Analysis of the Return on Investment and Economic Impact of Education

DEMONSTRATING THE VALUE OF
CANADA'S COLLEGES AND INSTITUTES

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MAIN REPORT

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Introduction

Canada's colleges and institutes create value in many ways.[2] They play a key role in helping students increase their employability and achieve their individual potential. By doing so, they create a steady supply of talented new workers who can in turn join the workforce and increase the productivity of the Canadian economy, a long-lasting impact that continues to benefit the nation for as long as those students' working lives last.

Colleges and institutes' program offerings support a range of public and private organizations in various sectors in Canada. The expenditures of Canada's colleges and institutes' students further support the national economy through the output and employment generated by organizations. Lastly, and just as importantly, the economic impact of Canada's colleges and institutes extends as far as the public sector in terms of increased tax receipts and decreased government costs.

OBJECTIVE OF THE REPORT

In this report we aim to assess the economic impact of Canada's colleges and institutes on the national economy and the benefits generated by colleges and institutes in return for the investments made by their key stakeholder groups: students, society, and taxpayers. Our approach is twofold. We begin with an economic impact analysis of Canada's colleges and institutes on the business community in Canada. To derive results, we rely on Emsi's Canadian Regional Input-Output (CRIO) model to calculate the additional income created in the Canadian economy as a result of the added skills of students attending Canada's colleges and institutes, student-linked input purchases, and consumer spending. Results of the national economic impact analysis are broken out according to the following two effects: 1) impact of the skills acquired by former domestic and international students still active in the Canada workforce, and 2) impact of international student spending.

The second component of the study is a standard investment analysis to determine how money spent on Canada's colleges and institutes performs as an investment over time. The investors in this case are students, society, and taxpayers, all of whom pay a certain amount in costs to support the educational activities at Canada's colleges and institutes. The students' investment consists of their out-of-pocket expenses and the opportunity cost of attending one of the colleges as opposed to working. Society invests in education by forgoing the services that it would have received had government not funded Canada's colleges and institutes and the business output that it would have enjoyed had students been employed instead of studying. Taxpayers contribute their investment through provincial and federal government funding.

In return for these investments, students receive a lifetime of higher earnings, society benefits from an enlarged economy and a reduced demand for social

2 This analysis covers both member and non-member institutions of Colleges and Institutes Canada. See Appendix 1 for a list of colleges and institutes included in this study.

services, and taxpayers benefit from an expanded tax base and a collection of public sector savings. To determine the feasibility of the investment, the model projects benefits into the future, discounts them back to their present value, and compares them to their present value costs. Results of the investment analysis for students, society, and taxpayers are displayed in the following four ways: 1) net present value of benefits, 2) rate of return, 3) benefit-cost ratio, and 4) payback period.

A wide array of data and assumptions are used in the study based on several sources, including the FY 2014-15 academic and financial reports from colleges and institutes, as well as industry and employment data from Statistics Canada, outputs of Emsi's CRIO model, and a variety of published materials relating education to social behaviour. The study aims to apply a conservative methodology and follows standard practice using only the most recognized indicators of investment effectiveness and economic impact.

IMPORTANT NOTES

There are three important notes that readers should bear in mind when reviewing the findings presented in this report. First, this report is not intended to be a vehicle for comparing Canada's colleges and institutes with other publicly-funded institutions in Canada or elsewhere. Other studies comparing the gains in income and social benefits of one institution relative to another address such questions more directly and in greater detail. Our intent is simply to provide Canada's colleges and institutes' management teams and stakeholders with pertinent information about the extent to which Canada's colleges and institutes impact the national economy and generate returns on investment. Differences between the results for Canada's colleges and institutes and those of other institutions, however, do not necessarily indicate that one institution is doing a better job than another. Results are a reflection of location, student body profile, and other factors that have little or nothing to do with the relative efficiency of the institutions. For this reason, comparing results between institutions or using the data to rank institutions is strongly discouraged.

Second, this report is useful in establishing a benchmark for future analysis, but it is limited in its ability to put forward recommendations on what Canada's colleges and institutes should do next. The implied assumption is that colleges and institutes can effectively improve their results if they increase the number of students they serve, help students to achieve their educational goals, and remain responsive to employer needs in order to ensure that students find meaningful jobs after exiting. Establishing a strategic plan for achieving these goals, however, is not the purpose of this report.

Third, and similarly, while this report is useful in demonstrating the current value of Canada's colleges and institutes, it is not intended for comparison with Emsi's previous study for Canada's colleges and institutes conducted in 2008. Emsi works to continuously update and improve our model to ensure that it conforms to best practices and stays relevant in today's economy. The present study reflects the latest version of our model, representing the most up-to-date theory and practices for conducting economic impact and investment analysis. Many of our former assumptions have been replaced with observed data, and we have researched the latest sources in order to update the background data used in our model with the most up-to-date data and information. Another key difference between the present study and the previous study is the scope of the colleges and institutes included our analysis. The previous study included 61 individual colleges and institutes, and their results were used to make inference to all 150 colleges and institutes in the nation at the time. The present study includes data from 145 of Canada's 174 colleges and institutes – a much larger sample size. For these reasons, differences between results from the 2008 study and the present study do not necessarily indicate changes in the value of Canada's colleges and institutes.

KEY FINDINGS

The results of this study show that Canada's colleges and institutes have a significant positive impact on the national economy and generate benefits in return for the investments made by their main stakeholder groups: students, society, and taxpayers. Using a two-pronged approach that involves a national economic impact analysis and an investment analysis, we calculate the benefits to each of these groups. Key findings of the study are as follows:

Economic impact on the national economy

- Approximately **94%** of all students who attended Canada's colleges and institutes (both domestic and international) stayed in Canada after exiting one of the colleges and institutes. Their enhanced skills and abilities bolster the output of employers, leading to higher national income and a more robust economy. The accumulated contribution of former students of Canada's colleges and institutes who were employed in the national workforce in FY 2014-15 amounted to **$189.5 billion** in added income in the Canadian economy.
- A total of **56,572** international students relocated to Canada and spent money at businesses to pay tuition and fees, buy books and supplies, purchase groceries, rent accommodation, pay for transport, attend local events, and so on. These expenditures added approximately **$1.6 billion** in income to the Canadian economy in FY 2014-15.
- The total effect of Canada's colleges and institutes on the national business community in Canada in FY 2014-15 was **$191.2 billion**, approximately equal to **12.7%** of the Gross Domestic Product.

Return on investment to students, society, and taxpayers

- Students paid a total of **$3.6 billion** to cover the cost of tuition and fees and books and supplies at Canada's colleges and institutes in FY 2014-15. They also forwent **$11.6 billion** in earnings that they would have generated had they been working instead of learning.
- In return for the monies invested in Canada's colleges and institutes, students receive a present value of **$57.9 billion** in increased earnings over their working lives. This translates to a return of **$3.80** in higher future earnings for every $1 that students pay for their education at Canada's colleges and institutes. The corresponding internal rate of return is **16.1%**.
- Society as a whole in Canada will receive a present value of **$122.5 billion** in higher earnings over the course of the students' working lives. Society will also benefit from **$2.4 billion** in present value social savings related to reduced crime, lower unemployment, and increased health and well-being across the country.
- For every dollar funded by society and spent by Canada's colleges and institutes in FY 2014-15, society as a whole will receive a cumulative value of **$5.40** in benefits, for as long as the FY 2014-15 student population remains active in the national workforce.
- Provincial and federal governments paid **$6.8 billion** to support the operations of Canada's colleges and institutes in FY 2014-15. The net present value of the added tax revenue stemming from the students' higher lifetime earnings and the increased output of businesses amounts to **$19.7 billion** in benefits to taxpayers. Savings to the public sector add another **$1 billion** in benefits due to a reduced demand for government-funded social services in Canada.
- Dividing the benefits to taxpayers by the amount that they paid to support Canada's colleges and institutes yields a **3.0** benefit-cost ratio, i.e., every $1 in costs returns **$3.00** in benefits. In other words, taxpayers fully recover the cost of the original investment and also receive a return of **$2.00** in addition to every dollar paid. The average annual internal rate of return for taxpayers is **10.5%**.

CHAPTER 1:

Profile of Canada's Colleges and Institutes and the National Economy

ABOUT CANADA'S COLLEGES AND INSTITUTES

This economic impact study quantifies the real, measurable effect which Canada's colleges and institutes have on the economy of Canada as a whole, as well as the effects their work has on the lives and careers of their students. In every province and territory, colleges and institutes offer a wide range of programs that enable Canadian students to pursue an education that will secure them a successful future, find them a role in the Canadian workforce, and help them pursue their own interests and enthusiasms.

Canada's colleges and institutes are responsible for a significant amount of applied research, working in partnership with federal and provincial government programs, private industries, and four-year universities across Canada. For more about some of this research and how it benefits Canada, see "Research Stories from Canada's Colleges and Institutes" on the next page. Canada's colleges and institutes also maintain strong connections with the Canadian Forces, Canadian immigration officials, and Canada's indigenous leaders to make sure higher education is available to all Canadians.

Both together and individually, these institutions are able to have an impact that extends across the nation and even beyond Canada's borders. Their international partnerships connect Canada's colleges and institutes to peers in 29 different countries in Africa, Latin America, India, China, and the Caribbean. Through these connections, thousands of Canadian students study abroad every year, while opening a parallel opportunity for many international students to bring their new perspectives to Canadian schools.

These international partnerships have a positive impact on both Canada itself and many foreign countries, as international students either take what they've learned home to help their economies or stay in Canada to use those skills. Canadian students who study abroad through programs at Canada's colleges and institutes have a similar opportunity to bring the world's insights back home to Canada when they return.

FINANCE AND STUDENT DATA FOR CANADA'S COLLEGES AND INSTITUTES

Estimating the benefits and costs of Canada's colleges and institutes requires three types of information: (1) finance data, (2) student demographic and achievement data, and (3) the national economic profile. For the purpose of this study, information on colleges and institutes and their students was obtained from Canada's colleges and institutes,[2] and data on the national economy were drawn from Emsi's proprietary data modeling tools.

2 See Appendix 1 for a list of Canada's colleges and institutes. Some colleges and institutes chose to not participate in the data collection process. In those cases, Emsi provided estimates for them based on publicly available data and averages from other colleges and institutes who did submit data. Data was unable to be collected for a number of smaller colleges and institutes. Data reflected in this study therefore covers the majority of Canada's colleges and institutes – 145 out of 174 colleges and institutes – but is conservative given the constraints in capturing data from all institutions.

Applied Research Stories from Canada's Colleges and Institutes

Beyond the direct impacts of education, Canada's colleges and institutes also benefit the Canadian economy through the wide range of research they facilitate. With over 763 specialized research centres and labs, home to 2,500 faculty and staff, as well as over 31,000 students, these institutions do work that make Canadians' lives better in a variety of areas. With an enormous number of partnerships with businesses and organizations – over 6,000 in 2015 – the applied research these students and faculty pursue is not limited to the lab. In fact, over 10,000 of those students have received support to pursue an entrepreneurial idea.

Healthcare and Medical Technology

In Toronto, Centennial College has developed new technology that makes it easier for operating room nurses to track the vital signs of their patients. Working in partnership with OASYS Healthcare, Centennial's researchers have improved both hospital efficiency and patient outcomes.

Meanwhile, at Saskatoon's Saskatchewan Polytechnic, medical technology researchers are working with IRG Informatics, a Canadian tech company, to use 3D sensory modeling to help students learn to give needles. The new technology tracks and analyzes the nurses' body mechanics, then gives them physical feedback for a perfect simulation.

Communications and Information Technology

At today's biggest concerts, the light show is moving beyond the stage and onto concert-goers themselves with the help of wearable technology being pioneered by Quebec's Cégep, Andre-Laureneau. In partnership with Pixmob, they're developing interactive optics that allow a show's designers to create programmable displays that use the crowd as the screen. They even showed off their prototypes at the 2014 Winter Olympics in Sochi.

Closer to home, Ontario's Lambton College is developing Android control apps for smart energy monitoring and control devices manufactured by Liricco Technologies. Liricco's Valta product line enables users to remotely control their power usage and maximize efficiency. With the new Android control app from Lambton, Liricco is able to expand their potential user base by 400%.

Agriculture, Food, Forestry and Fisheries

As part of a large group that includes Columbia Science, BC Salmon Farmers Association, Mainstream Biological, Cermaq Canada, Grieg Seafood, and Marine Harvest Canada, Vancouver Island's North Island College is developing improved practices at the region's many salmon farms, developing more sustainable and ecologically-sound aquaculture practices. The college's research helped industry make sure its practices weren't damaging ocean floor environments, ensuring that the industry could continue to grow.

And, in what's possibly the most delicious research being done in Canada, Prince Edward Island's Holland College is hard at work creating new opportunities for the island province's cheese industry. The college's facilities make it possible to test possible cheeses and ingredients for both flavour and food safety, to make sure the province's crucial dairy industry can expand.

Finance data

Revenues

Table 1.1 shows the annual revenues of Canada's colleges and institutes by funding source—a total of $11 billion in FY 2014-15. As indicated, tuition and mandatory fees comprised 24% of total revenue, revenue from provincial grants and contracts 61%, revenue from federal grants and contracts 1%, and all other non-government revenue (i.e., sales, donations, and non-government grants and contracts) the remaining 14%. These data are critical in identifying annual costs of educating the student body from the perspectives of students and taxpayers.

Expenditures

The combined payroll of Canada's colleges and institutes amounted to $6.1 billion, equal to 56% of colleges and institutes' total expenses for FY 2014-15. Other expenditures, including capital and purchases of supplies and services, made up $4.7 billion. These budget data appear in Table 1.2.

Student profile data

Demographics

Canada's colleges and institutes served 1.2 million total students[3] in the FY 2014-15 reporting year, including funded, international, and other unfunded students. These students represented 732,874 full-time equivalents (FTEs). The breakdown of the student body by gender was 51% male, 48% female, and 1% unknown. The students' overall average age was 28. An estimated 94% of all students (domestic and international) remain in Canada after attending one of Canada's colleges and institutes, and the remaining 6% settle outside the country.[4]

3 Total student headcount includes only a portion of unfunded students due to data constraints. If all unfunded and non-credit students were included, then the total number of students Canada's colleges and institutes served would be substantially higher.

4 Based on data supplied by Canada's colleges and institutes.

TABLE 1.1: Revenue by source, FY 2014-15

FUNDING SOURCE	TOTAL	% OF TOTAL
Tuition and mandatory fees	$2,682,096,072	24%
Provincial grants and contracts	$6,689,115,483	61%
Federal grants and contracts	$142,986,705	1%
Other non-government revenue	$1,522,517,739	14%
Total revenues	**$11,036,715,999**	**100%**

Source: Data supplied by Canada's colleges and institutes.

TABLE 1.2: Expenses by function, FY 2014-15

EXPENSE ITEM	TOTAL	%
Employee payroll	$6,135,193,386	56%
Capital depreciation	$631,525,742	6%
All other expenditures	$4,099,900,537	38%
Total expenses	**$10,866,619,665**	**100%**

Source: Data supplied by Canada's colleges and institutes.

Achievements

Table 1.3, on the next page, summarizes the breakdown of the student population by credential type and the corresponding number of FTEs. FTEs are used to standardize actual course loads against normal course loads in order to combine full-time and part-time student counts. FTE data combined with the number of credentials issued are key to determining how far students advance in their education during the analysis year and the associated value of their achievements.

As indicated, Canada's colleges and institutes served 3,017 graduate and post-degree students, 65,966 bachelor's degree students, 517,183 diploma students, and 191,151 certificate students. Canada's colleges and institutes also served 4,357 university transfer students, 55,877 apprenticeship students, and 48,147 short certificate students (i.e., students enrolled in programs less than three months in length). Another 43,576 students pursued developmental credentials, such as a high school diploma or a certificate in English as a Second Language.

TABLE 1.3: Breakdown of student population by credential type, FY 2014-15

CATEGORY	UNDUPLICATED HEADCOUNT	FTES	AVERAGE FTES PER STUDENT	NUMBER OF CREDENTIALS ISSUED
Graduate and post degree*	3,017	1,689	0.6	832
Bachelor's degree	65,966	49,015	0.7	9,248
Diploma	517,183	437,909	0.8	144,306
Certificate	191,151	118,945	0.6	81,549
University transfer	4,357	3,088	0.7	N/A
Apprenticeship	55,877	25,557	0.5	13,278
Short certificate	48,147	5,684	0.1	11,415
Developmental	43,576	21,379	0.5	4,014
Personal enrichment	13,703	3,936	0.3	N/A
Other	227,214	65,673	0.3	1,058
Total, all students	**1,170,190**	**732,874**	**0.6**	**265,700**
Total, less personal enrichment	**1,156,487**	**728,938**	**0.6**	**265,700**

* Graduate and post degree includes master's degree students.

Source: Data supplied by Canada's colleges and institutes.

TABLE 1.4: Earnings, other income, and GDP by major industrial sector in Canada, FY 2014-15

INDUSTRY SECTOR	LABOUR INCOME (MILLIONS)	NON-LABOUR INCOME (MILLIONS)	TOTAL INCOME (MILLIONS)	% OF TOTAL
Agriculture, forestry, fishing and hunting	$6,053	$22,258	$28,311	1.9%
Mining, quarrying, and oil and gas extraction	$19,024	$116,427	$135,451	9.0%
Utilities	$10,744	$25,711	$36,455	2.4%
Construction	$49,598	$58,372	$107,970	7.2%
Manufacturing	$78,156	$93,633	$171,789	11.4%
Wholesale trade	$41,485	$43,541	$85,026	5.7%
Retail trade	$50,852	$33,233	$84,085	5.6%
Transportation and warehousing	$32,713	$36,105	$68,817	4.6%
Information and cultural industries	$19,129	$32,952	$52,081	3.5%
Finance and insurance	$38,603	$72,307	$110,910	7.4%
Real estate and rental and leasing	$11,192	$61,737	$72,929	4.9%
Professional, scientific, and technical services	$50,401	$40,412	$90,814	6.0%
Management of companies and enterprises	$6,591	$2,392	$8,983	0.6%
Administrative and support, waste management and remediation services	$28,896	$12,330	$41,225	2.7%
Educational services	$58,690	$27,745	$86,435	5.8%
Health care and social assistance	$72,197	$33,358	$105,555	7.0%
Arts, entertainment, and recreation	$7,245	$5,042	$12,287	0.8%
Accommodation and food services	$20,847	$11,138	$31,985	2.1%
Other services (except public administration)	$22,515	$16,520	$39,035	2.6%
Public administration	$68,690	$64,351	$133,041	8.9%
Total	**$693,620**	**$809,563**	**$1,503,184**	**100.0%**

* Data reflect the most recent year for which data are available. Emsi data are updated quarterly.

† Numbers may not add due to rounding.

Source: Derived from data supplied by Statistics Canada and the Emsi impact model.

A total of 13,703 students enrolled in personal enrichment programs or courses. In the analysis, we exclude personal enrichment students and their corresponding FTE production under the assumption that they do not attain workforce skills that will increase their lifetime earnings. All other students – including those enrolled in non-credential workforce and career-oriented courses – comprised the remaining 227,214 students.

Altogether, Canada's colleges and institutes issued 265,700 credentials during the analysis year. The total FTE production for the student population (excluding personal enrichment students) was 728,938 FTEs, for an overall average of 0.6 FTEs per student.

NATIONAL PROFILE DATA

Gross Domestic Product

Table 1.4, on the previous page, summarizes the breakdown of the Canadian economy by major industrial sector, with details on earnings, other income, and Gross Domestic Product (GDP). Earnings include the wages and salaries of employees (excluding self-proprietors), and other income includes operating surplus, mixed income, and taxes less subsidies on production, products and imports. Together earnings and other income make up the total GDP. In Chapter 2, we use GDP as the backdrop against which we measure the relative impacts of colleges and institutes on economic growth in Canada. As shown in Table 1.4, total GDP in Canada is approximately $1.5 trillion, equal to $693.6 billion in earnings plus $809.6 billion in other income.

Jobs by industry

Table 1.5 provides the breakdown of jobs by industry in Canada. The retail trade industry is the country's largest employer, supporting 2.06 million jobs or 11.6% of total employment. The second largest employer is the Health care and social assistance industry, supporting 1.93 million jobs or 10.9% of total employment. Altogether, the country supports 17.7 million jobs.[5]

TABLE 1.5: Jobs by major industrial sector in Canada, FY 2014-15

INDUSTRY SECTOR	TOTAL JOBS	% OF TOTAL
Agriculture, forestry, fishing and hunting	410,111	2.3%
Mining, quarrying, and oil and gas extraction	226,041	1.3%
Utilities	123,646	0.7%
Construction	1,238,530	7.0%
Manufacturing	1,584,854	9.0%
Wholesale trade	833,170	4.7%
Retail trade	2,058,597	11.6%
Transportation and warehousing	818,294	4.6%
Information and cultural industries	363,095	2.1%
Finance and insurance	764,180	4.3%
Real estate and rental and leasing	371,087	2.1%
Professional, scientific, and technical services	1,225,348	6.9%
Management of companies and enterprises	104,748	0.6%
Administrative and support, waste management and remediation services	912,163	5.2%
Educational services	1,221,100	6.9%
Health care and social assistance	1,926,510	10.9%
Arts, entertainment, and recreation	342,517	1.9%
Accommodation and food services	1,128,579	6.4%
Other services (except public administration)	863,062	4.9%
Public administration	1,156,971	6.5%
Total	**17,672,600**	**100.0%**

* Data reflect the most recent year for which data are available. Emsi data are updated quarterly.
† Numbers may not add due to rounding.
Source: Derived from data supplied by Statistics Canada and the Emsi impact model.

Earnings by education level

Table 1.6 and Figure 1.1, on the next page, present the average earnings by education level in Canada at the

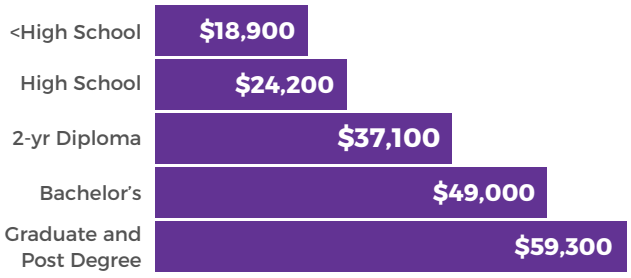
5 Job numbers reflect both wage and salary employees and self-employed workers.

TABLE 1.6: Expected earnings in Canada at midpoint of individual's working career by education level

EDUCATION LEVEL	INCOME
Less than high school	$18,900
High school or equivalent	$24,200
Two-year diploma	$37,100
Bachelor's degree	$49,000
Graduate and post degree	$59,300

* The earnings data represents median after-tax income for full year and part year, full-time and part-time workers, as well as those who received government assistance (such as employment insurance).
Source: Derived from data supplied by Statistics Canada and the Emsi impact model.

FIGURE 1.1: Expected income in Canada by education level at career midpoint



midpoint of the average-aged worker's career. These numbers are derived from data supplied by Statistics Canada and grown to reflect current year dollars.

As shown, students who achieve a two-year diploma can expect $37,100 in earnings per year, approximately $12,900 more than someone with a high school diploma. The difference between a high school diploma and the attainment of a bachelor's degree is even greater – up to $24,800 in higher income.

CONCLUSION

This chapter presents the broader elements of the database used to determine the results. Additional detail on data sources, assumptions, and general methods underlying the analyses are conveyed in the remaining chapters and appendices. The core of the findings is presented in the next two chapters— Chapter 2 considers the impact of Canada's colleges and institutes' on the national economy, and Chapter 3 looks at Canada's colleges and institutes as an investment. The appendices detail a collection of miscellaneous theory and data issues.

CHAPTER 2:

Economic Impact Analysis

Canada's colleges and institutes impact Canada in a variety of ways. As a primary source of education to residents, Canada's colleges and institutes supply trained workers to business and industry and contribute to associated increases in national output. Further, colleges and institutes attract monies to the country that would not have otherwise entered the economy through the expenditures of international students.

In this chapter we track the economic impacts of Canada's colleges and institutes under two headings: 1) the student productivity impact, comprising the added income created in the country as former domestic and international students of Canada's colleges and institutes expand the economy's stock of human capital, and 2) the international student spending impact, due to the spending of international students for tuition, room and board, and other personal expenses.

Economic impact analyses use different types of impacts to estimate the results. Frequently used is the sales impact, which comprises the change in business sales revenue in the economy as a result of increased economic activity. However, much of this sales revenue leaves the economy and overstates actual impacts. A more conservative measure – and the one employed in this study – is the **income impact**, which assesses the change in GDP. Income may be further broken out into the **labor income impact**, which assesses the change in employee compensation; and the **non-labor income impact**, which assesses the change in income business profits. Another way to state the income impact is **job equivalents**, a measure of the number of average-wage jobs that would be required to support the change in income. All of these measures – job equivalents, income with labor income and non-labor income detail, and sales – are used to estimate the economic impact results presented in this section.

The analysis breaks out the impact measures into different components, each based on the economic effect that caused the impact. The following is a list of each type of effect presented in this analysis:

- The **initial effect** is the exogenous shock to the economy caused by the initial spending of money, whether to pay for salaries and wages or to purchase goods or services.
- The initial round of spending creates more spending in the economy, resulting in what is commonly known as the **multiplier effect**. The multiplier effect comprises the additional activity that occurs across all industries in the economy and may be further decomposed into the following two types of effects:[6]
  - The **direct effect** refers to the additional economic activity that occurs as the industries affected by the initial effect spend money to purchase goods and services from their supply chain industries.
  - The **indirect effect** occurs as the supply chain of the initial industries creates even more activity in the economy through their own inter-industry spending.

6 Many regional models also include "induced effects" created by consumer spending. In national models, however, induced effects are generally regarded to overstate impacts and are thus excluded from the analysis.

Calculating multiplier effects requires the use of Emsi's Canadian Regional Input-Output (CRIO) model that captures the interconnection of industries, government, and households in the country. The Emsi CRIO model contains 304 industry sectors from the North American Industry Classification System (NAICS) and supplies the industry-specific multipliers required to determine the impacts associated with economic activity within Canada. For more information on the Emsi CRIO model and its data sources, see Appendix 5.

STUDENT PRODUCTIVITY IMPACT

Canada's colleges and institutes' greatest economic impact stems from the education, skills training, and career enhancement that they provide. Since they were established, colleges and institutes have supplied skills training to domestic and international students who have subsequently entered or re-entered the national workforce. As these skills accumulated, the stock of human capital in Canada expanded, boosting the competiveness of existing industries, attracting new industries, and generally enlarging overall output. The sum of all these several and varied effects, measured in terms of added national income, constitutes the total impact of current and past student productivity of Canada's colleges and institutes on the Canadian economy.

The initial effect of student productivity comprises two main components. The first and largest of these is the added earnings (i.e., wages and salaries) of former domestic and international students from Canada's colleges and institutes. Higher wages occur as the increased productivity of workers leads to greater business output. The reward to increased productivity does not stop there, however. Skilled workers make capital goods (e.g., buildings, production facilities, equipment, etc.) more productive too, thereby increasing the return on capital in the form of higher profits. The second component of the initial effect thus comprises the other (i.e., non-earnings) income generated by the businesses that employ former students of Canada's colleges and institutes.

The first step in estimating the initial effect of student productivity is to determine the added earnings that accrue to students. We begin by assembling the record of historical student headcounts (both credit and non-credit) over the past 30 years,[7] from FY 1985-86 to FY 2014-15. From this vector of historical headcounts, we remove the number of students not currently active in the national workforce, whether because they are still enrolled in education, or because they're unemployed, employed but working in a different country, or out of the workforce completely due to retirement or death. We estimate the historical employment patterns of students in the country using the following sets of data or assumptions: 1) a set of settling-in factors to determine how long it takes the average student to settle into a career;[8] 2) death, retirement, and unemployment rates from Statistics Canada; and 3) international migration data, provided by colleges and institutes.[9] The end result of these several computations is an estimate of the portion of students who were still actively employed in the country as of FY 2014-15. This number includes a portion of international students. Between domestic and international students, an estimated 94% of students remain in Canada after leaving colleges and institutes.

7 We apply a 30-year time horizon because the data on students who attended Canada's colleges and institutes prior to 1985-86 is less reliable, and because most of the students whom Canada's colleges and institutes served more than 30 years ago had left the national workforce by FY2014-15.

8 Settling-in factors are used to delay the onset of the benefits to students in order to allow time for them to find employment and settle into their careers. In the absence of hard data, we assume a range between one and three years for students who graduate with a credential, and between one and five years for continuing students. Workforce and professional development students are usually already employed while attending college, so they experience no delay in the onset of their benefits.

9 In the absence of data from colleges and institutes, Emsi provided an estimate based on student origin with the assumption that if a student originated from outside Canada, they were likely to return to their home country. This is a conservative assumption, however, given that international students who graduate from colleges and institutes have permanent immigration options allowing many to stay in Canada to work.

The next step is to transition from the number of students who were still employed in Canada to the number of skills they acquired from Canada's colleges and institutes. The students' course load, measured in terms of FTEs, serves as a reasonable proxy for accumulated skills. Table 1.3 in Chapter 1 provides the number of FTEs generated by the student population at Canada's colleges and institutes in FY 2014-15, equal to 728,938 FTEs (excluding the FTE production of personal enrichment students). This value we convert to credits by multiplying it by a factor of 30, the assumed number of credits per FTE.[10] The converted FTEs thus yield 21.9 million credits for the year.

The 21.9 million credits only represent the total credit production for the FY 2014-15 student population, however. What we need is an estimate of the historical credit production at Canada's colleges and institutes. To derive this, we determine the average number of credits per student during the analysis year – equal to 18.9 credits – and multiply this by the number of former students still active in the workforce during the analysis year. The end product – 383.8 million credits – appears in the top row of Table 2.1.

The next row in Table 2.1 shows the average value per credit, equal to $163. This value represents the average increase in wages that former students from Canada's colleges and institutes received during the analysis year for every credit they generated at colleges and institutes. The value per credit varies depending on the students' age, with the highest value applied to the credit production of students who had been employed the longest by FY 2014-15, and the lowest value per credit applied to students who were just entering the workforce. More information on the theory and calculations behind the value per credit appears in Appendix 6. In determining the amount of added earnings that accrue to former students, we multiply the credit production of colleges and institutes' former students in each year of the historical time horizon times the corresponding average value per credit for that year, then sum the products together. This calculation yields approximately $62.6 billion in gross higher wages received by former students in FY 2014-15 (as shown in Table 2.1).

TABLE 2.1: Number of credits still active in the workforce and added earnings created in the country

Number of credits in the workforce	383,818,301
Average value per credit	$163
Added earnings, gross	**$62,645,205,478**
Percent reduction for alternative education opportunities	10%
Added earnings, net	**$56,380,684,930**

Source: Emsi impact model.

The next row in the table shows an adjustment that we make to account for counterfactual outcomes. Counterfactual outcomes in economic analysis represent what would have happened if a given event had not happened. The event in this case is the training provided by Canada's colleges and institutes and subsequent influx of skilled labour into the national economy. The counterfactual scenario that we address is the adjustment for alternative education opportunities. Our assumption is that, if a portion of the students could have received training even if Canada's colleges and institutes and the other publicly-funded institutions in the country did not exist, the higher wages that accrue to those students cannot be counted as added earnings in Canada. The adjustment for alternative education opportunities amounts to a 10% reduction of the $62.6 billion in added earnings, meaning that 10% of the added earnings would have been generated in the country anyway, even if Canada's colleges and institutes did not exist. For more information on the calculation of the alternative education variable, see Appendix 7.

10 Converting FTEs to credits in this fashion allows us to break down the students' progression into a larger number of smaller increments. Institutions may have different methods for determining credit assignments; however, a general guideline is that since 1 week of full-time study earns 1 credit, and since there are 30 weeks in a typical academic year, then one FTE earns 30 credits.

The $56.4 billion in added earnings appears under the initial effect in the "Labour income" column of Table 2.2. Estimating the industry-specific effects on other income in the country – and the related multiplier effects – requires information on the specific industries where past students settle. While this information is not generally available, it is possible to build a sub-model that provides a plausible distribution of students across the 304 industry sectors of the CRIO model.

The sub-model relies on three assumptions. First, students with their newly acquired skills tend to locate in higher paying industries, so the sub-model weights industries according to their average wages, and directs more students to higher than to lower paying industries. Second, the larger an industry the greater the number of students it will attract, so the sub-model weights industries according to size, and directs more students to larger rather than smaller industries. Finally, students will be drawn to the more technically advanced industries, so the sub-model weights industries according to their technical advance, and directs more students to advanced, as opposed to less advanced, industries. This is done based on theory of economic development as a process of progressive stages outlined by Parr (1999).[11]

11 J.B. Parr, "Regional Economic Development: An Export Stages Framework," *Land Economics* 77, no. 1 (1999): 94–114.

Once students are distributed across the 304 industry sectors of the CRIO model, we multiply our estimate of the students' initial labour income effect ($56.4 billion) by the ratio of non-labour income to earnings provided by the CRIO model for each sector. This computation yields an estimated $60.9 billion in non-labour income attributable to former students of Canada's colleges and institutes. Summing initial labour income and non-labour income together provides the total initial income effect of student productivity in the Canadian economy, equal to approximately $117.2 billion.

The next few rows of Table 2.2 show the multiplier effects of student productivity. Multiplier effects occur as students generate an increased demand for consumer goods and services through the expenditure of their higher wages. Further, as the industries where students of Canada's colleges and institutes are employed increase their output, there is a corresponding increase in the demand for input from the industries in the employers' supply chain. Together, the incomes generated by the expansions in business input purchases and household spending constitute the multiplier effect of the increased productivity of former students of Canada's colleges and institutes.

To estimate multiplier effects, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from

TABLE 2.2: Student productivity impact, FY 2014-15

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Initial effect	**$56,380,685**	**$60,861,995**	**$117,242,679**	**$272,658,161**	**535**
MULTIPLIER EFFECT					
Direct effect	$19,740,216	$23,230,896	$42,971,111	$112,079,703	72
Indirect effect	$13,429,265	$15,878,272	$29,307,538	$75,585,101	12
Total multiplier effect	$33,169,481	$39,109,168	$72,278,649	$187,664,804	107
Total impact (initial + multiplier)	**$89,550,166**	**$99,971,163**	**$189,521,329**	**$460,322,964**	**192**
Net impact	**$35,401**	**$4,738**	**$40,139**	**$72,930**	**670**

Source: Emsi impact model.

the CRIO model. We then run the values through the CRIO model's multiplier matrix to determine the corresponding increases in industry output that occur in the country. Finally, we convert all increases in sales back to income using the income-to-sales ratios supplied by the CRIO model. The final results are $33.2 billion in labour income and $39.1 billion in non-labour income, for an overall total added income of $72.3 billion in multiplier effects. The grand total income impact of student productivity thus comes to $189.5 billion, the sum of all initial and multiplier effects. The total figures appear in the last row of Table 2.2.

INTERNATIONAL STUDENT SPENDING IMPACT

Canada's colleges and institutes served a total of 56,572 international students in FY 2014-15. These students spent money at businesses to purchase groceries, rent accommodation, pay for transportation, and so on. Not only do international students bring new money to the national economy to spend toward living expenses, but they also pay higher tuition and fees and purchase books and supplies. The expenditures of Canada's colleges and institutes' international students supported jobs and created new income in the national economy.

The international student spending impact differs from the student productivity impact in one fundamental way. Whereas the student productivity impact is the result of years of past instruction and the associated workforce accumulation of skills taught by Canada's colleges and institutes, the effects of international student spending depend on an annually-renewed injection of new sales in the national economy. Should Canada's colleges and institutes cease to exist, the international student spending impact would also immediately cease to exist; whereas the impact of colleges and institutes' former students would continue, as long as those students remained active in the workforce.

The average living expenses of international students appear in the first section of Table 2.3, equal to $33,829 per student per year.[12] Multiplying the $33,829 in annual costs by the number of international students generates gross sales of $1.9 billion.

TABLE 2.3: Average annual student cost of attendance and total sales generated by Canada's colleges and institutes' international students, FY 2014-15

Tuition and fees	$17,518
Books and supplies	$1,200
Room and board	$11,816
Personal expenses	$2,500
Transportation	$794
Total expenses per international student (A)	**$33,829**
Number of international students from Canada's colleges and institutes (B)	56,572
Gross sales generated by international students (A*B)	**$1,913,763,195**

* Numbers may not add due to rounding.
Source: Data on the cost of attendance and the number of international students estimated by Canada's colleges and institutes and Emsi.

Estimating the impacts generated by the $1.9 billion in international student spending begins with mapping the $1.9 billion in sales to the 304 industry sectors in the Emsi CRIO model. We do this by looking at the industries most affected by the spending of each category. For example, tuition and fees are spent by the international students at colleges and institutes. Therefore, we map the spending on tuition and fees to the Community Colleges and Cégep industry sector (NAICS 6112).

We now have five vectors detailing the spending of the international students. National spending is entered into the CRIO model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on national sales. We convert the sales figures to income using income-to-sales ratios, also provided by the CRIO model. Final results appear in the section labeled "Multiplier effect" in Table 2.4.

12 For data on the cost of attendance, see Roslyn Kunin and Associates: "Economic Impact of International Education in Canada - An Update." Report presented to the Department of Foreign Affairs and International Trade.

TABLE 2.4: International student spending impact, FY 2014-15

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Initial effect	**$0**	**$0**	**$0**	**$1,913,763**	**0**
MULTIPLIER EFFECT					
Direct effect	$688,453	$434,642	$1,123,096	$1,913,763	86
Indirect effect	$303,591	$218,629	$522,220	$1,057,353	9
Total multiplier effect	$992,045	$653,271	$1,645,316	$2,971,116	25
Total impact (initial + multiplier)	**$992,045**	**$653,271**	**$1,645,316**	**$4,884,879**	**119**
Total impact (initial + multiplier)	**$4,047**	**$3,009**	**$7,056**	**$40,115**	**119**

Source: Emsi impact model.

As seen in Table 2.4, the initial income effect is $0 because the income impact of international students only occurs when they spend part of their earnings to make a purchase at a local business. Otherwise, the students' earnings have no income impact on the national economy. The income impact of international student spending thus falls entirely under the multiplier effect, equal to a total of $1.6 billion in added national income. This value represents the direct added income created at the businesses patronized by the international students and the indirect added income created by the supply chain of those businesses.

SUMMARY OF ECONOMIC IMPACTS

Table 2.5 displays the grand total impact of Canada's colleges and institutes on Canada in FY 2014-15, including the student productivity impact and the international student spending impact. In total, colleges and institutes add $191.2 billion income to the national economy.

These results demonstrate several important points. First, Canada's colleges and institutes promote economic growth through the increase in productivity as former domestic and international students of Canada's colleges and institutes remain active in the national workforce, and through the spending of their international students. Second, the student productivity impact is by far the largest and most important impact of Canada's colleges and institutes, stemming from the higher earnings and other income of students and their employers. Third, income in Canada would be substantially lower without the educational activities of Canada's colleges and institutes.

TABLE 2.5: Total impacts of Canada's colleges and institutes, FY 2014-15

	LABOUR INCOME (THOUSANDS)	NON- LABOUR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)
Student productivity impact	$89,550,166	$99,971,163	$189,521,329	$460,322,964
International student spending impact	$992,045	$653,271	$1,645,316	$4,884,879
Total	**$90,542,211**	**$100,624,434**	**$191,166,644**	**$465,207,844**

Source: Emsi impact model.

CALCULATING JOB EQUIVALENTS BASED ON INCOME

In this study the impacts of Canada's colleges and institutes on the national economy are expressed in terms of income, specifically, the added income that would not have occurred in the country if colleges and institutes did not exist. Added income means that there is more money to spend, and increased spending means an increased demand for goods and services. Businesses hire more people to meet this demand, and thus jobs are created.

Not every job is the same, however. Some jobs pay more, others less. Some are full-time, others are part-time. Some jobs are year-round, others are temporary. Deciding what constitutes an actual job, therefore, is difficult to do. To address this problem, this study counts all jobs equally and reports them in terms of job equivalents, i.e., the number of average-wage jobs in the country that a given amount of income could potentially support. Job equivalents are calculated by dividing the added income created by colleges and institutes' students by the average earnings per worker in the country.

Based on the added income figures from Table 2.5, the job equivalents supported by the activities of Canada's colleges and institutes' students are as follows:

- Student productivity impact = **4,193,810** job equivalents
- International student spending impact = **36,408** job equivalents

Overall, the income created by Canada's colleges and institutes during the analysis year supports **4.2 million** average-wage jobs in the country.

CHAPTER 3:

Investment Analysis

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

In this chapter, we consider Canada's colleges and institutes as an investment from the perspectives of students, society, and taxpayers. The backdrop for the investment analysis for society and taxpayers is Canada.

STUDENT PERSPECTIVE

Analyzing the benefits and costs of education from the perspective of students is the most obvious—they give up time and money to go to college in return for a lifetime of higher earnings. The cost component of the analysis thus comprises the monies students pay (in the form of tuition and fees and forgone time and money), and the benefit component focuses on the extent to which the students' earnings increase as a result of their education.

Calculating student costs

Student costs consist of two main items: direct outlays and opportunity costs. Direct outlays include tuition and fees, equal to $2.7 billion from Table 1.1. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,200 each on books and supplies during the reporting year.[13] Multiplying this figure times the number of full-time equivalents (FTEs) produced by Canada's colleges and institutes in FY 2014-15 (see Table 1.3) generates a total cost of $874.7 million for books and supplies.

Opportunity cost is the most difficult component of student costs to estimate. It measures the value of time and earnings forgone by students who go to college rather than work. To calculate it, we need to know the difference between the students' full earning potential and what they actually earn while attending college.

We derive the students' full earning potential by weighting the average annual earnings in Table 1.6 according to the education level breakdown of the student population at the start of the analysis year.[14] The earnings in Table 1.6 reflect the midpoint of the average worker's career, however, not his or her earnings while attending college. Because of this, we adjust the earnings to the average age of the student population (28) to better reflect their earnings at their current age.[15]

13 See Roslyn Kunin and Associates, "Economic Impact of International Education in Canada - An Update," Report presented to the Department of Foreign Affairs and International Trade, revised May 2012.

14 To estimate the students' education level at the start of the analysis year, we first determine their education level at the end of the year (depending on the credentials they pursued), and then we move them backwards on the education ladder depending on their average course load.

15 We use the lifecycle earnings function identified by Jacob Mincer to scale the earnings levels to the students' current age. See Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," Journal of Political Economy 66, no. 4 (August 1958): 281–302. Further discussion on the Mincer function and its role in calculating the students' return on investment appears later in this chapter and in Appendix 6.

This calculation yields an average full earning potential of $19,296 per student.

In determining what students earn while attending college, an important factor to consider is the time that they actually spend at college, since this is the only time that they are required to give up a portion of their earnings. We use the students' FTE production as a proxy for time, under the assumption that the more FTEs students earn, the less time they have to work, and, consequently, the greater their forgone earnings. Overall, students attending Canada's colleges and institutes earned an average of 0.6 FTEs per student, which is equal to 63% of a full academic year. We thus include no more than $12,163 (or 63%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status while attending college. Canada's colleges and institutes estimate that 46% of their students are employed.[16] For the 54% who are not working, we assume that they are either seeking work or planning to seek work once they complete their educational goals (with the exception of personal enrichment students, who are not included in this calculation). By choosing to go to college, therefore, non-working students give up everything that they can potentially earn during the academic year (i.e., the $12,163). The total value of their forgone earnings thus comes to $8.3 billion.

Working students are able to maintain all or part of their earnings while enrolled. However, many of them hold jobs that pay less than statistical averages, usually because those are the only jobs they can find that accommodate their course schedule. To account for this, we assume that working students hold jobs that pay 69% of what they would have earned had they chosen to work full-time rather than go to college.[17] The remaining 31% comprises the percent of their full earning potential that they forgo. Obviously this assumption varies by person—some students forego more and others less. Without knowing the actual jobs that students hold while attending, however, the 31% in forgone earnings serves as a reasonable average.

Working students also give up a portion of their leisure time in order to go to school, and mainstream theory places a value on this.[18] The amount of leisure time that students forwent is approximately 1.9 hours per day.[19] Assuming that an hour of leisure is equal in value to an hour of work, we derive the total cost of leisure by multiplying the number of leisure hours foregone during the academic year by the average hourly pay of the

TABLE 3.1: Canada's colleges and institutes' student costs (thousands), FY 2014-15

DIRECT OUTLAYS	
Tuition and fees	$2,682,096
Books and supplies	$874,726
Less direct outlays personal enrichment students	-$5,499
Total direct outlays	**$3,551,323**
OPPORTUNITY COSTS	
Earnings forgone by non-working students	$8,283,652
Earnings forgone by working students	$1,843,997
Value of leisure time forgone by working students	$1,438,204
Total opportunity costs	**$11,565,853**
Total student costs	**$15,117,177**

Source: Based on data supplied by Canada's colleges and institutes and outputs of the Emsi impact model.

16 Based on the number of students who reported their employment status to Canada's colleges and institutes.

17 The 69% assumption is based on the difference in earnings between individuals in school and individuals not in school with a full-time job. See Statistics Canada, "Table 7: Average income by highest level of education attained, school/work status and gender," Statistics Canada Youth in Transition Survey, last modified July 2009, http://www.statcan.gc.ca/pub/81-595-m/2009075/tbl/tbl7-eng.htm.

18 See James M. Henderson and Richard E. Quandt, Microeconomic Theory: A Mathematical Approach (New York: McGraw-Hill Book Company, 1971).

19 Equal to the difference between the average number of leisure hours per day for students and the average number of leisure hours per day for non-students. See Human Resources and Skills Development Canada, "Leisure - Total Leisure Time," HRSDC Indicators of Well-being in Canada, http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=52 and Bureau of Labor Statistics, "Charts by Topic: Leisure and sports activities," BLS American Time Use Survey, last modified November 2012, http://www.bls.gov/TUS/CHARTS/LEISURE.HTM.

students' full earning potential. For working students, therefore, their total opportunity cost comes to $3.3 billion, equal to the sum of their foregone earnings ($1.8 billion) and forgone leisure time ($1.4 billion).

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to $3.6 billion, the sum of tuition and fees ($2.7 billion) and books and supplies ($874.7 million), less $5.5 million in direct outlays for personal enrichment students (these students are excluded from the cost calculations). Opportunity costs for all students amount to $11.6 billion. Summing all values together yields a total of $15.1 billion in student costs.

Linking education to earnings

Having estimated the costs of education to students, we weigh these costs against the benefits that students receive in return. The relationship between education and earnings is well documented and forms the basis for determining student benefits. As shown in Table 1.6, mean earnings levels at the midpoint of the average-aged worker's career increase as people achieve higher levels of education. The differences in earnings define the upper bound benefits of moving from one education level to the next.[20]

A key component in determining the students' return on investment is the value of their future benefits stream, i.e., what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to Canada's colleges and institutes' FY 2014-15 students first by determining their average annual increase in earnings, equal to $3.9 billion. This value represents the higher earnings that accrue to students at the midpoint of their careers and is calculated based on the marginal wage increases of the credits that students complete while attending college. For a full description of the methodology used to derive the $3.9 billion, see Appendix 6.

20 As discussed in Appendix 6, the upper bound benefits of education must be controlled for participant characteristics that also correlate with future wage increases, including inherent ability, socioeconomic status, and family background.

The second step is to project the $3.9 billion annual increase in earnings into the future, for as long as students remain in the workforce. We do this by applying a set of scalars derived from the slope of the earnings function developed by Jacob Mincer to predict the change in earnings at each age in an individual's working career.[21] Appendix 6 provides more information on the Mincer function and how it is used to predict future earnings growth. With the $3.9 billion representing the students' higher earnings at the midpoint of their careers, we apply scalars from the Mincer function to yield a stream of projected future benefits that gradually increase from the time students enter the workforce, come to a peak shortly after the career midpoint, and then dampen slightly as students approach retirement at age 65. This earnings stream appears in Column 2 of Table 3.2, on the next page.

The final step in calculating the students' future benefits stream is to net out potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.2 and represents the percentage of the total FY 2014-15 student population that will be employed in the workforce in a given year. Note that the percentages in the first five years of the time horizon are relatively lower than those in subsequent years. This is because many students delay their entry into the workforce, either because they continue to pursue their education or because they are unable to find a job immediately upon graduation. Accordingly, we apply a set of "settling-in" factors to account for the time needed by students to find employment and settle into their careers. As discussed in Chapter 2, settling-in factors delay the onset of the benefits by one to three years for students who graduate with a certificate or diploma, and by one to five years for continuing students. We apply no settling-in factors to the benefits for workforce students because the majority of them are employed while attending.

21 See Mincer, 1958.

TABLE 3.2: Projected benefits and costs, student perspective

YEAR	GROSS ADDED EARNINGS (MILLIONS)	LESS ADJUSTMENTS (MILLIONS)	NET ADDED EARNINGS (MILLIONS)	COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$2,452.6	29%	$704.3	$15,117.2	-$14,412.9
1	$2,547.5	41%	$1,052.1	$0.0	$1,052.1
2	$2,641.6	48%	$1,269.3	$0.0	$1,269.3
3	$2,734.6	59%	$1,608.7	$0.0	$1,608.7
4	$2,826.4	75%	$2,107.4	$0.0	$2,107.4
5	$2,916.5	93%	$2,713.1	$0.0	$2,713.1
6	$3,004.8	93%	$2,801.0	$0.0	$2,801.0
7	$3,090.8	93%	$2,886.2	$0.0	$2,886.2
8	$3,174.3	94%	$2,968.6	$0.0	$2,968.6
9	$3,255.0	94%	$3,047.7	$0.0	$3,047.7
10	$3,332.6	94%	$3,123.2	$0.0	$3,123.2
11	$3,406.9	94%	$3,194.8	$0.0	$3,194.8
12	$3,477.5	94%	$3,260.4	$0.0	$3,260.4
13	$3,544.2	94%	$3,321.8	$0.0	$3,321.8
14	$3,606.8	94%	$3,377.2	$0.0	$3,377.2
15	$3,665.0	94%	$3,427.8	$0.0	$3,427.8
16	$3,714.7	93%	$3,472.6	$0.0	$3,472.6
17	$3,763.6	93%	$3,503.8	$0.0	$3,503.8
18	$3,807.4	93%	$3,523.9	$0.0	$3,523.9
19	$3,846.0	91%	$3,518.3	$0.0	$3,518.3
20	$3,879.2	90%	$3,507.3	$0.0	$3,507.3
21	$3,907.0	89%	$3,489.6	$0.0	$3,489.6
22	$3,929.2	88%	$3,455.9	$0.0	$3,455.9
23	$3,936.4	86%	$3,404.7	$0.0	$3,404.7
24	$3,947.4	85%	$3,352.3	$0.0	$3,352.3
25	$3,945.0	84%	$3,303.8	$0.0	$3,303.8
26	$3,942.9	83%	$3,257.9	$0.0	$3,257.9
27	$3,936.7	81%	$3,174.6	$0.0	$3,174.6
28	$3,908.5	79%	$3,092.5	$0.0	$3,092.5
29	$3,850.8	71%	$2,727.9	$0.0	$2,727.9
30	$3,762.8	64%	$2,392.9	$0.0	$2,392.9
31	$3,632.3	58%	$2,099.6	$0.0	$2,099.6
32	$3,601.2	51%	$1,848.8	$0.0	$1,848.8
33	$3,533.5	41%	$1,436.9	$0.0	$1,436.9
34	$3,366.8	32%	$1,092.2	$0.0	$1,092.2
35	$3,239.3	25%	$808.7	$0.0	$808.7
36	$3,194.4	18%	$580.5	$0.0	$580.5
37	$3,149.7	13%	$401.8	$0.0	$401.8
38	$3,020.7	9%	$266.4	$0.0	$266.4
39	$2,834.7	6%	$168.4	$0.0	$168.4
40	$2,728.1	4%	$100.7	$0.0	$100.7
41	$1,132.2	5%	$53.1	$0.0	$53.1
42	$1,091.7	3%	$28.2	$0.0	$28.2
43	$1,051.3	1%	$13.4	$0.0	$13.4
44	$682.7	1%	$3.7	$0.0	$3.7
Present value of cash flows			**$57,888.8**	**$15,117.2**	**$42,771.6**
Benefit-cost ratio					3.8
Return on investment					2.8
Internal rate of return					16.1%
Payback period (no. of years)					8.0

* Includes the "settling-in" factors and attrition.

Source: Emsi college impact model.

Beyond the first five years of the time horizon, students will leave the workforce over time for any number of reasons, whether because of death, retirement, or unemployment. We estimate the rate of attrition using the same data and assumptions applied in the calculation of the attrition rate in the economic impact analysis of Chapter 2. The likelihood that students leave the workforce increases as they age, so the attrition rate is more aggressive near the end of the time horizon than in the beginning. Column 4 of Table 3.2 shows the net added earnings to students after accounting for both the settling-in patterns and attrition.

Return on investment to students

Having estimated the students' costs and their future benefits stream, the next step is to discount the results to the present to reflect the time value of money. For the student perspective we assume a discount rate of 3.3%[22] (see the "Discount Rate" box). The present value of the benefits is then compared to student costs to derive the investment analysis results, expressed in terms of a benefit-cost ratio, return on investment, rate of return, and payback period. The investment is feasible if returns match or exceed the minimum threshold values, i.e., a benefit-cost ratio greater than 1, a return on investment greater than 0, a rate of return that exceeds the discount rate, and a reasonably short payback period.

In Table 3.2, the higher earnings of Canada's colleges and institutes' students are projected across their working lives by applying the Mincer curve, adjusted to account for students who are not active in the workforce and discounted to the present. This yields a cumulative sum of approximately $57.9 billion, the present value of all of the future earnings increments (see Column 4 of Table 3.2). This may also be interpreted as the gross capital asset value of the students' higher earnings stream.

22 We use student loan rates to approximate the students' discount rate. Floating interest rates for Canada student loans are 2.5% plus the prime rate. See Government of Canada, "Interest Rates for Canada Student Loans," Student Loans & Grants. The prime rate – equal to 0.77% - is drawn from Bank of Canada, "Canadian interest rates and monetary policy variables: 10-year lookup," Bank of Canada Rates & Statistics. We thus have a student discount rate of 2.5% + 0.77% = 3.27%.

DISCOUNT RATE

The discount rate is a rate of interest that converts future costs and benefits to present values. For example, $1,000 in higher earnings realized 30 years in the future is worth much less than $1,000 in the present. All future values must therefore be expressed in present value terms in order to compare them with investments (i.e., costs) made today. The selection of an appropriate discount rate, however, can become an arbitrary and controversial undertaking. As suggested in economic theory, the discount rate should reflect the investor's opportunity cost of capital, i.e., the rate of return one could reasonably expect to obtain from alternative investment schemes. In this study we assume a 4.5% discount rate from the student perspective and a 1.4% discount rate from the perspective of taxpayers and society.

In effect, the aggregate FY 2014-15 student body is rewarded for their investment in Canada's colleges and institutes with a capital asset valued at $57.9 billion.

The students' cost of attending Canada's colleges and institutes is shown in Column 5 of Table 3.2, equal to a present value of $15.1 billion. Note that costs only occur in the single analysis year and are thus already in current year dollars. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of 3.8 (equal to $57.9 billion in benefits divided by $15.1 billion in costs).

The return on investment – or frequently referred to as "ROI" – is similar to the benefit-cost ratio except that the numerator used in the calculation is the net present value of the benefits, as opposed to the present value. This removes the cost of the investment from the numerator in order to derive the net return, i.e., the amount that investors receive over and above each dollar of their original investment. ROI can also be derived simply by subtracting 1 from the benefit-cost ratio. A positive ROI means that the investment is profitable. In the case of Canada's colleges and institutes' students, an ROI of 2.8 means that the

students receive an additional $2.80 in present value terms for every dollar they invest in colleges and institutes.

Another way to compare the same benefits stream and associated cost is to compute the internal rate of return. The internal rate of return indicates the interest rate that a bank would have to pay a depositor to yield an equally attractive stream of future payments.[23] Table 3.2 shows students of Canada's colleges and institutes earning average returns of 16.1% on their investment of time and money. This is a favourable return compared, for example, to approximately 1% on a standard bank savings account, or 7% on stocks and bonds (thirty-year average return).

Note that returns reported in this study are real returns, not nominal. When a bank promises to pay a certain rate of interest on a savings account, it employs an implicitly nominal rate. Bonds operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, then money is lost in real terms. In contrast, a real rate of return is on top of inflation. For example, if inflation is running at 3% and a nominal percentage of 5% is paid, then the real rate of return on the investment is only 2%. In Table 3.2, the 16.1% student rate of return is a real rate. With an inflation rate of 1.9% (the average rate reported over the past 20 years as per the Statistics Canada, Consumer Price Index), the corresponding nominal rate of return is 17.9%, higher than what is reported in Table 3.2.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[24] Beyond that point, returns are what economists would call "pure costless rent." As indicated in Table 3.2, students at Canada's colleges and institutes see, on average, a payback period of 8.0 years on their forgone earnings and out-of-pocket costs.

SOCIAL PERSPECTIVE

Society as a whole in Canada benefits from the education that Canada's colleges and institutes provide through the earnings that students create in the country and through the savings that they generate through their improved lifestyles. To receive these benefits, however, members of society must pay money and forgo services that they would have otherwise enjoyed if Canada's colleges and institutes did not exist. Society's investment in Canada's colleges and institutes stretches across a number of investor groups, from students to employers to taxpayers. From the social perspective, therefore, we weigh the benefits generated by Canada's colleges and institutes to society against the total social costs of generating those benefits. The total social costs include all institutional expenditures (payroll, capital expenditures, etc.) from Canada's colleges and institutes, all student expenditures, and all student opportunity costs. The social costs come to a total of $23.3 billion.

On the benefits side, any benefits that accrue to society as a whole – including students, employers, taxpayers, and anyone else who stands to benefit from the activities of Canada's colleges and institutes – are counted as benefits under the social perspective. We group these benefits under the following broad headings: 1) increased earnings in the country, and 2) social externalities stemming from improved health, reduced crime, and reduced unemployment in the country (see the "Beekeeper Analogy" box, on the next page, for a discussion of externalities). Both of these benefits components are described more fully in the following sections.

23 Note that, with a bank deposit or stock market investment, the depositor puts up a principal, receives in return a stream of periodic payments, and then recovers the principal at the end. An education investor, on the other hand, receives a stream of periodic payments that include the recovery of the principal as part of the periodic payments, but there is no principal recovery at the end. These differences notwithstanding, comparable cash flows for both bank and education investors yield the same internal rate of return.

24 Payback analysis is generally used by the business community to rank alternative investments when safety of investments is an issue. Its greatest drawback is that it takes no account of the time value of money. The payback period is calculated by dividing the cost of the investment by the net return per period. In this study, the cost of the investment includes tuition and fees plus the opportunity cost of time – it does not take into account student living expenses or interest on loans.

BEEKEEPER ANALOGY

Beekeepers provide a classic example of positive externalities (sometimes called "neighborhood effects"). The beekeeper's intention is to make money selling honey. Like any other business, receipts must at least cover operating costs. If they don't, the business shuts down.

But from society's standpoint there is more. Flowers provide the nectar that 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.

Educational institutions are like beekeepers. While their principal aim is to provide education and raise people's earnings, in the process an array of external benefits are created. Students' health and lifestyles are improved, and society indirectly benefits just as orchard owners indirectly benefit from beekeepers. Aiming at a more complete accounting of the benefits generated by education, the model tracks and accounts for many of these external social benefits.

Earnings growth in Canada

In the process of absorbing the newly-acquired skills of colleges and institutes' students, not only does the productivity of Canada's workforce increase, but so does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending colleges and institutes, and businesses earn more because student skills make capital more productive (i.e., buildings, machinery, and everything else). This in turn raises profits and other business property income. Together, increases in earnings and other income are considered the effect of a skilled workforce.

Estimating the effect of Canada's colleges and institutes on earnings growth in the country begins with the present value of the students' future earnings stream, which is displayed in Column 4 of Table 3.2. As earnings increase, so do other forms of income in the country, including monies gained through investments. To calculate the growth in other income, we multiply the increase in earnings by a ratio of Canada's GDP to total national earnings. Note that we do not include multiplier effects in accordance with best practices.

The sum of the students' higher earnings, multiplier effects, and increases in other income comprises the gross higher earnings that accrue to society as a whole in Canada. Not all of this may be counted as benefits to Canada, however. Some students leave during the course of their careers, and the higher earnings they receive as a result of their education leaves Canada with them. To account for this dynamic, we use estimates provided by colleges and institutes on the number of students who leave Canada upon exiting colleges and institutes.[25]

We apply another reduction factor to account for the students' alternative education opportunities. This is the same adjustment that we use in the calculation of the student productivity impact in Chapter 2 and is designed to account for the counterfactual scenario where Canada's colleges and institutes do not exist. The assumption in this case is that any benefits generated by students who could have received an education even without Canada's colleges and institutes cannot be counted as new benefits to society.[26] For this analysis, we estimate an alternative education variable of 10%, meaning that 10% of the student population at Canada's colleges and institutes would have generated benefits

25 In the absence of data from colleges and institutes, Emsi provided an estimate based on student origin with the assumption that if a student originated from outside Canada, they were likely to return to their home country. This is a conservative assumption, however, given that international students who graduate from colleges and institutes have permanent immigration options allowing many to stay in Canada to work.

26 A situation in which there were no public institutions in the country is virtually impossible. The adjustment is entirely hypothetical and is used merely to examine Canada's colleges and institutes in standard investment analysis terms by accounting for benefits that would have occurred anyway, even if the colleges and institutes did not exist.

anyway even without colleges and institutes. For more information on the calculation of the alternative education variable, see Appendix 7.

After adjusting for attrition and alternative education opportunities, we calculate the present value of the future higher earnings that occur in the country, equal to $122.5 billion (this value appears again later in this chapter in Table 3.3). Recall from the discussion of the student return on investment that the present value represents the sum of the future benefits that accrue each year over the course of the time horizon, discounted to current year dollars to account for the time value of money. The discount rate in this case is 1.8%, the real treasury interest rate recommended by the Bank of Canada for long-term investments.[27]

Social savings

In addition to the creation of higher earnings in the country, education is statistically associated with a variety of lifestyle changes that generate social savings, also known as external or incidental benefits of education. These represent the avoided costs that would have otherwise been drawn from private and public resources absent the education provided by Canada's colleges and institutes. Social benefits appear in Table 3.5 and break down into three main categories: 1) health savings, 2) crime savings, and 3) income assistance savings. Health savings include avoided medical costs, lost productivity, and other effects associated with smoking, alcoholism, obesity, and mental illness. Crime savings consist of avoided costs to the justice system (i.e., police protection, judicial and legal, and corrections), avoided victim costs, and benefits stemming from the added productivity of individuals who would have otherwise been incarcerated. Income assistance savings comprise avoided costs due to the reduced number of claims for employment insurance and other forms of employment-related social assistance.

27 Bank of Canada, "Government of Canada benchmark bond yields - long-term," Bank of Canada Selected Bond Yields, http://www.bankofcanada.ca/rates/interest-rates/canadian-bonds.

The model quantifies the social savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim income assistance. Deriving the probabilities involves assembling data from a variety of studies and surveys analyzing the correlation between education and health, crime, and income assistance at the national level. We spread the probabilities across the education ladder and multiply the marginal differences by the number of students who achieved credits at each step. The sum of these marginal differences counts as the upper bound measure of the number of students who, due to the education they received at Canada's colleges and institutes, will not have poor health, commit crimes,

TABLE 3.3: Present value of the future higher earnings and social savings in the country (thousands)

Higher earnings	**$122,507,397**
SOCIAL SAVINGS	
Health	
Smoking	$1,353,396
Alcoholism	$331,644
Obesity	$241,686
Mental illness	$248,491
Total health savings	**$2,175,218**
Crime	
Criminal Justice System savings	$19,797
Crime victim savings	$38,196
Added productivity	$8,214
Total crime savings	**$66,208**
Income assistance	
Employment insurance savings	$133,373
Employment-related social assistance savings	$68,058
Total income assistance savings	**$201,431**
Total social savings	**$2,442,857**
Total, higher earnings + social savings	**$124,950,254**

Source: Emsi impact model.

or claim income assistance. We dampen these results by the "ability bias" adjustment discussed earlier in this chapter and in Appendix 6 to account for other factors besides education that influence individual behaviour. We then multiply the marginal effects of education times the associated costs of health, crime, and income assistance.[28] Finally, we apply the same adjustments for attrition and alternative education to derive the net savings to society.

Table 3.3 displays the results of the analysis. The first row shows the higher earnings created in Canada, equal to $122.5 billion. Social savings appear next, beginning with a breakdown of savings related to health. These savings amount to a present value of $2.2 billion, including savings due to a reduced demand for medical treatment and social services, improved worker productivity and reduced absenteeism, and a reduced number of vehicle crashes and fires induced by alcohol or smoking-related incidents. Crime savings sum to $66.2 million, including savings associated with a reduced number of crime victims, added worker productivity, and reduced expenditures for police and law enforcement, courts and administration of justice, and corrective services. Finally, the present value of the savings related to income assistance amount to $201.4 million, stemming from a reduced number of persons in need of employment insurance and employment-related social assistance. All told, social savings amounted to $2.4 billion in benefits to society as a whole in Canada.

The sum of the social savings and the higher earnings in the country is $125 billion, as shown in the bottom row of Table 3.3. These accrue for years out into the future, for as long as colleges and institutes' FY 2014-15 students remain in the workforce.

Benefit-cost ratio to society

The $125 billion in present value benefits re-appears at the bottom of Column 2 in Table 3.4, on the next page,.

28 For a full list of the data sources used to calculate the social externalities, see the Resources and References section. See also Appendix 9 for a more in-depth description of the methodology.

The social cost of generating those benefits is listed in the next column, equal to $23.3 billion. Comparing the present value of the benefits and the social costs, we have a benefit-cost ratio of 5.4. This means that for every dollar invested in an education from Canada's colleges and institutes, whether it is the money spent on day-to-day operations of the college or money spent by students on tuition and fees, an average of $5.40 in benefits will accrue to society in Canada. Note that, unlike streams of benefits that go on into the future, the amount colleges and institutes spent of $23.3 billion was made in the single reporting year. The present value and nominal dollar value are thus the same.

Recall that the benefit-cost ratio reflects the measure of all benefits generated regardless of to whom they accrue. Students are the beneficiaries of higher earnings, employers are beneficiaries of lower absenteeism and increased worker productivity, still others are beneficiaries of improved health, and so on. These are widely-dispersed benefits that do not necessarily return to those funding colleges and institutes' expenditures. Inasmuch as investors and beneficiaries are not the same individuals, measures common to standard investment analyses such as return on investment, internal rate of return, and payback period no longer apply. From the social perspective, therefore, the benefit-cost ratio should be viewed strictly as a comparison between public benefits and funding support costs.

TAXPAYER PERSPECTIVE

From the taxpayer perspective, the pivotal step here is to limit overall public benefits shown in Tables 3.3 and 3.4 to those that specifically accrue to the provincial and federal government. For example, benefits resulting from earnings growth are limited to increased tax payments. Similarly, savings related to improved health, reduced crime, and fewer income assistance claims are limited to those received strictly by the provincial and federal government. In all instances, benefits to private residents or domestic businesses are excluded.

TABLE 3.4: Projected benefits and costs, taxpayer perspective

YEAR	BENEFITS TO SOCIETY (MILLIONS)	GOVERNMENT COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$1,289.6	$23,301.7	-$22,012.1
1	$1,810.7	$0.0	$1,810.7
2	$2,180.6	$0.0	$2,180.6
3	$2,757.5	$0.0	$2,757.5
4	$3,604.2	$0.0	$3,604.2
5	$4,631.5	$0.0	$4,631.5
6	$4,778.4	$0.0	$4,778.4
7	$4,921.0	$0.0	$4,921.0
8	$5,058.8	$0.0	$5,058.8
9	$5,191.2	$0.0	$5,191.2
10	$5,317.5	$0.0	$5,317.5
11	$5,437.4	$0.0	$5,437.4
12	$5,547.1	$0.0	$5,547.1
13	$5,649.8	$0.0	$5,649.8
14	$5,742.4	$0.0	$5,742.4
15	$5,827.0	$0.0	$5,827.0
16	$5,901.9	$0.0	$5,901.9
17	$5,954.8	$0.0	$5,954.8
18	$5,988.4	$0.0	$5,988.4
19	$5,978.3	$0.0	$5,978.3
20	$5,959.0	$0.0	$5,959.0
21	$5,927.8	$0.0	$5,927.8
22	$5,871.7	$0.0	$5,871.7
23	$5,786.6	$0.0	$5,786.6
24	$5,699.5	$0.0	$5,699.5
25	$5,618.9	$0.0	$5,618.9
26	$5,542.5	$0.0	$5,542.5
27	$5,402.7	$0.0	$5,402.7
28	$5,265.4	$0.0	$5,265.4
29	$4,660.3	$0.0	$4,660.3
30	$4,104.1	$0.0	$4,104.1
31	$3,616.4	$0.0	$3,616.4
32	$3,199.2	$0.0	$3,199.2
33	$2,490.8	$0.0	$2,490.8
34	$1,897.5	$0.0	$1,897.5
35	$1,408.4	$0.0	$1,408.4
36	$1,013.8	$0.0	$1,013.8
37	$703.9	$0.0	$703.9
38	$468.1	$0.0	$468.1
39	$296.9	$0.0	$296.9
40	$178.1	$0.0	$178.1
41	$94.5	$0.0	$94.5
42	$50.2	$0.0	$50.2
43	$23.9	$0.0	$23.9
44	$6.7	$0.0	$6.7
Net present value	**$124,950.3**	**$23,301.7**	**$101,648.6**
Benefit-cost ratio			5.4

Source: Emsi impact model.

Benefits to taxpayers

Table 3.5 displays the present value of the benefits to taxpayers. Added tax revenue appears in the first row. These figures are derived by multiplying the earnings growth figures from Table 3.3 by the prevailing tax rates in Canada. For the social externalities, we claim only the benefits that reduce the demand for government-supported social services, or the government benefits resulting from improved productivity among government employees. The present value of future tax revenues and government savings thus comes to approximately $20.6 billion.

TABLE 3.5: Present value of added tax revenue and government savings (thousands)

Added tax revenue	$19,685,375
GOVERNMENT SAVINGS	
Health-related savings	$737,314
Crime-related savings	$21,439
Income assistance savings	$201,431
Total government savings	**$960,184**
Total government benefits	**$20,645,559**

Source: Emsi impact model.

Return on investment

Provincial and federal government costs are reported in Table 3.6, on the next page, and come to $6.8 billion, equal to the annual contribution of provincial and federal government support to Canada's colleges and institutes. In return for their public support, therefore, taxpayers are rewarded with an investment benefit-cost ratio of 3.0 (= $20.6 billion ÷ $6.8 billion). The return on investment is 2.0, indicating a profitable investment.

At 10.5%, the rate of return to taxpayers is also favourable. As above, we assume a 1.8% discount rate when dealing with government investments and public finance issues. This is the return governments are assumed to be able to earn on generally safe investments of unused funds, or alternatively, the interest rate for which governments, as relatively safe borrowers, can obtain funds. A rate of return of 1.8% would mean that colleges and institutes just pay their own way. In principle, governments could borrow monies used to support Canada's colleges and institutes and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 10.5%, on the other hand, means that Canada's colleges and institutes not only pay their own way, but also generate a surplus that the provincial and federal government can use to fund other programs. It is unlikely that other government programs could make such a claim.

With and without social savings

Earlier in this chapter, social benefits attributable to education (reduced crime, fewer income assistance claims, and improved health) were defined as externalities that are incidental to the operations of colleges and institutes. Some would question the legitimacy of including these benefits in the calculation of rates of return to education, arguing that only the tangible benefits, i.e., higher earnings, should be counted. Tables 3.4 and 3.6 are inclusive of social benefits reported as attributable to Canada's colleges and institutes. Recognizing the other point of view, Table 3.7 shows the results for both the social and taxpayer perspectives exclusive of social benefits. As indicated, returns are still above threshold values (a benefit-cost ratio greater than 1.0, a return on investment greater than 0, and a rate of return greater than 1.8%), confirming that society and taxpayers receive value from investing in Canada's colleges and institutes.

TABLE 3.6: Projected benefits and costs, social perspective

YEAR	BENEFITS TO SOCIETY (MILLIONS)	SOCIAL COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$215.8	$6,832.1	-$6,616.3
1	$302.5	$0.0	$302.5
2	$363.8	$0.0	$363.8
3	$459.4	$0.0	$459.4
4	$599.7	$0.0	$599.7
5	$769.6	$0.0	$769.6
6	$793.3	$0.0	$793.3
7	$816.3	$0.0	$816.3
8	$838.5	$0.0	$838.5
9	$859.8	$0.0	$859.8
10	$880.1	$0.0	$880.1
11	$899.4	$0.0	$899.4
12	$917.0	$0.0	$917.0
13	$933.5	$0.0	$933.5
14	$948.4	$0.0	$948.4
15	$961.9	$0.0	$961.9
16	$974.0	$0.0	$974.0
17	$982.3	$0.0	$982.3
18	$987.6	$0.0	$987.6
19	$985.6	$0.0	$985.6
20	$982.1	$0.0	$982.1
21	$976.7	$0.0	$976.7
22	$967.3	$0.0	$967.3
23	$953.1	$0.0	$953.1
24	$938.6	$0.0	$938.6
25	$925.2	$0.0	$925.2
26	$912.5	$0.0	$912.5
27	$889.4	$0.0	$889.4
28	$866.7	$0.0	$866.7
29	$767.0	$0.0	$767.0
30	$675.4	$0.0	$675.4
31	$595.1	$0.0	$595.1
32	$526.4	$0.0	$526.4
33	$409.8	$0.0	$409.8
34	$312.2	$0.0	$312.2
35	$231.7	$0.0	$231.7
36	$166.8	$0.0	$166.8
37	$115.8	$0.0	$115.8
38	$77.0	$0.0	$77.0
39	$48.8	$0.0	$48.8
40	$29.3	$0.0	$29.3
41	$15.4	$0.0	$15.4
42	$8.3	$0.0	$8.3
43	$3.9	$0.0	$3.9
44	$1.1	$0.0	$1.1
Net present value	**$20,645.6**	**$6,832.1**	**$13,813.5**
Benefit-cost ratio			3.0
Return on investment			2.0
Internal rate of return			10.5%
Payback period (no. of years)			10.9

Source: Emsi college impact model.

CONCLUSION

This chapter has shown that Canada's colleges and institutes are an attractive investment to their major stakeholders – students, society, and taxpayers. Rates of return to students invariably exceed alternative investment opportunities. At the same time, taxpayers can take comfort in knowing that their expenditure of funds creates a wide range of positive social benefits and, perhaps more importantly, actually returns more to government budgets than it costs. Without these increased tax receipts and public sector savings provided by the educational activities of Canada's colleges and institutes and their students, the provincial and federal government would have to raise taxes to make up for lost revenues and added costs.

TABLE 3.7: Taxpayer and social perspectives with and without social savings

	INCLUDING SOCIAL SAVINGS (THOUSANDS)	EXCLUDING SOCIAL SAVINGS (THOUSANDS)
SOCIAL PERSPECTIVE		
Net present value	$101,648,554	$99,205,697
Benefit-cost ratio	5.4	5.3
TAXPAYER PERSPECTIVE		
Net present value	$13,813,457	$12,802,204
Benefit-cost ratio	3.0	2.9
Return on investment	2.0	1.9
Internal rate of return	10.5%	10.0%
Payback period (no. of years)	10.9	11.4

Source: Emsi impact model.

CHAPTER 4:

Sensitivity Analysis

Sensitivity analysis is the process by which researchers determine how sensitive the outputs of the model are to variations in the background data and assumptions, especially if there is any uncertainty in the variables. Sensitivity analysis is also useful for identifying a plausible range wherein the results will fall should any of the variables deviate from expectations. In this chapter we test the sensitivity of the model to the following input factors: 1) the alternative education variable, 2) the student employment variables, and 3) the discount rate.

ALTERNATIVE EDUCATION VARIABLE

The alternative education variable (10%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent the publicly-funded training providers in Canada. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the social and taxpayer investment analysis results to its magnitude. Variations in the alternative education assumption are calculated around base case results listed in the middle column of Table 4.1. Next, the model brackets the base case assumption on either side with a plus or minus 10%, 25%, and 50% variation in assumptions. Analyses are then redone introducing one change at a time, holding all other variables constant. For example, an increase of 10% in the alternative education assumption (from 10% to 11%) reduces the taxpayer perspective rate of return from 10.5% to 10.4%. Likewise, a decrease of 10% (from 10% to 9%) in the assumption increases the rate of return from 10.5% to 10.6%.

TABLE 4.1: Sensitivity analysis of alternative education variable, taxpayer and social perspective

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
Alternative education variable	5%	8%	9%	**10%**	11%	13%	15%
SOCIAL PERSPECTIVE							
Net present value (millions)	$121,402	$111,038	$105,294	**$101,649**	$98,142	$93,128	$85,383
Benefit-cost ratio	6.2	5.8	5.5	**5.4**	5.2	5.0	4.7
Return on investment	5.2	4.8	4.5	**4.4**	4.2	4.0	3.7
TAXPAYER PERSPECTIVE							
Net present value (millions)	$14,960	$14,387	$14,043	**$13,813**	$13,584	$13,240	$12,666
Benefit-cost ratio	3.2	3.1	3.1	**3.0**	3.0	2.9	2.9
Return on investment	2.2	2.1	2.1	2.0	2.0	1.9	1.9
Rate of return	11.1%	10.8%	10.6%	10.5%	10.4%	10.2%	9.9%

Based on this sensitivity analysis, the conclusion can be drawn that Canada's colleges and institutes investment analysis results from the social and taxpayer perspectives are not very sensitive to relatively large variations in the alternative education variable. As indicated, results are still 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 1.8%), even when the alternative education assumption is increased by as much as 50% (from 10% to 15%). The conclusion is that although the assumption is difficult to specify, the impact on overall investment analysis results for the taxpayer perspective is not very sensitive.

STUDENT EMPLOYMENT VARIABLES

Student employment variables are difficult to estimate because many students do not report their employment status or because colleges generally do not collect this kind of information. Employment variables include the following: 1) the percentage of students that are employed while attending one of the colleges or institutes, and 2) the percentage of earnings that working students receive relative to the earnings they would have received had they not chosen to attend one of the colleges or institutes. Both employment variables affect the investment analysis results from the student perspective.

Students incur substantial expense by attending Canada's colleges and institutes because of the time they spend not gainfully employed. Some of that cost is recaptured if students remain partially (or fully) employed while attending. It is estimated that 46% of students who reported their employment status are employed, based on data provided by Canada's colleges and institutes. This variable is tested in the sensitivity analysis by changing it first to 100% and then to 0%.

The second student employment variable is more difficult to estimate. In this study we estimate that students that are working while attending college earn only 69%, on average, of the earnings that they would have statistically received if not attending Canada's colleges and institutes. This suggests that many students hold jobs that accommodate their college attendance, though it is at an additional cost in terms of receiving a wage that is less than what they might otherwise make. The model captures this difference in wages and counts it as part of the opportunity cost of time. As above, the 69% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

The changes generate results summarized in Table 4.2, with "A" defined as the percent of students employed and "B" defined as the percent that students earn relative to their full earning potential. Base case results appear in the shaded row – here the assumptions remain unchanged, with A equal to 46% and B equal to 69%. Sensitivity analysis results are shown in non-shaded

TABLE 4.2: Sensitivity analysis of student employment variables

VARIATIONS IN ASSUMPTIONS	NET PRESENT VALUE (MILLIONS)	BENEFIT-COST RATIO	RETURN ON INVESTMENT	INTERNAL RATE OF RETURN
Base case: A = 46%, B = 69%	**$42,772**	**3.8**	**2.8**	**16.1%**
Scenario 1: A = 100%, B = 69%	$46,493	5.1	4.1	20.4%
Scenario 2: A = 46%, B = 100%	$44,616	4.4	3.4	18.0%
Scenario 3: A = 100%, B = 100%	$50,900	8.3	7.3	30.7%
Scenario 4: A = 0%, B = 0%	$40,094	3.3	2.3	13.9%

Note: A = percent of students employed; B = percent earned relative to statistical averages

rows. Scenario 1 increases A to 100% while holding B constant, Scenario 2 increases B to 100% while holding A constant, Scenario 3 increases both A and B to 100%, and Scenario 4 decreases both A and B to 0%.

1. **Scenario 1:** Increasing the percent of students employed (A) from 46% to 100%, the net present value, benefit-cost ratio, return on investment, and internal rate of return improve to $46.5 billion, 5.1, 4.1, and 20.4%, respectively, relative to base case results. Improved results are attributable to a lower opportunity cost of time – all students are employed in this case.

2. **Scenario 2:** Increasing earnings relative to statistical averages (B) from 69% to 100%, the net present value, benefit-cost ratio, return on investment, and internal rate of return improve to $44.6 billion, 4.4, 3.4, and 18.0%, respectively, relative to base case results – a strong improvement, again attributable to a lower opportunity cost of time.

3. **Scenario 3:** Increasing both assumptions A and B to 100% simultaneously, the net present value, benefit-cost ratio, return on investment, and internal rate of return improve yet further to $50.9 billion, 8.3, 7.3 and 30.7%, respectively, relative to base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to statistical averages) while attending classes.

4. **Scenario 4:** Finally, decreasing both A and B to 0% reduces the net present value, benefit-cost ratio, return on investment, and internal rate of return to $40.1 billion, 3.3, 2.3, and 13.9%, respectively, relative to base case results. These results are reflective of an increased opportunity cost – none of the students are employed in this case.[29]

It is strongly emphasized in this section that base case results are very attractive in that results are all above their threshold levels. As is clearly demonstrated here, results of the first three alternative scenarios appear much more attractive, although they overstate benefits. Results presented in Chapter 3 are realistic, indicating that investments in Canada's colleges and institutes generate excellent returns, well above the long-term average percent rates of return in stock and bond markets.

DISCOUNT RATE

The discount rate is a rate of interest that converts future monies to their present value. In investment analysis, the discount rate accounts for two fundamental principles: 1) the time value of money, and 2) the level of risk that an investor is willing to accept. Time value of money refers to the value of money after interest or inflation has accrued over a given length of time. An investor must be willing to forgo the use of his money in the present if he wishes to receive compensation for it in the future. The discount rate also addresses the investors' risk preferences by serving as a proxy for the minimum rate of return that the proposed risky asset must be expected to yield before the investors will be persuaded to invest in it. Typically, this minimum rate of return is determined by the known returns of less risky assets where the investors might alternatively consider placing their money.

In this study, we assume a 3.3% discount rate for students and a 1.8% discount rate for society and taxpayers.[30] Similar to the sensitivity analysis of the alternative education variable, we vary the base case discount rates for students, society, and taxpayers on either side by increasing the discount rate by 10%, 25%, and 50%, and then reducing it by 10%, 25%, and 50%. Note that, because the rate of return and the payback period are both based on the undiscounted cash flows, they are unaffected by changes in the discount rate. As

29 Note that reducing the percent of students employed to 0% automatically negates the percent they earn relative to full earning potential, since none of the students receive any earnings in this case.

30 These values are based on student loan rates from the Government of Canada and benchmark yields for long-term bonds from the Bank of Canada. See the Government of Canada, Student Loans & Grants and the Bank of Canada, Selected Bond Yields.

such, only variations in the net present value, benefit-cost ratio, and return on investment are shown for students, society, and taxpayers in Table 4.3, on the next page.

As demonstrated in the table, an increase in the discount rate leads to a corresponding decrease in the expected returns, and vice versa. For example, increasing the student discount rate by 50% (from 3.3% to 4.9%) reduces the students' benefit-cost ratio from 3.8 to 3.0. Conversely, reducing the discount rate for students by 50% (from 3.3% to 1.6%) increases the benefit-cost ratio from 3.8 to 4.9. The sensitivity analysis results for society and taxpayers show the same inverse relationship between the discount rate and the benefit-cost ratio, with the variance in results being the greatest under the social perspective (from a 6.2 benefit-cost ratio at a -50% variation from the base case to a 4.7 benefit-cost ratio at a 50% variation from the base case).

TABLE 4.3: Sensitivity analysis of discount rate

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
STUDENT PERSPECTIVE							
Discount rate	1.6%	2.5%	2.9%	3.27%	3.6%	4.1%	4.9%
Net present value (millions)	$59,617	$50,457	$45,688	$42,772	$40,047	$36,287	$30,786
Benefit-cost ratio	4.9	4.3	4.0	3.8	3.6	3.4	3.0
Return on investment	3.9	3.3	3.0	2.8	2.6	2.4	2.0
SOCIAL PERSPECTIVE							
Discount rate	0.9%	1.3%	1.6%	1.76%	1.9%	2.2%	2.6%
Net present value (millions)	$121,402	$111,038	$105,294	$101,649	$98,142	$93,128	$85,383
Benefit-cost ratio	6.2	5.8	5.5	5.4	5.2	5.0	4.7
Return on investment	5.2	4.8	4.5	4.4	4.2	4.0	3.7
TAXPAYER PERSPECTIVE							
Discount rate	0.9%	1.3%	1.6%	1.76%	1.9%	2.2%	2.6%
Net present value (millions)	$17,071	$15,362	$14,415	$13,813	$13,235	$12,408	$11,131
Benefit-cost ratio	3.5	3.2	3.1	3.0	2.9	2.8	2.6
Return on investment	2.5	2.2	2.1	2.0	1.9	1.8	1.6

Resources and References

Administration for Children and Families. Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 2010. August 2012. Accessed July 2013. http://www.acf.hhs.gov/sites/default/files/ofa/appendix_ys_final.pdf.

Administration for Children and Families. "Fiscal Year 2011 TANF Financial Data." Office of Family Assistance, TANF Financial Data. Updated August 2012. Accessed August 2013. http://www.acf.hhs.gov/programs/ofa/resource/tanf-financial-data-fy-2011.

American Automobile Association. "AAA Average Costs Per Mile" in "Your Driving Costs." AAA Association Communication: 2012. Accessed May 2012. http://newsroom.aaa.com/wp-content/uploads/2012/04/YourDrivingCosts2012.pdf.

American Community Survey. "Commuting in the United States: 2009" in "American Community Survey Reports." U.S. Department of Commerce Economics and Statistics Administration, September 2011.

Baryla, Edward and Douglas Dotterweich. "Student Migration: Do Significant Factors Vary by Region?" *Education Economics* 9, no. 3 (2001).

Becker, Gary S. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.* New York: Columbia College Press for NBER, 1964.

Bilkic, Natasa, Thomas Gries, and Margarethe Pilichowski. "Stay in school or start working? – The human capital investment decision under uncertainty and irreversibility." *Labour Economics* 19, no. 5 (October 2012): 706-717.

Bouchery, Ellen, Carol Simon, and Hendrick Harwood. "Economic Costs of Excessive Alcohol Consumption in the United States, 2006." The Lewin Group, February 2013. Report prepared for the Centers for Disease Control and Prevention and the National Foundation for the Centers for Disease Control and Prevention. Accessed August 2013. http://www.lewin.com/~/media/Lewin/Site_Sections/Publications/CDC_Report_Rev.pdf.

Bureau of Justice Statistics. "Appendix Table 1 - Prisoners under the jurisdiction of state or federal correctional authorities, by jurisdiction, December 31, 2000, 2008, and 2009." in "Prisoners in 2009 (revised)." NCJ 231675, December 2010. Revised October 2011. Accessed July 2013. http://www.bjs.gov/content/pub/pdf/p09.pdf.

Bureau of Labor Statistics. "Charts by Topic: Leisure and sports activities." American Time Use Survey. Last modified November 2012. Accessed July 2013. http://www.bls.gov/TUS/CHARTS/LEISURE.HTM.

Bureau of Labor Statistics. Consumer Price Index. Accessed January 2013. ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt.

Bureau of Labor Statistics. "Earnings and unemployment rates by educational attainment." BLS Employment Projections. Last modified May 2013. Accessed July 2013. http://www.bls.gov/emp/ep_chart_001.htm.

Bureau of Labor Statistics. "May 2012 National Occupational Employment and Wage Estimates United States." Occupational Employment Statistics. Accessed July 2013. http://www.bls.gov/oes/current/oes_nat.htm.

Bureau of Labor Statistics. "Table 7. Employment status

of the civilian noninstitutional population 25 years and over by educational attainment, sex, race, and Hispanic or Latino ethnicity." Current Population Survey, Labor Force Statistics. Accessed August 2013. http://www.bls.gov/cps/cpsaat07.pdf.

Bureau of Labor Statistics. "Table A-10. Unemployment rates by age, sex, and marital status, seasonally adjusted." Labor Force Statistics from the Current Population Survey. Last modified July 2013. Accessed July 2013. http://www.bls.gov/web/empsit/cpseea10.htm.

Buss, Christian, Jeffrey Parker, and Jon Rivenburg. "Cost, quality and enrollment demand at liberal arts colleges." *Economics of Education Review* 23, no.1 (February 2004): 57-65.

Card, David. "The causal effect of education on earnings." *Handbook of Labor Economics* 3 (1999): 1801-1863.

Card, David. "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems." *Econometrica* 69, no.5 (September 2001): 1127-1160.

Carson, Ann E. and Daniela Golinelli. "Table 1: Prisoners under the jurisdiction of state or federal correctional authorities, December 31, 2002–2012" in "Prisoners in 2012 - Advance Counts." Bureau of Justice Statistics, July 2013, NCJ 242467. Accessed August 2013. http://www.bjs.gov/content/pub/pdf/p12ac.pdf.

Center on Budget and Policy Priorities. "Policy Basics - How many weeks of unemployment are available?" Updated August 26, 2013. Accessed August 27, 2013. http://www.cbpp.org/files/PolicyBasics_UI_Weeks.pdf.

Centers for Disease Control and Prevention. "Adult Obesity Facts." Overweight and Obesity. Accessed August 2013. http://www.cdc.gov/obesity/data/adult.html#Prevalence.

Centers for Disease Control and Prevention. "Adults who are current smokers" in "Tobacco Use - 2011." Behavioral Risk Factor Surveillance System Prevalence and Trends Data. Accessed August 2013. http://apps.nccd.cdc.gov/brfss/list.asp?cat=TU&yr=2011&qkey=8161&state=All.

Centers for Disease Control and Prevention. "Heavy drinkers (adult men having more than two drinks per day and adult women having more than one drink per day)" in "Alcohol Consumption - 2012." Behavioral Risk Factor Surveillance System Prevalence and Trends Data. Accessed August 2013. http://apps.nccd.cdc.gov/brfss/list.asp?cat=AC&yr=2012&qkey=8381&state=All.

Centers for Disease Control and Prevention. "Table 1. Number of respondents to a question about mental health and percentage who self-reported frequent mental distress (FMD), by demographic characteristics – United States, Behavioral Risk Factor Surveillance System, 1993-1996" in "Self-Reported Frequent Mental Distress Among Adults – United States, 1993-1996." *Morbidity and Mortality Weekly Report* 47, no. 16 (May 1998): 325-331.

Centers for Disease Control and Prevention. "Table 3: Prevalence of current depression among adults aged ≥18 years, by sociodemographic characteristics and year – Behavioral Risk Factor Surveillance System, multiple states, 2006 and 2008" in "Mental Illness Surveillance Among Adults in the United States." *Morbidity and Mortality Weekly Report* 60 supplement (September 2011): 17.

Centers for Disease Control and Prevention. "Table 61. Age-adjusted prevalence of current cigarette smoking among adults aged 25 and over, by sex, race, and education level: United States, selected years 1974-2011." National Health Interview Survey, 2011. Accessed August 2013. http://www.cdc.gov/nchs/data/hus/2011/061.pdf.

College Board. "Figure 1: Average Estimated Full-Time

Undergraduate Budgets, 2012-13 (Enrollment-Weighted)" in "Average Estimated Undergraduate Budgets, 2012-13." The College Board, Annual Survey of Colleges. Accessed August 2013. http://trends.collegeboard.org/college-pricing/figures-tables/average-estimated-undergraduate-budgets-2012-13.

Congressional Budget Office. Student Loan and Pell Grant Programs - March 2012 Baseline. Congressional Budget Office Publications. Last modified March 13, 2012. Accessed July 2013. http://www.cbo.gov/sites/default/files/cbofiles/attachments/43054_StudentLoanPellGrantPrograms.pdf.

Criminal Justice Expenditure and Employment Extracts Program (CJEE). "Table 4. Justice system expenditure by character, state and type of government, fiscal year 2009 (preliminary)." Justice Expenditure and Employment Extracts 2009 (preliminary), NCJ 237913. Accessed July 2013. http://bjs.ojp.usdoj.gov/index.cfm?ty=pbdetail&iid=4335.

Dickerson, Andy, and Steven McIntosh. "The Impact of Distance to Nearest Education Institution on the Post Compulsory Education Participation Decision." *Urban Studies* 50, no. 4 (2013): 742-758.

Dynarski, Susan M. "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion." *American Economic Review* 93, no. 1 (2003): 279-288.

Economic Modeling Specialists, Intl. Labor market data and software. www.economicmodeling.com.

Federal Bureau of Investigation, Criminal Justice Information Services Division. "Table 12: Crime Trends by Population Group, 2009-2010" in "Uniform Crime Reports." Crime in the United States, Offenses Known to Law Enforcement. Accessed August 2013. http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/offenses-known-to-law-enforcement.

Federal Bureau of Investigation, Criminal Justice Information Services Division. "Table 29: Estimated Number of Arrests, United States, 2010" in "Uniform Crime Reports." Crime in the United States, Persons Arrested. Accessed August 2013. http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/10tbl29.xls.

Federal Bureau of Prisons. "Quick Facts About the Bureau of Prisons." Last updated July 27, 2013. Accessed August 19, 2013. http://www.bop.gov/news/quick.jsp#1.

Finkelstein, Eric A., Marco da Costa DiBonaventura, Somali M. Burgess, and Brent C. Hale. "The Costs of Obesity in the Workplace." *Journal of Occupational and Environmental Medicine* 52, no. 10 (October 2010): 971-976.

Guerino, Paul, Paige M. Harrison, and William J. Sabol. "Prisoners in 2010." Bureau of Justice Statistics, December 2011, NCJ 236096. Accessed August 2013. http://www.bjs.gov/content/pub/pdf/p10.pdf.

Hamadeh, Mohamad and Roy Khoueiri. "Demand Elasticities for Higher Education in the United States." *International Journal of Business and Economic Perspectives* 5, no. 2 (2010): 60-67.

Harlow, Caroline Wolf. "Table 1. Educational attainment for State and Federal prison inmates, 1997 and 1991, local jail inmates, 1996 and 1989, probationers, 1995, and the general population, 1997" in "Education and Correctional Populations." Bureau of Justice Statistics Special Report, January 2003, NCJ 195670. Accessed August 2013. http://bjs.ojp.usdoj.gov/index.cfm?ty=pbdetail&iid=814.

Henderson, James M. and Richard E. Quandt.

Microeconomic Theory: A Mathematical Approach. New York: McGraw-Hill Book Company, 1971.

IHS Consulting. "North Carolina Tourism 2011." Accessed March 27, 2013. http://www.travelks.com/includes/content/docs/media/2011-North Carolina-TSA-Results-with-Regional-Analysis.pdf.

Jaeger, David A. and Marianne E. Page. "New Evidence on Sheepskin Effects in the Returns to Education." *The Review of Economics and Statistics* 78, no. 4 (November 1996): 733-740.

Kelchtermans, Stijn and Frank Verboven. "Participation and Study Decisions in a Public System of Higher Education." *Journal of Applied Econometrics* 25, no.3 (2010): 355-391.

Knapp, Laura G., Janice E. Kelly-Reid, and Scott A. Ginder. "Table 1. Enrollment at all Title IV institutions, by control of institution, student level, level of institution, attendance status, gender, and race/ethnicity: United States, fall 2011" in *Enrollment in Postsecondary Institutions, Fall 2011; Financial Statistics, Fiscal Year 2011; and Graduation Rates, Selected Cohorts, 2003-2008.* Washington, DC: National Center for Education Statistics, December 2012. Accessed July 2013. http://nces.ed.gov/pubs2012/2012174rev.pdf.

Leigh, Andrew and Chris Ryan. "Estimating returns to education using different natural experiments techniques." *Economics of Education Review* 27 (2008): 149-160.

Leonesio, Michael V. "The Economics of Retirement: A Nontechnical Guide." *Social Security Bulletin* 59 no. 4 (Winter 1996): 29-50.

McCollister, Kathryn E., Michael T. French, and Hai Fang. "The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation." *Drug and Alcohol Dependence* 108 no.1-2 (April 1, 2010): 98-109. Accessed August 2013. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2835847/.

Mincer, Jacob. "Investment in Human Capital and Personal Income Distribution." *Journal of Political Economy* 66, no. 4 (August 1958): 281–302.

Mincer, Jacob. *Schooling, Experience and Earnings.* New York: National Bureau of Economic Research, 1974.

Minton, Todd. "Table 1: Inmates confined in local jails at midyear, average daily population, and incarceration rates, 2000–2012" in "Jail Inmates at Midyear 2012 - Statistical Tables." Bureau of Justice Statistics, May 2013, NCJ 241264. Accessed August 2013. www.bjs.gov/content/pub/pdf/jim12st.pdf.

Morgan, James N. and Edward H. Robb. "The impact of age upon interregional migration." *The Annals of Regional Science* 15, no. 3 (November 1981): 31-45.

National Center for Education Statistics. *Digest of Education Statistics: 2011.* Accessed July 2013. http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2012001.

National Center for Education Statistics, Integrated Post-secondary Education Data System (IPEDS). http://nces.ed.gov/ipeds/.

National Center for Health Statistics. "Table 74. Healthy weight, overweight, and obesity among persons 20 years of age and over, by selected characteristics: United States, selected years 1960-1962 through 2007-2010" in *Health, United States, 2011 With Special Feature on Socioeconomic Status and Health.* Hyattsville, MD: National Center for Health Statistics, 2012.

National Survey on Drug Use and Health. "Table 1 (REVISED). Serious Mental Illness (SMI) in Past Year among Persons Aged 18 or Older, by location: Percentages, Annual Averages Based on 2008 and 2009 NSDUHs" in *The NSDUH Mental Illness: State Estimates of Adult Mental Illness.* Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services

Administration, May 2012.

National Survey on Drug Use and Health. "Table B.1 – Illicit Drug Use in the Past Month, by Age Group and State: Percentages, Annual Averages Based on 2009 and 2010 NSDUHs" in *State Estimates of Substance Use and Mental Disorders from the 2009-2010 National Surveys on Drug Use and Health.* NSDUH Series H-43, HHS Publication No. (SMA) 12-4703. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2012.

Office of Management and Budget. Circular A-94 Appendix C. Last modified December 2012. Accessed July 2013. http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c.

Ogden, Cynthia L., Molly M. Lamb, Margaret D. Carroll, and Katherine M. Flegal. "Figure 3. Prevalence of obesity among adults aged 20 years and over, by education, sex, and race and ethnicity: United States 2005-2008" in "Obesity and Socioeconomic Status in Adults: United States 2005-2008." NCHS data brief no. 50. Hyattsville, MD: National Center for Health Statistics, 2010.

Polachek, Solomon W. "Earnings Over the Lifecycle: The Mincer Earnings Function and its Applications." *Foundations and Trends in Microeconomics* 4, no. 3 (2008): 165-272.

Polachek, Solomon W. "Mincer's Overtaking Point and the Lifecycle Earnings Distribution." *Review of the Economics of the Household* 1, no. 4 (December 2003): 273-304.

Ramey, Valerie and Neville Francis. "A Century of Work and Leisure." *American Economic Journal: Macroeconomics* 1, no.2 (2009): 189-224.

Sevilla, Almudena, Jose Ignacio Gimenez-Nadal, and Jonathan I. Gershuny. "Leisure Inequality in the United States: 1965-2003." IZA Discussion Paper no. 6708, July 2012.

Substance Abuse and Mental Health Services Administration. "Table 5.7B - Substance Dependence or Abuse in the Past Year among Persons Aged 26 or Older, by Demographic Characteristics: Percentages, 2010 and 2011." SAMSHA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2010 and 2011. Accessed August 2013. http://www.samhsa.gov/data/NSDUH/2011SummNatFindDetTables/NSDUH-DetTabsPDFWHTML2011/2k11DetailedTabs/Web/HTML/NSDUH-DetTabsSect5peTabs1to56-2011.htm.

Substance Abuse and Mental Health Services Administration. "Table A.2. Spending by Payer: Levels and Percent Distribution for Mental Health and Substance Abuse (MHSA), Mental Health (MH), Substance Abuse (SA), Alcohol Abuse (AA), Drug Abuse (DA), and All-Health, 2005" in *National Expenditures for Mental Health Services & Substance Abuse Treatment, 1986 – 2005.* DHHS Publication No. (SMA) 10-4612. Rockville, MD: Center for Mental Health Services and Center for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration, 2010.

Supplemental Nutrition Assistance Program. "State Activity Report Fiscal Year 2011." Food and Nutrition Service, Supplemental Nutrition Assistance Program, Program Accountability and Administration Division, December 2012. Accessed August 2013. http://www.fns.usda.gov/snap/qc/pdfs/2011_state_activity.pdf.

Truffer, Christopher J., Sean Keehan, Sheila Smith, Jonathan Cylus, Andrea Sisko, John Poisal, Joseph Lizonitz, and M. Kent Clemens. "Health Spending Projections Through 2019: The Recession's Impact Continues." Health Affairs 29, no. 3 (March 2010): 522-529.

U.S. Census Bureau. "Table 1. Educational Attainment of the Population 18 Years and Over, by Age, Sex, Race, and Hispanic Origin: 2012." Educational

Attainment in the United States: 2012 - Detailed Tables. Accessed August 2013. http://www.census.gov/hhes/socdemo/education/data/cps/2012/tables.html.

U.S. Census Bureau. "Table 1363. Household Net Savings Rate by Country: 1995 to 2008" in "The 2012 Statistical Abstract International Statistics." Accessed June 2013. http://www.census.gov/compendia/statab/2012/tables/12s1363.pdf.

U.S. Census Bureau. "Social Insurance and Human Services" in "The 2012 Statistical Abstract." Accessed August 2013. http://www.census.gov/compendia/statab/cats/social_insurance_human_services.html.

U.S. Census Bureau. "State Characteristics: Vintage 2012." Population Estimates. Updated June 13, 2013. Accessed August 28, 2013. http://www.census.gov/popest/data/state/asrh/2012/index.html.

U.S. Department of Health and Human Services. "Chapter II. Indicators of Dependence" in "2008 Indicators of Welfare Dependence." Annual Report to Congress, 2008. Accessed August 2013. http://aspe.hhs.gov/hsp/indicators08/index.shtml.

U.S. Department of Health and Human Services, Office of Family Assistance. "Table 10:26 - Temporary Assistance for Needy Families - Active Cases: Percent Distribution of TANF Adult Recipients by Educational Level, FY 2009" in Temporary Assistance for Needy Families Program Ninth Report to Congress, 2012. Accessed August 2013. http://www.acf.hhs.gov/sites/default/files/ofa/ar9appendix.pdf.

U.S. Department of Labor. "Minimum Wage Laws in the States - January 1, 2013." U.S. Department of Labor Wage and Hour Division (WHD). Accessed May 2013. http://www.dol.gov/whd/minwage/america.htm.

U.S. Department of Labor. Unemployment Insurance Data Summary, 4th Quarter 2012. Accessed July 2013. http://www.ows.doleta.gov/unemploy/content/data.asp.

U.S. Department of the Treasury. "The Economic Costs of Smoking in the United States and the Benefits of Comprehensive Tobacco Legislation." Office of Public Affairs Report-3113, March 1998. Accessed August 2013. http://www.treasury.gov/press-center/press-releases/Documents/tobacco.pdf.

Walden, Michael, "The Local Economic Impact of the Cooperating Raleigh Colleges: Update 2013." March 2014, Accessed September 2014. http://crcraleighcolleges.org/files/crcimpact2013-final.pdf

Witters, Dan, Sengeeta Agrawal, and Diana Liu. "Depression Costs U.S. Workplaces $23 Billion in Absenteeism." Gallup-Healthways Well-Being Index, Gallup Wellbeing, July 24, 2013. Accessed August 28, 2013. http://www.gallup.com/poll/163619/depression-costs-workplaces-billion-absenteeism.aspx.

Appendix 1: Canada's Colleges and Institutes

Canada's colleges and institutes are listed below. Included are a combination of CICan member and non-member institutions. In some instances for member institutions, Emsi used publicly available data for the analysis due to institutional capacity constraints. Data was unable to be collected for several non-member institutions. Regardless, the list below is a holistic view of those representing Canada's colleges and institutes, with the majority of institutions being included in this analysis.

Alberta

Alberta College of Art and Design
Bow Valley College
Centre Collégial de l'Alberta - Campus Saint-Jean**
Grande Prairie Regional College
Keyano College
Lakeland College
Lethbridge College
Medicine Hat College
NorQuest College
Northern Alberta Institute of Technology
Northern Lakes College
Olds College
Portage College
Red Deer College
Southern Alberta Institute of Technology
The Banff Center**

British Columbia

British Columbia Institute of Technology
Camosun College
Capilano University
Collège Éducacentre
College of New Caledonia
College of the Rockies
Douglas College
Emily Carr University of Art and Design
Justice Institute of British Columbia
Kwantlen Polytechnic University
Langara College
Native Education College*
Nicola Valley Institute of Technology
North Island College
Northern Lights College
Northwest Community College
Okanagan College
Selkirk College
University of the Fraser Valley
Vancouver Community College
Vancouver Island University

Manitoba

Assiniboine Community College
Manitoba Insitute of Trades and Technology
Red River College
Saint-Boniface
University College of the North

New Brunswick

Collège Communautaire du Nouveau-Brunswick
Maritime College of Forest Technology**
New Brunswick College of Craft and Design
New Brunswick Community College

Newfoundland and Labrador

Centre for Nursing Studies
College of the North Atlantic
Fisheries and Marine Institute

Northwest Territories

Aurora College
Collège Nordique Francophone

Nova Scotia

Dalhousie Agricultural Campus of Dalhousie University
Nova Scotia Community College
Université Sainte-Anne, Collège de l'Acadie*

Nunavut

Nunavut Arctic College

Ontario

Algonquin College
Anishinabek Educational Institute**
Cambrian College of Applied Arts and Technology
Canadore College of Applied Arts and Technology
Centennial College
Collège Boréal
Conestoga College Institute of Technology and Advanced Learning
Confederation College
Durham College
Fanshawe College of Applied Arts and Technology
First Nations Technical Institute
Fleming College
George Brown College
Georgian College of Applied Arts and Technology
Humber College Institute of Technology & Advanced Learning
Iohahi:io Akwesasne Adult Education**
Kenjgewin Teg Educational Institute (KTEI)
La Cité
Lambton College of Applied Arts and Technology
Loyalist College
Michener Institute of Education at UHN
Mohawk College
Niagara College
Northern College
Oshki-Pimache-o-win Education & Training Institute**
Sault College
Seneca College of Applied Arts and Technology
Sheridan College
Six Nations Polytechnic**
St. Clair College
St. Lawrence College
University of Guelph - Ridgetown Campus**

Prince Edward Island

Collège Acadie Île-du-Prince-Édouard
Holland College

Québec

Cégep André-Laurendeau
Cégep Beauce-Appalaches
Cégep d'Alma
Cégep de Baie-Comeau
Collège de Bois-de-Boulogne
Cégep de Chicoutimi
Cégep de Drummondville
Cégep de Granby
Cégep de Jonquière
Cégep de la Gaspésie et des Îles
Cégep de La Pocatière
Cégep de l'Abitibi-Témiscamingue
Cégep de Lévis-Lauzon
Cégep de l'Outaouais
Cégep de Matane
Cégep de Rimouski

Cégep de Rivière-du-Loup
Cégep de Sainte-Foy
Cégep de Saint-Félicien
Cégep de Saint-Hyacinthe
Cégep de Saint-Jérôme
Cégep de Saint-Laurent
Cégep de Sept-Îles
Cégep de Sherbrooke
Cégep de Sorel Tracy
Cégep de Thetford
Cégep de Trois-Rivières
Cégep de Victoriaville
Cégep du Vieux Montréal
Cégep Édouard-Montpetit
Cégep Garneau
Cégep Gérald-Godin
Cégep Limoilou
Cégep Marie-Victorin
Cégep régional de Lanaudière
Cégep Saint-Jean-sur-Richelieu
Centennial College**
Champlain Regional College
Collège Ahuntsic
Collège André-Grasset*
Collège Bart**
Collège de Maisonneuve
Collège de Rosemont
Collège de Valleyfield
Collège Ellis**
Collège International Des Marcellines**
Collège Jean-de-Brébeuf**
Collège Laflèche**
Collège LaSalle*
Collège Lionel-Groulx
Collège Mérici**
Collège Montmorency
Collège Nouvelles frontières**
Collège O'Sullivan de Montréal**
Collège O'Sullivan de Québec**
Collège Shawinigan
Collège Stanislas**
Collégial International Sainte-Anne**
Conservatoire Lassalle**
Dawson College
École de Musique Vincent-d'Indy**
École de sténographie judiciaire du Québec**
École national de Cirque**
Heritage College
Institut de technologie agroalimentaire – Québec**
Institut de tourisme et d'hôtellerie du Québec
Institut Teccart**
Institution Kiuna**
John Abbott College
Marianopolis College**
Seminaire de Sherbrooke**
Tav College*
Vanier College

Sasketchewan

Carlton Trail College
College Mathieu
Cumberland College
Dumont Technical Institute
Great Plains College
North West College
Northlands College
Parkland College
Saskatchewan Indian Institute of Technologies
Saskatechewan Polytechnic
Southeast College

Yukon

Yukon College

* Emsi provided data estimates based on publicly available information due to a lack of survey response or institutional capacity.
** Data was unable to be collected so institution is not included in this analysis.

Appendix 2: Glossary of Terms

Alternative education A "with" and "without" measure of the percent of students who would still be able to avail themselves of education absent the publicly-funded educational institutions in Canada. An estimate of 10%, for example, means that 10% of students do not depend directly on the existence of one of the colleges in order to obtain their education.

Asset value Capitalized value of a stream of future returns. Asset value measures what someone would have to pay today for an instrument that provides the same stream of future revenues.

Attrition rate Rate at which students leave the national workforce due to out-migration, retirement, or death.

Benefit-cost ratio Present value of benefits divided by present value of costs. If the benefit-cost ratio is greater than 1, then benefits exceed costs, and the investment is feasible.

Credit A measure of course value generally equal to 15 contact hours of instruction. In general, it requires 450 contact hours or 30 credits to complete one full-time equivalent, or FTE.

Demand 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 price increases.

Discounting Expressing future revenues and costs in present value terms.

Earnings Income which is received as a result of labour, i.e., wages and salaries.

Economics Study of the allocation of scarce resources among alternative and competing ends. Economics is not normative (what ought to be done), but positive (describes what is, or how people are likely to behave in response to economic changes).

Externalities Impacts (positive and negative) for which there is no compensation. Positive externalities of education include improved social behaviours such as lower crime, reduced unemployment, and improved health. Educational institutions do not receive compensation for these benefits, but benefits still occur because education is statistically proven to lead to improved social behaviours.

Full-time equivalent The full-time equivalent (FTE) measure is a method of standardizing the actual course loads of students against their normal course loads in order to normalize and combine the institution's full-time and part-time student counts.

Gross Domestic Product Measure of the final value of all goods and services produced in a region after netting out the cost of goods used in production. Alternatively, Gross Domestic Product (GDP) equals the combined incomes of all factors of production, i.e., labour, land and capital. These include wages, salaries, profits, rents, and other. Gross Domestic Product is also sometimes called "value added."

Initial effect Income generated by the initial injection of monies into the economy through the expenditures of colleges and institutes' students.

Input-output analysis Relationship between a given set of demands for final goods and services and the implied amounts of manufactured inputs, raw materials, and labour that this requires. In an educational setting, as students enter or rejoin the workforce with higher

skills, they earn higher salaries and wages. In turn, this generates earnings in all sectors of the economy, thereby increasing the demand for goods and services and jobs.

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

Multiplier The number of times a dollar cycles through the economy, generating additional income and jobs, before leaving the economy. Therefore, a multiplier of 1.7 estimates that a dollar will generate an additional $0.70 in the economy before leaving.

Multiplier effect Additional income created in the economy through multipliers. It consists of the income created by the supply chain of the industries initially affected by the spending of colleges and institutes and their students (i.e., the direct effect), income created by the supply chain of the initial supply chain (i.e., the indirect effect), and the income created by the increased spending of the household sector (i.e., the induced effect).

Net cash flow Benefits minus costs, i.e., the sum of revenues accruing from an investment minus costs incurred.

Net present value Net cash flow discounted to the present. All future cash flows are collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure.

Opportunity cost Benefits forgone from alternative B once a decision is made to allocate resources to alternative A. Or, if individuals choose not to attend one of the colleges, they forgo earnings that they would have received had they chose instead to work full-time. Forgone earnings, therefore, are the "price tag" of choosing to attend one of the colleges.

Payback period Length of time required to recover an investment—the shorter the period, the more attractive the investment. The formula for computing payback period is: payback period = cost of investment/net return per period.

Return on investment Net present value of benefits divided by present value of costs. If the return on investment (also referred to as the "ROI") is greater than 0, then the investment is feasible.

Appendix 3: Frequently Asked Questions (FAQs)

This appendix provides answers to some frequently asked questions about the results.

What is economic impact analysis?

Economic impact analysis quantifies the impact from a given economic event – in this case, the presence of colleges and institutes – on the economy of a specified region.

What is investment analysis?

Investment analysis is a standard method for determining whether or not an existing or proposed investment is economically viable. This methodology is appropriate in situations where a stakeholder puts up a certain amount of money with the expectation of receiving benefits in return, where the benefits that the stakeholder receives are distributed over time, and where a discount rate must be applied in order to account for the time value of money.

How does the rate of return of colleges and institutes compare to that of other institutions?

In general, Emsi discourages comparisons between institutions since many factors, such as regional economic conditions, institutional differences, and student demographics are outside of the control of colleges and institutes. It is best to compare the rate of return to the discount rates of 3.3% (for students) and 1.8% (for society and taxpayers), which can also be seen as the opportunity cost of the investment (since these stakeholder groups could be spending their time and money in other investment schemes besides education). If the rate of return is higher than the discount rate, the stakeholder groups can expect to receive a positive return on their educational investment.

Emsi recognizes that some institutions may want to make comparisons. As a word of caution, if comparing to an institution that had a study commissioned by a firm other than Emsi, then differences in methodology will create an "apples to oranges" comparison and will therefore be difficult. The study results should be seen as unique to each institution.

Net Present Value (NPV): How do I communicate this in layperson's terms?

Which would you rather have: a dollar right now or a dollar 30 years from now? That most people will choose a dollar now is the crux of net present value. The preference for a dollar today means today's dollar is worth more than it would be in the future (in most people's opinion). Because the dollar today is worth more than a dollar in 30 years, the dollar 30 years from now needs to be adjusted to express its worth today. Adjusting the values for "this time value of money" is called discounting and the result of adding them all up after discounting each value is called net present value.

Internal Rate of Return (IRR): How do I communicate this in layperson's terms?

Using the bank as an example, an individual must decide between spending all of their paycheque today and putting it into savings. If they spend it today, they know what it is worth: $1 = $1. If they put it into savings, they need to know that there will be some sort of return to them for spending those dollars in the future rather than now. This is why banks offer interest rates and deposit interest earnings. This makes it so an individual can expect, for example, a 3f% return in the future for money that they put into savings now.

Total Economic Impact: How do I communicate this in layperson's terms?

Big numbers are great, but putting it into perspective can be a challenge. To add perspective, find an industry with roughly the same "% of GDP" as colleges and institutes (Table 1.4). This percentage represents its portion of the total GDP. This allows colleges and institutes to say that they do just as much for Canada as the entire Utility industry, for example. This powerful statement can help put the large total impact number into perspective.

Appendix 4: Example of Sales versus Income

Emsi's economic impact study differs from many other studies because we prefer to report the impacts in terms of income rather than sales (or output). Income is synonymous with value added or GDP. In this case, sales represent what the students, their employers, and the associated suppliers and consumers in the supply chain spend. Sales include all the intermediary costs associated with producing goods and services. Income is a net measure that excludes these intermediary costs:

Income = Sales – Intermediary Costs

For this reason, income is a more meaningful measure of new economic activity than reporting sales. This is evidenced by the use of GDP by economists when considering the economic growth or size of a country.

To demonstrate the difference between income and sales, let us consider an example of a baker's production of a loaf of bread. The baker buys the ingredients such as eggs, flour, and yeast for $2.00. He uses capital such as a mixer to combine the ingredients and an oven to bake the bread and convert it into a final product. Overhead costs for these steps are $1.00. Total intermediary costs are $3.00. The baker then sells the loaf of bread for $5.00.

The sales amount of the loaf of bread is $5.00. The income from the loaf of bread is equal to the sales amount less the intermediary costs:

Income = $5.00 – $3.00 = $2.00

In our analysis, we provide context behind the income figures by also reporting the associated number of jobs. The impacts are also reported in sales and earnings terms for reference.

Appendix 5: Emsi's Canada Regional Input-Output Model

INTRODUCTION AND DATA SOURCES

Emsi's Canada Regional Input-Output (CRIO) modeling tool estimates the economic relationships among a region's industries and households. The model provides a unified source for regional economic information but more importantly, it provides the essential vehicle for estimating regional multiplier effects. Emsi constructed the CRIO modeling tool using the most disaggregated and up-to-date regional data available for Canada and applying best input-output modeling practices as indicated by the professional literature. The result is a complex automated process capable of creating regionalized models for any geographic area comprised of Census Division and Census Subdivision areas.

Our primary data sources are the following:

- Regional and national jobs-by-industry totals, and national sales-to-jobs ratios (derived from Emsi's industry employment and earnings data process).
- Statistics Canada, "L Level" industry-by-industry input-output tables.

CREATION OF THE IO COEFFICIENTS MATRIX

Table A5.1 illustrates sample amounts that each specific industry purchases from other industries. Industry purchases (inputs) run down the columns, while industry sales (output) run across the rows.

In looking at the table above, the value 1,532.5 means that Industry 2 purchases $1,532,500,000 worth of commodities and/or services from Industry 1. The whole table is an economic double-entry accounting system, configured so that all money inflows have corresponding outflows elsewhere. All regular industries (such as "oil and gas exploration," "machinery manufacturing," "supermarkets," "hospitals," and so on) are captured in the input-output matrix.

TABLE A5.1: Sample input-output table (millions)

	INDUSTRY 1	INDUSTRY 2	...	HOUSEHOLDS
Industry 1	3.3	1,532.5	...	242.1
Industry 2	9.2	23.0	...	1,982.7
...	...	...	...	...
Households	819.3	2,395.6	...	0

TABLE A5.2: Sample "A" matrix

	INDUSTRY 1	INDUSTRY 2	...	HOUSEHOLDS
Industry 1	.001	.112	...	.035
Industry 2	.097	0	...	.065
...	...	...	...	...
Households	.002	.076	...	0

Column elements of the input-output table (Table A5.1 above) are "normalized" on column sums (showing the value of total input purchases) to show individual input purchases as percentages of each industry's overall input purchases. Thus, the cell containing .112 In Table A5.2 means that Industry 2 spends 11.2% of its total input purchases to obtain inputs from Industry 1. The matrix can be viewed as a collection of fixed coefficient production functions. In applied work, the IO coefficients matrix is commonly called the "A" matrix.

REGIONALIZING THE NATIONAL A MATRIX

To create a regional input-output model, we "regionalize" a 304 sector version of the Canada national model derived from publicly available Canadian national L level models. Our regionalization method is based

on the work of economist A.T. Flegg[31] and involves the creation of region-specific matrices of modified cross-industry location quotients (CILQ)s. In general, a CILQ indicates the relative importance of the supplying (row) industry to the demanding (column) industry. A CILQ less than 1.0 is taken to indicate a likelihood that the supplying industry's output is insufficient to meet the using industry's overall input demand, and national model IO coefficients are adjusted downward accordingly, with the deficit imported from other regions.[32] Flegg's breakthrough "modification" to the CILQ IO regionalizing approach was the incorporation of a logarithmic term capturing the effects on trade of relative regional size. Flegg's modified CILQ is commonly called the "Flegg LQ," or FLQ formula.

For off-diagonal elements (i.e., where i does not equal j), the CRIO modeling tool utilizes a standard Flegg formulation as follows:

Where the CILQ (left-hand) multiplicative term has a limiting value of 1.0, and:

J = jobs

i = row industry

j = column industry

R = region

N = nation

γ = calibrating power term

For diagonal elements (i.e., where i equals j) and for the household column, we follow Flegg and apply a standard simple location quotient, again with a ceiling of 1.0:

$$FLQ_{i,j} = \left(\frac{\frac{J_i^R}{\Sigma J^R}}{\frac{J_i^N}{\Sigma J^N}} \right) \times \left(\log_2 \left(1 + \frac{\Sigma J^R}{\Sigma J^N} \right) \right)^{\gamma}$$

One final model element needs regionalizing, and that is the household row. The regionalizing term for the household row indicates the proportion of total labour requirements obtained from workers residing in the region. Lacking region specific data on commuting, we assume a household row regionalizing factor of 75%, thereby assuming that 25% of labour needs are provided by regional in-commuters.

Consider next the calibrating power term gamma shown in the Flegg equations above. The most recent empirical tests of the Flegg LQ approach suggest an optimal value for the calibrating term equal to roughly 0.2,[33] although Emsi comparisons of the Canada Flegg model and the Emsi IO US model suggest a value of 0.1 is better suited for the more dispersed regional economies of North America.

Let us return again to our illustrative FLQ regionalizing process. Based on the formulation presented above, we create a separate matrix of FLQs for all industries in a region. For example, the cell containing the FLQ of .12 in Table A5.3 was calculated by using Industry 1 as the row industry (or i in the Flegg equation above) and Industry 2 as the column industry (or j in the Flegg equation above). The FLQ is interpreted as measuring the proportion of regional requirements of input i by sector j that is satisfied by firms located in the region. In our example above, 12% of Industry 2's demand for the output of Industry 1 are satisfied by local Industry 1. The remaining 88% (= 100% - 12%) of demand is assumed to be imported. On this definition, the matrix of FLQ's can be interpreted as a matrix of "regional trade coefficients."

31 A.T. Flegg and T. Tohmo, "Regional Input-Output Tables and the FLQ Formula: A Case Study of Finland," Regional Studies 47, no. 5 (2013): 703-721; A.T. Flegg and C.D. Webber, "Regional Size, Regional Specialization and the FLQ Formula," Regional Studies 34, no. 6 (2000): 563-569; A.T. Flegg and C.D. Webber, "Regional Size, Industrial Location and Input-Output Expenditure Coefficients," Regional Studies 32, no. 55 (1997):435-444; A.T. Flegg and C.D. Webber, "On the Appropriate Use of Location Quotients in Generating Regional Input-Output Tables: Reply," Regional Studies 31, no. 8 (1997): 795-805; A.T. Flegg and C.D. Webber, "On the Appropriate Use of Location Quotients in Generating Regional Input-Output Tables," Regional Studies 29, no. 6 (1994): 547-561.

32 For a complete discussion of CILQ IO regionalizing methods, see Chapter 8 in Ronald E. Miller and Peter D. Blair, Input-Output Analysis: Foundations and Extensions (New York: Cambridge University Press, 2009).

33 Flegg et al., "Regional Input-Output Tables and the FLQ Formula," 703-721.

TABLE A5.3: Sample FLQ matrix

	INDUSTRY 1	INDUSTRY 2	...	HOUSEHOLDS
Industry 1	.88	.12	...	.47
Industry 2	.98	1	...	.09
...	...	...	...	...
Households	.20	.76	...	1

The "regionalizing" process is completed by computing the element-by-element product of region-based FLQs, interpreted as regional trade coefficients, and national input-output coefficients, interpreted as technical coefficients. The result is a matrix of regional input-output coefficients.

Consider the mathematics. The regional FLQ matrix is constructed with the same dimensions as the national A matrix. Industries that do not exist in the region appear in the Flegg matrix with zero rows and zero columns. The element-by-element product appears then as follows:

$$A^R = A^N \circ F^R$$

Where:

$\circ$ = Hadamard (element-by-element) multiplication

A^N = national IO coefficients matrix (i.e., technical coefficients)

F^R = FLQ matrix

A^R = regional IO coefficients matrix

ESTIMATING REGIONAL INPUT-OUTPUT MULTIPLIER EFFECTS

The most important use of regional input-output models is the estimation of regional multiplier effects. Regional IO multiplier analysis has a long tradition in regional science, and is nowadays viewed as the exclusive method for estimating regional multiplier effects. Following standard practice, input-output multiplier effects are estimated via the regional IO multiplier matrix derived from identity matrix I and the regional IO coefficients matrix AR as follows:

$$B^R = (I - A^R)^{-1}$$

Where:

B^R = multiplier matrix for region R

Given a unit change (i.e., dollar change) in column industry activity (called the "initial" change), multiplier matrix elements show the resulting direct, indirect and induced change in row industry sales. "Direct" change refers to resulting input purchases. "Indirect" change refers to additional input purchases created as a result of the direct purchases. "Induced" change refers to sales resulting from the spending of newly-created household incomes. Job and income effects are obtained by computing jobs-to-sales and income-to-sales ratios and applying these to regional multiplier matrix elements.

Appendix 6: Value per Credit and the Mincer Function

Two key components in determining the economic impact and return on investment of education are 1) the value of the students' educational achievements, and 2) the change in that value over the students' working careers. Both of these components are described in detail in this appendix.

VALUE PER CREDIT

Typically, the educational achievements of students are marked by the credentials they earn. However, not all students who attended Canada's colleges and institutes in the FY 2014-15 analysis year obtained a degree or certificate. Some returned the following year to complete their education goals, while others took a few courses and entered the workforce without graduating. As such, the only way to measure the value of the students' achievement is through their course load, measured in terms of credits. This approach allows us to see the benefits to all students who attended Canada's colleges and institutes, not just those who earned a credential.

To calculate the value per credit, we first determine how many credits are required to complete each education level. For example, assuming that one FTE is equal to 30 credits, a student generally completes 60 credits (or two full-time years' worth of study) in order to move from a high school diploma to a two-year diploma, another 60 credits to move from a two-year diploma to a bachelor's degree, and so on. This progression of credits generates an education ladder beginning at the less than high school level and ending with the completion of a doctoral degree, with each level education representing a separate stage in the progression.

The second step is to assign a unique value to the credits in the education ladder based on the wage differentials presented in Table 1.6. For example, the difference in earnings between a high school diploma and a two-year diploma is $12,900. We spread this $12,900 wage differential across the 60 credits that occur between the high school diploma and the two-year diploma, applying a ceremonial "boost" to the last credit in the stage to mark the achievement of the degree.[34] We repeat this process for each education level in the ladder.

Of course, several other factors such as ability, socioeconomic status, and family background also positively correlate with higher earnings. Failure to account for these factors results in what is known as an "ability bias." Research by Card (1999) indicates that the upper limit benefits defined by correlation should be discounted by 10%.[35] As such, we reduce the marginal differences between education levels by 10%.

Next we map the credit production of Canada's colleges and institutes' FY 2014-15 student population to the education ladder. Table 1.3 provides information on the credit production of Canada's colleges and institutes' students broken out by educational achievement. In total, students completed 21.9 million credits during the analysis year, excluding the credit production of personal enrichment students. We map each of these

34 Economic theory holds that workers that acquire education credentials send a signal to employers about their ability level. This phenomenon is commonly known as the "sheepskin" or "signaling" effect. The ceremonial boosts applied to the achievement of degrees in the Emsi college impact model are derived from Ana Ferrer and Craig Riddell, "The role of credentials in the Canadian labour market," Canadian Journal of Economics 35, no. 4 (November 2002): 879-905.

35 David Card, "The causal e ect of education on earnings," Handbook of Labor Economics 3 (1999): 1801-1863. Card acknowledges that ability is unobservable and the instrumental variable techniques for measuring the ability bias are different. He concludes that the "best available" evidence suggests a "small upward bias (on the order of 10%)."

credits to the education ladder depending on the students' education level and the average number of credits they completed during the year. For example, two-year diploma graduates are allocated to the stage between the high school diploma and the two-year diploma, and the average number of credits they complete informs the shape of the distribution curve used to spread out their total credit production within that stage of the progression.

The sum product of the credits earned at each step within the education ladder and their corresponding

$$\Delta E = \sum_{i=1}^{n} e_i h_i \quad \text{where } i \in 1, 2, \ldots n$$

value yields the students' aggregate annual increase in earnings (ΔE), as shown in the following equation:

and n is the number of steps in the education ladder, e_i is the marginal earnings gain at step i, and h_i is the number of credits completed at step i.

Table A6.1 displays the result for students' aggregate annual increase in earnings (ΔE), a total of $3.9 billion. By dividing this value by the students' total production of 21,868,152 credits during the analysis year, we derive an overall average value of $180 per credit.

TABLE A6.1: Aggregate annual increase in earnings of Canada's colleges and institutes' students and average value per credit

Aggregate annual increase in earnings	$3,934,846,602
Total credits in FY 2014-15*	21,868,152
Average value per credit	**$180**

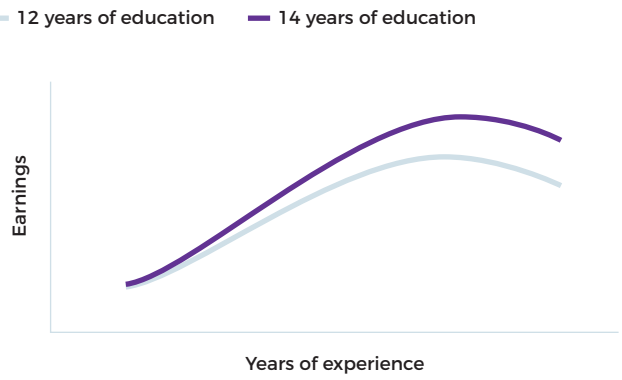
* Excludes the credit production of leisure students.
Source: Emsi college impact model.

MINCER FUNCTION

The $180 value per credit in Table A6.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated and non-educated workers grows through time. These basic patterns in earnings over time were originally identified by Jacob Mincer, who viewed the lifecycle earnings distribution as a function with the key elements being earnings, years of education, and work experience, with age serving as a proxy for experience.[36] Mincer's earnings function is still upheld in recent data and has served as the foundation for a variety of research pertaining to labour economics.

Figure A6.1 illustrates several important points about the Mincer function. First, as demonstrated by the shape of the curves, an individual's earnings initially increase at an increasing rate, then increase at a decreasing rate, reach a maximum somewhere well after the midpoint of the working career, and then decline in later years. Second, individuals with higher levels of education reach their maximum earnings at an older age compared to individuals with lower levels of education (recall that age serves as a proxy for years of experience). And third, the benefits of education, as measured by the difference in

FIGURE A6.1: Lifecycle change in earnings, 12 years versus 14 years of education



36 See Mincer, 1958 and Jacob Mincer, "Schooling, Experience and Earnings" (New York: National Bureau of Economic Research, 1974). See also Gary S. Becker, Human Capital: A Theoretical Analysis with Specific Reference to Education (New York: Columbia College Press for NBER, 1964).

earnings between education levels, increase with age.

In calculating the student productivity impact in Chapter 2, we use the slope of the curve in Mincer's earnings function to condition the $180 value per credit to the students' age and work experience.[37] To the students just starting their career during the analysis year, we apply a lower value per credit; to the students in the latter half or approaching the end of their careers we apply a higher value per credit. The original $180 value per credit applies only to the credit production of students precisely at the midpoint of their careers during the analysis year.

In Chapter 3 we again apply the Mincer function, this time to project the benefits stream of Canada's colleges and institutes' FY 2014-15 student population into the future. Here too the value per credit is lower for students at the start of their career and higher near the end of it, in accordance with the scalars derived from the slope of the Mincer curve illustrated in Figure A6.1.

CONCLUSION

This appendix demonstrates the significance of the value per credit and the Mincer function in determining the initial effect of student productivity on the national economy in Chapter 2 and the students' return on their educational investment in Chapter 3. Both chapters provide further discussion on the role that the students' credit production and corresponding increase in earnings plays in calculating the study outcomes.

37 The Mincer equation is computed based on estimated coefficients presented in Robert J. Willis, "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Function" in Handbook of Labor Economics, Vol. 1 (Amsterdam: Elsevier Science Publishers, 1986): 525–602. These are adjusted to current year dollars in the usual fashion by applying the GDP implicit price deflator. The function does not factor in temporary economic volatility, such as high growth periods or recessions. In the long run, however, the Mincer function is a reasonable predictor.

Appendix 7: Alternative Education Variable

In a scenario where colleges and institutes did not exist, some of their students would still be able to avail themselves of an alternative comparable education. These students create benefits in Canada even in the absence of colleges and institutes. The alternative education variable accounts for these students and is used to discount the benefits we attribute to Canada's colleges and institutes.

Recall this analysis considers only relevant economic information regarding colleges and institutes. Considering the existence of various other academic institutions surrounding them, we have to assume that a portion of the students could find alternative educations and either remain in or return to Canada. For example, some students may participate in online programs while remaining in the country. Others may attend an international institution and return to Canada upon completing their studies. For these students – who would have found an alternative education and produced benefits in the country regardless of the presence of colleges and institutes – we discount the benefits attributed to colleges and institutes. An important distinction must be made here: the benefits from students who would find alternative educations outside the country and not return to the country are not discounted. Because these benefits would not occur in Canada without the presence of colleges and institutes, they must be included.

In the absence of Canada's colleges and institutes, we assume 10% of their students would find alternative education opportunities and remain in or return to the country. We account for this by discounting the student productivity impact, the benefits to taxpayers, and the benefits to society in Canada in Chapters 2 and 3 by 10%. In other words, we assume 10% of the benefits created by the students would have occurred anyways in the counterfactual scenario where colleges and institutes did not exist. A sensitivity analysis of this adjustment is presented in chapter 4.

Appendix 8: Overview of Investment Analysis Measures

The purpose of this appendix is to provide context to the investment analysis results using the simple hypothetical example summarized in Table A8.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.[38]

Assumptions are as follows:

- Benefits and costs are projected out ten years into the future (Column 1).
- The student attends the college for one year, and the cost of tuition is $1,500 (Column 2).
- Earnings forgone while attending college for one year (opportunity cost) come to $20,000 (Column 3).
- Together, tuition and earnings forgone cost sum to $21,500. This represents the out-of-pocket investment made by the student (Column 4).
- In return, the student earns $5,000 more per year than he would have otherwise earned without the education (Column 5).
- The net cash flow (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).
- The assumed "going rate" of interest is 4%, the rate of return from alternative investment schemes for the use of the $21,500.

Results are expressed in standard investment analysis terms, which are as follows: the net present value, the

38 Note that this is a hypothetical example. The numbers used are not based on data collected from an existing college.

TABLE A8.1: Example of the benefits and costs of education for a single student

1	2	3	4	5	6
YEAR	TUITION	OPPORTUNITY COST	TOTAL COST	HIGHER EARNINGS	NET CASH FLOW
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
Net present value			**$21,500**	**$35,753**	**$14,253**
Internal rate of return					18%
Benefit-cost ratio					1.7
Payback period					4.2 years

internal rate of return, the benefit-cost ratio, the return on investment, and the payback period. Each of these is briefly explained below in the context of the cash flow numbers presented in Table A8.1.

NET PRESENT VALUE

The student in Table A8.1 can choose either to attend college or to forgo post-secondary education and maintain their present employment. If they decide to enroll, certain economic implications unfold. Tuition and fees must be paid, and earnings will cease for one year. In exchange, the student calculates that with post-secondary education, their earnings will increase by at least the $5,000 per year, as indicated in the table.

The question is simple—will the prospective student be economically better off by choosing to enroll? If he adds up higher earnings of $5,000 per year for the remaining nine years in Table 1, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different. Benefits are far lower than $45,000 because future money is worth less than present money. Costs (tuition plus earnings forgone) are felt immediately because they are incurred today, in the present. Benefits, on the other hand, occur in the future. They are not yet available. All future benefits must be discounted by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[39]

Let us take 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. Put another way, $4,807 deposited in the bank today earning 4% interest will grow to $5,000 in one year; and $3,377 deposited today would grow to $5,000 in ten years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 ten years from today given the going rate of interest of 4%. The process of discounting—finding the present value of future higher earnings—allows the model to express values on an equal basis in future or present value terms.

The goal is to express all future higher earnings in present value terms so that they can be compared to investments incurred today (in this example, tuition plus earnings forgone). As indicated in Table A8.1, the cumulative present value of $5,000 worth of higher earnings between years 2 and 10 is $35,753 given the 4% interest rate, far lower than the undiscounted $45,000 discussed above.

The net present value of the investment is $14,253. This is simply the present value of the benefits less the present value of the costs, or $35,753 - $21,500 = $14,253. In other words, the present value of benefits exceeds the present value of costs by as much as $14,253. The criterion for an economically worthwhile investment is that the net present value is equal to or greater than zero. Given this result, it can be concluded that, in this case, and given these assumptions, this particular investment in education is very strong.

INTERNAL RATE OF RETURN

The internal rate of return is another way of measuring the worth of investing in education using the same cash flows shown in Table A8.1. In technical terms, the internal rate of return is a measure of the average earning power of money used over the life of the investment. It is simply the interest rate that makes the net present value equal to zero. In the discussion of the net present value above, the model applies the "going rate" of interest of 4% and computes a positive net present value of $14,253. The question now is what the interest rate would 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 A8.1. Or, if a discount rate of 18% were applied to the net present value calculations instead of the 4%, then the net present value would reduce to zero.

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

What does this mean? The internal rate of return of 18% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the net present value equals zero. Or, at 18%, higher earnings of $5,000 per year for the next nine years will earn back all investments of $21,500 made plus pay 18% for the use of that money ($21,500) in the meantime. Is this a good return? Indeed, it is. If it is compared to the 4% "going rate" of interest applied to the net present value calculations, 18% is far higher than 4%. It may be concluded, therefore, that the investment in this case is solid. Alternatively, comparing the 18% rate of return to the long-term 7% rate or so obtained from investments in stocks and bonds also indicates that the investment in education is strong relative to the stock market returns (on average).

A word of caution—the approach for calculating the internal rate of return can sometimes generate wild or unbelievable results that defy the imagination. Technically, the approach requires at least one negative cash flow 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 would still be possible to compute the internal rate of return, but it would be a staggering 333% because only a negative $1,500 cash flow would be offsetting nine subsequent years of $5,000 worth of higher earnings. Although the 333% return would technically be correct, it would not be consistent with the conventional understanding of returns expressed as percentages.

BENEFIT-COST RATIO

The benefit-cost ratio is simply the present value of benefits divided by present value of costs, or $35,753 ÷ $21,500 = 1.7 (based on the 4% discount rate). Of course, any change in the discount rate would also change the benefit-cost ratio. Applying the 18% internal rate of return discussed above would reduce the benefit-cost ratio to 1.0, the breakeven solution where benefits just equal costs. Applying a discount rate higher than the 18% would reduce the ratio to lower than 1.0, 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.

RETURN ON INVESTMENT

The return on investment is similar to the benefit-cost ratio, except that it measures the net (as opposed to gross) benefits of an investment relative to the investment's cost. In terms of dollars, the return on investment represents the benefits received over and above the original investment. It is calculated simply by dividing the net present value of the benefits by the total costs of the investment, or $15,080 ÷ $21,500 = 0.7 (again based on the 4% discount rate). This means that the investment will return the original cost of the investment plus an additional $.70 for every dollar invested. A positive value for the return on investment measure (i.e., any value above 0) indicates that the investment has been profitable.

PAYBACK PERIOD

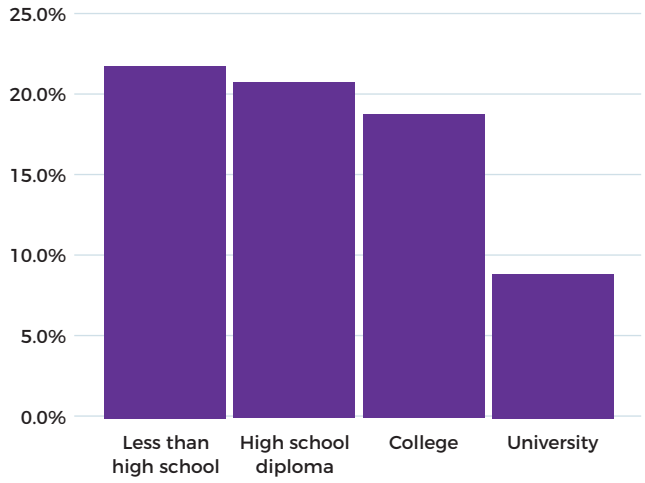
This is the length of time from the beginning of the investment (consisting of tuition and earnings forgone) until higher future earnings give a return on the investment made. For the student in Table A8.1, it will take roughly 4.2 years of $5,000 worth of higher earnings to recapture his investment of $1,500 in tuition and the $20,000 in earnings forgone while attending college. Higher earnings that occur beyond 4.2 years are the returns that make the investment in education in this example economically worthwhile. The payback period is a fairly rough, albeit common, means of choosing between investments; the shorter the payback period, the stronger the investment.

Appendix 9: Social Externalities

Education has a predictable and positive effect on a diverse array of social benefits. These, when quantified in dollar terms, represent significant social savings that directly benefit society as a whole, including taxpayers. In this appendix we discuss the following three main benefit categories: 1) improved health, 2) reductions in crime, and 3) reductions in income assistance.

It is important to note that the data and estimates presented here should not be viewed as exact, but rather as indicative of the positive impacts of education on an individual's quality of life. The process of quantifying these impacts requires a number of assumptions to be made, creating a level of uncertainty that should be borne in mind when reviewing the results.

FIGURE A9.1: Prevalence of smoking by education level



HEALTH

Statistics clearly show the correlation between increases in education and improved health. The manifestations of this are found in four health-related variables: smoking, alcoholism, obesity, and mental illness. There are other health-related areas that link to educational attainment, but these are omitted from the analysis until we can invoke adequate (and mutually exclusive) databases and are able to fully develop the functional relationships between them.

A9.1.1 Smoking

Figure A9.1 shows the prevalence of cigarette smoking among adults aged 15 years and over, based on data provided by the Health Canada Canadian Tobacco Use Monitoring Survey (CTUMS). As indicated, the percent of persons who smoke begins to decline beyond the level of less than high school.

Alcohol abuse

Alcoholism is difficult to measure and define. There are many patterns of drinking, ranging from abstinence to heavy drinking. Alcohol abuse is riddled with social costs, including healthcare expenditures for treatment, prevention, and support; workplace losses due to reduced worker productivity; and other effects.

Figure A9.2 compares the prevalence rate of heavy drinking among males and females aged 15 at the less than secondary level to the prevalence rate at the university degree level, based on data supplied by Statistics Canada and the Canadian Center on Substance Abuse Canadian Addiction Survey (CAS). These statistics give an indication of the correlation between education and the reduced probability of alcoholism. As indicated, heavy drinking falls from a 25.2% prevalence rate among males at a less than secondary level to a 19.1% prevalence rate among males with a postsecondary degree. Similarly, heavy drinking among females ranges

FIGURE A9.2: Prevalence of heavy drinking by sex and education level

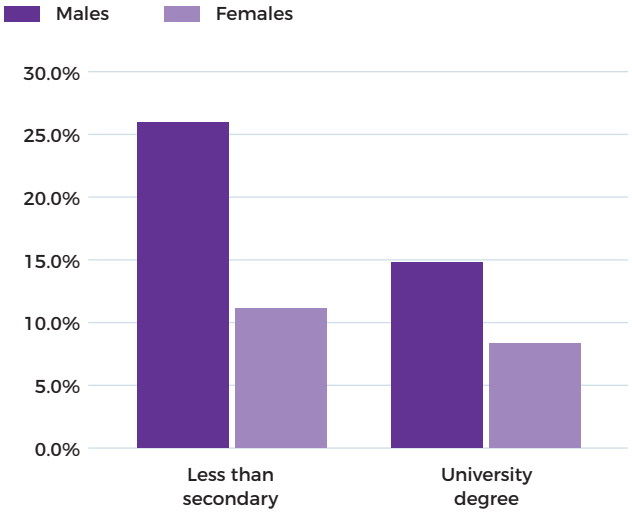


FIGURE A9.3: Prevalence of obesity by education level

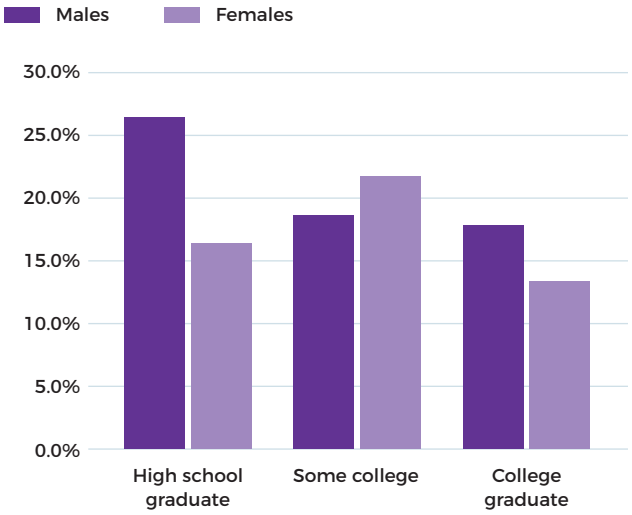
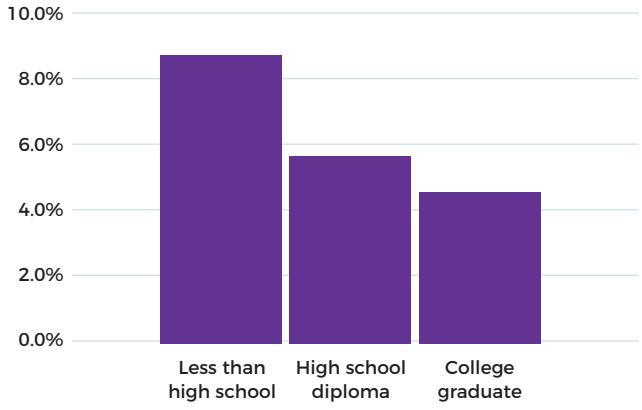


FIGURE A9.4: Prevalence of fair or poor mental health by education level



from a 10.7% prevalence rate at the less than secondary level to a 8.1% prevalence rate at the postsecondary degree level.

Obesity

The rise in obesity and diet-related chronic diseases has led to increased attention on how expenditures relating to obesity have increased in recent years. The economic burden of obesity consists of both the direct costs to the health care system and the indirect costs to productivity, as defined and measured by a joint report from the Public Health Agency of Canada and the Canadian Institute of Health Information.[40]

Figure A9.3 shows the prevalence of obesity among adults aged 18 years and over by education and sex, based on data supplied by Statistics Canada. As indicated, college graduates are less likely to be obese than individuals with a high school diploma. However, the prevalence of obesity among females with some college is actually greater than females with no more than a high school diploma. In general, though, obesity tends to decline with increasing levels of education.

Mental illness

The economic burden of mental health problems in Canada includes the cost of treatment and lost productivity in the workplace. Figure A9.4 summarizes the prevalence rate among adults aged 15 years and older that perceive their mental health to be fair or poor by education level, based on combined data from Statistics Canada and the Government of Canada. As shown, college graduates are less likely to suffer from fair or poor mental health than someone with a secondary or less than secondary education, with the prevalence of mental illness being the highest among people without a high school diploma.

40 Public Health Agency of Canada and the Canadian Institute for Health Information, *Obesity in Canada*, https://secure.cihi.ca/free_products/Obesity_in_canada_2011_en.pdf.

CRIME

As people achieve higher education levels, they are statistically less likely to commit crimes. The analysis identifies the following three types of crime-related expenses: 1) criminal justice expenditures, including police protection, judicial and legal, and corrections, 2) victim costs, and 3) productivity lost as a result of time spent in jail or prison rather than working.

Figure A9.5 displays the probability that an individual will be placed in custody by education level. Data are derived from the breakdown of adults in correctional services by province as provided by combined data from Statistics Canada and the Canadian Centre for Justice Statistics, divided by the total adult population. As indicated, the probability of being placed in custody drops on a sliding scale as education levels rise.

Victim costs comprise health care, productivity losses, stolen/damaged property, and third-party costs (including victim services). Some of these costs are hidden, while others are available in various databases. Estimates of victim costs vary widely, attributable to differences in how the costs are measured. The lower end of the scale includes only tangible out-of-pocket costs, while the higher end includes intangible costs related to pain and suffering.

Yet another measurable benefit is the added economic productivity of people who are now gainfully employed, all else being equal, and not in custody. The measurable productivity benefit is simply the number of additional people employed multiplied by the average earnings of their corresponding education levels.

INCOME ASSISTANCE

Statistics show that as education levels increase, the unemployment rate declines, as shown in Figure A9.6. These data are supplied by the Statistics Canada Labour Force Survey (LFS). Unemployment rates range from 15.0% for those with less than a high school diploma to 5.2% for those at the bachelor's degree level.

Figure A9.7, on the next page, relates the breakdown of employment-related social assistance recipients by gender and education level, derived from data supplied by Statistics Canada, the Centre for Urban and Community Studies, and the Federal-Provincial-Territorial Directors of Income Support. As shown, the demographic characteristics of social assistance

FIGURE A9.5: Percent of adult population that are in custody by education level

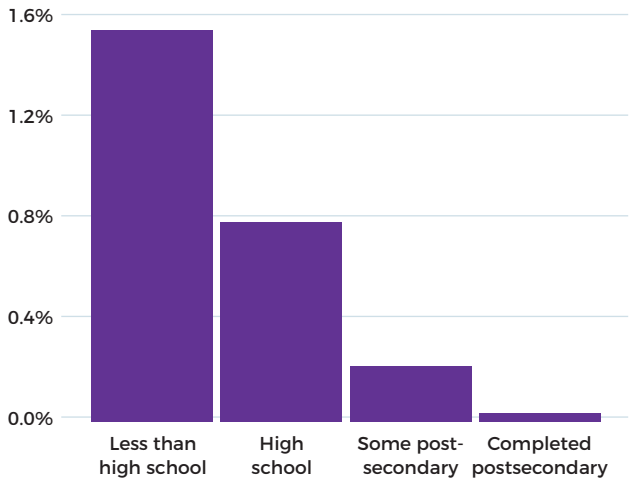


FIGURE A9.6: Unemployment rates by education level

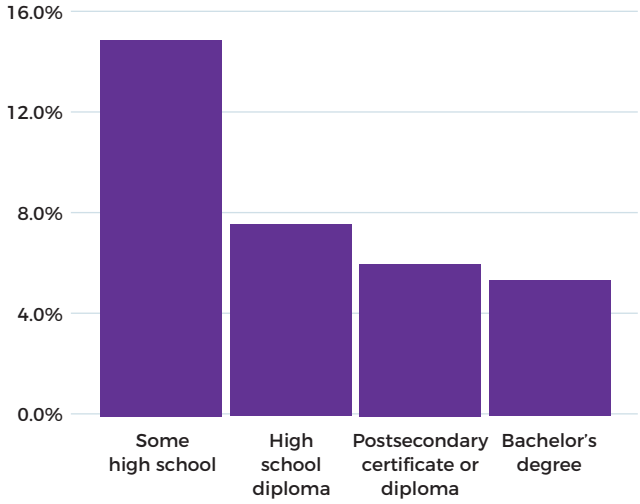
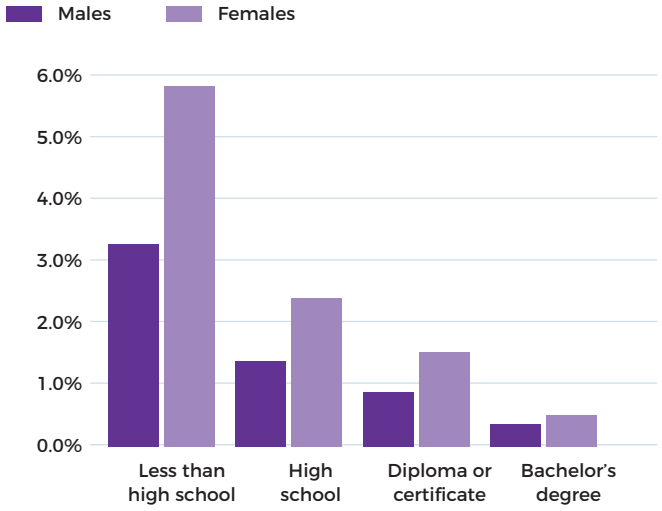


FIGURE A9.7: Probability of claiming employment-related social assistance by gender and education level



recipients are weighted heavily towards the less than high school and high school categories, with a much smaller representation of individuals with greater than a high school education.

CONCLUSION

The statistical databases bear out the simple correlation between education and improved health, lower custody rates, and fewer claimants of income assistance. These by no means comprise the full range of benefits one possibly can link to education. Other social benefits certainly may be identified in the future as reliable statistical sources are published and data are incorporated into the analytical framework. However, the fact that these incidental benefits occur and can be measured is a bonus that enhances the economic attractiveness of education.