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The Socioeconomic Benefits Generated by 24 Colleges of Applied Arts and Technology in Ontario

Long Report

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The Socioeconomic Benefits Generated by 24 Colleges of Applied Arts and Technology in Ontario

Volume 1: Main Report

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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 colleges. Questions of a technical nature concerning the approach, assumptions, and/or results should be directed to CCbenefits, Inc., c/o Drs. Kjell Christophersen and Hank Robison, 1150 Alturas Dr., Suite 102, Moscow ID 83843, phone: 208-882-3567, fax: 208-882-3317, e-mail: ccbenefits@moscow.com.

ACRONYMS

ABE	Adult Basic Education
ACCT	Association of Community College Trustees
B/C	Benefit/Cost Ratio
CAAT	College of Applied Arts and Technology
CHE	Credit Hour Equivalent
ESL	English as a Second Language
HS	High School
IO	Input-Output analysis
ITAL	Institute of Technology and Advanced Learning
NCF	Net Cash Flow
NPV	Net Present Value
RR	Rate of Return

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 increase funding or fund colleges at the current levels if it is demonstrated that the economic benefits gained from the education exceed the costs.

This economic impact study consists of several reports:

- The present report is the **Main Volume** for the study. It is largely intended for a limited audience (economists, institutional researchers, financial officers, etc.) interested in the overall transparency of the study, the assumptions used, the data imbedded in the model that generate the results, and the results themselves.

- The **Detailed Tables** are a tabular summary of all results broken out by entry level of education and gender (also intended for a limited audience).

- The **Executive Summary** is a six-page report intended for a wide audience, written in layman's terms.

- The **Fact Sheet**, a one-page "super-executive" summary, is also intended for a wide audience where the main results are presented in bullet form.

- The **Taxpayer Perspective Sheet** is a one-page layman's write-up of the differences between the "broad" and "narrow" taxpayer results.

- Finally, we submit a **PowerPoint** presentation of the main results to each college.

These reports aim to bring to the attention of all education stakeholders the economic roles played by the 24 colleges in the province of Ontario. There is something in it for the students—will they be better off attending college or should they just forego additional education and stay employed where they are? There is something in it for the taxpayers—should they continue with their investments at current levels, or is it in their

economic interest to increase or decrease the funding? There is something in it for the local community—to what extent does it benefit from the daily operations of the colleges, and which sectors of the economy benefit relatively more?

Economic impact studies that provide answers to these kinds of questions are not new. In contrast to other similar studies, however, the ACCT vision was that the model reach 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 local 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 local situations to the greatest extent possible.

One final note of importance: although the written reports generated are similar in text to the reports prepared for other colleges, the results differ widely. **These differences, however, do not necessarily indicate that some colleges are doing a better job than others.** 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 provincial and local taxpayers fund the colleges. Therefore, if the average student rate of return for College A is 8%, and that of College B is 12%, that does not mean that B is doing a better job than A. Rather, it is attributable to the employment opportunities in the region, or that one college may enroll more women than men, or more funded than unfunded students. In turn, the student body profiles are associated with their own distinct earnings functions reflecting these employment and gender differences. The location of the college, therefore, dictates the student body profile, which, to a large extent, translates into the magnitudes of the results. Thus, College A with a 8% student rate of return may actually be a better or more efficiently managed school than College B with a 12% student rate of return. Any difference in management efficiency is not equal to the difference between the two returns.

Chapter 1
INTRODUCTION

OVERVIEW

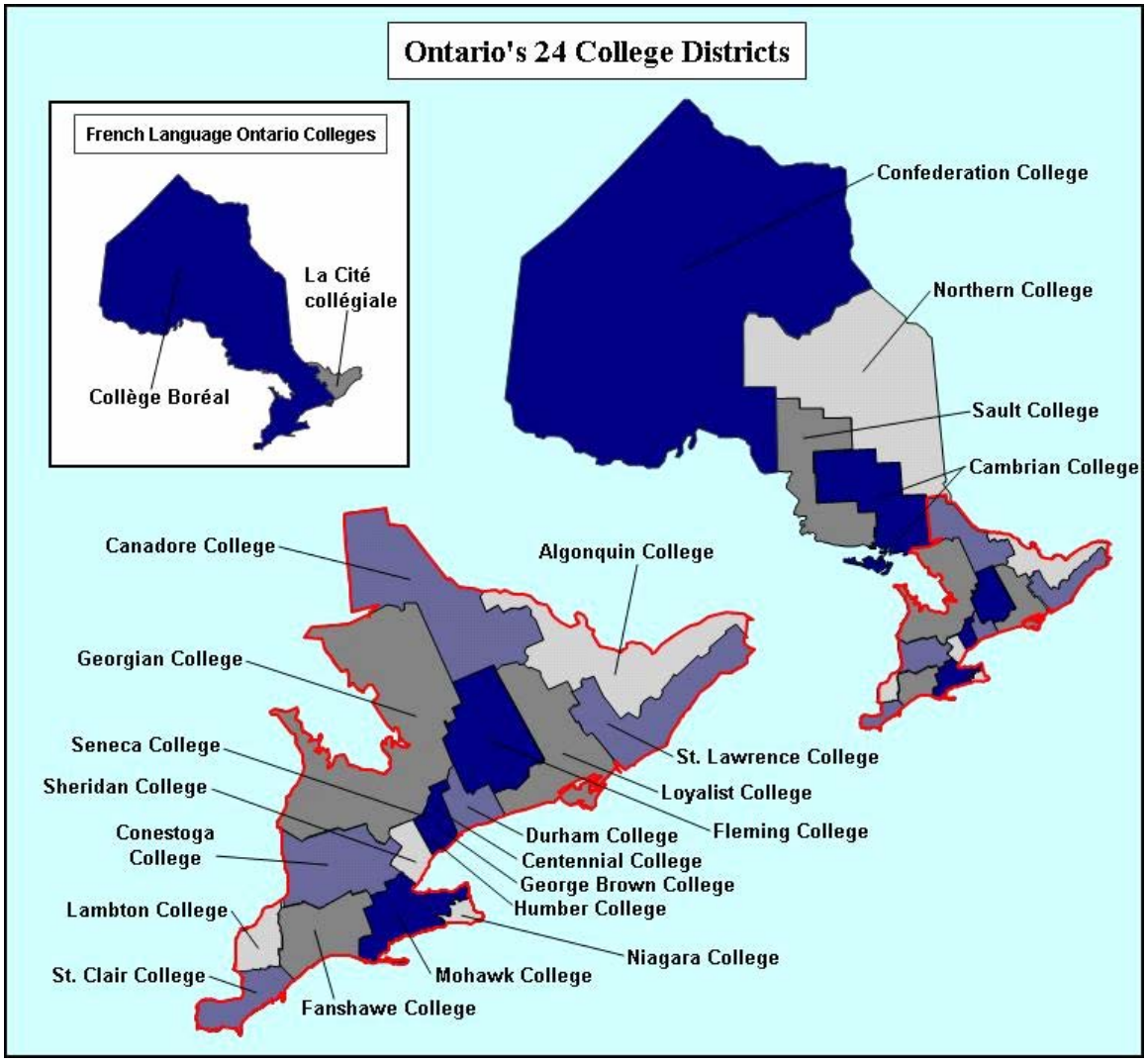
Ontario's 24 Colleges of Applied Arts and Technology generate a wide array of benefits. Students benefit directly from higher personal earnings, and society at large benefits indirectly from cost savings (avoided costs) associated with reduced welfare and unemployment, improved health, and reduced crime. 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 Ontario colleges investigate the attractiveness of the returns they generate in the province (**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) province-wide economic benefits, including returns to the business community.

The main volume has four chapters and four 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 benefits, returns to business, and regional 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 glossary of terms. **Appendix 2** 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 3** provides a detailed technical/theoretical explanation of how benefits must be adjusted if the college can still stay open absent provincial and local government support.

Table 1.1. Ontario Participating Colleges, Funded Enrollment

Name of College	Abbreviation	Enrollment
Algonquin College	ALGO	30,434
Cambrian College	Cambrian	7,416
Canadore College	CC	4,529
Centennial College	Centennial	23,564
Collège Boréal	BORE	2,658
Conestoga College ITAL	Conestoga	22,544
Confederation College	CONF	6,448
Durham College	DCAAT	18,227
Fanshawe College	FANS	28,918
Sir Sandford Fleming College	SSFC	13,554
George Brown College	GRBR	33,061
Georgian College	GEORGIAN	14,125
Humber ITAL	HUMB	32,783
La Cité collégiale	LCC	6,755
Lambton College	Lambton	4,052
Loyalist College	LC	10,929
Mohawk College	Mohawk	32,305
Niagara College	NCAAT	22,114
Northern College	Northern	4,645
Sault College	Sault	2,257
Seneca College	Seneca	38,865
Sheridan College ITAL	Sheridan	27,241
St. Clair College	STCL	21,494
St. Lawrence College	SLC	16,470
Total		425,388

Figure 1.1. Geographical Distribution of Participating Colleges



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 (see **Tables 2.7** and **2.9** and the references section at the end of this report). 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 funded and unfunded attendance,[1] 2) per student, and 3) in the aggregate (province-wide).

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 approach allows us to express the benefits occurring incrementally (every year) in the future in present value terms so that they can be compared with the costs incurred in the present. The present value analysis determines the economic feasibility of investing in college education—i.e., whether the benefits outweigh the costs. The time horizon over which future benefits are measured is

[1]CHEs may also be defined as instructional contact hours. Colleges prepare people both for jobs and for diplomas. 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.

the retirement age (65) less the average age of the students weighted by their total achievements (CHEs).[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 4) the payback period—the number of years needed to fully recover the investments made (see **Appendices 1** and **2** for a more detailed explanation of the meaning of these terms).

PROVINCE-WIDE ECONOMIC AND BUSINESS COMMUNITY BENEFITS

The benefits of a robust economy are many: jobs, increased business revenues, greater availability of public investment funds, and eased tax burdens. The financial and educational activities of the 24 Colleges of Applied Arts and Technology in Ontario benefit provincial businesses directly by raising the skill level of the provincial labour force and providing opportunities for direct contract training of employees. Businesses in the province benefit as well as the presence of a trained labour 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 provincial economy.

In this study we show the impact of Ontario's 24 colleges as a creator of earnings in the provincial economy. Increased earnings are displayed by industrial sector (for the purposes of this report, we employ the major divisions of the Standard Industrial Classification—SIC—which includes all industrial and service sectors). The role that the 24 colleges play in the provincial economy is then indicated by the percentage of sector-by-sector earnings explained by the colleges. The geographic boundaries of the regional economy used in this report are shown in **Figure 1.1.** In general, these college-linked earnings fall under two categories: 1) earnings generated by the annual operating expenditures of the colleges; and 2) earnings attributable to the college skills embodied in the workforce.

[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.

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 college institutional researchers on the scene applied well-informed judgments and estimations on the basis of their intimate knowledge of their college and student body.

This chapter contains six assumption sections, all based on various data imbedded in the analytic model: 1) the aggregate profiles of the 24 colleges; 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 province-wide economic effects.

PROFILE

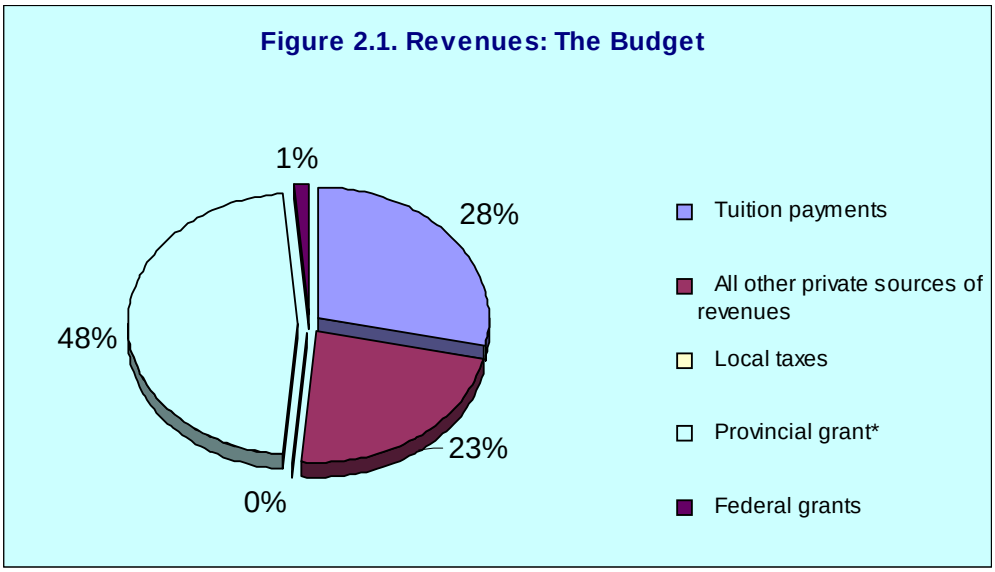
Faculty, Staff, and Operating Budgets

The Ontario Colleges of Applied Arts and Technology employed 14,170 full- and 25,138 part-time faculty and staff in fiscal year 2002/03 amounting to a total annual payroll of some $1.2 billion. **Table 2.1** shows the aggregate annual revenues by funding source: a total of $2.1 billion. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (28.2%) plus 23.1% from other private sources (such as contract revenues, interest payments and the like). Public funding is comprised of local taxes (0.2%), provincial aid (47.1%), and federal grants (1.3%). These budget data are critical in identifying the annual costs of educating the college 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, the Budget

Sources	Revenues	Total	% of Total
Private Funding			
Tuition payments	$583,771,083		28.2%
All other private sources of revenues	$478,024,193	$1,061,795,276	23.1%
Public Funding			
Local taxes	$4,446,110		0.2%
Provincial grant*	$975,272,893		47.1%
Federal grants	$27,916,175	$1,007,635,178	1.3%
Total		$2,069,430,454	100%

Figure 2.1. Revenues: The Budget



The Students

Students attend colleges for different reasons: to obtain Diplomas or Certificates in professional/technical programs, to obtain basic skills, or perhaps to take refresher courses or participate in unfunded programs**.** 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 24 colleges in the Province of Ontario. The unduplicated student body (headcount) is 586,597 (fiscal 2002/03 enrollment). This total consists of both funded and unfunded students.

Some students forego earnings entirely while attending college while others may hold full- or part-time jobs. Information about student employment plays a role in determining the *opportunity cost* of education incurred by the students while attending

the Ontario 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 (71%) while attending college, and how much they earned (61%) 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	425,388
Total headcount of non-credit students	162,778
Total unduplicated enrollment, all campuses in province	586,597
% of students employed while attending colleges	71%
% of full-time earning potential	61%
Students remaining in province after leaving colleges	95%
Thirty-year attrition rate (leaving province)	6%
"Settling In" factors (years):	
Completing Diploma	2.0
Completing Certificate	0.5
Non-completing transfer track	2.5
Non-completing workforce	0.0
ABE/ESL	0.5

As indicated in the table, it is estimated that 95% of the students remain in the province (as defined in **Figure 1.1**) and thereby generate province-wide benefits. The remaining 5% leave the province altogether and are not counted as part of the economic development benefits. The 95% retention rate applies only to the first year, however. We assume that 6% of the students, and thus associated benefits, will leave the province 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 24 Ontario colleges.

Entry-Level Education and Gender

Table 2.3 and **Figure 2.2** show the education level and gender of the aggregate student body. This breakdown is used only to add precision to the analysis, not for purposes of comparing between different groups.[4] Five education entry levels are indicated in approximate one-year increments, ranging from less than HS to greater than two years post HS. These provide the platform upon which the economic benefits are computed.

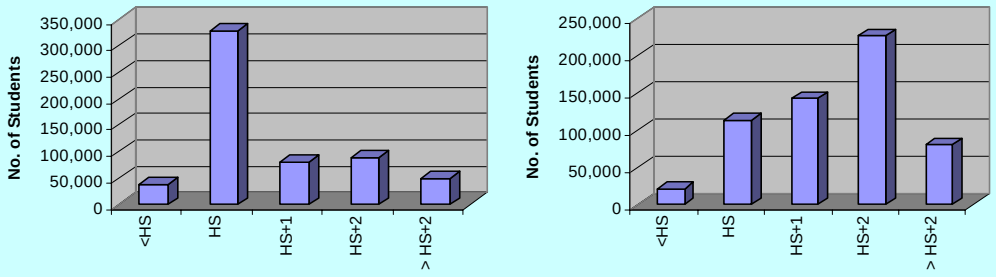
The *entry level* characterizes the education level of the students when they first enter the colleges; this is consistent with the way most colleges keep their records. The analysis in this report, however, is based on the educational achievements of the students during the current year. As not all students reported in the enrollment figures for the fiscal year are in their first year of college, an adjustment was made to account for students who had accumulated instructional contact hours during their college experience and moved up from the "HS 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 159,060 males who first entered with a high school diploma, it is estimated that only 55,203 still remain in that category at the beginning of the analysis year, meaning that 103,856 students have actually moved up from the "HS equivalent" category to the "One year post HS or less" category or beyond since they first entered the colleges.[5] (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 entry level.

[4] In this volume we present the gender breakdown only in **Table 2.3**. Otherwise, the breakdown is presented as weighted averages for the remainder of the report. However, the separate companion volume—**Volume 2: Detailed Results**—does show the breakdown by gender and level of education.
[5] These calculations are internal to the model, based on parameters (such as the frequency of "stopouts") that characterize how typical college students progress over time in their college career from when they first started up to the analysis year.

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

	Male		Female		Total	
Entry Level	Entry Level	Begin Year	Entry Level	Begin Year	Entry Level	Begin Year
< HS	19,503	10,835	18,723	10,402	38,225	21,237
HS equivalent	159,060	55,203	170,000	58,719	329,059	113,922
One year post HS or less	36,186	68,284	44,630	75,177	80,815	143,461
Two years post HS or less	39,937	105,686	49,513	121,889	89,450	227,575
> Two years post HS	20,374	35,050	28,673	45,351	49,047	80,402
Total	275,059	275,059	311,538	311,538	586,597	586,597

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 nine categories: 1) retirees and/or self-enrichment students, 2) three-year diploma completers, 3) two-year diploma completers, 4) one-year certificate completers, 5) apprenticeship programs completers, 6) apprenticeship program non-completers, 7) all other funded students, 8) ABE/ESL students,[6] and 9) all other unfunded students.

As indicated in the table, students achieving their graduation goals would be those completing three-year diplomas, two-year diplomas, one-year certificates, or apprenticeship programs (4.9%, 7.7%, 3.8%, and 1.3%, respectively). The majority of students are found in categories 7 and 9 (53.4% and 23.4%, respectively), which consist of funded or unfunded students who either fulfill their educational needs, or return the following year to continue to work toward their goals. The retired and leisure students (0.9%), apprenticeship program non-completers (2.3%), and ABE/ESL students (2.2%) 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 24 colleges to acquire skills that will increase their earnings. ABE/ESL 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 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 fourth column shows the average age of the students generating the benefits (excluding retirees). The time horizon for the analysis is 37 years, which is the difference between the average age (27.9 years) and retirement age (65 years).

As indicated in Column 5, the average three-year diploma, two-year diploma, and certificate student completed 40.6, 40.1, and 40.1 CHEs of study, respectively, during the analysis year. The total number of CHEs completed during the year of analysis for the entire student body is 11.6 million. Finally, the last column shows the average time the students are actually in attendance during the analysis year. This information is needed to determine the opportunity cost of their education (or the time they would otherwise have been working and earning wages).

Table 2.4. Levels of Achievement

Student Body Categories	Student Distribution	Head-count	Avg. Age	CHEs This Year	Total CHEs	# Years Attend.
1. Retired Students	0.9%	5,152	69	9.8	50,311	0.33
2. Students Completing 3-Year Diploma	4.9%	28,867	24	40.6	1,172,503	1.35
3. Students Completing 2-Year Diploma	7.7%	44,974	24	40.6	1,824,961	1.35
4. Students Completing Certificate (1-Year Diploma)	3.8%	22,526	27	40.1	904,268	1.34
5. Students Completing Apprenticeship Programs	1.3%	7,692	29	19.9	153,078	0.66
6. Non-Completing Apprenticeship Program Students	2.3%	13,743	28	18.2	250,766	0.61
7. All Other Funded Students	53.4%	313,299	29	19.9	6,221,970	0.66
8. ABE/ESL Students	2.2%	12,875	27	25.4	327,434	0.85
9. All Other Unfunded Students	23.4%	137,470	34	4.8	658,505	0.16
Total or weighted averages	100.0%	586,597	27.9	19.8	11,563,797	
Credits required for one full-time year equivalent of study					30	

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

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

Figure 2.3. Number of Students

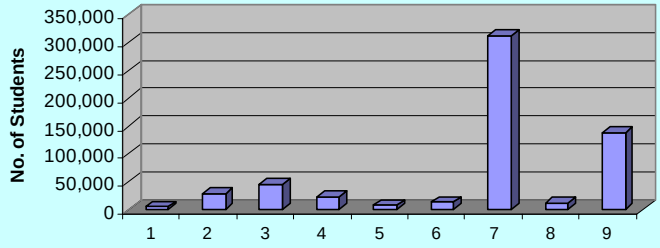
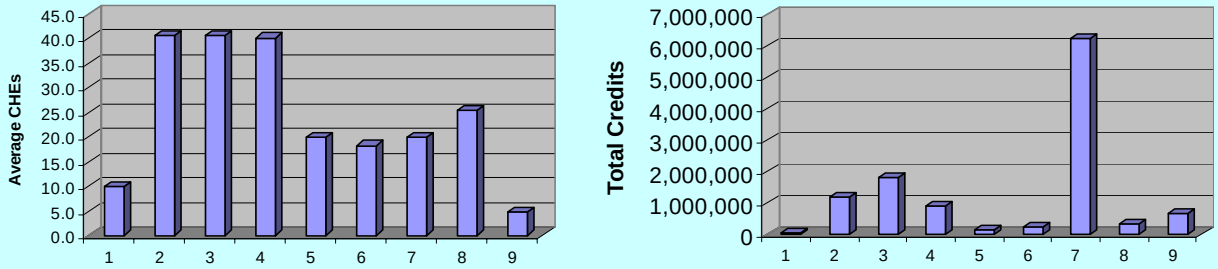


Figure 2.4. Average and Total CHEs Earned for the Analysis Year



ANNUAL PRIVATE BENEFITS

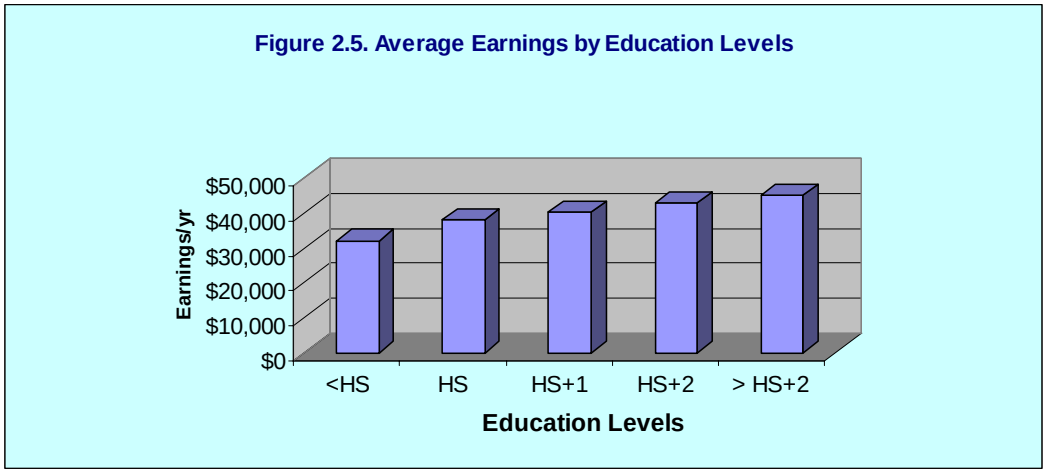
The earnings statistics in **Table 2.5** and **Figure 2.5,** on which the benefit estimates (reported in **Chapter 3**) are based, reflect all occupations (technical and non-technical). The lower the education level, the lower the average earnings, regardless of the subject matters studied. The distinguishing 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 profile of Ontario's 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.

Table 2.5. Weighted Average Earnings

Entry Level	Average Earnings	Difference
One year short of HS	$32,037	NA
HS equivalent	$37,878	$5,841
One-year Certificate	$40,043	$2,164
Two-year Diploma	$42,565	$2,522
Three-year Diploma or Above	$44,869	$2,304



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 24 colleges in the Ontario 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.

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.

Colleges 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 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 college education.

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

Higher Earnings

Broad Perspective: Higher education begets higher earnings. The economy generates more income than it would without the college skills embodied in the labour force. From the broad taxpayer perspective, the total increase in earnings is counted as benefits of college education, adjusted down by the alternative education variable in **Table 2.9** (12.0%)—these

students would still be able to attend college elsewhere even if the CAAT system in the province were not present.

Narrow Perspective: Higher earnings translate into higher provincial and local *tax collections*. In the narrow taxpayer perspective we assume that the provincial and local authorities will collect 17.2% of the higher earnings in the form of taxes—the estimated composite of all taxes other than the federal income taxes.[7]

Health Savings

The improved health of students generates savings in three measurable ways: 1) lower absenteeism from work, 2) reduced smoking, and 3) reduced alcohol abuse (**Table 2.6**; see also **Figures 2.6-2.8**). These variables are based on softer (i.e., less-documented) data. In general, statistics show a positive correlation between higher education and improved health habits. **Table 2.6** 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 profile 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 provincial and local government is an employer. Accordingly, we assume a taxpayer's portion of absenteeism savings at 2.8%, equal to the estimated public portion of employment in the province. As for smoking and alcohol-related savings, the taxpayers benefit to the extent that provincial and local health subsidies (to hospitals, for example) are reduced. We assume that 40% of the total benefits can be counted as taxpayer savings.[8]

[7] The tax data are obtained from Statistics Canada.
[8] The subsidy data are obtained from Statistics Canada, Canadian Institute for Health Information, "Healthcare in Canada" 82-222-xie.

Table 2.6. Reduced Absenteeism, Smoking, and Alcohol Habits

	Absenteeism		Smoking		Alcohol Abuse	
Education Level	Days	%/Year	Average	Reduction	Average	Reduction
< HS	8.6	3.3%	27.8%	NA	6.9%	NA
HS equivalent	7.2	2.8%	22.5%	19.0%	6.3%	8.6%
One year post HS or less	6.6	2.5%	19.9%	11.4%	5.8%	8.4%
Two years post HS or less	5.8	2.2%	17.1%	14.1%	5.0%	13.2%
> Two years post HS	5.5	2.1%	15.8%	7.6%	4.6%	8.6%

1. Adrian, M. "Social Costs of Alcohol." *Canadian Journal of Public Health,* 79, September-October, 1988: 316-322.

2. Kaiserman, Murray J. T*he Cost of Smoking in Canada, 1991* . Chronic Diseases in Canada, 18(1), 1997.

3. Single, Eric, Lynda Robson, Xiaodi Xie, et al. *The Costs of Substance Abuse in Canada* . Canadian Centre on Substance Abuse (CCSA), 1996. http://www.ccsa.ca/docs/costhigh.htm.

4. Statistics Canada. *Absence Rates of Full-Time Paid Workers, by Sex and North America Industry Classification System (NAICS)* . CANSIM II, Table 279-0030, annual.

5. Statistics Canada. "Injuries." *Statistical Report on the Health of Canadians*, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, 1999: 241-252.

6. Statistics Canada. "Lifestyle Behaviors, Drinking and Problem Drinking." *Statistical Report on the Health of Canadians*, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, 1999: 171-176.

Figure 2.6. Days of Absenteeism by Education Levels

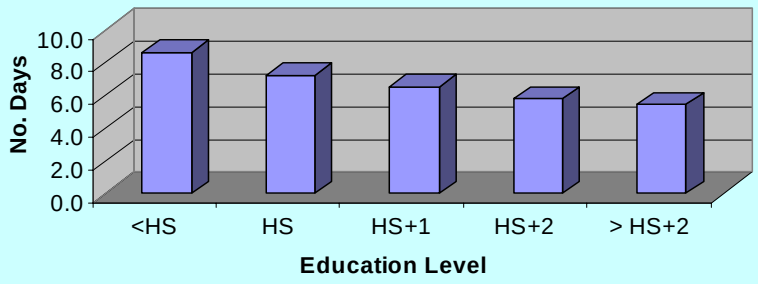
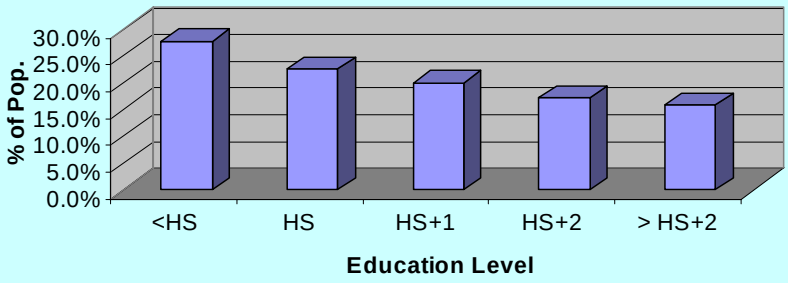
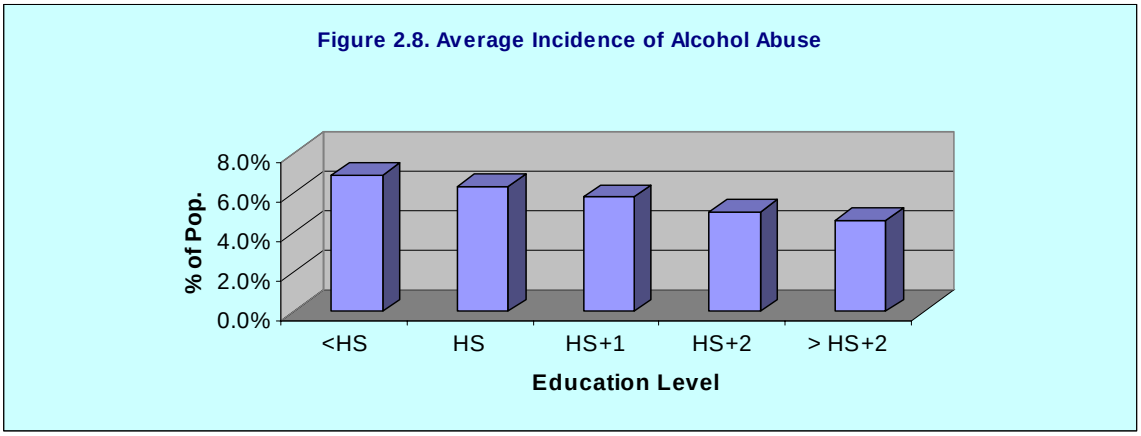


Figure 2.7. Average Incidence of Smoking by Education Levels





Crime Reduction Benefits

Table 2.7 and **Figure 2.9** relate the probabilities of incarceration to education levels—incarceration drops on a sliding scale as education levels rise (linked to the gender profile of the student body).[9] The implication is, as people achieve higher education levels, they are statistically less likely to commit crimes. The correlation difference between before and after the education achievement (multiplied by the average cost per year) comprises the upper limit of the benefits attributable to education.

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).

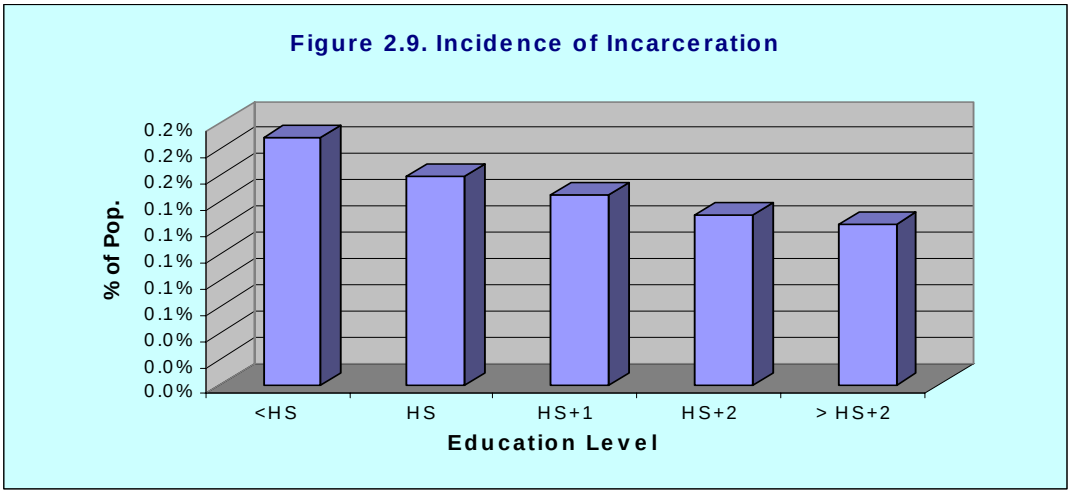
Narrow Perspective: We assume that nearly all (80%) of the incarceration savings accrue to the provincial and local taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to the potential victims, not to the taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our "composite" provincial and local government average tax rate (17.2%) to the added productivity of persons *not* incarcerated to arrive at the taxpayer benefits.

[9] See also Beck and Harrison for similar studies in the United States.

Table 2.7. Incarceration Rates

Education Level	Average	Reduction
< HS	0.2%	NA
HS equivalent	0.2%	15.5%
One year post HS or less	0.1%	8.8%
Two years post HS or less	0.1%	10.7%
> Two years post HS	0.1%	5.6%

1. Citizens United for Rehabilitation of Errants (CURE). Correctional Education. http://www.curenational.org/Position/curepo5.html.
2. Statistics Canada. *A One-Day Snapshot of Inmates in Canada's Adult Correctional Facilities*. Canadian Centre for Justice Statistics, No. 85-601-XIE, 1999.
3. Statistics Canada. *Crimes by Type of Offense*. CANSIM II, Tables 252-0013 and 252-0014, 2002.
4. Statistics Canada. *Juristat*. Canadian Centre for Justice Statistics, No. 85-002-XIE, annual.
5. Statistics Canada. "Injuries." *Statistical Report on the Health of Canadians*, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, 1999: 241-252.
6. Statistics Canada. *Population 15 Years and Over by Highest Degree, Certificate or Diploma, Provinces and Territories*. Nation Series Files, Census of Canada, 1996.



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 employment insurance to education levels (linked to the gender profiles of the student bodies). As above, all welfare and unemployment savings are reduced by 10% in recognition of other causation factors.

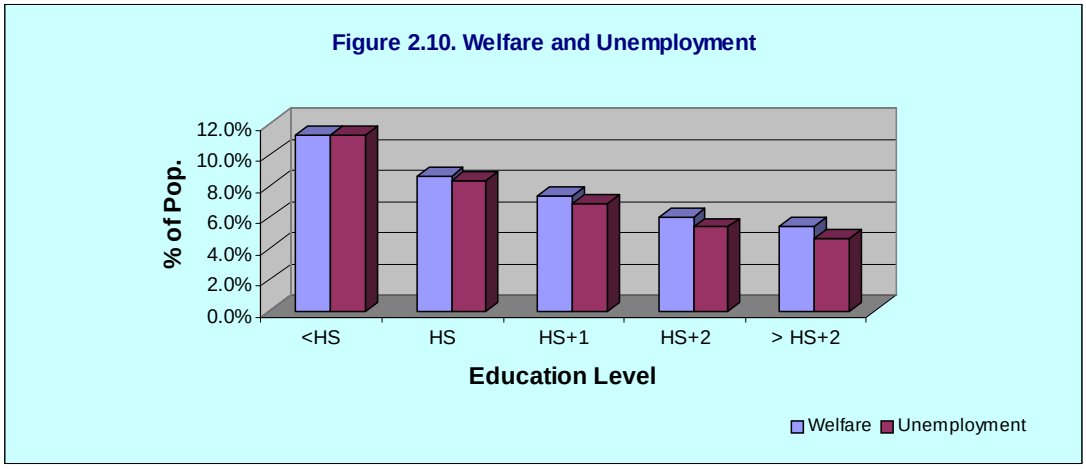
Broad Perspective: Reduced welfare and employment insurance claims multiplied by the average cost per year are counted in full as benefits in the broad taxpayer perspective (less the students covered by the alternative education variable, as above).

Narrow Perspective: Taxpayer benefits from reduced welfare are limited to 26%—the extent to which the provincial and local taxpayers subsidize the welfare system. None is claimed for employment insurance, because none of these costs are borne by the provincial taxpayers.[10]

Table 2.8. Welfare and Unemployment

	Social Assistance		Unemployment	
Education Level	Average	Reduction	Average	Reduction
< HS	11.2%	NA	11.2%	NA
HS equivalent	8.6%	23.0%	8.3%	25.9%
One year post HS or less	7.4%	14.4%	6.9%	16.9%
Two years post HS or less	6.0%	18.6%	5.4%	22.4%
> Two years post HS	5.4%	10.6%	4.6%	13.4%

1. National Council of Welfare. *Profiles of Welfare: Myths and Realties*. Spring 1998. http://www.ncwcnbes.net/htmdocument/reportprowelfare/ProfilesWelfare.htm.
2. Statistics Canada. "Employment and Unpaid Work." *Statistical Report on the Health of Canadians*, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, 1999: 44-48.
3. Drolet, Marie and René Morissette. "To What Extent Are Canadians Exposed to Low Income?" Statistics Canada, No. 11F0019MIE2000146, 2000.



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 provincial and local government taxpayers, which is part of the colleges' operating and capital costs (the budget—see **Table 2.1**). These are briefly discussed below.

[10] The welfare subsidy data are obtained from Statistics Canada.

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. Some may even go into debt. 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 plus the estimated dollar value of the leisure time given up. For students working full time, the only opportunity cost of time charged is for the value of the leisure time given up.[11] 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 midpoint of a working life trajectory that begins with low entry-level wages and culminates with a typical worker's highest wages around age 60.[12] The earnings data shown in **Table 2.5** are specific to the province of Ontario, weighted, however, to reflect the specific gender makeup of the aggregate student body.

- The opportunity cost of time is then conditioned by the average age of the student (27.9 years, see **Table 2.4**). In particular, the average earnings at the midpoint ($40,278 in **Table 3.5**) are adjusted downward to $24,552 to reflect the average earnings at age 27.9.

[11] Elementary consumer theory presents a tradeoff between income and leisure (e.g., Henderson and Quandt, 1958). Students able to work full or part time while attending college maintain all or part of their incomes, but give up a significant amount of their leisure time. Failing to impute value to the leisure foregone would underestimate the cost of attending college.

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

The Budget

Beyond the student perspective, our assessment of Ontario's colleges considers the benefits and costs from the provincial and local government taxpayer perspective. Accordingly, only the provincial and local government revenues in **Table 2.1** are included as costs in the investment and benefit/cost assessment. All else equal, the larger the other revenue sources in **Table 2.1** (federal grants, student tuition, and contract revenues) relative to provincial and local government revenues, the larger will be the relative economic payback to the taxpayers.

OTHER ASSUMPTIONS

Table 2.9 lists several other assumptions imbedded in the analytic model: 1) the discount rate and time horizon, 2) crime-related costs (incarceration costs that are inclusive of the cost per prison year plus all costs associated with arrest, investigation, trial and finally incarceration),[13] 3) welfare and unemployment costs per year,[14] and 4) health-related costs.[15] The alternative education opportunity assumption is discussed later in this chapter in association with the province-wide economic impacts.

[13] Crime-related cost estimates are adjusted to the current year using the Canada Consumer Price Index. They are obtained from the Canadian Centre for Justice Statistics and Statistics Canada.
[14] As indicated in the table, we assume that the average duration on welfare and employment insurance 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.
[15] The incarceration, health, welfare and unemployment probability, and cost variables are internal to the analytic model.

Table 2.9. Miscellaneous Variables

	Variables
Discount rate	4.0%
Time horizon, years to retirement	37.1
Average cost per prison year (arrest, trial, incarceration, rehab., etc.)	$71,000
Average length of incarceration (total years)	4.0
Average victim cost	$ 85,000
Average cost per year on welfare	$ 65,740
Average duration on welfare (total years)	4.0
Average cost per unemployment year	$ 36,249
Average duration on unemployment (total years)	4.0
Smoking-related medical costs per year	$ 2,574
Alcohol-related medical costs per year	$ 13,039
Alternative education opportunities	12.0%

Assumptions adapted from:

1. Adrian, M. "Social Costs of Alcohol." *Canadian Journal of Public Health* 79, September-October, 1988: 316-322.

2. Kaiserman, Murray J. *The Cost of Smoking in Canada, 1991* . Chronic Diseases in Canada, 18(1), 1997. http://www.hc-sc.gc.ca/pphb-dgspsp/publicat/cdic-mcc/18-1/c_e.html.

3. Single, Eric, Lynda Robson, Xiaodi Xie, et al. *The Costs of Substance Abuse in Canada* . Canadian Centre on Substance Abuse (CCSA), 1996. http://www.ccsa.ca/docs/costhigh.htm.

4. Statistics Canada. *A One-Day Snapshot of Inmates in Canada's Adult Correctional Facilities* . Canadian Centre for Justice Statistics, No. 85-601-XIE, 1999.

5. Statistics Canada. *Juristat* . Canadian Centre for Justice Statistics, No. 85-002-XIE, annual.

PROVINCE-WIDE ECONOMIC BENEFITS

In general, the province-wide economy is affected by the presence of Ontario's 24 Colleges of Applied Arts and Technology in two ways: from their 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 provincial workforce deepens the economy's stock of human capital, which attracts new industry and makes existing industry more productive.

Estimating these province-wide economic effects requires a number of interrelated models. Multiplier effects are obtained with an input-output (IO) model constructed for Ontario.[16] Estimating college operations effects requires an additional model that takes

[16] The economic impact model for the 24 colleges in Ontario is constructed using data purchased from Economic Modeling Specialists, Inc. and EMSI input-output (IO) modeling software (Moscow, ID: 2002). This software employs a standard regional-purchase-coefficient (RPC) non-survey IO modeling technique, similar to that used in constructing the Utah Multiregional IO (UMRIO) model (Governor's Office of Planning and Budget et al. [Salt Lake City, UT: Demographic and Economic Analysis, 1994]), the Idaho Economic Modeling Project (IDAEMP) (M. H. Robison, R. Coupal, N. Meyer, and eds [Moscow, ID: University of Idaho, College of Agriculture, 1991]), the Oregon Economic Modeling System (OREMS)

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 province-wide economy entails five basic steps:

1. Estimate the number of past students still active in the province-wide workforce.

2. Adjust for alternative education opportunities.

3. Estimate the increased earnings of the students still active in the province-wide workforce.

4. Adjust the overall earnings estimated in step 3 to account for a collection of substitution effects. This provides an estimate of the direct increase in province-wide earnings.

5. Allocate the direct increase in province-wide 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: 1) the size of provincial industries, and 2) the size of the overall province-wide 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 province-wide economy.

(M. H. Robison, Proceeding at the 29th Annual Pacific Northwest Economic Conference [Missoula, MT: 1995]), models chronicled for small areas (see M. H. Robison, "Community Input-Output Models," *Annals of Regional Science* 31 no.3 [1997]: 325-351), IMPLAN models constructed using IMPLAN IO modeling software (Stillwater, MN: Minnesota IMPLAN Group, annual) and "Regional IO models" (RIO models) constructed by Rutgers University, Center for Urban Policy Research (New Brunswick, NJ: Rutgers University, 2002).

The Impact of Ontario Colleges' Operations

The first step in estimating the impact of the 24 Ontario colleges' 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-province and out-of-province vendors. The net provincial portion is derived in Column 6.

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 24 Ontario colleges were asked to use their best judgment.

The first row in **Table 2.10** shows salaries, wages, and benefits. These *direct* earnings are part of the province'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-Province Spending," are fed into the economic region IO model.[17] The IO model provides an estimate of indirect effects, and these appear as "Indirect Earnings" in **Table 3.16**.

[17] **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 community, evidenced by the fact that an estimated 96% of all college expenditures benefit vendors in the province ($1,961,821 / $2,034,995 = 96%).

Table 2.10. Profile of College Spending In and Out of Provincial Economy ($ Thousands)

Spending Categories	Total Dollar Amount (1)	% In-Province (2)	% Out of Province (3)	% Manufact. In-Province (4)	% Manufact. Out of Province (5)	Net In-Province Spending (6)
Salaries, Wages, and Benefits	$1,250,771	98%	2%			$1,228,271
Travel	$17,537	83%	17%			$14,642
Electricity and Natural Gas	$41,151	96%	4%			$39,325
Telephone	$14,327	95%	5%			$13,636
Building Materials and Gardening Supplies	$17,966	96%	4%	78%	22%	$17,314
General Merchandise Stores	$178,009	89%	11%	54%	46%	$159,075
Eating and Drinking	$5,012	90%	10%			$4,493
Maintenance and Repair Construction	$49,361	99%	1%			$49,110
New Construction	$98,108	97%	3%			$95,302
Insurance	$24,555	99%	1%			$24,304
Legal Services	$10,100	100%	0%			$10,098
Credit Agencies	$28,607	99%	1%			$28,408
Postal Service	$7,803	94%	6%			$7,346
Accounting, Auditing, and Bookkeeping	$2,016	100%	0%			$2,016
Marketing	$24,537	98%	2%			$24,161
Other Business Services	$131,213	92%	8%			$120,769
Water Supply and Sewerage Systems	$2,514	100%	0%			$2,507
Printing and Publishing	$11,982	98%	2%			$11,753
Rental Property	$13,231	99%	1%			$13,065
Services to Buildings	$26,364	98%	2%			$25,721
Unemployment Compensation	$25,904	93%	7%			$24,073
Honoraria and Other Payments to Households	$53,924	86%	14%			$46,431
Total	$2,034,995					$1,961,821

Note: This table provides details for the summary of the colleges' role in the provincial 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 province-wide workforce from the 24 colleges in Ontario. **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 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 24 Ontario 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 province immediately upon leaving college. As shown in the table, 95% of the students remain in the province upon leaving the colleges, and 5% leave the province.

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 provincial workforce, have out-migrated, retired, or died. As shown in **Table 2.11**, 6% 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 workforce."

Column 7 shows the average CHEs generated per year back to 1973. These data were obtained by dividing total year-by-year CHEs by the corresponding headcount.[18] Column 8 shows the product of the year-by-year average CHEs, and the estimate of the

[18] 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 2002/03.

number of past students active in the current workforce in Column 6. Looking to the total in Column 8, we estimate that the current Ontario workforce embodies some 234.5 million CHEs of past instruction from the 24 Colleges of Applied Arts and Technology.

Table 2.11. Critical Variables

Assumptions	Values
Current headcount of students	586,597
Students remaining in province after leaving colleges	95%
Thirty-year attrition	6%
Decay rate	0.2%
Overall average of credits earned per student this year	19.8

Reducing the CHEs to Account for Alternative Education Opportunities

The 234.5 million CHEs of past instruction from Ontario's 24 colleges indicated in **Table 2.12** increase the skills embodied in the province-wide workforce and, through them, the overall size of the provincial economy in terms of earnings. Before turning to the income calculation, however, it is fair to ask to what degree past students would have been able to obtain schooling (and therefore skills) absent the college system in Ontario. This is the common "with and without condition" in applied economic analysis.

The institutional research staffs provided the estimate of the alternative education opportunity variable (12.0%) by taking into account opportunities such as private trade schools and colleges, public three-year institutions, correspondence schools, and so on. Accordingly, when calculating the net increase in regional income attributable to the 24 colleges, the historic CHEs indicated in **Table 2.12** are reduced by 12.0%.

From Embodied CHEs to Direct Province-wide Income Effects

In the standard model, province-wide 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 *province-wide 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.

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

Year	Student Enrollment Headcount 1	Subtract Retired Students 2	Subtract Students Migrating Immediately 3	Students Who Have Left College (Leavers) 4	Leavers Who Have Settled Into Jobs 5	# Settled Into Jobs - Active in the Workforce 6	Average Credit Equivalents 7	Credits Embodied in the Workforce 8	Assumptions: % of Students in Workforce 9	Assumptions: "Settling" Factor 10	Assumptions: Active in Workforce 11
1973	257,124	254,866	242,128	242,128	242,128	227,090	19.8	4,496,723	100%	100%	93.8%
1974	270,468	268,092	254,693	254,693	254,693	239,386	19.8	4,740,197	100%	100%	94.0%
1975	284,134	281,638	267,563	267,563	267,563	252,020	19.8	4,990,370	100%	100%	94.2%
1976	297,921	295,304	280,545	280,545	280,545	264,814	19.8	5,243,711	100%	100%	94.4%
1977	310,046	307,322	291,963	291,963	291,963	276,181	19.8	5,468,792	100%	100%	94.6%
1978	323,724	320,880	304,843	304,843	304,843	288,982	19.8	5,722,275	100%	100%	94.8%
1979	353,795	350,688	333,161	333,161	333,161	316,502	19.8	6,267,215	100%	100%	95.0%
1980	368,030	364,798	346,566	346,566	346,566	329,941	19.8	6,533,325	100%	100%	95.2%
1981	381,987	378,632	359,708	359,708	359,708	343,186	19.8	6,795,593	100%	100%	95.4%
1982	394,593	391,128	371,579	371,579	371,579	355,270	19.8	7,034,883	100%	100%	95.6%
1983	406,898	403,324	383,166	383,166	383,166	367,132	19.8	7,269,768	100%	100%	95.8%
1984	430,483	426,702	405,376	405,376	405,376	389,244	19.8	7,707,610	100%	100%	96.0%
1985	438,215	434,366	412,657	412,657	412,657	397,083	19.8	7,862,833	100%	100%	96.2%
1986	448,474	444,535	422,318	422,318	422,318	407,248	19.8	8,064,126	100%	100%	96.4%
1987	462,226	458,166	435,268	435,268	435,268	420,634	19.8	8,329,193	100%	100%	96.6%
1988	474,787	470,617	447,096	447,096	447,096	432,990	19.8	8,573,843	100%	100%	96.8%
1989	485,096	480,835	456,804	456,804	456,804	443,337	19.8	8,778,745	100%	100%	97.1%
1990	502,640	498,225	473,324	473,324	473,324	460,354	19.8	9,115,697	100%	100%	97.3%
1991	525,314	520,700	494,676	494,676	494,676	482,150	19.8	9,547,293	100%	100%	97.5%
1992	539,275	534,538	507,823	507,823	507,823	496,023	19.8	9,821,990	100%	100%	97.7%
1993	546,409	541,610	514,541	514,541	514,541	503,660	19.8	9,973,230	100%	100%	97.9%
1994	555,684	550,803	523,274	523,274	523,274	513,305	19.8	10,164,207	100%	100%	98.1%
1995	553,545	548,683	521,261	521,261	521,261	512,424	19.8	10,146,758	100%	100%	98.3%
1996	541,138	536,385	509,577	509,577	509,577	502,010	19.8	9,940,543	100%	100%	98.5%
1997	544,509	539,727	512,752	512,752	512,752	506,218	19.8	10,023,886	100%	100%	98.7%
1998	552,421	547,569	520,203	520,203	520,203	514,673	19.8	10,191,295	100%	100%	98.9%
1999	562,412	557,472	529,611	529,611	529,611	525,102	19.8	10,397,810	100%	100%	99.1%
2000	567,944	562,955	534,819	534,549	481,094	478,019	19.8	9,465,492	100%	90%	99.4%
2001	530,121	525,465	499,203	487,971	365,978	364,417	19.8	7,216,008	98%	75%	99.6%
2002	586,597	581,445	552,385	469,527	234,764	234,764	19.8	4,648,674	85%	50%	100.0%
Embodied Total								234,532,084			

A key part of the overall model is the "engine" that estimates the value per CHE of instruction.[19] The product of per-CHE added earnings, and the total of embodied past college instruction from the 24 Ontario colleges (234.5 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 *province-wide* income?

The answer to this question depends on the magnitude of certain elasticity assumptions at work in the province-wide 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

[19] 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**.

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?

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 province-wide income. This estimate for Ontario's colleges 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 and 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 province. Here, the existence of skilled workers enables industry to do things they could not do otherwise. Locally skilled workers may attract new industry to the province (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 province without extraordinary inducements or wage premiums that would otherwise increase costs and reduce competitiveness. Province-wide 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 province-wide income to specified economic changes.

The Industries where Past Students Work

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

multipliers in this way requires that the direct effects be disaggregated into specific industrial sectors. Disaggregating direct impacts avoids IO aggregation error,[20] and it facilitates an analysis of the 24 Ontario colleges' 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 province-wide economy. The table provides a draft-stage vehicle for collecting information from the 24 Ontario colleges on the sectoral breakdown of their past students, and it documents the information provided by the colleges. **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 provincial economy. For example, 3.9% of all province-wide jobs are in the Agriculture and Agricultural services sector, 6.1% 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 3.9% of all province-wide jobs are in the Agriculture and Agricultural services sector, only 0.4% of past students are estimated to be in that sector. In contrast, while 6.1% of all jobs are in the Finance, Insurance, and Real Estate sector, 11.7% 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.[21]

[20] 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 EMSI IO modeling system conveys industry detail at roughly the SIC 4-digit level. An assembly of data on direct past student effects at this fine level of detail is not realistic. Our solution is to disaggregate past student direct effects to the nineteen sectors appearing in **Table 2.13**.

[21] 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 24 Ontario 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 college 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 province-wide earnings directly attributable to the college skills embodied in the current region workforce. Next, we turn to the indirect effects on both the demand- and supply-sides.

First, consider demand-side effects. Province-wide earnings are larger because of the skills embodied in past college students still active in the workforce. As earnings increase, so do industry outputs and industry purchases of inputs.[22] 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 province-wide 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 Rutgers et al, 2002.

[22] 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

becomes in some degree self-perpetuating. The location of a new industry (A) in the province 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.[23] 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 province-wide IO model.[24]

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 and Agricultural Services	3.9%	0.4%	0.4%	859,670
Mining, Sand, and Gravel	0.3%	0.0%	0.0%	77,037
Construction	5.8%	0.5%	0.5%	1,286,574
Manufacturing: Food, Wood, Paper, and Textiles	4.1%	1.9%	1.9%	4,517,847
Manufacturing: Chemicals, Petroleum, Stone, and Glass	6.7%	6.4%	6.4%	15,004,802
Manufacturing: Computer and Electronic Equipment	0.7%	1.3%	1.3%	3,012,790
Manufacturing: Other	4.2%	4.0%	4.0%	9,279,336
Transportation	4.9%	2.3%	2.3%	5,456,231
Public Utilities	1.3%	0.6%	0.6%	1,449,421
Publishing and Communications	5.0%	9.5%	9.5%	22,228,244
Trade	16.6%	15.8%	15.8%	37,093,500
Finance, Insurance, and Real Estate	6.1%	11.7%	11.7%	27,359,440
Motels, Eating/Drinking, and Amusement/Recreation	7.0%	3.3%	3.3%	7,831,460
Consumer Services	5.7%	2.7%	2.7%	6,307,701
Business Services	6.9%	6.6%	6.6%	15,391,067
Medical/Educational/Social Services	14.5%	27.6%	27.6%	64,685,384
Federal Government	2.9%	2.7%	2.7%	6,357,894
Provincial Government	3.5%	2.7%	2.7%	6,333,684
Total	100%	100%	100%	234,532,084

produce a set of province-wide economic multiplier effects. These are all captured and included as part of the demand-side indirect effects.

[23] For a more complete discussion of agglomeration and cumulative causation see Krugman (1999).

[24] Agglomeration effects are difficult to estimate. Our procedure assumes that so-called "supply-driven IO multiplier effects" capture the agglomeration effects. To increase the plausibility of this assumption, we apply only the direct effects associated with the industries in the highest stages of development.

Chapter 3
PRIVATE, PUBLIC, AND PROVINCE-WIDE 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 net present value, rate of return, and benefit/cost ratio, and 4) the province-wide 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, 19.8 CHEs at the 24 Ontario 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 certificate or diploma, and for others, to acquire certain skills that will increase their productivity in the workforce. A total of 586,597 students will capture $806.9 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 $100.2 million, $77.7 million, and $1.6 million (rounded). In **Table 3.2**, these same results are presented in greater detail—health-related absenteeism will decline by 260,800 days per year, translating to a total of 1003 years' worth of productivity gained per year (based on 260 workdays per year). Annual total dollar savings from reduced absenteeism days equals $40.8 million. There will be 10,000 fewer smokers and 2,600 fewer alcohol abusers,

amounting to annual total dollar savings of $25.6 and $33.8 million, respectively, inclusive of insurance premiums and personal payments.

Crime-Related Savings

There will be an estimated 60 fewer people incarcerated as a result of the higher education obtained, saving the taxpayers a total of about $566,000 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 $71,000 per year (inclusive of arrest, prosecution, incarceration, and rehabilitation). Fewer people incarcerated means more people gainfully employed—this translates to $375,000 in additional annual earnings for the province. Victim costs will be reduced by $677,600 per year.

Welfare and Unemployment Savings

There will be 4,800 and 5,500 fewer people on welfare and employment insurance, respectively, in the community. The corresponding total dollar savings for the provincial community amounts to $57.8 million ($18.9 million for welfare + $38.8 million for unemployment savings) for one year, assuming that the average time spent on welfare and employment insurance is 4.0 years (see **Table 2.9**) spread over a thirty-year period.

Total Public Benefits

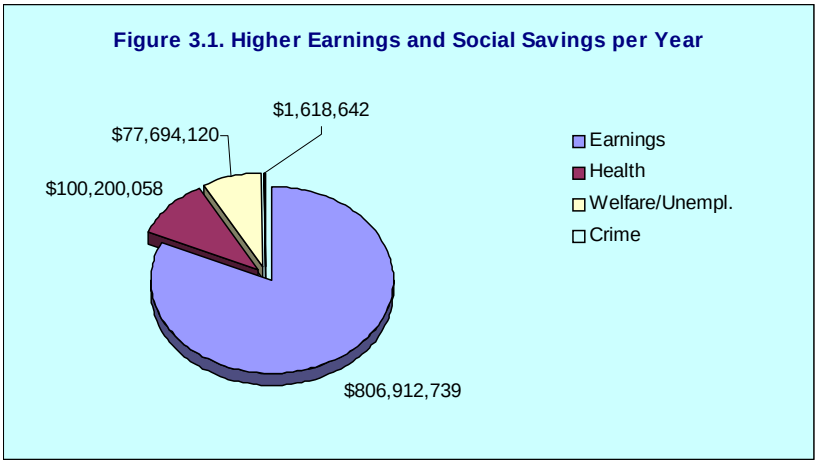
All told, there will be $159.6 million in public savings per year in the community—the sum of all health, crime, and welfare/employment insurance benefits in **Table 3.2.**

Table 3.1 Higher Earnings and Social Benefits

		Social (External Benefits)			
Level of Education	Higher Earnings	Improved Health	Lower Welfare Unemployment	Lower Crime	Total
< HS	$28,276,015	$4,093,222	$4,511,168	$96,575	$36,976,979
HS equivalent	$31,379,151	$2,052,451	$1,880,743	$41,044	$35,353,390
One year post HS or less	$210,815,552	$37,826,612	$31,453,616	$660,998	$280,756,779
Two years post HS or less	$320,434,112	$34,553,155	$25,009,524	$522,900	$380,519,691
> Two years post HS	$216,007,910	$21,674,617	$14,839,069	$297,125	$252,818,720
Total	$806,912,739	$100,200,058	$77,694,120	$1,618,642	$986,425,559

Table 3.2. Summary of Annual Benefits

	Units	Earnings	Social Savings
Higher earnings	NA	$806,912,739	
Health benefits			
Absenteeism savings (days)	260,816	NA	$40,785,437
Fewer smokers, medical savings (# persons)	9,961	NA	$25,635,600
Fewer alcohol abusers (# persons)	2,591	NA	$33,779,021
Crime benefits			
Incarceration savings (# persons)	56	NA	$566,019
Crime victim savings	NA	NA	$677,628
Added productivity (fewer incarcerated)	NA	NA	$374,995
Welfare/Unemployment benefits			
Welfare savings (# persons)	4,844	NA	$18,937,383
Unemployment savings (# persons)	5,479	NA	$38,847,060
Total		$806,912,739	$159,603,143



ANNUAL BENEFITS PER CHE AND PER STUDENT

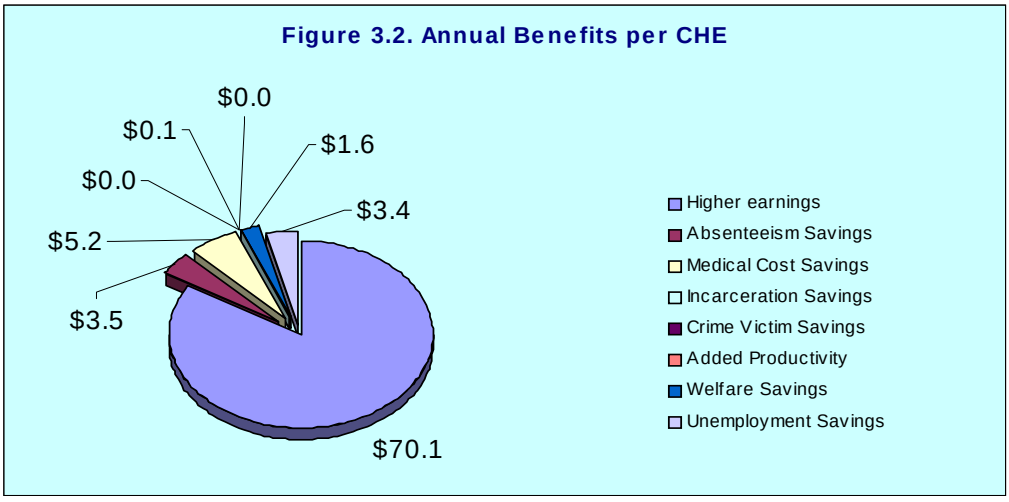
The aggregate benefits reported in **Tables 3.1** and **3.2** above are expressed per CHE and per student in **Table 3.3**. These are also displayed in the form of a pie chart in **Figure 3.2**. On average, students capture: 1) $70 per year in higher earnings per CHE,[25] and 2) $1,432 per year in higher earnings on the basis of the number of CHEs completed. **Converted to a full-year equivalent (30 CHEs), the annual earnings would amount to $2,169 per student**. On average, the social benefits per CHE range from a low of $0 for Added Productivity to a high of $5 per CHE for Medical Cost Savings. On a per student

[25] Thus, a student attending for 10 CHEs will add $700 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.

basis, they range from a low of $1 per student for Added Productivity to a high of $115 for Medical Cost Savings. On a full-year equivalent basis (30 CHEs), the social savings would amount to $440 per student (the total of $2,607 less $2,169 of higher private earnings as indicated in **Table 3.3**).[26]

Table 3.3. Annual Benefits Per Credit and Student

	Per CHE	Per Student	Annualized
Higher earnings	$70	$1,432	$2,169
Absenteeism Savings	$4	$70	$107
Medical Cost Savings	$5	$115	$174
Incarceration Savings	$0	$2	$3
Crime Victim Savings	$0	$2	$3
Added Productivity	$0	$1	$2
Welfare Savings	$2	$32	$49
Unemployment Savings	$3	$66	$100
Total	$84	$1,721	$2,607



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

[26] The values in **Table 3.3** and **Figure 3.2** are calculated based on the various statistical sources referenced in **Table 2.9**, in conjunction with the student profile and headcount numbers provided by the college.

investment is feasible if all discounted future benefits are greater than or equal to the costs.[27]

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.[28] These are simply different ways of expressing the results. All of the present value results shown are intermediary steps that *ultimately generate* the net present values, rates of return, and benefit/cost 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 provincial and local tax revenues (from increased incomes), and savings from reduced provincial and local government expenditures for incarceration, health, and welfare.

Table 3.4. Some Definitions

Definitions	
Student (Private) 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 provincial government tax collections plus lower provincial govt. expenditures related to health, crime, welfare and unemployment
Student Costs	Tuition (**Table 2.1**) plus opportunity cost of time
Taxpayer Costs	Provincial Taxes, 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

[27] 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 thirty 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.

[28] The criteria for feasibility: 1) the net present value must be positive or equal to zero; 2) the rate of return must be equal to or greater than the returns from other similar risk investments; 3) the benefit/cost ratio must be equal to or greater than 1; and 4) the payback period is the number of years of benefits required to fully recover the investment made.

On the cost side, student costs consist of the tuition paid by the students (28.2% 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 (23.1%). The taxpayer costs consist of the provincial and local tax items in **Table 2.1**, or a total of 47.3%**.**

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 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 $24,552 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).

We then deduct the retired student body (0.9%) to arrive at the net number of students subject to opportunity cost calculations— 581,445 students. The 166,660 not working are charged the full opportunity cost of time (based on the average term in attendance), or $2.7 billion. The 414,785 working students are charged only a fraction of the full opportunity cost, or $2.6 billion as indicated in the table. Finally, we adjust the opportunity cost downward by student aid grants and the estimated 60% adjustment for the restricted use of these grants for tuition and fees.

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

				Opp. Cost
Average statistical annual income of given gender profile			$40,278	
Annual income, given gender profile, at current age of students			$24,552	
CHEs per student (net of retired)		19.8		
% of full year in attendance and earnings foregone while attending		66%	$16,206	
Total number of students			586,597	
Less retired students, %		0.9%	5,152	
Remaining students subject to opportunity cost computation			581,445	
Students not working while attending college and opportunity cost		29%	166,660	$2,700,842,267
Number of working students			414,785	
Earnings relative to statistical averages (%) and opportunity cost		61%	$6,318	$2,620,567,236
Working students % and number		71%	414,785	
Value of Leisure time (at 1/3 working time)	20%		$3,241	
Value of Leisure time foregone				$1,344,373,711
Total opportunity cost				$6,665,783,214
Federal and Provincial grants awarded the students			$29,485,922	
Restricted portion of student aid (tuition and fees)		60%	$17,691,553	($11,794,369)
GRAND TOTAL STUDENT OPPORTUNITY COST				$6,653,988,845

We also present the results in different ways. First, the student perspective results indicate whether the education obtained at the Ontario 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 provincial and local taxpayer contributions in **Table 2.1**) in a **broad taxpayer perspective** in present value terms. Third and finally, in a **narrow taxpayer perspective**, we compare only a portion of the public benefits (taxpayer actual savings) to the public costs; i.e., do provincial and local taxpayer investments of $979.7 million (**Table 2.1**) pay off in terms of the public savings generated?

The Student Perspective

The collective investment of the students (time and money) is assessed in **Table 3.6.** Column 1 tracks the increased earnings of the student body as they leave the colleges, and follows them over the course of their assumed working lives (65 - 27.9 = 37 years, see **Table 2.4**). The upward trend in earnings mimics the Mincer equation (see Willis, 1986). It reflects both the growth in students' earnings over time and the spread in the increased earnings attributable to education.[29] 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.

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

Table 3.6. Student Earnings ($ Thousands)

Year	1 Higher Earnings Gross	2 Higher Earnings Net	3 Cost	4 Net Cash Flow
1	$265,993	$239,393	$7,696,194	($7,456,800)
2	$335,185	$301,666	$0	$301,666
3	$372,641	$335,377	$0	$335,377
4	$412,396	$371,156	$0	$371,156
5	$454,399	$408,959	$0	$408,959
6	$498,580	$448,722	$0	$448,722
7	$544,841	$490,357	$0	$490,357
8	$593,061	$533,755	$0	$533,755
9	$643,096	$578,786	$0	$578,786
10	$694,773	$625,296	$0	$625,296
11	$747,897	$673,108	$0	$673,108
12	$802,249	$722,024	$0	$722,024
13	$857,584	$771,826	$0	$771,826
14	$913,640	$822,276	$0	$822,276
15	$970,133	$873,120	$0	$873,120
16	$1,026,763	$924,086	$0	$924,086
17	$1,083,212	$974,891	$0	$974,891
18	$1,139,154	$1,025,239	$0	$1,025,239
19	$1,194,252	$1,074,827	$0	$1,074,827
20	$1,248,163	$1,123,347	$0	$1,123,347
21	$1,300,543	$1,170,489	$0	$1,170,489
22	$1,351,049	$1,215,944	$0	$1,215,944
23	$1,399,342	$1,259,408	$0	$1,259,408
24	$1,445,095	$1,300,586	$0	$1,300,586
25	$1,487,991	$1,339,192	$0	$1,339,192
26	$1,527,729	$1,374,956	$0	$1,374,956
27	$1,564,031	$1,407,628	$0	$1,407,628
28	$1,596,640	$1,436,976	$0	$1,436,976
29	$1,625,324	$1,462,792	$0	$1,462,792
30	$1,649,882	$1,484,894	$0	$1,484,894
31	$1,670,144	$1,503,129	$0	$1,503,129
32	$1,652,051	$1,486,846	$0	$1,486,846
33	$1,647,722	$1,482,950	$0	$1,482,950
34	$1,655,058	$1,489,553	$0	$1,489,553
35	$1,570,513	$1,413,461	$0	$1,413,461
36	$1,290,402	$1,161,361	$0	$1,161,361
37	$1,183,193	$1,064,874	$0	$1,064,874
0	$676,452	$608,807	$0	$608,807
0	$605,864	$545,277	$0	$545,277
NPV		$15,993,257	$7,400,186	$8,593,071
IRR				9.0%
B/C ratio				2.2
Payback (years)				14.4

Expressing the Investment Analysis Results

Economists and financial experts have different ways of expressing investment analysis results. The standard and most familiar ones are those we present here: the **net present value** (NPV) is a dollar measure, the **internal rate of return** (IRR) is expressed as a percentage return on investment; the **benefit/cost ratio** (B/C) is simply a ratio of how many dollars worth of benefits are received per cost dollar; and the **payback period** is a simple calculation of how many years worth of benefits will be needed before all of the investments are recovered. The net present values, rates of return, benefit/cost ratios and payback periods are all derived from the same data (shown in **Tables 3.6**, **3.7**, and **3.8** for the student and the broad and narrow taxpayer perspectives, respectively).

Readers unfamiliar with the interpretation of these standard investment analysis results are encouraged to consult the short layman's guide provided in **Appendix 2** of this report: "Explaining the Results—a Primer." A glossary of terms is also provided in **Appendix 1**.

Does attending the 24 Ontario colleges make economic sense for the students? The answer is a resounding **yes**. The future stream of benefits (higher earnings) accruing to the students has a net present value of $8.6 billion **(Table 3.6)—**a positive net present value (greater than zero) indicates that the investments made are strongly feasible. The benefit/cost ratio of 2.2 is strongly positive since the ratio is well above 1. The rate of return of 9.0% 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 college.

The payback period for a student (tuition plus the earnings foregone) is 14.4 years—the higher earnings received beyond that period are pure economic rent—or a persistent earnings flow over and beyond the initial investments.

The Broad Taxpayer Perspective

Table 3.7 assesses one year's operation of the colleges from the broad taxpayer perspective. The Legislature, on behalf of taxpayers, must weigh requests for funding against the myriad other public needs. As such, they need information to better allocate increasingly scarce resources between alternative and competing ends. Column 1 shows the stream of total benefits, including increased earnings and social savings from reduced spending on incarceration, health, welfare, and unemployment. Specifics on the estimation of values in Column 1 are presented in **Volume 2: Detailed Results, Table 19**. Column 2 adjusts for the 12% alternative education opportunity assumption (the percentage of the student body able to avail themselves of similar education elsewhere, absent the Ontario Colleges of Applied Arts and Technology). Column 3 conveys an adjustment needed to account for the fact that some of the colleges might be able to operate at some level of enrollment absent provincial and local government support, i.e., by raising tuition (see **Appendix 3** for technical details). Column 4 is simply Column 1 less Column 2 and Column 3. Column 5 shows the provincial and local taxpayer costs for a single year, as reflected in provincial and local tax items in **Table 2.1**. Finally, Column 6 considers the broad perspective on the taxpayer's investment in a cash flow sense, subtracting annual costs from annual benefits.

The net present value given this broad perspective is $11.4 billion and the benefit/cost ratio is 13.1. **More succinctly, every dollar of tax monies spent on college education will generate a cumulative total of $13.09 worth of social savings (accrued incrementally) for as long as the students are active in the workforce.**[30]

[30]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, therefore, we express all rates of return as: "NA" (particularly for the broad taxpayer perspective where high returns are expected). Only the benefit/cost 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 Prov. & Local Gov Funding	4 Net Benefits	5 Total Taxpayer Costs	6 Less College Income Cash Flow
1	$1,874,355	$39,177	$21,611	$1,813,568	$979,719	$833,849
2	$344,120	$44,376	$3,827	$295,918	$0	$295,918
3	$364,699	$47,037	$4,048	$313,614	$0	$313,614
4	$386,519	$49,857	$4,286	$332,377	$0	$332,377
5	$409,543	$52,830	$4,539	$352,174	$0	$352,174
6	$433,721	$55,952	$4,807	$372,963	$0	$372,963
7	$458,988	$59,211	$5,089	$394,687	$0	$394,687
8	$485,267	$62,600	$5,386	$417,281	$0	$417,281
9	$512,467	$66,105	$5,696	$440,666	$0	$440,666
10	$540,483	$69,712	$6,018	$464,752	$0	$464,752
11	$569,196	$73,407	$6,351	$489,438	$0	$489,438
12	$598,477	$77,172	$6,693	$514,611	$0	$514,611
13	$628,181	$80,989	$7,043	$540,149	$0	$540,149
14	$658,158	$84,838	$7,400	$565,920	$0	$565,920
15	$688,242	$88,697	$7,761	$591,784	$0	$591,784
16	$718,263	$92,544	$8,124	$617,595	$0	$617,595
17	$748,044	$96,357	$8,488	$643,198	$0	$643,198
18	$777,399	$100,112	$8,850	$668,437	$0	$668,437
19	$806,144	$103,784	$9,208	$693,152	$0	$693,152
20	$834,089	$107,350	$9,559	$717,180	$0	$717,180
21	$861,049	$110,785	$9,903	$740,361	$0	$740,361
22	$886,836	$114,065	$10,235	$762,536	$0	$762,536
23	$911,273	$117,168	$10,553	$783,551	$0	$783,551
24	$934,184	$120,072	$10,857	$803,255	$0	$803,255
25	$955,405	$122,755	$11,142	$821,508	$0	$821,508
26	$974,782	$125,198	$11,408	$838,176	$0	$838,176
27	$992,173	$127,383	$11,652	$853,138	$0	$853,138
28	$1,007,450	$129,294	$11,873	$866,284	$0	$866,284
29	$1,020,501	$130,916	$12,068	$877,517	$0	$877,517
30	$1,031,230	$132,238	$12,237	$886,755	$0	$886,755
31	$1,039,560	$133,250	$12,377	$893,933	$0	$893,933
32	$1,024,002	$132,017	$12,489	$879,496	$0	$879,496
33	$1,017,247	$131,376	$12,570	$873,300	$0	$873,300
34	$1,018,536	$131,467	$12,622	$874,447	$0	$874,447
35	$960,427	$124,226	$12,642	$823,559	$0	$823,559
36	$777,727	$103,791	$12,632	$661,304	$0	$661,304
37	$717,033	$91,751	$12,591	$612,692	$0	$612,692
0	$407,359	$44,904	$12,357	$350,098	$0	$350,098
0	$363,573	$40,503	$12,259	$310,811	$0	$310,811
NPV				$12,331,423	$942,038	$11,389,385
IRR						NA
B/C ratio						13.1
Payback (years)						NA

The Narrow Taxpayer Perspective

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

Table 3.8, Column 1 shows additions to provincial and local government revenues stemming from the operation of the Ontario colleges during the single analysis year. The values in Column 1 are computed by applying average provincial and local government tax rates to the net increase in province-wide income attributed to the Ontario college system.[31] Also included in Column 1 are reductions (entered as negatives) in provincial and local government expenditures on crime, welfare, unemployment, and health. Projected dollar amounts in Column 1 are thus the sum of additional taxes collected, plus associated tax dollars saved as a result of the education provided by the colleges during the single analysis year.

Column 2 reflects the adjustment attributable to the alternative education variable, while Column 3 reflects the ability of some of the colleges to operate without the current level of provincial and local government support, as discussed above and in **Appendix 3**. Column 4 shows net benefits, Column 1 minus Columns 2 and 3. Column 4 shows provincial and local government costs, taken directly from **Table 2.1**. Finally, Column 6 subtracts provincial and local government cost from benefits, thereby providing the temporal cash flow needed for the investment analysis. As shown at the bottom of the table, the colleges provide provincial and local government with an aggregate annual return of $1.2 billion expressed as a net present value on its one-year investment. Alternatively, the one-year investment generates a 12.1% rate of return and a benefit/cost ratio of 2.3, both indicating that the investment is attractive. The payback period is 10.7 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, provincial governments fund the operation and maintenance of public 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, provincial 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.

[31] Increased income includes a portion of direct student earnings, as well as salaries and wages at the colleges during the single analysis year, and an additional increment aimed at a collection of backward

Table 3.8. Taxpayer Perspective: Narrow ($ Thousands)

Year	1 Total Taxpayer Benefits	2 Benefits from Alt. Ed. Opportunities	3 Benefits w/o Prov. & Local Gov Funding	4 Net Taxpayer Benefits	5 Total Taxpayer Costs	6 Net Cash Flow
1	$326,095	$3,835	$3,765	$318,495	$979,719	($661,224)
2	$62,138	$8,013	$697	$53,428	$0	$53,428
3	$65,667	$8,469	$735	$56,463	$0	$56,463
4	$69,411	$8,953	$776	$59,682	$0	$59,682
5	$73,362	$9,463	$819	$63,080	$0	$63,080
6	$77,512	$9,999	$865	$66,648	$0	$66,648
7	$81,850	$10,559	$913	$70,378	$0	$70,378
8	$86,363	$11,140	$964	$74,258	$0	$74,258
9	$91,034	$11,742	$1,017	$78,275	$0	$78,275
10	$95,847	$12,362	$1,072	$82,413	$0	$82,413
11	$100,780	$12,997	$1,129	$86,654	$0	$86,654
12	$105,810	$13,644	$1,188	$90,979	$0	$90,979
13	$110,914	$14,299	$1,248	$95,367	$0	$95,367
14	$116,065	$14,961	$1,309	$99,795	$0	$99,795
15	$121,235	$15,624	$1,371	$104,240	$0	$104,240
16	$126,394	$16,285	$1,434	$108,675	$0	$108,675
17	$131,511	$16,940	$1,496	$113,075	$0	$113,075
18	$136,555	$17,585	$1,558	$117,412	$0	$117,412
19	$141,494	$18,216	$1,620	$121,658	$0	$121,658
20	$146,295	$18,828	$1,680	$125,786	$0	$125,786
21	$150,926	$19,418	$1,739	$129,769	$0	$129,769
22	$155,355	$19,982	$1,796	$133,577	$0	$133,577
23	$159,551	$20,515	$1,851	$137,186	$0	$137,186
24	$163,484	$21,013	$1,903	$140,568	$0	$140,568
25	$167,126	$21,473	$1,952	$143,701	$0	$143,701
26	$170,449	$21,892	$1,997	$146,560	$0	$146,560
27	$173,430	$22,267	$2,039	$149,125	$0	$149,125
28	$176,047	$22,594	$2,077	$151,376	$0	$151,376
29	$178,279	$22,871	$2,110	$153,298	$0	$153,298
30	$180,112	$23,097	$2,139	$154,876	$0	$154,876
31	$181,530	$23,269	$2,163	$156,098	$0	$156,098
32	$178,796	$23,051	$2,182	$153,562	$0	$153,562
33	$177,603	$22,937	$2,196	$152,470	$0	$152,470
34	$177,807	$22,951	$2,204	$152,652	$0	$152,652
35	$167,669	$21,687	$2,208	$143,774	$0	$143,774
36	$135,816	$18,124	$2,205	$115,486	$0	$115,486
37	$125,215	$16,022	$2,198	$106,995	$0	$106,995
0	$71,208	$7,851	$2,157	$61,200	$0	$61,200
0	$63,549	$7,081	$2,140	$54,328	$0	$54,328
NPV				$2,171,821	$942,038	$1,229,784
IRR						12.1%
B/C ratio						2.3
Payback (years)						10.7

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 24 Ontario colleges are a notable

and forward multiplier effects.

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 colleges 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 Ontario colleges were reduced, taxes would have to be raised in order for provincial and local governments to continue their support of other activities at current levels. The taxpayer investments of 47% 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 college education (reduced crime, welfare and unemployment, and improved health) were defined as *external benefits*, incidental to the operations of the colleges. 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 colleges. 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 benefit/cost ratio greater than 1) confirming that the taxpayers receive great value from investing in Ontario's colleges.

Table 3.9. Taxpayer Perspective ($ Thousands)

	Broad Perspective With Social Savings		Narrow Perspective With Social Savings	
	Included	Excluded	Included	Excluded
NPV	$11,389,385	$9,175,024	$1,229,784	$802,966
IRR	NA	NA	12.1%	9.1%
B/C ratio	13.1	10.7	2.3	1.9
Payback (years)	NA	NA	10.7	12.0

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 province through local taxes and appropriations (see "PV of all costs" in **Table 3.10**).

Table 3.10. Summary of Investment Analysis Results

	Aggregate	Per CHE	Per Student
PV of student benefits, increased earnings	$ 15,993,257,229	$1,389	$ 27,506
Health benefits, captured by society			
PV of absenteeism savings	$ 715,717,795	$62	$ 1,231
PV of tobacco and alcohol abuse medical savings	$ 1,002,021,014	$87	$ 1,723
Crime			
PV of reduced incarceration	$ 9,545,845	$1	$ 16
PV of reduced victim costs	$ 11,428,124	$1	$ 20
PV of earnings (opportunity gained)	$ 6,162,556	$1	$ 11
Unemployment and welfare			
PV of reduced welfare rolls	$ 319,376,868	$28	$ 549
PV of reduced unemployment	$ 638,400,770	$55	$ 1,098
Sum of all present values, benefits	$ 18,695,910,201	$ 1,624	$ 32,154
PV of all costs			
PV of state and local contribution to college budget	$ 979,719,003	$85	$ 1,685
PV of opportunity cost of education plus tuition	$ 7,696,194,000	$668	$ 13,236
Sum of all present values, costs	$ 8,675,913,003	$ 754	$ 14,921
NPV, Student Perspective ($ Thousands)		$8,593,071	
RR, Student Perspective		9%	
B/C Ratio, Student Perspective		2.2	
Payback Period, Student Perspective		14.4	
NPV, Taxpayer Perspective: Broad ($ Thousands)		$11,389,385	
RR, Taxpayer Perspective: Broad		NA	
B/C Ratio, Taxpayer Perspective: Broad		13.1	
Payback Period, Taxpayer Perspective: Broad		NA	
NPV, Taxpayer Perspective: Narrow ($ Thousands)		$1,229,784	
RR, Taxpayer Perspective: Narrow		12.1%	
B/C Ratio, Taxpayer Perspective: Narrow		2.3	
Payback Period, Taxpayer Perspective: Narrow		10.7	

Figure 3.3. Investment Analysis: Present Value of Benefits

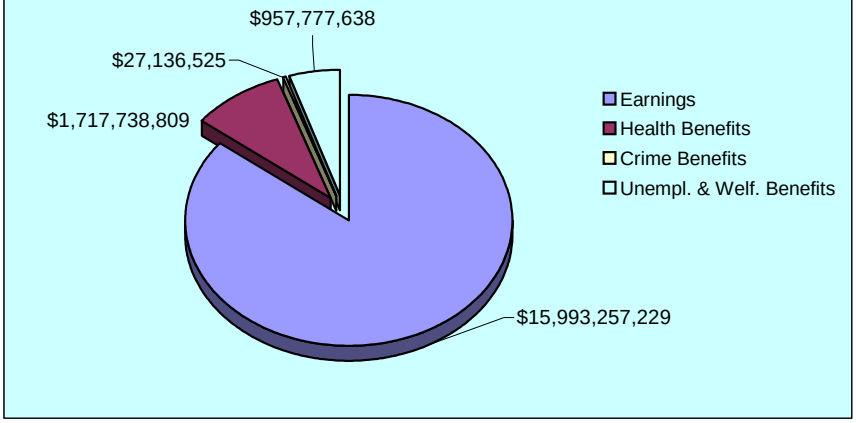
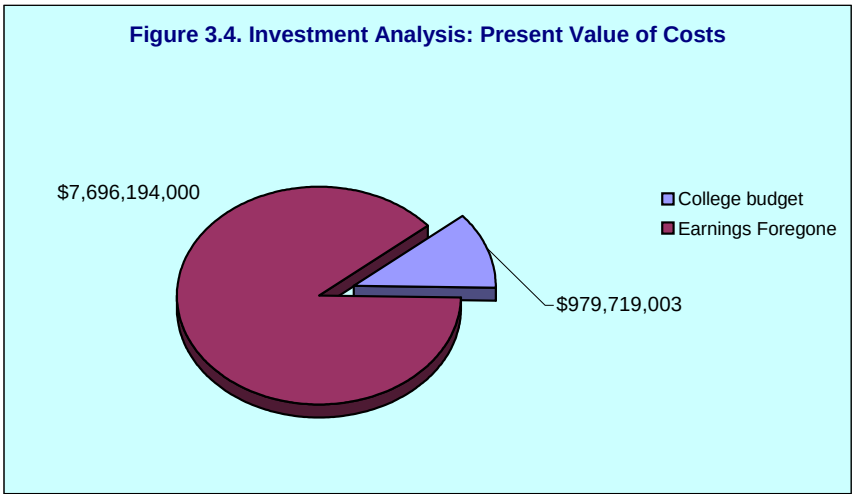


Figure 3.4. Investment Analysis: Present Value of Costs



PROVINCE-WIDE ECONOMIC BENEFITS

The 24 Ontario Colleges of Applied Arts and Technology play an important role in the resiliency, growth, and development of the provincial economy. In 2002, the Province of Ontario generated overall earnings (wages, salaries, and proprietors' income) equal to $254.7 billion.[32] The portion of this total credited to the existence of the 24 Ontario colleges is discussed in the four subsections below, both in the aggregate and with industry detail. The industry-specific analysis highlights Ontario's colleges' contribution to the province-wide business community.

[32] Total earnings for the Province of Ontario are obtained from Statistics Canada.

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 we estimate the net portion that can be counted as increased regional income—the *direct impact* of past Ontario college instruction. In the third section we utilize the multipliers of the regional IO model and estimate the *indirect impact* of past Ontario college instruction on province-wide 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 Ontario's colleges on earnings in the province.

Earnings Linked to Operation and Capital Spending

Table 2.10 in **Chapter 2** shows the Ontario colleges' 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 provincial vendors and other suppliers, i.e., the portion that stays in the provincial economy. The values in Column 6 are applied to the Ontario IO model to estimate the associated multiplier effects.

Table 3.11 shows the results of the IO multiplier analysis of the operating and capital spending of the 24 colleges. Column 1 is for reference, showing 2002 total earnings by industry. Column 2 shows the portion of total earnings explained by (or accounted for by) the spending of Ontario colleges, and Column 3 shows college-linked earnings as a percentage of total earnings by industry. For example, the construction sector in the Province of Ontario had $8.0 billion in total earnings in 2002. Of this, the spending of Ontario's colleges accounts for $41.6 million (or 0.5%). Similarly, the business services sector (services to buildings, advertising, reproduction, legal and accounting services, etc.) had $27.9 billion in total earnings in 2002, of which $70.4 million (or 0.3%) was explained by the spending of the 24 colleges. All told, the spending of Ontario's colleges explained $1.5 billion, or 0.6% of all province-wide earnings in 2002.

Table 3.11. Earnings Linked to College Operations Expenditures

Industries	Earnings Baseline ($ Thousands) 1	Earnings College-Linked ($ Thousands) 2	% College-Linked 3
Agriculture and Agricultural Services	$23,555,724	$2,172	0.0%
Mining, Sand, and Gravel	$860,491	$176	0.0%
Construction	$8,042,966	$41,631	0.5%
Manufacturing: Food, Wood, Paper, and Textiles	$6,761,061	$5,058	0.1%
Manufacturing: Chemicals, Petroleum, Stone, and Glass	$14,036,148	$7,420	0.1%
Manufacturing: Computer and Electronic Equipment	$1,209,254	$133	0.0%
Manufacturing: Other	$8,078,645	$5,650	0.1%
Transportation	$15,789,209	$15,804	0.1%
Public Utilities	$3,078,278	$14,648	0.5%
Publishing and Communications	$6,456,025	$9,199	0.1%
Trade	$31,443,805	$58,211	0.2%
Finance, Insurance, and Real Estate	$15,988,459	$32,399	0.2%
Motels, Eating/Drinking, and Amusement/Recreation	$7,165,384	$10,708	0.1%
Consumer Services	$10,951,464	$5,343	0.0%
Business Services	$27,872,504	$70,368	0.3%
Medical/Educational/Social Services	$50,064,338	$25,933	0.1%
Federal Government	$10,042,714	$6,024	0.1%
Province Government (less the college)	$12,082,322	$3,912	0.0%
Ontario's Colleges of Applied Arts and Technology	$1,228,271	$1,228,271	100.0%
Total	$254,707,062	$1,543,059	0.6%

Past Student Economic Development Effects: The Direct Effect

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

In **Table 2.13** we derived an estimate of 234.5 million of past CHEs embodied in the present-day province-wide 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 Ontario college instruction on province-wide earnings:

- Step 1: We show the 234.5 million of past CHEs embodied in the current workforce.

- Step 2: As shown earlier in this chapter (**Table 3.3**), the average net value for earnings was reported as $70. The net value was derived as the gross value less

10%.[33] For the province-wide economic development effect, however, we need to begin with the *gross* value per CHE, or $78.

- Step 3: The product of the total embodied CHEs and the gross value per CHE comprises the initial estimate of the aggregate addition of Ontario college instruction to past student earnings.

- Step 4: In **Chapter 2**, **Table 2.2** we described the source and meaning of the alternative education opportunity variable. Absent the CAAT system in Ontario, 12.0% of the students would still be able to obtain their education elsewhere. This portion of the added earnings is not credited to Ontario's colleges in the calculation of province-wide 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 50% 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 provincial skilled for provincial unskilled workers, and the substitution of out-of-province workers for in-province workers. As for the specific 50% 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 Provincial Income Effect of Embodied CHEs

0	Variables
Total embodied CHEs	234,532,084
Gross value per CHE	$78
Increased earnings of past students	$18,183,851,249
Alternative education variable, %	12%
Gross earnings net of alternative education variable	$15,998,201,556
Substitution Effects Rate	50%
Net earnings attributable to colleges	$7,999,100,778

[33] **Table 3.3** assigns a $70 net value per CHE of instruction at Ontario's colleges. This is a net value reflecting a 10% reduction from the gross value 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.

As shown in the last entry of **Table 3.12**, our analysis concludes that earnings in the Province of Ontario are $8.0 billion larger than they would be otherwise, because of the skills of past students embodied in the present-day workforce.

The province-wide business community is naturally interested in how the 24 Ontario Colleges of Applied Arts and Technology affect its operations. This is shown in **Table 3.13**. Beginning with Column 4 in **Table 2.13, t**he 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 Ontario college skilled workers they employ. The Manufacturing: Computer and Electronic Equipment sector, for example, is estimated to employ Ontario college students with a combined 3.0 million hours of CHEs (see **Table 2.13**). Because of the skills of these past students, the Manufacturing: Computer and Electronic Equipment sector is estimated to generate earnings that are $1.2 million (or 5.8%) 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 province-wide direct effect of past student skills are shown in the bottom row of **Table 3.13**: overall regional earnings are $8.0 billion (or 3.1%) higher than they would be if the 24 Ontario colleges did not exist.

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

Table 3.13. Past Student Direct Effects

	Earnings		
	Baseline	College-Linked	% College Linked
	----------($ Thousands)----------		
Industries	1	2	3
Agriculture and Agricultural Services	$23,555,724	$68,242	0.3%
Mining, Sand, and Gravel	$860,491	$2,493	0.3%
Construction	$8,042,966	$23,301	0.3%
Manufacturing: Food, Wood, Paper, and Textiles	$6,761,061	$97,936	1.4%
Manufacturing: Chemicals, Petroleum, Stone, and Glass	$14,036,148	$406,636	2.9%
Manufacturing: Computer and Electronic Equipment	$1,209,254	$70,066	5.8%
Manufacturing: Other	$8,078,645	$234,043	2.9%
Transportation	$15,789,209	$228,711	1.4%
Public Utilities	$3,078,278	$44,590	1.4%
Publishing and Communications	$6,456,025	$374,070	5.8%
Trade	$31,443,805	$910,946	2.9%
Finance, Insurance, and Real Estate	$15,988,459	$926,391	5.8%
Motels, Eating/Drinking, and Amusement/Recreation	$7,165,384	$103,793	1.4%
Consumer Services	$10,951,464	$158,635	1.4%
Business Services	$27,872,504	$807,483	2.9%
Medical/Educational/Social Services	$50,064,338	$2,900,789	5.8%
Federal Government	$10,042,714	$290,944	2.9%
Provincial Government	$13,310,594	$350,032	2.6%
Total	$254,707,062	$7,999,101	3.1%

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 provincial multiplier generates still further rounds of industry output and earnings.[34]

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 provincial output attracts new industry,

[34] 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 Ontario IO model.

facilitates economies of scale, enhances workforce efficiency through information sharing, and otherwise enhances the province-wide business climate.[35]

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
	----------($ Thousands)----------		
Industries	1	2	3
Agriculture and Agricultural services	$23,555,724	$31,832	0.1%
Mining, Sand, and Gravel	$860,491	$3,667	0.4%
Construction	$8,042,966	$14,418	0.2%
Manufacturing: Food, Wood, Paper, and Textiles	$6,761,061	$44,926	0.7%
Manufacturing: Chemicals, Petroleum, Stone, and Glass	$14,036,148	$109,198	0.8%
Manufacturing: Computer and Electronic Equipment	$1,209,254	$3,929	0.3%
Manufacturing: Other	$8,078,645	$71,208	0.9%
Transportation	$15,789,209	$217,334	1.4%
Public Utilities	$3,078,278	$34,150	1.1%
Publishing and Communications	$6,456,025	$110,362	1.7%
Trade	$31,443,805	$326,207	1.0%
Finance, Insurance, and Real Estate	$15,988,459	$201,886	1.3%
Motels, Eating/Drinking, and Amusement/Recreation	$7,165,384	$84,495	1.2%
Consumer Services	$10,951,464	$46,192	0.4%
Business Services	$27,872,504	$181,542	0.7%
Medical/Educational/Social Services	$50,064,338	$212,596	0.4%
Federal Government	$10,042,714	$33,148	0.3%
Provincial Government	$13,310,594	$130,538	1.0%
Total	$254,707,062	$1,857,626	0.7%

Focusing on particular effects, we can now say that because of the indirect effect of past students, earnings in the Publishing & Communications sector will be $110.4 million (or 1.7%) 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 province-wide total earnings are $254.7 billion, of which $1.9 billion (or 0.7%) are due to the indirect effect of past students.

[35] We estimate agglomeration effects as "forward" multiplier effects. The Ontario 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 Ontario IO model.

Overall Effect of Ontario Colleges on the Province-wide Economy

The tables above detail the regional economic effects attributable to Ontario's colleges 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

	Earnings		
	Baseline	College-Linked	% College-Linked
	----------($ Thousands)----------		
Industries	1	2	3
Agriculture and Agricultural services	$23,555,724	$102,246	0.4%
Mining, Sand, and Gravel	$860,491	$6,336	0.7%
Construction	$8,042,966	$79,349	1.0%
Manufacturing: Food, Wood, Paper, and Textiles	$6,761,061	$147,921	2.2%
Manufacturing: Chemicals, Petroleum, Stone, and Glass	$14,036,148	$523,253	3.7%
Manufacturing: Computer and Electronic Equipment	$1,209,254	$74,127	6.1%
Manufacturing: Other	$8,078,645	$310,901	3.8%
Transportation	$15,789,209	$461,850	2.9%
Public Utilities	$3,078,278	$93,387	3.0%
Publishing and Communications	$6,456,025	$493,630	7.6%
Trade	$31,443,805	$1,295,364	4.1%
Finance, Insurance, and Real Estate	$15,988,459	$1,160,675	7.3%
Motels, Eating/Drinking, and Amusement/Recreation	$7,165,384	$198,996	2.8%
Consumer Services	$10,951,464	$210,170	1.9%
Business Services	$27,872,504	$1,059,394	3.8%
Medical/Educational/Social services	$50,064,338	$3,139,317	6.3%
Federal Government	$10,042,714	$330,116	3.3%
Provincial Government (less the college)	$12,082,322	$484,482	4.0%
Ontario's Colleges of Applied Arts and Technology	$1,228,271	$1,228,271	100.0%
Total	$254,707,062	$11,399,786	4.5%

Individual rows in **Table 3.15** show how particular industries benefit from the past and present existence of the 24 Ontario colleges. For example, our analysis suggests Ontario's Publishing and Communications sector owes $6.5 billion (or 7.6%) of its overall earnings to the past and present existence of Ontario's colleges. The effect of the 24 colleges on other industries is shown in the table. The bottom row of **Table 3.15** indicates that region-wide earnings are $254.7 billion, of which $11.4 billion (or 4.5%) are due to the past and present existence of the 24 Ontario colleges.

Table 3.16. Summary of Colleges' Role in the Provincial Economy

	Earnings ($ Thousands)	% of Total	Multipliers
Total Earnings in Province	$254,707,062	100%	
Earnings Attributable to College Operations			
Direct Earnings of Faculty and Staff	$1,228,271	0.5%	
Indirect Earnings	$314,788	0.1%	
TOTAL	$1,543,059	0.6%	1.2563
Earnings Attributable to Past Student Econ. Dev. Effects			
Direct Earnings	$7,999,101	3.1%	
Indirect Earnings	$1,857,626	0.7%	
TOTAL	$9,856,727	3.9%	1.2322
GRAND TOTAL	$11,399,786	4.5%	

Table 3.16 provides one last view of the regional economic effects of Ontario's colleges, 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 earnings of the faculty and staff of the 24 Ontario colleges, $1.2 billion, or 0.5% of overall province-wide earnings (this item is also shown in college spending, **Table 2.10**). The second item shows the indirect effect of the colleges' operations and capital spending: $314.8 million, or 0.1% of all province-wide earnings. All told, the operations and capital spending of Ontario's 24 Colleges of Applied Arts and Technology can be credited with $1.5 billion, or 0.6% of Ontario's $254.7 billion in overall earnings.

The next set of items detail the effect of past students still active in the Ontario workforce. Past students directly explain $8.0 billion, or 3.1% of all province-wide earnings (shown on the total row of **Table 3.13**). These same students indirectly explain $1.9 billion, or 0.7% of all province-wide earnings (shown on the total row of **Table 3.14**). In all, past students still active in the workforce can be credited with $9.9 billion, or 3.9% of all earnings in the Province of Ontario.

Finally, the bottom row of **Table 3.16** shows the overall role of the 24 colleges in the provincial economy: $11.4 billion, or 4.5% of all province-wide 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 that promote college education.* 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: 1) the impacts associated with changes in the student employment variables for the investment analysis, and 2) 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. These variables include: 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 the 24 colleges. Both employment variables relate to the earnings foregone by the students—the opportunity cost of time—and they affect the investment analysis results (net present value, rate of return, benefit/cost ratio, and payback period).

Percent of Students Employed

The students incur substantial expense by attending Ontario's colleges 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 71% 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 24 colleges, it is estimated that the students working while attending classes earn only 61%, on average, of the earnings they would have statistically received if not attending the colleges. 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 analyses) 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—71% for the portion of students employed, and 61% 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 71% to 100% first (holding all of the other assumptions constant), the rate of return, benefit/cost ratio, and payback period results would improve to 13.3%, 3.5, and 10.6 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 61% to 100% second (holding the second employment assumption constant at the base case level), the rate of return, benefit/cost ratio, and payback period results would improve to 15.8%, 4.5, and 9.0 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 rate of return, benefit/cost ratio, and payback period results would improve yet further to 48.0%, 16.1, and 3.4 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	71%	9.0%	2.2	14.4
Employed	100%	13.3%	3.5	10.6
2. Percent of	61%	9.0%	2.2	14.4
Earnings	100%	15.8%	4.5	9.0
1 = 100%, 2 = 100%		48.0%	16.1	3.4

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 Ontario's colleges will generate excellent returns, well above the long-term average percent rates of return of alternative investments schemes associated with a similar level of risk.

PROVINCE-WIDE ECONOMIC DEVELOPMENT

The economic impacts of higher education can be calculated in different ways. Our approach was to estimate the economic impacts of the 24 colleges in Ontario 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. 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 provincial businesses, which, as argued by some, should be counted among the regional economic impacts attributable to the colleges.

In our analysis, however, we exclude student spending because most of the students already reside in province. 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 province to obtain an education elsewhere if the CAAT system were not present. Thus, the province 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 provincial economy. The table parallels **Table 3.16** in the previous chapter, but adds the section "Earnings Attributable to Student Spending,"[36] creating some $615.7 million in

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

additional earnings for the provincial businesses patronized by students (the direct effects), plus another $190.2 million in earnings stemming from related multiplier effects (indirect effects). Adding the student spending to the mix increases Ontario colleges' total "explanatory power" of the regional earnings from 4.5% in **Table 3.16** to 4.8% in **Table 4.2**.

Table 4.2. Summary of Colleges' Role in the Provincial Economy - Earnings

	Earnings ($ Thousands)	% of Total
Total Earnings in Province	$254,707,062	100%
Earnings Attributable to Student Spending		
Direct Earnings	$615,713	0.2%
Indirect Earnings	$190,226	0.1%
TOTAL	$805,939	0.3%
Earnings Attributable to College Operations		
Direct Earnings of Faculty and Staff	$1,228,271	0.5%
Indirect Earnings	$314,788	0.1%
TOTAL	$1,543,059	0.6%
Earnings Attributable to Past Student Econ. Dev. Effects		
Direct Earnings	$7,999,101	3.1%
Indirect Earnings	$1,857,626	0.7%
TOTAL	$9,856,727	3.9%
GRAND TOTAL	$12,205,726	4.8%

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 hospital. In terms of direct economic impact, both have spent $50,000. However, the expenditures will likely have very different meanings to the provincial economy. Of the $50,000 spent for the luxury automobile, perhaps $10,000 remains in-province as salesperson commissions and auto dealer income (part of the province's overall earnings), while the other $40,000 leaves the province 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 province's overall

earnings), while only $10,000 leaves the province, 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 impact of Ontario's colleges 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 $679.8 billion.[37] Direct local spending by students reflects their total spending, reduced by the estimated portion that leaks out-of-province to purchase goods produced elsewhere.[38] In the usual fashion, indirect effects reflect the action of local economic multiplier effects, also estimated by the economic model.

Direct provincial expenditures include all spending by the colleges for consumer items and for faculty and staff salaries. Both items are reduced to reflect purchases from outside the province. All told, the operation of the 24 colleges is estimated to explain some $29.3 billion in regional gross sales, a number substantially larger than the $12.2 billion explained by the colleges in regional gross earnings shown in **Table 4.2**.

While the gross sales impacts shown in **Table 4.3** are not incorrect, we prefer to report college impacts in terms of earnings (**Table 3.16**) rather than gross sales, because they reflect the economic realities in the province 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.

[37] Simply stated, economy-wide gross sales are obtained by multiplying sector-specific regional earnings by a national estimate of sales-to-earnings.
[38] Students purchase gasoline for their cars, for example, and while the trade margin stays in-province, in most cases the producer price of gasoline itself will leak out to the oil-producing region.

Table 4.3. Summary Colleges' Role in the Provincial Economy - Sales

	Gross Sales (1,000)	% of Total
Total Gross Sales	$679,761,033	100%
Gross Sales Attributable to Student Spending		
Direct Spending by Students	$1,563,242	0.2%
Indirect Spending Effect	$537,832	0.1%
TOTAL	$2,101,074	0.3%
Gross Sales Attributable to College Operations		
Direct Expenditures of Colleges	$733,550	0.1%
Indirect Spending Effect	$200,104	0.0%
TOTAL	$933,654	0.1%
Gross Sales Attributable to Past Student Econ. Dev. Effects		
Direct Gross Sales	$20,975,011	3.1%
Indirect Gross Sales	$5,251,711	0.8%
TOTAL	$26,226,722	3.9%
GRAND TOTAL	$29,261,450	4.3%

VARIABLES REQUIRING JUDGMENT

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

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 regularly 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 (12.0% 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 CAAT colleges in the province. The attrition

rate (6% in **Table 2.2)** characterizes the mobility of the exiting students out of the region over the next thirty 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**.

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 net present value, rate of return, benefit/cost ratio, 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 12% to 15.0%) will reduce the narrow taxpayer perspective rate of return from 12.1% to 11.8%. Likewise, a decrease of 25% (from 12% to 9%) in the assumption will generate an increase in the rate of return from 12.1% to 12.5%.

Based on this sensitivity analysis, the conclusion can be drawn that the investment analysis results for Ontario's colleges 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 (net present value greater than 0, benefit/cost ratio greater than 1, and rate of return greater than the discount rate of 4.0%) even when the Alternative Education assumption is increased by as much as 75% (from 12% to 21%). 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.

Table 4.4 Sensitivity Analysis of Alternative Education and Attrition Rate Variables ($ Thousands)

		-75%	-50%	-25%	Base Case	25%	50%	75%
Alternative Education Variable		3.0%	6.0%	9.0%	12.0%	15.0%	18.0%	21.0%
Narrow Taxpayer Perspective								
Investment results	NPV	$1,439,387	$1,369,519	$1,299,652	$1,229,784	$1,159,916	$1,090,048	$1,020,181
	RR	13.3%	12.9%	12.5%	12.1%	11.8%	11.4%	11.0%
	B/C ratio	2.5	2.5	2.4	2.3	2.2	2.2	2.1
	Pay Back	9.9	10.1	10.4	10.7	11.0	11.3	11.6
		-75%	**-50%**	**-25%**	**Base Case**	**25%**	**50%**	**75%**
Attrition Rate Variable		1.6%	3.1%	4.7%	6.2%	7.8%	9.3%	10.9%
Regional Economic Development								
Earnings Attributable to College		$11,625,253	$11,550,556	$11,475,404	$11,399,786	$11,323,691	$11,247,106	$11,170,018
% of Total Earnings in Province		4.6%	4.5%	4.5%	4.5%	4.4%	4.4%	4.4%
Credits Embodied in the Workforce		239,896,862	238,119,503	236,331,334	234,532,084	232,721,470	230,899,197	229,064,957

Attrition Rate

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 6% (from **Table 2.2**) by the increments indicated in the table. The impacts on the results are more pronounced, as indicated in **Table 4.4**. Earnings attributable to the college, for example, range from a high of $11.6 billion at -75% to a low of $11.2 billion 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 local workforce decreases; hence, the earnings attributable to the college decrease accordingly.

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Appendix 1: Glossary of Terms

Alternative education	The alternative education variable is a "with" and "without" measure. It is a measure of the percent of students who would still be able to avail themselves of alternative education opportunities absent the CAAT system in the province. An estimate of 20%, for example, means that 20% of the students do not depend directly on the existence of the colleges in order to obtain their education. We then back 20% out the impact calculations.
Attrition rate	An attrition (decay) rate of students is applied to benefits occurring in the future. The rate refers to the fact that not all students remain in the local region once exiting the college, but some will out-migrate, retire, or die. This rate is either estimated by the college institutional researchers, or it is derived from the literature as a default value if the variable cannot be estimated by the college.
Benefit/cost ratio	The benefit/cost ratio separately discounts the flow of benefits and costs over time to the present and then divides the sum of the discounted benefits by the sum of the discounted costs. If the benefit/cost ratio is greater than one, then the benefits exceed costs and the investment is feasible. For every dollar expended we get more than one dollar back. This, however, does not necessarily mean that the investment is the best one. There are many feasible projects but only one optimal one. We must compare between investments—the higher the benefit/cost ratio, the more attractive the project.
Demand	The demand for education describes the relationship between the market price of education and the volume of education demanded (expressed in terms of enrollment). The law of the downward-sloping demand curve is related to the fact that enrollment increases only if the price (tuition and fees) is lowered, or conversely, enrollment decreases if the price (tuition and fees) increases.

Discounting	Discounting is the process of expressing future revenues and costs in present value terms. The discount rate converts future revenues into present values so they can be compared to costs incurred in the present.
Economics	Economics is the study of the allocation of scarce resources among alternative and competing ends. Economics is not normative (what *ought* to be done), but positive (describes *what is*, or how people are likely to behave in response to economic changes). Allocation of resources is the key focus of economics. Taxpayer dollars, for example, are scarce and there will be competing uses and pressures. Taxpayers vote to tax themselves to fund transportation, the health sector, education, and/or other priorities. They have choices and must allocate between them.
Elasticity of demand	In this report, the elasticity of demand refers to the degree of responsiveness of the quantity of education demanded (enrollment) to changes in market prices (tuition and fees). If a decrease in tuition increases total revenues, the demand is elastic. If it decreases total revenues, the demand is inelastic. If total revenues remain the same, the elasticity of demand is said to be unitary.
Externalities	Externalities (positive and negative) occur when impacts are generated for which there is no compensation. Hillside logging, for example, may create a negative externality because of erosion that lowers the productivity of downstream farms, but the logger does not compensate the farmers. For colleges, positive external benefits could be improved social behaviors manifested in lower crime, reduced welfare and unemployment, and improved health. Colleges cannot take direct credit, nor do they receive compensation for these manifestations, but the benefits still occur by virtue of the fact that the colleges exist and that the higher education they provide ultimately leads to improved social behaviors.

Input-output analysis

Input-output analysis is a branch of economics that addresses production relationships in an economy. In particular, it refers to the relation between a given set of demands for final goods and services, and the implied amounts of manufactured inputs, raw materials, and labour this requires. In an educational setting, as colleges pay wages and salaries and spend money for supplies in the local economic region, they also generate earnings in all of the sectors of the economy, thereby increasing the demand for goods and services and jobs. Moreover, as the students enter or rejoin the workforce with higher skills obtained at the colleges, they also earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy, subject to the familiar multiplier effect (see below).

Internal rate of return

The internal rate of return (IRR) is the rate of interest which, when used to discount the cash flows associated with investing in education, reduces its net present value to zero (i.e., where the present value of the revenues accruing from the investment are just equal to the present value of the costs incurred). This, in effect, is the breakeven rate of return on the investment since it shows the highest rate of interest at which the investment makes neither a profit nor a loss. IRR results are expressed as a percentage**.**

Multiplier

Multipliers are a measure of the overall regional earnings per dollar of earnings at the college (i.e., per dollar of college faculty and staff earnings). In our context, the multiplier can be defined as the total of on- and off-campus earnings divided by on-campus earnings. Multiplier effects are the result of in-area spending by the college on locally supplied goods and services, and of the local everyday spending of college faculty and staff. We also include in the off-campus portion of the multiplier the added regional earnings attributable to past-students still active in the local labour force. The regional economy is larger because of the skills of these past students, and because of the added spending associated with their higher incomes, and from spending

	associated with the enlarged output of the industries where these past students are employed.
Net cash flow	The net cash flow (NCF) is benefits minus costs, i.e., the sum of the revenues accruing from an investment minus the costs incurred.
Net present value	The net present value (NPV) is the net cash flow discounted to the present. All future cash flows are, in this way, collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure. If the net present value is positive, we have done better than alternative investment schemes, all else being equal.
Opportunity cost	The opportunity cost comprises the benefits foregone from alternative B once a decision is made to allocate resources to alternative A. Or, if an individual chooses not to attend college, he or she foregoes the higher future earnings associated with higher education. The benefit of higher education, therefore, is the "price tag" of choosing not to attend college.
Payback Period	This is a measure of the period of time required to recover an investment. The shorter the period, the more attractive is the investment. The formula for computing payback period is: Payback period = cost of investment/net return per period

Appendix 2: 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.[39]

Table 1. Costs and Benefits

Year	Tuition	Opportunity Cost	Total Cost	Higher Earnings	NCF
1	2	3	4	5	6
1	$1,500	$20,000	$21,500	$0	($21,500)
2	$0	$0	$0	$5,000	$5,000
3	$0	$0	$0	$5,000	$5,000
4	$0	$0	$0	$5,000	$5,000
5	$0	$0	$0	$5,000	$5,000
6	$0	$0	$0	$5,000	$5,000
7	$0	$0	$0	$5,000	$5,000
8	$0	$0	$0	$5,000	$5,000
9	$0	$0	$0	$5,000	$5,000
10	$0	$0	$0	$5,000	$5,000
NPV			$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 college for one year for which he or she pays a tuition of $1,500 (Column 2).

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

3) The opportunity cost of time (the earnings foregone while attending the college 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: 1) to attend college, or 2) forget about higher education and hold on to the present employment. If he or she decides to enroll, certain economic implications unfold: 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.[40] A brief example: at 4%, the present value of $5,000 to be received one year from today is $4,807. If the $5,000 were to be received in year ten, the present value would reduce to $3,377. Or put another way, $4,807 deposited in the bank today earning 4% interest will grow to $5,000 in one year; and $3,377 deposited today would grow to $5,000 in ten years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 ten years from today given the going rate of interest of 4%. The process of discounting—finding the present value of future higher earnings—allows us to express values on an equal basis in future or present value terms.

Our goal is to express all future higher earnings in present value terms so that we can compare them to the investments incurred today—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 net present value is equal to or greater than zero. Given this result, it can be concluded that, *in this case*, and given these assumptions, this particular investment in college education is very strong.

THE INTERNAL RATE OF RETURN (IRR)

The internal rate of return 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 internal rate of return is a measure of the average earning power of the money used over the life

[40] 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.

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

What does this mean? The internal rate of return of 18% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the net present value equals zero. Or, at 18%, the higher incomes of $5,000 per year for the next nine 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 rates obtained from investments in stocks and bonds. Again, the 18% is far higher, indicating that the investment in college education is strong relative to the stock market returns (on average).

A word of caution—the IRR approach can sometimes generate "wild" or "unbelievable" results—percentages that defy the imagination. Technically, the approach requires at least one negative cash flow (tuition plus opportunity cost of time) to offset all subsequent positive flows. For example, if the student works full time while attending college, the opportunity cost of time would be much lower—the only out-of-pocket cost would be the $1,500 paid for tuition. In this case, it is still possible to compute the internal rate of return, but it would be a staggering 333% because only a negative $1,500 cash flow will be offsetting 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 "NA" or "> than 100%."

THE BENEFIT/COST RATIO (B/C)

The benefit/cost ratio is simply the present value of benefits divided by present value of costs, or $35,747 / $21,500 = 1.7 (based on the 4% discount rate). Of course, any change in the discount rate will also change the benefit/cost ratio. If we applied the 18% internal

rate of return discussed above, the benefit/cost ratio would reduce to 1.0—or the breakeven solution where benefits just equal the costs. Applying a discount rate higher than the 18% would reduce the ratio to less than one and the investment would not be feasible. The 1.7 ratio means that a dollar invested today will return a **cumulative** $1.70 over the ten year time period.

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 college. 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 3: Adjusting for the Benefits Available Absent Provincial and local Government Support

INTRODUCTION

The investment analysis presented in the Main Report weighs the benefits of college enrollment (measured in terms of CHEs) against the support provided by provincial and local government. If, without provincial and local government support a college 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 college would have to close its doors absent provincial 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 provincial and local government support level," then provincial and local government support can only be credited with the difference (i.e., the actual enrollment less the enrollment at zero provincial 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.

PROVINCIAL 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 provincial 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 provincial and local government support covers C% of all costs. At this point in the analysis, we assume that the college has only two sources of revenues: student tuition payments and provincial and local government support.

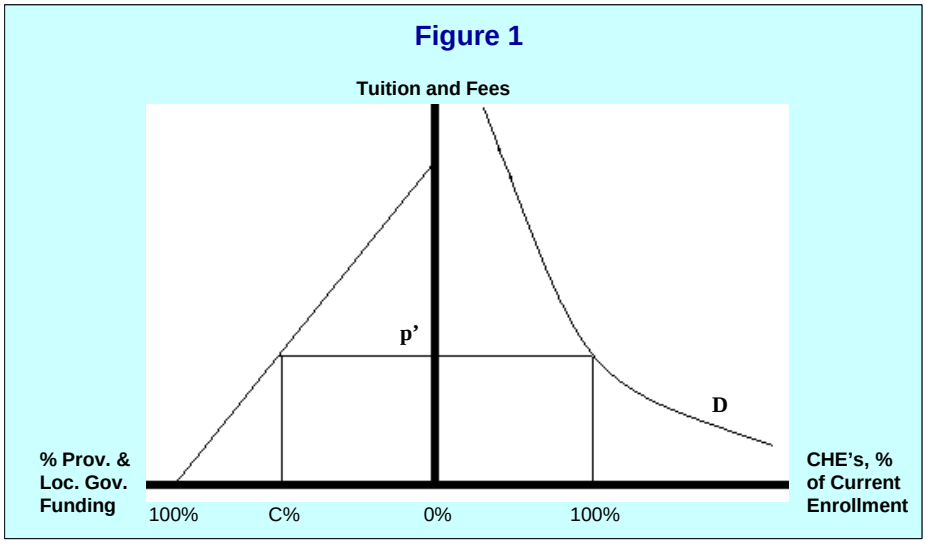
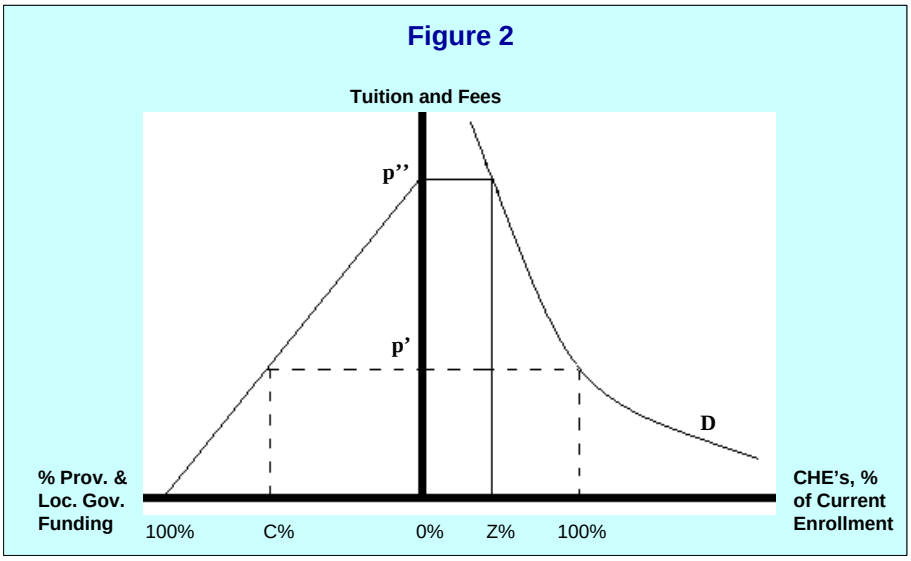


Figure 2 shows another important reference point in the model—where provincial and local government support is 0%, tuition rates are increased to p", and enrollment is Z% (less than 100%). The reduction in enrollment reflects price elasticity in the students' school vs. no-school decision. Neglecting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



FROM ENROLLMENT TO BENEFITS

This appendix is mainly focused on the size of college enrollment (i.e., the production of CHEs) and its relationship to student versus provincial 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 provincial 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 provincial 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 provincial and local government support, the benefits appropriately attributed to provincial and local government support is given by:

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

THE COLLEGE SHUTDOWN POINT

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

Figure 3

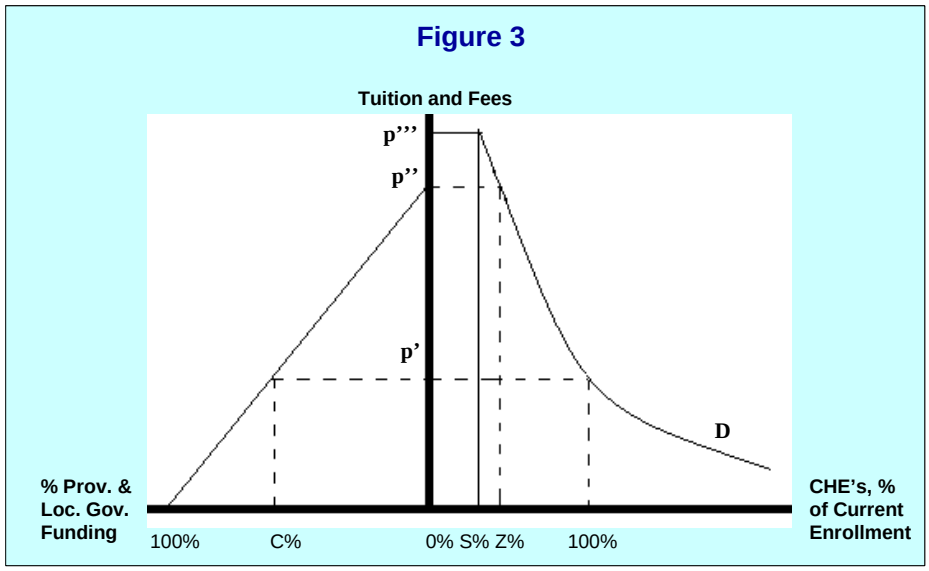
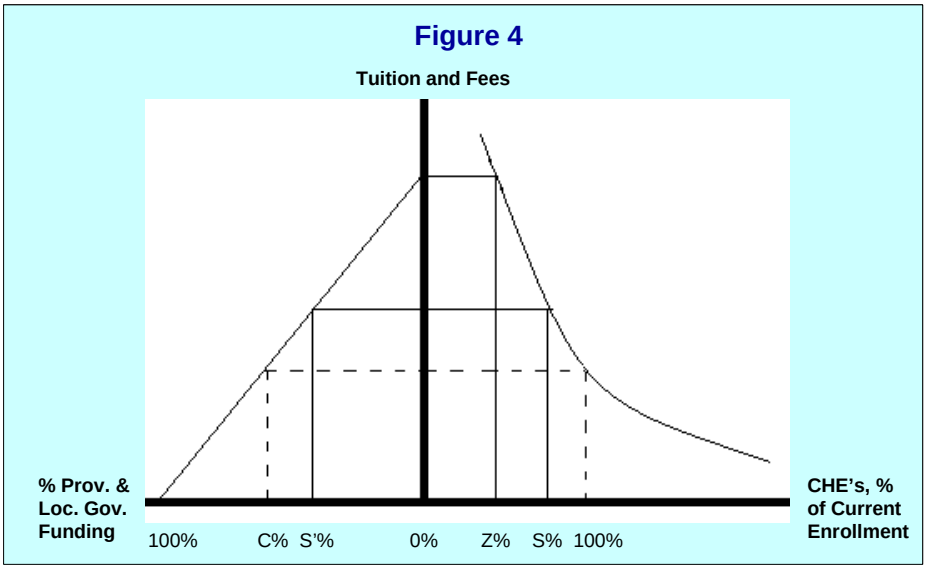


Figure 4 illustrates yet another scenario. Here the college shutdown point occurs at an enrollment level greater than Z% (the level of zero provincial and local government support), meaning some minimum level of provincial and local government support is needed for the school to operate at all. This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



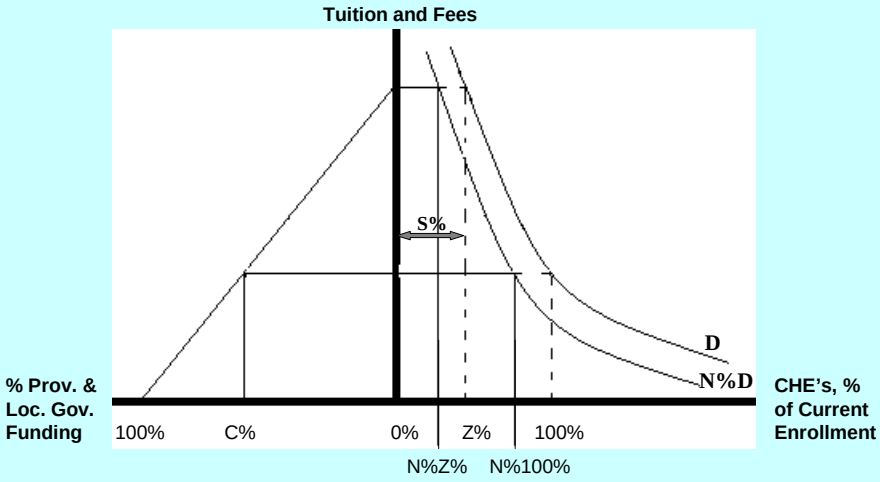
ADJUSTING FOR ALTERNATIVE EDUCATION OPPORTUNITIES

Because there may be education alternatives to the college, we must make yet another adjustment. The question asked is: "Absent the colleges, what percentage of the students would be able to obtain their education elsewhere?" The benefits associated with the college 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 college could operate absent provincial and local government support (i.e., Z% occurs at an enrollment level greater than the college shutdown level S%). In this case, the benefits generated by enrollments absent provincial 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 provincial and local government support is given by:

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

Figure 5



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

Figure 6