

Economic Impact of \$1,530 million of Grouse in Situ Oil Sands Project in Lac la Biche, Alberta

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Simulations run on the Canadian Regional Input-Output Model (CRIOM), developed and maintained by PolicyModel Corp. CRIOM is available online at PolicyModels.com.

Overview

This report summarizes the economic impact of \$1530000000 of spending on final domestic demand, in both Lac la Biche and the Rest-of-Canada. Economic indicators presented include: gross output, gross domestic product, employment, taxes, international and inter-regional imports.

The population Census profile of Lac la Biche is also provided to complete the socio-economic description of the region. Census profile data on population, households, housing, mobility, language, education, labour force, employment by industry class, unemployment, and occupation. The labour market of a region affects impact interpretation, since smaller populations may be unable to accommodate the regional employment demands from a large project.

The economic impact is computed using a regional input-output model specific to the industry detail in Lac la Biche. The input-output model framework is the cornerstone of economic analysis, with the general method in use for over 60 years (Leontief, 1950). The description of the model and underlying databases and assumptions are available in the appendices.

Census 2006 Profile of Lac la Biche

The 2006 Census of the population creates a demographic picture of Lac la Biche. The indicators presented are: population by age and gender, immigration and population mobility, household characteristics, housing, language, education, and labour force characteristics.

The Census data is taken 'as is' so for some smaller regions some data is unavailable, and to protect an individual's privacy rights Statistics Canada rounds to the nearest 5 persons, as a consequence, the detail in the table may not sum to the total presented.

Population, Immigration, and Mobility

Lac la Biche covers a land area of 6.18 square kilometres with a population of 2758. Canadian citizens make up 2620 of the population and the remainder are not Canadian citizens.

Immigration has, and remains, a large part of the population growth and change Canada.

Immigrant generational profile for Lac la Biche is: 1st generation at 45, 2nd generation at 45, and 3rd generation at 350.

Table 1: Population by Age Group and Gender

Age Group	Male	Female
TOTAL	1320	1435
0 to 4 years	125	120
5 to 9 years	110	115
10 to 14 years	120	110
15 to 19 years	105	100
20 to 24 years	100	115
25 to 29 years	110	110
30 to 34 years	85	105
35 to 39 years	80	85
40 to 44 years	95	110
45 to 49 years	75	90
50 to 54 years	80	85
55 to 59 years	70	65
60 to 64 years	30	50
65 to 69 years	45	40
70 to 74 years	35	45
75 to 79 years	30	35
80 to 84 years	20	30
85 years and over	15	45

A fundamental right of Canadians is the freedom of to move. Table 2 shows the migration patterns of the residents the population, for a 1 year and 5 year period. The Census information is based on the address of respondents. An individual with no change of address is considered a non-mover. Movers can be broken down into non-migrants (CSD does not change), intraprovincial (within the same province but a different CSD), interprovincial (different province), and external (coming from abroad).

POLICY MODELS

Table 2: Individual Mobility Status

Status	1 Year Ago	5 Years Ago
TOTAL	2615	2435
Non-movers	1935	1255
Movers	680	1175
Non-migrants	385	585
Migrants	295	590
Internal migrants	290	580
Intraprovincial migrants	175	345
Interprovincial migrants	115	240
External migrants	10	10

Household and Housing

Household demographics show the relationship between the population and families, where Statistics Canada uses the Census Family definition. Housing data provides information on the types of structures in the region, and also shows how individuals and families are grouped within these structures.

Table 3: Census Families and Private Household Composition

	Census Families	Private Household
TOTAL	730	1005
1 person		265
2 persons	350	310
3 persons	125	145
4 to 5 persons		240
4 persons	150	
5 or more	105	
6 or more		50
Average number of persons	3.00	2.70
Average number of children at home	1.20	

Household tenure (ownership) affects consumption. The cost of housing is a direct measure for households that rent, but households that own the property are adjusted for the imputed rent of their housing. Characteristics of the housing are key inputs into the imputed rent calculation.

Table 4: Housing Tenure and Characteristics

	Value
Owned	560
Rented	455
Band housing	0
Average number of rooms per dwelling	6.10
Average number of bedrooms per dwelling	2.80

The most common population density measure is persons per square kilometre. Other density measures provide additional socio-economic information on a region. Average number of persons per household and average number of bedrooms per dwelling indicates crowding and sleeping arrangements. Structure count and mixture of types are useful in interpreting the rural/urban density.

Table 5: Structural Type of Occupied Private Dwellings

	Count
TOTAL	1005
Single-detached house	560
Semi-detached house	35
Row house	25
Apartment, duplex	20
Apartment, building that has five or more storeys	5
Apartment, building that has fewer than five storeys	250
Other single-attached house	0
Movable dwelling	105

In an urban context, a larger proportion of structures with multiple dwellings generally coincides with higher land value. Since with higher land costs of construction should lead to a stronger preference for vertical construction.

Language and Education

Language plays an important role in a community, since a common language facilitates economic actions. Multiple languages in a region can lead to polarization of the community, especially if one of the languages are significantly smaller in population.

Table 6: Spoken Language

	Mother Tongue	Spoken in the Home
Single responses	2655	2665
English	2185	2610
French	125	25
Non-official languages	350	35
Multiple responses	15	0
English and French	0	0
English and non-official language	10	0
French and non-official language	0	0
English, French and non-official language	0	0

Public services are offered in both official languages, English and French, but a large share of the population using non-official languages can lead to fractionalization of the community.

Table 7: Official Language in Use

	Knowledge	Spoken
English	2470	2555
French	0	115
English and French	200	0
Neither English nor French	0	0

Education affects the community's ability to accommodate highly technical projects or activities. Education, along with work experience, is a fundamental part of human capital development and is viewed as a cornerstone of productivity growth.

Table 8: Highest Level of Education

	15 to 24 years	25 to 64 years	65 years and over
TOTAL	405	1305	310
No certificate, diploma or degree	155	290	235
Certificate, diploma or degree	250	1015	75
High school	145	270	10
Apprenticeship or trades	15	160	15
College, CEGEP, or other non-university	70	230	10
University	15	360	35
University below bachelor	0	50	30
University	20	310	10
Bachelor's degree	20	225	0
University above bachelor	0	15	10
Master's degree	0	65	0
Doctorate	0	0	0
Medicine, dentistry, veterinary, or optometry	0	0	0

Labour Force

The labour force data is used to interpret if the region can internally accommodate an increase in employment demand from a new project or activity (shock). The unemployment rate is an indicator of tightness or slackness in the labour market, which affects the population's willingness to work (participation rate). A tight labour market will generally cause an increase in participation, since employment opportunities are higher and labour compensation is pushed up.

Table 9: Labour Force Composition

	Total	Male	Female
Population 15 years and over	2025	980	1040
Labour force	1430	780	645
Employed	1370	755	620
Unemployed	60	30	30
Not in labour force	595	200	395
Participation rate	70.60	79.60	62.00
Employment rate	67.70	77.00	59.60
Unemployment rate	4.20	3.80	4.70

Table 10: Employment by Class of Worker

	Total	Male	Female
All classes	1420	780	635
Paid	1280	690	590
Employees	1205	635	570
Self-employed (incorporated)	70	55	15
Self-employed	130	85	45
Unpaid family	15	0	10
Not applicable	10	0	10

Highly specialized project or activities generally require more specialized occupations and skills. A region with a diverse composition of occupations can potentially satisfy these demands internally. Conversely, if the occupational structure of the region is sparse then these demands must be satisfied from the external environment. This creates an additional form of income leakage because these external workers will be more likely have higher savings rates or transfer income directly to other regions.

Table 11: Labour Force by Occupation

	Total	Male	Female
All occupations	1420	780	640
A Management	135	95	45
B Business, finance and administration	185	80	110
C Natural and applied sciences and related	95	60	35
D Health	85	15	65
E Social science, education, government and reli...	200	55	145
F Art, culture, recreation and sport	10	10	0
G Sales and service	330	130	205
H Trades, transport and equipment operators and...	295	280	10
I Unique to primary industry	70	55	15
J Unique to processing, manufacturing and utiliti...	10	10	0
Not applicable	10	0	10

The industrial composition describes the ability of the region to provide inputs to new projects or activities. A more diverse industrial composition increases the ability of the region to retain and cycle income internally; higher multipliers.

Table 12: Labour Force by Industry

	Total	Male	Female
All industries	1420	780	635
11 Agriculture, forestry, fishing and hunting	50	30	25
21 Mining and oil and gas extraction	60	65	0
22 Utilities	10	10	0
23 Construction	175	125	50
31-33 Manufacturing	30	25	10
41 Wholesale trade	15	15	0
44-45 Retail trade	205	125	85
48-49 Transportation and warehousing	95	85	10
51 Information and cultural industries	30	35	0
52 Finance and insurance	15	0	10
53 Real estate and rental and leasing	30	10	25
54 Professional, scientific and technical services	15	10	10
55 Management of companies and enterprises	0	0	0
56 Administrative, support, waste and remediation	20	10	10
61 Educational services	170	60	110
62 Health care and social assistance	90	0	95
71 Arts, entertainment and recreation	25	15	10
72 Accommodation and food services	130	35	95
81 Other services	70	50	20
91 Public administration	160	85	80
Not applicable	10	0	10

Results

CRIOM provides impact results for all available economic indicators. Aggregates are presented in the report, however detailed results are provided in the associated Excel file.

Impact Summary

Table 13 shows the aggregated main economic indicators, given that the initial shock is \$1530000000 the implicit Type-I and Type-II multipliers can be determined as a ratio.

Table 13: Gross Output, GDP, Employment, and Labour Income

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Gross Output (\$)				
Lac la Biche	1247171872.4	368751227.98	197849511.37	1813772611.77
Rest-of-Canada	152897650.08	827947754.06	714108880.87	1694954285.03
Gross Domestic Product (\$)				
Lac la Biche	430573205.53	188817206.31	128697976.34	748088388.2
Rest-of-Canada	73133803.39	390714862.64	378046896.27	841895562.32
Employment (full-time equivalent)				
Lac la Biche	4146.62	1886.32	1627.59	7660.53
Rest-of-Canada	565.39	4145.73	4946.72	9657.85
Labour Income (\$)				
Lac la Biche	319958145.67	130516462.06	49628130.36	500102738.11
Rest-of-Canada	38745101.37	242178638.56	188749480.97	469673220.93

Gross output (sales) show that over half of the initial impact is retained in Canada. Technically the direct domestic Region-to-Region trade is considered a 'leakage', like international imports, tax revenue, and savings. This is feature of the model allows for the examination of industrial diversity of the selected region and Canada as a whole. Industrial diversity is high enough that Lac la Biche retains the lion's share of the domestic impact. The patterns observed in the gross output results are reflected in the other indicators, especially gross domestic product. GDP is the most appropriate means of computing multipliers, since it does not include any double counting. The total impact national multiplier is 1.039 (Type-II), with a Type-I multiplier of 0.707. The Lac la Biche Type-I multiplier is 0.404 and the Type-II multiplier is 0.488, both of which reflect the gross output results. The industrial mix of the selected region will result in the small differences observed. Employment impacts are significant with 17318.38 jobs created, of which 4146.62 jobs stem from the initial impact. The direct and indirect labour income, from the initial impact, is \$731398347.66, which generates an additional \$238377611.33 of induced labour income.

Industry Impacts

The main strength of the IO model framework is the considerable amount of industrial detail available in the results. The following tables are the high level aggregate impact results.

Table 14a: Industry Gross Domestic Product, in Lac la Biche, Alberta

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Summary Industries				
Goods Producing Industries	419940148.36	128317688.32	9450114.54	557707951.24
Service Industries	10633057.16	60499517.99	119247861.79	190380436.95
Industry Detail				
Crop and animal production	0	62143.35	305049.3	367192.65
Forestry and logging	6685.56	66337.81	143936.52	216959.88
Fishing, hunting and trapping	0	1149.47	35905.22	37054.69
Support activities for agriculture and fore...	0	43363.31	18301.34	61664.66
Mining and oil and gas extraction	4510931.18	119081897.61	1901178.03	125494006.82
Utilities	16758.81	1413771.94	2368108.73	3798639.48
Construction	405427040.23	1556548.98	2780068.68	409763657.89
Manufacturing	9978732.59	6092475.86	1897566.71	17968775.17
Wholesale trade	9696242.71	12178321.22	3601438.54	25476002.48
Retail trade	801749.29	3921949.29	22342676.83	27066375.41
Transportation and warehousing	8638.19	2158597.5	1459829.08	3627064.77
Information and cultural industries	20196.7	920460.07	1175544.69	2116201.47
Finance, insurance, real estate and rental ...	5566.05	16281431.68	60738602.97	77025600.71
Professional, scientific and technical serv...	62770.64	15287012.2	1672093.65	17021876.49
Administrative and support, waste manag...	361.55	3158270.44	1863717.28	5022349.27
Educational services	0	268541.1	519009.89	787550.99
Health care and social assistance	0	178954.25	5950496.4	6129450.65
Arts, entertainment and recreation	2071.78	233246.49	1530709.15	1766027.42
Accommodation and food services	2320.15	1124369.23	6715754.6	7842443.99
Other services (except public administrat...	29515.3	2742227.57	3713818.79	6485561.66
Operating, office, cafeteria, and laborator...	0	0	0	0
Travel and entertainment, advertising an...	0	0	0	0
Transportation margins	0	0	0	0
Non-profit institutions serving households	0	16229.15	4614608.09	4630837.24
Government sector	3624.8	2029907.79	3349561.84	5383094.42

The goods sector GDP impacts exceed that of the service sector impacts for Lac la Biche. Direct effects in the goods sector are higher than the service sector. Goods sector dominate the Service sector for the indirect effects. Derived primarily from consumer patterns and industry mix in Lac la Biche, the induced effects in the service sector come in stronger than the goods sector.

Direct Effects

The strongest direct effect are in Construction with \$405427040 of GDP generated with \$405427040 coming from Oil and gas engineering construction, and \$0 from Other activities of the construction industry. The next largest direct impact occurs in Manufacturing valued at \$9978733. The two main components are: Machinery manufacturing at \$7856237, and Fabricated metal product manufacturing at \$1675446.

Indirect Effects

Indirect effects are focused in Mining and oil and gas extraction with \$119081898 of GDP generated with \$113480905 coming from Support activities for mining and oil and gas extraction, and \$3745778 from Oil and gas extraction. The next largest indirect impact occurs in Finance, insurance, real estate and rental and leasing valued at \$16281432. The two main components are: Monetary authorities and depository credit intermediation at \$5748307, and Rental and leasing services and lessors of non-financial intangible assets (except copyrighted works) at \$5379764.

Induced Effects

Induced effects are focused in Finance, insurance, real estate and rental and leasing with \$60738603 of GDP generated with \$44186158 coming from Owner-occupied dwellings, and \$8144086 from Lessors of real estate. The next largest induced effect occurs in Retail trade valued at \$22342677.

Total Impact

The total impact are focused in Construction with \$409763658 of GDP generated with \$405427040 coming from Oil and gas engineering construction, and \$4157234 from Repair construction. The next largest total impact occurs in Mining and oil and gas extraction valued at \$125494007. The two main components are: Support activities for mining and oil and gas extraction at \$113766529, and Oil and gas extraction at \$9752217.

Table 14b: Industry Gross Domestic Product, in the Rest-of-Canada

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Summary Industries				
Goods Producing Industries	50134932.5	139649008.1	71447430.96	261231371.59
Service Industries	22998870.88	251065854.53	306599465.31	580664190.74
Industry Detail				
Crop and animal production	3847.62	851794.12	5397762.35	6253404.09
Forestry and logging	13928.93	484610.72	491494.93	990034.58
Fishing, hunting and trapping	563.78	10186.33	166586.1	177336.21
Support activities for agriculture and fore...	1922.34	173536.02	285015.45	460473.81
Mining and oil and gas extraction	13445969.06	56375081.21	12678632.96	82499683.22
Utilities	202311.53	7710415.66	13936815.25	21849542.45
Construction	32814.15	3111932.84	5495128.42	8639875.41
Manufacturing	36433575.09	70931451.2	32995995.51	140361021.81
Wholesale trade	17470430.88	35517166.86	21495639.29	74483237.04
Retail trade	402375.19	6416833.48	36420646.94	43239855.61
Transportation and warehousing	189032.82	24711313.5	18354772.12	43255118.44
Information and cultural industries	1013607.28	13690254.85	22579804.25	37283666.39
Finance, insurance, real estate and rental ...	345941.53	45659531.56	118173101.34	164178574.43
Professional, scientific and technical serv...	1607990.77	96779626.71	15722542.25	114110159.73
Administrative and support, waste manag...	131775.12	13509666.83	11323335.51	24964777.47
Educational services	33442.05	285431.95	954483.49	1273357.49
Health care and social assistance	91158.55	629943.75	7250438.82	7971541.11
Arts, entertainment and recreation	37203.81	729759.03	5095182.29	5862145.13
Accommodation and food services	15495.81	2609402.69	13432909.13	16057807.64
Other services (except public administrat...	78061.31	4372376.79	11717297.11	16167735.21
Operating, office, cafeteria, and laborator...	0	0	0	0
Travel and entertainment, advertising an...	0	0	0	0
Transportation margins	0	0	0	0
Non-profit institutions serving households	4678.71	91382.14	12014330.33	12110391.18
Government sector	1577677.05	6063164.39	12064982.44	19705823.87

The service sector GDP impacts exceed that of the goods sector impacts for the Rest-of-Canada. Direct effects in the goods sector are higher than the service sector. Service sector dominate the goods sector for the indirect effects. Derived primarily from consumer patterns and industry mix in the Rest-of-Canada, the induced effects in the service sector come in stronger than the goods sector.

Direct Effects

The strongest direct effect are in Manufacturing with \$36433575 of GDP generated with \$26943686 coming from Machinery manufacturing, and \$5034666 from Fabricated metal product manufacturing. The next largest direct impact occurs in Wholesale trade valued at \$17470431.

Indirect Effects

Indirect effects are focused in Professional, scientific and technical services with \$96779627 of GDP generated with \$75819522 coming from Architectural, engineering, legal and accounting services, and \$19125538 from Other professional, scientific and technical services. The next largest indirect impact occurs in Manufacturing valued at \$70931451. The two main components are: Primary metal manufacturing at \$19666193, and Fabricated metal product manufacturing at \$16960690.

Induced Effects

Induced effects are focused in Finance, insurance, real estate and rental and leasing with \$118173101 of GDP generated with \$45641067 coming from Owner-occupied dwellings, and \$20686776 from Monetary authorities and depository credit intermediation. The next largest induced effect occurs in Retail trade valued at \$36420647.

Total Impact

The total impact are focused in Finance, insurance, real estate and rental and leasing with \$164178574 of GDP generated with \$45641067 coming from Owner-occupied dwellings, and \$33036032 from Other finance, insurance and real estate and management of companies and enterprises. The next largest total impact occurs in Manufacturing valued at \$140361022. The two main components are: Machinery manufacturing at \$35132867, and Fabricated metal product manufacturing at \$23155959.

Table 15a: Industry Employment, in Lac la Biche, Alberta

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Summary Industries				
Goods Producing Industries	4017.24	1014.78	65.91	5097.92
Service Industries	129.39	871.54	1561.68	2562.61
Industry Detail				
Crop and animal production	0	1.08	5.88	6.97
Forestry and logging	0.06	0.62	1.35	2.04
Fishing, hunting and trapping	0	0.01	0.36	0.37
Support activities for agriculture and fore...	0	0.94	0.4	1.33
Mining and oil and gas extraction	5.41	934.48	2	941.89
Utilities	0.05	4.59	8.01	12.66
Construction	3938.41	15.95	29.34	3983.7
Manufacturing	73.3	57.09	18.58	148.98
Wholesale trade	108.35	136.09	40.25	284.69
Retail trade	19.25	94.19	536.56	650
Transportation and warehousing	0.08	29.76	19.04	48.89
Information and cultural industries	0.64	8.05	17.62	26.31
Finance, insurance, real estate and rental ...	0.19	335.1	161.48	496.77
Professional, scientific and technical serv...	0.02	97.36	6.89	104.26
Administrative and support, waste manag...	0.01	32.76	36.22	68.99
Educational services	0	8.91	17.22	26.14
Health care and social assistance	0	2.84	128.07	130.91
Arts, entertainment and recreation	0.06	7.13	46.63	53.82
Accommodation and food services	0.06	38.47	250.79	289.33
Other services (except public administrat...	0.67	56.03	91.6	148.3
Operating, office, cafeteria, and laborator...	0	0	0	0
Travel and entertainment, advertising an...	0	0	0	0
Transportation margins	0	0	0	0
Non-profit institutions serving households	0	0.45	162.57	163.02
Government sector	0.05	24.4	46.72	71.17

The goods sector employment impacts exceed that of the service sector impacts for Lac la Biche. Direct effects in the goods sector are higher than the service sector. Goods sector dominate the Service sector for the indirect effects. Derived primarily from consumer patterns and industry mix in Lac la Biche, the induced effects in the service sector come in stronger than the goods sector.

Table 15b: Industry Employment, in the Rest-of-Canada

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Summary Industries				
Goods Producing Industries	311.71	1058.99	580.35	1951.05
Service Industries	253.68	3086.75	4366.37	7706.8
Industry Detail				
Crop and animal production	0.07	16.26	109.86	126.19
Forestry and logging	0.13	4.55	4.62	9.3
Fishing, hunting and trapping	0.01	0.1	1.65	1.76
Support activities for agriculture and fore...	0.03	3.34	7.35	10.73
Mining and oil and gas extraction	16.34	317.22	15.31	348.87
Utilities	0.65	24.62	44.87	70.14
Construction	0.21	29.82	56.86	86.89
Manufacturing	294.28	663.07	339.84	1297.19
Wholesale trade	195.23	396.9	240.21	832.34
Retail trade	9.66	154.1	874.65	1038.41
Transportation and warehousing	1.87	319.73	228.29	549.89
Information and cultural industries	11.34	92.19	207.66	311.18
Finance, insurance, real estate and rental ...	6.89	1025.82	980.83	2013.54
Professional, scientific and technical serv...	1.58	637.19	61.02	699.8
Administrative and support, waste manag...	1.43	161.93	179.52	342.87
Educational services	1.11	9.47	31.68	42.26
Health care and social assistance	2.18	9.15	156.25	167.58
Arts, entertainment and recreation	1.06	22.53	142.88	166.48
Accommodation and food services	0.46	89.87	487.24	577.57
Other services (except public administrat...	1.49	91.48	391.04	484
Operating, office, cafeteria, and laborator...	0	0	0	0
Travel and entertainment, advertising an...	0	0	0	0
Transportation margins	0	0	0	0
Non-profit institutions serving households	0.07	1.58	222.99	224.64
Government sector	19.31	74.8	162.12	256.24

The service sector employment impacts exceed that of the goods sector impacts for the Rest-of-Canada. Direct effects in the goods sector are higher than the service sector. Service sector dominate the goods sector for the indirect effects. Derived primarily from consumer patterns and industry mix in the Rest-of-Canada, the induced effects in the service sector come in stronger than the goods sector.

Leakages

An impact can be interpreted as the flow of incomes through the economy from a given shock. This income is then spent, which in turn generates more income and the cycle continues. The 3 types of effects describe this flow of income as it occurs in the impact.

Income that is received and not spent is identified as 'leakage'. The most common types of leakage are: savings, taxes, and imports. In the IO model framework, it is generally the case that these income flows accumulate. However, certain specialized models will 'fully-close the model' by imposing, either assumed or estimated, behavior on the spending patterns associated with these stocks. The CRIOM does not impose these additional assumptions about this spending behaviour.

Saving is not an output of CRIOM, because not all income flows are identified. CRIOM describes the earned income associated with a shock, but does not give guidance to changes in government transfers, and investment income from both domestic and international sources.

Tax Revenue

The second form of leakage is tax revenue. Although the government may spend this additional income, as transfers or expenditure on goods and services, it could also use this income to reduce deficits or public debt. Although not exhaustive, some major tax revenue sources are given below.

Table 16: Tax Revenue

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Lac la Biche, Alberta				
Final Demand Tax	541516.25	27145938.32	3882143.39	31569597.96
Industrial taxes	21331976.38	5466770.51	14827138.43	41625885.32
Personal Income Tax	73206468.37	28792481.53	14586880.17	116585830.07
Federal Personal Income Tax	52843894.25	20783776.12	10529500.61	84157170.98
Provincial Personal Income Tax	20362574.12	8008705.41	4057379.56	32428659.09
Corporate Income Tax	7618678.82	5376585.52	5060329.23	18055593.57
Federal Corporate Income Tax	5329201.27	3760876.01	3539657.41	12629734.69
Provincial Corporate Income tax	2289477.55	1615709.51	1520671.82	5425858.88
Total Tax	102698639.82	66781775.88	38356491.22	207836906.92
Rest-of-Canada				
Final Demand Tax	0	18431381.69	13618356.17	32049737.86
Industrial taxes	2117121.81	16693407.61	30990010.77	49800540.19
Personal Income Tax	8608840.19	55842920.13	47621336.39	112073096.71
Federal Personal Income Tax	5117968.11	33198697.85	28310954.27	66627620.22
Provincial Personal Income Tax	3490872.08	22644222.28	19310382.12	45445476.49
Corporate Income Tax	3715601.81	14344734.79	15669237.95	33729574.55
Federal Corporate Income Tax	2464421.92	9514334.62	10392828.81	22371585.36
Provincial Corporate Income tax	1251179.88	4830400.17	5276409.14	11357989.2
Total Tax	14441563.8	105312444.23	107898941.28	227652949.31

International imports

Imports for a region can either be international or Rest-of-Canada, which provides income to foreigners or the remaining domestic economy, respectively. Spending patterns of foreigners and the Rest-of-Canada must be assumed. A common assumption about foreigner income is that it is entirely spent outside of Canada, which is both strong and simplifying. This treatment of foreign income will marginally reduce the multiplier, but this reduction is small because the foreign country can potentially have hundreds of other trading partners.

Static import shares assume that a fixed percentage of each commodity consumed in Canada is sourced from foreign suppliers, and this feature is included in most IO models. In CRIOM, static import shares are applied to every region, since detailed regional data is unavailable.

Table 17a: International Imports, Lac la Biche, Alberta

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Total	283221278.24	40796339.21	9270179.78	333287797.29
Goods	259144672.41	34316170.83	6179902.39	299640745.68
Services	24076605.84	6480168.38	3090277.39	33647051.61
Commodity Detail				
Grains	4046.24	8346.71	2912.73	15305.67
Other agricultural products	3094.66	44593.87	115882.25	163570.78
Forestry products	247.07	3875.47	1742.53	5865.07
Fish and seafood and hunting and trappi...	117.9	2414.85	6586.59	9119.34
Metal ores and concentrates	7788.64	37083.45	40163.47	85035.55
Mineral fuels	192769.89	3360547	1704218.36	5257535.26
Non-metallic minerals	178551.7	138118.5	30890.78	347560.98
Services incidental to mining	2220659.06	3314.75	992.91	2224966.73
Meat, fish and dairy products	4016.49	61759.43	269768.26	335544.19
Fruit, vegetable and other food products ...	18751.59	90445.54	256100.82	365297.95
Soft drinks and alcoholic beverages	323.72	105828.85	168792.27	274944.84
Tobacco and tobacco products	25.02	458.07	105.24	588.33
Leather, rubber, and plastic products	1089316.15	2828422.97	289260.43	4206999.55
Textile products	21661.86	264710.23	128854.49	415226.58
Hosiery, clothing and accessories	677.29	315741.28	30647.83	347066.4
Lumber and wood products	8039.79	32239.9	32994.77	73274.45
Furniture and fixtures	116174.09	4978.67	6359.53	127512.29
Wood pulp, paper and paper products	558751.62	848287.6	273621.44	1680660.66
Printing and publishing	492.23	838412.7	154313.6	993218.53
Primary metal products	47682911.14	3318057.83	104724.51	51105693.49
Fabricated metal products	37875009.78	1905166.84	185995.99	39966172.62
Machinery	96987084.38	7925438.51	335297.29	105247820.19
Motor vehicles, other transportation equi...	29040994.34	1110132.71	160710.81	30311837.86
Electrical, electronic and communicatio...	12945710.37	4812196.55	342203.34	18100110.27
Non-metallic mineral products	231692.3	521904.07	68710.75	822307.12
Petroleum and coal products	2064862.42	1573980.59	379592.18	4018435.19

Table 17a: International Imports , Lac la Biche, Alberta (continued)

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Chemicals, pharmaceuticals and chemic...	679496.42	2975474.79	616631.56	4271602.77
Miscellaneous manufactured products	29432065.31	1187553.86	472820.58	31092439.75
Residential building construction	0	0	0	0
Non-residential construction	0	0	0	0
Repair construction	0	0	0	0
Transportation and storage	205932.35	1430043.49	332747.09	1968722.93
Communications services	182139.65	132129.11	136399.84	450668.6
Other utilities	20775.68	68833.52	45124.76	134733.96
Wholesaling margins	518502.42	82210.32	12124.88	612837.63
Retailing margins and services	0	0	0	0
Gross imputed rent	0	0	0	0
Finance, insurance, and real estate servic...	1818405.91	1048119.64	1271397.09	4137922.64
Business and computer services	14544981.7	1544763.78	713906.44	16803651.92
Private education services	15187.29	8205.37	10638.18	34030.84
Health and social services	1.48	4438.15	5314.39	9754.02
Accommodation services and meals	30.4	1326603.95	278505.36	1605139.72
Other services	4545542.46	801917.34	234531.2	5581991
Transportation margins	0	0	0	0
Operating, office, cafeteria and laborator...	0	0	0	0
Travel, entertainment, advertising and pr...	0	0	0	0
Services of non-profit institutions servin...	0	0	0	0
Government sector services	0	0	0	0
Non-competing imports	4411.97	21679.93	46873.22	72965.11
Unallocated imports and exports	0	0	0	0
Sales of other government services	35.44	7909.03	1722.02	9666.49

The Lac la Biche impact results in international imports, with \$105247820 of Machinery, \$51105693 of Primary metal products, and \$39966173 of Fabricated metal products. The three largest direct effects imports are \$96987084 of Machinery, \$47682911 of Primary metal products, and \$37875010 of Fabricated metal products. The indirect effects, industry demand for goods and services, generates \$7925439 of Machinery, \$4812197 of Electrical, electronic and communication products, and \$3360547 of Mineral fuels. The induced consumption results in import of \$1704218 of Mineral fuels, \$1271397 of Finance, insurance, and real estate services, and \$713906 of Business and computer services.

International imports are also an important component of the impact in the Rest-of-Canada.

Table 17b: International Imports, Rest-of-Canada

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Total	22749705.79	88973650.76	51273839.76	162997196.36
Goods	20913815.7	72427655.79	37072486.23	130413957.77
Services	1835890.08	16545994.97	14201353.53	32583238.58
Commodity Detail				
Grains	7492.83	56678.45	143021.29	207192.57
Other agricultural products	6373.14	117249.96	639242.99	762866.09
Forestry products	1111.44	32277.41	21164.56	54553.41
Fish and seafood and hunting and trappi...	468.68	10686.05	89902.59	101057.32
Metal ores and concentrates	23207.1	836112.68	260618.05	1119937.83
Mineral fuels	380606.23	11557990.84	7957586.69	19896183.77
Non-metallic minerals	23418.98	264245.3	218787.56	506451.84
Services incidental to mining	6828.46	10984.41	6498.26	24311.13
Meat, fish and dairy products	7996.54	178657.98	1114079.12	1300733.65
Fruit, vegetable and other food products ...	34900.11	332382.81	1843628.22	2210911.14
Soft drinks and alcoholic beverages	891.75	191680.74	429679.97	622252.45
Tobacco and tobacco products	171.74	2179.51	16747.42	19098.67
Leather, rubber, and plastic products	563640.84	2328129.29	1689714.86	4581485
Textile products	92060.21	542253.36	945821.32	1580134.89
Hosiery, clothing and accessories	5325.88	180470.94	133752.27	319549.09
Lumber and wood products	31564.79	130147.97	142633.55	304346.3
Furniture and fixtures	13665.09	27860.73	55461.91	96987.72
Wood pulp, paper and paper products	319445.22	2158699.11	1962967.39	4441111.72
Printing and publishing	6625.6	1133662.92	811900.64	1952189.17
Primary metal products	6458916.09	22383864.7	1271698.81	30114479.61
Fabricated metal products	1340577.26	2273170.92	919927.74	4533675.92
Machinery	6385560.74	5994350.1	1893802.49	14273713.32
Motor vehicles, other transportation equi...	2293201.53	3560910.14	3422584.78	9276696.46
Electrical, electronic and communicatio...	1732164.48	5267692.47	2834303.74	9834160.69
Non-metallic mineral products	50681.98	619183.85	390352.76	1060218.58
Petroleum and coal products	145333.85	2371536.8	1653117.47	4169988.12
Chemicals, pharmaceuticals and chemic...	653117.73	7240358.98	4639558.66	12533035.38
Miscellaneous manufactured products	335295.87	2635221.81	1570429.37	4540947.05
Residential building construction	0	0	0	0
Non-residential construction	0	0	0	0
Repair construction	0	0	0	0
Transportation and storage	232020.06	2935736.53	1797524.39	4965280.98
Communications services	73164.17	812008.9	870693.5	1755866.57
Other utilities	27267.87	171350.11	160126.5	358744.49
Wholesaling margins	29002.46	109598.13	61171.04	199771.63
Retailing margins and services	0	0	0	0

Table 17b: International Imports , Rest-of-Canada (continued)

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Gross imputed rent	0	0	0	0
Finance, insurance, and real estate servic...	635474.15	3570105.56	4729980.36	8935560.06
Business and computer services	680479.31	5519936.13	3681137.76	9881553.2
Private education services	4042.48	29101.43	31005.91	64149.82
Health and social services	3857.14	10108.67	14686.14	28651.96
Accommodation services and meals	987	1846133.63	1172100.42	3019221.05
Other services	99632.82	1330538.05	1129544.36	2559715.23
Transportation margins	0	0	0	0
Operating, office, cafeteria and laborator...	0	0	0	0
Travel, entertainment, advertising and pr...	0	0	0	0
Services of non-profit institutions servin...	0	0	0	0
Government sector services	0	0	0	0
Non-competing imports	42633.23	192240.94	539760.27	774634.45
Unallocated imports and exports	0	0	0	0
Sales of other government services	500.94	8152.46	7124.62	15778.02

The Rest-of-Canada impact results in international imports, with \$30114480 of Primary metal products, \$19896184 of Mineral fuels, and \$14273713 of Machinery. The three largest direct effects imports are \$6458916 of Primary metal products, \$6385561 of Machinery, and \$2293202 of Motor vehicles, other transportation equipment and parts. The indirect effects, industry demand for goods and services, generates \$22383865 of Primary metal products, \$11557991 of Mineral fuels, and \$7240359 of Chemicals, pharmaceuticals and chemical products. The induced consumption results in import of \$7957587 of Mineral fuels, \$4729980 of Finance, insurance, and real estate services, and \$4639559 of Chemicals, pharmaceuticals and chemical products.

Region-to-region imports

Region-to-region trade is the sale of goods and services between regions within Canada. The degree to which a region needs to import goods and services from other domestic sources depends on the industrial diversity of the region. A very diverse region will be able to internally supply most of the required inputs. Whereas a region with few differentiated industries will require more external suppliers.

In CRIOM, the region-to-region trade shares are computed based on the industrial diversity identified in the Canadian Business Patterns data, and the region's estimated final and industrial commodity demand. This makes each region's IO model unique. CRIOM extends this further by closing the region-to-region trade, since each import for one region is an export for the other. This treatment of intra-country trade results in an improved estimation of the implicit economic multipliers.

Table 18a: Region-to-region Imports, Lac la Biche, Alberta

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Total	510026295.5	67823034.73	28471908.25	606321238.53
Goods	209184814.83	26468040.75	7574812.5	243227668.13
Services	300841480.66	41354993.97	20897095.75	363093570.4
Commodity Detail				
Grains	0	6449.07	41613.85	48062.92
Other agricultural products	16172.49	141708.49	275978.41	433859.38
Forestry products	1035.01	16597.82	10295.63	27928.46
Fish and seafood and hunting and trappi...	80.42	2855.26	8121.18	11056.85
Metal ores and concentrates	4779.22	36929.57	12865.25	54574.04
Mineral fuels	131740.06	1946264.12	1027349.76	3105353.94
Non-metallic minerals	1208748.16	272057.88	65017.26	1545823.3
Services incidental to mining	55139443.99	82306	24654.29	55246404.28
Meat, fish and dairy products	16971.6	381890.23	1611704.45	2010566.28
Fruit, vegetable and other food products ...	25252.57	189619.73	670170.93	885043.23
Soft drinks and alcoholic beverages	703.63	303607.75	366598.69	670910.07
Tobacco and tobacco products	0	0	0	0
Leather, rubber, and plastic products	518606.8	3114443.01	356126.3	3989176.11
Textile products	7625.91	100309.7	49696.88	157632.49
Hosiery, clothing and accessories	1612.57	48122.58	27027.04	76762.2
Lumber and wood products	45069.64	143380.74	123339.32	311789.71
Furniture and fixtures	262356.21	1490.84	4463.45	268310.51
Wood pulp, paper and paper products	350620.96	800364.37	396334.91	1547320.24
Printing and publishing	2322.69	1198951.1	251931.2	1453204.99
Primary metal products	46530152.95	3345354.55	89829.01	49965336.52
Fabricated metal products	25625564.21	1373990.45	293614.06	27293168.72
Machinery	98247819.71	3066400.04	89405.31	101403625.06
Motor vehicles, other transportation equi...	8275825.08	344950.64	59171.55	8679947.28

Table 18a: Region-to-region Imports , Lac la Biche, Alberta (continued)

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Electrical, electronic and communicatio...	2154679.56	1075639.26	93373.27	3323692.08
Non-metallic mineral products	1162591.3	1372459.34	154888.34	2689938.98
Petroleum and coal products	12554735.59	5179125.86	992963.19	18726824.65
Chemicals, pharmaceuticals and chemic...	930789.2	1571603.51	361755.78	2864148.5
Miscellaneous manufactured products	11108959.3	433474.86	141177.47	11683611.64
Residential building construction	0	0	0	0
Non-residential construction	0	0	0	0
Repair construction	0	0	0	0
Transportation and storage	1283750.2	3620593.22	1051541.22	5955884.64
Communications services	2714348.3	2235750.71	2115528.04	7065627.05
Other utilities	714701.72	1835357.74	1417233.88	3967293.34
Wholesaling margins	53827710.19	8534566.04	1258730.29	63621006.52
Retailing margins and services	554210.12	704653.13	153452.2	1412315.45
Gross imputed rent	0	0	0	0
Finance, insurance, and real estate servic...	10280727.37	6065883.48	6465526.53	22812137.39
Business and computer services	132053765.81	8734093.85	3889178.6	144677038.27
Private education services	26946.3	30495.44	28299.03	85740.77
Health and social services	18.18	67228.99	92412.69	159659.85
Accommodation services and meals	55.57	480479.05	109775.38	590310
Other services	23552790.01	3834645.29	1300525.9	28687961.2
Transportation margins	15465475.4	2665929.87	421983.2	18553388.47
Operating, office, cafeteria and laborator...	577770.48	396180.51	62079.93	1036030.92
Travel, entertainment, advertising and pr...	4649401.02	2004710.88	2491834.11	9145946.01
Services of non-profit institutions servin...	0	0	0	0
Government sector services	0	0	0	0
Non-competing imports	89.15	341.88	889.67	1320.7
Unallocated imports and exports	0	0	0	0
Sales of other government services	276.85	61777.88	13450.81	75505.54

Review of the region-to-region import leakage can provide insight into opportunities for economic development. Building up some local industrial diversity in response to a known shock can increase the implicit multipliers, and more economic benefits are retained within the region.

The Lac la Biche impact results in region-to-region imports, with \$144677038 of Business and computer services, \$101403625 of Machinery, and \$63621007 of Wholesaling margins. The three largest direct effects imports are \$132053766 of Business and computer services, \$98247820 of Machinery, and \$55139444 of Services incidental to mining. The indirect effects, industry demand for goods and services, generates \$8734094 of Business and computer services, \$8534566 of Wholesaling margins, and \$6065883 of Finance, insurance, and real estate services. The induced consumption results in import of \$6465527 of Finance, insurance, and real estate services, \$3889179 of Business and computer services, and \$2491834 of Travel, entertainment, advertising and promotion.

Region-to-region imports are also an important component of the impact in the Rest-of-Canada.

Table 18b: Region-to-region Imports, Rest-of-Canada

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Total	5952.97	31035.7	25826.79	62815.48
Goods	465.77	6368.58	9502.29	16336.65
Services	5487.2	24667.12	16324.5	46478.83
Commodity Detail				
Grains	1.97	16.48	51.51	69.96
Other agricultural products	21.32	506.77	4125.26	4653.35
Forestry products	8.88	277.86	189.98	476.71
Fish and seafood and hunting and trappi...	0.06	1.32	11.39	12.78
Metal ores and concentrates	0	0	0	0
Mineral fuels	74.3	1324.6	1022.78	2421.69
Non-metallic minerals	0.08	4.31	1.95	6.34
Services incidental to mining	890.62	1432.68	847.56	3170.86
Meat, fish and dairy products	0.44	11.09	65.76	77.29
Fruit, vegetable and other food products ...	0.34	6.11	36.53	42.98
Soft drinks and alcoholic beverages	1.57	189.03	426.98	617.58
Tobacco and tobacco products	0	0	0	0
Leather, rubber, and plastic products	0	0.43	0.21	0.65
Textile products	2.63	47.67	49.7	100
Hosiery, clothing and accessories	0.06	0.46	1.64	2.16
Lumber and wood products	21.48	125.23	86.71	233.42
Furniture and fixtures	0	0	0	0
Wood pulp, paper and paper products	0.5	1.17	1.04	2.7
Printing and publishing	0.99	2000.78	1572.17	3573.93
Primary metal products	8.73	58.58	2.02	69.34
Fabricated metal products	198.23	355.4	56.63	610.26
Machinery	14.36	34.69	9.65	58.69
Motor vehicles, other transportation equi...	0.31	1.85	1.4	3.55
Electrical, electronic and communicatio...	0	0	0	0
Non-metallic mineral products	0.13	69.19	145.92	215.24
Petroleum and coal products	61.97	907.58	602.73	1572.29
Chemicals, pharmaceuticals and chemic...	1	26.41	72.71	100.12
Miscellaneous manufactured products	0.08	7.43	2.63	10.15
Residential building construction	0	0	0	0
Non-residential construction	0	0	0	0
Repair construction	46.34	394.13	964.98	1405.45
Transportation and storage	3950.9	16747.09	8011.17	28709.16
Communications services	0.03	321.53	257.62	579.18
Other utilities	32.52	314.3	413.98	760.8
Wholesaling margins	0	0	0	0

Table 18b: Region-to-region Imports , Rest-of-Canada (continued)

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Retailing margins and services	58.65	654.37	906.99	1620.01
Gross imputed rent	0	0	0	0
Finance, insurance, and real estate servic...	74.12	601.73	967.66	1643.51
Business and computer services	89.2	887.33	641.83	1618.37
Private education services	281.96	1326.29	2016.33	3624.58
Health and social services	18.79	49.04	69.19	137.02
Accommodation services and meals	1.03	894.41	572.77	1468.21
Other services	89.38	1438.35	1619.4	3147.13
Transportation margins	0	0	0	0
Operating, office, cafeteria and laborator...	0	0	0	0
Travel, entertainment, advertising and pr...	0	0	0	0
Services of non-profit institutions servin...	0	0	0	0
Government sector services	0	0	0	0
Non-competing imports	0	0	0	0
Unallocated imports and exports	0	0	0	0
Sales of other government services	0	0	0	0

The Rest-of-Canada impact results in Region-to-region imports, with \$28709 of Transportation and storage, \$4653 of Other agricultural products, and \$3625 of Private education services. The three largest direct effects imports are \$3951 of Transportation and storage, \$891 of Services incidental to mining, and \$282 of Private education services. The indirect effects, industry demand for goods and services, generates \$16747 of Transportation and storage, \$2001 of Printing and publishing, and \$1438 of Other services. The induced consumption results in import of \$8011 of Transportation and storage, \$4125 of Other agricultural products, and \$2016 of Private education services.

Appendix A: Input-Output Methodology

Input-Output (IO) models are a standard tool in economic analysis, for more than half a century, derived primarily from the work of Wassily W. Leontief in the 1950s. An IO model is used to answer economic questions like: identify the industries that are most strongly affected by a change in (shock to) final demand (consumption, investment, government expenditure, and exports). The standard IO model structure can be augmented, with the inclusion of additional data sources, to answer other policy questions like: determine the number of jobs created from a specific type of public spending, and compute the tax revenue generated from a particular shock. The main extensions of the IO model framework is the estimation of key economic indicators: gross output, GDP, Employment (full-time equivalents), labour income, and a variety of aggregate taxes.

In the standard IO model framework the first round of spending (demand) is called the 'direct effects', which is translated into industry gross output (sales). The directly affected industries require inputs to production, which results in subsequent and iterative rounds of spending-selling between the industries in the economy. The gross output generated in these interactions is classified as 'indirect effects'. 'Induced effects' are defined as any additional gross output generated as a result of increased income, either personal, corporate, or both. The sum of these three effects is the 'total impact'.

These effects are also used to compute both Type-I and Type-II 'multipliers' for each of these indicators. Where the 'multipliers' are defined as:

$$\text{Type-I multiplier} = (\text{Direct effects} + \text{Indirect effects}) / (\text{Initial Shock})$$

$$\text{Type-II multiplier} = (\text{Total Impact}) / (\text{Initial Shock})$$

The direct effects (Gd) are computed as:

$$G_d = D * L * E * s$$

where: s is the initial shock vector, E is the Final Demand matrix, D is the Make matrix, and L is the leakage matrix defined as $L = (I - u - v - z)$ and I is the identity matrix, u is the international import share, v is the inter-regional import share, and z is the inter-regional export share (the latter two items are not required in a national IO model).

The indirect effects (Gi) are computed as:

$$G_i = A * D * L * E * s - G_d$$

where: A is industry-to-industry transactions matrix, defined as $A = \text{inverse}(I - D * L * B)$.

Leakages affect the sourcing of inputs so with each successive iteration more imports are used to satisfy production demand.

The induced effects (Gn) are computed as:

$$G_n = P * A * D * L * E * s - G_d - G_i$$

where: P is the matrix that determines the effect of induced labour income, defined as

$P = \text{inverse}(I - A * D * L * E_c * mpc * w)$, where w is the labour income share of gross output, mpc is the region's marginal propensity to consume (or share of income not leaked to savings), and E_c is the personal consumption portion of the final demand matrix.

Advantages of Regional IO Models

1. Detailed industrial view of the economic impact.
2. Very specific regional impact, with the advantage of 2-way linkages between the selected CSD and the Rest-of-Canada. This ensures that the national impact is invariant to the CSD chosen.
3. The implicit multipliers generated are unique to each CSD selected.
4. Modern computing has made this class of model relatively easy to use and more accessible.
5. Web-based IO models, like CRIOM, provide an inexpensive option that is available world-wide with a very short time-frame from 'input to report'. As a thin-client solution there are only three requirements; a browser with internet access, Microsoft Excel (or equivalent), and Adobe PDF reader.

Disadvantages of Regional IO Models

1. The tables used to generate the model and analysis are static (underlying IO tables taken from a particular year). The IO tables take the statistical agencies several years to compile, so the best option is to use the most recent table available.
2. Inputs to production are assumed to be perfectly elastic, so doubling the size of the shock doubles the size of the impact.
3. There are no resource constraints, so each input is available in infinite quantities. For example, an Employment impact is not constrained by the population of the region.
4. Relative prices are assumed to be fixed in an IO model. Since resource constraints are not respected, relative prices remain unchanged.
5. Commodity availability is assumed to be equivalent to national patterns, which may not be the case for all Census Sub-divisions.

The specific application determines if the advantages outweigh the disadvantages for regional IO models. The IO models are a cornerstone economic analysis tool, which are in use throughout the world, and are even included as a major component of highly technical dynamic and equilibrium models.

Appendix B: CRIOM Data Sources

The underlying data used in CRIOM comes from a variety of Statistics Canada data sets, including Census of the population, National Income and Expenditure Accounts, Canadian Business Patterns, and input-output tables. The 2006 Census Profiles for each region are used in the model to obtain some specific shares that are not captured by the other data sources. The National Income and Expenditure Accounts are used to obtain the marginal propensity to consume for each province, and by assumption the provincial rate is the same in all of its sub-regions.

The Canadian Business Patterns (CBP) is a database containing detailed industrial information by Census-subdivision (CSD). The establishment counts and employment sizes are used to develop an initial estimate of the industrial activity in the region. The detailed NAICS industries are then mapped to the input-output tables' aggregation of industries in Canada. However, there are several weaknesses with using this method directly which include the construction industry, personal services, and government activity. The latter two are dealt with by incorporating Census information. The NAICS construction industry detail includes industries centered around an activity rather than the investment asset representation (IO based). This requires the development of a NAICS construction industry to IO industry map. The CBP is released twice a year, and the current version of CRIOM uses the December 2010 database.

The input-output structure of CRIOM is based on the Statistics Canada working level public-use 2007 national input-output tables. These tables include many suppressed entries to protect individual firms outlined by the Statistics Act. PolicyModels imputes these values by using the TRAS method of Gilchrist and St. Louis (1999) which uses the information at the Large, Medium and Small aggregations of the IO tables. Final examination of imputed estimates are done by hand and any adjustments are included in the initial estimates and the process is repeated until a reasonable set of IO tables is developed.

A key feature of all regional IO models is the treatment of region-to-region trade within a country. The most naive method, used in RIMS II by the U.S. Department of Commerce (1997), is the assumption that if a region has sufficient production to satisfy demand then inter-regional imports will be zero, otherwise inter-regional imports will be greater than zero. This method will inflate a region's multipliers because it does not take into account 'cross-hauling' of similar goods. Cross-hauling is when more than one similar type of good has both inter-regional imports and inter-regional exports, an example of which may be fruit. A second method, used by REMI (Stevens, Treyz, Ehrlich and Bower, 1983), is estimate the regional purchase coefficient (share of a region's demand satisfied by the region's production) based on the transportation network of the region. However, this is only appropriate for goods producing industries and provides no information cross-hauling of services. At the national level, this may appear to be a small problem, but as the region of interest shrinks the flow of services across its borders increases to be a big problem.

PolicyModels uses a novel approach by estimating the relationship between the regional purchase coefficients (RPC) and the region's share of national production. The nonlinear maximum likelihood estimation ensures that as the region's production share approaches one so does the RPC, conversely with zero and zero. The estimation uses the inter-provincial trade data from Statistics Canada, which allows for the inclusion of other attributes like commodity type, year, and the region's size. The coefficients generated from the estimation are then used to determine the RPC for any sub-region in Canada. The main advantage of this method is that services are represented as well as goods.

With over 4000 Census Sub-divisions represented in the CBP and 1000s types impacts available (not including the magnitude of the shocks), the database requirements are relatively small. Each model run generates an approximation of the region's IO tables, then uses these to determine the impact. The disadvantage of this method is that it could be potentially slower than a simple database lookup, if each impact were already run. The advantage is increased flexibility since each impact case does not depend on the results already existing.

Appendix B: Glossary of Terms

Input-Output Tables

An input-output table is used to describe the dollar value flows of commodities between industry, persons, government, and foreigners. In the case of regional input-output tables, these flows are extended to include inter-regional flows. The set of tables consist of a Make table, a Use table, and a Final Demand table. The Make table identifies the commodities produced in the region by industry. While the Use table is a description of the commodity inputs to production by industry. The Final Demand table shows the commodity breakdown of personal consumption, government expenditure, business and government investment, inventory change, international and inter-regional exports, and international and inter-regional imports.

Input-Output Model

An input-output model is developed by converting a set of input-output tables into input-output matrixes and vectors, then use matrix algebra to define the model's algorithm. The model's vectors are changed (initial shock) and the algorithm will compute the economic impact on industries.

Economic Impact

An economic impact using an input-output model can be disaggregated into three effects: direct effects, indirect effects, and induced effects.

Direct Effects

The industrial change that occurs resulting from the initial shock. The initial shock is broken down between the region's production, international imports, taxes, and inter-regional imports. The industrial direct effects are translated using fixed ratios into other economic indicators, including: employment, GDP, labour income, and taxes.

Indirect Effects

The resulting industrial change from the increase in inputs required to produce the commodities of the directly affected industries. This is an iterative calculation since each supplying industry will also require inputs, and so on. At each iteration, 'leakages' are removed from the region in the form of taxes, international and inter-regional imports. The industrial indirect effects are translated using fixed ratios into other economic indicators, including: employment, GDP, labour income, and taxes.

Induced Effects

Direct and indirect effects generate labour income for households (i.e. wages and salaries), which can either be saved or used to purchase consumer products. Saving is a leakage to the flow of income in the economy. While spending this income will create more demand for both domestic and international commodities, which in turn will generate more industrial production and labour income. This cycle continues until the leakages erode the flow of income to zero. The industrial induced effects are translated using fixed ratios into other economic indicators, including: employment, GDP, labour income, and taxes.

Leakages

A leakage is a transaction that removes income from the flow of income in the domestic economy. The main types of leakages are savings, taxes, inventory additions, international imports, and, in the case of a specific region, inter-regional imports.

Canadian Business Patterns (CBP)

A Statistics Canada database that reflects the current number of establishments and employment size categories. The database is taken from the Business Register Database, and is organized using NAICS.

North American Industry Classification System (NAICS)

An industrial classification that is based around the product that generates the highest revenue for a firm. NAICS is a common system in place in Canada, United States of America, and Mexico.

Census Family

A group of more than one person: (1) a married or common-law couple (with or without children), or (2) a lone parent with at least one child present, and (3) a grandparent with at least one grandchild and the parents are not present.

Appendix D: References

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