Modernization of the Input-Output tables

Industry Accounts Division

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Introduction

The 2012 historical revision to the Canadian System of National Accounts (CSNA) has resulted in substantial impacts on the Input-Output tables published by Statistics Canada. Beginning with reference year 2009, the Input-Output (IO) tables will incorporate new classifications meant to enhance their relevance to contemporary issues, conceptual revisions required to better align them with the latest international standard, the System of National Accounts 2008 (SNA 2008)[1], and some time series breaks from previously published estimates due to improvements in estimation methods and to revisions in source data that could not be integrated during normal production cycles.

Since classification changes and other improvements are introduced with 2009 and prior estimates are not revised, the new IO tables are not fully comparable to previously published estimates for the period 1961 to 2008. While 2009 and future estimates will be fully integrated with the quarterly Canadian Economic Accounts and other CSNA products, prior estimates are no longer aligned.

This paper explains the modifications to the structure of the IO tables brought about by the conceptual, methodological, and classification changes. However, it does not attempt to empirically quantify the impact of these changes nor those of the statistical improvements. An overview of the aggregate statistical changes in the IO tables introduced in 2009 can be gleaned from other CSNA publications that have provided analysis of revisions to the GDP aggregates introduced by the historical revision[2]. Section I will discuss the conceptual and methodological changes while Section II will provide an overview of the main classification changes.

I. Conceptual and methodological revisions

There are four conceptual revisions and one major methodological[3] revision that affect the IO tables. The first three conceptual revisions relate to the capitalization of expenditures on research and development (R&D), military weapons systems, and exploration services. The fourth revision is in the treatment of the personal expenditures of non-residents on education and medical services. The methodological change affects the treatment of inter-provincial payments of taxes on products.

The first two changes capitalize expenditures on R&D and military weapons systems that were previously treated as intermediate consumption, and are new conceptual revisions introduced in SNA 2008. The third change removes the routing of exploration services through the non-residential construction industries. A simplification that is due to the introduction of a new fixed capital formation category for intellectual property products in SNA 2008. The fourth change expands the coverage of the personal expenditure travel

[1] United Nations. 2009. *System of National Accounts 2008*. New York.
[2] Statistics Canada. 2012. Revisions analysis – Canadian System of National Accounts 2012. *Latest Developments in the Canadian Economic Accounts*. Catalogue no. 13-605-X. Ottawa: Statistics Canada.
[3] The conceptual framework provides the theoretical definition of what is being measured while the methodologies define the real-world methods used to measure it.

categories to include medical and education services. This change in treatment has no impact on the total level of personal expenditures; it only implies a shift of values between the non-travel and travel categories. This latter change is not due to the new international standard but is rather designed to bring the CSNA closer to pre-existing international definitions. Finally, the refinement to the treatment of taxes on products paid by non-residents of a province or territory improves the coherence of the valuations and therefore the quality of the provincial supply-use framework.

i. Research and development

Research and development is defined by SNA 2008 as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and use of this stock of knowledge to devise new applications" (SNA 2008, par. 10.103). Since the economic benefits of such activities accrue over a period of time that exceeds the standard one year demarcation, R&D is treated as capital formation. In cases where the expenditures do not entail any economic benefits, they are treated as intermediate consumption (SNA 2008, par. 6.230). While measurement difficulties had previously prevented the SNA from treating R&D as an asset, recent progress in compilation methods have made it possible to opt for this change in treatment.

The output of R&D is measured in the usual manner based on receipts from sales for market producers and sum of costs for non-market producers. However, most R&D by market producers is produced on own account and capitalizing these activities requires imputing an explicit output. A consistent valuation of own-account output of R&D by market producers would require valuing it as if it were sold on the market. In practice, though, it is valued on the basis of the total production costs including the costs of fixed assets used in production. That is, no attempt is made to estimate a net return on capital for own-account production of R&D.

Finally, the international standard recognizes that research and development "is not an ancillary activity, and a separate establishment should be distinguished for it when possible" (SNA 2008, par. 6.207). Thus, where feasible, R&D output does not appear as a secondary output of industries but is instead classified to the R&D industry (IO industry code BS541700)[4].

The capitalization of R&D in the business sector raises the GDP level of the industries that make those expenditures by the amount of market purchases and own-account output of R&D. On the expenditure side, GDP increases by an equal amount of investments on research and development in the Intellectual Property Products (IPP) categories of the fixed capital formation categories.

[4] In general, market revenues for R&D services are used as an indicator of firms that are of sufficient size and autonomy to qualify as separate establishments.

For the government and Non Profit Institutions Serving Households (NPISH) sectors, other operating surplus and consequently income-based GDP are raised by the amount of capital consumption of the stock of R&D. Expenditure-based GDP increases by an equivalent amount. The final consumption expenditures of government decrease by the sum of purchases and own-account production of R&D and increase by the level of consumption of fixed capital of R&D. Government and NPISH sector investments in own-account and purchased R&D appear in the IPP categories.

ii. Capitalization of military weapons systems

SNA 2008 recommends treating all expenditures on military equipment as fixed capital formation and on durables such as munitions and bombs as inventory additions, to be withdrawn from inventories and recorded as intermediate consumption when used (SNA 2008, par. 6.232). The new standard also recommends the separate classification of weapons systems and military inventories, at least for the capital account (SNA 2008, chapter 10).

Previously, in accordance with SNA 1993, the CSNA treated both weapons systems and munitions as intermediate expenditures. Weapons systems have been reclassified from intermediate inputs to capital expenditures. The treatment of military inventories, however, has not changed to comply with the new standard; the small values involved were not deemed to be worth the increased compilation costs.

In the IO tables, weapons systems are now included with the values of other capital expenditures on Machinery and Equipment (M&E) of the defence industry. The income-expenditure accounts of the CSNA show an estimate of the value of total weapons purchases.

The overall impact of the capitalization of weapons systems as compared to the previous treatment is to increase GDP levels. In the defence services industry, the reduction of intermediate inputs is accompanied by an increase in other operating surplus due to the additional consumption of fixed capital associated with the augmented capital stock. The impact on the output of the industry is the result of the net impact of decreasing intermediate inputs and increasing other operating surplus. In final demand, government final consumption expenditure on defence services replicates the changes to output while M&E increases by an equivalent amount to the decreased intermediate inputs of weapons.

Other operating surplus and therefore income-based GDP increase by the additional amount of consumption of fixed capital associated with the increased stock of M&E. Expenditure-based GDP increases by an equivalent amount through the net change of increased M&E minus the decrease in government current expenditures.

iii. Capitalization of exploration services

The new framework defines a separate category for IPPs under Fixed Capital Formation (FCF). The new IPP category covers investments in software, R&D, and mineral exploration. Previously in the IO tables, exploration activities appeared as construction investment, embedded in the 'Gas and oil facility construction' commodity for oil and gas and 'Other engineering construction' for mining.

The production of oil and gas exploration was and remains classified to the oil and gas extraction industry and similarly the production of mining exploration to the services incidental industry. Previously, the production was rerouted through the construction industries. An imputation was made to show exploration services as consumption of intermediate inputs and as outputs of the construction industries. This did not affect value-added by industry but did create a double count of gross transactions. A reclassification of the exploration activities from the construction to the IPP categories in final demand has removed the need to route transactions through the construction industries.

iv. Travel expenditures on education and medical services

In the previous vintage of the IO tables, the expenditures of residents on education and medical services were included in the household final consumption expenditure categories of education and medical services of the geography of their permanent residence regardless of whether these occurred within or outside their geography of residence. In the modernized framework, these services are now treated similarly to all other expenditures and appear instead in the household consumption categories of the geography where they actually occur. Concomitantly, the travel categories now also show the expenditures on education and medical services of residents abroad and of non-residents, similarly to all other expenditures. These changes do not affect total household final consumption expenditures but only their distribution across the travel and non-travel categories.

v. Interprovincial trade and taxes on products

The IO accounts now include flows of taxes on products in inter-provincial exports and imports at basic prices; an element that did not appear in previous vintages of the IO tables. Previously, the IO tables would only show taxes collected by a province or territory as applicable to expenditures within the province or territory. Methodological changes have been implemented to show taxes paid by the purchaser that are remitted to jurisdictions outside their geography of residence. Tax margin files have been expanded to include for each province, the taxes paid to other provinces. In final demand at basic prices, taxes paid by residents of a province or territory to other provinces or territories are shown under interprovincial or territorial imports; conversely, taxes paid by non-residents are shown under interprovincial exports.

II. Classification changes

In comparison to the previous version, the new tables have more services and fewer goods for both industries and commodities, and a redefinition of the content of the fictive commodities and industries. They now also incorporate a complete sector for NPISH, a separate industry for the better sectoring of the activities of aboriginal government, the creation of a new category in FCF for IPP and an accompanying redefinition of the coverage of M&E and construction, and the elimination of a separate construction category for transfer costs on non-residential construction made redundant by the allocation of these costs to the relevant construction industries.

i. Industries

The industry classification structure is organized according to three broad sectors of the economy: the business, government, and NPISHs sectors. The business sector is disaggregated by industry according to the North American Industrial Classification System (NAICS), which classifies establishments into industries on the basis of the similarity of their production processes. The NPISH sector is similarly disaggregated by NAICS industry but, unlike the business sector, most activities are concentrated in a few industries. The government sector is not disaggregated by NAICS industry, but instead by broad functions, such as education, health, recreation, administration, etc. Government business enterprises that behave essentially like private enterprises by deriving most of their income from market sales are classified to the business sector industries and not the government sector.

In general the IO tables show the secondary outputs of industries, however, an exception is made in the case of the secondary output of construction activities. The latter are allocated to the construction industries. Thus, the construction industries include all construction activities including contract and own-account construction by establishments not classified to the construction industry. Coverage of the construction industries remains activity based, however, as mentioned in section I (iii), exploration services are no longer included in construction output.

In addition to the industrial classification system, the IO accounts have established fictive industries as a routing mechanism. A number of goods and services originating in different industries, whose use is related to a common activity and for which there is limited statistical information on consumption, are grouped into fictive industries. Estimates are made of the commodity inputs into the fictive industries but no primary inputs are assigned to them, so their output is equal to their intermediate inputs. Some of the fictive industries are redefined to realign them with more current data sources. The composition of the fictive aggregations can be seen in the inputs of the fictive industry.

As with the previous vintage, the IO industry classification is still based on the NAICS 2007. However, to enhance its relevance to current economic structures, the new IO classification generally provides less detail in the goods-producing industries and greater detail in the services industries. Overall, the number of industries is reduced from 298 to

235. For example, while the number of food, textile, and chemical manufacturing industries is reduced, further detail is provided by separating oil and gas extraction into conventional and non-conventional extraction, the wholesale industry into 9 wholesaling industries, and the retail industry into 12 retailing industries. The aboriginal government services industry, previously embedded in the non-profit sector is now classified to the government sector.

The IO industry codes indicate the sectoring. Business sector industries begin with the letters 'BS' (211 industries), government sector industries with 'GS' (11), NPISH with 'NP' (7), and the fictive industries with 'FC' (6).

Concordances between NAICS 2007 and the Input-Output industrial classification system are available from the Industry Accounts Division.

ii. Commodities

The new commodity classification is based on a new standard, the North American Product Classification System (NAPCS). The new standard is more aligned with contemporary economic structures and provides more rigorous and detailed definitions of the IO commodities. The introduction of this system is also part of a broader harmonization of commodity classifications at Statistics Canada used, for example, in the compilation of manufacturing, services, and trade and industrial prices data. The total number of commodities is decreased from 727 to 481 in comparison to the old classification. In general, the number of goods commodities is reduced while the number of services commodities is increased. And obviously, the same comments apply to the fictive commodities as to the fictive industries.

A disadvantage of such a major overhaul of the classification is the loss of time series continuity with previously published IO tables. The many-to-many relationships between the old and the new classifications preclude the possibility of creating a concordance from the old to new commodities.

iii. Final demand categories

The final demand table shows expenditures on commodities by distinct final expenditure categories. The categories show each of the final consumption expenditures of households, NPISH, and government, fixed capital formation expenditures, inventory additions and withdrawals, and exports and imports. Most of the final demand categories embed further details. The final consumption expenditures of households are disaggregated by type of expenditure, the final consumption expenditures of government are disaggregated by level of government and broad function, while fixed capital formation is disaggregated by industry.

a. Household final consumption expenditure categories

The new household final consumption expenditure categories are based on the international classification standard, the Classification of Individual Consumption According to Purpose (COICOP). The new categories no longer distinguish imputed expenditures on own-output or income-in-kind, with the exception of the imputation for owner-occupied dwellings.

The old personal expenditure categories combined the expenditures of the household sector with the collective consumption expenditures of the NPISH and aboriginal government. The new categories exclude the two latter activities.

The four travel categories remain unchanged. However, as previously mentioned, trade in education and medical services by the personal sector are now included in travel expenditures. As a consequence, the related non-travel PE categories decrease by an amount equivalent to the value of these new travel imports and increase by an amount equivalent to the value of these travel exports.

At their most detailed level, the new PE categories are now the same between the IO tables and the Income and Expenditure Accounts. This will allow users a more seamless transition between the timelier IEA product and the less timely but enhanced commodity detail available from the IO tables.

b. NPISH categories

The NPISH final consumption expenditure categories, previously embedded with the personal expenditure categories are now shown as a separate category in final demand. Previously they were included in the ‘Operating expenditures of non-profit institutions serving households’ as well as other personal expenditure categories covering medical care, education, culture, and recreation among others.

c. Government Final Consumption Expenditure categories

The Government Final Consumption Expenditure category now include a separate category for the expenditures of Aboriginal government, which were previously included in the personal expenditures categories.

d. Fixed capital formation industries

Previously, the FCF category showed the construction and M&E expenditures of industries. In the new classifications, the FCF category shows expenditures on construction, M&E, and IPP. The new IPP category covers investments in software, R&D, and mineral exploration. In the previous vintages of the IO tables, software investments were included in M&E, spending on mineral exploration in the construction category, and expenditures on R&D in the intermediate consumption of industries. FCF industries are realigned with the new industries in the input and output tables. One of the

main differences is the explicit classification of the NPISH sector industries, which were previously combined with the business sector industries. Transfer costs on non-residential construction are no longer shown as an aggregate for the total business sector but are distinguished separately for each construction industry.

ii. Margins

There are three important changes that affect the margins. The pipeline margin has been split into two separate crude oil and natural gas pipeline margins. There are no changes to the tax margins at the national level but the provincial tax margins now articulate the province of origin and the province of destination of the tax payments. Finally, the wholesale margin no longer embeds the value of the non-margin wholesaling commissions.

iii. The aggregation structure of the classifications

New aggregations have been designed to accompany the new classifications. The main criteria used for determining the IO aggregations were: analytical usefulness, economic significance, and the protection of confidential information. It is worth reemphasizing that regardless of the level of aggregation the figures in the 2009 tables will not be directly comparable to figures from tables for any reference years prior to 2009.

Table 1 IO classifications and aggregations, 2009

Code	Title	Industries	Final Demand	Commodities
DC	Detailed confidential	235	280	481
D	Detailed	234	280	470
S	Summary	35	25	74

Table 1 shows the number of industries, commodities, and final demand categories for the Detailed confidential level (DC), Detailed (D), and Summary (S) aggregation levels of the tables. The aggregations are hierarchical in nature. The DC level IO tables are not released publically due to confidentiality restrictions. The national IO tables are published at the D and S levels while the provincial tables are only published at the S level due to confidentiality restrictions. The D aggregation is released nationally with some data suppression for confidentiality, that is, the tables are not completely additive due to missing confidential values. While suppressed values are set to zero, all published values and totals are correct values. At the provincial level, GDP and output by industry will also be published at the D level, with some data suppressions for confidentiality.

Currently, the IO tables in basic prices are published on CANSIM while the margin and purchaser price tables are available on request from Industry Accounts Division.

In general, total output and GDP components by industry contain no suppressions for confidentiality. In final demand, category totals as well as household final consumption expenditures by commodity are free of suppressions. And finally, the S level national IO tables are free of any suppressions for confidentiality.

The Summary aggregation was designed to provide the maximum amount of information at the provincial level given confidentiality constraints. They provide about 10 more industries and 15 more commodities than the previous provincial IO tables. The final demand categories now include the new Non-Profit Institutions Serving Households sector and Intellectual Property Product categories.