SEPTEMBER 2019

THOMPSON RIVERS UNIVERSITY

The Economic Value of Thompson Rivers University Capital Projects

MAIN REPORT

Emsi

Contents

Executive Summary

THIS analysis considers the economic impact of recent capital projects at Thompson Rivers University (TRU). These projects include campus maintenance, renovations of the first and second floors of TRU's Old Main Building, and the construction of the Industrial Training & Technology Centre (ITTC) and the Nursing & Population Health (NPH) Building. Capital spending for these projects will amount to $87.4 million from FY 2016 to FY 2021. These projects will expand the university's capacity and allow it to positively affect a greater number of students and, through those students, the economy at large.[1]

These projects will expand the university's capacity and ***allow it to positively affect a greater number of students*** *and, through those students, the economy at large.*

Short-run capital spending impacts

As the $87.4 million is spent, it will create a significant amount of new economic activity that will ripple throughout the TRU Region[2] economy. These impacts span from FY 2016, when the capital spending began, to FY 2021, when the capital spending is expected to be completed.

From FY 2016 to FY 2021, the capital spending will create a present value of **$41.4 million** in total added income for the TRU Region.

Long-run operations spending impacts

As the capital projects are completed, they will add various capacities that will help TRU meet excess student demand. Utilizing these new capacities will create the demand for added faculty and staff and their associated day-to-day operational expenditures. These operations spending impacts began in FY 2019, when the ITTC became operational, and

1 This analysis reflects planning assumptions as of May 2019. If additional funding is secured in the future, TRU may expand its capacity beyond what is projected in this analysis. Nevertheless, this analysis reflects realistic and conservative estimates of the impact of these planned capital projects.

2 This is TRU's college region designated by the Government of British Columbia. It is comprised of a group of census subdivisions in south central British Columbia.

will steadily increase as enrolment at the ITTC increases. In FY 2021, when the NPH Building becomes operational, these impacts will increase yet further. Operations for both new facilities are expected to stabilise in FY 2025.

From FY 2019 to FY 2026, the final year of this analysis, the increased operations spending resulting from the capital projects will create a present value of **$11.4 million** in total added income.

Long-run student spending impacts

As the capital projects are completed, they will allow TRU to serve additional students it would not have otherwise had the capacity to serve. Some of these students will relocate from outside the TRU Region. Some students from the region may leave if not for the added capacities at TRU. The money that these students will spend toward living expenses in the TRU Region is attributable to the capital projects.

From FY 2020, when the first additional students enroll, to FY 2026, the last year of this analysis, the students' spending will create a present value of **$5 million** in total added income for the regional economy.

Long-run alumni impacts

The added capacities created by the capital projects will help TRU respond to the demands of a growing economy and student population. The added capacities will create additional alumni who otherwise would not have been served by TRU. These alumni represent a significant increase in the stock of human capital available to the TRU Region's economy. They will begin to accrue in FY 2020, when the first additional students graduate. The added earnings and increased productivity of these alumni will create long-run impacts across the regional economy.

Accounting for an enrolment ramp-up period, by FY 2026, the increased capacities created by the capital projects will have produced over 900 additional alumni. From FY 2020 to FY 2026, the additional alumni will add a present value of **$8.9 million** in total added income for the regional economy.

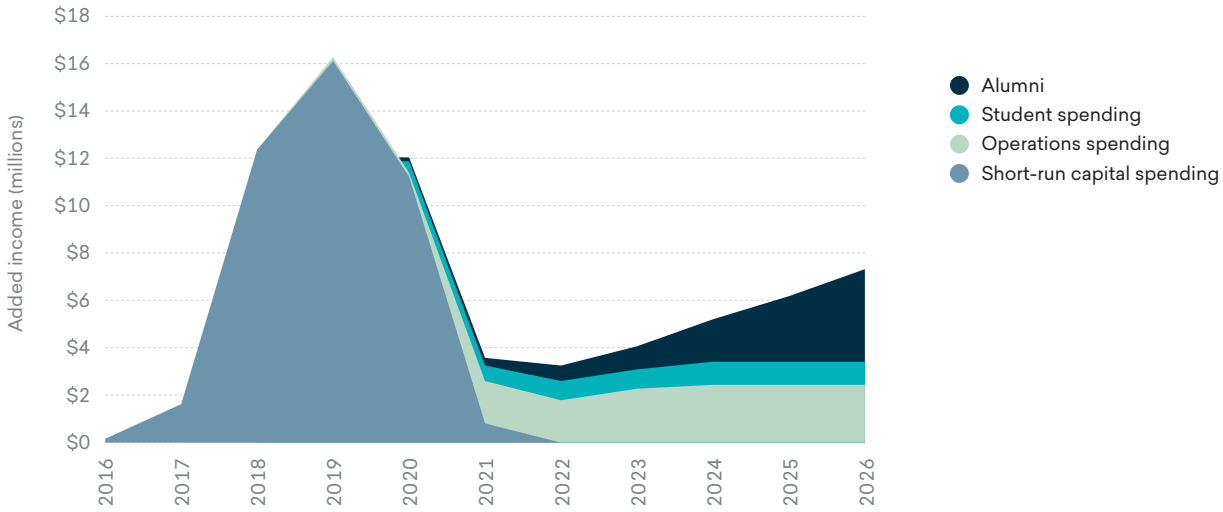
Total impact

From FY 2016 to FY 2026, the present value of short-run and long-run impacts created by the capital projects will create a total economic impact on the TRU Region's economy of **$66.7 million** in added income.

Important Note

When reviewing the impacts estimated in this study, it's important to note that it primarily reports impacts in the form of added income rather than sales. Sales includes all of the intermediary costs associated with producing goods and services. Income, on the other hand, is a net measure that excludes these intermediary costs and is synonymous with gross regional product (GRP) and value added. For this reason, it is a more meaningful measure of new economic activity than sales.

TOTAL IMPACTS FROM FY 2016 TO FY 2026, UNDISCOUNTED



ANNUAL IMPACTS

The economic impacts discussed thus far are those summed across the analysis years of FY 2016 to FY 2026 and adjusted to present values. However, each of the three long-run types of impacts will create an annual impact. These break down as follows:

- **Operations spending annual impact:** The capital projects will increase TRU's operational spending. By FY 2024, when operations stabilise, increased operations spending will add around **$2.5 million** in income on an annual basis, equivalent to supporting **23 jobs** per year.
- **Student spending annual impact:** Once the additional number of students TRU is able to serve stabilises at around 377 students, **$1 million** in income will be added per year, or **19 jobs** supported, as a result of spending from retained and relocated students in the region.
- **Alumni annual impact:** As a result of the expanded capacities made possible through the capital projects, TRU will produce more alumni every year, who will then accumulate in the regional workforce. By FY 2026, the last year of this analysis, additional alumni are estimated to add **$3.9 million** in total income to the economy per year, supporting **42 jobs**. This annual impact is expected to increase every year as TRU continues to serve more students and they enter the regional workforce.

The total annual impact from the capital projects will be at least **$7.4 million** in added income. This is equivalent to supporting **84 jobs** every year.

Acknowledgments

Emsi gratefully acknowledges the excellent support of the staff at Thompson Rivers University in making this study possible. Special thanks go to Dorys Crespin Mueller, Executive Director, Integrated Planning & Effectiveness, who collected and organised much of the data and information requested. Any errors in the report are the responsibility of Emsi and not of any of the above-mentioned individuals.

CHAPTER 1:

Introduction

THOMPSON Rivers University (TRU) is a comprehensive, learner-centered, environmentally responsible institution that serves its regional, national, and international learners and their communities through high quality and flexible education, training, research, and scholarship. With campuses in Kamloops and Williams Lake, numerous secondary locations, and a variety of online options, the university aims to make quality postsecondary education affordable and accessible. In FY 2018, TRU served an enrolment of over 28,000 students.

Over its 40-year history, TRU has regularly updated, upgraded, and expanded its facilities in order to make sure its students receive the best education possible. This includes ensuring students have access to modern equipment and facilities for training. As part of that ongoing process, TRU regularly performs campus maintenance and has planned two new facilities for its Kamloops campus in recent years.

The first of these is the TRU Nursing and Population Health (NPH) Building. This stand-alone facility is expected to be completed in FY 2020, and will provide over 4,500 square-metres of classrooms, office space, study and research laboratories, and student spaces to support the growth of TRU's nursing programs.

TRU is a comprehensive, learner-centered, environmentally responsible institution.

The second facility is the recently completed Industrial Training and Technology Centre (ITTC), which opened in September 2018. The ITTC is larger than the NPH Building, at over 5,400 square-metres. and adds significant capacity for the university's trades programs. These capacities include the addition of new programs like industrial process technician, power engineering, HVAC/refrigeration technician, and machinist. The ITTC's facilities include laboratories, several shop areas, and classrooms, which serve as an extension of the existing trades building to which it is attached.

Funds allocated to spending on the capital projects will be used to develop the various capital resources of TRU. This will expand the university's capacity, allowing it to positively affect a greater number of students and, through those students, the economy at large. The investment will only include the spending required for the capital projects (i.e. the campus maintenance, renovations of the Old Main Building's first and second floors, and the construction of the ITTC and NPH Building). This analysis will quantify the new economic activity created by the capital projects in the short-run and long-run. We estimate four types of impacts:

- **Short-run capital spending impacts:** The initial spending for the capital projects will span from FY 2016 to FY 2021 and total $87.4 million. As this money is spent, it will create new economic activity that will ripple throughout the TRU Region's economy.

- **Long-run operations spending impacts:** As the ITTC and NPH Building become operational, they will add various capacities that will help TRU meet excess student demand. Utilizing this new capacity will create the demand for added faculty and staff and their associated day-to-day operational expenditures. These operations spending impacts began in FY 2019. As the added capacity continues year after year, the operations spending impacts will grow until stabilising in FY 2025. The capital projects will provide long-run operations spending impacts across the TRU Region.

- **Long-run student spending impacts:** The added capacities of the capital projects will allow TRU to serve additional students it would not otherwise have the capacity to serve. Some of these students will relocate to the region in order to attend the university and others, originally from the region, will remain in the region because of opportunities provided by the capital projects. These students will spend money on housing, food, and entertainment in the region. This injection of money is attributable to the capital projects, which will allow TRU to begin serving additional students in FY 2020. The spending from these students will continue to impact the economy year after year.

- **Long-run alumni impacts:** The added capacities created by the capital projects will help TRU respond to not only the demands of students but also the demands of a growing economy. Additional alumni will begin to accrue in FY 2020, the first year the additional students begin graduating. By FY 2026, the final year of this analysis, over 900 additional alumni will have been produced as a result of the capital projects, the majority of whom are expected to remain in the region. These alumni represent a significant increase in the stock of human capital available to the TRU Region's economy. The added earnings and increased productivity of these alumni will create long-run impacts across the regional economy.

This analysis spans across the four types of impacts from FY 2016 to FY 2026. However, the long-run impacts will continue long after the final year of this analysis.

About economic impact analysis

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 gross regional product, or GRP. Income may be further broken out into the **labour income impact**, which assesses the change in employee compensation; and the **non-labour income impact**, which assesses the change in income business profits. Another way to state the income impact is **jobs**, a measure of the number of full- and part-time jobs that would be required to support the change in income. All of these measures – added labour and non-labour income, total income, jobs, and sales – are used to estimate the economic impact results presented in this chapter.

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, purchase goods or services, or cover operating expenses.
- 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 three types of effects:
    - 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.
    - The **induced effect** refers to the economic activity created by the household sector as the businesses affected by the initial, direct, and indirect effects raise salaries or hire more people.

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 region. The Emsi CRIO model contains 303 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 the region. For more information on the Emsi CRIO model and its data sources, see Appendix 3.

CHAPTER 2:

Economic Impact of Capital Projects

THIS analysis quantifies the economic impacts associated with TRU's capital projects, beginning in FY 2016. These projects include campus maintenance, renovations of the Old Main Building's first and second floors, and the construction of the Industrial Training & Technology Centre (ITTC) and Nursing & Population Health (NPH) Building. Capital spending for these projects will amount to $87.4 million from FY 2016 to FY 2021. TRU will receive a total of $36.9 million of external funding for these projects; the remaining spending will come from institutional funds (Table 2.1).

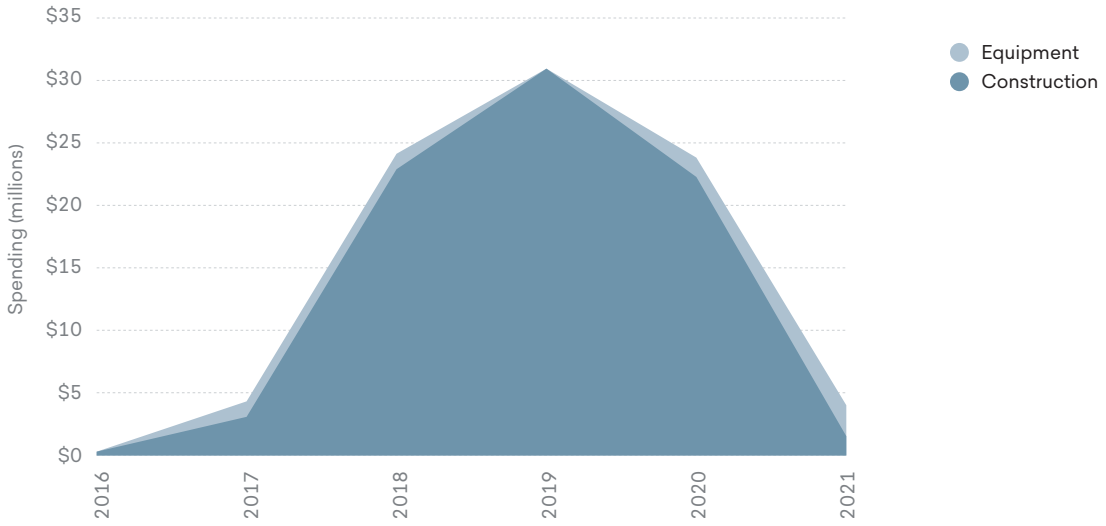
TABLE 2.1: CAPITAL SPENDING BY YEAR AND FUNCTION, UNDISCOUNTED

Funding source	Amount	% of total
Provincial government	$18,193,939	21%
Federal government	$15,289,000	17%
Institutional funds	$50,484,462	58%
Other sources of funding	$3,443,776	4%
Total	**$87,411,177**	**100%**

Source: TRU.

Funds allocated to spending on the capital projects will be used to develop the various capital resources of TRU, thereby expanding the university's capacity and allowing it to positively affect a greater number of students and, through those students, the economy at large. TRU has outlined the proportion of funds that would be spent on construction and equipment – such as computers and lab materials. Figure 2.1 outlines the total spending in these categories by year for the capital projects.

FIGURE 2.1: SHORT-RUN CAPITAL SPENDING BY YEAR AND FUNCTION, UNDISCOUNTED



Source: TRU.

The capital projects will create impacts on the TRU Region's economy in a variety of ways. The initial capital investments will consist of the construction of the capital projects, providing short-run spending impacts. Once the construction is completed, the new capacities will allow TRU to serve additional students whom they would otherwise not be able to serve. The capital projects will create new jobs for additional faculty and staff, and will increase the day-to-day operational purchases from local businesses. Additionally, TRU will attract more students to the region and retain students in the region that would have left, thus positively impacting the regional economy through the students' spending. This will provide a steady stream of long-run spending impacts year after year. Lastly, as the students who would otherwise not have been served graduate, they create long-run benefits within the region.

In this section, we estimate these impacts under four headings: 1) the short-run capital spending impact from the spending on construction and equipment purchases; 2) the long-run operations spending impact from the new capacities added to the university's payroll and purchases; 3) the long-run student spending impact from the day-to-day expenditures of additional students the university is able to serve; and 4) the long-run alumni impact from the additional graduates that TRU will be able to produce. The impacts are measured on the TRU Region, which is TRU's college region designated by the Government of British Columbia. It is comprised of a group of census subdivisions in south central British Columbia.[3]

3 See Government of British Columbia College Regions. https://www2.gov.bc.ca/gov/content/data/geographic-data-services/land-use/administrative-boundaries/college-regions.

Short-run capital spending impacts

The construction spending will be used for campus maintenance and renovations, as well as to construct new state-of-the-art facilities and to purchase equipment to serve more students. As outlined in Figure 2.1, the spending will occur during the course of six years. We refer to this period as the construction phase. Over the course of the construction phase, a total of $87.4 million will be spent. This spending will create a significant increase in the demand for the goods and services that are required to construct the capital projects. The initial spending will create subsequent rounds of spending and corresponding multiplier effects that will generate still more jobs and income throughout the TRU Region's economy. The short-run capital spending impacts only extend until FY 2021, when the construction phase ends.

The first step in estimating the multiplier effects of the construction spending is to map the two spending categories in Figure 2.1 – construction and equipment – to the 303 industries of the Emsi CRIO model. We assume TRU's spending patterns on the capital projects approximately match national averages for those categories and apply national spending patterns for the Educational Services (Universities) industry sector (NAICS 6113).

The next step is to estimate the portion of these expenditures that occur inside the region. The expenditures occurring outside the region are known as leakages. We estimate in-region expenditures using regional purchase coefficients (RPCs), a measure of the overall demand for the commodities produced

by each sector that is satisfied by TRU Region suppliers, for each of the 303 industries in the CRIO model. For example, if 80% of the demand for NAICS 2371 (Utility System Construction) is satisfied by regional suppliers, the RPC for that industry is 80%. The remaining 20% of the demand for NAICS 2371 is provided by suppliers located outside TRU Region.

The spending is multiplied, industry by industry, by the corresponding RPC to arrive at the in-region spending. Of the $87.4 million spent during the course of the construction phase, we estimate $66 million will be spent within TRU Region and $21.4 million will be spent on out-of-region goods and services (Table 2.2). Finally, in-region spending is entered, industry by industry, into the CRIO model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on labour income, non-labour income, total added income, and sales.

TABLE 2.2: CAPITAL SPENDING BY YEAR AND PLACE OF OCCURRENCE, UNDISCOUNTED

Year	In-region (thousands)	Out-of-region (thousands)	Total (thousands)
FY 2016	$196	$51	$247
FY 2017	$2,759	$1,571	$4,330
FY 2018	$18,475	$5,659	$24,134
FY 2019	$24,598	$6,363	$30,961
FY 2020	$18,083	$5,688	$23,771
FY 2021	$1,866	$2,103	$3,969
Total	**$65,977**	**$21,434**	**$87,411**

Source: Emsi impact model.

To illustrate the detailed economic impact calculation, Table 2.3 presents the impact of capital spending for the first year of spending, FY 2016. The initial sales effect is equal to $247 thousand, the total spending in FY 2016. The in-region impacts created by the initial effect appear in the next four rows under the section labelled *multiplier effect*.

TABLE 2.3: CAPITAL SPENDING IMPACT, FY 2016

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
Initial effect	$0	$0	$0	$247
Multiplier effect				
Direct effect	$49	$39	$88	$196
Indirect effect	$15	$12	$28	$61
Induced effect	$13	$10	$23	$51
Gross impact (initial + multiplier)	**$77**	**$62**	**$139**	**$556**
Less alternative uses of funds	-$4	-$4	-$8	-$15
Net impact	**$73**	**$58**	**$131**	**$541**

To fund the capital projects, TRU will receive an estimated $77.1 million of the funding from external sources. Between federal, provincial, and a portion of the institutional funds, it is estimated that 88% of the funding is from outside of the TRU Region. The remaining $10.3 million stems from sources within the region. Had these regional funds been spent on other projects, other economic impacts would have been created in the region. This scenario is commonly known as a counterfactual; i.e., what has not happened but what would have happened if a given event – in this case, the capital projects receiving these funds – had not occurred. In economic analysis, impacts that occur under counterfactual conditions are used to offset the impacts that actually occur in order to derive the true impact of the event under analysis.

We estimate this counterfactual by simulating a scenario where public monies are instead spent on consumer goods and savings. This simulates the public monies being returned to the taxpayers and being spent by the household sector. Our approach is similar to that described above. We map these public funds to the detailed industries of the CRIO model using national household expenditure coefficients, use the industry RPCs to estimate in-region spending, and run the in-region spending through the CRIO model's multiplier matrix to derive multiplier effects. The results of this exercise for FY 2016 are shown as negative values in the row labelled "Less alternative uses of funds" in Table 2.3. The total net impacts of the construction spending each year are equal to the total gross impacts less the impacts of the alternative uses of funds.

FIGURE 2.2: SHORT-RUN CAPITAL SPENDING IMPACTS BY YEAR, UNDISCOUNTED

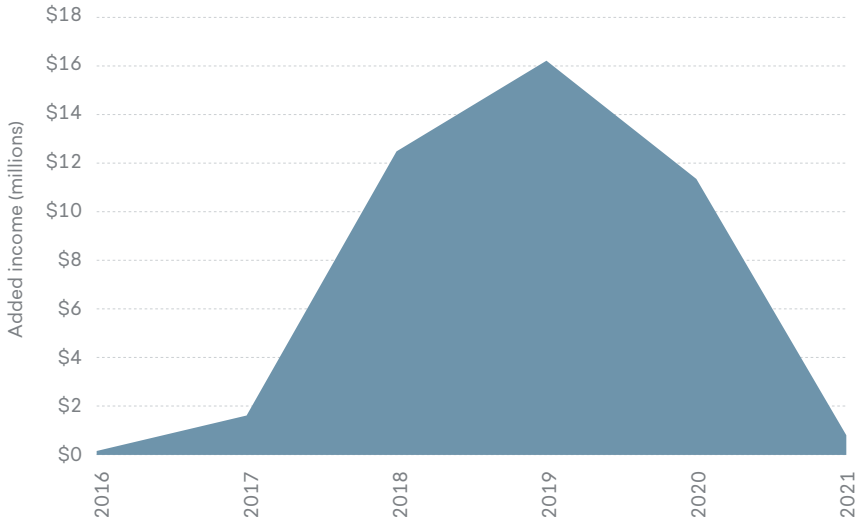


Table 2.3 and Figure 2.2 present undiscounted impacts. In order to understand the total impact from FY 2016 to FY 2021, we bring all past and future impacts to present values.[4] This is done using a discount rate of 2.8%, the discount rate recommended by the Bank of Canada for long-term investments.[5] Once this adjustment is made, we sum the present value of each year's impacts to reach a total net impact of capital spending from FY 2016 to FY 2021. Results are presented in Table 2.4. Spending toward the capital projects will create a net total short-run economic impact of $41.4 million in added income for the TRU Region.

Spending toward the capital projects will create a net total short-run economic impact of ***$41.4 million*** *in added income for the TRU Region.*

TABLE 2.4: PRESENT VALUE OF SHORT-RUN CAPITAL SPENDING IMPACTS, TOTAL FROM FY 2016 TO FY 2021

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2016–FY 2021, TOTAL				
Initial effect	$0	$0	$0	$85,150
Multiplier effect				
Direct effect	$15,834	$12,742	$28,576	$64,305
Indirect effect	$4,948	$3,976	$8,925	$20,009
Induced effect	$4,118	$3,302	$7,420	$16,560
Gross impact	**$24,900**	**$20,019**	**$44,920**	**$186,023**
Less alternative uses of funds	-$1,726	-$1,799	-$3,525	-$6,601
Net impact	**$23,174**	**$18,220**	**$41,394**	**$179,422**

4 For the purposes of this study, present values are in 2018 dollars. This is to provide consistency with TRU's comprehensive university-wide economic impact study, which uses FY 2018 as the year of analysis.

5 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/.

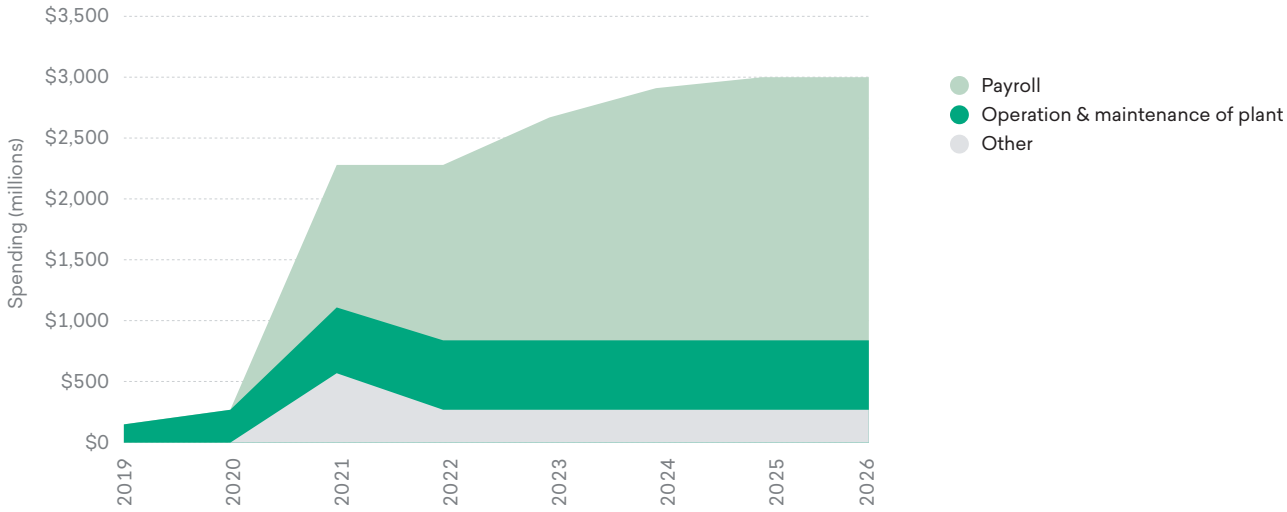
Long-run operations spending impacts

As the ITTC and NPH Building projects are completed, TRU will begin to utilise the newly added capacities. These capital projects will provide valuable services to improve the university's programs and training experiences for students. Utilizing these added capacities will create a new wave of economic activity that will include additional payroll for new faculty and staff, new capital and equipment spending, and added spending on other supplies (e.g., office supplies). In this section, we estimate the economic impact of this new round of operations spending that will occur as the construction is completed. These economic impacts will continue annually as long as the added capacities created by the capital projects are utilised. We estimate the operational impacts between FY 2019 (when the ITTC becomes operational, the first of the projects to do so), and FY 2026, the final year of this analysis.

To begin this analysis, we consider the revenue and spending needed to operate the capital projects per year. TRU provided information regarding the estimated increase in revenues and operations spending required for the capital projects. While the ITTC is not expected to result in additional faculty and staff at this time, the university spent $602.9 thousand for non-pay expenditures, including amortization and operation and maintenance of plant in FY 2019. This reflects a partial year of spending, as the ITTC became operational about halfway through the year. Expenses for the ITTC will reach full levels in FY 2020. In FY 2021, when the NPH Building becomes operational, the university expects to spend an additional $1.1 million on payroll and $1.4 million on non-pay expenses for the NPH Building, including amortization, operation & maintenance of plant, and other spending. In this analysis, we exclude expenses for amortization, as they represent a devaluing of the university's assets rather than an outflow of expenditures.

The added operational spending from the ITTC and NPH Building will grow over time until stabilised in FY 2025. By FY 2025, TRU is expected to spend $3 million per year for operations for the ITTC and NPH Building. To fund these operations, once stabilised, the university will use a combination of institutional funds, tuition from additional students, and provincial funding**.** Figure 2.3 outlines the operational expenditures by year and type.

FIGURE 2.3: ADDED OPERATIONS SPENDING (EXCLUDING AMORTIZATION) BY YEAR AND TYPE, UNDISCOUNTED



Source: TRU.

The first step in estimating the operations spending impacts is to map these categories to the 303 industries of the Emsi CRIO model. Assuming that the spending patterns of the university's personnel approximately match those of the average consumer, we map payroll to spending on industry outputs using national household expenditure coefficients supplied by the CRIO. For the other two expenditures categories (operation & maintenance of plant and other), we assume the spending patterns approximately match national averages and apply the national spending coefficients for the Educational Services (Universities) industry sector (NAICS 6113).

Using the RPCs, we estimate the portion of these expenditures that occur inside the region. The vectors of expenditures are multiplied, industry by industry, by the corresponding RPC to arrive at the in-region expenditures associated with the capital projects. Finally, in-region spending is entered, industry by industry, into the CRIO model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on labour income, non-labour income, total added income, and sales.

Table 2.5 presents the economic impact of operations spending for the first year of increased operations, FY 2019, and the last year of the analysis, FY 2026. For each year, the top row shows the initial effects of operations in terms of labour income, non-labour income, total added income, and sales. However, some of the funding for these increased operations came from regional sources. Consequently, we must account for any alternate uses of these funds. This is similar to the counterfactual we considered in the short-run capital spending

impacts section. The results of this exercise are shown as negative values in the rows labeled “Less alternative uses of funds” in Table 2.5. Figure 2.4 presents the total operations spending impacts by year in terms of added income.

TABLE 2.5: OPERATIONS SPENDING IMPACTS, FY 2019 AND FY 2026

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2019				
Initial effect	$0	$0	$0	$157
Multiplier effect				
Direct effect	$28	$31	$59	$104
Indirect effect	$7	$7	$14	$26
Induced effect	$8	$8	$16	$29
Gross impact	**$43**	**$46**	**$89**	**$315**
Less alternative uses of funds	-$11	-$11	-$22	-$41
Net impact, FY 2019	**$32**	**$35**	**$67**	**$274**
FY 2026				
Initial effect	$1,972	$0	$1,972	$3,005
Multiplier effect				
Direct effect	$134	$144	$278	$511
Indirect effect	$31	$33	$65	$123
Induced effect	$349	$364	$713	$1,329
Gross impact	**$2,487**	**$541**	**$3,028**	**$4,967**
Less alternative uses of funds	-$272	-$283	-$554	-$1,038
Net impact, FY 2026	**$2,216**	**$258**	**$2,474**	**$3,929**

FIGURE 2.4: OPERATIONS SPENDING IMPACTS BY YEAR, UNDISCOUNTED

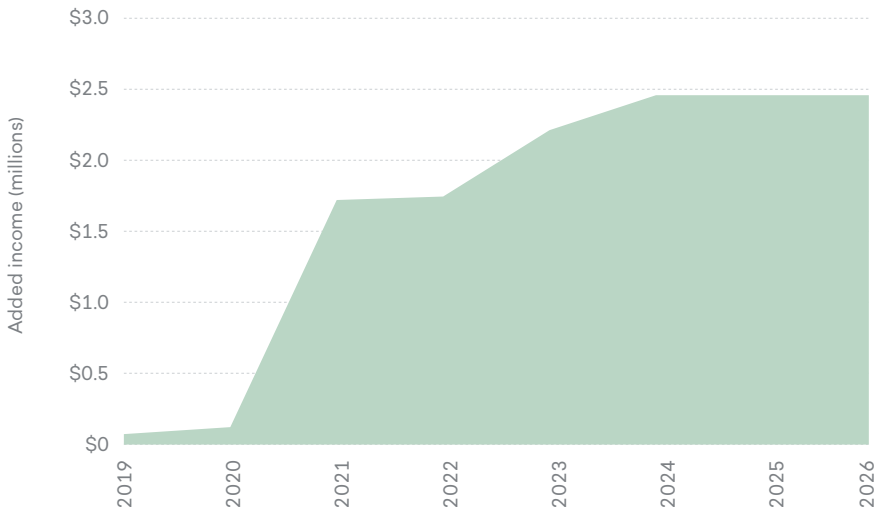


Table 2.5 and Figure 2.4 present undiscounted impacts. The total impacts, summed across FY 2019 to FY 2026 and adjusted to reflect present values, are presented in Table 2.6. From FY 2019 to FY 2026, the present value of increased operations spending resulting from the capital projects will create $9.9 million in labour income and $1.5 million in non-labour income, equal to $11.4 million in total added income.

TABLE 2.6: PRESENT VALUE OF OPERATIONS SPENDING IMPACTS, TOTAL FROM FY 2019 TO FY 2026

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2019–FY 2026, TOTAL				
Initial effect	$8,419	$0	$8,419	$14,256
Multiplier effect				
Direct effect	$801	$858	$1,658	$3,047
Indirect effect	$187	$198	$385	$733
Induced effect	$1,556	$1,618	$3,174	$5,903
Gross impact	**$10,962**	**$2,674**	**$13,636**	**$23,939**
Less alternative uses of funds	-$1,089	-$1,134	-$2,223	-$4,162
Net impact	**$9,873**	**$1,539**	**$11,413**	**$19,777**

ANNUAL OPERATIONS SPENDING IMPACTS

While the total impacts that occur from FY 2019 to FY 2026 are relevant because of the temporal nature of the operations spending, it is critical to understand that there will be a recurring annual operations spending impact as long as the capacities created by the capital projects are utilised. These are the true long-run operations spending impacts. Without making any assumptions for growth beyond the time frame of this analysis, the TRU Region's economy will enjoy an annual impact of $2.6 million in total added income from operations spending. This is equivalent to supporting 24 jobs every year.

Long-run student spending impacts

Students will contribute to the economic impact of the capital projects. The ITTC and NPH Building will add to TRU's capacity, allowing the university to serve more students. Once enrolment stabilises at 377 students in FY 2024, approximately 41% of the additional students will originate from outside the region. All of these students will relocate to the region in order to attend TRU. These students will bring monies with them to spend on living arrangements, food, transportation, and so forth.

The capital projects will add to TRU's capacity, allowing the university to serve more students.

Once stabilised, of the estimated 377 additional students served each year, an estimated 223 will be from the TRU Region. However, not all of them will remain in the region if not for the added capacities created by the capital projects. We apply a conservative assumption that 10% of these students will leave the TRU Region for other education opportunities if the TRU did not have the additional capacity to serve them. The money that these students, called retained students, will spend on groceries, accommodation, transportation, and so on will now remain in the region.

The spending of these relocated and retained students while they attend TRU can be attributed to the capital projects. The average costs for students appear in Table 2.7, equal to $10,861 per student. Note that this table excludes expenses for books and supplies, since these monies may already be reflected in the operations spending impact discussed in the previous section.

TABLE 2.7: AVERAGE ANNUAL STUDENT SPENDING

Room and board	$5,050
Personal expenses	$4,735
Transportation	$1,076
Total expenses per student	**$10,861**

Source: Student costs provided by provided by TRU and a report by Roslyn Kunin and Associates.

The student spending impacts are expected to start in FY 2020, when the first additional students are served, and last until FY 2026, the final year of this analysis. Table 2.8 outlines the total number of students TRU expects to serve each year. By multiplying the $10,861 in annual costs by the number of relocated or retained students each year, we arrive at a total of $2.7 million in annual sales, once stabilised.[6] The student spending impacts continue until FY 2026, the cutoff date in this study's time horizon.

TABLE 2.8: ADDED STUDENTS AND TOTAL SALES BY YEAR, UNDISCOUNTED

Year	Additional students	Additional relocated students	Additional retained students	Sales from relocated students (thousands)	Sales from retained students (thousands)	Total sales (thousands)
FY 2020	189	69	12	$1,042	$181	$1,223
FY 2021	242	93	15	$1,405	$225	$1,630
FY 2022	295	117	18	$1,769	$268	$2,037
FY 2023	348	141	21	$2,132	$312	$2,445
FY 2024	377	154	22	$2,331	$336	$2,667
FY 2025	377	154	22	$2,331	$336	$2,667
FY 2026	377	154	22	$2,331	$336	$2,667

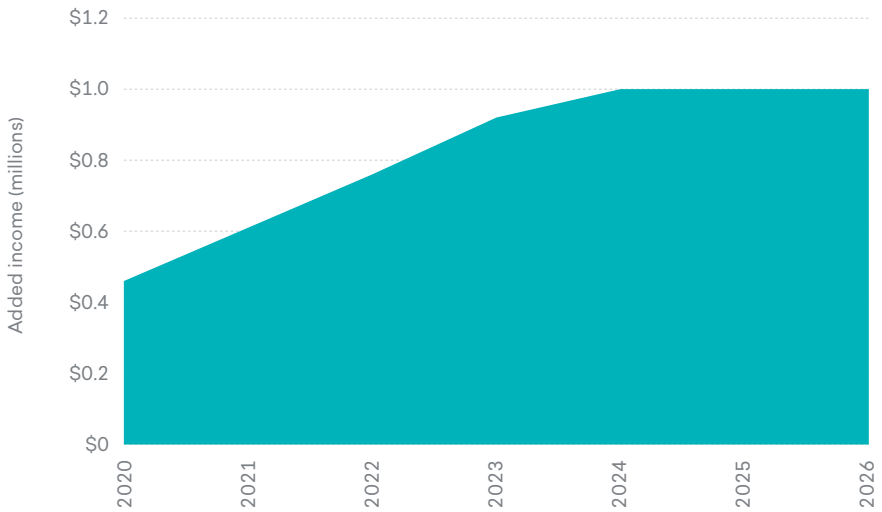
Estimating the impacts generated by the student spending follows a procedure similar to that of the other impacts previously described. We distribute the sales to the industry sectors of the CRIO model, apply RPCs to reflect in-region spending, and run the sales figures through the CRIO model to derive multiplier effects. Unlike the previous impacts, the initial effect is purely sales-oriented and there is no change in labour or non-labour income. The impact of student spending thus falls entirely under the multiplier effect. Table 2.9 outlines the impacts in detail in FY 2020 and FY 2026, the first and last years of the student spending impacts in this analysis, while Figure 2.5 outlines the impacts for every year.

6 Numbers may not match by multiplying due to rounding.

TABLE 2.9: STUDENT SPENDING IMPACTS, FY 2020 AND FY 2026

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2020				
Initial effect	$0	$0	$0	$880
Multiplier effect				
Direct effect	$140	$172	$312	$573
Indirect effect	$26	$38	$64	$116
Induced effect	$36	$46	$83	$146
Total impact, FY 2020	**$203**	**$257**	**$459**	**$1,714**
FY 2026				
Initial effect	$0	$0	$0	$1,919
Multiplier effect				
Direct effect	$305	$376	$681	$1,251
Indirect effect	$58	$82	$140	$252
Induced effect	$79	$101	$180	$318
Total impact, FY 2026	**$442**	**$560**	**$1,002**	**$3,740**

FIGURE 2.5: STUDENT SPENDING IMPACTS BY YEAR, UNDISCOUNTED



The total long-run student spending impacts, summed across those years and adjusted to reflect present values, are presented in Table 2.10. From FY 2020 to FY 2026 , the additional students will add $2.2 million in labour income and $2.8 million in non-labour income, totaling $5 million in total added income for the TRU Region's economy.

TABLE 2.10: PRESENT VALUE OF STUDENT SPENDING IMPACTS, TOTAL FROM FY 2020 TO FY 2026

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2020–FY 2026, TOTAL				
Initial effect	$0	$0	$0	$9,528
Multiplier effect				
Direct effect	$1,516	$1,868	$3,383	$6,211
Indirect effect	$286	$409	$695	$1,251
Induced effect	$393	$502	$895	$1,577
Total impact	**$2,195**	**$2,779**	**$4,974**	**$18,567**

ANNUAL STUDENT SPENDING IMPACTS

While the total impacts that occur from FY 2020 to FY 2026 are relevant because of the temporal nature of the capital projects, there will be recurring annual student spending impacts as long as the capital projects serve students. These are the true long-run student spending impacts. The TRU Region's economy will benefit from $1.0 million in total added income annually, which is equivalent to supporting 19 jobs.

Long-run alumni impacts

While TRU's capital projects will create economic impacts through capital, operations, and student spending, the real mission and purpose of TRU and of the capital projects is to foster human capital – i.e., knowledge, creativity, imagination, and entrepreneurship. The added capacities created by the capital projects will allow TRU to serve a larger student population. By FY 2026, an estimated 904 new alumni will have graduated from the university as a result of the capital projects.[7] These are alumni that would have otherwise not graduated from TRU but for the capital projects.

Students attending TRU's programs at the ITTC and NPH Building will receive **a wide range of knowledge, skills, and abilities** *that will increase their productivity.*

Students attending TRU's programs at the ITTC and NPH Building will receive a wide range of knowledge, skills, and abilities that will increase their productivity and allow them to command a higher wage once they enter the workforce. But the reward of increased productivity does not stop there. Talented professionals make capital, such as buildings, production facilities, and equipment, more productive too. The employers of TRU's alumni enjoy the fruits of this increased productivity in the form of additional non-labour income (i.e., higher profits). In this section, we estimate the economic impacts stemming from the higher labour income of these alumni in combination with the increased productivity that will be enjoyed by their future employers. The time horizon for this portion of the analysis falls between

7 Emsi worked with TRU to determine the expected number of additional alumni.

FY 2020 and FY 2026, the earliest and latest points in the analysis time frame when the capital projects would add a new cohort of additional alumni to the TRU Region's economy. Note that, unlike the alumni impact in the university-wide economic impact study conducted by Emsi for TRU for FY 2018, in this long-run analysis, only those students that graduate are measured.

There is an important difference between the alumni impact and the impacts estimated in the previous sections. Whereas the short-run and long-run spending impacts stem from an injection of new sales into the regional economy, the alumni impact stems from the increased human capital that will accumulate in the TRU Region workforce as a result of the capital projects. The initial effect of alumni is comprised of two main components. The first and largest of these is the added labour income of TRU's graduates. The second component is the added non-labour income of the businesses that will employ alumni of TRU.

To estimate the added labour income created each year, we use the number of additional alumni produced and their *incremental* added labour income stemming from their educations. The number of alumni is calculated using the enrolments as outlined in the student spending impact (Table 2.8) and multiplying them by each degree level's graduation rate. The incremental labour income is the difference between the earnings at each level of education of new graduates and the earnings at the level of education the students had when entering TRU. For example, since the majority of certificate-seeking students that will be served as a result of the ITTC will enter with a high school diploma, the incremental added labour income associated with the alum is the difference between the average earnings for someone with a certificate and someone with a high school diploma entering the workforce.[8] The average earnings in the TRU Region associated with each level of educational attainment are listed in Table 2.11 and Figure 2.6. The added labour income created each year is equal to the sum of the incremental earnings of each year's new alumni working in the regional workforce.

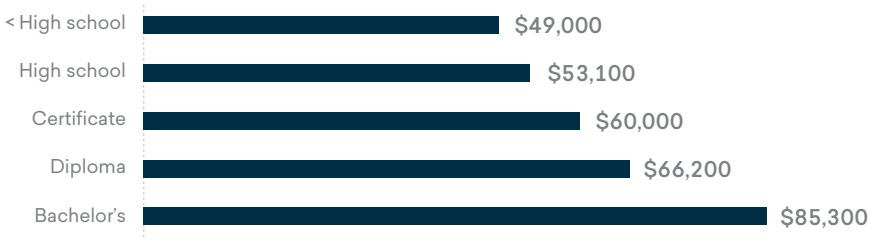
TABLE 2.11: AVERAGE ANNUAL EARNINGS BY EDUCATION LEVEL IN THE TRU REGION

Year	Annual earnings	Difference in earnings from high school diploma	Once stabilised, annual graduates*
Less than high school	$49,000	n/a	n/a
High school	$53,100	$4,100	n/a
Certificate	$60,000	$6,900	106
Diploma	$66,200	$13,100	n/a
Bachelor's	$85,300	$32,200	53

* Graduates were calculated using projected annual enrolments and graduation rates provided by TRU.
Source: Derived from data provided by Statistics Canada and outputs of Emsi's CRIO model. These earnings have been tailored to reflect earnings for students in TRU's programs related to the ITTC and NPH Building.

8 For bachelor's degree graduates entering the workforce, we also use the difference in earnings between someone with a bachelor's degree and someone with a high school degree.

FIGURE 2.6: AVERAGE ANNUAL EARNINGS BY EDUCATION LEVEL IN THE TRU REGION



Source: Derived from data provided by Statistics Canada and outputs of Emsi's CRIO model. These earnings have been tailored to reflect earnings for students in TRU's trades and nursing programs related to the ITTC and NPH Building.

Because we only want to consider alumni that would graduate as a result of the capital projects, there are two counterfactuals we must consider. First, there are alternative education opportunities. In the scenario where the capital projects do not occur and TRU does not serve these additional students, a portion of these additional alumni may receive an alternative comparable education elsewhere and work post-graduation in the TRU Region. The incremental labour income that accrues to these students cannot be counted towards the added labour income created by the capital projects. We assume 15% of these alumni would receive an alternative comparable education. This means that 15% of the added labour income from the additional alumni would be generated in the TRU Region's economy anyway, even without the added capacities from the capital projects.

Second, we need to account for the importation of labour. Suppose the capital projects do not occur and the added capacities of TRU do not exist. These alumni would not graduate and there would be fewer skilled workers in the TRU Region. However, businesses could still satisfy some of their need for skilled labour by recruiting from outside the TRU Region. We refer to this as the labour import effect. Lacking information on its possible magnitude, we assume 50% of the jobs that students fill at regional businesses could have been filled by workers recruited from outside the region.

As seen in Table 2.12, the weighted average wage increase per additional alumnus is $13,736. This differential was dampened to account for "ability bias" to account for other factors besides education that influence individual behavior. After accounting for the two above counterfactual scenarios, the net wage increase per alumnus is $4,807.

TABLE 2.11: WEIGHTED AVERAGE EARNINGS INCREASE PER ADDITIONAL ALUMNUS

Average wage increase per alumnus	$13,736
Alternative education variable	15%
Labour import effect	50%
Net wage increase per alumnus	**$4,807**

Source: Emsi impact model.

It is important to understand that the alumni impacts are cumulative as more alumni are produced. For example, the first alumni graduate from certificate programs at the end of FY 2020. The added labour income in FY 2020 will only consist of their incremental earnings. Alumni are also produced in FY 2021 from the second cohort of certificate students. The total incremental added labour income in FY 2021 will equal the sum of the alumni added labour income from FY 2020 and FY 2021. This accumulates each year, increasing in FY 2024 when the first cohort of additional bachelor's degree students graduates from nursing programs as a result of the NPH Building. This continues until FY 2026, the cut-off date in this study's time horizon. Each year's alumni are adjusted for various measures of attrition such as unemployment and migration to determine how many are active in the regional workforce. Table 2.13 shows the accumulation of alumni. Using these active alumni, we then calculate added labour income by year.

TABLE 2.13: ADDITIONAL ALUMNI AND LABOUR INCOME BY YEAR

Fiscal year	Annual alumni	Cumulative alumni in region (after attrition)	Added labour income, undiscounted (thousands)*
FY 2020	106	46	$60
FY 2021	106	110	$146
FY 2022	106	178	$241
FY 2023	106	246	$340
FY 2024	159	338	$591
FY 2025	159	444	$953
FY 2026	159	552	$1,343

* The added labour income is calculated using the cumulative active alumni.
Source: TRU and the Emsi impact model.

Now that we have the labour income portion of our initial effect, we estimate the non-labour income portion of the initial effect. As discussed earlier in this section, businesses that employ alumni from TRU enjoy higher profits as a result of the increased productivity of their capital assets. To estimate this additional income, we allocate the initial increase in labour income to the four-digit NAICS industry sectors where students are most likely to be employed. We do so by using inverse staffing patterns, which break down the industries in which students are most likely to be employed. Finally, we apply a matrix of wages by industry and by occupation from the CRIO model to map the occupational distribution of the initial labour income effects to the detailed industry sectors in the CRIO model.[9]

Once these allocations are complete, we apply the ratio of non-labour to labour income provided by the CRIO model for each sector to our estimate of initial labour income. This computation yields the non-labour income attributable to TRU's additional alumni. Summing initial labour and non-labour income together

9 For example, if the CRIO model indicates that 60% of wages paid to workers in NOC 3012 (Registered nurses and registered psychiatric nurses) occur in NAICS 6221 (General Medical and Surgical Hospitals), then we allocate 60% of the initial labour income effect under NOC 3012 to NAICS 6221.

provides the total initial effect of these additional alumni in the TRU Region's economy, as represented by the "Total added income" column. We now have a complete initial effect from which we can derive the multiplier effects. To do so, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from the CRIO model. We then run the values through the CRIO's multiplier matrix, as described at the beginning of this section. Table 2.14 outlines the impacts in detail in FY 2020 and FY 2026, the first and last years of the alumni impacts in this analysis, while Figure 2.7 outlines the impacts for every year of the analysis.

TABLE 2.14: ALUMNI IMPACTS, FY 2020 AND FY 2026, UNDISCOUNTED

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2020				
Initial effect	$60	$59	$119	$241
Multiplier effect				
Direct effect	$9	$10	$18	$40
Indirect effect	$2	$2	$4	$9
Induced effect	$17	$15	$31	$56
Total impact, FY 2020	**$87**	**$86**	**$173**	**$345**
FY 2026				
Initial effect	$1,343	$1,333	$2,676	$5,398
Multiplier effect				
Direct effect	$196	$213	$409	$894
Indirect effect	$42	$48	$89	$199
Induced effect	$371	$330	$700	$1,244
Total impact, FY 2026	**$1,951**	**$1,923**	**$3,874**	**$7,734**

FIGURE 2.7: ALUMNI IMPACTS BY YEAR, UNDISCOUNTED

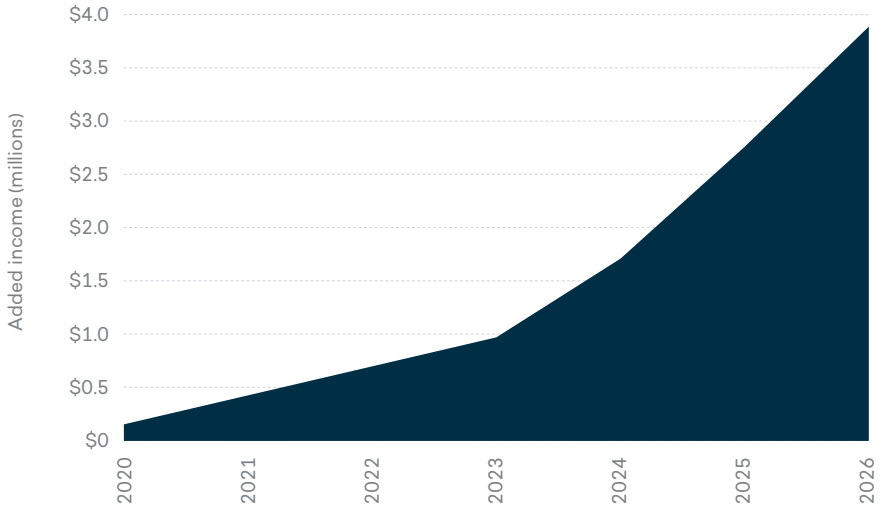


Table 2.14 and Figure 2.7 present the undiscounted alumni impacts. The total long-run alumni impacts, summed across FY 2020 to FY 2026 and adjusted to reflect present values, are presented in Table 2.15. From FY 2020 to FY 2026, the additional alumni will add $4.5 million in labour income and $4.4 million in non-labour income, equal to $8.9 million in total added income.

TABLE 2.15: PRESENT VALUE OF ALUMNI IMPACTS, TOTAL FROM FY 2020 TO FY 2026

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2020–FY 2026, TOTAL				
Initial effect	$3,076	$3,052	$6,128	$12,363
Multiplier effect				
Direct effect	$448	$488	$936	$2,046
Indirect effect	$95	$109	$204	$456
Induced effect	$849	$755	$1,604	$2,848
Net impact	**$4,469**	**$4,403**	**$8,872**	**$17,714**

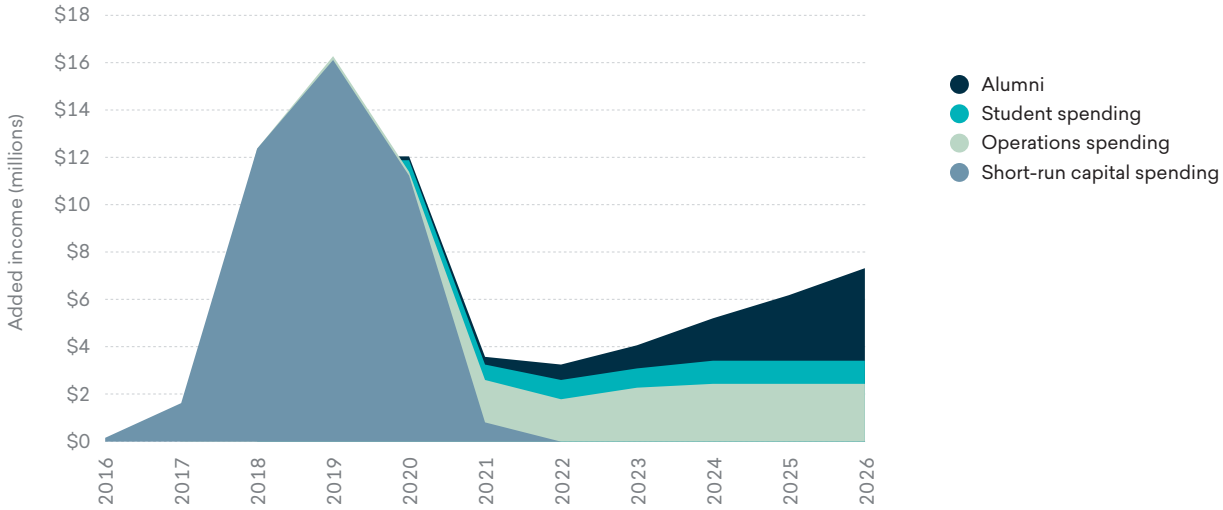
ANNUAL ALUMNI IMPACTS

Similar to the long-run spending impacts, recurring alumni impacts will continue as long as TRU serves additional students as a result of the capital projects. However, unlike the previous long-run spending impacts, the alumni impacts will continue to accumulate and grow as more and more alumni are produced and as long as these alumni remain in TRU Region. The capital projects will allow TRU to graduate around 159 additional alumni per year. Most of these students will work in the region, creating an annual impact of at least $3.9 million in total added income each year, equivalent to supporting 42 jobs per year for the TRU Region. This annual impact is expected to increase every year for several years as the capital projects continues to graduate more students and they enter the regional workforce.

Total economic impacts

In this analysis, we estimate four types of economic impacts created by the capital projects: short-run capital spending impacts, and long-run operations spending, student spending, and alumni impacts. Given each type of impact has different timelines, they occur at different points in time across our analysis timeframe of FY 2016 to FY 2026. Figure 2.8 presents the undiscounted year-by-year totals of the four impacts.

FIGURE 2.8: TOTAL IMPACTS BY YEAR, UNDISCOUNTED



To understand what these impacts mean in present value terms, we adjust them to present values using a discount rate of 2.8%. From FY 2016 to FY 2026, the short-run and long-run impacts created by the capital projects will provide a total present value economic impact on the TRU Region's economy of $39.7 million in labour income and $26.9 million in non-labour income, equal to $66.7 million in total added income. Table 2.16 presents the present value sum of the total impacts from FY 2016 to FY 2026.

TABLE 2.16: PRESENT VALUE TOTAL IMPACTS FROM FY 2016 TO FY 2026

	Labour income (thousands)	Non-labour income (thousands)	Total added income (thousands)	Sales (thousands)
FY 2016–FY 2026, TOTAL				
Initial effect	$11,495	$3,052	$14,547	$121,297
Multiplier effect				
Direct effect	$18,599	$15,954	$34,553	$75,609
Indirect effect	$5,516	$4,693	$10,208	$22,449
Induced effect	$6,916	$6,177	$13,093	$26,888
Gross impact	**$42,526**	**$29,875**	**$72,401**	**$246,243**
Less alternative uses of funds	-$2,815	-$2,933	-$5,748	-$10,763
Net impact	**$39,711**	**$26,942**	**$66,653**	**$235,480**

ANNUAL IMPACTS

The economic impacts discussed thus far are those summed across the analysis years of FY 2016 to FY 2026 and adjusted to present values. However, each of the three long-run types of impacts will create an annual impact. These break down as follows:

- **Operations spending annual impact:** The capital projects will increase TRU's operational spending. By FY 2024, when operations stabilise, increased operations spending will add around **$2.5 million** in income on an annual basis, equivalent to supporting **23 jobs** per year.
- **Student spending annual impact:** Once the additional number of students TRU is able to serve stabilises at around 377 students, **$1.0 million** in income will be added per year, or **19 jobs** supported, as a result of spending from retained and relocated students in the region.
- **Alumni annual impact:** As a result of the expanded capacities made possible through the capital projects, TRU will produce more alumni every year, who will then accumulate in the regional workforce. By FY 2026, the last year of this analysis, additional alumni are estimated to add **$3.9 million** in total income to the economy per year, supporting **42 jobs**. This annual impact is expected to increase every year as TRU continues to serve more students and they enter the regional workforce.

The total annual impact from the capital projects will be at least **$7.4 million** in added income. This is equivalent to supporting **84 jobs** every year.

Resources and References

Bank of Canada. "Canadian interest rates and monetary policy variables: 10-year lookup." Bank of Canada Rates & Statistics. http://www.bankofcanada.ca/rates/interest-rates/canadian-interest-rates/.

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/.

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." *Labor Economics* 19, no. 5 (October 2012): 706-717.

Canadian Automobile Association. "Driving Costs 2013." CAA, August 2013. http://www.caa.ca/driving-costs/.

Canada Mortgage and Housing Corporation, 2016 Rental Market Report. "Table 1.0. Rental market indicators." https://www.cmhc-schl.gc.ca/odpub/esub/64667/64667_2016_A01.pdf?lang=en. Accessed September 2017.

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

Desjardins, Louise and Darren King. "Expectations and Labour Market Outcomes of Doctoral Graduates from Canadian Universities." Statistics Canada, Human Resources and Skills Development Canada, Tourism and Centre for Education Statistics Division, January 2011. http://www.statcan.gc.ca/pub/81-595-m/81-595-m2011089-eng.pdf.

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.

Emsi labour market data and software. http://www.economicmodeling.com.

Ferrer, Ana and Craig Riddell. "The role of credentials in the Canadian labour market." *Canadian Journal of Economics* 35, no. 4 (November 2002): 879-905.

Flegg, A.T. 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.

Emsi

Emsi is a labour market analytics firm that integrates data from a wide variety of sources to serve professionals in postsecondary education, economic development, workforce development, talent acquisition, and site selection. Emsi is a leading provider of economic impact studies and labour market data to educational institutions in Canada, the U.S. and internationally. Since 2000, Emsi has completed over 2,000 economic impact studies for institutions across four countries. Visit www.economicmodeling.com for more information about Emsi's products and services.

Flegg, A.T. 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.

Flegg, A.T. and T. Tohmo. "Regional Input-Output Tables and the FLQ Formula: A Case Study of Finland." *Regional Studies* 47, no. 5 (2013): 703-721.

Flegg, A.T. and C.D. Webber. "Regional Size, Industrial Location and Input-Output Expenditure Coefficients." *Regional Studies* 32, no. 55 (1997): 435-444.

Flegg, A.T. and C.D. Webber. "Regional Size, Regional Specialization and the FLQ Formula." *Regional Studies* 34, no. 6 (2000): 563-569.

Government of Canada. "Current and Forthcoming Minimum Hourly Wage Rates for Experienced Adult Workers in Canada." Government of Canada Minimum Wage Database. http://srv116.services.gc.ca/dimt-wid/sm-mw/rpt1.aspx?lang=eng.

Government of Canada. "Deciding when to apply for your CPP retirement pension." Government of Canada Service Canada. http://www.servicecanada.gc.ca/eng/isp/pub/factsheets/cppretirement/when.shtml.

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

Human Resources and Skills Development Canada. "Level of Education, 15 years of age and over, 1990-2012 (percent)." Indicators of Well-Being in Canada, Learning - Educational Attainment. http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=29.

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.

The International Comparative Higher Education and Finance Project. "Table 2: Higher Education Expenses Borne by Parents and Students, Canadian Colleges and Universities First Degree [Academic] Year 2009-10" in "Higher Education Finance and Cost-Sharing in Canada." University of Buffalo, The State University of New York, Graduate School of Education. Updated April 2010.

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

Miller, Ronald E. and Peter D. Blair. *Input-Output Analysis: Foundations and Extensions*. New York: Cambridge University Press, 2009.

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.

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.

OECD. "Household savings" in *OECD Factbook 2011-2012: Economic, Environmental and Social Statistics*. OECD Publishing. http://dx.doi.org/10.1787/factbook-2011-22-en.

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

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.

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. http://www.international.gc.ca/education/assets/pdfs/economic_im-pact_en.pdf.

Statistics Canada. "Income in 2010 (34), Age Groups (10B), Sex (3) and Highest Certificate, Diploma or Degree (11) for the Population Aged 15 Years and Over in Private Households of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2011 National Household Survey." 2011 National Household Survey, Statistics Canada Catalogue no. 99-014-X2011040. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/dt-td/Rp-eng.cfm?Lang=E&Apath=3&Detail=0&DIM=0&FL=A&Free=0&gc=0&gid=0&gk=0&grp=0&pid=106637&prid=0&Ptype=105277&S=0&Showall=0&Sub=0&Temporal=2013&Theme=98&VID=0&Vnamee=&Vnamef=.som/l01/cst01/health80a-eng.htm.

Statistics Canada. "Labour force characteristics, seasonally adjusted, by province (monthly)." Statistics Canada Summary Tables. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/lfss01a-eng.htm.

Statistics Canada. "Life Tables, Canada, Provinces and Territories." Catalogue no. 84-537-X. http://www.statcan.gc.ca/pub/84-537-x/84-537-x2013003-eng.pdf.

Statistics Canada. "Table 051-0001. Estimates of population, by age group and sex for July 1, Canada, provinces and territories." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0510001&tabMode=dataTable&srchLan=-1&p1=-1&p2=9#customizeTab.

Statistics Canada. "Table 051-0046. Estimates of population by census metropolitan area, sex and age group for July 1, based on the Standard Geographical Classification (SGC) 2006." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=0510046&pattern=0510046&searchTypeByValue=1&p2=35.

Statistics Canada. "Table 051-0052. Estimates of population by census division, sex and age group for July 1, based on the Standard Geographical Classification (SGC) 2006." http://www5.statcan.gc.ca/cansim/pick-choisir?lang=eng&p2=33&id=0510052.

Statistics Canada. "Table 7: Average income by highest level of education attained, school/work status and gender." Statistics Canada Publication 81-595-M. http://www.statcan.gc.ca/pub/ 81-595-m/2009075/tbl/tbl7-eng.htm.

Statistics Canada. "Table 111-0027. Provincial and international in-, out- and net-migration estimates, by provincial regions." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=1110027&tabMode=dataTable&srchLan=-1&p1=-1&p2=9.

Statistics Canada. "Table 202-0407. Income of individuals, by sex, age group and income source, 2011 constant dollars." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=2020407&paSer=&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid=.

Statistics Canada. "Table 282-0002: Labour force survey estimates (LFS), by sex and detailed age group." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=2820002&paSer=&pattern=&stByVal=1&p1=1&p2=37&tabMode=dataTable&csid=.

Statistics Canada. "Table 282-0004: Labour force survey estimates (LFS), by educational attainment, sex and age group." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/pick-choisir?lang=eng&p2=33&id=2820004.

Statistics Canada. "Table 282-0086: Labour force survey estimates (LFS), supplementary unemployment rates by sex and age group." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=2820086&paSer=&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid=.

Statistics Canada. "Table 282-0089. Labour force survey estimates (LFS), employment by class of worker and sex, seasonally adjusted and unadjusted." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=2820089&pattern=282-0069..282-0089&tabMode=dataTable&srchLan=-1&p1=-1&p2=31.

Statistics Canada. "Table 384-0037. Gross domestic product, income-based, provincial and territorial." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a46?lang=eng&childId=3840037&CORId=3764&viewId=2.

Statistics Canada. "Table 477-0019: Public postsecondary enrolments, by registration status, Pan-Canadian Standard Classification of Education (PCSCE), Classification of Instructional Programs, Primary Grouping (CIP_PG), sex and immigration status." Statistics Canada CANSIM. http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=4770019&paSer=&pattern=&stByVal=1&p1=1&p2=31&tabMode=dataTable&csid=.

Stone, Charley, Carl Van Horn, and Cliff Zukin. "Chasing the American Dream: Recent College Graduates and the Great Recession." New Brunswick, NJ: Rutgers University, May 2012. http://www.heldrich.rutgers.edu/sites/default/files/content/Chasing_American_Dream_Report.pdf.

Willis, Robert J. "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions." In *Handbook of Labor Economics*, Vol. 1. Edited by Kenneth J. Arrow and Michael D. Intriligator. Amsterdam: Elsevier Science Publishers, 1986: 525-602.

Appendix 1: Glossary of Terms

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

Alternative use of funds A measure of how monies that are currently used to fund the university might have otherwise been used if the university did not exist.

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

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).

Gross regional 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 regional product (GRP) equals the combined incomes of all factors of production, i.e., labour, land and capital. These include wages, salaries, profits, rents, and other. gross regional product is also sometimes called "value added."

Initial effect Income generated by the initial injection of monies into the economy through the expenditures of the university and its 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, when institutions pay wages and salaries and spend money for supplies in the region, they also generate earnings in all sectors of the economy, thereby increasing the demand for goods and services and jobs. Moreover, as students enter or rejoin the workforce with higher skills, they earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy.

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 the university and its 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).

Appendix 2: 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 gross regional product (GRP). 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 gross domestic product (GDP) – a measure of income – by economists when considering the economic growth or size of a country. The difference is GRP reflects a region and GDP 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, income can be found by summing the labour income and non-labour income. To provide context behind these figures, we also report the number of jobs associated with the income. The impacts are also reported in sales terms for reference.

Appendix 3: Emsi CRIO

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 regionalised 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 A3.1 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.

TABLE A3.1: 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

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.

Column elements of the input-output table (Table A3.1 above) are "normalised" 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 A3.2 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**.**

TABLE A3.2: SAMPLE "A" MATRIX

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

Regionalising the national A matrix

To create a regional input-output model, we "regionalise" a 303-sector version of the Canada national model derived from publicly available Canadian national L level models. Our regionalisation method is based on the work of economist A.T. Flegg[10] 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.[11] Flegg's breakthrough "modification" to the CILQ IO regionalising 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.

10 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.

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

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

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

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 regionalising, and that is the household row. The regionalising 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 regionalising 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,[12] 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 regionalising process. Based on the formulation presented above, we create a separate matrix of FLQs for all indus-

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

tries in a region. For example, the cell containing the FLQ of .12 in Table A3.3 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."

TABLE A3.3: SAMPLE FLQ MATRIX

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

The "regionalising" 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:

$$A^R = A^N \, o \, F^R$$

Where:

o = 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 A^R 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.