1.4 million. Finally, the last column shows the average time the students are actually in residence on campus during the analysis year. This information is needed to determine the opportunity cost of their education.

Table 2.4. Levels of Achievement

Student Body	Student Distribution	Headcount Credit and Non-Credit	Avg. Age	CHEs This Year	Total Credits	# Years Resid.
Retired + self-enrichment students	2.4%	2,547	67	5.2	13,323	0.17
Completing AA	11.4%	12,074	29	18.0	217,695	0.60
Completing Certificate	0.8%	804	34	15.9	12,766	0.53
Continuing transfer track	50.9%	54,006	26	13.7	741,580	0.46
Continuing workforce & non-credit	32.6%	34,666	32	10.6	368,222	0.35
ABE/ESL/GED	2.0%	2,105	30	5.2	10,890	0.17
Total or weighted averages	100.0%	106,201	28.4	13.0	1,364,477	
Credits required for one full-time year equivalent of study					30	

Note: weighted average of CHEs per year does not include the retired students

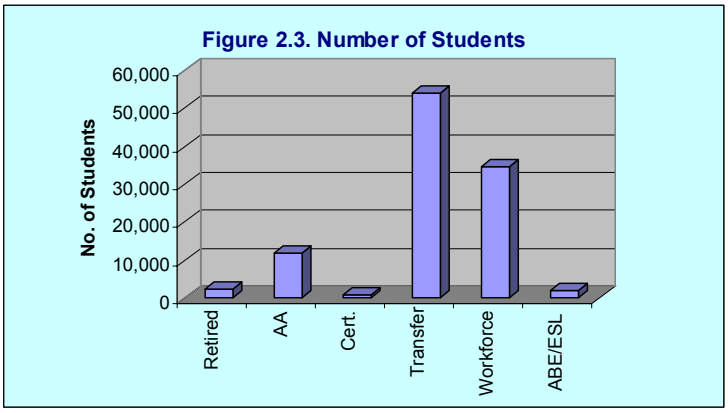
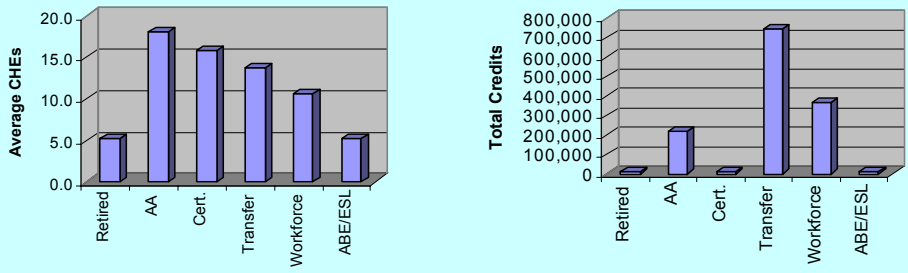


Figure 2.4. Average and Total CHEs Earned for the Analysis Year



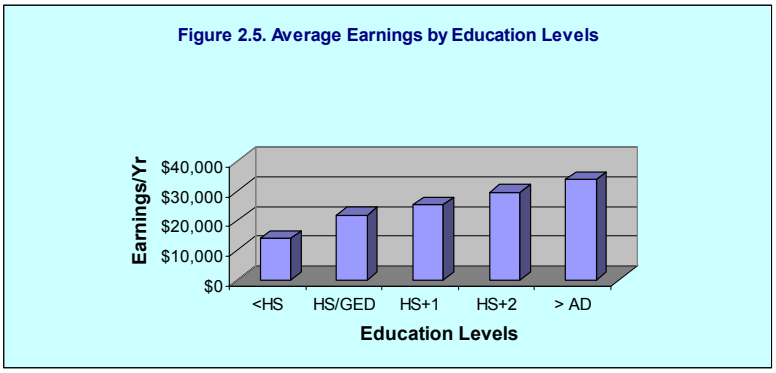
ANNUAL PRIVATE BENEFITS

The earnings statistics in **Table 2.5,** on which the benefit estimates (reported in **Chapter 3** below) are based, reflect all occupations (technical and non-technical). The earnings statistics are also displayed in **Figure 2.5**. The lower the education level, the lower the average earnings, regardless of the subject matters studied. The distinguishing feature among the achievement categories, therefore, is the number of CHEs completed. Statistics indicate that earnings are highly correlated with education, but correlation does not necessarily mean causation. Higher education is not the only factor explaining the private and public benefits reported in the statistics. Other variables such as ability, family background, and socioeconomic status play significant roles. The *simple correlation* between higher earnings and education nonetheless defines the *upper limit* of the effect measured. Our estimates of higher education's impact on earnings are based on a survey of recent econometric studies. A literature review by Chris Molitor and Duane Leigh (March, 2001) indicates that the upper limit benefits defined by correlation should be discounted by 10%. Absent any similar research for the social variables (health, crime, and welfare and unemployment), we assume that the same discounting factor applies as well to the public benefits.

As education milestones are achieved, students move into higher levels of average earnings. **Table 2.5** shows average earnings by one-year education increments, linked to the gender and ethnicity profile of the Oklahoma community colleges' student body. The differences between the steps are indicated in the last column. We also assume that *all* education has value, and thereby attribute value to students completing less than full steps as well. Specific detail on **Table 2.5** data sources and estimating procedures is found in **Appendix 2.**

Table 2.5. Weighted Average Earnings

Entry Level	Average Earnings	Diff.
1 short of HS/GED	$13,932	NA
HS/GED equivalent	$21,729	$7,797
1-year Certificate	$25,214	$3,485
2-year Associate Degree	$29,655	$4,441
1 year post Associate Degree	$33,772	$4,117



ANNUAL PUBLIC BENEFITS

Both students and society at large benefit from higher earnings. Indeed, the principal motivation for publicly funded higher education is to raise the productivity of the workforce and the incomes that the students will enjoy once they complete their studies. Society benefits in other ways as well. Higher education is associated with a variety of lifestyle changes that generate savings; e.g., reduced welfare and unemployment, improved health, and reduced crime. Note that these are *external* or *incidental* benefits of education (see box). Colleges are created to provide education, not to reduce crime, welfare and unemployment, or improve health. The fact that these incidental benefits occur and can be measured, however, is a bonus that enhances the economic attractiveness of the college operations. It should not be taken to mean that taxpayers should channel more money to colleges on the strength of these external benefits. Our purpose is simply to bring to the attention of education stakeholders that the activities of the 14 colleges in the Oklahoma system impact society in many more ways than simply the education they provide. In so doing, we have identified and measured some social benefits obviously related to educational achievements and included them in the mix of impacts generated by the colleges.

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

The Beekeeper Analogy

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

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

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

Higher Earnings

Broad Perspective: Higher education begets higher earnings. The economy generates more income than it would without the CC skills embodied in the labor force. From the broad taxpayer perspective, the total increase in earnings is counted as benefits of CC education, adjusted down by the alternative education variable in **Table 2.9** (17.1%)—these students would still attend college elsewhere even if the CCs were not present.

Narrow Perspective: Higher earnings translate into higher state and local *tax collections*. In the narrow taxpayer perspective we assume that the state and local authorities will collect 15.5% of the higher earnings in the form of taxes—the estimated composite of all taxes other than the federal income taxes.[6]

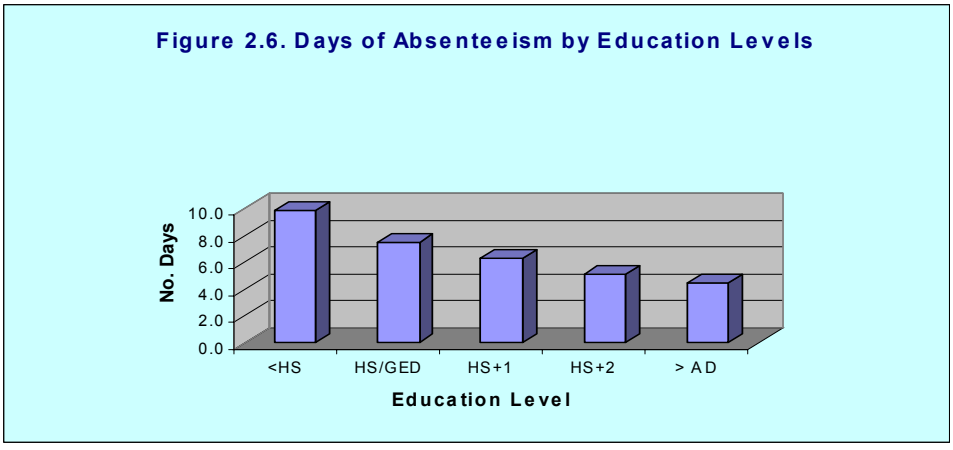
[6] The tax data are obtained from the U.S. Census Bureau. See also **Appendix 2**.

Health Savings

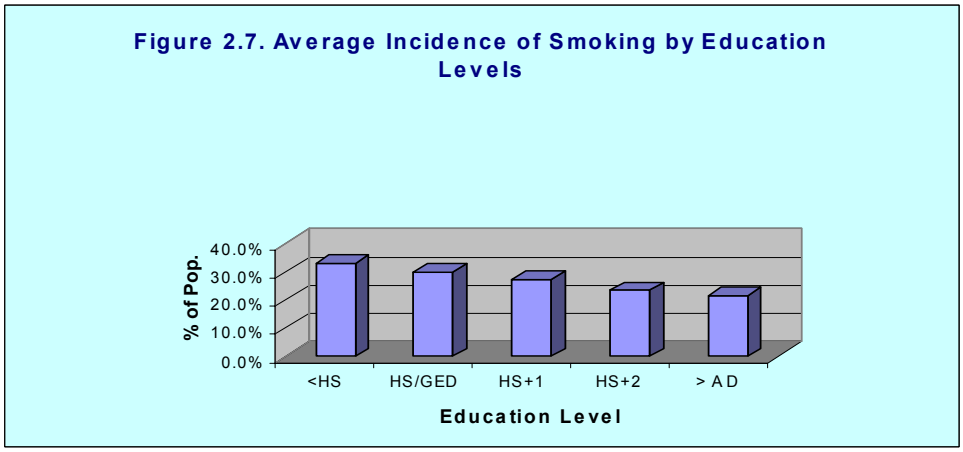
The improved health of students generates savings in three measurable ways: 1) lower absenteeism from work, 2) reduced smoking, and 3) reduced alcohol abuse (**Table 2.6**; see also **Figures 2.6-2.8**). These variables are based on softer (i.e., less-documented) data. In general, statistics show a positive correlation between higher education and improved health habits. The table shows the calculated reductions in the incidences of smoking and alcohol abuse as a function of adding the higher education, also linked to the gender and ethnicity profiles of the aggregate student body. Recall from above, the health savings are reduced by 10% in recognition of causation variables not yet identified.

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

Narrow Perspective: Taxpayers benefit from reduced absenteeism to the extent that the state and local government is an employer. Accordingly, we assume a taxpayer's portion of absenteeism savings at 12.8%, equal to the estimated public portion of employment in the state.[7] As for smoking and alcohol-related savings, the taxpayers benefit to the extent that state and local health subsidies (to hospitals, for example) are reduced. We assume that 6% of the total benefits can be counted as taxpayer savings.



[7] The ratio of state and local earnings over total earnings in the US (Regional Economic Information System—REIS, Bureau of Economic Analysis, Dept. of Commerce, 1998).



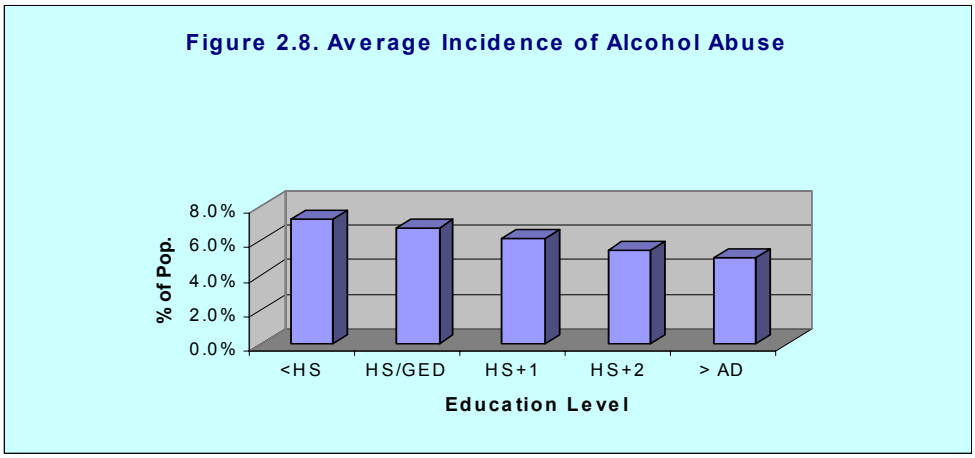


Table 2.6. Reduced Absenteeism, Smoking and Alcohol Habits

	Absenteeism		Smoking		Alcohol Abuse	
Education Level	Days	%/Year	Average	Reduction	Average	Reduction
< HS/GED	9.9	3.8%	33.0%	NA	7.3%	NA
HS/GED equivalent	7.5	2.9%	29.9%	9.3%	6.7%	8.0%
1 year post HS or less	6.3	2.4%	27.2%	9.0%	6.2%	7.8%
2 years post HS or less	5.1	1.9%	23.5%	13.8%	5.4%	12.1%
> AD	4.5	1.7%	21.4%	8.7%	5.0%	7.7%

1. Absenteeism: U.S. Department of Labor, Bureau of Labor Statistics, Division of Labor Force Statistics, ftp://ftp.bls.gov/pub/special.requests/lf/aat46.txt

2. Smoking: *Health,* United States, 2001, Table 61: Centers for Disease Control and Prevention; National Center for Health Statistics; and *The Economic Costs of Smoking in the United States and the Benefits of Comprehensive Tobacco Legislation,* U.S. Treasury Department, http://www.ustreas.gov/press/releases/docs/tobacco.pdf

3. Alcoholism: *Health Promotion and Disease Questionnaire* of the 1990 National Health Interview Survey of the Center for Health Statistics; and National Institute on Drug Abuse and the National Institute on Alcohol Abuse and Alcoholism,http://www.nida.nih.gov/EconomicCosts/Index.html.

Crime Reduction Benefits

The first column of **Table 2.7** relates the probabilities of incarceration to education levels—incarceration drops on a sliding scale as education levels rise (linked to the gender and ethnicity profile of the aggregate student body). The percentage reductions are based on total prison population relative to the population at large.[8] The implication is, as people achieve higher education levels, they are statistically less likely to commit crimes. The difference between before and after comprises the benefit attributable to education (see also **Figure 2.9**).

We identify three types of crime-related expenses: 1) the expense of incarceration, including prosecution, imprisonment, and reform, 2) victim costs, and 3) productivity lost as a result of time spent in jail or prison rather than working. As with our other social statistics, crime-related expenses are reduced by 10% in recognition of other causation factors.

Broad Perspective: From the broad taxpayer perspective, all reductions in crime-related expenses are counted as a benefit (less the students covered by the alternative education variable, as above).

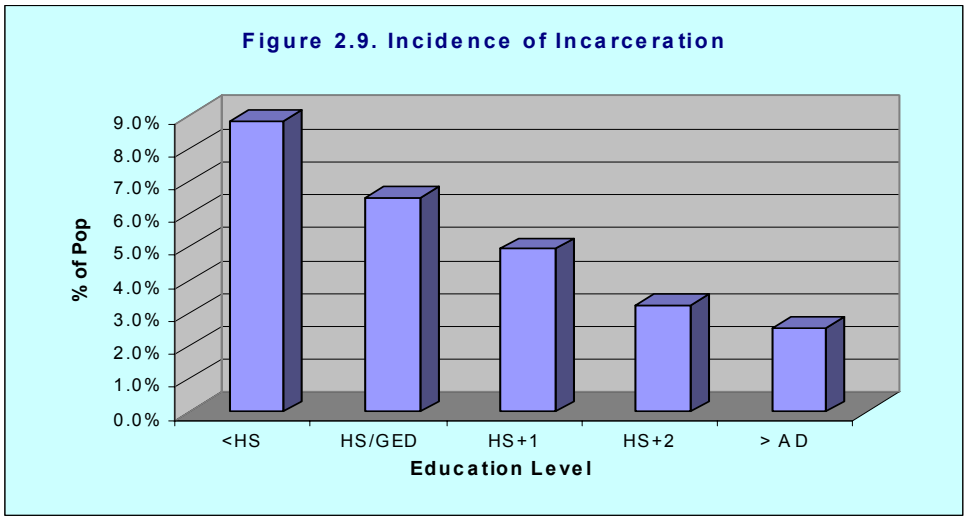
Narrow Perspective: We assume that nearly all (80%) of the incarceration savings accrue to the state and local taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to the potential victims, not to the taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our "composite" state and local government average tax rate (15.5%) to the added productivity of persons *not* incarcerated to arrive at the taxpayer benefits.

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

Table 2.7. Incarceration Rates

Education Level	Average	Reduction
< HS/GED	8.8%	NA
HS/GED equivalent	6.5%	26.5%
1 year post HS or less	4.9%	23.8%
2 years post HS or less	3.3%	34.2%
> AD	2.5%	22.2%

1. *Literacy Behind Walls*, National Center for Education Statistics, Prison Literacy Programs, DIGEST No. 159 Literacy in Corrections, Correctional Educational Association,
2. T. P. Bonczar & Alan J. Beck; *Lifetime Likelihood of Going to State or Federal Prison*, US Department of Justice, Office of Justice Programs, March 1997.
3. *Criminal Justice Expenditure and Employment*, Extracts Program (CJEE), author: Sidra Lea Gifford, askbjs@ojp.usdoj.gov (202) 307-0765, 12/14/00.



Welfare and Unemployment Reduction Benefits

Higher education is statistically associated with lower welfare and unemployment. **Table 2.8** and **Figure 2.10** relate the probabilities of individuals applying for welfare and/or unemployment assistance to education levels (linked to the gender and ethnicity profiles of the student bodies). As above, all welfare and unemployment savings are reduced by 10% in recognition of other causation factors.

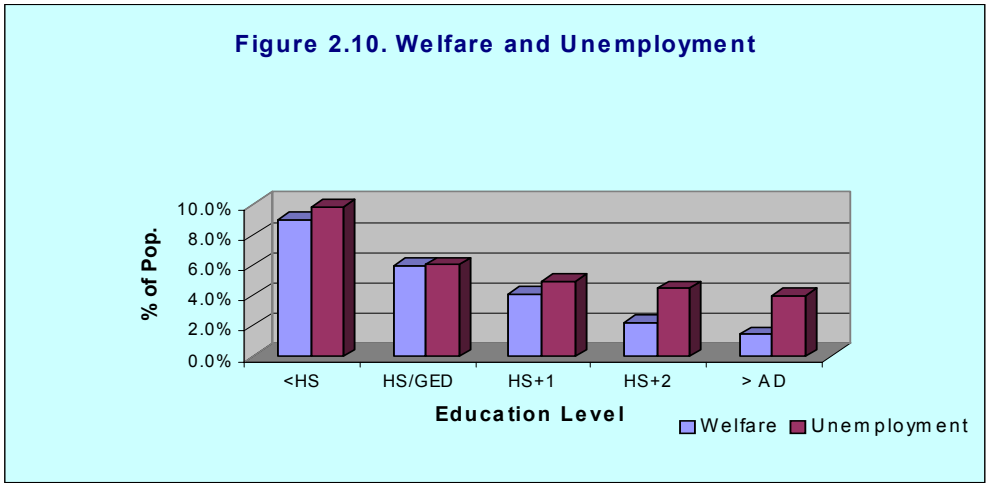
Broad Perspective: Reduced welfare and unemployment claims are counted in full as benefits in the broad taxpayer perspective (less the students covered by the alternative education variable, as above).

Narrow Perspective: Taxpayer benefits from reduced welfare are limited to 16%--the extent to which the state and local taxpayers subsidize the welfare system. None is claimed for unemployment, because none of these costs are borne by the state taxpayers.

Table 2.8. Welfare & Unemployment

	Welfare		Unemployment	
Education Level	Average	Reduction	Average	Reduction
< HS/GED	9.0%	NA	9.9%	NA
HS/GED equivalent	6.0%	33.5%	6.0%	38.9%
1 year post HS or less	4.1%	31.4%	4.9%	18.0%
2 years post HS or less	2.2%	46.6%	4.5%	9.8%
> AD	1.5%	33.5%	4.0%	10.4%

1. Temporary Assistance for Needy Families, TANF Program 3rd annual report to Congress, US Dept of Health and Human Resources, Table 10:12.
2. The Heritage Foundation, *Means-Tested Welfare Spending: Past and Future Growth*, Testimony by Robert Rector, (3/07/01).



COSTS

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

Opportunity Cost of Time

The opportunity cost of time is, by far, the largest cost. While attending college, most students forego some earnings, because they are not employed or are employed only part-time. The assumptions are discussed in conjunction with **Table 2.2** above. For the non-working students, the opportunity cost is the full measure of the incomes not earned during their CC attendance. For students working part-time, the opportunity cost is the difference between what they could make full-time less what they are making part-time. No opportunity cost of time is charged for the fully employed. The opportunity costs are derived from the earnings categories by education entry levels given in **Table 2.5**, although with some important modifications, as briefly described below:

- The earnings in **Table 2.5** are averages based on trajectories of earnings for all ages, from 17 to 65 (roughly defining the time spent engaged in the workforce).

- The average earnings, therefore, define the mid-point of a working life trajectory that begins with low entry-level wages and culminates with a typical worker's highest wages around age 60.[9] The earnings data shown in **Table 2.5** are specific to the State of Oklahoma, weighted, however, to reflect the specific gender and ethnicity makeup of the aggregate student body. Details on earnings and education sources are found in **Appendix 2**.

- The opportunity cost of time is then conditioned by the average age of the student (28.4 years, see **Table 2.4**). In particular, the average earnings at the midpoint ($25,314 in **Table 3.5**) are adjusted downward to $15,431 to reflect the average earnings at age 28.4.

The Budget

Beyond the student perspective, our assessment of the Oklahoma community colleges considers the benefits and costs from the state and local government taxpayer perspective. Accordingly, only the state and local government revenues in **Table 2.1** are included as costs in the investment and benefit-cost assessment. All else equal, the

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

larger the other revenue sources in **Table 2.1** (federal grants, student tuition, and contract revenues) relative to state and local government revenues, the larger will be the relative economic payback to the taxpayers.

OTHER ASSUMPTIONS

Table 2.9 lists several other assumptions imbedded in the analytic model: a) the discount rate and time horizon, b) crime-related costs (incarceration costs are inclusive of the cost per prison year plus all costs associated with arrest, investigation, trial and finally incarceration), c) welfare and unemployment costs per year,[10] and d) health-related costs.[11] Annual real increases in costs are also included, although these are not used in the study. The alternative education opportunity assumption is discussed later in this chapter in association with the statewide economic impacts.

[10] As indicated in the table, we assume that the average duration on welfare and unemployment is 4.0 and 4.0 years, respectively. This means that, over the next 30 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.
[11] The incarceration, health, welfare and unemployment probability and cost variables are internal to the analytic model.

Table 2.9. Miscellaneous Variables

	Variables
Discount rate	4.0%
Time horizon, years to retirement	36.6
Avg. cost/prison year (all incl.: arrest, trial, incarc., rehab. etc.)	$77,178
Avg. length of incarc. (total years over 30-year time horizon)	4.0
Real cost increase per prison year	0.0%
Average victim cost	$ 85,000
Real victim cost increase per year	0.0%
Average cost per welfare year	$ 75,138
Avg. duration on welfare (total years over 30-year time horizon)	4.0
Welfare/unemployment cost increase per year	0.0%
Average cost per unemployment year	$ 36,249
Avg. duration on unempl. (total years over 30-year time horizon)	4.0
Smoking-related medical costs per year	$ 2,962
Alcohol-related medical costs/year	$ 7,946
Real medical cost increase per year	0.0%
Alternative education opportunities	17.1%

Assumptions adapted from:

1. Bureau of Justice Statistics, Table #. 05 Total direct and intergovernmental expenditure, by activity and level of government, fiscal years 1980-97, Criminal Justice Expenditure and Employment Extracts Program, 12/14/00.

2. OICJ The Extent and Costs of Victimization, Crime and Justice: The Americas, Dec-Jan 1995.

3. The Heritage Foundation, *Means-Tested Welfare Spending: Past and Future Growth*, Testimony by Robert Rector, (3/07/01).

4. U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/news.release/annpay.t01.htm.

5. The Economic Costs of Smoking in the United States and the Benefits of Comprehensive Tobacco Legislation, http://www.ustreas.gov/press/releases/docs/tobacco.pdf.

6. National Institute on Drug Abuse and the National Institute on Alcohol Abuse and Alcoholism, found at: http://www.nida.nih.gov/EconomicCosts/Index.html.

STATEWIDE ECONOMIC BENEFITS

In general, the statewide economy is affected by the presence of the 14 community college districts in Oklahoma in two ways: from its day-to-day operations (including capital spending), and from students who enter the workforce with increased skills. Day-to-day operations of the colleges provide the *direct* jobs and earnings of the faculty and staff, and additional *indirect* jobs and earnings through the action of regional multiplier effects. At the same time, the presence of college-trained past and present students in the state workforce deepens the economy's stock of human capital, which attracts new industry and makes existing industry more productive.

Estimating these statewide economic effects requires a number of interrelated models. Multiplier effects are obtained with an input-output (IO) model constructed for Oklahoma.[12] Estimating CC operations effects requires an additional model that takes CC expenditures, deducts spending that leaks from the economy, and bridges what is left to the sectors of the IO model.

Estimating the skill-enhancing effect of past students on the statewide economy entails five basic steps.

1. Estimate the number of past students still active in the statewide workforce.
2. Adjust for alternative education opportunities.
3. Estimate the increased earnings of the students still active in the statewide workforce.
4. Adjust the overall earnings estimated in step 2 to account for a collection of substitution effects. This provides an estimate of the direct increase in statewide earnings.

[12] The economic impact model for the 14 community colleges in Oklahoma is constructed using IMPLAN input-output modeling software, and data purchased from the Minnesota IMPLAN Group. IMPLAN is the most widely used approach for constructing input-output models. The IMPLAN website (www.implan.com) boasts of over 1,300 active database and software users in the United States as well as internationally. IMPLAN users include federal and state government, universities, as well as private sector consultants.

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

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

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

The Impact of Oklahoma's CC Districts' Operations

The first step in estimating the impact of the 14 Oklahoma CC districts' operations is to assemble data on their combined operating and capital expenditures. These data are assembled from college budgets and collected into the categories of **Table 2.10**. Column 1 simply shows the total dollar amount of spending. Columns 2 through 5 apportion that spending to in-state, and out-of-state vendors. The net state portion is derived in Column 6. Net state spending shown in Column 6 is fed into the statewide IO model.[13]

The information on total spending required for Column 1 is generally readily available, though sorting specific items to the categories of the table can take some time. Information in Columns 2 through 5 is generally more problematic: hard data are scarce on the local/non-local split. In these cases, the staff members of the 14 Oklahoma CC districts were asked to use their best judgment.

The first row in **Table 2.10** shows salaries and wages. These *direct* earnings are part of the state's overall earnings by place-of-work: These appear later as "Direct Earnings of Faculty and Staff" in the table of findings, **Table 3.16**. Dollar values in **Table 2.10** Column 6, "Net In-State Spending," are fed into the economic region IO model. The IO model provides an estimate of indirect effects, and these appear as "Indirect Earnings" in findings **Table 3.16**.

[13] **Table 2.10**, by itself, might provide useful information to local audiences—Chambers of Commerce, local business establishments, Rotary clubs, and the like. The table indicates that the colleges are "good neighbors" in the state community, evidenced by the fact that an estimated 92% of all college expenditures benefit state vendors ($336,293 / $366,385 = 92%).

Table 2.10. Profile of CCs Spending in and out of State Economy ($ Thousands)

Spending Categories	Tot. Dollar Amount (1)	In-State % (2)	Out of State % (3)	In-State % (4)	Out of State % (5)	Net In-State Spending (6)
Salaries and wages	$200,406	95%	5%			$189,881
Travel	$3,567	91%	9%			$3,256
Electricity and natural gas	$7,812	93%	7%			$7,250
Telephone	$1,188	85%	15%			$1,007
Building materials & gardening supplies	$2,571	90%	10%	48%	52%	$2,324
General merchandise stores	$38,117	75%	25%	26%	74%	$28,430
Eating & drinking	$2,111	84%	16%			$1,773
Maintenance & repair construction	$9,324	93%	7%			$8,701
New construction	$24,353	100%	0%			$24,232
Insurance	$11,920	98%	2%			$11,633
Legal services	$481	100%	0%			$481
Credit agencies	$382	94%	6%			$358
U.S. postal service	$1,822	90%	10%			$1,647
Accounting, auditing & bookkeeping	$690	100%	0%			$690
Marketing	$1,467	95%	5%			$1,399
Other business services	$34,049	83%	17%			$28,143
Water supply & sewerage systems	$790	100%	0%			$790
Printing & publishing	$1,513	97%	3%			$1,470
Rental property	$2,196	96%	4%			$2,116
Services to buildings	$3,912	96%	4%			$3,742
Unemployment compensation	$168	100%	0%			$168
Honoraria + other payments to households	$17,547	96%	4%			$16,803
Total	$366,385					$336,293

Note: this table provides details for the summary of the college role in the state economy (Table 3.16)

Estimating CHEs Embodied in the Present-Day Workforce

This section describes the submodel for estimating the CHEs of past instruction embodied in the present-day statewide workforce from the 14 community college districts in Oklahoma. **Table 2.11** indicates variables critical to the model, while **Table 2.12** shows the various steps in the calculation. The various values appearing in **Table 2.11** originally appear (with citation) in **Table 2.2** and **Table 2.4**. Considering **Table 2.12** one column at a time reveals the steps involved in estimating embodied CHEs.

Column 1 provides an estimate of the enrollment history (unduplicated headcount) of the students enrolled in the 14 Oklahoma CC districts. Column 2 represents the non-retired students, in other words, the students who have the potential to go into the workforce. Column 3 is the same as Column 2, but net of students who leave the state immediately upon leaving college. As shown in the table, 95% of the students remain in the state upon leaving the CC's, and 5% leave the state.

Column 4 goes one step further—a comparison of Columns 3 and 4 indicates that all past students have left college except for the last three years (1999-2002) where students are still enrolled (the leaver assumptions are shown in Column 9).

Column 5 further reduces leavers to focus only on those who have settled into a somewhat permanent occupation. As shown in Column 10 (the "settling factor"), it is assumed that all students settle into permanent occupations by their fourth year out of school. Settling-in assumptions are specified in **Table 2.2** above.

Column 6 transitions further from leavers who have settled into jobs to leavers still active in the current workforce. Here we net off workers who, subsequent to leaving college and settling into the state workforce, have out-migrated, retired, or died. As shown in **Table 2.11**, 20% of the past students will out-migrate, retire or die over the course of the next 30 years. This "30-year attrition" follows an assumed logarithmic decay function shown in Column 11 labeled "active in state workforce."

Column 7 shows the average CHEs generated per year back to 1973. These data were obtained by dividing total year-by-year CHEs by the corresponding headcount.[14] Column 8 shows the product of the year-by-year average CHEs, and the estimate of the number of past students active in the current workforce in Column 6. Looking to the total in Column 8, we estimate that the current Oklahoma workforce embodies some 30.7 million CHEs of past instruction from the 14 community college districts.

Table 2.11. Critical Variables

Assumptions	Values
Current headcount of students	106,201
Students remaining in-state after leaving CC	95%
30-year attrition	20%
Decay rate	0.7%
Overall average of credits earned per student this year	13.0

Reducing the CHEs to Account for Alternative Education Opportunities

The 30.7 million CHEs of past instruction from the 14 Oklahoma CC districts indicated in **Table 2.12** increase the skills embodied in the statewide workforce and, through them, the overall size of the state economy in terms of earnings. Before turning to the income calculation, however, it is fair to ask to what degree past students would have been able to obtain schooling (and therefore skills) absent the community college system in Oklahoma. This is the common "with and without condition" in applied economic analysis.

[14] We used the current year estimate of CHEs (see **Table 2.4**), adjusted for the retired students, as a proxy for the average achievement per student in all prior years before FY 2002.

The IR staffs provided the estimate of the alternative education opportunity variable (17.1%) by taking into account opportunities such as private trade schools and colleges, public four-year institutions, correspondence schools, and so on. Accordingly, when calculating the net increase in regional income attributable to Oklahoma's CC Districts, the historic CHE's indicated in **Table 2.12** are reduced by 17.1%.

Table 2.12. Estimating Credit Hours of Instruction Embodied in the Workforce

Year	Student Enrollment Headcount 1	Subtract Retired Students 2	Subtract Students Migrating Immediately 3	Students who have left college (Leavers) 4	Leavers Who Have Settled Into Jobs 5	# Settled Into Jobs - Active in the Workforce 6	Average Credit Equivalents 7	Credits Embodied in the Workforce 8	Assumptions: % of Students in Workforce 9	Assumptions: "Settling" Factor 10	Assumptions: Active in Workforce 11
1973	43,642	42,595	40,465	40,465	40,465	32,372	13.04	421,980	100%	100%	80%
1974	49,552	48,363	45,945	45,945	45,945	37,031	13.04	482,702	100%	100%	81%
1975	56,554	55,198	52,438	52,438	52,438	42,579	13.04	555,031	100%	100%	81%
1976	64,703	63,152	59,994	59,994	59,994	49,078	13.04	639,745	100%	100%	82%
1977	72,281	70,548	67,020	67,020	67,020	55,235	13.04	720,005	100%	100%	82%
1978	78,816	76,926	73,079	73,079	73,079	60,679	13.04	790,960	100%	100%	83%
1979	80,460	78,530	74,604	74,604	74,604	62,407	13.04	813,488	100%	100%	84%
1980	86,275	84,206	79,996	79,996	79,996	67,417	13.04	878,798	100%	100%	84%
1981	95,667	93,372	88,704	88,704	88,704	75,314	13.04	981,731	100%	100%	85%
1982	102,054	99,606	94,626	94,626	94,626	80,942	13.04	1,055,096	100%	100%	86%
1983	106,623	104,066	98,862	98,862	98,862	85,197	13.04	1,110,560	100%	100%	86%
1984	103,855	101,365	96,296	96,296	96,296	83,605	13.04	1,089,812	100%	100%	87%
1985	104,838	102,324	97,208	97,208	97,208	85,027	13.04	1,108,338	100%	100%	87%
1986	105,915	103,375	98,206	98,206	98,206	86,541	13.04	1,128,084	100%	100%	88%
1987	103,710	101,223	96,162	96,162	96,162	85,372	13.04	1,112,845	100%	100%	89%
1988	106,010	103,468	98,294	98,294	98,294	87,917	13.04	1,146,019	100%	100%	89%
1989	107,585	105,005	99,755	99,755	99,755	89,890	13.04	1,171,728	100%	100%	90%
1990	109,102	106,486	101,162	101,162	101,162	91,838	13.04	1,197,126	100%	100%	91%
1991	111,553	108,878	103,434	103,434	103,434	94,602	13.04	1,233,158	100%	100%	91%
1992	119,296	116,435	110,614	110,614	110,614	101,924	13.04	1,328,597	100%	100%	92%
1993	123,164	120,210	114,200	114,200	114,200	106,014	13.04	1,381,912	100%	100%	93%
1994	118,199	115,364	109,596	109,596	109,596	102,499	13.04	1,336,101	100%	100%	94%
1995	114,223	111,483	105,909	105,909	105,909	99,791	13.04	1,300,796	100%	100%	94%
1996	110,738	108,082	102,678	102,678	102,678	97,469	13.04	1,270,524	100%	100%	95%
1997	107,916	105,328	100,062	100,062	100,062	95,694	13.04	1,247,397	100%	100%	96%
1998	106,481	103,928	98,731	98,731	98,731	95,127	13.04	1,240,000	100%	100%	96%
1999	107,757	105,173	99,914	99,914	99,914	96,985	13.04	1,264,222	100%	100%	97%
2000	106,841	104,279	99,065	99,015	89,113	87,147	13.04	1,135,977	100%	90%	98%
2001	107,547	104,968	99,720	97,476	73,107	72,028	13.04	938,894	98%	75%	99%
2002	111,514	108,840	103,398	87,888	43,944	43,944	13.04	572,820	85%	50%	100%
Embodied Total								30,654,447			

From Embodied CHEs to Direct Statewide Income Effects

In the standard model, statewide income is expressed as a function of physical and human capital. Human capital is increased by adding new workers or by enhancing the skills of existing workers – the former adds the productivity of the new workers; the latter increases the productivity of existing workers. Increased human capital has a direct and indirect effect on *statewide income*. The direct effect is conveyed in the higher earnings of the newly skilled workers themselves, while the indirect stems from associated multiplier effects. This section describes our process for estimating the direct effect.

A key part of the overall model is the "engine" that estimates the value per CHE of instruction.[15] The product of per-CHE added earnings, and the total of embodied past CC instruction from the 14 Oklahoma CC districts (30.7 million CHEs, **Table 2.12**) provides the dollar estimate of how much more past students are earning as a result of their CC coursework. The question is: how much of this added *personal* income can be counted as added *statewide* income?

The answer to this question depends on the magnitude of certain elasticity assumptions at work in the statewide income model. As shown in the text box, the elasticities can vary from perfectly inelastic to perfectly elastic. The text box describes the issue according to "two polar cases," one accepting all of the added student income, the other accepting none of it. Obviously the actual value will lie somewhere between. How much of increased past student income should be counted as increased regional income?

[15] Briefly, the engine that estimates the value per CHE does so by combining earnings/education data from **Table 2.5** with information on aggregate student achievements during the analysis year (from **Table 2.4**). These calculations are discussed more fully in **Chapter 3**.

There is considerable empirical literature on the economic development effects of education, though mainly in the international rather than regional context. In a recent study, Bils and Klenow (2000) survey previous work on the subject and advance a model of their own. Based on their findings, we reduce the full past student income increase (the perfectly inelastic case) by 2/3 to arrive at our estimate of the net increase in statewide income. This estimate for Oklahoma's CC Districts appears in **Table 3.16** under the heading "Earnings Attributable to Past Student Economic Development Effects," "Direct Earnings."

Elasticity of Substitution: Two Polar Cases

Polar Case 1, Two Inelastic Assumptions.

Assumption #1: *The rate of technical substitution between local skilled and unskilled workers is infinitely inelastic.* Skilled workers are able to perform tasks that unskilled workers cannot. Here, the added skills only increase value; they do not replace or substitute for existing production inputs. The added skills enable product line expansion, increased competitiveness of existing industry, and they attract new industry. Earnings and output expand as a result.

Assumption #2: *The rate of technical substitution between local and non-local workers is infinitely inelastic.* Skilled workers cannot be attracted from outside the state. Here, the existence of state skilled workers enables industry to do things they could not do otherwise. Locally skilled workers may attract new industry to the state (there is a near stand-alone development theory based on the notion that skilled workers attract new industry—Borts and Stein, 1964).

Polar Case 2, Two Elastic Assumptions.

Assumption #1: *The rate of technical substitution between local skilled and unskilled workers is infinitely elastic.* This implies that skilled workers are substituted for unskilled workers in a manner that creates no net additional regional earnings. Businesses simply replace lower productivity (and lower paid) unskilled workers with some smaller number of higher productivity (and higher paid) skilled workers, with no net change in overall output or earnings.

Assumption #2: *The rate of technical substitution between local and non-local workers is infinitely elastic.* Here existing or new industry can draw skilled workers from outside the state without extraordinary inducements or wage premiums that would otherwise increase costs and reduce competitiveness. Statewide growth is driven by something other than local workforce skills. Hamilton et al., 1991, provides a broad discussion of the issues that work to limit the response of statewide income to specified economic changes.

The Industries where Past Students Work

Calculating the indirect impacts of workforce-embodied CC skills also requires the use of the statewide IO model discussed above. The model captures the extent to which a dollar spent turns over in the economy. We estimate indirect income effects by applying the IO multiplier to the direct effects. The

use of IO multipliers in this way requires that the direct effects be disaggregated into specific industrial sectors. Disaggregating direct impacts avoids IO aggregation error,[16] and it facilitates an analysis of the 14 Oklahoma CC districts' contribution to the business sector – an analysis that appears in **Chapter 3**.

Table 2.13 provides information on the sectoral distribution of jobs in the statewide economy. The table provides a draft-stage vehicle for collecting information from the 14 Oklahoma CC districts on the sectoral breakdown of their past students, and it documents the information provided by the college. **Table 2.13** appears with four columns briefly described below.

Column 1 appears for reference and simply shows by sector the current distribution of *all jobs* in the state economy. For example, 5.8% of all statewide jobs are in the Agriculture & Agricultural services sector, 6.3% of all jobs are in the Finance, Insurance and Real Estate sector, and so on. Column 2 shows the distribution by sector of *past students*, i.e., an estimate of the industries where they currently work. For example, while 5.8% of all statewide jobs are in the Agriculture & Agricultural services sector, only 0.6% of past students are estimated to be in that sector. In contrast, while 6.3% of all jobs are in the Finance, Insurance and Real Estate sector, 13.0% of past students are estimated to be in that sector.

There is a long-standing theory of regional development known as *stage theory*. The notion is that regional economies develop by progressing from "low stage industries" (agriculture, mining, logging, etc.), to "higher stage industries" (process manufacturing, fabricative manufacturing), and finally to specialized finance, engineering, and so on. The distribution of past students shown in column 2 is derived mechanically, on the assumption that past students tend to find jobs in the higher development stage industries.[17]

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

[17] Parr (1999) describes four stages of economic development: primary production, process manufacturing, fabricative manufacturing, and producer services and capital export. We apply a

In the course of assembling the data for our analysis, the 14 Oklahoma CC districts have examined the distribution of past students as indicated in Column 2, and made any adjustments needed to accurately reflect the current realities. The revised distribution appears in Column 3. In the case where Columns 2 and 3 show the same percentages, the research staffs at the colleges have concluded that no changes to the mechanical estimates appearing in Column 2 were needed.

Column 4 applies the distribution of student percentages in Column 3 to the total historic CHEs embodied in the workforce. This latter total is obtained from **Table 2.12**, and reappears at the bottom of Column 4 as the total. In **Chapter 3**, we estimate the contribution to student earnings per CHE of CC instruction. This product provides our estimate of the direct effect of past CC operations on regional earnings by industry.

The Indirect Economic Development Effects of Students

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

First, consider demand-side effects. Statewide earnings are larger because of the skills embodied in past students from the 14 Oklahoma CC districts still active in the workforce. As earnings increase, so do industry outputs and industry purchases of inputs.[18] These in turn generate subsequent rounds of increased earnings, which are measured with the familiar multiplier effects. These indirect effects on the demand-side are estimated in the statewide IO model by converting the embodied CHEs shown in **Table 2.13** into direct increased industry sales.

Second, consider the supply-side indirect effect. Economic development theory describes a process of "cumulative causation," or "agglomeration," whereby growth

"development score" to Parr's stages: low scores for lower stage sectors and higher scores for higher development sectors. The scores are applied to employment in each sector, then normalized to form weights for distributing past students. The end result is that past students favor higher stage industries. For additional detail on the use of this approach for classifying industries by industrial stage see Robison and others, 2002.

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

becomes in some degree self-perpetuating. The location of a new industry (A) in the state attracts other industries (B, C, and D) that use industry A's outputs as inputs. This, in turn, produces subsequent rounds of industry growth, and so on.[19] To estimate agglomeration effects, we configure our economic region IO model to provide a set of so-called supply-driven multipliers (see for example Miller and Blair, 1985). We estimate the supply-side effects by converting the embodied CHEs shown in **Table 2.13** into direct increased industry value added, and then apply these to the multipliers of the supply-driven statewide IO model.[20]

Table 2.13. Estimating the Distribution of Past Students by Industrial Sectors of the Regional Economy

Industries	Distribution of All Jobs 1	Provisional Distribution of Past Students 2	Final Distribution of Past Students 3	Distribution of Historic CHEs Embodied in Current Workforce 4
Agriculture & Agricultural Services	5.8%	0.6%	0.6%	182,747
Mining, Sand, and Gravel	2.8%	0.3%	0.3%	89,067
Construction	5.2%	0.5%	0.5%	164,451
Manufacturing: Food/Wood & Paper/Textiles	2.3%	1.2%	1.2%	359,655
Manufacturing: Chemicals/Petroleum/Stone & Glass	5.2%	5.4%	5.4%	1,645,466
Manufacturing: Computer & Electronic Equipment	0.5%	1.0%	1.0%	301,809
Manufacturing: Other	1.5%	1.5%	1.5%	462,397
Transportation	2.7%	1.4%	1.4%	420,872
Public Utilities	0.4%	0.2%	0.2%	69,143
Publishing & Communications	1.7%	3.5%	3.5%	1,061,086
Trade	20.4%	20.9%	20.9%	6,414,626
Finance, Insurance, and Real Estate	6.3%	13.0%	13.0%	3,982,988
Motels & Eating/Drinking & Amusement/Recreation	6.4%	3.3%	3.3%	1,010,222
Consumer Services	5.3%	2.7%	2.7%	832,256
Business Services	7.4%	7.7%	7.7%	2,345,721
Medical/Educational/Social services	10.3%	21.1%	21.1%	6,461,676
Federal Government	4.2%	4.3%	4.3%	1,314,783
State & Local Government	11.6%	11.5%	11.5%	3,535,482
Total	100.0%	100.0%	100.0%	30,654,447

[19] For a more complete discussion of agglomeration and cumulative causation see Krugman (1999).
[20] Agglomeration effects are difficult to estimate. Our procedure assumes that so-called "supply-driven IO multiplier effects" capture the agglomeration effects. To increase the plausibility of this assumption, we apply only the direct effects associated with the industries in the highest stages of development.

Chapter 3
PRIVATE, PUBLIC AND STATEWIDE ECONOMIC BENEFITS

INTRODUCTION

This chapter summarizes the main study results in four sections: 1) the aggregate annual private and public benefits; 2) these same benefits measured per CHE and per student; 3) future benefits expressed in terms of NPV, RR, and B/C ratio, and 4) the statewide economic benefits.

ANNUAL BENEFITS

Higher Student Earnings

The annual benefits are summarized in **Tables 3.1** and **3.2** (see also **Figure 3.1**). We begin with earnings growth in **Table 3.1**. Last year, each student completed, on average, 13.0 CHEs at the 14 Oklahoma CC districts (see **Table 2.4**), only a fraction of one full year of study. This is because the majority of students attend for a variety of purposes as discussed in conjunction with **Table 2.4**: for some, to make progress towards an eventual degree, and for others, simply to acquire certain skills that will increase their productivity in the workforce. A total of 106,201 students will capture $158.8 million worth of higher annual earnings based on this average increase in educational attainment.

Social Savings

Health-Related Savings

Also in **Table 3.1**, we see that improved health, lower welfare and unemployment, and lower crime will result in annual dollar savings to the taxpayers of $12.0 million, $6.9 million, and $19.3 million (rounded). In **Table 3.2**, these same results are presented in greater detail—health-related absenteeism will decline by 55,047 days per year, translating to a total of 212 years' worth of productivity gained per year (based on 260 workdays per year). Annual total dollar savings from reduced absenteeism days equals

$5.1 million. There will be 1,509 fewer smokers and 301 fewer alcohol abusers, amounting to annual total dollar savings of $4.5 and $2.4 million, respectively, inclusive of insurance premiums, personal payments, and withholding for Medicare and Medicaid.

Crime-Related Savings

There will be 714 fewer people incarcerated as a result of the higher education obtained, saving the taxpayers a total of about $7.8 million per year. The assumptions pertaining to these results are listed in **Table 2.9** in the previous chapter. They are based on an average duration of 4.0 years incarcerated at an average cost of $77,178 per year (inclusive of arrest, prosecution, incarceration, and rehabilitation).[21] Fewer people incarcerated means more people gainfully employed—this translates to $3.0 million in additional annual earnings for the state. Victim costs will be reduced by $8.5 million per year.

Welfare and Unemployment Savings

There will be 833 and 438 fewer people on welfare and unemployment, respectively, in the community. The corresponding total dollar savings for the state community amounts to $6.9 million ($3.3 million for welfare + $3.6 million for unemployment savings) for one year, assuming that the average time spent on welfare and unemployment is 4.0 years (see **Table 2.9**) spread over a 30-year period.

Total Public Benefits

All told, there will be $38.2 million in public savings per year in the community—the sum of all health, crime, and welfare/unemployment benefits in **Table 3.2.**

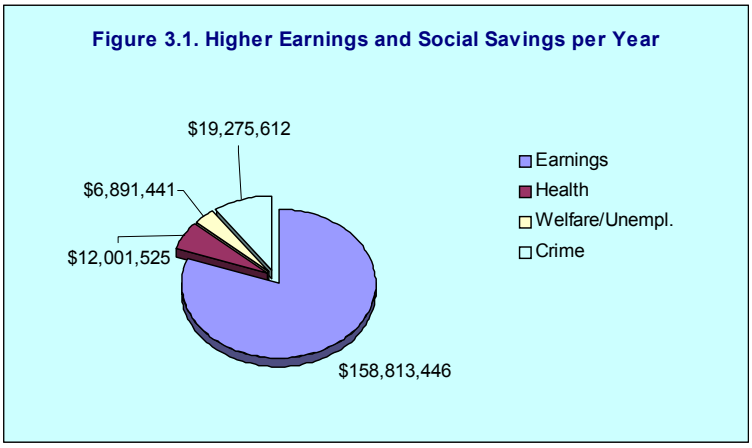
Table 3.1 Student Body Achievements, Higher Earnings

		Social (External Benefits)			
Level of Education	Higher Earnings	Improved Health	Lower Welfare Unemployment	Lower Crime	Total
< HS/GED	$3,383,178	$231,589	$368,834	$520,077	$4,503,677
HS/GED equivalent	$4,934,598	$187,909	$335,196	$378,805	$5,836,508
1 year post HS or less	$55,717,852	$5,671,191	$3,784,878	$10,322,132	$75,496,054
2 years post HS or less	$79,707,042	$4,977,354	$2,030,040	$6,991,937	$93,706,373
> Associate Degree	$15,070,777	$933,481	$372,493	$1,062,661	$17,439,413
Total	$158,813,446	$12,001,525	$6,891,441	$19,275,612	$196,982,025

[21] The calculation is as follows: 714 not incarcerated x $77,178/4.0 years/37 years to retirement from **Table 2.9** = $375,988.

Table 3.2. Summary of Annual Benefits

	Units	Earnings	Social Savings
Higher earnings	NA	$158,813,446	
Health benefits			
Absenteeism savings (days)	55,047	NA	$5,140,287
Fewer smokers, medical savings (# persons)	1,509	NA	$4,468,866
Fewer alcohol abusers (# persons)	301	NA	$2,392,373
Crime benefits			
Incarceration savings (# persons)	714	NA	$7,760,390
Crime victim savings	NA	NA	$8,546,906
Added productivity (fewer incarcerated)	NA	NA	$2,968,316
Welfare/unemployment benefits			
Welfare savings (# persons)	833	NA	$3,297,124
Unemployment savings (# persons)	438	NA	$3,594,317
Total		$158,813,446	$38,168,579



ANNUAL BENEFITS PER CHE AND PER STUDENT

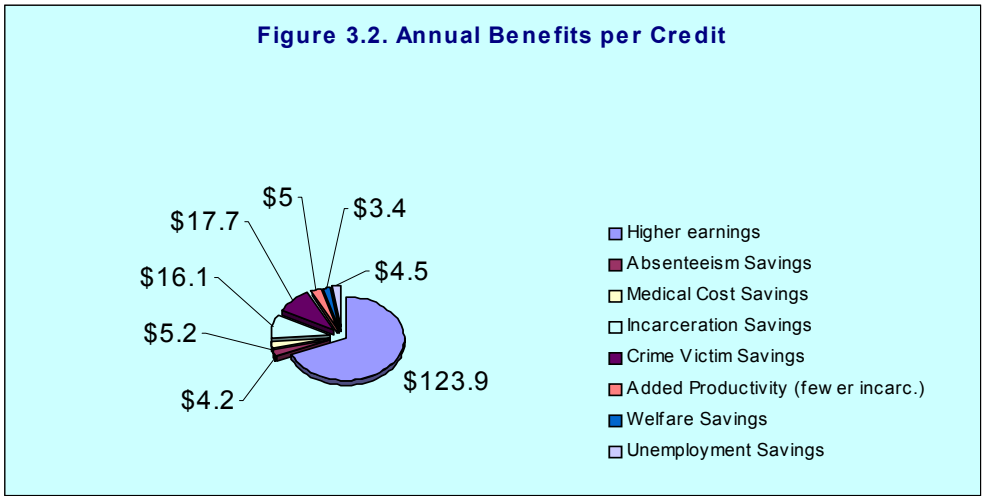
The aggregate benefits reported in **Tables 3.1** and **3.2** above are expressed per CHE and per student in **Table 3.3**. These are also displayed in the form of a pie chart in **Figure 3.2**. On average, students capture: a) $124 per year in higher earnings per CHE,[22] and b) $1,577 per year in higher earnings per student on the basis of the number of CHEs completed. **Converted to a full-year equivalent (30 CHEs), the annual earnings would amount to $3,629 per student**. On average, the social benefits per CHE range from a low of $3 for Welfare Savings to a high of $18 per CHE for Crime Victim Savings. On a per

[22] Thus, a student attending for 10 CHEs will add $1,239 per year to the lifetime earnings. A longer curriculum will add substantially more. The earnings expectations are portrayed as linear but with many computational steps involved (see **Chapter 2**). The extrapolation is based on the averages of low earnings additions for leavers completing few CHEs, plus higher additions for leavers completing more CHEs.

student basis, they range from a low of $44 per student for Welfare Savings to a high of $226 for Crime Victim Savings. On a full-year equivalent basis (30 CHEs), the social savings would amount to $1,654 per student (the total of $5,282 less $3,629 of higher private earnings as indicated in **Table 3.3**).[23]

Table 3.3. Annual $ per Credit and Student

	Per Credit	Per Student	Annualized
Higher earnings	$124	$1,577	$3,629
Absenteeism Savings	$4	$53	$122
Medical Cost Savings	$5	$66	$153
Incarceration Savings	$16	$205	$472
Crime Victim Savings	$18	$226	$520
Added Productivity (fewer incarc.)	$5	$68	$156
Welfare Savings	$3	$44	$100
Unemployment Savings	$4	$57	$131
Total	$180	$2,295	$5,282



THE INVESTMENT ANALYSIS: INCORPORATING FUTURE BENEFITS

The results in **Tables 3.1** and **3.2** provide only a single-year snapshot of the benefits. As long as the students remain in the workforce, however, the CC-acquired skills continue to add productivity over time. In the investment analysis, the higher earnings and avoided costs are projected into the future over the working life of the student,

[23] The values in **Table 3.3** and **Figure 3.2** are calculated based on model parameters.

discounted to the present, and then compared to the present costs of education. The investment is feasible if all discounted future benefits are greater than or equal to the costs.[24]

The investment analysis results are shown in **Table 3.10** (in the aggregate, per CHE and per student). The end results sought are the **Net Present Value (NPV)**, **Rate of Return (RR)**, the **Benefit/Cost (B/C)** ratio and the **Payback Period**.[25] These are simply different ways of expressing the results. All of the present value results shown are intermediary steps that *ultimately generate* the NPVs, RRs and B/C ratios.

We begin with some definitions in **Table 3.4. Private** benefits are the higher earnings captured by the students themselves. **Broad taxpayer benefits** are the additions to earnings plus lower overall expenditures related to health, crime, welfare, and unemployment. **Narrow taxpayer benefits** include increased state and local tax revenues (from increased incomes), and savings from reduced state and local government expenditures for incarceration, health and welfare.

[24] Future benefits are worth less than present benefits. The present value of $5,000 to be received 30 years from today is worth only $1,603 given a 4% discount rate ($5,000/(1.04)^{30} = $1,603). If the same benefits occur each year for 30 years, each year's benefit must be discounted to the present, summed and collapsed into one value that represents the *cumulative* present value of all future benefits. Thus, the present value of 30-years' worth of $5,000 per year is $90,000.

[25] The criteria for feasibility: a) NPV must be positive or equal to zero; b) RR must be equal to or greater than the returns from other similar risk investments; c) the B/C ratio must be equal to or greater than 1; and d) the payback period is the number of years of benefits required to fully recover the investment made.

Table 3.4. Some Definitions

Terms	Definitions
Student Benefits	Higher earnings captured by the students
Taxpayer Benefits: Broad	Additions to earnings plus lower overall expenditures related to health, crime, welfare and unemployment
Taxpayer Benefits: Narrow	Increased state & local government tax collections plus lower state & local govt. expenditures related to health, crime, welfare and unemployment
Student Costs	Tuition (**Table 2.1**) + opportunity cost of time
Taxpayer Costs	Taxes (state and local, see **Table 2.1**)
Results:	
Student Perspective	Student Benefits / Student Costs
Taxpayer Perspective: Broad	Taxpayer Benefits (Broad) / Taxpayer Costs
Taxpayer Perspective: Narrow	Taxpayer Benefits (Narrow) / Taxpayer Costs

On the cost side, student costs consist of the tuition paid by the students (14.3% of the total in **Table 2.1**) and, most importantly, the opportunity cost of time (the earnings foregone). Also included here are the other sources of institutional revenues from private sources (19.2%). The taxpayer costs consist of the state and local tax items in **Table 2.1**, or a total of 11.4% plus 46.8% = 58.2%**.**

The opportunity cost (earnings foregone) incurred by the student body in the aggregate is estimated in **Table 3.5**. The first number in the table is the overall average statistical annual income of the student body (given gender and ethnicity characteristics). This number, however, reflects the midpoint of the lifetime trajectory of earnings, while what *is* needed is the earnings of the students while enrolled (which is expected to be less than earnings at the midpoint). This is the second number in the table, or $15,431 per year, assuming full-time employment. The adjustment from the first to the second number takes into account the average age of the student body and the relationship between earnings and age as specified by the well-known and tested "Mincer equation" (see, for example, Willis 1986, p 530).

We then deduct the retired student body (2.4%) to arrive at the net number of students subject to opportunity cost calculations— 103,654 students. The 25,410 not working are charged the full opportunity cost of time (based on the average term in residence), or $170.4 million. The 78,244 working students are charged only a fraction of the full opportunity cost (62%), or $199.4 million as indicated in the table. Finally, we adjust the opportunity cost downward by the Pell and other student aid grants and the estimated 10% adjustment for the restricted use of these grants for tuition and fees.

Table 3.5. Opportunity Costs (Earnings Foregone), $ per Year

			Opp. Cost
Avg. statistical annual income of given gender and ethnicity profile		$25,314	
Annual income, given gender and ethnicity profile, at current age of students		$15,431	
CHEs per student (net of retired)	13.0		
Avg. term in residence and avg. income while in residence	43%	$6,705	
Total number of students		106,201	
Less retired %	2.4%	2,547	
Remaining students subject to opportunity cost computation		103,654	
Students not working while attending college and opportunity cost	25%	25,410	$170,367,210
No. of working students		78,244	
% working part time, earnings relative to stat. averages, and opp. cost	62%	$2,548	$199,401,841
Total opportunity cost			$369,769,051
Pell and other student aid		$52,182,447	
Restricted portion of student aid (tuition and fees)	10%	$5,218,245	($46,964,202)
GRAND TOTAL STUDENT OPPORTUNITY COST			$322,804,849

We also present the results in different ways. First, the student perspective results indicate whether the education obtained at the Oklahoma community colleges pays by comparing the private benefits (higher earnings) to the private costs. Second (as discussed in the previous chapter), we compare *all* private and public benefits to the public costs (the state and local taxpayer contributions in **Table 2.1**) in a **broad taxpayer perspective** in present value terms. Third and finally, in a **narrow taxpayer perspective**, we compare only a portion of the public benefits (taxpayer actual savings) to the public costs; i.e., do state and local taxpayer investments of $180.8 million (**Table 2.1**) pay off in terms of the public savings generated?

The Student Perspective

The collective investment of the students (time and money) is assessed in **Table 3.6.** Column 1 tracks the increased earnings of the student body as they leave the colleges, and follows them over the course of their assumed working lives (65 - 28.4 = 37 years, see **Table 2.4**). The upward trend in earnings mimics the Mincer equation (see Willis, 1986). It reflects both the growth in students' earnings over time and the spread in the increased earnings attributable to education.[26] Column 2 is simply Column 1 reduced by the 10% discount value that accounts for causation factors affecting student earnings. Column 3 shows the cost of the single year's education. Finally, Column 4 looks at the educational investment from a cash flow perspective, subtracting annual costs from the annual benefits.

Table 3.6. Student Earnings ($ Thousands)

Year	1 Higher Earnings Gross	2 Higher Earnings Net	3 Cost	4 Net Cash Flow
1	$22,067	$19,860	$425,820	($405,960)
2	$32,727	$29,454	$0	$29,454
3	$81,030	$72,927	$0	$72,927
4	$89,529	$80,576	$0	$80,576
5	$98,488	$88,639	$0	$88,639
6	$107,889	$97,100	$0	$97,100
7	$117,709	$105,938	$0	$105,938
8	$127,919	$115,127	$0	$115,127
9	$138,484	$124,636	$0	$124,636
10	$149,366	$134,429	$0	$134,429
11	$160,520	$144,468	$0	$144,468
12	$171,897	$154,707	$0	$154,707
13	$183,443	$165,098	$0	$165,098
14	$195,099	$175,589	$0	$175,589
15	$206,804	$186,124	$0	$186,124
16	$218,493	$196,644	$0	$196,644
17	$230,097	$207,087	$0	$207,087
18	$241,546	$217,391	$0	$217,391
19	$252,769	$227,492	$0	$227,492
20	$263,693	$237,324	$0	$237,324
21	$274,247	$246,822	$0	$246,822
22	$284,359	$255,923	$0	$255,923
23	$293,959	$264,563	$0	$264,563
24	$302,982	$272,683	$0	$272,683
25	$311,362	$280,225	$0	$280,225
26	$319,040	$287,136	$0	$287,136
27	$325,961	$293,365	$0	$293,365
28	$332,076	$298,869	$0	$298,869
29	$337,341	$303,607	$0	$303,607
30	$341,719	$307,547	$0	$307,547
31	$345,179	$310,661	$0	$310,661
32	$347,699	$312,929	$0	$312,929
33	$349,262	$314,336	$0	$314,336
34	$349,862	$314,876	$0	$314,876
35	$349,499	$314,549	$0	$314,549
36	$348,180	$313,362	$0	$313,362
0	$175,822	$158,240	$0	$158,240
0	$76,280	$68,652	$0	$68,652
0	$38,856	$34,970	$0	$34,970
NPV		$3,300,837	$409,443	$2,891,394
IRR				23.4%
B/C ratio				8.1
Payback (years)				6.4

Does attending the 14 Oklahoma Community College districts make economic sense for the students? The answer is a resounding **yes**. The future stream of benefits (higher earnings) accruing to the students has an NPV of $2.9 billion **(Table 3.6)—**a positive NPV (greater than zero) indicates that the investments made are strongly feasible. The B/C ratio of 8.1 is strongly positive since the ratio is well above 1. The RR of 23.4% is also well above the long-term rates of return obtainable in the stock or bond markets, and certainly above the 4.0% discount rate used in the analysis. In the long run,

[26] We computed a Mincer equation based on the estimated coefficients presented in Willis, 1986, p. 545. These were adjusted to 2001 dollars in the usual fashion by applying the "GDP Implicit Price Deflator."

therefore, the average student will be substantially better off attending a community college. The payback period for a student (tuition plus the earnings foregone) is 6.4 years—the higher earnings received beyond that period are pure economic rent—or a persistent earnings flow over and beyond the initial investments.

The Broad Taxpayer Perspective

Table 3.7 assesses one year's operation of the CCs from the broad taxpayer perspective. The Legislature, on behalf of taxpayers, must weigh requests for funding against the myriad other public needs. As such, they need information to better allocate increasingly scarce resources between alternative and competing ends. Column 1 shows the stream of total benefits, including increased earnings, and social savings from reduced spending on incarceration, health, welfare and unemployment. Specifics on the estimation of values in Column 1 are presented in **Volume 2: Detailed Results, Table 19**. Column 2 adjusts for the 17% alternative education opportunity assumption (the percentage of the student body able to avail themselves of similar education elsewhere, absent the Oklahoma community colleges). Column 3 conveys an adjustment needed to account for the fact that some of the CCs might be able to operate at some level of enrollment absent state and local government support, i.e., by raising tuition (see **Appendix 3** for technical details). Column 4 is simply Column 1 less Column 2 and Column 3. Column 5 shows the state and local taxpayer cost for a single year, as reflected in state and local tax items in **Table 2.1**. Finally, Column 6 considers the broad perspective on the taxpayer's investment in a cash flow sense, subtracting annual costs from annual benefits.

The NPV given this broad perspective is $2.8 billion and the B/C ratio is 16.9. **More succinctly, every dollar of tax monies spent on community college education will generate a total of $16.90 worth of social savings.**[27]

[27]A word of caution—the RR approach sometimes generates percentage results 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. A very high percentage return may be technically correct, but perhaps not consistent with conventional understanding of returns expressed as percentages. For purposes of the reports prepared for all colleges in the statewide system, therefore, we express all RR results as: "NA" (particularly for the broad taxpayer perspective where high returns are expected). Only the B/C ratio is reported for the broad taxpayer perspective.

Table 3.7. Taxpayer Perspective: Broad ($ Thousands)

Year	1 All Benefits	2 Benefits from Alt. Ed. Opportunities	3 Benefits w/o State & Local Gov Funding	4 Net Benefits	5 Total Taxpayer Costs	6 Less College Income Cash Flow
1	$402,013	$10,317	$21,360	$370,336	$180,828	$189,507
2	$64,414	$11,592	$4,049	$48,773	$0	$48,773
3	$101,024	$18,070	$5,463	$77,491	$0	$77,491
4	$107,183	$19,144	$5,783	$82,255	$0	$82,255
5	$113,669	$20,275	$6,122	$87,271	$0	$87,271
6	$120,465	$21,461	$6,478	$92,526	$0	$92,526
7	$127,554	$22,698	$6,851	$98,005	$0	$98,005
8	$134,910	$23,983	$7,238	$103,689	$0	$103,689
9	$142,508	$25,310	$7,640	$109,558	$0	$109,558
10	$150,316	$26,674	$8,053	$115,588	$0	$115,588
11	$158,299	$28,070	$8,478	$121,751	$0	$121,751
12	$166,420	$29,490	$8,911	$128,019	$0	$128,019
13	$174,638	$30,928	$9,350	$134,360	$0	$134,360
14	$182,908	$32,375	$9,794	$140,739	$0	$140,739
15	$191,184	$33,824	$10,239	$147,121	$0	$147,121
16	$199,417	$35,266	$10,684	$153,468	$0	$153,468
17	$207,558	$36,692	$11,125	$159,741	$0	$159,741
18	$215,554	$38,094	$11,560	$165,900	$0	$165,900
19	$223,353	$39,461	$11,986	$171,906	$0	$171,906
20	$230,903	$40,786	$12,400	$177,717	$0	$177,717
21	$238,153	$42,058	$12,800	$183,295	$0	$183,295
22	$245,050	$43,270	$13,182	$188,599	$0	$188,599
23	$251,547	$44,411	$13,544	$193,592	$0	$193,592
24	$257,596	$45,475	$13,884	$198,237	$0	$198,237
25	$263,154	$46,453	$14,199	$202,502	$0	$202,502
26	$268,178	$47,338	$14,486	$206,354	$0	$206,354
27	$272,632	$48,123	$14,743	$209,765	$0	$209,765
28	$276,482	$48,804	$14,969	$212,710	$0	$212,710
29	$279,701	$49,373	$15,162	$215,166	$0	$215,166
30	$282,265	$49,828	$15,320	$217,116	$0	$217,116
31	$284,155	$50,165	$15,443	$218,547	$0	$218,547
32	$285,359	$50,382	$15,529	$219,448	$0	$219,448
33	$285,868	$50,478	$15,577	$219,813	$0	$219,813
34	$285,682	$50,451	$15,589	$219,642	$0	$219,642
35	$284,804	$50,303	$15,563	$218,938	$0	$218,938
36	$283,244	$50,036	$15,499	$217,709	$0	$217,709
0	$137,270	$28,249	$13,196	$95,825	$0	$95,825
0	$58,465	$9,599	$6,397	$42,468	$0	$42,468
0	$29,562	$5,751	$4,561	$19,250	$0	$19,250
NPV				$2,937,897	$173,873	$2,764,023
IRR						NA
B/C ratio						16.9
Payback (years)						NA

The Narrow Taxpayer Perspective

Table 3.8 provides an investment analysis of the Oklahoma community colleges from the narrow taxpayer perspective. Recall from **Chapter 2** that the narrow perspective considers only monies that actually appear on the books of state and local governments: revenue items such as tax receipts, and expenditure items such as road, bridge and street maintenance, police, public libraries and hospitals, jails and prisons, welfare payments, and so on.

Table 3.8, Column 1 shows additions to state and local government revenues stemming from the operation of the Oklahoma community colleges during the single analysis year. The values in Column 1 are computed by applying average state and local government tax rates to the net increase in statewide income attributed to the Oklahoma community college system.[28] Also included in Column 1 are reductions (entered as negatives) in state and local government expenditures on crime, welfare, unemployment and health. Projected dollar amounts in Column 1 are thus the sum of additional taxes collected, plus associated tax dollars saved as a result of the education provided by the colleges during the single analysis year.

Column 2 reflects the adjustment attributable to the alternative education variable, while Colum 3 reflects the ability of some of the CCs to operate without the current level of state and local government support, as discussed above and in **Appendix 3**. Column 4 shows net benefits, Column 1 minus Columns 2 and 3. Colum 4 shows state and local government costs, taken directly from **Table 2.1**. Finally, Column 6 subtracts state and local government cost from benefits, thereby providing the temporal cash flow needed for the investment analysis. As shown at the bottom of the table, the colleges provide state and local government with an aggregate annual return of $317.7 million expressed as a net present value on its one year investment. Alternatively, the one year investment generates a 14.9% RR and a B/C ratio of 2.8, both indicating that the investment is attractive. The payback period is 8.8 years.

The returns shown in **Table 3.8** would be attractive even in the private sector, and they are very attractive in the public sector. Recall that the public sector generally undertakes those activities the private sector finds unprofitable, i.e., investments that generate book revenues insufficient to cover book costs, thus requiring taxpayer subsidy. For example, state governments fund the operation and maintenance of state parks at a substantial loss, collecting revenues in the form of camping and entrance fees that cover only a fraction of costs. Taxpayers are willing to subsidize parks because they perceive off-budget benefits, e.g., access to the outdoors, state development effects, environmental protection, and so on, that justify the budgetary losses. Note that this broader collection of off-budget benefits would normally be captured in the broad taxpayer perspective.

Table 3.8. Taxpayer Perspective: Narrow ($ Thousands)

Year	1 Total Taxpayer Benefits	2 Benefits from Alt. Ed. Opportunities	3 Benefits w/o State & Local Gov Funding	4 Net Taxpayer Benefits	5 Total Taxpayer Costs	6 Net Cash Flow
1	$64,966	$539	$3,468	$60,959	$180,828	($119,869)
2	$12,531	$2,293	$779	$9,459	$0	$9,459
3	$18,203	$3,296	$998	$13,909	$0	$13,909
4	$19,147	$3,460	$1,047	$14,640	$0	$14,640
5	$20,142	$3,634	$1,099	$15,410	$0	$15,410
6	$21,185	$3,815	$1,153	$16,216	$0	$16,216
7	$22,274	$4,005	$1,211	$17,058	$0	$17,058
8	$23,404	$4,202	$1,270	$17,932	$0	$17,932
9	$24,571	$4,406	$1,332	$18,834	$0	$18,834
10	$25,772	$4,615	$1,395	$19,761	$0	$19,761
11	$26,999	$4,830	$1,460	$20,709	$0	$20,709
12	$28,248	$5,048	$1,527	$21,674	$0	$21,674
13	$29,512	$5,269	$1,594	$22,649	$0	$22,649
14	$30,785	$5,491	$1,663	$23,631	$0	$23,631
15	$32,058	$5,714	$1,731	$24,613	$0	$24,613
16	$33,325	$5,936	$1,799	$25,590	$0	$25,590
17	$34,577	$6,155	$1,867	$26,555	$0	$26,555
18	$35,807	$6,370	$1,934	$27,503	$0	$27,503
19	$37,007	$6,580	$1,999	$28,427	$0	$28,427
20	$38,168	$6,784	$2,063	$29,321	$0	$29,321
21	$39,282	$6,979	$2,124	$30,178	$0	$30,178
22	$40,341	$7,165	$2,183	$30,993	$0	$30,993
23	$41,339	$7,340	$2,239	$31,760	$0	$31,760
24	$42,267	$7,503	$2,291	$32,473	$0	$32,473
25	$43,119	$7,652	$2,339	$33,127	$0	$33,127
26	$43,887	$7,788	$2,383	$33,717	$0	$33,717
27	$44,568	$7,907	$2,422	$34,238	$0	$34,238
28	$45,155	$8,011	$2,457	$34,687	$0	$34,687
29	$45,644	$8,097	$2,486	$35,060	$0	$35,060
30	$46,031	$8,166	$2,510	$35,355	$0	$35,355
31	$46,313	$8,216	$2,528	$35,569	$0	$35,569
32	$46,489	$8,247	$2,541	$35,701	$0	$35,701
33	$46,557	$8,260	$2,548	$35,749	$0	$35,749
34	$46,518	$8,254	$2,549	$35,715	$0	$35,715
35	$46,371	$8,229	$2,544	$35,598	$0	$35,598
36	$46,118	$8,185	$2,534	$35,399	$0	$35,399
0	$22,482	$4,634	$2,151	$15,697	$0	$15,697
0	$9,553	$1,573	$1,041	$6,939	$0	$6,939
0	$4,844	$946	$741	$3,157	$0	$3,157
NPV				$491,573	$173,873	$317,699
IRR						14.9%
B/C ratio						2.8
Payback (years)						8.8

Investments in public education are usually viewed in the same way as investments in parks and other publicly subsidized activities, i.e., activities that generate losses from a narrow investment perspective but are justified by net benefits from a broad investment perspective. As shown in **Table 3.8,** however, the 14 Oklahoma CC districts are a notable exception to this general net-subsidy rule. The narrow perspective rate of return

[28] Increased income includes a portion of direct student earnings, salaries and wages at the colleges during the single analysis year, and an additional increment aimed at a collection of backward and forward multiplier effects.

is strongly positive, and thereby indicates that the taxpayers' investments in the college generate increased public revenues and reduced expenditures that actually exceed the subsidy by taxpayers. **The practical effect of this is the following: if the investments made in the Oklahoma community colleges were reduced, taxes would have to be raised in order for state and local governments to continue their support of other activities at current levels. The taxpayer investments of 58% of the total revenues (Table 2.1), in effect, subsidize other sectors of the economy that also receive taxpayer support. The simple bottom line from the narrow taxpayer perspective is that benefits accruing to the taxpayers far outweigh the relatively low investments they make in the colleges.**

With and Without Social Benefits

In **Chapter 2** the social benefits attributable to CC education (reduced crime, welfare and unemployment, and improved health) were defined as *external benefits*, incidental to the operations of the college. Colleges do not directly aim at creating these benefits. Some would question the legitimacy of including these benefits in the calculation of the rates of return to higher education, arguing that only the direct benefits—the higher earnings—should be counted. **Tables 3.7** and **3.8** are both inclusive of the social benefits reported here as attributable to the college. Recognizing the other point of view, **Table 3.9** shows the rates of return for both the broad and narrow perspectives exclusive of the social benefits. As indicated, the returns are still well above the threshold values (a B/C ratio greater than 1) confirming that the taxpayers receive great value from investing in Oklahoma's CC Districts.

Table 3.9. Taxpayer Perspective ($ Thousands)

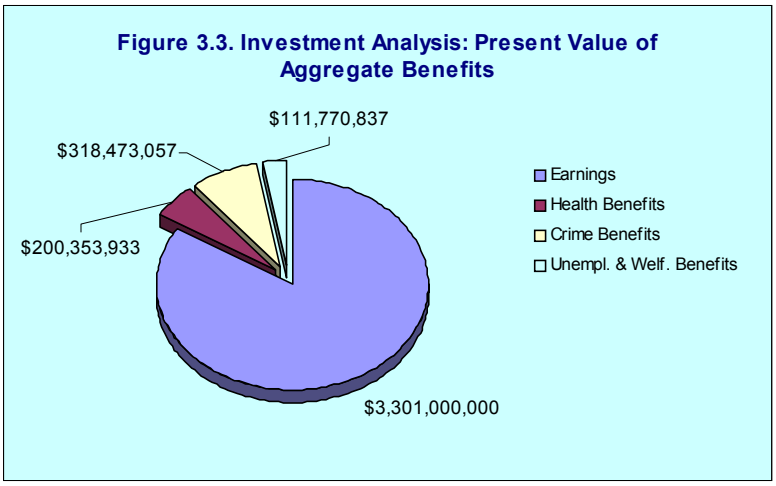
	Broad Perspective With Social Savings		Narrow Perspective With Social Savings	
	Included	Excluded	Included	Excluded
NPV	$2,764,023	$2,313,767	$317,699	$212,405
IRR	NA	NA	14.9%	10.8%
B/C ratio	16.9	14.3	2.8	2.2
Payback (years)	NA	NA	8.8	12.3

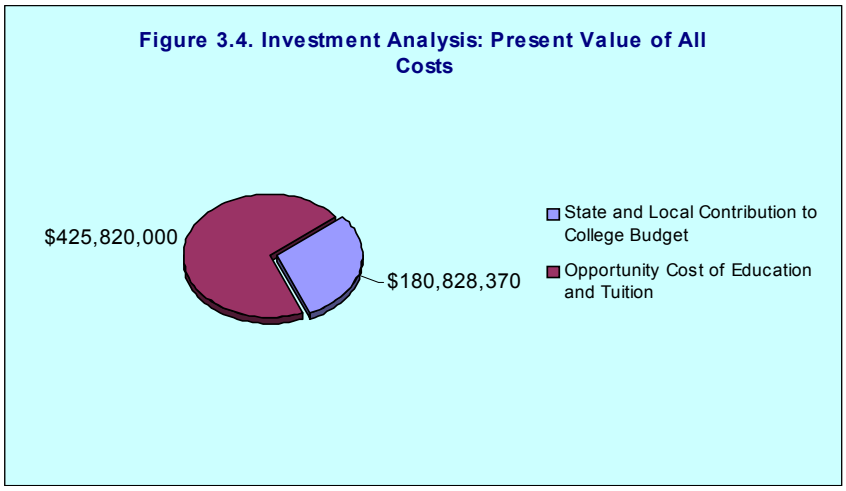
Summary

A summary of the investment analysis results (also reported in **Tables 3.6 – 3.8** above) is provided in **Table 3.10,** on aggregate, per CHE, and per student bases. The pie chart in **Figure 3.3** shows the breakdown of the present values of the aggregate benefits, taken from **Table 3.10**. **Figure 3.4** shows the breakdown of the investments made by the students (tuition and fees plus opportunity cost of time) and the contribution made by the state through local taxes and appropriations (see "PV of all costs" in **Table 3.10**).

Table 3.10. Benefit - Cost Summary

	Aggregate	Per Credit	Per Student
PV of student benefits, increased earnings	$ 3,301,000,000	$2,419	$ 31,083
Health benefits, captured by society			
PV of absenteeism savings	$ 87,654,437	$64	$ 825
PV of tobacco and alcohol abuse medical savings	$ 112,699,495	$83	$ 1,061
Crime			
PV of reduced incarceration	$ 127,468,538	$93	$ 1,200
PV of reduced victim costs	$ 140,387,491	$103	$ 1,322
PV of earnings (opportunity gained)	$ 50,617,028	$37	$ 477
Unemployment and welfare			
PV of reduced welfare rolls	$ 54,157,026	$40	$ 510
PV of reduced unemployment	$ 57,613,811	$42	$ 542
Sum of all present values, benefits	$ 3,931,597,827	$ 2,881	$ 37,020
PV of all costs			
PV of state and local contribution to college budget	$ 180,828,370	$133	$ 1,703
PV of opportunity cost of education + tuition	$ 425,820,000	$312	$ 4,010
Sum of all present values, costs	$ 606,648,370	$ 445	$ 5,712
NPV, Student Perspective		$2,891,394	
RR, Student Perspective		23%	
B/C Ratio, Student Perspective		8.1	
Payback Period, Student Perspective		6.4	
NPV, Taxpayer Perspective: Broad		$2,764,023	
RR, Taxpayer Perspective: Broad		NA	
B/C Ratio, Taxpayer Perspective: Broad		16.9	
Payback Period, Taxpayer Perspective: Broad		NA	
NPV, Taxpayer Perspective: Narrow		$317,699	
RR, Taxpayer Perspective: Narrow		14.9%	
B/C Ratio, Taxpayer Perspective: Narrow		2.8	
Payback Period, Taxpayer Perspective: Narrow		8.8	





STATEWIDE ECONOMIC BENEFITS

The 14 Oklahoma Community College districts play an important role in the resiliency, growth and development of the state economy. In 2002, the State of Oklahoma generated overall earnings (wages, salaries and proprietors' income) equal to $60.7 billion.[29] The portion of this total credited to the existence of the 14 Oklahoma CC districts is discussed in the four subsections below, both in the aggregate and with

[29] Total earnings for the State of Oklahoma are obtained from Woods & Poole Economic, Inc. (see www.woodsandpoole.com). Woods & Poole Economic, Inc. specializes in county-level economic and demographic projections. Their earnings estimates are based on estimates published by the US Department of Commerce, Regional Economic Information System (REIS), projected forward on the basis of historic trends.

industry detail. The industry-specific analysis highlights the Oklahoma CC districts' contribution to the statewide business community.

We begin with the day-to-day operating and capital expenditures of the colleges. These are fed into the regional IO model to estimate the earnings impacts generated by industry. Next, we consider the value of workforce-embodied CHEs to the earnings of past students, and then estimate the net portion that can be counted as increased regional income—the *direct impact* of past Oklahoma CC instruction. In the third section we utilize the multipliers of the regional IO model and estimate the *indirect impact* of past Oklahoma CC instruction on statewide earnings. In the fourth and final subsection we combine the three separate effects: 1) CC operations and capital spending effects, 2) past student direct effects, and 3) past student indirect effects, to arrive at the overall aggregate effect of Oklahoma's CC Districts on earnings in the State of Oklahoma.

Earnings Linked to Operation and Capital Spending

Table 2.10 in **Chapter 2** shows the 14 Oklahoma CC districts' operating and capital spending during the analysis year. The last column (Column 6) of that table shows how much of the overall spending is captured by state vendors and other suppliers, i.e., the portion that stays in the state economy. The values in Column 6 are applied to the State of Oklahoma IO model to estimate the associated multiplier effects.

Table 3.11 shows the results of the IO multiplier analysis of Oklahoma's CC Districts' operating and capital spending. Column 1 is for reference, showing 2002 total ea*rnings* by industry. Column 2 shows the portion of total earnings explained by (or accounted for by) Oklahoma's CC Districts' spending, and Column 3 shows college-linked earnings as a percentage of total earnings by industry. For example, the construction sector in the State of Oklahoma had $3.1 billion in total earnings in 2002. Of this, Oklahoma's CC Districts' spending accounts for $12.4 million (or 0.4%). Similarly, the business-services sector (services to buildings, advertising, reproduction, legal and accounting services, etc.) had $5.1 billion in total earnings in 2002, of which $28.4 million (or 0.6%) was explained by Oklahoma's CC Districts' spending. All told, Oklahoma's CC Districts' spending explained $330.8 million, or 0.5% of all statewide earnings in 2002.

Table 3.11. Earnings Linked to Oklahoma's CC Districts Operations Expenditures

Industries	Earnings Baseline ($1,000) 1	Earnings College-Linked ($1,000) 2	% College-Linked 3
Agriculture & Agricultural Services	$1,258,288	$1,475	0.1%
Mining, Sand, and Gravel	$2,961,463	$1,356	0.0%
Construction	$3,119,570	$12,408	0.4%
Manufacturing: Food/Wood & Paper/Textiles	$1,418,637	$2,755	0.2%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$5,606,516	$5,432	0.1%
Manufacturing: Computer & Electronic Equipment	$767,672	$124	0.0%
Manufacturing: Other	$1,589,817	$129	0.0%
Transportation	$2,184,394	$3,765	0.2%
Public Utilities	$743,689	$2,624	0.4%
Publishing & Communications	$1,670,422	$2,205	0.1%
Trade	$8,698,421	$20,995	0.2%
Finance, Insurance, and Real Estate	$3,169,847	$10,351	0.3%
Motels & Eating/Drinking & Amusement/Recreation	$1,833,717	$6,368	0.3%
Consumer Services	$2,065,100	$5,442	0.3%
Business Services	$5,116,890	$28,416	0.6%
Medical/Educational/Social services	$6,202,257	$20,808	0.3%
Federal Government	$4,521,894	$3,006	0.1%
State & Local Government (less the college)	$7,590,945	$2,723	0.0%
Oklahoma's CC Districts	$200,406	$200,406	100.0%
Total	$60,719,947	$330,791	0.5%

Past Student Economic Development Effects: The Direct Effect

Switching now to the past students, the objective is to assign value to the embodied CHE's still operative in the statewide workforce. These skills increase the productivity of the statewide workforce: existing industry becomes more efficient, competitive, and able to expand product lines. Also, new industry can be attracted to the state. The net effect is an enlargement of the statewide income, whether existing industry expands or new industry is created.

In **Table 2.13** we derived an estimate of 30.7 million of past CHEs embodied in the present-day statewide workforce. In **Table 3.12**, we detail the steps that take us from CHEs embodied in the workforce to an estimate of the *net* impact of Oklahoma's CC Districts' instruction on statewide earnings:

- Step 1: We show the 30.7 million of past CHEs embodied in the current workforce.

- Step 2: As shown earlier in this chapter (**Table 3.3**), the average net value for earnings was reported as $124. The net value was derived as the gross value less

10%.[30] For the statewide economic development effect, however, we need to begin with the *gross* value per CHE, or $129.

- Step 3: The product of the total embodied CHEs and the gross value per CHE comprises the initial estimate of the aggregate addition to past student earnings of Oklahoma's CC Districts' instruction.

- Step 4: In **Chapter 2**, **Table 2.2** we described the source and meaning of the "alternative education opportunity variable." Absent Oklahoma's CC Districts, 17.1% of the students would still be able to obtain their education elsewhere. This portion of the added earnings is not credited to Oklahoma's CC Districts in the calculation of statewide growth effects for reasons stated in the previous chapter. The initial estimate of the aggregate addition to past student earnings, therefore, is restated as the net of the alternative education opportunity, indicated in **Table 3.12**.

- Step 5: Finally, the last adjustment reduces the earnings of past students to all but 33% of the previous number. As discussed in detail in **Chapter 2** (see text box on polar cases), the reasons for the significant discounting of past student earnings pertains largely to issues of worker substitution, i.e., the substitution of state skilled for state unskilled workers, and the substitution of out-of-state workers for in-state workers. As for the specific 33% value, this is borrowed from the economics literature on national income growth and education (see: Bils and Klenow, 2000).

Table 3.12. Estimating the Net Statewide Income Effect of Embodied CHEs

	Variables
Total embodied CHEs	30,654,447
Gross value per Oklahoma's CC Districts CHE	$129
Increased earnings of past Oklahoma's CC Districts students	$3,964,351,608
Alternative education %	17%
Gross earnings attributable to Oklahoma's CC Districts, net of alternative education variable	$3,287,835,301
Substitution Effects Rate	33%
Net earnings attributable to Oklahoma's CC Districts	$1,084,985,649

[30] **Table 3.3** assigns a $124 net per CHE value of Oklahoma's CC Districts' instruction. This is a net value reflecting a 10% reduction from the gross value of $1.1 billion to account for a collection of correlation-causation factors as discussed in **Chapter 2** under the section "Annual Private Benefits." Rather than *personal* income effects, however, the present section looks at *regional* income effects. Estimating the latter entails an entirely different set of correlation-causation adjustments; hence, we start again with the gross value, $1.1 billion.

As shown in the last entry of **Table 3.12**, our analysis concludes that earnings in the State of Oklahoma are $1.1 billion larger than they would be otherwise, because of the skills of past students embodied in the present-day workforce.

The statewide business community is naturally interested in how the 14 Oklahoma CC districts affect its operations. This is shown in **Table 3.13**. Beginning with Column 4 in **Table 2.13,** the distribution of historic past student CHEs by industrial sector is translated in **Table 3.13** into the increase in aggregate earnings across these same industrial sectors. The distribution of aggregate earnings is based on the distribution of past student CHEs (**Table 2.13**, Column 4), weighted according to relative industry earnings.

The dollar figures shown in Column 2 of **Table 3.13** indicate how much larger the earnings in these industries are as a direct result of the Oklahoma CC skilled workers they employ. The Manufacturing: Computer & Electronic Equipment sector, for example, is estimated to employ Oklahoma CC students with a combined 301,809 hours of CHEs (see **Table 2.13**). Because of the skills of these past students, the Manufacturing: Computer & Electronic Equipment sector is estimated to generate earnings that are $767.7 million (or 3.5% larger than they would be otherwise). The benefit to the business community is simply this: additional earnings mirror additional business volume, sales revenues, and property incomes. The direct effect of past students on other sectors is shown in the table. The statewide direct effect of past student skills are shown in the bottom row of **Table 3.13**: overall regional earnings are $1.1 billion (or 1.8%) higher than they would be if the 14 Oklahoma CC districts did not exist.

Earnings are larger because outputs are larger, existing industries produce more, and new industries are attracted to the state by the existence of a skilled workforce. The earnings effects shown in **Table 3.13** are called *direct effects,* because they reflect a portion of the increased earnings of past students themselves.

Table 3.13. Past Student Direct Effects

	Earnings		
	Baseline	College-Linked	% College Linked
	----------($1,000)----------		
Industries	1	2	3
Agriculture & Agricultural Services	$1,258,288	$2,216	0.2%
Mining, Sand, and Gravel	$2,961,463	$5,216	0.2%
Construction	$3,119,570	$5,494	0.2%
Manufacturing: Food/Wood & Paper/Textiles	$1,418,637	$12,493	0.9%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$5,606,516	$98,747	1.8%
Manufacturing: Computer & Electronic Equipment	$767,672	$27,042	3.5%
Manufacturing: Other	$1,589,817	$28,001	1.8%
Transportation	$2,184,394	$19,237	0.9%
Public Utilities	$743,689	$6,549	0.9%
Publishing & Communications	$1,670,422	$58,842	3.5%
Trade	$8,698,421	$153,205	1.8%
Finance, Insurance, and Real Estate	$3,169,847	$111,661	3.5%
Motels & Eating/Drinking & Amusement/Recreation	$1,833,717	$16,149	0.9%
Consumer Services	$2,065,100	$18,186	0.9%
Business Services	$5,116,890	$90,124	1.8%
Medical/Educational/Social services	$6,202,257	$218,480	3.5%
Federal Government	$4,521,894	$79,644	1.8%
State & Local Government	$7,791,352	$133,699	1.7%
Total	$60,719,947	$1,084,986	1.8%

Past Student Economic Development Effects: The Indirect Effect

To the direct effects shown in **Table 3.13**, we must now add *indirect effects* stemming from the action of the regional multiplier process. As earnings increase because of higher industry output, the demand for additional industry inputs increases as well. Moreover, with the higher *direct* earnings (shown in **Table 3.13**), workers have more money to spend, which increases sales in consumer-oriented sectors of the economy. On top of these added business inputs and worker expenditures, the action of the state multiplier generates still further rounds of industry output and earnings.[31]

There is another part to the indirect effect. Economic development theory describes an *agglomeration effect* whereby regional growth itself stimulates growth (see "The Indirect Economic Development Effects of Students" discussion in **Chapter 2**). In general, agglomeration occurs when additional state output attracts new industry, facilitates

[31] The multiplier effects described in this paragraph are traditional "backward" multiplier effects, and are estimated by applying the change in sectoral earnings shown in **Table 3.13** to the State of Oklahoma IO model.

economies of scale, enhances workforce efficiency through information sharing, and otherwise enhances the statewide business climate.[32]

Table 3.14 shows the total of the various indirect effects that accompany the direct effects of **Table 3.13**. These effects reflect increased business outputs independent of the actual employment of past students in particular sectors: i.e., they reflect the action of the multiplier process.

Table 3.14. Past Student Indirect Effects

Industries	Earnings Baseline ($1,000)	Earnings College-Linked ($1,000)	% College-Linked
Agriculture & Agricultural services	$1,258,288	$26,105	2.1%
Mining, Sand, and Gravel	$2,961,463	$40,145	1.4%
Construction	$3,119,570	$48,710	1.6%
Manufacturing: Food/Wood & Paper/Textiles	$1,418,637	$32,338	2.3%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$5,606,516	$111,432	2.0%
Manufacturing: Computer & Electronic Equipment	$767,672	$6,656	0.9%
Manufacturing: Other	$1,589,817	$8,706	0.5%
Transportation	$2,184,394	$54,297	2.5%
Public Utilities	$743,689	$18,379	2.5%
Publishing & Communications	$1,670,422	$33,547	2.0%
Trade	$8,698,421	$216,043	2.5%
Finance, Insurance, and Real Estate	$3,169,847	$102,914	3.2%
Motels & Eating/Drinking & Amusement/Recreation	$1,833,717	$62,706	3.4%
Consumer Services	$2,065,100	$65,399	3.2%
Business Services	$5,116,890	$206,422	4.0%
Medical/Educational/Social services	$6,202,257	$202,413	3.3%
Federal Government	$4,521,894	$54,956	1.2%
State & Local Government	$7,791,352	$89,307	1.1%
Total	$60,719,947	$1,380,475	2.3%

Focusing on particular effects, we can now say that because of the indirect effect of past students, earnings in the Business Services sector will be $206.4 million (or 4.0%) higher than would otherwise be the case. Other indirect sectoral effects are as shown in the table. The bottom row of **Table 3.14** indicates that region-wide total earnings are $60.7 billion, of which $1.4 billion (or 2.3%) is due to the indirect effect of past students.

[32] We estimate agglomeration effects as "forward" multiplier effects. The State of Oklahoma IO model is configured to provide a set of so-called supply-driven multipliers (see for example Miller and Blair, 1985). Agglomeration effects are obtained by applying the change in higher stage sectoral earnings from **Table 3.13** to the supply-driven form of the State of Oklahoma IO model.

Overall Effect of Oklahoma's CC Districts on the Statewide Economy

The tables above detail the regional economic effects attributable to Oklahoma's CC Districts in three parts. The effect of day-to-day college operations and capital spending is shown in **Table 3.11**. The direct effect of past students still active in the workforce is shown in **Table 3.13**. Finally, the indirect effect of past students still active in the workforce is shown in **Table 3.14**. **Table 3.15** combines these separate effects into one summary table.

Table 3.15. Total Effect

Industries	Earnings Baseline	Earnings College-Linked ($1,000)	% College-Linked
Agriculture & Agricultural services	$1,258,288	$29,796	2.4%
Mining, Sand, and Gravel	$2,961,463	$46,717	1.6%
Construction	$3,119,570	$66,612	2.1%
Manufacturing: Food/Wood & Paper/Textiles	$1,418,637	$47,586	3.4%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$5,606,516	$215,611	3.8%
Manufacturing: Computer & Electronic Equipment	$767,672	$33,822	4.4%
Manufacturing: Other	$1,589,817	$36,836	2.3%
Transportation	$2,184,394	$77,299	3.5%
Public Utilities	$743,689	$27,553	3.7%
Publishing & Communications	$1,670,422	$94,594	5.7%
Trade	$8,698,421	$390,243	4.5%
Finance, Insurance, and Real Estate	$3,169,847	$224,926	7.1%
Motels & Eating/Drinking & Amusement/Recreation	$1,833,717	$85,223	4.6%
Consumer Services	$2,065,100	$89,028	4.3%
Business Services	$5,116,890	$324,962	6.4%
Medical/Educational/Social services	$6,202,257	$441,702	7.1%
Federal Government	$4,521,894	$137,605	3.0%
State & Local Government (less the college)	$7,590,945	$225,729	3.0%
Oklahoma's CC Districts	$200,406	$200,406	100.0%
Total	$60,719,947	$2,796,252	4.6%

Individual rows in **Table 3.15** show how particular industries benefit from the past and present existence of the 14 Oklahoma CC districts. For example, our analysis suggests the State of Oklahoma's Medical/Educational/Social services sector owes $441.7 million (or 7.1%) of its overall earnings to the past and present existence of Oklahoma's CC Districts. The effect of Oklahoma's CC Districts on other industries is shown in the table. The bottom row of **Table 3.15** indicates that region-wide earnings are $60.7 billion, of which $2.8 billion (or 4.6%) is due to the past and present existence of the 14 Oklahoma CC districts.

Table 3.16. Summary of CCs Role in the State Economy

	Earnings ($Thousands)	% of Total
Total Earnings in State	$60,719,947	100%
Earnings Attributable to College Operations		
Direct Earnings of Faculty and Staff	$200,406	0.3%
Indirect Earnings	$130,385	0.2%
TOTAL	$330,791	0.5%
Earnings Attributable to Past Student Econ. Dev. Effects		
Direct Earnings	$1,084,986	1.8%
Indirect Earnings	$1,380,475	2.3%
TOTAL	$2,465,461	4.1%
GRAND TOTAL	$2,796,252	4.6%

Table 3.16 provides one last view of the regional economic effects of Oklahoma's CC Districts, a fully aggregated view with no industry detail. Consider the items under the heading "Earnings Attributable to Oklahoma's CC Districts Operations." The first item is simply the wages and salaries of the faculty and staff of the 14 Oklahoma CC districts, $200.4 million, or 0.3% of overall statewide earnings (this item is also shown in college spending **Table 2.11**). The second item shows the indirect effect of the colleges' operations and capital spending: $130.4 million, or 0.2% of all statewide earnings. All told, the operations and capital spending of the 14 Oklahoma CC districts can be credited with $330.8 million, or 0.5% of the State of Oklahoma's $60.7 billion in overall earnings.

The next set of items detail the effect of past students still active in the State of Oklahoma workforce. Past students directly explain $1.1 billion, or 1.8% of all statewide earnings (shown on the total row of **Table 3.13**). These same students indirectly explain $1.4 billion, or 2.3% of all statewide earnings (shown on the total row of **Table 3.14**). In all, past students still active in the workforce can be credited with $2.5 billion, or 4.1% of all earnings in the State of Oklahoma.

Finally, the bottom row of **Table 3.16** shows Oklahoma's CC Districts' overall role in the state's economy: $2.8 billion, or 4.6% of all statewide earnings.

Chapter 4
SENSITIVITY ANALYSIS OF KEY VARIABLES

INTRODUCTION

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

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

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

THE STUDENT EMPLOYMENT VARIABLES

Probably the most difficult data to collect are for the two employment variables (because colleges generally do not collect this kind of information as a matter of formal routine): 1) the percent of the students employed, and 2) of those employed, the earnings received by the students relative to the full earnings they would have received if not attending Oklahoma's CC Districts. Both employment variables relate to the earnings foregone by the students—the opportunity cost of time—and they affect the investment analysis results (NPV, RR, B/C, and payback period).

Percent of Students Employed

The students incur substantial expense by attending Oklahoma's CC Districts because of the time they spend not gainfully employed. Some of that cost is recaptured if the student remains partially (or fully) employed while attending. It is estimated that 75% of the current student body is employed. We test this variable in the sensitivity analysis by changing this assumption to 100%. This change would mean that *all* of the students are employed, reducing the average opportunity cost of time accordingly.

Percent of Earnings Relative to Full Earnings

The second opportunity cost variable is more difficult to estimate. On average for all 14 colleges, it is estimated that the students working while attending classes earn only 62%, on average, of the earnings they would have statistically received if not attending the CC. This suggests that many of the students hold part-time jobs earning minimum wage (or less than their "statistical" wages). The model captures these differences and counts them as a part of the opportunity cost of time. As above, we test this variable in the sensitivity analysis by changing the assumption to 100%. This would mean that the students are fully employed, and the average opportunity cost of time would be reduced accordingly.

Results

The changed assumptions (both of which would be consistent with advocacy analysis) generate the results summarized in **Table 4.1**. Here, the base case assumptions taken from **Table 2.2** are reflected in the two shaded rows for the variables tested—75% for the portion of students employed, and 62% for their earnings relative to the statistical averages. These (base case) assumptions are held constant in the shaded rows for the student perspective. The sensitivity analysis results are shown in the non-shaded rows—the extent to which the investment analysis results would change if the two base case variables were increased to 100%, first separately, and second, together. Changing both assumptions to 100% (all students fully employed) would automatically increase the benefits because the opportunity cost of time would reduce to zero.

1. Increasing the students employed assumption from 75% to 100% first (holding all of the other assumptions constant), the RR, B/C, and payback period results would

improve to 28.8%, 10.7, and 5.3 years, respectively, relative to the base case results. The improved results are attributable to a lower opportunity cost of time—all students would be employed in this case.

2. Increasing the earnings relative to the statistical averages from 62% to 100% second (holding the second employment assumption constant at the base case level), the RR, B/C, and payback period results would improve to 37.6%, 15.2, and 4.3 years, respectively, relative to the base case results—a strong improvement over the base case results, again attributable to a lower opportunity cost of time.

3. Finally, increasing both of the above assumptions to 100% simultaneously, the RR, B/C, and payback period results would improve yet further to 73.3%, 33.3, and 2.7 years, respectively, relative to the base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to the statistical averages) while attending classes. These results are unrealistic, albeit not uncommon for advocacy analyses.

Table 4.1 Sensitivity Analysis of Student Perspective

Variables	Assumptions	RR	B/C	Payback
1. Percent Employed	75%	23.4%	8.1	6.4
	100%	28.8%	10.7	5.3
2. Percent of Earnings	62%	23.4%	8.1	6.4
	100%	37.6%	15.2	4.3
1 = 100%, 2 = 100%		73.3%	33.3	2.7

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

STATEWIDE ECONOMIC DEVELOPMENT

The economic impacts of higher education can be calculated in different ways. Our approach was to estimate the economic impacts of the 14 community colleges based on

college operations and capital spending (**Table 3.16**), and the increased productivity effects of past students in the regional workforce. The impacts were expressed in terms of regional *earnings*, i.e., area wages, salaries and proprietors' income, published by the U.S. Department of Commerce.[33] Others often add student spending to the impacts and express the results in terms of sales instead of earnings—both will substantially inflate the numerical measures of the impacts so that they appear larger than they really are. In the present section we address these two issues: 1) the addition of student spending effects to impact estimates, and 2) the expression of economic impacts in terms of regional gross sales rather than earnings.

The Economic Impact of Student Spending

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

In our analysis, however, we exclude student spending because most of the students already reside in state. Student expenditures, therefore, do not represent new monies in the region, but rather a redirection of monies that would have been spent anyway. The other side of the argument is that, even though the college-related spending of a resident student does not constitute new money, some students would leave the state to obtain an education elsewhere if the college were not present. Thus, the state loses the spending and related jobs and incomes. Both cases have merit, although we believe the former is more reasonable than the latter. This is because only a few students will actually be able to avail themselves of an education elsewhere (see **Table 2.9**). Our approach, therefore, is to exclude student spending, recognizing at the same time, that the regional impact estimates may err on the conservative side.

In **Table 4.2** we show the potential magnitude of student spending effects in the state economy. The table parallels **Table 3.16** in the previous chapter, but adds the section

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

"Earnings Attributable to Student Spending,"[34] creating some $103.4 million in additional earnings for the state businesses patronized by students (the direct effects), plus another $128.8 million in earnings stemming from related multiplier effects (indirect effects). Adding the student spending to the mix increases Oklahoma's CC Districts' total "explanatory power" of the regional earnings from 4.6% in **Table 3.16** to 5.0% in **Table 4.2**.

Table 4.2. Summary of CCs Role in the State Economy - Earnings

	Earnings ($ Thousands)	% of Total
Total Earnings in State	$60,719,947	100%
Earnings Attributable to Student Spending		
Direct Earnings	$103,361	0.2%
Indirect Earnings	$128,796	0.2%
TOTAL	$232,158	0.4%
Earnings Attributable to College Operations		
Direct Earnings of Faculty and Staff	$200,406	0.3%
Indirect Earnings	$130,385	0.2%
TOTAL	$330,791	0.5%
Earnings Attributable to Past Student Econ. Dev. Effects		
Direct Earnings	$1,084,986	1.8%
Indirect Earnings	$1,380,475	2.3%
TOTAL	$2,465,461	4.1%
GRAND TOTAL	$3,028,409	5.0%

Economic Impacts Reported as Gross Sales

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

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

[34] We estimated student spending effects by borrowing average college student information from a study conducted for higher education economic impacts in Illinois (University of Illinois, 2000). Student spending by broad expenditure category was bridged to the sectors of the statewide economy input-output model. Adjustments were made consistent with the model's regional accounts to allow for spending leakages.

expenditures will likely have very different meanings to the state economy. Of the $50,000 spent for the luxury automobile, perhaps $10,000 remains in-state as salesperson commissions and auto dealer income (part of the county's overall earnings), while the other $40,000 leaves the state 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 state, 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 4.3 expresses Oklahoma's CC Districts' impacts in terms of gross sales rather than earnings. Note that gross sales measures are everywhere larger than earnings. The economy-wide measure of total gross sales estimated by the economic model is $189.2 billion.[35] Direct local spending by students reflects their total spending, reduced by the estimated portion that leaks out-of-state to purchase goods produced elsewhere.[36] In the usual fashion, indirect effects reflect the action of local economic multiplier effects, also estimated by the economic model.

Direct state expenditures include all spending by the college for consumer items and for faculty and staff salaries. Both items are reduced to reflect purchases from outside the state. All told, the operation of the 14 colleges is estimated to explain some $8.6 billion in regional gross sales, a number substantially larger than the $3.0 billion explained by the college in regional gross earnings shown in **Table 4.2**.

While the gross sales impacts shown in **Table 4.3** are not incorrect, we prefer to report college impacts in terms of earnings (**Table 3.16**) rather than gross sales, because they reflect the economic realities in the state much more accurately. Advocacy studies, on the other hand, will often opt to express the results in terms of sales because the numbers are much more impressive. Such results, however, will likely not stand up to rigorous peer scrutiny in the economics profession.

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

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

Table 4.3. Summary of CCs Role in the State Economy - Sales

	Gross Sales (1,000)	% of Total
Total Gross Sales	$189,233,098	100%
Gross Sales Attributable to Student Spending		
Direct Spending by Students	$283,019	0.1%
Indirect Spending Effect	$394,897	0.2%
TOTAL	$677,916	0.4%
Gross Sales Attributable to College Operations		
Direct Expenditures of CC	$146,413	0.1%
Indirect Spending Effect	$245,286	0.1%
TOTAL	$391,698	0.2%
Gross Sales Attributable to Past Student Econ. Dev. Effects		
Direct Gross Sales	$3,270,399	1.7%
Indirect Gross Sales	$4,281,645	2.3%
TOTAL	$7,552,045	4.0%
GRAND TOTAL	$8,621,659	4.6%

THE ATTRITION RATE

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

One variable has consistently raised concerns among institutional researchers— the "Attrition Rate" variable, discussed in detail in **Table 2.2**. It cannot be specified on the basis of hard data collected on a regular basis by the college; rather, it is based on well-informed judgments made by faculty and staff intimately familiar with the student body. The attrition rate (20% in **Table 2.2)** characterizes the mobility of the exiting students out of the region over the next 30 years or so through retirement, out-migration and/or death. Given the nature of this variable and the difficulty in accurately specifying it, the obvious question is: how great a role does the attrition rate play in the magnitude of the results? The results are presented in the sensitivity analysis **Table 4.4**.

Table 4.4 Sensitivity Analysis of Attrition Rate Variable

	-75%	-50%	-25%	Base Case	25%	50%	75%
Attrition Rate Variable	5.0%	10.0%	15.00%	20%	25.00%	30.0%	35.0%
Regional Economic Development							
Earnings Attributable to College	$3,004,751	$2,936,753	$2,867,297	$2,796,252	$2,723,461	$2,648,745	$2,571,888
% of Total Earnings in State	4.9%	4.8%	4.7%	4.6%	4.5%	4.4%	4.2%
Credits Embodied in the Workforce	33,246,835	32,401,376	31,537,797	30,654,447	29,749,405	28,820,418	27,864,810

The attrition rate variable only affects the regional economic development results (**Table 3.16**). Variations in the attrition rate are calculated around the base case assumption of 20% (from **Table 2.2**), shown in the middle column of **Table 4.4**. We bracket the base case assumption on either side with plus or minus 25%, 50% and 75% variation in the assumptions. The analyses are then redone introducing one change at a time, holding all the other variables constant. Earnings attributable to the college, for example, range from a high of $3.0 million at -75% to a low of $2.6 million at a 75% variation from the base case assumption for this variable. This means that, if the attrition of the ex-students over time increases, the number of CHEs embodied in the current state workforce decreases; hence, the earnings attributable to the college decrease accordingly.

REFERENCES

Beck, Allen J. and Paige M. Harrison, 2001. Prisoners in 2000. US Department of Justice, Office of Justice Programs. NCJ 188207, August 2001. http://www.ojp.usdoj.gov/bjs/abstract/p00.htm.

Becker, Gary S., 1964. Human Capital: A Theoretical Analysis With Special Reference to Education. New York: Columbia University Press for NBER.

Bils, M. and P.J. Klenow, 2000. Does Schooling Cause Growth? American Economic Review, 90(5), 1160-1183.

Bonczar, Thomas P. and Alan J. Beck, 1997. Lifetime Likelihood of Going to State or Federal Prison. US Department of Justice, Office of Justice Programs, March 1997.

Borts, G. H., and J. L. Stein, 1964. Economic Growth in a Free Market. NY: Columbia University Press.

Cato Institute; Policy Analysis 240, 1995. Authors: Michael Tanner, Stephen Moore, and David Hartman. The Work Versus Welfare Tradeoff, An Analysis of Total Welfare Benefits by State.

Centers for Disease Control and Prevention; National Center for Health Statistics, Health, United States, 2001, Table 61.

The Center for Health Statistics, Health Promotion and Disease Questionnaire of the 1990 National Health Interview Survey.

Christaller, 1966; Central Places in Southern Germany (C.W. Baskins, trans.). Englewood Cliffs, N.J., Prentice Hall.

Christophersen, Kjell A., and H. Robison, 2000. The Socioeconomic Benefits of Community Colleges, Illustrated with Case Studies of Everett Community College and Walla Walla Community College in Washington State. Volume 1: Summary Report. EMSI, Consulting Economists.

Drake, R. L. 1976. A Shortcut to Estimates of Regional Input – Output Multipliers: Methodology and Evaluation. International Regional Science Review, Vol. 1, No. 2, Fall 1976.

Grubb, Norton, CCRC Brief No. 2, ICCN 15-26-2049, June 1999.

Heritage Foundation, Means-Tested Welfare Spending: Past and Future Growth, Testimony by Robert Rector, (3/07/01), http://www.heritage.org/library/testimony/test080101.html.

Losch, 1954. The Economics of Location (W.H. Woglom and W.F. Stolper, trans.). New Haven: Yale University Press.

Miller, R.E. and P. Blair. 1985. Input-Output Analysis: Foundations and Extensions. Englwood Cliffs, NJ: Prentice Hall.

Mincer, Jacob, 1958. Investment in Human Capital and Personal Income Distribution", *Journal of Political Economy*: 281-302.

Minnesota IMPLAN Group, Inc. www.implan.com.

Molitor, Chris and D. Leigh. March 2001. Estimating the Returns to Schooling: Calculating the Difference Between Correlation and Causation. Discussion Paper prepared for CCbenefits, Inc.

National Center for Education Statistics, The Digest of Education Statistics: 2000, 1990 K Street, NW, Washington, DC 20006, USA, Phone: (202) 502-7300, http://nces.ed.gov/pubs2001/digest/list_figures.html.

National Center for Education Statistics, Literacy Behind Walls, Prison Literacy Programs, DIGEST No. 159 Literacy in Corrections, Correctional Educational Association, http://www.nifl.gov/newworld/correct.htm.

National Institute on Drug Abuse and the National Institute on Alcohol Abuse and Alcoholism, http://www.nida.nih.gov/EconomicCosts/Index.html

Parr, J.B. 1999. "Regional Economic Development: An Export-Stages Framework." Land Economics, 77(1): 94-114.

Robison, M.H. 1997. "Community Input-Output Models for Rural Area Analysis: with an Example from Central Idaho," Annals of Regional Science, 31(3), 325-351.

Stevens, B.H., G.I. Treyz, D.J. Ehrlich, and J.R. Bower, 1983. "A New Technique for the Construction of Non-Survey Regional Input-Output Models," International Regional Science Review, 8(3), 271-186.

University of Illinois, Institute of Government and Public Affairs, 2000. Illinois Higher Education: Building the Economy, Shaping Society. Illinois Board of Higher Education.

US Census Bureau, Current Population Survey, 2000.

US Dept. of Commerce, Regional Economic Information Systems, Zip Code Business Patterns, 1998.

US Dept. of Commerce, US Bureau of the Census, 1998. Money Income of the United States 1998, Current Population Reports, Household and Economic Statistics Division.

U.S. Department Of Health And Human Services,Centers for Disease Control and Prevention, National Center for Health Statistics, Division of Data Services, Hyattsville, MD, 20782-2003, (301) 458-4636, http://www.cdc.gov/nchs/.

US Dept. of Commerce, County Business Patterns, annual.

US Dept. of Commerce, Economic Development Administration, "The Impact of EDA RLF Loans on Economic Restructuring," undertaken by Rutgers University Center for Urban Policy Research and Economic Modeling Specialists, Inc., 2002.

US Dept. of Commerce, Regional Economic Information System, county data on CD ROM, annual.

US Department of Commerce Statistical Abstract, 1997-1999.

Willis, Robert J., 1986, in *Handbook of Labor Economics, Vol. 1* , edited by Kenneth J. Arrow and Michael D. Intriligator. North Holland: Amsterdam

The National Clearinghouse for Alcohol and Drug Information
11426 Rockville Pike, Suite 200, Rockville, Maryland,
http://www.health.org/govstudy/bkd265/Index.htm

National Institute on Alcohol Abuse and Alcoholism (NIAAA)
6000 Executive Boulevard - Willco Building
Bethesda, Maryland 20892-7003, http://www.niaaa.nih.gov/

Bureau of Justice Statistics, Table #. 05 Total direct and intergovernmental expenditure, by activity and level of government, fiscal years 1980-97, Criminal Justice Expenditure and Employment Extracts Program, 12/14/00.

US Department of Labor, Bureau of Labor Statistics, Office of Employment and Unemployment, 2000.

US Department of Labor, The Public Purpose: U.S. Employee Absences by Industry, 2000.

U.S. Department of Treasury, The Economic Costs of Smoking in the United States and the Benefits of Comprehensive Tobacco Legislation http://www.ustreas.gov/press/releases/docs/tobacco.pdf.

Woods and Poole Economics, Inc. http://woodsandpoole.com.

Appendix 1: Explaining the Results—a Primer

The purpose of this appendix is to provide some context and meaning to investment analysis results in general, using the simple hypothetical example summarized in **Table 1** below. The table shows the projected (assumed) benefits and costs over time for one student and the associated investment analysis results.[37]

Table 1. Costs and Benefits

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

The assumptions are as follows:

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

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

[37] Note that this is a hypothetical example. The numbers used are not based on data collected from any of the community colleges.

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

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

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

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

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

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

THE NET PRESENT VALUE (NPV)

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

The question is simple: will the prospective student be economically better off by choosing to enroll? If we add up the higher earnings of $5,000 per year for the remaining nine years in **Table 1**, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different—

the benefits are far lower than $45,000 because future money is worth less than present money. The costs (tuition plus foregone earnings) are felt immediately because they are incurred today—in the present. The benefits (higher earnings), on the other hand, occur in the future. They are not yet available. We must discount all future benefits by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[38] 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 10, 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 10 years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 10 years from today given the going rate of interest of 4%. The process of discounting—finding the present value of future higher earnings—allows us to express values on an equal basis in future or present value terms.

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

The measure we are looking for is the NPV result of $15,074. It is simply the present value of the benefits less the present value of the costs, or $35,747 - $20,673 = $15,074. In other words, the present value of benefits exceeds the present value of costs by as much as $15,074. The criterion for an economically worthwhile investment is that the NPV 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 CC education is very strong.

THE INTERNAL RATE OF RETURN (IRR)

The IRR is another way of measuring the worth of the investment in education using the same cash flows shown in **Table 1**. In technical terms—the IRR is a measure of the

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

average earning power of the money used over the life of the investment. It is simply the interest rate that makes the NPV equal to zero. In the NPV example above we applied the "going rate" of interest of 4% and computed a positive NPV of $15,074. The question now is: what would the interest rate have to be in order to reduce the NPV to zero? Obviously it would have to be higher—18% in fact, as indicated in **Table 1**. Or, if we applied 18% to the NPV calculations instead of the 4%, then the NPV would reduce to zero.

What does this mean? The IRR of 18% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the NPV equals zero. Or, at 18%, the higher incomes of $5,000 per year for the next 9 years will earn back all the investments of $21,500 made plus pay 18% for the use of that money (the $21,500) in the meantime. Is this a good return? Indeed it is—first, if we compare it to the 4% "going rate" of interest we applied to the NPV calculations, 18% is far higher than 4%. We can conclude, therefore, that the investment in this case is solid. Alternatively, we can compare the rate to the long-term 7% rate or so obtained from investments in stocks and bonds. Again, the 18% is far higher, indicating that the investment in CC 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 IRR, but it would be a staggering 333% because only a negative $1,500 cash flow will be offsetting 9 subsequent years of $5,000 worth of higher earnings. The 333% return is technically correct, but not consistent with conventional understanding of returns expressed as percentages. For purposes of this report, therefore, we express all results in the Main Report exceeding 100% simply as: "> than 100%."

THE BENEFIT/COST RATIO (B/C)

The B/C 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 B/C ratio. If we applied the 18% IRR discussed above, the B/C ratio would reduce to 1.0—or the breakeven solution where benefits just equal the costs. Applying a discount rate higher than the 18 percent 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 10-year time period.

THE PAYBACK PERIOD

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

Appendix 2: Methodology for Creating Income Gains by Levels of Education

The US Bureau of the Census reports income in two ways:

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

2) Educational attainment by mean income and sex.

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

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

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

Further contact information: a) Income Surveys Branch, b) Housing & Household Economic Statistics Division, c) U.S. Census Bureau, and d) U.S. Department of Commerce.

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

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

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

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

4. To simplify the analysis, all nonwhite males are averaged together as are all nonwhite females. The same process is repeated for white males and white females.

5. The educational levels of attainment are aggregated together in some categories to model the educational system of community colleges. These numbers are then adjusted for inflation to 2001dollars.

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

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

INTRODUCTION

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

STATE AND LOCAL GOVERNMENT SUPPORT VERSUS TUITION

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

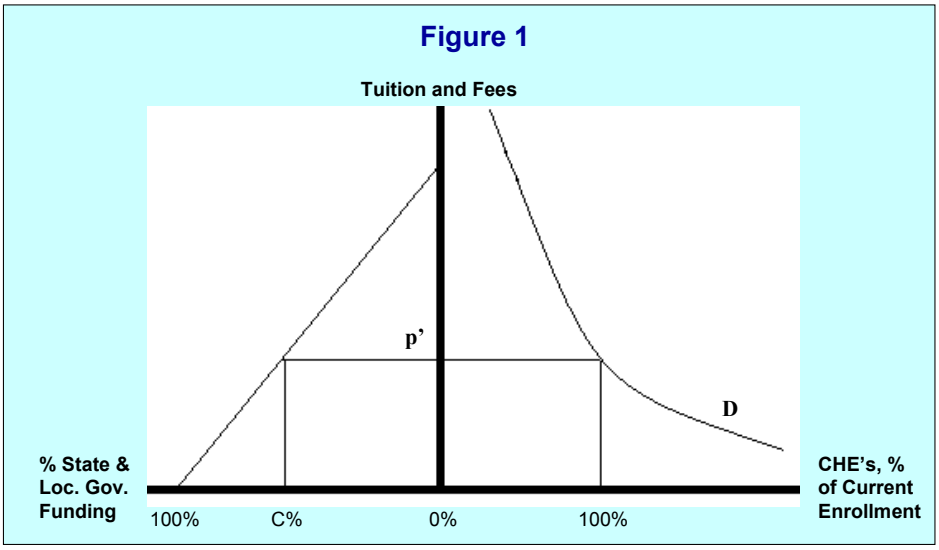
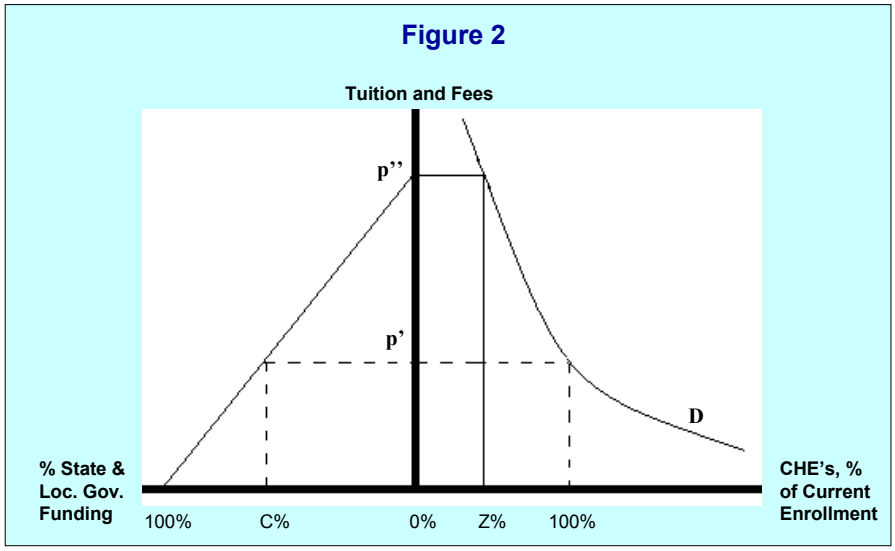


Figure 2 shows another important reference point in the model—where state and local government support is 0%, tuition rates are increased to p", and enrollment is Z% (less than 100%). The reduction in enrollment reflects price-elasticity in the students' school vs. no-school decision. Neglecting for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



FROM ENROLLMENT TO BENEFITS

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

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

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

reflects the total benefits generated by enrollments at their current levels, measured in our Main Report and shown in **Table 3.7** for the broad taxpayer perspective, and in **Table 3.8** for the narrow taxpayer perspective.

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

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

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

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

THE CC SHUTDOWN POINT

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

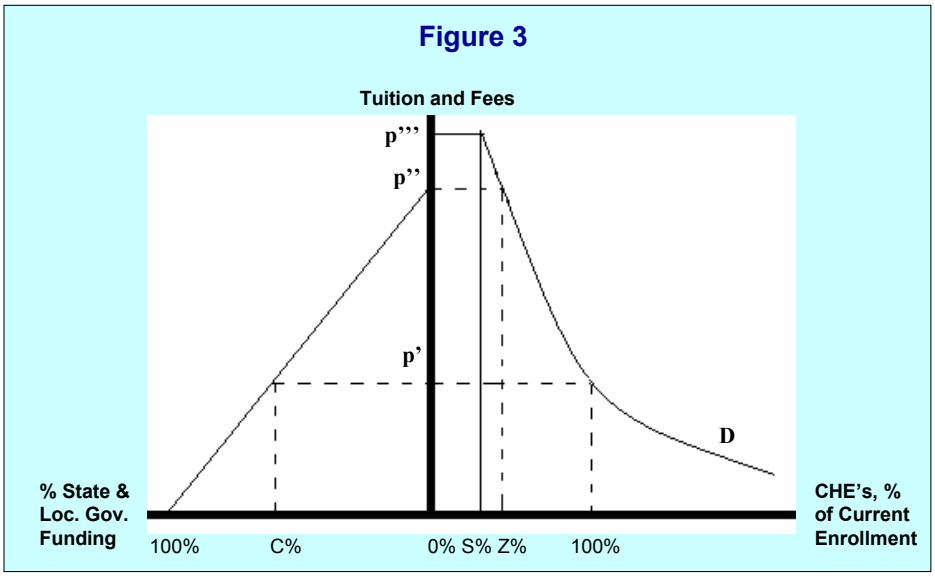
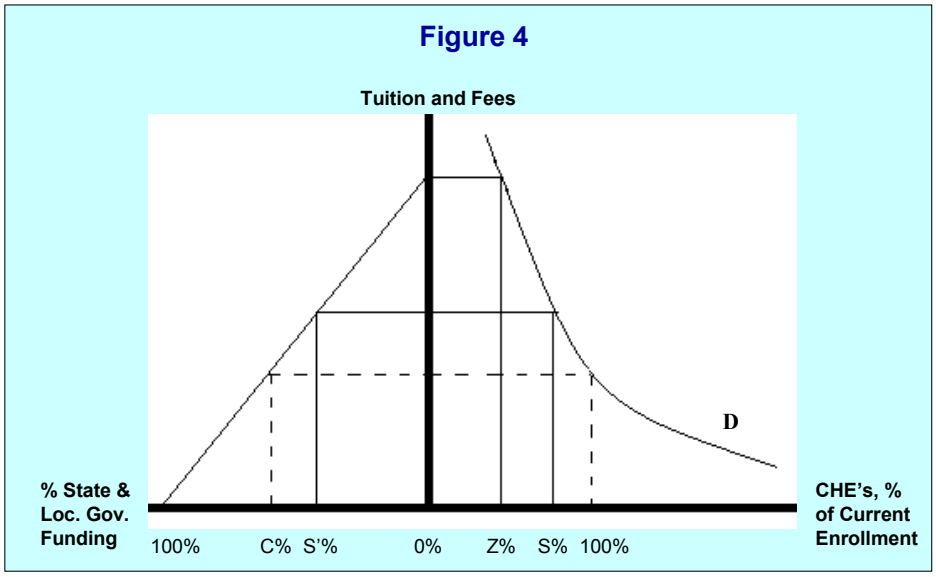


Figure 4 illustrates yet another scenario. Here the CC shutdown point occurs at an enrollment level greater than Z% (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the school to operate at all. This minimum portion 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 CC enrollment, or B=B(100%).

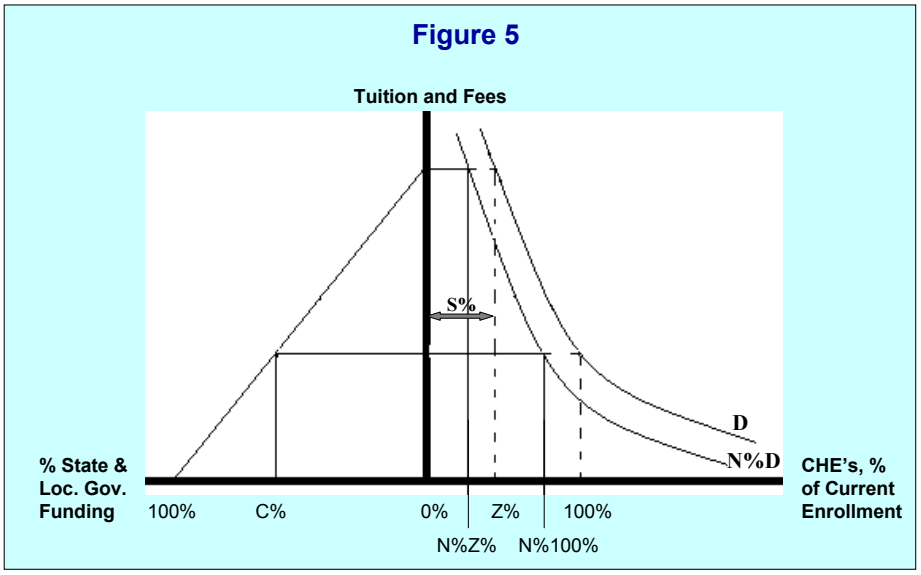


ADJUSTING FOR ALTERNATIVE EDUCATION OPPORTUNITIES

Because there may be education alternatives to the CC, we must make yet another adjustment. The question asked is: "Absent the CC, what percentage of the students would be able to obtain their education elsewhere?" The benefits associated with the CC education of these students are deducted from the overall benefit estimates.

The adjustment for alternative education is easily incorporated into our simple graphic model. For simplicity, let A% equal the percent of students with alternative education opportunities, and N% equal the percent of students without an alternative. Note that: N% + A% = 100%. **Figure 5** presents the case where the CC could operate absent state and local government support (i.e., Z% occurs at an enrollment level greater than the CC 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) $B = B(N\%100\%) - B(N\%Z\%)$



Finally, **Figure 6** presents the case where the CC cannot remain open absent some minimum S'% level of state and local government support. In this case the CC 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%).