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ABSTRACT

This document contains an executive summary, main report, and detailed results that examine to what extent the thirty community and technical colleges in the district of Washington positively affect the economy of the state. The four areas of benefits are: (1) contributions to local jobs and incomes; (2) higher earnings captured by existing students; (3) broad collection of social benefits including reduced crime and improved health; and (4) benefits returned to taxpayers. The following are some of the key findings of the study: (1) the 30 community colleges in Washington create $7,045.0 million of the annual earnings in the state economy; (2) the community colleges pay wages and salaries which generate additional income; (3) each year new students get their degrees and join the workforce which creates a stronger economy; (4) for every credit a student earns, they will make a $100 more per year; and (5) taxpayers benefit from community colleges by having improved health, reduced crime, and reduced welfare/unemployment. For all of these reasons, the document concludes that community colleges better the lives of students and reduce the need for taxpayer-supported social services. Furthermore, community colleges improve the local and state economy. Contains numerous graphs and tables. (MZ)

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The Socioeconomic Benefits Generated by 30 Community College Districts in Washington

Executive Summary

[and]

Volume 1: Main Report

[and]

Volume 2: Detailed Results

Kjell A. Christophersen & M. Henry Robison

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The Socioeconomic Benefits Generated by 30 Community College Districts in Washington

State of Washington

Executive Summary

27-Feb-2003

Kjell A. Christophersen & M. Henry Robison

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Executive Summary

HIGHLIGHTS

- The 30 community and technical college districts in Washington pay $636.4 million in direct faculty and staff wages and salaries, and explain an additional $6,409 million in wages and salaries off campus.
- Taxpayers see a real money "book" return of 19.6% on their annual investments in the community and technical colleges and recover all investments in 6.8 years.
- Students enjoy an attractive 21% annual return on their investment of time and money—for every $1 the student invests in CTC education, he or she will receive a cumulative $5.46 in higher discounted future earnings over the next 34 years.
- The State of Washington benefits from improved health and reduced welfare, unemployment, and crime, saving the public some $168.0 million per year.

INTRODUCTION

How does the State of Washington economy benefit from the presence of the 30 community and technical college districts in the state? An obvious question often asked, but rarely answered with more than anecdotes. The Washington Community and Technical College Districts (Washington's CTC Districts) contracted with CCbenefits, Inc. to apply a comprehensive economic model they have developed to capture and quantify the economic and social benefits of community and technical colleges (CTCs). The model, which took over a year to develop with funding from the Association for Community College Trustees (ACCT), relies on data collected from individual CTCs, and translates these into common sense benefit-cost and investment terms. It has been subjected to peer review, field tested on over 220 different CTCs throughout the nation, and now applied to the community and technical college districts in Washington. Model results are based on solid economic theory, carefully drawn functional relationships, and a wealth of national and local education-related data. The model provides relief from the all-too-common "advocacy analyses" that inflate benefits, understate costs, and thus discredit the process of higher education impact assessment.

Four types of benefits are tracked: (1) contributions to local job and income formation (regional economic benefits); (2) higher earnings captured by exiting students; (3) a broad collection of social benefits (improved health, reduced crime, lower welfare, and unemployment); and (4) the return to taxpayers for their CTC support.

THE RESULTS

For a more in-depth exploration of the study, the reader is encouraged to consult the main report containing the detailed assumptions, their context, and the computation procedures.

➢ Statewide Perspective

The 30 CTC districts in the State of Washington explain $7,045.0 million of all annual earnings in the state economy (see

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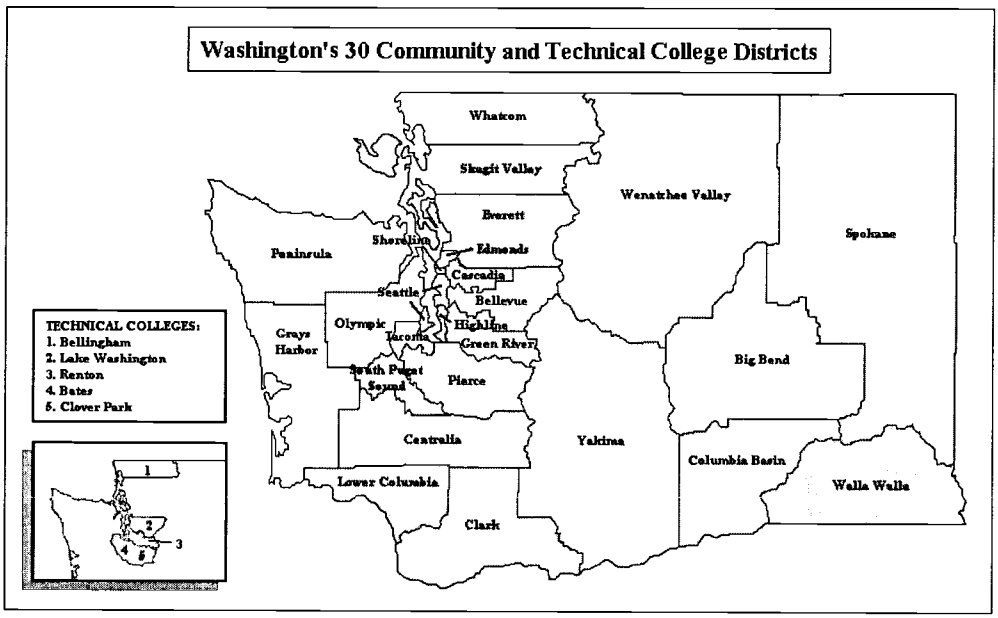
map). The earnings explained by the community and technical colleges are equal to that of roughly 184,398 jobs. The earnings and job effects break down as follows:



- *Operations and Capital Spending*

The 30 CTC districts pay wages and salaries, which generate additional incomes as they are spent. Likewise, the aggregate CTC operating and capital expenditures generate still further earnings. Altogether, these earnings account for $1,044.8 million annually in the State of Washington economy (equal to that of 36,690 jobs).

- *Higher Earnings due to Past Instruction*

Each year students leave the 30 community and technical college districts and join or rejoin the local workforce. Their added skills translate to higher earnings and a more robust economy. Based on current enrollment, turnover, and the growth of instruction over time, the workforce embodies an estimated 116.0 million credits of past instruction (credit and non-credit hours). The accumulated contribution of past CTC instruction adds some $6,000.3 million in annual earnings to the State of Washington economy (equal to that of 147,709 jobs).

➢ **Student Perspective**

The student's perspective on the benefits of higher education is the most obvious: he or she sacrifices tuition and current earnings for a lifetime of higher earnings. For every credit completed students will, on average, earn $100 more per year each year they are in the workforce. Alternatively, for every full-time year they attend they will earn an additional $4,409 per year. In the aggregate (all exiting students), the higher earnings amount to some $806.7 million per year for each year they remain in the workforce.

From an investment standpoint, the CTC students will, on average, enjoy a 21% rate of return on their investments of time and money, which compares favorably with the returns on other investments, e.g., the long-term return on US stocks and bonds. The corresponding B/C ratio (the sum of the discounted future benefits divided by the sum of the discounted

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costs) is 5.5, i.e., for every $1 the student invests in CTC education, he or she will receive a cumulative of $5.46 in discounted higher future earnings over the next 34 years. The payback period (the time needed to recover all costs) is 6.9 years.

➢ **Taxpayer Perspectives**

The state government spent $557,476,671 in support of the Washington community and technical college districts during the analysis year. Is this a good use of taxpayer money? Our analysis indicates that the answer is a resounding yes: returns far outweigh the costs, particularly when a collection of social savings is included in the assessment. For example, persons with higher education are less likely to smoke or abuse alcohol, draw welfare or unemployment benefits, or commit crimes. This translates into associated dollar savings (avoided costs) amounting to some $36 per credit per year, counted as an indirect benefit of CTC education. When aggregated across all exiting students, the State of Washington will benefit from $168.0 million worth of avoided costs per year, broken down as follows:

- *Improved Health*

State of Washington area employers will see health-related absenteeism decline by 270,018 days per year, with a corresponding annual dollar savings of $28.6 million. The state will benefit from the health-related savings of 6,245 fewer smokers and 1,675 fewer alcohol abusers. The corresponding dollar savings are $18,499,150 and $13,306,509 per year, now and into the future (these savings include insurance premiums, co-payments and deductibles, and withholding for Medicare and Medicaid).

- *Reduced Crime*

Studies show that incarceration drops with each year of higher education. In the State of Washington, 2,267 fewer individuals will be incarcerated per year, resulting in annual savings of $22,585,577 (combined savings from reduced arrest, prosecution, jail, and reform costs). Reductions in victim costs (e.g., property damage, legal expenses, lost workdays, etc.) result in savings of $24,874,628 per year. Finally, that people are employed rather than incarcerated adds $10,008,002 of earnings per year to the economy.

- *Reduced Welfare/Unemployment*

There will be 6,247 fewer people on welfare, and 2,652 fewer drawing unemployment benefits per year, respectively, saving some $26,627,517 and $23,430,842 per year in the state.

➢ **Taxpayer Return on Investment**

The return on a year's worth of state government investment in the Washington's CTC Districts is obtained by projecting the associated educational benefits into the future, discounting them back to the present, and weighing these against the $557,476,671 state taxpayers spent during the analysis year to support the 30 CTCs in the system. The analysis is based on the portion of CTC operations that is wholly dependent on state government support. Two investment perspectives are possible, one broad and one narrow.

- *Broad Perspective*

Taxpayers expect their annual investment in the CTCs to result in higher lifetime earnings for students and social savings from lifestyle changes (reduced crime, welfare and unemployment, and improvements in health). From a broad investment perspective, the value of *all* future earnings and associated social savings is compared to the year's worth of state taxpayer support that made the benefits possible. Following this procedure, the B/C ratio generated for the whole system is 20.8, i.e., every dollar of state tax money invested in Washington's CTCs today returns a cumulative of $21 over the next 34 years.

- *Narrow Perspective*

The narrow perspective limits the benefit stream to the state government budget, namely increased tax collections and expenditure savings. For example, in place of total increased student earnings, the narrow perspective includes only the increased state and local tax receipts from those higher earnings. Similarly, in place of overall crime, welfare, unemployment and health savings, the narrow perspective includes only those portions that translate to actual reductions in state and local government expenditures.

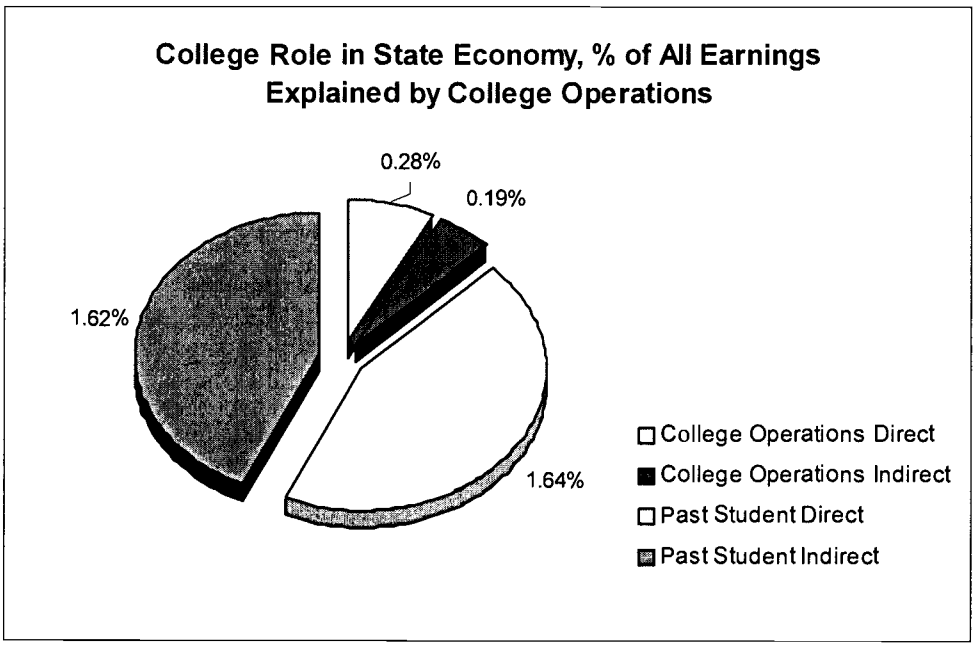
Note here that it is normal for the state government to undertake activities wanted by the public, but which are unprofitable in the marketplace. This means that positive economic returns are generally not expected from government investments. From the narrow taxpayer perspective, therefore, even a small positive return (a B/C ratio equal to or just greater than 1, and/or a rate of return equal to or just greater than the 4.0% discount rate used in this analysis) would be a most favorable outcome, certainly one that justifies continued taxpayer support of the CTC. For Washington, the narrow perspective results greatly exceed the minimum expectations. The results indicate strong and positive returns: a RR of 19.6%, a B/C ratio of 3.4 (every dollar of state tax money invested today returns a cumulative $3.43 over the next 30 years), and a short payback period of only 6.8 years.

CONCLUSION

The results of this study demonstrate that the investment in the Washington community and technical colleges is sound from multiple perspectives. It enriches the lives of students and reduces the demand for taxpayer-supported social services. Finally, it contributes to the vitality of both the local and state economies.

Benefits at a Glance

Regional Analysis			Regional Impact
Regional Economic Development			
Increment from Washington's CTC Districts operations			$1,044,764,000
Increment from past student productivity			$6,000,268,000
Total			$7,045,032,000
Job equivalent			184,398
Annual Benefits			
Higher earnings			
Aggregate (all students)			$806,699,460
Per Credit			$100
Per year full time equivalent student			$4,409
Social savings			
Aggregate (all students)			$167,962,034
Per Credit			$36
Per year full time equivalent student			$1,583
Investment Analysis	**RR**	**B/C Ratio**	**Payback (Years)**
Students	20.7%	5.5	6.9
Taxpayers: Broad Perspective	NA	20.8	NA
Taxpayers: Narrow Perspective	19.6%	3.4	6.8



In sum, the graph shows that the CTCs explain a total of 4.7% of all earnings ($148.85 billion) generated from all sources in the state.

This short summary report is one of four products generated for this impact study. In addition, one long report intended for economists and CTC institutional researchers (87 pp) lays out the detailed assumptions and analysis. Another report (10 pp) provides detailed tabular results by gender, ethnicity, and entry levels of education. Lastly, a PowerPoint presentation is developed showing the main results for CTC Presidents to adapt and use in speeches before state legislators and other education stakeholders.

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FACT SHEET: ECONOMIC IMPACT OF WASHINGTON COMMUNITY AND TECHNICAL COLLEGE DISTRICTS

What role do the Washington Community and Technical College Districts (Washington's CTC Districts) play in the statewide economy? Business sales in the State of Washington are $16,194.9 million larger, and labor income is $7,045.0 million larger due to the past and present operations of Washington's CTC Districts. The benefits of a robust state economy translate into job and investment opportunities, increased business revenues, greater availability of public funds, and an eased tax burden.

Washington's CTC Districts stimulate the state economy

• Washington's CTC Districts had operating expenses of $1,315.8 million in fiscal 2002, and spent $1,223.8 million (93%) of this in the State of Washington to purchase supplies and pay salaries and benefits.

• Washington's CTC Districts employ 10,559 full-time and 16,077 part-time faculty and staff. Washington's CTC Districts paid faculty and staff wages of $646.0 million in fiscal 2002.

• For every $1 Washington's CTC Districts pay in salaries and benefits, there is an additional $0.64 in salaries and benefits generated off-campus in the State of Washington economy—this is the commonly known multiplier effect.

• Washington CTC Districts' activities encourage new business, assist existing business, and create long-term economic growth. The colleges enhance worker skills and provide customized training to local business and industry. It is estimated that the present-day State of Washington workforce embodies over 116.0 million credit and non-credit hours of past and present Washington's CTC Districts training.

• Washington's CTC Districts skills embodied in the present-day workforce increase the output of industries in the State of Washington economy where the former students are employed by $7,569.16 million. Associated multiplier effects (sometimes called indirect effects) in other industries increase sales by $7,522.99 million.

• Washington's CTC Districts skills from current and former students increase salaries and benefits in the State of Washington by $3,088.3 million directly, and by another $2,912.0 million indirectly in fiscal 2002.

Washington's CTC Districts leverage taxpayer dollars

• The state government allocated $557.5 million in support of Washington's CTC Districts in fiscal 2002. For every dollar appropriated by the state government, Washington's CTC Districts' spending alone generated $1.87 in salaries and benefits in the State of Washington.

• For every dollar appropriated by the state government in fiscal 2002, student earnings will increase by an average of $1.45 per year, every year through the rest of their working lives. Likewise, for every state dollar appropriated, the State of Washington will see social savings of $0.30 per year, every year (i.e., reduced incarceration and health care expenditures, reduced expenditures on unemployment and welfare, and reduced absenteeism).

Washington's CTC Districts generate a return on government investment

• The state government support for Washington's CTC Districts in fiscal 2002 will be fully recovered in 6.8 years, in the form of higher tax receipts (from increased student wages) and avoided costs (e.g., from reduced public expenditures on incarceration).

• Accounting for increased tax receipts and avoided costs, the state government will see a rate of return of 19.6% on their fiscal 2002 support for Washington's CTC Districts.

Washington's CTC Districts increase individuals' earning potential

• 484,982 credit and non-credit students attended the colleges in fiscal 2002, 49% of which were employed full- or part-time while attending.

• 79.1% of the students stay in the state and contribute to the statewide economy after they leave the colleges.

• Studies demonstrate that education increases lifetime earnings. The average annual earnings of a student with a 1-year certificate is $30,564, or 80.9% more than someone without a high school diploma or GED, and 16.0% more than a student with a high school diploma. The average earnings of someone with an Associate Degree is $35,941, or 112.7% more than someone without a high school diploma or GED, and 36.4% more than a student with a high school diploma or GED.

• After leaving college, the average Washington's CTC Districts student will spend 34 years in the workforce. The student who leaves with a two-year college degree will earn $326,529 more than someone with a high school diploma or GED.

• Over their next 34 years in the workforce, the average Washington's CTC Districts student's discounted lifetime earnings will increase $5.46 for every education dollar invested (in the form of tuition, fees, books, and foregone earnings from employment).

• Students enjoy an attractive 20.7% rate of return on their Washington's CTC Districts educational investment, and recover all costs (including wages foregone while attending Washington's CTC Districts) in 6.9 years.

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WASHINGTON COMMUNITY AND TECHNICAL COLLEGE DISTRICTS AND THE TAXPAYER PERSPECTIVES

The Washington Community and Technical College Districts consider the return on investment from two taxpayer perspectives: broad and a narrow. The broad perspective counts all benefits regardless of recipient, while the narrow perspective counts only benefits that accrue back to the state government in the form of book or accounting revenues. Note that the narrow perspective is the accounting stance of the private sector: revenues on one side of the books, costs on the other, and profits equaling the difference. The CCbenefits model indicates that the Washington Community and Technical College Districts are a uniquely attractive investment for the state government. This finding is clearly indicated from the results of the narrow taxpayer perspective investment analysis. To better appreciate this finding, we develop these two perspectives more fully below.

BROAD INVESTMENT PERSPECTIVE

The effectiveness of government programs is often expressed through the use of a benefit/cost ratio. A ratio greater than one is minimally necessary for a worthwhile public project, while a ratio greater than one is taken to indicate a particularly strong endorsement. Consider some examples. A transportation authority sells the public on a new road or bridge by demonstrating that savings in travel time and vehicle expenses greatly exceed the project's cost. Another example: the success of a government program aimed at revitalizing a depressed economy is said to be demonstrated when the incomes created by the program greatly exceed the program cost. In still a third example, expenditures on public parks are sometimes justified by showing that the value of the recreation, including scenic and other values that accrue to park users, exceeds the public outlay for park construction, operation, and the cost of extractive resources not used. In all these cases, note that overall benefits are counted and not just those that accrue back to the state government. This is the hallmark of the broad benefit-cost (i.e., investment) perspective.

The broad investment perspective imbedded in the CCbenefits model measures a diverse collection of community college benefits, including the increased earnings of students plus external benefits associated with savings on health care, reduced expenditures on crime (e.g., prosecution, incarceration and victim costs), reduced welfare and unemployment expenditures, and costs associated with absenteeism from work. These benefits accrue to different publics such as students, employers, victims of crime, the federal government, and state taxpayers. The broad perspective tallies this varied collection of benefits and measures this against the outlays of the state government. State government taxpayers can view a broad perspective benefit-cost ratio greater than 1.0 as a minimal indicator of a worthwhile public investment.

NARROW INVESTMENT PERSPECTIVE

Among the benefits tracked under the broad perspective is a subset that accrues to the state government. A portion of higher student earnings will be captured by the state government in the form of added tax receipts. Additionally, because the state government bears part of the cost of crime, its budget benefits from education-induced crime reductions. The same holds in varying degrees for the other assorted benefits of an educated populace. The bottom line: while the state government spends money in support of the Washington Community and Technical College Districts, they receive benefits in the form of increased tax receipts and an assortment of reduced expenditures or avoided social costs. The narrow investment perspective counts only benefits that could be entered into the books of the state government.

Worthwhile public projects routinely generate negative narrow perspective returns. Generally, the role of government is to provide services that the public wants, but the business sector finds unprofitable. Considerable funds are spent on public parks, for example, yet except for entry fees and some concessionaire or special events receipts, no moneys directly return to state taxpayers. From a narrow investment perspective, taxpayer returns are negative, and the park is justified by the benefits tracked under the broad perspective.

An important finding of the CCbenefits analysis of the Washington Community and Technical College Districts is that the results are not only strong from the broad perspective but unlike most government endeavors, the taxpayer investments generate strong results from the narrow investment perspective as well. Economists generally assume a 4.0% discount rate in analyzing government projects, assuming that governments can obtain unsecured loans at a rate of 4.0%, or receive a return of 4.0% on any excess funds were they to be invested. **Since the Washington Community and Technical College Districts' narrow taxpayer perspective rate of return of 19.6% is substantially greater than 4.0%, the state government actually makes money on the investment—the colleges put more money back into the state treasury than they take out.** By funding the colleges, therefore, other beneficiaries of state funding are actually subsidized through the revenues generated by the colleges.

The Socioeconomic Benefits Generated by 30 Community and Technical College Districts in Washington

Volume 1: Main Report

27-Feb-2003

M. Henry Robison & Kjell A. Christophersen

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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.

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ACRONYMS

SBCTC	State Board for Community and Technical Colleges
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
CTC	Community and Technical Colleges
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 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

Washington's 30 community and technical college districts (CTCs) 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 Washington Community and Technical College Districts investigate the attractiveness of the returns generated by the 30 community and technical 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 government support.

Table 1.1. WA Participating CTCs and FY '02 Credit Enrollment

Name of College	Abbreviation	Credit Enrollment
Bates Technical College	BTC	13,898
Bellevue Community College	BCC	19,739
Bellingham Technical College	BTC	8,062
Big Bend Community College	BBCC	3,470
Cascadia Community College	CCC	3,058
Centralia College	Centralia	6,282
Clark College	Clark	16,179
Clover Park Technical College	CPTC	17,495
Columbia Basin College	CBC	10,729
Community Colleges of Spokane	CCS	30,465
Edmonds Community College	EdCC	13,958
Everett Community College	EvCC	12,302
Grays Harbor College	GHC	4,499
Green River Community College	GRCC	10,187
Highline Community College	HCC	10,570
Lake Washington Technical College	LWTC	6,386
Lower Columbia College	LCC	5,531
Olympic College	Olympic	9,535
Peninsula Community College	PCC	8,990
Pierce College	Pierce	18,859
Renton Technical College	RTC	10,022
Seattle Community College District	SCCD	33,389
Shoreline Community College	SCC	10,486
Skagit Valley College	SVC	8,639
South Puget Sound Community College	SPSCC	7,855
Tacoma Community College	TCC	10,769
Walla Walla Community College	WWCC	9,550
Wenatchee Valley College	WVC	4,663
Whatcom Community College	WCC	5,917
Yakima Valley Community College	YVCC	8,441
Total		339,925

Note: Schools appearing in grey did not participate in the study of the individual CTCs. Data for these schools was obtained from the State Board and estimated from trends in the participating schools.

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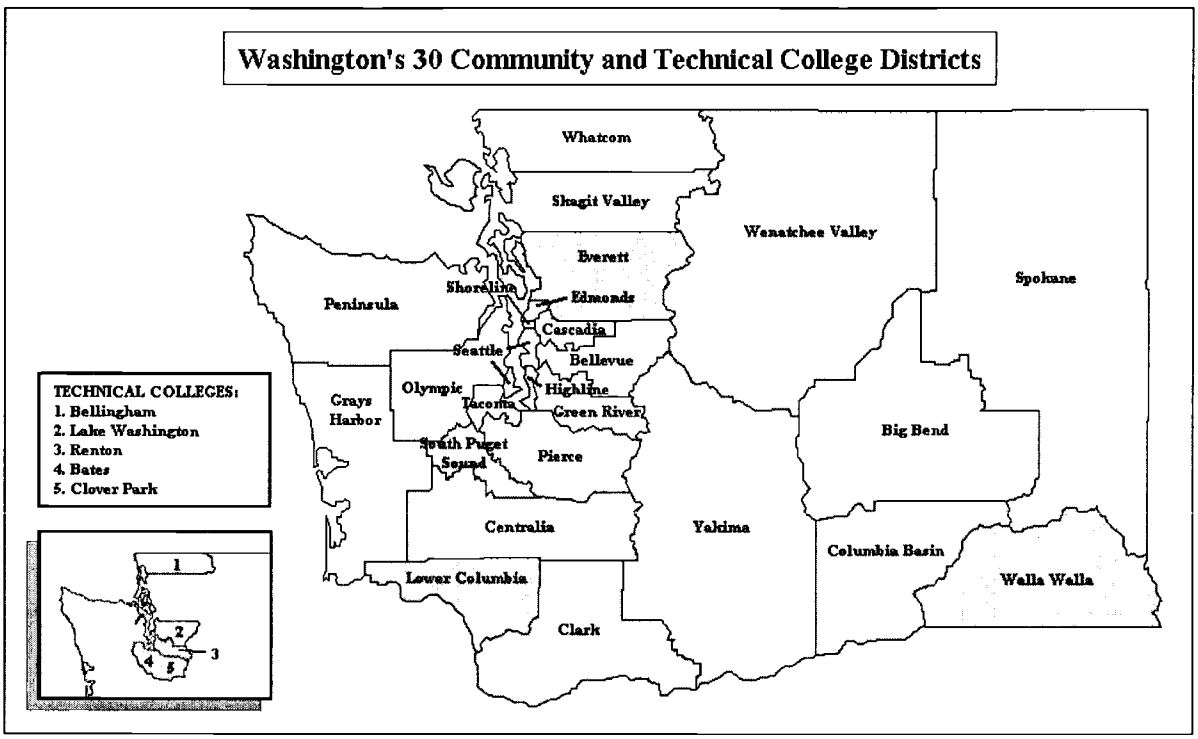
Figure 1.1. Geographical Distribution of Participating CTCs



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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 CTC 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]

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

[1]Instruction hours are not the same as credit hours. CTCs 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.

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 30 Washington Community and Technical 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 30 Washington Community and Technical College Districts as a creator of earnings in the state economy. Increased earnings are displayed by industrial sector, and the role of Washington's CTC 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 CTC-linked earnings fall under two categories: 1) earnings generated by the annual operating expenditures of the colleges; and 2) earnings attributable to the CTC 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 30 CTCs; 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.

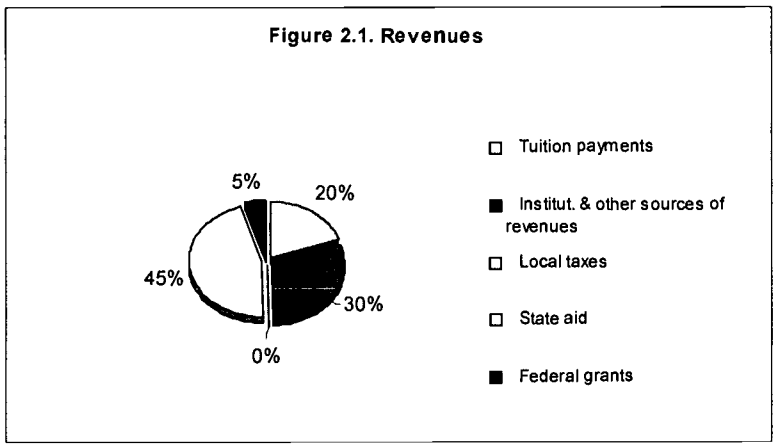
PROFILE

Faculty, Staff, and Operating Budgets

The Washington community and technical colleges employed 10,559 full- and 16,077 part-time faculty and staff in fiscal year 2002 amounting to a total annual payroll of some $636.4 million. **Table 2.1** shows the aggregate annual revenues by funding source: a total of $1,227 million. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (19.6%) plus 30.2% from other private sources (such as contract revenues, interest payments and the like). Public funding is comprised of state aid (45.4%) and federal grants (4.8%). These budget data are critical in identifying the annual costs of educating the CTC 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	$240,455,123		19.6%
Institut. & other sources of revenues	$370,150,168	$610,605,291	30.2%
Public Funding			
Local taxes	$47,500		0.0%
State aid	$557,429,171		45.4%
Federal grants	$59,121,224	$616,597,895	4.8%
Total		$1,227,203,186	100%



The Students

Students attend community and technical colleges for different reasons: to prepare for transfer to four-year institutions, to obtain Associate Degrees or Certificates in professional/technical programs, to obtain basic skills, 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 30 CTCs in the state of Washington. The unduplicated student body (headcount) is 484,982 (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

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the Washington community and technical 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 (49%) while attending college, and how much they earned (67%) 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	339,925
Total headcount of unduplicated non-credit students	149,821
Total unduplicated enrollment, all campuses	484,982
% of students employed while attending college	49%
% of full-time earning potential	67%
Students remaining in state after leaving college	79%
Attrition rate over time (leaving state)	33%
"Settling In" factors (years):	
Completing Associate Degree	1.9
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 79% of the students remain in the state (as defined in **Figure 1.1**) and thereby generate statewide benefits. The remaining 21% leave the state altogether and are not counted as part of the economic development benefits. The 79% retention rate applies only to the first year, however. We assume that 33% 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 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.

[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 30 Washington community or technical colleges.

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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.

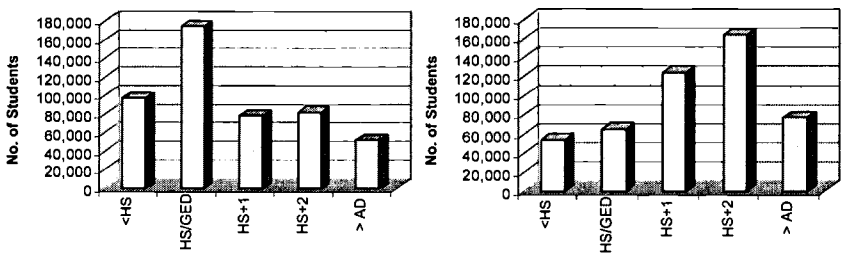
The *entry level* characterizes the education level of the students when they first enter the colleges; this is consistent with the way most colleges keep their records. The analysis in this report, however, is based on the educational achievements of the students during the current year. As not all 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 and technical 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 59,008 white males who first entered with HS/GED equivalent, it is estimated that only 21,084 still remain in that category at the beginning of the analysis year, meaning that 37,923 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 CTC 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	27,383	15,101	18,715	10,321	32,554	17,953	19,120	10,544	97,772	53,919
HS/GED equivalent	59,008	21,084	21,557	9,286	69,115	24,783	24,562	10,180	174,242	65,333
1 year post HS or less	24,312	40,301	6,787	15,393	38,183	51,173	9,416	17,747	78,698	124,614
2 years post HS or less	25,079	51,116	9,908	19,451	35,108	69,479	11,790	23,337	81,885	163,383
> AD	16,172	24,351	4,129	6,646	25,876	37,448	6,207	9,288	52,384	77,733
Total	151,953	151,953	61,097	61,097	200,835	200,835	71,097	71,097	484,982	484,982

Figure 2.2. Student Body Education Level: Entry vs. Beginning of Analysis Year



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 (2.5% and 1.9%, 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 (28.1% + 50.0% = 78.1% in the transfer track and workforce categories, respectively). The retired and leisure students (1.7%) and ABE/ESL/GED students (15.7%) 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 and technical colleges to acquire skills that 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.

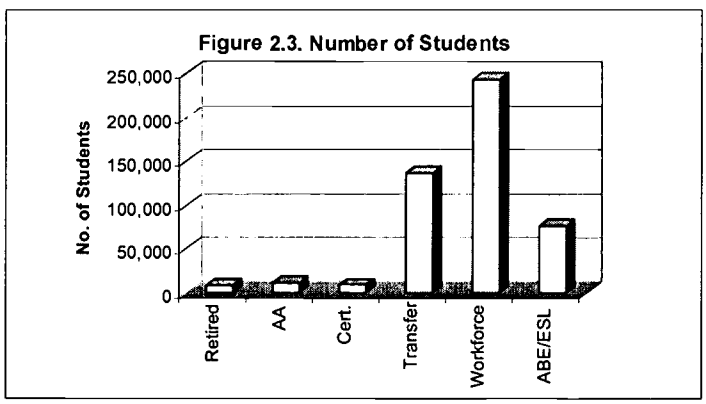
The fifth column shows the average age of the students generating the benefits (excluding retirees). The time horizon for the analysis is 37.4 years, which is the difference between the average age (31.0 years) and retirement age (65 years).

As indicated in Column 6, the average Associate Degree and Certificate student completed 34.0 and 29.9 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 8,596,548. 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 + recreation students	1.4%	6,692	68	10.5	70,161	0.23
Completing AA	2.4%	11,494	31	34.0	390,713	0.76
Completing Certificate	1.9%	9,047	34	29.9	270,451	0.66
Non-completing transfer track	30.0%	145,544	25	22.7	3,306,110	0.50
Non-completing workforce & non-credit	48.7%	236,016	34	15.2	3,584,998	0.34
ABE/ESL/GED	15.7%	76,188	32	13.6	1,035,420	0.30
Total or weighted averages	100.0%	484,982	30.8	18.0	8,657,853	
Credits required for one full-time year equivalent of study					45	

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



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

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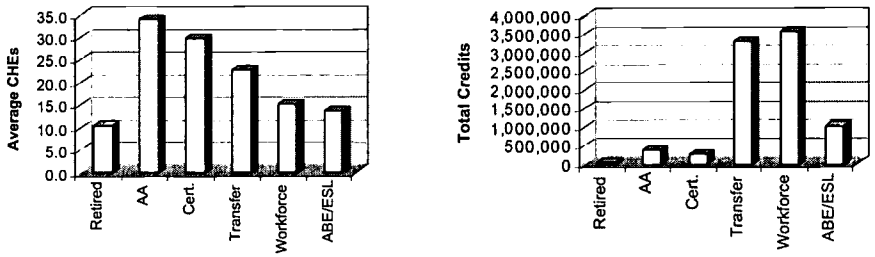
Figure 2.4. Average and Total CHEs Earned for the Analysis Year



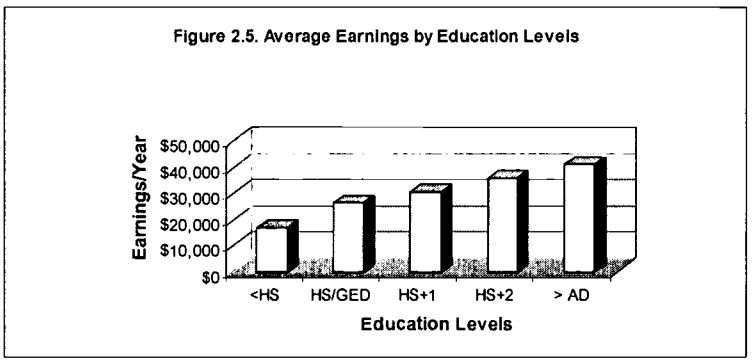
ANNUAL PRIVATE BENEFITS

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 Washington community and technical 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	$16,899	NA
HS/GED equivalent	$26,343	$9,443
1-year Certificate	$30,564	$4,221
2-year Associate Degree	$35,941	$5,378
1 year post Associate Degree	$40,927	$4,985



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

CTCs 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 CTC education.

Higher Earnings

Broad Perspective: Higher education begets higher earnings. The economy generates more income than it would without the CTC skills embodied in the labor force. From the broad taxpayer perspective, the total increase in earnings is counted as benefits of CTC education, adjusted down by the alternative education variable in **Table 2.9** (22.6%)—these students would still attend college elsewhere even if the CTCs were not present.

Narrow Perspective: Higher earnings translate into higher state *tax collections.* In the narrow taxpayer perspective we assume that the state authorities will collect 16.2% of the higher earnings in the form of taxes—the estimated composite of all taxes other than the federal income taxes.[6]

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.

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

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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 government is an employer. Accordingly, we assume a taxpayer's portion of absenteeism savings at 11.8%, 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 health subsidies (to hospitals, for example) are reduced. We assume that 6% of the total benefits can be counted as taxpayer savings.

Table 2.6. Reduced Absenteeism, Smoking and Alcohol Habits

	Absenteeism		Smoking		Alcohol Abuse	
Education Level	Days	%/Year	Average	Reduction	Average	Reduction
< HS/GED	11.0	4.2%	32.0%	NA	9.6%	NA
HS/GED equivalent	8.4	3.2%	28.9%	9.4%	8.9%	8.0%
1 year post HS or less	7.1	2.7%	26.3%	9.1%	8.2%	7.7%
2 years post HS or less	5.6	2.2%	22.6%	14.0%	7.2%	12.0%
> AD	5.0	1.9%	20.6%	8.9%	6.6%	7.6%

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.

[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).

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Figure 2.6. Days of Absenteeism by Education Levels

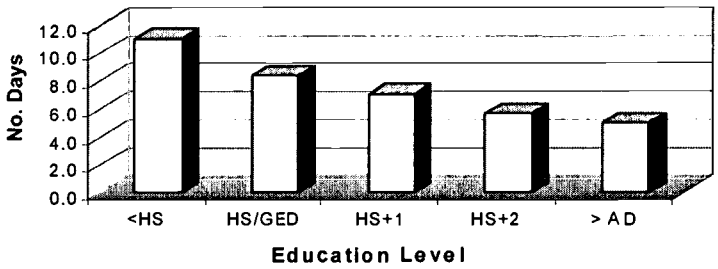


Figure 2.7. Average Incidence of Smoking by Education Levels

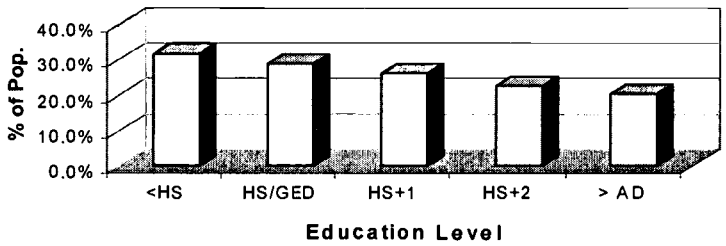
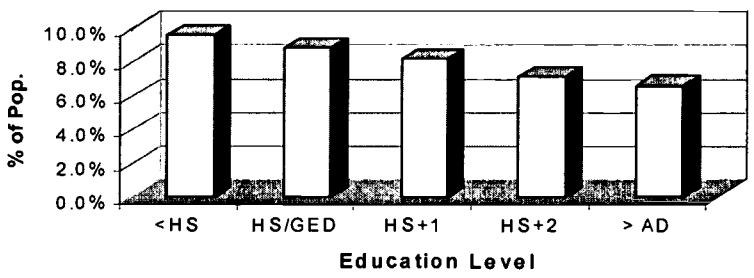


Figure 2.8. Average Incidence of Alcohol Abuse



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).

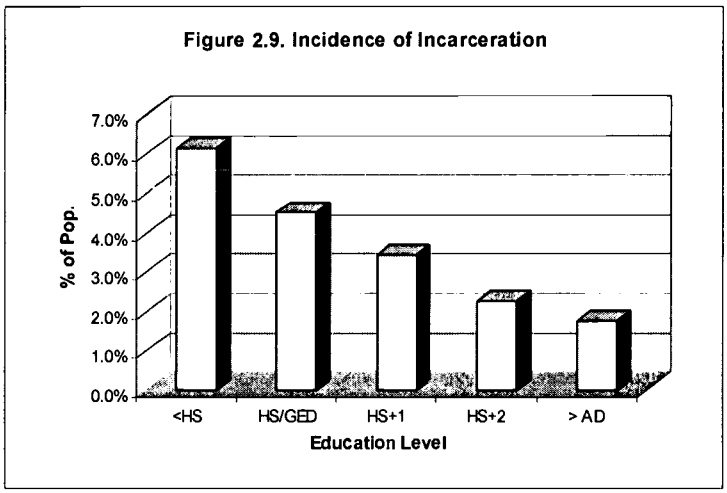
Narrow Perspective: We assume that nearly all (80%) of the incarceration savings accrue to the state taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to the potential victims, not to the taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our "composite" state government average tax rate (16.2%) 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	6.1%	NA
HS/GED equivalent	4.5%	26.6%
1 year post HS or less	3.4%	23.8%
2 years post HS or less	2.3%	34.2%
> AD	1.8%	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.

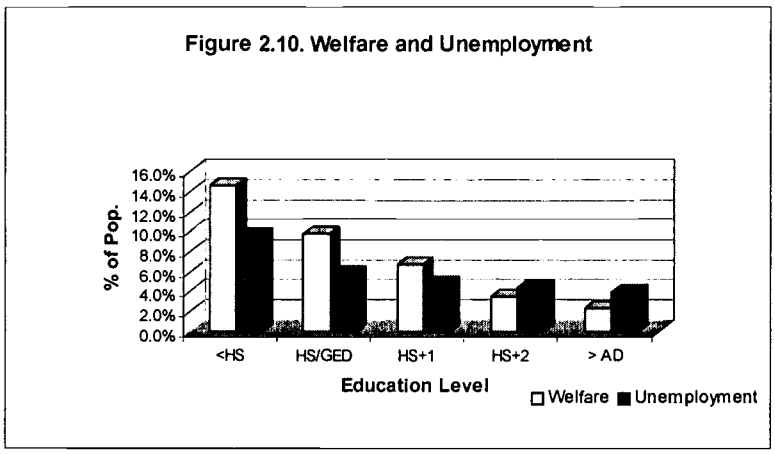
Broad Perspective: Reduced welfare and unemployment claims are counted in full as benefits in the broad taxpayer perspective (less the students covered by the alternative education variable, as above).

Narrow Perspective: Taxpayer benefits from reduced welfare are limited to 16%--the extent to which the state 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	14.7%	NA	9.7%	NA
HS/GED equivalent	9.8%	33.5%	5.9%	39.0%
1 year post HS or less	6.7%	31.4%	4.9%	17.9%
2 years post HS or less	3.6%	46.6%	4.4%	9.7%
> AD	2.4%	33.5%	4.0%	10.2%

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 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 college 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 Washington, 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 (31.0 years, see **Table 2.4**). In particular, the average earnings at the midpoint ($30,695 in **Table 3.5**) are adjusted downward to $22,041 to reflect the average earnings at age 31.0.

The Budget

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

other revenue sources in **Table 2.1** (federal grants, student tuition, and contract revenues) relative to state 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.

Table 2.9. Miscellaneous Variables

	Variables
Discount rate	4.0%
Time horizon, years to retirement	34.0
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	22.6%

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.

[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.

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STATEWIDE ECONOMIC BENEFITS

In general, the statewide economy is affected by the presence of the 30 community and technical college districts in Washington 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 Washington.[12] Estimating college operations effects requires an additional model that takes college expenditures, deducts spending that leaks from the economy, and bridges what is left to the sectors of the IO model.

Estimating the skill-enhancing effect of past students on the 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 30 community colleges in Washington 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 Washington's CTC District Operations

The first step in estimating the impact of the 30 Washington CTC district 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 30 Washington community and technical colleges 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 93% of all college expenditures benefit state vendors ($1,223,797 / $1,315,785 = 93%).

Table 2.10. Profile of College 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	$646,000	99%	1%			$636,368
Travel	$10,511	72%	28%			$7,620
Electricity and natural gas	$19,403	87%	13%			$16,846
Telephone	$8,263	81%	19%			$6,698
Building materials & gardening supplies	$241	88%	12%	59%	41%	$212
General merchandise stores	$145,456	77%	23%	47%	53%	$112,248
Eating & drinking	$993	96%	4%			$953
Maintenance & repair construction	$29,871	99%	1%			$29,660
New construction	$58,927	98%	2%			$57,818
Insurance	$108,766	82%	18%			$89,546
Legal services	$1,562	93%	7%			$1,456
Credit agencies	$324	97%	3%			$314
U.S. postal service	$1,267	84%	16%			$1,070
Accounting, auditing & bookkeeping	$955	100%	0%			$953
Marketing	$1,002	95%	5%			$956
Other business services	$57,391	86%	14%			$49,498
Water supply & sewerage systems	$3,708	99%	1%			$3,684
Printing & publishing	$9,909	90%	10%			$8,955
Rental property	$14,509	100%	0%			$14,488
Services to buildings	$512	96%	4%			$491
Unemployment compensation	$2,685	97%	3%			$2,616
Honoraria + other payments to households	$193,531	94%	6%			$181,346
Total	$1,315,785					$1,223,797

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 30 community and technical college districts in Washington. **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 30 Washington community and technical colleges. 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, 79% of the students remain in the state upon leaving the colleges, and 21% leave the state.

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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**, 33% 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 1972. 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 Washington workforce embodies some 116.0 million CHEs of past instruction from the 30 community and technical college districts.

Table 2.11. Critical Variables

Assumptions	Values
Current headcount of students	484,982
Students remaining in-state after leaving CC	79%
30-year attrition	33%
Decay rate	1.3%
Overall average of credits earned per student this year	17.9

Reducing the CHEs to Account for Alternative Education Opportunities

The 116.0 million CHEs of past instruction from the 30 Washington community and technical colleges 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.

[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.

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 and technical college system in Washington. This is the common "with and without condition" in applied economic analysis.

The IR staffs provided the estimate of the alternative education opportunity variable (22.6%) 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 Washington's CTC Districts, the historic CHE's indicated in **Table 2.12** are reduced by 22.6%.

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

									Assumptions		
	Student Enrollment Headcount	Subtract Retired Students	Subtract Students Migrating Immediately	Students who have left college (Leavers)	Leavers Who Have Settled Into Jobs	# Settled Into Jobs - Active in the Workforce	Average Credit Equivalents	Credits Embodied in the Workforce	% of Students in Workforce	"Settling" Factor	Active in Workforce
Year	1	2	3	4	5	6	7	8	9	10	11
1973	227,862	223,927	177,109	177,109	177,109	119,345	17.85	2,130,635	100%	100%	67.4%
1974	234,939	230,882	182,609	182,609	182,609	124,681	17.85	2,225,907	100%	100%	68.3%
1975	241,011	236,849	187,329	187,329	187,329	129,598	17.85	2,313,679	100%	100%	69.2%
1976	248,814	244,517	193,394	193,394	193,394	135,566	17.85	2,420,223	100%	100%	70.1%
1977	253,149	248,778	196,764	196,764	196,764	139,755	17.85	2,495,014	100%	100%	71.0%
1978	263,587	259,036	204,877	204,877	204,877	147,445	17.85	2,632,298	100%	100%	72.0%
1979	271,733	267,040	211,208	211,208	211,208	154,015	17.85	2,749,583	100%	100%	72.9%
1980	287,396	282,433	223,383	223,383	223,383	165,050	17.85	2,946,596	100%	100%	73.9%
1981	293,829	288,755	228,383	228,383	228,383	170,980	17.85	3,052,455	100%	100%	74.9%
1982	285,090	280,167	221,590	221,590	221,590	168,091	17.85	3,000,890	100%	100%	75.9%
1983	281,476	276,615	218,781	218,781	218,781	168,158	17.85	3,002,091	100%	100%	76.9%
1984	285,070	280,147	221,574	221,574	221,574	172,561	17.85	3,080,694	100%	100%	77.9%
1985	290,907	285,883	226,111	226,111	226,111	178,427	17.85	3,185,414	100%	100%	78.9%
1986	295,469	290,367	229,658	229,658	229,658	183,626	17.85	3,278,227	100%	100%	80.0%
1987	304,371	299,115	236,577	236,577	236,577	191,664	17.85	3,421,723	100%	100%	81.0%
1988	321,606	316,053	249,973	249,973	249,973	205,199	17.85	3,663,364	100%	100%	82.1%
1989	342,602	336,686	266,292	266,292	266,292	221,490	17.85	3,954,212	100%	100%	83.2%
1990	350,628	344,573	272,530	272,530	272,530	229,682	17.85	4,100,447	100%	100%	84.3%
1991	403,368	396,403	313,523	313,523	313,523	267,729	17.85	4,779,703	100%	100%	85.4%
1992	421,211	413,937	327,392	327,392	327,392	283,275	17.85	5,057,233	100%	100%	86.5%
1993	422,661	415,362	328,519	328,519	328,519	288,015	17.85	5,141,861	100%	100%	87.7%
1994	432,177	424,714	335,915	335,915	335,915	298,400	17.85	5,327,267	100%	100%	88.8%
1995	434,777	427,269	337,936	337,936	337,936	304,172	17.85	5,430,299	100%	100%	90.0%
1996	434,350	426,849	337,604	337,604	337,604	307,898	17.85	5,496,823	100%	100%	91.2%
1997	444,079	436,410	345,166	345,166	345,166	318,963	17.85	5,694,376	100%	100%	92.4%
1998	449,583	441,820	349,445	349,445	349,445	327,195	17.85	5,841,322	100%	100%	93.6%
1999	467,158	459,091	363,105	363,105	363,105	344,488	17.85	6,150,055	100%	100%	94.9%
2000	483,056	474,714	375,462	375,271	337,744	324,672	17.85	5,796,284	100%	90%	96.1%
2001	480,504	472,206	373,478	365,075	273,806	266,694	17.85	4,761,230	98%	75%	97.4%
2002	484,982	476,607	376,959	320,415	160,207	160,207	17.85	2,860,143	85%	50%	100.0%
Embodied Total								115,990,046			

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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 college instruction from the 30 Washington CTC districts (116.0 million CHEs, **Table 2.12**) provides the dollar estimate of how much more past students are earning as a result of their college 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 Washington's CTC 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 CTC 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

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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 30 Washington CTC 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 30 Washington community and technical colleges 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, 4.0% of all statewide jobs are in the Agriculture & Agricultural services sector, 7.5% 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 4.0% of all statewide jobs are in the Agriculture & Agricultural services sector, only 0.4% of past students are estimated to be in that sector. In contrast, while 7.5% of all jobs are in the Finance, Insurance and Real Estate sector, 14.8% 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]

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[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 30 Washington community and technical colleges 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 CTC instruction. This product provides our estimate of the direct effect of past college 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 CTC skills embodied in the current region workforce. Next, we turn to the indirect effects on both the demand and supply- sides.

Consider first demand-side effects. Statewide earnings are larger because of the skills embodied in past students from the 30 Washington CTC 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	4.0%	0.4%	0.0%	52,595
Mining, Sand, and Gravel	0.1%	0.0%	0.1%	102,172
Construction	6.0%	0.6%	6.5%	7,532,473
Manufacturing: Food/Wood & Paper/Textiles	3.5%	1.7%	3.4%	3,925,705
Manufacturing: Chemicals/Petroleum/Stone & Glass	2.5%	2.5%	0.3%	347,793
Manufacturing: Computer & Electronic Equipment	1.0%	1.9%	0.9%	1,087,275
Manufacturing: Other	3.8%	3.7%	4.9%	5,678,117
Transportation	2.6%	1.3%	2.8%	3,298,329
Public Utilities	0.3%	0.2%	0.5%	576,607
Publishing & Communications	1.6%	3.1%	1.7%	1,992,648
Trade	21.6%	21.3%	26.2%	30,404,095
Finance, Insurance, and Real Estate	7.5%	14.8%	4.9%	5,652,014
Motels & Eating/Drinking & Amusement/Recreation	7.6%	3.7%	8.6%	9,985,414
Consumer Services	3.9%	1.9%	0.1%	66,623
Business Services	8.5%	8.4%	9.0%	10,456,175
Medical/Educational/Social services	10.3%	20.3%	22.1%	25,633,816
Federal Government	3.8%	3.8%	8.0%	9,224,326
State & Local Government	11.4%	10.5%	0.0%	-
Total	100.0%	100.0%	100.0%	115,990,046

[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.

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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, 17.9 CHEs at the 30 Washington community and technical colleges (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 484,982 students will capture $806.7 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 $60.4, $50.1, and $57.5 million (rounded). In **Table 3.2**, these same results are presented in greater detail—health-related absenteeism will decline by 270,018 days per year, translating to a total of 1039 years' worth of productivity gained per year (based on 260 workdays per year). Annual total dollar savings from reduced absenteeism days equals $28.6 million. There

will be 6,245 fewer smokers and 1,675 fewer alcohol abusers, amounting to annual total dollar savings of $18.50 and $13.3 million, respectively, inclusive of insurance premiums, personal payments, and withholding for Medicare and Medicaid.

Crime-Related Savings

There will be 2,267 fewer people incarcerated as a result of the higher education obtained, saving the taxpayers a total of about $22,585,577 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 $10,008,002 in additional annual earnings for the state. Victim costs will be reduced by $24,874,628 per year.

Welfare and Unemployment Savings

There will be 6,247 and 2,652 fewer people on welfare and unemployment, respectively, in the community. The corresponding total dollar savings for the state community amounts to $50,058,359 ($26,627,517 welfare + $23,430,842 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 $168.0 million in public savings per year in the community – the sum of all health, crime, and welfare/unemployment benefits in **Table 3.2.**

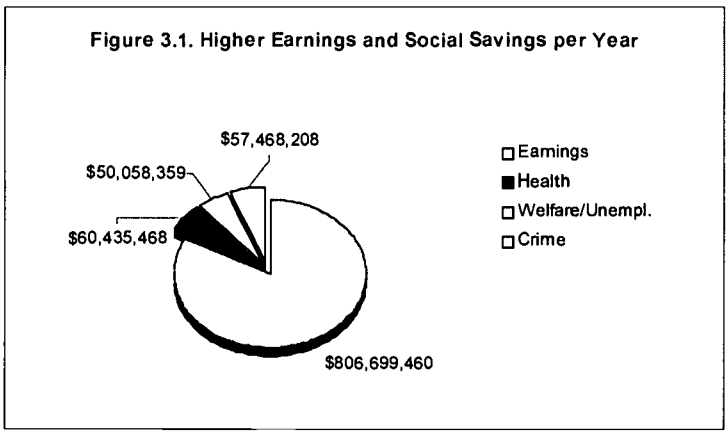
Table 3.1 Student Body Achievements, Higher Earnings

		Social (External Benefits)			
Level of Education	Higher Earnings	Improved Health	Lower Welfare Unemployment	Lower Crime	Total
< HS/GED	$67,224,434	$4,930,603	$9,040,440	$7,233,239	$88,428,716
HS/GED equivalent	$96,016,922	$3,866,375	$7,720,457	$5,233,251	$112,837,005
1 year post HS or less	$215,024,753	$23,324,069	$20,018,302	$25,280,672	$283,647,797
2 years post HS or less	$270,332,048	$17,926,670	$8,571,219	$13,394,110	$310,224,049
> Associate Degree	$158,101,303	$10,387,749	$4,707,940	$6,326,935	$179,523,927
Total	$806,699,460	$60,435,468	$50,058,359	$57,468,208	$974,661,494

[21] The calculation is as follows: 2,267 not incarcerated x $77,178/4.0 years/34 years to retirement from **Table 2.9** = $1,285,581.

Table 3.2. Summary of Annual Benefits

	Units	Earnings	Social Savings
Higher earnings	NA	$806,699,460	
Health benefits			
Absenteeism savings (days)	270,018	NA	$28,629,809
Fewer smokers, medical savings (# persons)	6,245	NA	$18,499,150
Fewer alcohol abusers (# persons)	1,675	NA	$13,306,509
Crime benefits			
Incarceration savings (# persons)	2,267	NA	$22,585,577
Crime victim savings	NA	NA	$24,874,628
Added productivity (fewer incarcerated)	NA	NA	$10,008,002
Welfare/unemployment benefits			
Welfare savings (# persons)	6,247	NA	$26,627,517
Unemployment savings (# persons)	2,652	NA	$23,430,842
Total		$806,699,460	$167,962,034



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) $100 per year in higher earnings per CHE,[22] and b) $1,749 per year in higher earnings per student on the basis of the number of CHEs completed. **Converted to a full-year equivalent (45 CHEs), the annual earnings would**

[22] Thus, a student attending for 10 CHEs will add $997 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.

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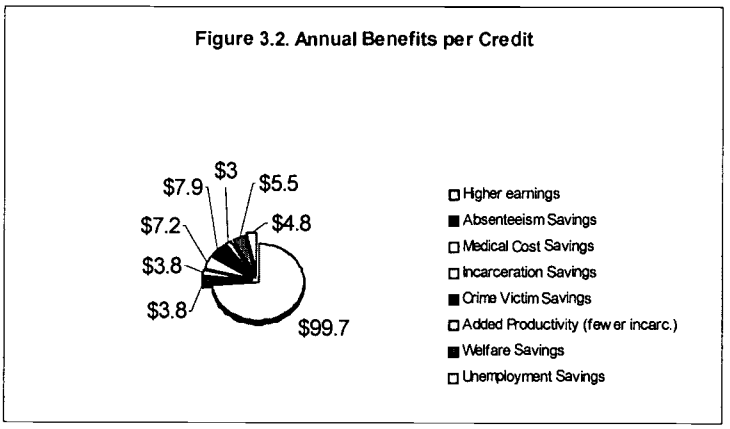
amount to $4,409 per student. On average, the social benefits per CHE range from a low of $3 for Added Productivity (fewer incarcerated) to a high of $8 per CHE for Crime Victim Savings. On a per student basis, they range from a low of $48 per student for Added Productivity (fewer incarcerated) to a high of $139 for Crime Victim Savings. On a full-year equivalent basis (45 CHEs), the social savings would amount to $1,583 per student (the total of $5,992 less $4,409 of higher private earnings as indicated in **Table 3.3**).

Table 3.3. Annual $ per Credit and Student

	Per Credit	Per Student	Annualized
Higher earnings	$100	$1,749	$4,409
Absenteeism Savings	$4	$66	$166
Medical Cost Savings	$4	$67	$170
Incarceration Savings	$7	$126	$318
Crime Victim Savings	$8	$139	$351
Added Productivity (fewer incarc.)	$3	$48	$122
Welfare Savings	$6	$97	$245
Unemployment Savings	$5	$84	$211
Total	$135	$2,377	$5,992



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 college-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, discounted to the present, and then compared to the present costs of education. The

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investment is feasible if all discounted future benefits are greater than or equal to the costs.[23]

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**.[24] 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 tax revenues (from increased incomes), and savings from reduced state government expenditures for incarceration, health and welfare.

[23] 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.

[24] 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 (19.6% 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 (30.2%). The taxpayer costs consist of the state tax items in **Table 2.1**, or a total 45.4%.

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 $22,041 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 (1.7%) to arrive at the net number of students subject to opportunity cost calculations— 476,607 students. The 245,160 not working are charged the full opportunity cost of time (based on the average term in residence), or $2,143,717,634. The 231,447 working students are charged only a fraction of the full opportunity cost (67%), or $668,500,593 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.

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

			Opp. Cost
Avg. statistical annual income of given gender and ethnicity profile		$30,695	
Annual income, given gender and ethnicity profile, at current age of students		$22,041	
CHEs per student (net of retired)	17.9		
Avg. term in residence and avg. income while in residence	40%	$8,744	
Total number of students		484,982	
Less retired %	1.7%	8,375	
Remaining students subject to opportunity cost computation		476,607	
Students not working while attending college and opportunity cost	51%	245,160	$2,143,717,634
No. of working students		231,447	
% working part time, earnings relative to stat. averages, and opp. cost	67%	$2,888	$668,500,593
Total opportunity cost			$2,812,218,227
Pell and other student aid		$160,009,684	
Restricted portion of student aid (tuition and fees)	10%	$16,000,968	($144,008,716)
GRAND TOTAL STUDENT OPPORTUNITY COST			$2,668,209,511

We also present the results in different ways. First, the student perspective results indicate whether the education obtained at the Washington community and technical 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 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 $557,476,671 (**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 - 31.0 = 34 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.[25] 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.

[25] We computed a Mincer equation based on the estimated coefficients presented in Willis, 1986, p. 545. These were adjusted to 2002 dollars in the usual fashion by applying the "GDP Implicit Price Deflator."

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Table 3.6. Student Earnings ($ Thousands)

Year	1 Higher Earnings Gross	2 Higher Earnings Net	3 Cost	4 Net Cash Flow
1	$301,992	$271,792	$3,268,103	($2,996,311)
2	$342,634	$308,370	$0	$308,370
3	$519,508	$467,557	$0	$467,557
4	$566,588	$509,929	$0	$509,929
5	$615,556	$554,000	$0	$554,000
6	$666,254	$599,628	$0	$599,628
7	$718,500	$646,650	$0	$646,650
8	$772,088	$694,879	$0	$694,879
9	$826,787	$744,108	$0	$744,108
10	$882,345	$794,111	$0	$794,111
11	$938,490	$844,641	$0	$844,641
12	$994,929	$895,436	$0	$895,436
13	$1,051,355	$946,219	$0	$946,219
14	$1,107,447	$996,702	$0	$996,702
15	$1,162,872	$1,046,585	$0	$1,046,585
16	$1,217,293	$1,095,564	$0	$1,095,564
17	$1,270,365	$1,143,328	$0	$1,143,328
18	$1,321,744	$1,189,569	$0	$1,189,569
19	$1,371,090	$1,233,981	$0	$1,233,981
20	$1,418,069	$1,276,262	$0	$1,276,262
21	$1,462,359	$1,316,123	$0	$1,316,123
22	$1,503,650	$1,353,285	$0	$1,353,285
23	$1,541,653	$1,387,488	$0	$1,387,488
24	$1,576,098	$1,418,488	$0	$1,418,488
25	$1,606,741	$1,446,066	$0	$1,446,066
26	$1,594,102	$1,434,692	$0	$1,434,692
27	$1,616,962	$1,455,266	$0	$1,455,266
28	$1,635,560	$1,472,004	$0	$1,472,004
29	$1,649,769	$1,484,793	$0	$1,484,793
30	$1,614,126	$1,452,713	$0	$1,452,713
31	$1,549,483	$1,394,535	$0	$1,394,535
32	$1,472,934	$1,325,641	$0	$1,325,641
33	$1,437,176	$1,293,459	$0	$1,293,459
34	$1,234,336	$1,110,902	$0	$1,110,902
0	$733,965	$660,568	$0	$660,568
0	$390,043	$351,038	$0	$351,038
0	$228,985	$206,086	$0	$206,086
0	$76,935	$69,242	$0	$69,242
0	$54,385	$48,946	$0	$48,946
NPV		$17,156,294	$3,142,407	$14,013,887
IRR				20.7%
B/C ratio				5.5
Payback (years)				6.9

Does attending the 30 Washington Community and Technical 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 $14,013,887 thousand **(Table 3.6)**—a positive NPV (greater than zero) indicates that the investments made are strongly feasible. The B/C ratio of 5.5 is strongly positive since the ratio is well above 1. The RR of 20.7% 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, therefore, the average student will be substantially better off attending a

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community or technical college. The payback period for a student (tuition plus the earnings foregone) is 6.9 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 CTCs from the broad taxpayer perspective. The Legislature, on behalf of the 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 23% alternative education opportunity assumption (the percentage of the student body able to avail themselves of similar education elsewhere, absent the Washington community and technical colleges). Column 3 conveys an adjustment needed to account for the fact that some of the CTCs might be able to operate at some level of enrollment absent state 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 taxpayer costs for a single year, as reflected in state 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 $10,609 million and the B/C ratio is 20.8. **More succinctly, every dollar of tax monies spent on community and technical college education will generate a total of $20.79 worth of social savings.**[26]

[26]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	$1,194,132	$67,258	$39,661	$1,087,214	$557,477	$529,738
2	$376,268	$71,387	$12,289	$292,592	$0	$292,592
3	$481,889	$91,600	$15,463	$374,825	$0	$374,825
4	$507,122	$96,351	$16,324	$394,447	$0	$394,447
5	$533,094	$101,231	$17,212	$414,650	$0	$414,650
6	$559,689	$106,221	$18,124	$435,344	$0	$435,344
7	$586,780	$111,294	$19,054	$456,432	$0	$456,432
8	$614,230	$116,425	$19,999	$477,807	$0	$477,807
9	$641,892	$121,585	$20,953	$499,354	$0	$499,354
10	$669,610	$126,746	$21,911	$520,953	$0	$520,953
11	$697,220	$131,877	$22,867	$542,477	$0	$542,477
12	$724,554	$136,945	$23,816	$563,793	$0	$563,793
13	$751,438	$141,918	$24,751	$584,769	$0	$584,769
14	$777,696	$146,763	$25,667	$605,265	$0	$605,265
15	$803,151	$151,449	$26,557	$625,146	$0	$625,146
16	$827,629	$155,941	$27,415	$644,273	$0	$644,273
17	$850,957	$160,209	$28,234	$662,514	$0	$662,514
18	$872,969	$164,221	$29,010	$679,738	$0	$679,738
19	$893,505	$167,949	$29,737	$695,819	$0	$695,819
20	$912,413	$171,364	$30,408	$710,640	$0	$710,640
21	$929,554	$174,443	$31,020	$724,091	$0	$724,091
22	$944,799	$177,160	$31,567	$736,071	$0	$736,071
23	$958,034	$179,497	$32,046	$746,491	$0	$746,491
24	$969,160	$181,436	$32,452	$755,273	$0	$755,273
25	$978,095	$182,962	$32,783	$762,351	$0	$762,351
26	$961,551	$178,258	$33,036	$750,256	$0	$750,256
27	$966,319	$179,028	$33,210	$754,082	$0	$754,082
28	$968,800	$179,373	$33,303	$756,124	$0	$756,124
29	$968,980	$179,292	$33,315	$756,373	$0	$756,373
30	$940,478	$168,233	$33,247	$738,999	$0	$738,999
31	$896,046	$159,306	$33,098	$703,643	$0	$703,643
32	$845,828	$153,830	$32,870	$659,128	$0	$659,128
33	$819,680	$150,601	$32,565	$636,513	$0	$636,513
34	$696,500	$134,877	$32,187	$529,436	$0	$529,436
0	$412,798	$64,054	$4,781	$343,962	$0	$343,962
0	$215,894	$29,037	$4,723	$182,135	$0	$182,135
0	$125,541	$14,575	$0	$110,966	$0	$110,966
0	$41,263	$4,126	$0	$37,136	$0	$37,136
0	$28,986	$2,899	$0	$26,088	$0	$26,088
NPV				$11,145,091	$536,035	$10,609,055
IRR						NA
B/C ratio						20.8
Payback (years)						NA

The Narrow Taxpayer Perspective

Table 3.8 provides an investment analysis of the Washington community and technical colleges from the narrow taxpayer perspective. Recall from **Chapter 2** that the narrow perspective considers only monies that actually appear on the books of the state government: 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 government revenues stemming from the operation of the Washington community and technical colleges during the single analysis year. The values in Column 1 are computed by applying average state government tax rates to the net increase in statewide income attributed to the Washington community and technical college system.[27] Also included in Column 1 are reductions (entered as negatives) in state 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 CTCs to operate without the current level of state 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 government costs, taken directly from **Table 2.1**. Finally, Column 6 subtracts state government costs from benefits, thereby providing the temporal cash flow needed for the investment analysis. As shown at the bottom of the table, the colleges provide the state government with an aggregate annual return of $1,303.5 million expressed as a net present value on its one year investment. Alternatively, the one year investment generates a 19.6% RR and a B/C ratio of 3.4, both indicating that the investment is attractive. The payback period is 6.8 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.

[27] 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.

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	$227,941	$7,080	$0	$220,861	$557,477	($336,616)
2	$62,904	$13,139	$0	$49,765	$0	$49,765
3	$81,602	$17,044	$0	$64,558	$0	$64,558
4	$85,841	$17,929	$0	$67,912	$0	$67,912
5	$90,209	$18,842	$0	$71,367	$0	$71,367
6	$94,685	$19,777	$0	$74,908	$0	$74,908
7	$99,248	$20,730	$0	$78,518	$0	$78,518
8	$103,874	$21,696	$0	$82,178	$0	$82,178
9	$108,539	$22,670	$0	$85,869	$0	$85,869
10	$113,216	$23,647	$0	$89,569	$0	$89,569
11	$117,877	$24,621	$0	$93,256	$0	$93,256
12	$122,493	$25,585	$0	$96,908	$0	$96,908
13	$127,034	$26,533	$0	$100,501	$0	$100,501
14	$131,470	$27,460	$0	$104,011	$0	$104,011
15	$135,772	$28,358	$0	$107,414	$0	$107,414
16	$139,909	$29,222	$0	$110,686	$0	$110,686
17	$143,851	$30,046	$0	$113,805	$0	$113,805
18	$147,570	$30,823	$0	$116,747	$0	$116,747
19	$151,039	$31,547	$0	$119,492	$0	$119,492
20	$154,231	$32,214	$0	$122,017	$0	$122,017
21	$157,123	$32,818	$0	$124,305	$0	$124,305
22	$159,693	$33,355	$0	$126,339	$0	$126,339
23	$161,922	$33,820	$0	$128,102	$0	$128,102
24	$163,792	$34,211	$0	$129,581	$0	$129,581
25	$165,289	$34,523	$0	$130,766	$0	$130,766
26	$166,403	$34,756	$0	$131,647	$0	$131,647
27	$167,126	$34,907	$0	$132,219	$0	$132,219
28	$167,452	$34,975	$0	$132,477	$0	$132,477
29	$167,381	$34,960	$0	$132,420	$0	$132,420
30	$166,913	$34,863	$0	$132,050	$0	$132,050
31	$166,055	$34,683	$0	$131,371	$0	$131,371
32	$164,813	$34,424	$0	$130,389	$0	$130,389
33	$163,199	$34,087	$0	$129,112	$0	$129,112
34	$161,227	$33,675	$0	$127,552	$0	$127,552
0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0
NPV				$1,946,207	$536,035	$1,410,172
IRR						22.1%
B/C ratio						3.6
Payback (years)						6.1

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 30 Washington CTC districts are a notable exception to this general net-subsidy rule. The narrow perspective rate of return 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 Washington community and technical colleges were reduced, taxes would**

have to be raised in order for the state government to continue its support of other activities at current levels. The taxpayer investments of 45% 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 CTC 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 Washington's CTC Districts.

Table 3.9. Taxpayer Perspective ($ Thousands)

	Broad Perspective With Social Savings		Narrow Perspective With Social Savings	
	Included	Excluded	Included	Excluded
NPV	$10,609,055	$8,429,212	$1,303,529	$912,268
IRR	NA	NA	19.6%	15.1%
B/C ratio	20.8	16.7	3.4	2.7
Payback (years)	NA	NA	6.8	8.8

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 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	$ 17,156,000,000	$1,996	$ 35,375
Health benefits, captured by society			
PV of absenteeism savings	$ 498,175,302	$58	$ 1,027
PV of tobacco and alcohol abuse medical savings	$ 546,500,391	$64	$ 1,127
Crime			
PV of reduced incarceration	$ 388,076,436	$45	$ 800
PV of reduced victim costs	$ 427,408,031	$50	$ 881
PV of earnings (opportunity gained)	$ 163,841,643	$19	$ 338
Unemployment and welfare			
PV of reduced welfare rolls	$ 457,527,018	$53	$ 943
PV of reduced unemployment	$ 383,587,805	$45	$ 791
Sum of all present values, benefits	$ 20,021,116,627	$ 2,329	$ 41,282
PV of all costs			
PV of state and local contribution to college budget	$ 557,476,671	$65	$ 1,149
PV of opportunity cost of education + tuition	$ 3,268,103,000	$380	$ 6,739
Sum of all present values, costs	$ 3,825,579,671	$ 445	$ 7,888
NPV, Student Perspective		$14,013,887	
RR, Student Perspective		21%	
B/C Ratio, Student Perspective		5.5	
Payback Period, Student Perspective		6.9	
NPV, Taxpayer Perspective: Broad		$10,609,055	
RR, Taxpayer Perspective: Broad		NA	
B/C Ratio, Taxpayer Perspective: Broad		20.8	
Payback Period, Taxpayer Perspective: Broad		NA	
NPV, Taxpayer Perspective: Narrow		$1,303,529	
RR, Taxpayer Perspective: Narrow		19.6%	
B/C Ratio, Taxpayer Perspective: Narrow		3.4	
Payback Period, Taxpayer Perspective: Narrow		6.8	

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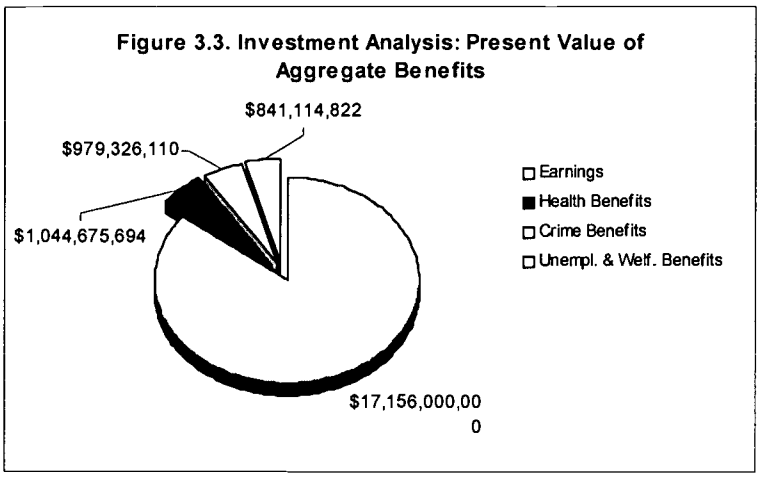

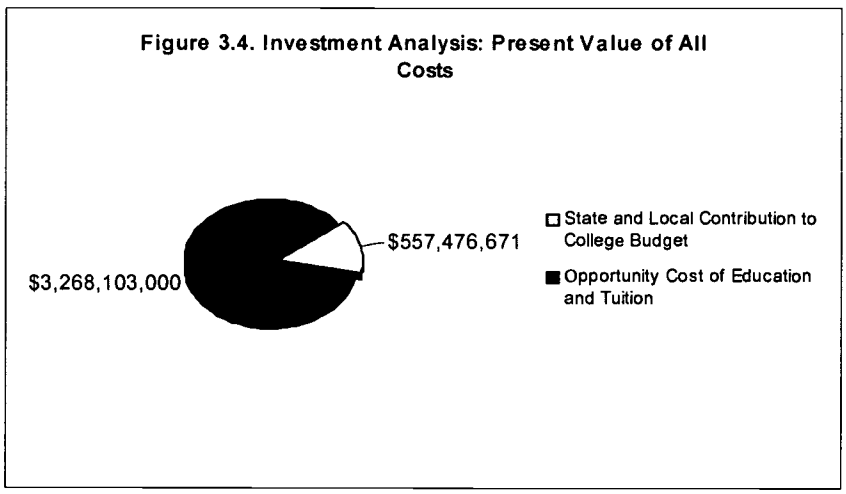

STATEWIDE ECONOMIC BENEFITS

The 30 Washington Community and Technical College districts play an important role in the resiliency, growth and development of the state economy. In 2002, the State of Washington generated overall earnings (wages, salaries and proprietors' income) equal to $148.85 billion.[28] The portion of this total credited to the existence of the 30

[28] Total earnings for the State of Washington 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.

Washington community and technical colleges is discussed in the four subsections below, both in the aggregate and with industry detail. The industry-specific analysis highlights the Washington CTC 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 Washington CTC instruction. In the third section we utilize the multipliers of the regional IO model and estimate the *indirect impact* of past Washington CTC instruction on statewide earnings. In the fourth and final subsection we combine the three separate effects: 1) college operations and capital spending effects, 2) past student direct effects, and 3) past student indirect effects, to arrive at the overall aggregate effect of Washington's CTC Districts on earnings in the State of Washington.

Earnings Linked to Operation and Capital Spending

Table 2.10 in **Chapter 2** shows the 30 Washington CTC 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 Washington IO model to estimate the associated multiplier effects.

Table 3.11 shows the results of the IO multiplier analysis of Washington's CTC Districts' operating and capital spending. Column 1 is for reference, showing 2002 total e*arnings* by industry. Column 2 shows the portion of total earnings explained by (or accounted for by) Washington's CTC 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 Washington had $9.52 billion in total earnings in 2002. Of this, Washington's CTC Districts' spending accounts for $35.80 million (or 0.4%). Similarly, the business-services sector (services to buildings, advertising, reproduction, legal and accounting services, etc.) had $25.32 billion in total earnings in 2002, of which $72.72 million (or 0.3%) was explained by Washington's CTC Districts' spending. All told, Washington's CTC Districts' spending explained $1.04 billion, or 0.7% of all statewide earnings in 2002.

Table 3.11. Earnings Linked to Washington's CTC Districts Operations Expenditures

	Earnings		
	Baseline	College-Linked	% College-Linked
	----------($1,000)----------		
Industries	1	2	3
Agriculture & Agricultural Services	$3,133,720	$2,109	0.07%
Mining, Sand, and Gravel	$267,353	$782	0.29%
Construction	$9,515,112	$35,803	0.38%
Manufacturing: Food/Wood & Paper/Textiles	$5,233,716	$8,417	0.16%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$4,756,049	$9,316	0.20%
Manufacturing: Computer & Electronic Equipment	$2,517,342	$1,264	0.05%
Manufacturing: Other	$8,869,277	$6,744	0.08%
Transportation	$4,123,563	$10,581	0.26%
Public Utilities	$1,015,038	$10,468	1.03%
Publishing & Communications	$4,065,900	$7,830	0.19%
Trade	$21,899,320	$73,112	0.33%
Finance, Insurance, and Real Estate	$9,519,727	$45,097	0.47%
Motels & Eating/Drinking & Amusement/Recreation	$5,618,021	$23,404	0.42%
Consumer Services	$3,901,690	$14,069	0.36%
Business Services	$25,321,266	$72,721	0.29%
Medical/Educational/Social services	$14,085,708	$71,344	0.51%
Federal Government	$7,692,820	$5,549	0.07%
State & Local Government (less the college)	$16,681,348	$9,786	0.06%
Washington's CTC Districts	$636,368	$636,368	100.00%
Total	$148,853,336	$1,044,764	0.70%

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 116.0 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 Washington's CTC Districts' instruction on statewide earnings:

- Step 1: We show the 116.0 million of past Washington's CTC Districts' 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 $100. The net value was derived as the gross value less

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10%.[29] For the statewide economic development effect, however, we need to begin with the *gross* value per CHE, or $104.

- 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 Washington's CTC Districts' instruction.

- Step 4: In **Chapter 2, Table 2.2** we described the source and meaning of the "alternative education opportunity variable." Absent Washington's CTC Districts, 22.6% of the students would still be able to obtain their education elsewhere. This portion of the added earnings is not credited to Washington's CTC 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 SBCJC CHEs

	Variables
Total embodied CHEs	115,990,046
Gross value per Washington's CTC Districts CHE	$104
Increased earnings of past Washington's CTC Districts students	$12,093,886,544
Alternative education %	23%
Gross earnings attributable to Washington's CTC Districts, net of alternative edı	$9,358,406,367
Substitution Effects Rate	33%
Net earnings attributable to Washington's CTC Districts	$3,088,274,101

[29] **Table 3.3** assigns a $100 net per CHE value of Washington's CTC Districts' instruction. This is a net value reflecting a 10% reduction from the gross value of $3,088.27 million 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, $3,088.27 million.

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As shown in the last entry of **Table 3.12**, our analysis concludes that earnings in the State of Washington are $3,088.27 million 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 30 Washington community and technical colleges 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 skilled workers they employ. The Medical/Educational/Social services sector, for example, is estimated to employ Washington CTC students with a combined 25,633,816 hours of CHEs (see **Table 2.13**). Because of the skills of these past students, the Medical/Educational/Social services sector is estimated to generate earnings that are $14.09 million (or 4.3% 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 $3.09 billion (or 2.1%) higher than they would be if the 30 Washington CTC 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

Industries	Earnings Baseline ($1,000) 1	Earnings College-Linked ($1,000) 2	% College Linked 3
Agriculture & Agricultural Services	$3,133,720	$712	0.0%
Mining, Sand, and Gravel	$267,353	$3,211	1.2%
Construction	$9,515,112	$207,007	2.2%
Manufacturing: Food/Wood & Paper/Textiles	$5,233,716	$102,103	2.0%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$4,756,049	$11,501	0.2%
Manufacturing: Computer & Electronic Equipment	$2,517,342	$49,084	1.9%
Manufacturing: Other	$8,869,277	$233,720	2.6%
Transportation	$4,123,563	$90,523	2.2%
Public Utilities	$1,015,038	$31,848	3.1%
Publishing & Communications	$4,065,900	$88,858	2.2%
Trade	$21,899,320	$537,304	2.5%
Finance, Insurance, and Real Estate	$9,519,727	$125,085	1.3%
Motels & Eating/Drinking & Amusement/Recreation	$5,618,021	$128,648	2.3%
Consumer Services	$3,901,690	$1,169	0.0%
Business Services	$25,321,266	$543,098	2.1%
Medical/Educational/Social services	$14,085,708	$610,913	4.3%
Federal Government	$7,692,820	$323,489	4.2%
State & Local Government	$17,317,716	$0	0.0%
Total	$148,853,336	$3,088,274	2.1%

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.[30]

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

[30] 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 Washington IO model.

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economies of scale, enhances workforce efficiency through information sharing, and otherwise enhances the statewide business climate.[31]

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

	Earnings		
	Baseline	College-Linked	% College-Linked
Industries	----------($1,000)----------		
Agriculture & Agricultural services	$3,133,720	$33,922	1.1%
Mining, Sand, and Gravel	$267,353	$7,409	2.8%
Construction	$9,515,112	$84,722	0.9%
Manufacturing: Food/Wood & Paper/Textiles	$5,233,716	$79,580	1.5%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$4,756,049	$112,678	2.4%
Manufacturing: Computer & Electronic Equipment	$2,517,342	$33,049	1.3%
Manufacturing: Other	$8,869,277	$102,564	1.2%
Transportation	$4,123,563	$106,690	2.6%
Public Utilities	$1,015,038	$36,280	3.6%
Publishing & Communications	$4,065,900	$66,700	1.6%
Trade	$21,899,320	$505,343	2.3%
Finance, Insurance, and Real Estate	$9,519,727	$217,822	2.3%
Motels & Eating/Drinking & Amusement/Recreation	$5,618,021	$168,277	3.0%
Consumer Services	$3,901,690	$123,586	3.2%
Business Services	$25,321,266	$563,757	2.2%
Medical/Educational/Social services	$14,085,708	$442,875	3.1%
Federal Government	$7,692,820	$76,939	1.0%
State & Local Government	$17,317,716	$149,799	0.9%
Total	$148,853,336	$2,911,994	2.0%

Focusing on particular effects, we can now say that because of the indirect effect of past students, earnings in the Public Utilities sector will be $36.28 million (or 3.6%) 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 $148.85 billion (or 2.0%) larger due to the indirect effect of past students.

[31] We estimate agglomeration effects as "forward" multiplier effects. The State of Washington 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 Washington IO model.

Overall Effect of Washington's CTC Districts on the Statewide Economy

The tables above detail the regional economic effects attributable to Washington's CTC 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 ($1,000)	Earnings College-Linked ($1,000)	% College-Linked
Agriculture & Agricultural services	$3,133,720	$36,743	1.2%
Mining, Sand, and Gravel	$267,353	$11,402	4.3%
Construction	$9,515,112	$327,533	3.4%
Manufacturing: Food/Wood & Paper/Textiles	$5,233,716	$190,099	3.6%
Manufacturing: Chemicals/Petroleum/Stone & Glass	$4,756,049	$133,495	2.8%
Manufacturing: Computer & Electronic Equipment	$2,517,342	$83,397	3.3%
Manufacturing: Other	$8,869,277	$343,028	3.9%
Transportation	$4,123,563	$207,794	5.0%
Public Utilities	$1,015,038	$78,597	7.7%
Publishing & Communications	$4,065,900	$163,388	4.0%
Trade	$21,899,320	$1,115,759	5.1%
Finance, Insurance, and Real Estate	$9,519,727	$388,004	4.1%
Motels & Eating/Drinking & Amusement/Recreation	$5,618,021	$320,329	5.7%
Consumer Services	$3,901,690	$138,825	3.6%
Business Services	$25,321,266	$1,179,576	4.7%
Medical/Educational/Social services	$14,085,708	$1,125,132	8.0%
Federal Government	$7,692,820	$405,978	5.3%
State & Local Government (less the college)	$16,681,348	$159,585	1.0%
Washington's CTC Districts	$636,368	$636,368	100.0%
Total	$148,853,336	$7,045,033	4.7%

Individual rows in **Table 3.15** show how particular industries benefit from the past and present existence of the 30 Washington CTC districts. For example, our analysis suggests the State of Washington's Medical/Educational/Social services sector owes $14.09 billion (or 8.0%) of its overall earnings to the past and present existence of Washington's CTC Districts. The effect of Washington's CTC Districts on other industries is shown in the table. The bottom row of **Table 3.15** indicates that region-wide earnings are $148.85 billion (or 4.7%) larger due to the past and present existence of the 30 Washington community and technical colleges.

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Table 3.16. Summary of Washington's CTC Districts Role in the Regional Economy

	Earnings ($Thousands)	% of Total
Total Earnings in College-Hosting Region	$148,853,336	100.00%
Earnings Attributable to Washington's CTC Districts Operations		
Direct Earnings of Faculty and Staff	$636,368	0.4%
Indirect Earnings	$408,396	0.3%
TOTAL	$1,044,764	0.7%
Earnings Attributable to Past Student Econ. Dev. Effects		
Direct Earnings	$3,088,274	2.1%
Indirect Earnings	$2,911,994	2.0%
TOTAL	$6,000,268	4.0%
GRAND TOTAL	$7,045,033	4.7%

Table 3.16 provides one last view of the regional economic effects of Washington's CTC Districts, a fully aggregated view with no industry detail. Consider the items under the heading "Earnings Attributable to College Operations." The first item is simply the wages and salaries of the faculty and staff of the 30 Washington community and technical colleges, $636.4 million, or 0.4% 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: $408.4 million, or 0.3% of all statewide earnings. All told, the operations and capital spending of the 30 Washington CTC districts can be credited with $1.0 billion, or 0.7% of the State of Washington's $148.9 billion in overall earnings.

The next set of items detail the effect of past students still active in the State of Washington workforce. Past students directly explain $3.1 billion, or 2.1% of all statewide earnings (shown on the total row of **Table 3.13**). These same students indirectly explain $2.9 billion, or 2.0% 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 $6.0 billion, or 4.0% of all earnings in the State of Washington.

Finally, the bottom row of **Table 3.16** shows Washington's CTC Districts' overall role in the state's economy: $7.0 billion, or 4.7% 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 Washington's CTC 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 Washington's CTC 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 49% 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 30 colleges, it is estimated that the students working while attending classes earn only 67%, on average, of the earnings they would have statistically received if not attending the community or technical college. 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—49% for the portion of students employed, and 67% 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 49% to 100% first (holding all of the other assumptions constant), the RR, B/C, and payback period results would improve to 33.8%, 9.7, and 4.5 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 67% 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 25.0%, 6.9, and 5.8 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 >100%, 29.7, and 2.0 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	49%	20.7%	5.5	6.9
	100%	33.8%	9.7	4.5
2. Percent of Earnings	67%	20.7%	5.5	6.9
	100%	25.0%	6.9	5.8
1 = 100%, 2 = 100%		>100%	29.7	2.0

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 Washington's CTC 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 30 community and technical 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.[32] 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 "Earnings Attributable to Student Spending,"[33] creating some $520.2 million in

[32] 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.

[33] 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

additional earnings for the state businesses patronized by students (the direct effects), plus another $552.7 million in earnings stemming from related multiplier effects (indirect effects). Adding the student spending to the mix increases the Washington's CTC Districts total "explanatory power" of the regional earnings from 4.7% in **Table 3.16** to 5.5% in **Table 4.2**.

Table 4.2. Summary of Washington's CTC Districts Role in the Regional Economy - Earnings

	Earnings ($ Thousands)	% of Total
Total Earnings in College-Hosting Region	$148,853,336	100%
Earnings Attributable to Student Spending		
Direct Earnings	$520,212	0.3%
Indirect Earnings	$552,748	0.4%
TOTAL	$1,072,960	0.7%
Earnings Attributable to Washington's CTC Districts Operations		
Direct Earnings of Faculty and Staff	$636,368	0.4%
Indirect Earnings	$408,396	0.3%
TOTAL	$1,044,764	0.7%
Earnings Attributable to Past Student Econ. Dev. Effects		
Direct Earnings	$3,088,274	2.1%
Indirect Earnings	$2,911,994	2.0%
TOTAL	$6,000,268	4.0%
GRAND TOTAL	$8,117,993	5.5%

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 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

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.

$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 the Washington's CTC 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 $383.4 billion.[34] Direct local spending by students reflects their total spending, reduced by the estimated portion that leaks out-of-state to purchase goods produced elsewhere.[35] 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 30 colleges is estimated to explain some $18,930.6 million in regional gross sales, a number substantially larger than the $8,118.0 million explained by the college in regional gross earnings shown in **Table 4.2**.

Table 4.3. Summary of Washington's CTC Districts Role in the Regional Economy - Sales

	Gross Sales (1,000)	% of Total
Total Gross Sales in College-Hosting Region	$383,444,577	100%
Gross Sales Attributable to Student Spending		
Direct Local Spending by Students	$1,292,444	0.3%
Indirect Spending Effect	$1,443,254	0.4%
TOTAL	$2,735,698	0.7%
Gross Sales Attributable to Washington's CTC Districts Operations		
Direct Local Expenditures of Washington's CTC Districts	$587,428	0.2%
Indirect Spending Effect	$515,282	0.1%
TOTAL	$1,102,711	0.3%
Gross Sales Attributable to Past Student Econ. Dev. Effects		
Direct Gross Sales	$7,569,161	2.0%
Indirect Gross Sales	$7,522,989	2.0%
TOTAL	$15,092,151	3.9%
GRAND TOTAL	$18,930,560	4.9%

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

[35] 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.

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.

VARIABLES REQUIRING "JUDGMENT"

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

Two variables have consistently raised concerns among institutional researchers—the "Alternative Education Opportunity" and "Attrition Rate" variables discussed in detail in **Tables 2.9** and **2.2**, respectively. Neither can be specified on the basis of hard data collected on a regular basis by the college; rather, they are based on well-informed judgments made by faculty and staff intimately familiar with the student body. Recall from **Chapter 2** that the alternative education opportunity variable (22.6% in **Table 2.9**) is characterized as a "negative benefit"—the taxpayer benefits are reduced by the percent indicated to account for the portion of the current student body who could obtain a similar education elsewhere, absent the college. The attrition rate (33% 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 these variables and the difficulty in accurately specifying them, the obvious question is: how great a role do they play in the magnitudes of the results? The results are presented in the sensitivity analysis **Table 4.4**.

Table 4.4 Sensitivity Analysis of Alternative Education and Attrition Rate Variables

		-75%	-50%	-25%	Base Case	25%	50%	75%
Alternative Education Variable		5.7%	11.3%	16.96%	23%	28.27%	33.9%	39.6%
Narrow Taxpayer Perspective								
Investment results	NPV	$1,303,529	$1,303,529	$1,303,529	$1,303,529	$1,303,529	$1,303,529	$1,303,529
	RR	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%
	B/C ratio	3.4	3.4	3.4	3.4	3.4	3.4	3.4
	Pay Back	6.8	6.8	6.8	6.8	6.8	6.8	6.8
		-75%	-50%	-25%	Base Case	25%	50%	75%
Attrition Rate Variable		8.2%	16.3%	24.46%	33%	40.77%	48.9%	57.1%
Regional Economic Development								
Earnings Attributable to Washington's CTC D		$7,934,351	$7,649,321	$7,353,503	$7,045,033	$6,721,438	$6,379,320	$6,013,790
% of Total Earnings in Region		5.3%	5.1%	4.9%	4.7%	4.5%	4.3%	4.0%
Credits Embodied in the Workforce		133,181,294	127,671,419	121,953,022	115,990,046	109,734,687	103,121,268	96,055,293

Alternative Education Opportunity

Variations in the Alternative Education assumption are calculated around the base case assumptions listed in the middle column of **Table 4.4** for the taxpayer perspective results (the variable does not affect the student investment analysis results). The NPV, RR, B/C and payback results listed in the base case column were all presented and discussed in Chapter 3. Next, we bracket the base case assumption on either side with plus or minus 25%, 50% and 75% variation in the assumptions. The analyses are then redone introducing one change at a time, holding all the other variables constant. For example, an increase of 25% in the Alternative Education assumption (from 23% to 28.27%) will reduce the narrow taxpayer perspective RR from 19.6% to 19.6%. Likewise, a decrease of 25% (from 23% to 17%) in the assumption will generate an increase in the RR from 19.6% to 19.6%.

Based on this sensitivity analysis, the conclusion can be drawn that the Washington CTC investment analysis results from the narrow taxpayer perspective are not very sensitive to relatively large variations in the Alternative Education variable. As indicated, the results are still well above their threshold levels (NPV greater than 0, B/C ratio greater than 1, and RR greater than the discount rate of 4%) even when the Alternative Education assumption is increased by as much as 75% (from 23% to 40%). The conclusion is simply that, although the assumption is difficult to specify and will require judgment on the part of the institutional researcher, its impact on the overall investment analysis results for the narrow taxpayer perspective is not very sensitive.

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Attrition Variable

The attrition rate variable only affects the regional economic development results (**Table 3.16**). As above, we increase and decrease the assumption relative to the base case assumption of 33% (from **Table 2.2**) by the increments indicated in **Table 4.4**. The impacts on the results are more pronounced, as indicated in the table. Earnings attributable to the college, for example, range from a high of $7,934,351 at -75% to a low of $6,013,790 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.

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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.[36]

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 CTC for one year for which he or she pays a tuition of $1,500 (Column 2).

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

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3) The opportunity cost of time (the earnings foregone while attending the CTC 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 community or technical college, 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.[37] A brief example: at 4%, the present value of $5,000 to be received one year from today is $4,807. If the $5,000 were to be received in year 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 CTC education is very strong.

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

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 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 CTC 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 CTC. 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 and technical colleges. These numbers are then adjusted for inflation to 2001 dollars.

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 CTC enrollment (measured in terms of CHEs) against the support provided by state and local government. If, without state and local government support a CTC 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 CTC 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 CTC has only two sources of revenues, student tuition payments and state and local government support.

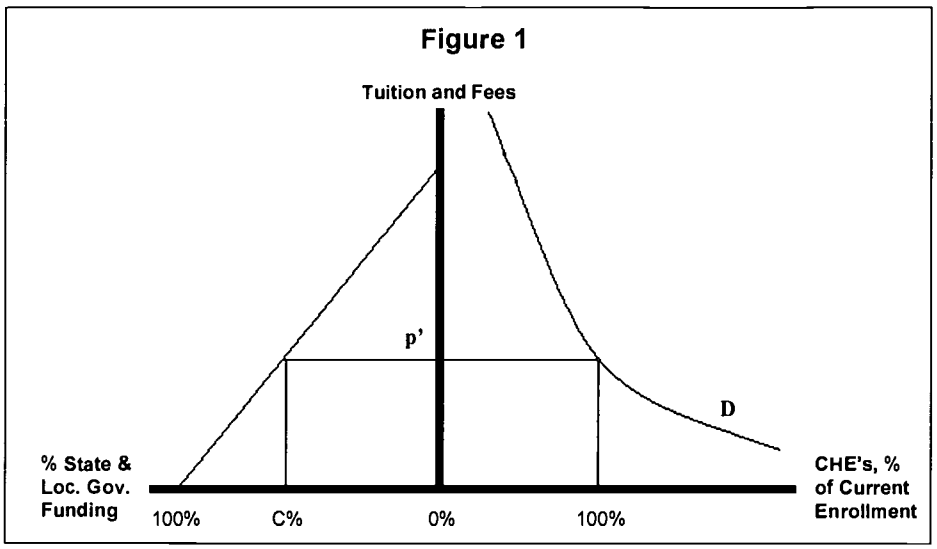
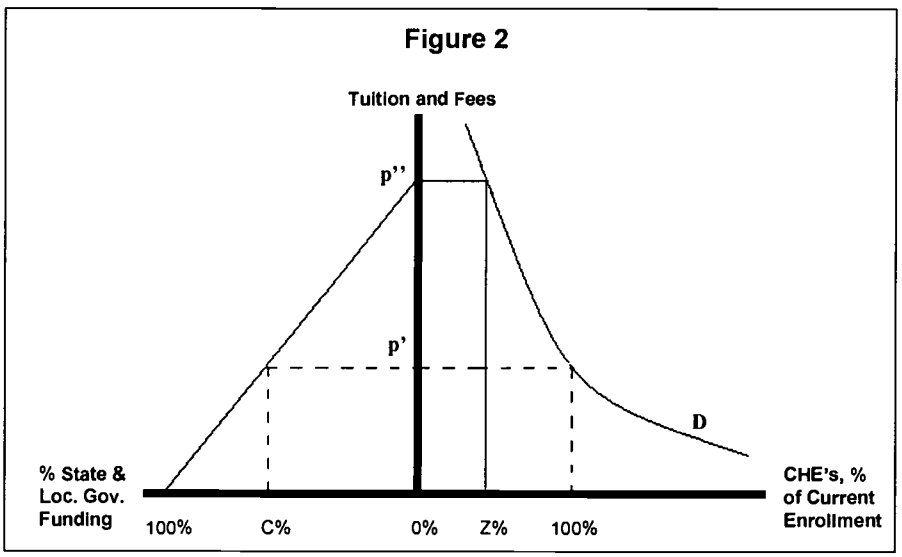


Figure 2 shows another important reference point in the model—where state and local government support is 0%, tuition rates are increased to p", and enrollment is Z% (less than 100%). The reduction in enrollment reflects price-elasticity in the students' school vs. no-school decision. Neglecting for the moment those issues concerning the CTCs minimum operating scale (considered below in the section on "The CTC Shutdown Point"), the implication for our investment analysis is that the benefits of state and local government support for the CTC 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 CTC 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 CTC SHUTDOWN POINT

CTC 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 CTC 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 CTC shutdown point but otherwise plays no role in the estimation of state and local government benefits. These remain as shown in equation (3).

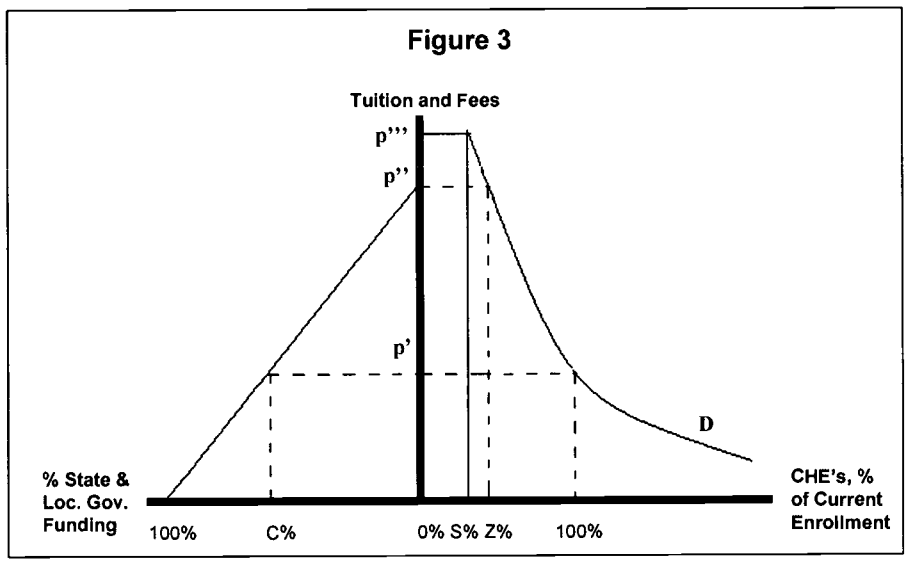
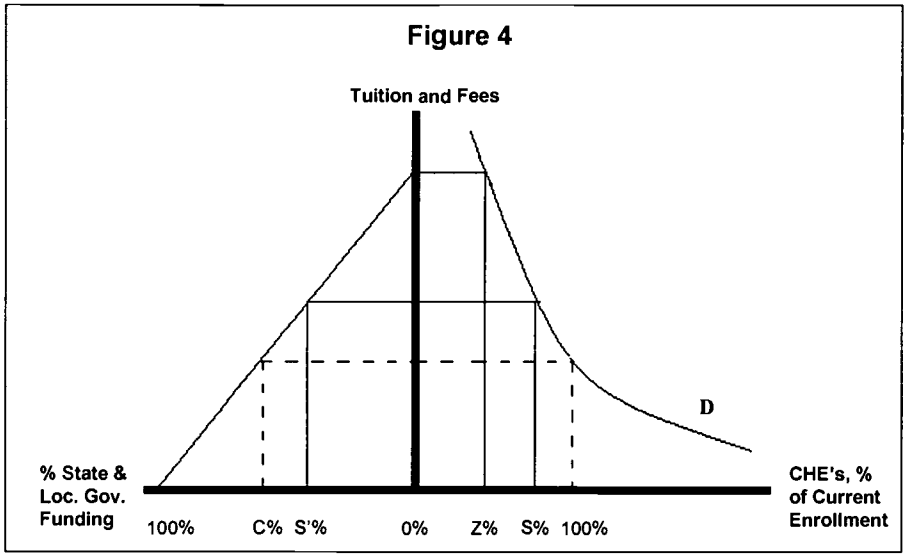


Figure 4 illustrates yet another scenario. Here the CTC shutdown point occurs at an enrollment level greater than Z% (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the school to operate at all. This minimum portion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

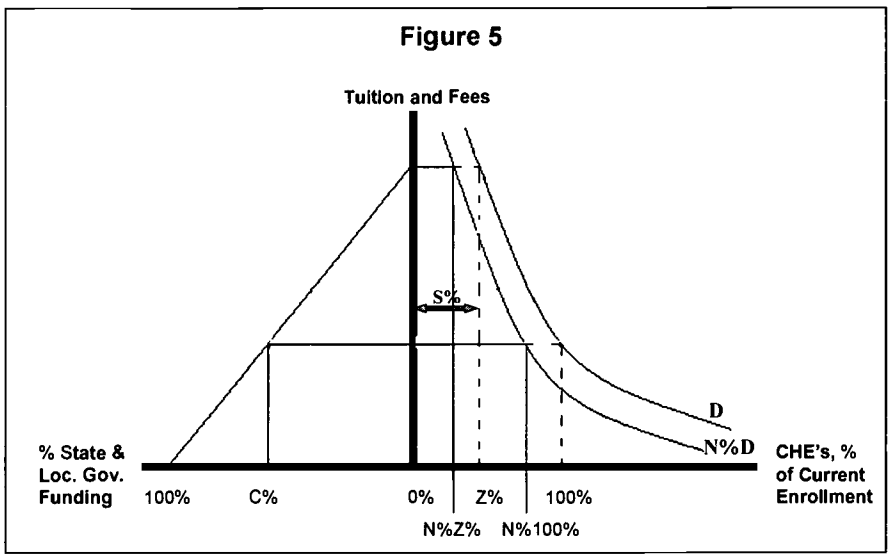


ADJUSTING FOR ALTERNATIVE EDUCATION OPPORTUNITIES

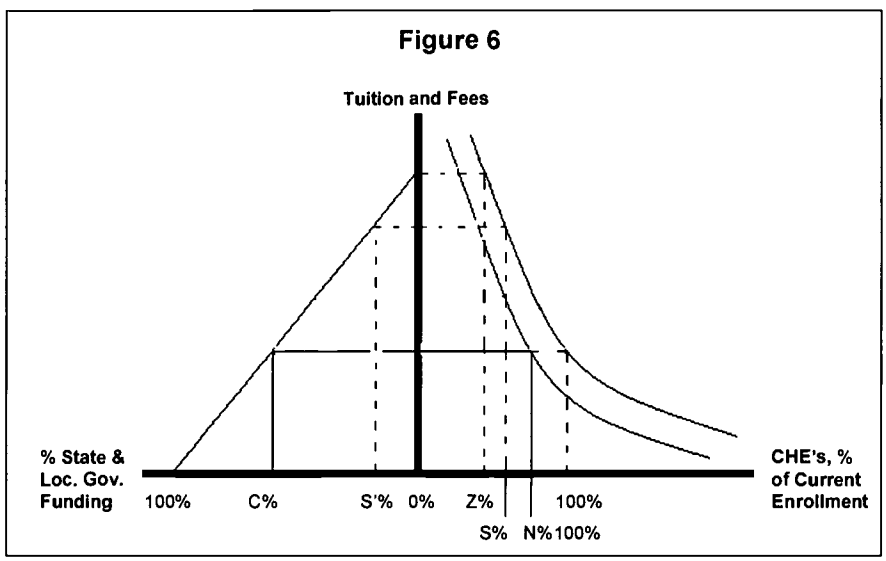
Because there may be education alternatives to the CTC, we must make yet another adjustment. The question asked is: "Absent the CTC, what percentage of the students would be able to obtain their education elsewhere?" The benefits associated with the CTC education of these students are deducted from the 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 CTC could operate absent state and local government support (i.e., Z% occurs at an enrollment level greater than the CTC 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 CTC cannot remain open absent some minimum S'% level of state and local government support. In this case the CTC 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%).



The Socioeconomic Benefits Generated by Washington Community and Technical College Districts

State of Washington

Volume 2: Detailed Results

by

Entry Level of Education

Gender and Ethnicity

27-Feb-2003

M. Henry Robison & Kjell A. Christophersen

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INTRODUCTION

The purpose of this volume is to present the results of the economic impact analysis in detail by gender, ethnicity and entry level of education. It is kept as a separate volume intended for limited distribution only, however, because this effort is not about gender and ethnicity differences *per se*. The study is about the overall economic impacts generated by community and technical colleges (CTCs). As such, the Main Report and the short Executive Summary both present the results without reference to gender and ethnicity differences.

We feel, nevertheless, that it is important to present *all* of the results for the sake of completeness, not just the consolidated ones, so long as the users of the detailed information remain prudent in its use and distribution. The results should not be used, for example, to further political agendas. Other studies about gender and ethnicity differences address such questions better and in greater detail. Our intent is simply to provide CTC presidents with pertinent information should specific questions arise.

On the input side, gender and ethnicity are important variables that help characterize the student body profile. We collect the profile data and link it to national statistical databases which are already broken out by gender and ethnic differences. The student body profile, to a large extent, drives the magnitudes of the results which are presented in detail in this volume and in a consolidated fashion in the Main Report and the Executive Summary.

Tables 19 and **20** in this report are particularly important. They provide the data needed for computing the investment analysis results in **Tables 3.7** and **3.8** in the **Main Report**—the broad and narrow taxpayer perspectives. In **Table 19**, every other column (the higher taxes and the avoided cost columns) provides the data needed for the narrow taxpayer perspective. The remaining columns provide the data needed for the broad taxpayer perspective. **Table 20** provides the detailed calculations on student earnings that feed into the first column of **Table 19**.

DETAILED RESULTS

Table 1. Higher Annual Earnings Based on Achievements During Analysis Year, Aggregate

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	$27,954,463	$11,800,480	$18,668,833	$8,800,658	$67,224,434
HS/GED equivalent	$39,774,851	$16,790,247	$26,812,274	$12,639,550	$96,016,922
1 year post HS or less	$99,833,922	$25,993,879	$68,155,923	$21,041,029	$215,024,753
2 years post HS or less	$124,452,852	$26,535,493	$95,780,432	$23,563,271	$270,332,048
> Associate Degree	$70,017,344	$15,973,871	$57,183,609	$14,926,478	$158,101,303
Total	$362,033,433	$97,093,971	$266,601,071	$80,970,985	$806,699,460

Table 2. No. of Days Reduced Absenteeism/Year

	Male		Female		Reduce
	White	Minority	White	Minority	Absent.
< HS/GED	8,990	7,900	13,892	17,218	48,000
HS/GED equivalent	4,371	3,841	6,754	8,371	23,338
1 year post HS or less	23,698	13,085	37,162	30,757	104,702
2 years post HS or less	14,183	6,350	24,856	16,280	61,668
> Associate Degree	6,988	3,319	13,048	8,955	32,310
Total	58,231	34,494	95,712	81,581	270,018

Table 3. Employer Savings from Reduced Absenteeism, $ per Year

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	$879,192	$477,159	$698,783	$695,122	$2,750,256
HS/GED equivalent	$657,428	$356,802	$539,727	$536,899	$2,090,857
1 year post HS or less	$4,121,213	$1,405,404	$3,461,669	$2,299,467	$11,287,753
2 years post HS or less	$2,889,689	$799,045	$2,736,461	$1,438,541	$7,863,735
> Associate Degree	$1,616,995	$474,290	$1,641,666	$904,256	$4,637,208
Total	$10,164,517	$3,512,700	$9,078,306	$5,874,285	$28,629,809

Table 4. Fewer Smokers

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	197	20	176	23	416
HS/GED equivalent	158	17	142	19	337
1 year post HS or less	1,131	85	1,051	102	2,370
2 years post HS or less	894	65	950	85	1,993
> Associate Degree	480	41	551	56	1,129
Total	2,860	230	2,870	285	6,245

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Table 5. Medical Savings from Reduced Smoking, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$583,922	$60,194	$520,393	$67,133	$1,231,642
HS/GED equivalent	$467,439	$51,621	$420,872	$57,456	$997,389
1 year post HS or less	$3,351,374	$252,612	$3,113,755	$303,246	$7,020,987
2 years post HS or less	$2,647,829	$193,200	$2,813,307	$251,071	$5,905,406
> Associate Degree	$1,421,826	$122,292	$1,632,892	$166,717	$3,343,726
Total	$8,472,390	$679,918	$8,501,220	$845,622	$18,499,150

Table 6. Fewer Alcohol Abusers

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	41	28	34	16	119
HS/GED equivalent	34	24	27	13	98
1 year post HS or less	262	112	194	63	631
2 years post HS or less	231	80	166	46	523
> Associate Degree	133	49	93	28	303
Total	700	292	516	167	1,675

Table 7. Medical Savings from Reduced Alcohol Abuse, $/Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$325,266	$225,256	$272,501	$125,683	$948,706
HS/GED equivalent	$272,429	$188,027	$215,471	$102,203	$778,130
1 year post HS or less	$2,080,076	$886,996	$1,545,045	$503,211	$5,015,329
2 years post HS or less	$1,832,868	$634,666	$1,322,410	$367,585	$4,157,529
> Associate Degree	$1,052,798	$385,701	$742,339	$225,978	$2,406,815
Total	$5,563,437	$2,320,646	$4,097,766	$1,324,660	$13,306,509

Table 8. Fewer Incarcerated, Aggregate for Student Body

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	150.8	126.6	2.0	22.3	301.7
HS/GED equivalent	95.4	97.6	1.3	16.3	210.6
1 year post HS or less	506.2	414.3	6.8	69.8	997.1
2 years post HS or less	230.3	243.9	3.5	39.4	517.1
> Associate Degree	86.8	131.3	1.4	20.6	240.2
Total	1,070	1,014	15	168	2,267

Table 9. Savings from Reduced Incarceration, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$1,502,528	$1,261,558	$20,025	$221,868	$3,005,979
HS/GED equivalent	$951,043	$972,156	$12,668	$162,172	$2,098,040
1 year post HS or less	$5,043,877	$4,128,424	$68,082	$695,372	$9,935,754
2 years post HS or less	$2,294,706	$2,430,460	$34,538	$392,780	$5,152,484
> Associate Degree	$865,309	$1,308,703	$13,891	$205,416	$2,393,320
Total	$10,657,464	$10,101,302	$149,204	$1,677,608	$22,585,577

Table 10. Crime Victim Savings, Aggregate for Student Body, $/Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$1,654,810	$1,389,417	$22,054	$244,354	$3,310,635
HS/GED equivalent	$1,047,432	$1,070,684	$13,952	$178,609	$2,310,677
1 year post HS or less	$5,555,074	$4,546,840	$74,982	$765,848	$10,942,744
2 years post HS or less	$2,527,275	$2,676,788	$38,039	$432,588	$5,674,689
> Associate Degree	$953,009	$1,441,340	$15,299	$226,235	$2,635,883
Total	$11,737,599	$11,125,070	$164,326	$1,847,634	$24,874,628

Table 11. Productivity Gained (Fewer Incarcerated), $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$577,500	$299,476	$4,008	$35,641	$916,625
HS/GED equivalent	$481,865	$304,220	$3,410	$35,039	$824,534
1 year post HS or less	$2,800,664	$1,415,817	$20,189	$165,504	$4,402,174
2 years post HS or less	$1,478,436	$967,142	$11,983	$109,376	$2,566,937
> Associate Degree	$634,246	$592,453	$5,520	$65,513	$1,297,732
Total	$5,972,710	$3,579,108	$45,111	$411,074	$10,008,002

Table 12. Fewer People on Welfare

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	243.1	374.0	137.2	181.4	935.8
HS/GED equivalent	161.8	248.9	91.3	120.7	622.8
1 year post HS or less	912.1	882.5	522.4	461.6	2778.7
2 years post HS or less	466.0	366.1	297.9	208.9	1338.8
> Associate Degree	189.6	157.6	129.3	94.7	571.2
Total	1,973	2,029	1,178	1,067	6,247

Table 13. Community Welfare Savings, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$1,036,248	$1,594,141	$584,893	$773,240	$3,988,522
HS/GED equivalent	$689,651	$1,060,943	$389,262	$514,612	$2,654,468
1 year post HS or less	$3,887,744	$3,761,654	$2,226,624	$1,967,502	$11,843,524
2 years post HS or less	$1,986,075	$1,560,428	$1,269,771	$890,239	$5,706,514
> Associate Degree	$808,041	$671,819	$551,163	$403,466	$2,434,489
Total	$8,407,760	$8,648,985	$5,021,712	$4,549,060	$26,627,517

Table 14. Fewer People on Unemployment

	Male		Female		
	White	Minority	White	Minority	Total
< HS/GED	106	132	161	172	572
HS/GED equivalent	107	133	161	173	573
1 year post HS or less	144	236	217	328	925
2 years post HS or less	55	69	95	105	324
> Associate Degree	41	54	74	88	257
Total	453	625	709	866	2,652

Table 15. Unemployment Savings, $ per Year

	Annual Costs, Male		Annual Costs, Female		
	White	Minority	White	Minority	Total
< HS/GED	$938,649	$1,170,040	$1,421,021	$1,522,207	$5,051,918
HS/GED equivalent	$941,264	$1,173,299	$1,424,979	$1,526,447	$5,065,989
1 year post HS or less	$1,271,877	$2,085,897	$1,919,344	$2,897,660	$8,174,778
2 years post HS or less	$487,458	$607,952	$840,749	$928,547	$2,864,706
> Associate Degree	$359,301	$481,391	$657,340	$775,420	$2,273,451
Total	$3,998,549	$5,518,579	$6,263,433	$7,650,281	$23,430,842

Table 16. Summary of Annual Impacts, $ per Year

	Male		Female		
	White	Minority	White	Minority	Total
Higher earnings	$362,033,433	$97,093,971	$266,601,071	$80,970,985	$806,699,460
Absenteeism Savings	$10,164,517	$3,512,700	$9,078,306	$5,874,285	$28,629,809
Medical Cost Savings	$14,035,826	$3,000,564	$12,598,986	$2,170,282	$31,805,659
Incarceration Savings	$10,657,464	$10,101,302	$149,204	$1,677,608	$22,585,577
Crime Victim Savings	$11,737,599	$11,125,070	$164,326	$1,847,634	$24,874,628
Add Prod. (fewer incarc.)	$5,972,710	$3,579,108	$45,111	$411,074	$10,008,002
Welfare Savings	$8,407,760	$8,648,985	$5,021,712	$4,549,060	$26,627,517
Unemployment Savings	$3,998,549	$5,518,579	$6,263,433	$7,650,281	$23,430,842
Total	$427,007,858	$142,580,278	$299,922,148	$105,151,209	$974,661,494

Table 17. Annual Impacts per Credit Hour Equivalent, $ per Year

	Male		Female		Weighted
	White	Minority	White	Minority	Average
Higher earnings	$ 136	$ 91	$ 76	$ 65	$ 100
Absenteeism Savings	$ 4	$ 3	$ 3	$ 5	$ 4
Medical Cost Savings	$ 5	$ 3	$ 4	$ 2	$ 4
Incarceration Savings	$ 4	$ 9	$ 0	$ 1	$ 7
Crime Victim Savings	$ 4	$ 10	$ 0	$ 1	$ 8
Add Prod. (fewer incarc.)	$ 2	$ 3	$ 0	$ 0	$ 3
Welfare Savings	$ 3	$ 8	$ 1	$ 4	$ 6
Unemployment Savings	$ 1	$ 5	$ 2	$ 6	$ 5
Total	$ 160	$ 133	$ 85	$ 84	$ 135

Table 18. Annual Impacts per Student, $ per Year

	Male		Female		Weighted
	White	Minority	White	Minority	Average
Higher earnings	$ 2,383	$ 1,589	$ 1,327	$ 1,139	$ 1,749
Absenteeism Savings	$ 67	$ 57	$ 45	$ 83	$ 66
Medical Cost Savings	$ 92	$ 49	$ 63	$ 31	$ 67
Incarceration Savings	$ 70	$ 165	$ 1	$ 24	$ 126
Crime Victim Savings	$ 77	$ 182	$ 1	$ 26	$ 139
Add Prod. (fewer incarc.)	$ 39	$ 59	$ 0	$ 6	$ 48
Welfare Savings	$ 55	$ 142	$ 25	$ 64	$ 97
Unemployment Savings	$ 26	$ 90	$ 31	$ 108	$ 84
Total	$ 2,810	$ 2,334	$ 1,493	$ 1,479	$ 2,377

Table 19. Cumulative Impact Over Time ($'000), Details for Both Taxpayer Perspectives

			Health						Crime				Welfare / Unemployment			
Year	Earnings Net	Added Taxes	Reduced Absent.	Avoided Cost	Medical Saving	Avoided Cost	Incarc-eration	Avoided Cost	Victims	Avoided Cost	Product. Gained	Avoided Cost	Reduced Welfare	Avoided Cost	Reduced Unempl.	Avoided Cost
1	$1,232,249	$199,065	$28,630	$3,370	$31,806	$1,908	$22,586	$18,068	$24,875	$0	$10,008	$1,617	$26,628	$4,260	$23,431	$0
2	$211,140	$34,109	$28,502	$3,355	$31,632	$1,898	$22,462	$17,970	$24,739	$0	$9,914	$1,602	$26,482	$4,237	$23,210	$0
3	$317,762	$51,333	$28,375	$3,340	$31,459	$1,888	$22,339	$17,871	$24,603	$0	$9,821	$1,586	$26,337	$4,214	$22,992	$0
4	$343,991	$55,571	$28,249	$3,325	$31,287	$1,877	$22,217	$17,774	$24,469	$0	$9,728	$1,572	$26,193	$4,191	$22,776	$0
5	$370,951	$59,926	$28,123	$3,310	$31,115	$1,867	$22,095	$17,676	$24,335	$0	$9,637	$1,557	$26,050	$4,168	$22,561	$0
6	$398,528	$64,381	$27,997	$3,295	$30,945	$1,857	$21,975	$17,580	$24,202	$0	$9,546	$1,542	$25,907	$4,145	$22,349	$0
7	$426,595	$68,915	$27,873	$3,280	$30,776	$1,847	$21,854	$17,484	$24,069	$0	$9,456	$1,528	$25,765	$4,122	$22,139	$0
8	$455,015	$73,506	$27,748	$3,266	$30,608	$1,836	$21,735	$17,388	$23,938	$0	$9,367	$1,513	$25,625	$4,100	$21,930	$0
9	$483,640	$78,130	$27,625	$3,251	$30,440	$1,826	$21,616	$17,293	$23,807	$0	$9,279	$1,499	$25,484	$4,078	$21,724	$0
10	$512,315	$82,763	$27,501	$3,237	$30,274	$1,816	$21,498	$17,198	$23,677	$0	$9,192	$1,485	$25,345	$4,055	$21,519	$0
11	$540,875	$87,376	$27,379	$3,222	$30,108	$1,606	$21,380	$17,104	$23,547	$0	$9,105	$1,471	$25,206	$4,033	$21,317	$0
12	$569,153	$91,945	$27,257	$3,208	$29,943	$1,797	$21,263	$17,011	$23,418	$0	$9,019	$1,457	$25,068	$4,011	$21,116	$0
13	$596,975	$96,439	$27,135	$3,194	$29,780	$1,787	$21,147	$16,918	$23,290	$0	$8,935	$1,443	$24,931	$3,989	$20,918	$0
14	$624,165	$100,832	$27,014	$3,179	$29,617	$1,777	$21,031	$16,825	$23,163	$0	$8,850	$1,430	$24,795	$3,967	$20,721	$0
15	$650,547	$105,093	$26,694	$3,165	$29,455	$1,767	$20,916	$16,733	$23,036	$0	$8,767	$1,416	$24,659	$3,945	$20,526	$0
16	$675,945	$109,196	$26,774	$3,151	$29,294	$1,758	$20,802	$16,641	$22,910	$0	$8,685	$1,403	$24,524	$3,924	$20,333	$0
17	$700,167	$113,113	$26,655	$3,137	$29,133	$1,748	$20,688	$16,550	$22,785	$0	$8,603	$1,390	$24,390	$3,902	$20,141	$0
18	$723,107	$116,815	$26,536	$3,123	$28,974	$1,738	$20,575	$16,460	$22,660	$0	$8,522	$1,377	$24,257	$3,881	$19,952	$0
19	$744,545	$120,279	$26,418	$3,109	$28,816	$1,729	$20,462	$16,370	$22,536	$0	$8,442	$1,364	$24,124	$3,860	$19,764	$0
20	$764,350	$123,478	$26,300	$3,095	$28,658	$1,719	$20,350	$16,280	$22,413	$0	$8,362	$1,351	$23,992	$3,839	$19,578	$0
21	$782,381	$126,391	$26,183	$3,082	$28,501	$1,710	$20,239	$16,191	$22,290	$0	$8,284	$1,338	$23,861	$3,818	$19,394	$0
22	$798,511	$128,997	$26,066	$3,068	$28,345	$1,701	$20,128	$16,103	$22,168	$0	$8,206	$1,326	$23,731	$3,797	$19,211	$0
23	$812,625	$131,277	$25,950	$3,054	$28,190	$1,691	$20,018	$16,015	$22,047	$0	$8,128	$1,313	$23,601	$3,776	$19,030	$0
24	$824,625	$133,215	$25,834	$3,041	$28,036	$1,682	$19,909	$15,927	$21,926	$0	$8,052	$1,301	$23,472	$3,755	$18,851	$0
25	$834,428	$134,799	$25,719	$3,027	$27,883	$1,673	$19,800	$15,840	$21,807	$0	$7,976	$1,289	$23,343	$3,735	$18,674	$0
26	$821,729	$132,747	$25,604	$3,014	$27,730	$1,664	$19,692	$15,753	$21,687	$0	$7,901	$1,276	$23,216	$3,714	$18,498	$0
27	$827,337	$133,653	$25,490	$3,000	$27,578	$1,655	$19,584	$15,667	$21,569	$0	$7,827	$1,264	$23,089	$3,694	$18,324	$0
28	$830,651	$134,189	$25,376	$2,987	$27,428	$1,646	$19,477	$15,581	$21,451	$0	$7,753	$1,252	$22,962	$3,674	$18,152	$0
29	$831,658	$134,351	$25,263	$2,973	$27,278	$1,637	$19,370	$15,496	$21,333	$0	$7,680	$1,241	$22,837	$3,654	$17,981	$0
30	$807,661	$130,475	$25,151	$2,960	$27,128	$1,628	$19,264	$15,411	$21,217	$0	$7,608	$1,229	$22,712	$3,634	$17,812	$0
31	$769,569	$124,321	$25,039	$2,947	$26,980	$1,619	$19,159	$15,327	$21,101	$0	$7,536	$1,217	$22,588	$3,614	$17,644	$0
32	$726,129	$117,304	$24,927	$2,934	$26,832	$1,610	$19,054	$15,243	$20,985	$0	$7,465	$1,206	$22,464	$3,594	$17,478	$0
33	$703,251	$113,608	$24,816	$2,921	$26,686	$1,601	$18,950	$15,160	$20,870	$0	$7,395	$1,195	$22,341	$3,575	$17,314	$0
34	$599,519	$96,850	$24,705	$2,908	$26,540	$1,592	$18,846	$15,077	$20,756	$0	$7,326	$1,183	$22,219	$3,555	$17,151	$0
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
PV	$11,292,165	$1,824,208	$498,175	$58,633	$546,500	$32,790	$388,076	$310,461	$427,408	$0	$163,842	$26,468	$457,527	$73,204	$383,588	$0

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Table 20. Earnings Calculations, Taxpayer Perspectives ($'000)

Year	Gross Student Earnings	Net of Attrition	Direct Earnings Net	Indirect Student Earnings	Net Total Student Earnings	Total CC Earnings	Total Earnings Net
1	$301,992	$301,992	$99,657	$87,827	$187,485	$1,044,764	$1,232,249
2	$342,634	$340,095	$112,231	$98,909	$211,140	$0	$211,140
3	$519,508	$511,837	$168,906	$148,856	$317,762	$0	$317,762
4	$566,588	$554,085	$182,848	$161,143	$343,991	$0	$343,991
5	$615,556	$597,511	$197,179	$173,773	$370,951	$0	$370,951
6	$666,254	$641,931	$211,837	$186,691	$398,528	$0	$398,528
7	$718,500	$687,139	$226,756	$199,839	$426,595	$0	$426,595
8	$772,088	$732,916	$241,862	$213,152	$455,015	$0	$455,015
9	$826,787	$779,024	$257,078	$226,562	$483,640	$0	$483,640
10	$882,345	$825,212	$272,320	$239,995	$512,315	$0	$512,315
11	$938,490	$871,217	$287,501	$253,374	$540,875	$0	$540,875
12	$994,929	$916,765	$302,533	$266,621	$569,153	$0	$569,153
13	$1,051,355	$961,580	$317,321	$279,654	$596,975	$0	$596,975
14	$1,107,447	$1,005,376	$331,774	$292,391	$624,165	$0	$624,165
15	$1,162,872	$1,047,870	$345,797	$304,750	$650,547	$0	$650,547
16	$1,217,293	$1,088,780	$359,297	$316,647	$675,945	$0	$675,945
17	$1,270,365	$1,127,829	$372,183	$328,004	$700,187	$0	$700,187
18	$1,321,744	$1,164,747	$384,367	$338,741	$723,107	$0	$723,107
19	$1,371,090	$1,199,278	$395,762	$348,783	$744,545	$0	$744,545
20	$1,418,069	$1,231,179	$406,289	$358,061	$764,350	$0	$764,350
21	$1,462,359	$1,260,223	$415,873	$366,508	$782,381	$0	$782,381
22	$1,503,650	$1,286,204	$424,447	$374,064	$798,511	$0	$798,511
23	$1,541,653	$1,308,938	$431,950	$380,676	$812,625	$0	$812,625
24	$1,576,098	$1,328,267	$438,328	$386,297	$824,625	$0	$824,625
25	$1,606,741	$1,344,057	$443,539	$390,889	$834,428	$0	$834,428
26	$1,594,102	$1,323,603	$436,789	$384,940	$821,729	$0	$821,729
27	$1,616,962	$1,332,635	$439,769	$387,567	$827,337	$0	$827,337
28	$1,635,560	$1,337,973	$441,531	$389,120	$830,651	$0	$830,651
29	$1,649,769	$1,339,596	$442,067	$389,592	$831,658	$0	$831,658
30	$1,614,126	$1,300,942	$429,311	$378,350	$807,661	$0	$807,661
31	$1,549,483	$1,239,586	$409,063	$360,506	$769,569	$0	$769,569
32	$1,472,934	$1,169,615	$385,973	$340,156	$726,129	$0	$726,129
33	$1,437,176	$1,132,764	$373,812	$329,439	$703,251	$0	$703,251
34	$1,234,336	$965,678	$318,674	$280,846	$599,519	$0	$599,519
0	$733,965	$569,959	$188,087	$165,760	$353,847	$0	$353,847
0	$390,043	$300,642	$99,212	$87,435	$186,647	$0	$186,647
0	$228,985	$175,192	$57,813	$50,951	$108,764	$0	$108,764
0	$76,935	$58,426	$19,280	$16,992	$36,272	$0	$36,272
0	$54,385	$40,994	$13,528	$11,922	$25,450	$0	$25,450

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