Economic Impact of $5 billion of Federal Government Expenditure: a National Impact

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Charles Saunders, PolicyModels Corp.

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Overview

This report summarizes the economic impact of $5000000000 of spending on final domestic demand, in Canada. Economic indicators presented include: gross output, gross domestic product, employment, taxes, international and inter-regional imports.

The population Census profile of Canada 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 accomodate the regional employment demands from a large project.

The economic impact is computed using an input-output model based on the 2007 public-use input-output tables available from Statistics Canada. 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 appendicies.

Census 2006 Profile of Canada

The 2006 Census of the Population provides demographic information on Canada, which include: 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

Canada covers a land area of 9017698.92 square kilometres with a population of 31612897. Canadian citizens make up 29480160 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 Canada is: 1st generation at 1760865, 2nd generation at 1760865, and 3rd generation at 4006420.

Table 1: Population by Age Group and Gender

Age Group	Male	Female
TOTAL	15475970	16136930
0 to 4 years	864600	825940
5 to 9 years	926860	882515
10 to 14 years	1065860	1014065
15 to 19 years	1095285	1045205
20 to 24 years	1047945	1032440
25 to 29 years	975945	1009635
30 to 34 years	987715	1032510
35 to 39 years	1083495	1124775
40 to 44 years	1285535	1324925
45 to 49 years	1290130	1330470
50 to 54 years	1158970	1198335
55 to 59 years	1026395	1058230
60 to 64 years	780140	809730
65 to 69 years	593805	640770
70 to 74 years	493465	560320
75 to 79 years	386485	493090
80 to 84 years	251420	395285
85 years and over	161925	358685

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).

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Table 2: Individual Mobility Status

Status	1 Year Ago	5 Years Ago
TOTAL	30897210	29544485
Non-movers	26534115	17457165
Movers	4363095	12087315
Non-migrants	2554260	6507905
Migrants	1808830	5579410
Internal migrants	1511305	4419370
Intraprovincial migrants	1221560	3566795
Interprovincial migrants	289745	852580
External migrants	297530	1160035

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	8896840	12435520
1 person		3328370
2 persons	4291665	4176930
3 persons	1959210	1982305
4 to 5 persons		2590725
4 persons	1840575	
5 or more	805395	
6 or more		357185
Average number of persons	2.90	2.50
Average number of children at home	1.10	

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	8509785
Rented	3878500
Band housing	49185
Average number of rooms per dwelling	6.40
Average number of bedrooms per dwelling	2.70

The most common population density measure is persons per square kilometre. Other density measures provide additional socio-economic information about Canadians. 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	12435520
Single-detached house	6871315
Semi-detached house	591590
Row house	690490
Apartment, duplex	676290
Apartment, building that has five or more storeys	1114925
Apartment, building that has fewer than five storeys	2289390
Other single-attached house	37995
Movable dwelling	163520

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 to a stronger preference for vertical construction.

Language and Education

Language plays an important role in a community, since a common language facillitates 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 Toungue	Spoken in the Home
Single responses	30848270	30665025
English	17882775	20584775
French	6817655	6608125
Non-official languages	6147840	3472130
Multiple responses	392760	576000
English and French	98625	94055
English and non-official language	240005	406455
French and non-official language	43335	58885
English, French and non-official language	10790	16600

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

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Table 7: Official Language in Use

	Knowledge	Spoken
English	21129945	23197090
French	4141850	7204390
English and French	5448850	331925
Neither English nor French	520385	507620

Education affects the community's ability to accomodate 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	4207810	17382115	4074295
No certificate, diploma or degree	1679020	2683510	1735800
Certificate, diploma or degree	2528790	14698605	2338500
High school	1528010	4156735	868675
Apprenticeship or trades	185175	2156010	444235
College, CEGEP, or other non-university	458375	3533370	443380
University	357235	4852480	582205
University below bachelor	87425	866735	181990
University	269810	3985745	400215
Bachelor's degree	233655	2538355	209455
University above bachelor	22500	416820	54220
Master's degree	10130	774655	82190
Doctorate	1300	142185	33465
Medicine, dentistry, veterinary, or optometry	2225	113735	20885

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.

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Table 9: Labour Force Composition

	Total	Male	Female
Population 15 years and over	25664220	12470785	13193435
Labour force	17146135	9020595	8125540
Employed	16021180	8431530	7589645
Unemployed	1124955	589065	535895
Not in labour force	8518090	3450190	5067900
Participation rate	66.80	72.30	61.60
Employment rate	62.40	67.60	57.50
Unemployment rate	6.60	6.50	6.60

Table 10: Employment by Class of Worker

	Total	Male	Female
All classes	16861185	8884805	7976375
Paid	15535410	8081435	7453975
Employees	14816200	7558525	7257675
Self-employed (incorporated)	719210	522905	196300
Self-employed	1274505	787230	487270
Unpaid family	51265	16140	35125
Not applicable	284950	135785	149170

Highly specialized project or activities generally require more specialized occupations and skills. Canada's diverse composition of occupations can satisfy most additional demands, however in some cases certain skills must be obtained from abroad. This creates an additional form of income leakage as foreign workers can transfer income back to their home country.

Table 11: Labour Force by Occupation

	Total	Male	Female
All occupations	16861185	8884805	7976375
A Management	1631730	1032940	598790
B Business, finance and administration	3025425	863420	2162005
C Natural and applied sciences and related	1108045	865825	242225
D Health	950365	188845	761515
E Social science, education, government and reli...	1414320	451145	963175
F Art, culture, recreation and sport	502195	225340	276850
G Sales and service	4037725	1716465	2321255
H Trades, transport and equipment operators and...	2550295	2374605	175690
I Unique to primary industry	648310	503790	144525
J Unique to processing, manufacturing and utiliti...	992765	662430	330335
Not applicable	284950	135790	149165

A country's industrial composition directly affects its ability to use domestically produced inputs versus international imports. This industrial diversity allows it to retain and cycle more income internally, hence higher multipliers. Canada has vast natural resources, well developed manufacturing and service sectors, an efficient transportation network, and close proximity to the US, results in both a high proportion of exports and imports.

Table 12: Labour Force by Industry

	Total	Male	Female
All industries	16861185	8884810	7976370
11 Agriculture, forestry, fishing and hunting	523650	368785	154870
21 Mining and oil and gas extraction	238810	195165	43645
22 Utilities	132950	100040	32905
23 Construction	1069095	938970	130120
31-33 Manufacturing	2005980	1421545	584435
41 Wholesale trade	739305	494575	244730
44-45 Retail trade	1917170	859720	1057450
48-49 Transportation and warehousing	820195	615140	205055
51 Information and cultural industries	417320	225295	192030
52 Finance and insurance	689210	253660	435550
53 Real estate and rental and leasing	303510	165625	137885
54 Professional, scientific and technical services	1122445	621925	500520
55 Management of companies and enterprises	20530	10410	10125
56 Administrative, support, waste and remediation	722695	400620	322075
61 Educational services	1150535	379910	770620
62 Health care and social assistance	1716255	308060	1408200
71 Arts, entertainment and recreation	346315	177795	168515
72 Accommodation and food services	1126695	446545	680145
81 Other services	819880	383840	436035
91 Public administration	978615	517170	461440
Not applicable	284950	135785	149165

Results

CIOM provides impact results for all available economic indicators. Aggregates are presented in the report; 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 $5000000000 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 ($)				
Canada	5000000000	2765866939.04	4429690933.97	12195557873.03
Gross Domestic Product ($)				
Canada	3151430565.25	1265762317.25	2461431560.03	6878624442.54
Employment (full-time equivalent)				
Canada	33320.61	31368.12	31933.65	96622.37
Labour Income ($)				
Canada	2720341939.99	769223945.5	1157880834.07	4647446719.57

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 1.376 (Type-II), with a Type-I multiplier of 0.883, both of which reflect the gross output results. Employment impacts are significant with 96622.37 jobs created, of which 33320.61 jobs stem from the initial impact. The direct and indirect labour income, from the initial impact, is $3489565885.49, which generates an additional $1157880834.07 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 14: Industry Gross Domestic Product, in Canada

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Summary Industries				
Goods Producing Industries	0	301499893.61	392946791.22	694446684.84
Service Industries	3151430565.25	964262423.64	2068484768.81	6184177757.7
Industry Detail				
Crop and animal production	0	4259164.04	27700488.63	31959652.67
Forestry and logging	0	1962230.72	3086505.87	5048736.58
Fishing, hunting and trapping	0	74939.28	983568.96	1058508.24
Support activities for agriculture and fore...	0	541662.49	1473312.44	2014974.93
Mining and oil and gas extraction	0	39790528.4	70819082.45	110609610.85
Utilities	0	28365557.66	79198540.82	107564098.48
Construction	0	80077471.47	40195436.4	120272907.87
Manufacturing	0	146428339.55	169489855.66	315918195.22
Wholesale trade	0	77450070.42	121905011.36	199355081.78
Retail trade	0	34398804.96	285433375.84	319832180.81
Transportation and warehousing	0	75191697.16	96246232.32	171437929.48
Information and cultural industries	0	92757216.54	115387779.48	208144996.02
Finance, insurance, real estate and rental ...	0	158805765.73	869034773.2	1027840538.93
Professional, scientific and technical serv...	0	196898603.05	84491640.86	281390243.91
Administrative and support, waste manag...	0	133265900.97	64053983.91	197319884.87
Educational services	0	16396238.79	7157256.62	23553495.41
Health care and social assistance	0	40958082.68	64121415.58	105079498.26
Arts, entertainment and recreation	0	10224889.42	32184199.93	42409089.35
Accommodation and food services	0	26377944.19	97868887.27	124246831.46
Other services (except public administrat...	0	28737526.14	74954158.85	103691685
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	6925905.63	80772388.72	87698294.35
Government sector	3151430565.25	65873777.95	74873664.88	3292178008.08

The service sector GDP impacts exceed that of the goods sector impacts for Canada. This is also the case for direct, indirect and induced effects.

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Direct Effects

The strongest direct effect are in Government sector with $3151430565 of GDP generated with $3151430565 coming from Other federal government services and defence services, and $0 from Other provincial and territorial public services. The next largest direct impact occurs in Non-profit institutions serving households valued at $0. The two main components are: Non-profit education institutions at $0, and Other non-profit institutions serving households at $0.

Indirect Effects

Indirect effects are focused in Professional, scientific and technical services with $196898603 of GDP generated with $96501400 coming from Other professional, scientific and technical services, and $94941348 from Architectural, engineering, legal and accounting services. The next largest indirect impact occurs in Finance, insurance, real estate and rental and leasing valued at $158805766. The two main components are: Lessors of real estate at $63917768, and Monetary authorities and depository credit intermediation at $38814048.

Induced Effects

Induced effects are focused in Finance, insurance, real estate and rental and leasing with $869034773 of GDP generated with $436321271 coming from Owner-occupied dwellings, and $131303087 from Lessors of real estate. The next largest induced effect occurs in Retail trade valued at $285433376.

Total Impact

The total impact are focused in Government sector with $3292178008 of GDP generated with $3173599022 coming from Other federal government services and defence services, and $33463057 from Other municipal government services. The next largest total impact occurs in Finance, insurance, real estate and rental and leasing valued at $1027840539. The two main components are: Owner-occupied dwellings at $436321271, and Lessors of real estate at $195220855.

Table 15: Industry Employment, in Canada

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Summary Industries				
Goods Producing Industries	0	2565.49	3139.12	5704.61
Service Industries	33320.61	28802.63	28794.53	90917.77
Industry Detail				
Crop and animal production	0	85.59	562.18	647.78
Forestry and logging	0	18.43	28.98	47.41
Fishing, hunting and trapping	0	0.74	9.75	10.49
Support activities for agriculture and fore...	0	11.2	37.63	48.83
Mining and oil and gas extraction	0	52.25	84.07	136.32
Utilities	0	91.69	256.86	348.55
Construction	0	837.26	418.66	1255.93
Manufacturing	0	1468.33	1740.98	3209.31
Wholesale trade	0	865.5	1362.28	2227.78
Retail trade	0	826.09	6854.72	7680.81
Transportation and warehousing	0	959.69	1201.4	2161.09
Information and cultural industries	0	607.55	1094.27	1701.82
Finance, insurance, real estate and rental ...	0	18223.4	5548.56	23771.97
Professional, scientific and technical serv...	0	944.31	329.85	1274.16
Administrative and support, waste manag...	0	2085.92	1047.92	3133.84
Educational services	0	544.16	237.53	781.69
Health care and social assistance	0	561.09	1381.07	1942.16
Arts, entertainment and recreation	0	314.57	920.53	1235.1
Accommodation and food services	0	903.84	3584.85	4488.7
Other services (except public administrat...	0	603.77	2344.31	2948.08
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	482.63	1872.79	2355.42
Government sector	33320.61	880.11	1014.44	35215.15

The service sector employment impacts exceed that of the goods sector impacts for Canada. This is also the case for direct, indirect and induced effects.

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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 recieved 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 CIOM does not impose these additional assumptions about this spending behaviour.

Saving is not an output of CIOM, because not all income flows are identified. CIOM 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
Canada				
Final Demand Tax	0	220479585.55	85910758.41	306390343.96
Industrial taxes	87142358.69	71138045.94	222549419.06	380829823.69
Personal Income Tax	592815154.48	185003961.16	303080350.8	1080899466.44
Federal Personal Income Tax	363343435.7	113391120.92	185761539.87	662496096.49
Provincial Personal Income Tax	229471718.78	71612840.24	117318810.93	418403369.95
Corporate Income Tax	39921567.67	41581932.8	100894046.97	182397547.44
Federal Corporate Income Tax	26787202.21	27901300.16	67699476.64	122387979.01
Provincial Corporate Income tax	13134365.46	13680632.64	33194570.32	60009568.42
Total Tax	719879080.85	518203525.44	712434575.24	1950517181.53

International imports

International imports provides income to foreigners. The spending patterns of foreigners are assumed, with 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.

Table 17: International Imports, Canada

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Total	247158307.87	320288625.21	294082818.86	861529751.97
Goods	194839820.97	231241072	210091508.08	636172401.08
Services	52318486.9	89047553.2	83991310.78	225357350.9
Commodity Detail				
Grains	0	189662.85	708850.95	898513.8
Other agricultural products	52446.17	1111142.68	3667899.17	4831488.02
Forestry products	0	125133.32	111267.5	236400.81
Fish and seafood and hunting and trappi...	0	89153.55	468680.66	557834.21
Metal ores and concentrates	0	1133344.89	1460997.79	2594342.68
Mineral fuels	833758.03	26251588.66	46930661.13	74016007.82
Non-metallic minerals	0	587753.64	1212772.33	1800525.97
Services incidental to mining	0	20367.37	36387.17	56754.53
Meat, fish and dairy products	0	1943849.82	6721815.7	8665665.52
Fruit, vegetable and other food products ...	0	2598175.32	10199095.47	12797270.8
Soft drinks and alcoholic beverages	0	2188233.72	2906982.44	5095216.15
Tobacco and tobacco products	0	9925.93	81859.1	91785.03
Leather, rubber, and plastic products	0	11200117.41	9612553.58	20812671
Textile products	0	2636447.69	5220064.55	7856512.24
Hosiery, clothing and accessories	10071652.31	1040965.05	798547.01	11911164.37
Lumber and wood products	0	995385.25	853086.25	1848471.5
Furniture and fixtures	0	76028.32	300287.65	376315.97
Wood pulp, paper and paper products	1070402.5	12381741.69	10863869.87	24316014.06
Printing and publishing	84107.01	11571351.71	4693229.97	16348688.7
Primary metal products	0	14190498.96	6685754.51	20876253.46
Fabricated metal products	3806382.03	9642952.72	5371846.31	18821181.06
Machinery	17239433.79	17294721.47	10827492.97	45361648.23
Motor vehicles, other transportation equi...	95394242.84	28823814.32	17405280.91	141623338.07
Electrical, electronic and communicatio...	14763474.12	23655648.81	15429371.3	53848494.23
Non-metallic mineral products	0	2559686.15	2229827.01	4789513.16
Petroleum and coal products	9991808.22	9624114.75	9873559.58	29489482.55

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Table 17: International Imports , Canada (continued)

	Direct Effects	Indirect Effects	Induced Effects	Total Impact
Chemicals, pharmaceuticals and chemic...	36727245.09	27991288.56	25531097	90249630.65
Miscellaneous manufactured products	4804868.84	21328344.78	9924757.38	36057970.99
Residential building construction	0	0	0	0
Non-residential construction	0	0	0	0
Repair construction	0	0	0	0
Transportation and storage	506447.82	25918868.5	10347450.43	36772766.74
Communications services	3805603.59	3150242.45	4891793.6	11847639.65
Other utilities	555505.35	467774.91	996974.96	2020255.22
Wholesaling margins	236764.74	404159.96	356023.12	996947.81
Retailing margins and services	0	0	0	0
Gross imputed rent	0	0	0	0
Finance, insurance, and real estate servic...	1106079.96	11863240.49	29150723.88	42120044.33
Business and computer services	35583297.83	15169964.27	21348218.97	72101481.08
Private education services	1133631.52	127099.72	202279.46	1463010.7
Health and social services	1622990.24	162617.88	97149.36	1882757.48
Accommodation services and meals	7981.65	24524876.37	7046083.84	31578941.86
Other services	7534497.79	6480147.57	6625777.24	20640422.59
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	725385.99	2849477.64	3574863.63
Unallocated imports and exports	0	0	0	0
Sales of other government services	225686.41	32807.72	42971.13	301465.25

The Canada impact results in international imports, with $141623338 of Motor vehicles, other transportation equipment and parts, $90249631 of Chemicals, pharmaceuticals and chemical products, and $74016008 of Mineral fuels. The three largest direct effects imports are $95394243 of Motor vehicles, other transportation equipment and parts, $36727245 of Chemicals, pharmaceuticals and chemical products, and $35583298 of Business and computer services. The indirect effects, industry demand for goods and services, generates $28823814 of Motor vehicles, other transportation equipment and parts, $27991289 of Chemicals, pharmaceuticals and chemical products, and $26251589 of Mineral fuels. The induced consumption results in import of $46930661 of Mineral fuels, $29150724 of Finance, insurance, and real estate services, and $25531097 of Chemicals, pharmaceuticals and chemical products.

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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:
   Type-I multiplier = (Direct effects + Indirect effects) / (Initial Shock)
   Type-II multiplier = (Total Impact) / (Initial Shock)

The direct effects (Gd) are computed as:
   $Gd = D*L*E*s$
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),I is the identity matrix, and u is the international import share.

The indirect effects (Gi) are computed as:
   $Gi = A*D*L*E*s - Gd$
where: A is industry-to-industry transactions matrix, defined as A=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:
   $Gn = P*A*D*L*E*s - Gd - Gi$
where: P is the matrix that determines the effect of induced labour income, defined as P=inverse(I - A*D*L*Ec*mpc*w), were 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 Ec is the personal consumption portion of the final demand matrix.

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Advantages of an IO Model
   1. Detailed industrial view of the economic impact.
   2. Modern computing has made this class of model relatively easy to use and more accessible.
   3. Web-based IO models, like CIOM, 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 an IO Model
   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.

The specific application determines if the advantages outweigh the disadvantages for 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.

Technical Note
Induced effects of CIOM and CRIOM (regional version) differ marginally since the latter model assumes that the local tax and the marginal propensity to consume rates are at the specific province's rates. Whereas CIOM uses the national rates when computing the induced effects.

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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, 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 and tax rates.

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 are developed.

The 2006 Census of the Population is used 'as is' for reporting the demographic characteristics of Canada.

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Appendix B: Glossary of Terms

Input-Output Tables
A input-output tables are 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.

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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.

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

Gilchrist, Donald A. and St. Louis, Larry V. (1999) 'Completing Input-Output Tables using Partial Information, with an Application to Canadian Data', Economic Systems Research, 11: 2, 185 — 194

Leontief W: Input-Output Economics, 2nd Edition, Oxford University Press, New York (1986).

Adapted from Statistics Canada, Canadian Input-Output Accounts, 2007. This does not constitute an endorsement by Statistics Canada of this product.

Adapted from Statistics Canada, Census of Population, 2006. This does not constitute an endorsement by Statistics Canada of this product.