

Canadian Monthly GDP Estimates

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Canadian Monthly GDP by industry estimates

Abstract:

The history of the collection and interpretation of industrial statistics is relatively long in Canada. The first publication containing estimates of output for selected industries was released in 1926. Ever since, monthly measures by industry have been prepared and published on a continuing basis. The concepts and methods evolved over the years and eventually the scope of these measures was extended to cover all industries, culminating in 1971 with the first publication of the Canadian monthly GDP by industry statistics.

The evolution and the shaping of the Canadian monthly GDP by industry program have been greatly influenced by the issues and challenges of monitoring the health of the Canadian economy in a consistent and detailed way. Among the factors that influenced the evolution of the program, the integration of the monthly statistics to the Canadian System of National Accounts (CSNA) has certainly been the dominant one. Other factors related to coherence also played a role in the design of the program. As well, decisions related to timeliness and accuracy also significantly influenced its development. This paper reviews the most important factors explaining the characteristics of the Canadian monthly GDP program. The emphasis is on the projection approach, the choice of volume measures and seasonal adjustment. Other topics such as revision policy, relationships with data providers and the dissemination of the monthly GDP statistics are also covered. A brief description of the IT system is presented in an annex.

History of the monthly GDP by industry program

In 1926, in response to a growing need for information on the state of the Canadian economy, Statistics Canada¹ began publishing measures of industry output on a regular monthly basis extending back to 1919. A key feature of the statistics released was a new indicator, called the Index of Physical Volume of Business. This indicator was a comprehensive measure covering the activities in forestry, mining, construction, manufacturing, trade, exports, imports, railway carloadings, shares traded and bank debits. The weighted average of a sub-group consisting of forestry, mining, manufacturing and construction was called the Index of Industrial Production (IIP) and was considered to be one of the best indicators of current economic trends in Canada. This indicator was subsequently redefined to include mining, manufacturing and utilities to follow international standards.

¹ Prior to 1971, Canada's national statistical office was called the Dominion Bureau of Statistics.

The development of annual and quarterly measures of GDP by industry in volume terms for the remainder of the economy started in Statistics Canada in 1952. In the early summer of 1953 the first preliminary estimates, providing quarterly volume of output at 1949 prices and covering all industries was circulated for internal use. The data were constructed to approximate the concept of GDP at factor cost by industry of origin and were expressed in index form. For several years it was found that the estimates of GDP by industry and the deflated Gross National Expenditures estimates generally moved in the same direction and at the same pace.

In May 1963, annual and quarterly indexes of Real Domestic Product (RDP) covering all industries in the economy were released. The project of converting the entire RDP by industry program to a monthly basis was completed in 1968. The data, extending back to 1961, were prepared on an experimental basis until the middle of 1970. At that point the statistics were considered of sufficient quality to be released to the public. The statistics were eventually renamed as Gross Domestic Product by industry. While the statistics were prepared on a monthly basis, annual estimates were also prepared in parallel to serve as benchmarks for the monthly program. The statistics were however not benchmarked to the Input-Output Accounts until 1986 when various CSNA industry accounts were all integrated, including the Income and Expenditure Accounts. In its long evolution, the monthly industry statistics have always been compiled in a context of integration. For several decades, the data were prepared in parallel with other statistics about the economy. They are now totally integrated within the production accounts of the Canadian SNA (CSNA) and reconciled with the Income and Expenditure Accounts. They also serve as a key input into the quarterly compilation of the labour productivity measures by industry.

The evolution and shaping of the Canadian monthly GDP by industry program have been greatly influenced by the issues and challenges of monitoring the health of the Canadian economy in a consistent and detailed way. The integration of the monthly statistics to other CSNA accounts has certainly been a dominant factor. Other factors related to coherence also played a role in the design of the program. It goes without saying that decisions related to timeliness and accuracy also significantly influenced its development.

This paper reviews the most important factors explaining the characteristics of the Canadian monthly GDP program. The emphasis is on the projection approach, the choice of volume measures and seasonal adjustment. Other topics such revision policy, relationships with data providers and the dissemination of the monthly GDP statistics are also covered. A brief description of the IT system is presented in an annex.

Description of the Canadian monthly GDP by industry program

Industry Accounts Division, the group responsible for Monthly GDP, compiles integrated industry statistics according to the concepts recommended in the System of National Accounts 1993 Manual. The products and services of the division can be sub-divided into two main groups. The first group deals with information on the structure of the Canadian economy. It consists of the input-output accounts and their related analytical products. The second group focuses on the measurement of current economic conditions, such as the national Monthly GDP by industry. Statistics are reconciled with those of the Income and Expenditure Accounts (IEA), and are used for productivity measurement and in the compilation of satellite accounts by other CSNA divisions. The monthly

section is composed of a staff of about 15 persons, 12 of which being actively engaged in the monthly production.

The monthly GDP by industry estimates are prepared according to a projector or indicator approach as opposed to an econometric approach. The data are projections of the latest set of input-output accounts (I-OA). Even though the goal of the program is to derive GDP estimates, the focus of the analysis is production in real terms. Even though monthly/quarterly supply-use tables are not part of the program, the data are analyzed in that context using a series of indicators. They are eventually benchmarked to the I-O accounts which are made available to the monthly GDP program 30/32 months after the reference year.

The projectors are deflated indicators of production or sales, or physical indicators. Employment data are also used as projectors. A special procedure is used in the case of crops due to the annual nature of that industry. A quadratic minimization technique is used to allocate monthly the various crops (on a seasonally adjusted basis), taking into consideration the harvest quarter. There are cases where the value added for certain industries is based on the use of their output by other industries like in the case of truck transportation. In addition, for those industries where output should be equivalent to the final demand expenditures, such as construction of new residential buildings, the same indicators are used for production as those used in the compilation of the Income and Expenditure Accounts.

The monthly GDP estimates are compiled for some 240 industries, according to the North American Industry Classification System. The statistics are released 60 days after the reference month and jointly with the quarterly Income and Expenditure Accounts at quarter times. The release dates of the monthly GDP data are announced one year in advance.

Much of the source data for the program are collected by and produced within Statistics Canada. Additional data sources include other governmental agencies, private firms and industry associations. The Monthly Survey of Manufactures provides information for a large number of industries, in terms of shipments (turnover) and inventories. This information combined with information from Prices Division allows computing GDP estimates for about 130 manufacturing industries. In the mining sector (including oil and gas extraction), the information available is essentially in volume terms. Data from Statistics Canada and the Department of Natural Resources allow compiling GDP estimates for 13 of the 16 industries of that sector. In the case of residential and non-residential building, the projectors are derived from a model based on building permits and starts. The data are available for several types of residential building and 3 types of non-residential building.

In the services sector, the list of survey is less comprehensive. However, the monthly wholesale and retail trade surveys offer a fair amount of detail. The GDP estimate for the wholesale trade sector is based on sales of about 15 kinds of wholesalers. In the case of retail trade, sales for 20 types of retailers are available. Surveys on air, rail and urban transport, as well as restaurants and telecommunications are available on a monthly basis. Private sector data are used to derive GDP estimates for industries such as accommodation and real estate agents. The results of the Survey on Employment, Payroll and Hours are used to project GDP for several services industries including public sector estimates i.e. public administration, health and education services.

Since the release dates of the monthly GDP data are announced one year in advance, internal and external data providers are asked once a year to confirm that their data will be delivered according to a pre-determined schedule as well as to provide an early indication of any foreseen methodological changes.

Projector system

Ideally, the monthly GDP by industry estimates would be based on complete information on both output and inputs. In practice this information can only be obtained from annual surveys and with a lag. As a result, the derivation of the monthly GDP data rely on a less comprehensive databases compared to other CSNA statistics. The focus of monthly surveys is on sales, shipments (turnover), inventories. They generally do not have a commodity dimension. Nonetheless monthly surveys do provide sufficient data on each industry to serve as suitable indicators of the sub-annual movements in production.

The program assumes that changes in the indicators selected for an industry, generally the volume of production in real terms, approximate very well the changes in that industry's value added in real terms. This assumption is valid to the extent that changes in technology function usually occur slowly. In light of this hypothesis, the monthly projectors are also subject to error in cases where the product mix of an industry changes significantly from one month to the next. In the absence of commodity detail the system was designed to calculate production at the most detailed level of industries possible, a level where production is less diversified. This not only helps to capture more precisely changes in production and in the product mix, but it also helps in capturing the seasonality more accurately. Of course, at a lower level of aggregation the data are often less robust, which requires a more careful analysis of the movements in the data used as projectors.

As indicated above, most of the projectors are based on gross output data. The preferred method to derive gross output in volume terms is via deflation. This is the case for the manufacturing sector, wholesale and retail trade. In the mining and forestry sectors, physical indicators are used. The projection in the services sector other than retail and wholesale trade is more challenging since less information is available. Although volume and sales indicators are available for a few transportation and consumer services industries, employment is commonly used as a projector for a majority of business and personal services industries. Employment-based projectors, i.e. hours worked, are also used for the public sector (public administration, education and health care). In the financial sector, projectors are based on deflated assets and liabilities. Administrative data are sometimes available as in the case of the gaming industry and attendance at sporting events. The monthly GDP section is investigating the use of administrative data related to the Goods and Services Tax² (GST) in order to improve its projectors in the services sector.

The estimation of the value added is done in a series of steps. The first step is the validation of the projector. Often this step consists in bringing the source data in the monthly GDP database, compiling indicators in volume terms and according to SNA concepts and returning the data to survey divisions (data providers) in order to help them assess the quality of their data. This applies

² Essentially a value added tax (VAT).

notably to wholesale trade sales as well as turnover/inventory data of the Monthly Survey of Manufacturing. In many cases, the focus is simply on the movement of the raw data relative to past years.

The next step consists in comparing the level and/or the movement of the projector with related indicators such as exports. A significant amount of analysis focussing on inter-industry relationships is also done, for example, the manufacturing of construction material, the wholesaling of that material and construction activity. This type of analysis is extended to the Income and Expenditure Accounts results at the time of the quarter. Analysts pay particular attention to the coherence of many statistics of the two sets of accounts. Among others, production of motor vehicles or extraction of oil and gas in relation to exports or the coherence between the gross output of food and accommodation services relative to consumer spending on those same services. In general, the assessment is done in volume terms after seasonal adjustment.

The next step consists in applying a series of ratios to the final projector in order to derive value added. At that point, the trading day and seasonal factors have already been applied. The set of ratios includes a gross output ratio to bring the level of the projector to that calculated in the I-O accounts. A so-called GDP-to-gross ratio is then applied to the projector to derive value added. Occasionally the results are adjusted to take into account a perceived upward or downward bias in the movement of the projector. In such cases, the ratios are based on analysis covering several years.

A macro adjustment ratio is also included in each industry methodology. That ratio is used exclusively in the reconciliation of the movement of the quarterly Income and Expenditure Accounts GDP and the monthly GDP. This ratio is only applied to a selected number of industries, the fairly large ones, where the application of a macro adjustment will only change the industry growth rate marginally. The macro adjustment is only done after an extensive data reconciliation process between the two systems.

Analysts are responsible for specific industries and meet formally once (sometime twice) a month to assess the overall results. Given the interdependency of the industry results and, to a lesser extent, to exchange best practices on specific issues, the analysts are engaged in frequent discussions with each other. The analysts are also in regular communication with the data suppliers to discuss issues affecting the quality and timeliness of the data. At the time of the quarter, similar meetings take place with analysts responsible for the Income and Expenditure Accounts.

Volume measures

The monthly GDP statistics are only released in volume terms. They are prepared in two forms, in a constant price Laspeyres form and an annually chained-volume form, with the same reference year for both. The focus is exclusively on the chained-volume when disseminated.

The monthly GDP Laspeyres and chained-Laspeyres statistics are eventually calibrated to the annual volume data obtained from the national input-output accounts which are available with a 30/32-month lag. In Canada, GDP estimates of the I-O accounts are prepared according to a chained-Laspeyres index (weights of the previous year) as well as a chained-Fisher index.

Because of resource limitations, the national I-O tables cannot be prepared on a Laspeyres basis. The calibration of the monthly GDP statistics on a Laspeyres basis is done using the growth rates of the I-O chained-Laspeyres data.

The monthly chained-Laspeyres data are calibrated to the annual chained-Fisher data from the I-O accounts. Accordingly, for the most current period, extending back to the last set of I-O tables; the movement in the monthly GDP data reflects more that of a chained-Laspeyres measure than that of a chained-Fisher one. For this reason, the statistics are often referred to as “Fisher index with a Laspeyres tail”.

It is important to note that that on a quarterly basis, the Income and Expenditure Accounts’ volume measure of GDP are prepared in a chained-Fisher form. The quarterly GDP reconciliation of the monthly industry program and Income and Expenditure Accounts described in the previous section brings the monthly GDP measure closer to a chained-Fisher form than to the chained-Laspeyres form.

Rebasing and re-referencing

Prior to the conversion to the chained-Fisher formula in 2001, rebasing was done every five years on average in the CSNA. Now, re-referencing, i.e. changing the reference year of the volume measure, is also done every five years. Revisions to the North American Industry Classification System are normally implemented at the same time. In order to maintain an as long as possible historical record of monthly GDP by industry, the old constant price measures are linked to the new annually-chained ones. A mechanical scaling process that preserved the old growth rates was used. For periods prior to the base year, the volume series at each level of detail is adjusted to the new reference year segment by multiplying it by a linking factor. The linking factor is the ratio of the value of GDP in the new reference year over the value of GDP for that year evaluated at the prices of the previous base years.

Trading-day and seasonal adjustments

Seasonal adjustments of the monthly GDP data are performed at the most detailed level possible. At the moment, the monthly GDP by industry program uses X-11-ARIMA for the seasonal adjustment of its time series. A conversion to X-12-ARIMA is under way. Two factors are extracted during the seasonal adjustment process and stored separately on the monthly GDP database, the trading-day factor and the seasonal factor. Both factors are stored independently in order to facilitate their analysis, notably the seasonal factor. Projectors based on stock-type series such as employment are not trading-day adjusted. Trading-day factors are computed once a year whereas seasonal factors are recomputed every month. The goal of re-computing the seasonal factors every month is to capture the most up to date signal in the series as it continues to be updated. In addition, seasonal factors are less reliable for data points near the end of time series than for those in the interior. The revision policy of the monthly GDP program is such that the series can be revised as far back as possible in order to avoid breaks in the seasonally adjusted series.

The fact that the seasonal factors are stored separately facilitates the detection of outliers or sources of revisions. The stability of the seasonal factors from year to year for a given month is often an indication of the quality of the series being seasonally adjusted. It is also very useful to evaluate moving seasonality. Special procedures are in place to ensure adjustments made over time do not distort the seasonal pattern of the original series.

The monthly GDP program does not produce the trend-cycle of its series. The trend-cycle is of prime interest when attempting to assess movements over long periods which is not the primary focus of the monthly GDP program. The focus is normally on month-to-month fluctuations and irregular variations due to phenomena such as strikes, layoffs, plant closures or unfavourable weather.

Analysis

Data providers play an important role in the compilation of the monthly GDP data. Of course, they provide the input data necessary for computing Monthly GDP, but they are also asked to provide qualitative information or economic intelligence that would help in explaining the GDP results. Information such as plant closures, strikes, shortages of inputs, introduction of new products or strong foreign demand are examples of information that subject matter divisions are asked to provide to the monthly GDP staff.

Subject matter divisions within Statistics Canada generally provide their data to the Monthly GDP section before they officially release them. This provides an opportunity for the Monthly GDP analysts to ask questions and make comments on the data before publication, leading sometimes to investigations and changes in the original estimates. This approach has proven to be very useful in assessing the quality of the data. As mentioned earlier, the monthly GDP staff performs deflation and seasonal adjustment to source data and, for selected industries, send the results back to subject matter divisions in order to help assess the quality of the original data. This whole approach is made possible only by a strict adherence to the established data transfer protocol and to the pre-determined schedule.

Analysts of the monthly GDP program continuously gather information from electronic media to establish economic intelligence about their industries. The information they gather concerns events that might explain large variations in the output of industries or a change in the relationship between output and value added (such as strikes, plants openings and closings, etc.). In addition, indicators not used directly in the computation of monthly GDP are examined to establish economic linkage, such as external trade data and hours worked. Indicators from private firms and associations are also used.

Every quarter, the monthly GDP results are reconciled with those of the quarterly Income and Expenditure Accounts. The results are reconciled in terms of growth rates. Growth rates are expected to be within a 0.2% range. The trend of the growth rates is also expected to be similar. Annually, a difference of 0.3% would not be uncommon. The two programs are not fully reconciled because of conceptual and statistical differences. Conceptually, the difference arises from the fact that the monthly GDP by industry is measured at basic prices whereas the Income and Expenditure Accounts (IEA) are at market prices. Statistically, the difference arises from the use of different data

sources and also from distinct deflation approaches. The monthly GDP is an annually-chained volume measure whereas the IEA one is a quarterly-chained Fisher measure.

Revision policy

The monthly GDP by industry program has been following a very rigorous revision process for over 20 years. Communication of the revision period under review is included with each monthly release. The production of the monthly GDP estimates includes two main revision processes, a monthly process and an annual process. A historical revision process takes place every 10 to 15 years. All the processes are linked to revision processes that affect the whole of the CSNA. Source data are also revised regularly but the timing of their revisions is quite different from that of the CSNA.

The monthly GDP statistics are calibrated to the Input-Output Accounts during an annual revision process. At that point, final I-O benchmarks for the year $t-4$ and preliminary I-O benchmarks for year $t-4$ are provided to the monthly GDP program. With the release of the July GDP results, the monthly GDP is revised back 5 years. Until the release of the month of December, the monthly GDP is revised back to January of the current year. These months continue to be revised until the next annual revision. As a result, prior to the month of the annual revision, the series are revised for the previous 19 months, i.e. from January of year $t-1$ to July of the current year. The main reason for going back that far is to push back any breaks that could be caused by revisions to the seasonal factors.

Monthly revisions

When estimates of GDP by industry are prepared for a current month, several preceding months are revised. The two main sources for the regular monthly revisions are revisions to the source data and revisions to the seasonal factors. Trading-day factors are normally revised only once a year.

Revisions to the source data generally reflect more complete response to surveys. Revisions to the seasonally adjusted estimates are caused by re-estimating the seasonal parameters each month. Seasonally adjusted estimates are less reliable near the end of the time series than in the interior, therefore as time passes and a given month works its way back to the interior of a time series, its seasonally adjusted value is revised to produce a more accurate estimate. The revisions to the seasonal parameters are generally random and decrease in time. The largest monthly revision usually occurs with the addition of the month of December, since revisions to both the source data and the seasonal factors tend to be more significant with the closing of the calendar year than in other months.

Quarterly revisions

With the release of the third month of the quarter, the monthly GDP estimates are reconciled with those of the quarterly Income and Expenditure Accounts. Both sets of data are subject to quarterly revisions because some important data sources are only available quarterly such as the survey of corporate financial results which is used to estimate surplus.

Except for unusual revisions, no special information is provided to users about the sources of the monthly revisions. However, each quarter a meeting is held the day after the release with the some

principal clients, mainly private forecasting firms and government officials, to explain in more detail the results for three programs: Income and Expenditure Accounts, Monthly GDP by industry, and the Balance of Payments. At the meeting, movement of time series and what caused them are reviewed at a fairly detailed level. Revisions and patterns of revisions are reviewed as well.

Annual revisions

Each year, when the annual Input-Output tables are released, the monthly GDP series are normally revised for several years. The main purpose of the annual revision is to incorporate the newly released and the revised benchmark levels. The revision span is restricted to cover only the most recent five and a half years of monthly estimates, one year more than the revised benchmarks in order to reduce the break between the historical and the newly revised segments of the GDP series.

In addition to the previously described sources of revisions, the annual revisions also include the effects of:

- incorporating revisions to monthly source data that extend further back in time than would be picked up in the regular monthly revision cycle;
- updating the trading-day factors;
- reviewing the seasonal adjustment parameters;
- changing methods of estimating monthly GDP for specific industries.

Occasionally revisions due to rebasing and the implementation of a new industrial classification are also made. If possible these are timed to coincide with the annual revision cycle.

Dissemination

According to an advance notice of publication dates, the monthly GDP statistics are generally released the last working day of the month except in December when they are released prior to the Christmas Holiday. As part of the peer review process prior to official release within Statistics Canada, the results are presented each month to a Senior Management Committee composed mainly of the Chief Statistician and the Assistant Chief Statisticians.

Staff from the Privy Council Office, Department of Finance as well as Department of Industry receive the results the afternoon prior to the release in order to prepare briefings to the ministers and the Clerk of the Privy Council at the end of that day. This enables these senior federal government officials to be in a position to answer questions at the time of the release.

The data are made available to users on CANSIM, Statistics Canada's database, at 8:30 am the day of the release. A text summarizing the results is also released on the website of Statistics Canada at the same time. Journalists have access to the text and the data about one hour prior to the time of the release in a secured area where they cannot disseminate information before the official time of the release. Detailed documentation on the data sources and methods used for compiling Monthly GDP by industry is available through the Statistics Canada's Website. Interactions with the main users about these sources and methods as well as overall quality of the results take place on a regular basis.

Annex 1 - The computer system

The following is a brief description of the computer system that is used to compute and analyze monthly GDP by industry in Canada. This system was specifically designed for the management of time series and which is capable of providing the necessary tools for the step by step tracking and analysis of the size, timing and the many sources of revisions.

The computer application is a menu-driven facility which allows multiple users to simultaneously input, manipulate, analyze and output data.

The data are structured and stored in this database in the form of time series. A time series is a set of data points where each data value is an observation of a given phenomena (some measure or result of economic production), repeated over regular time intervals. The data stored in the database are not only those that serve as inputs into the computation of GDP but also include data to support the analysis and confrontation of such results. The centralized nature of the database – as opposed to various individual repositories – allows for an efficient and coordinated access to the data.

A separate time series exists for each type of data (actual, estimate) and level of adjustment (raw, seasonally adjusted, reconciled with annual benchmarks and quarterly income and expenditure-based GDP, etc.) When it is necessary to apply an adjustment to the source data, the correction is stored in a distinct series and is added to the original value. Other adjustments, such as trading day, Easter and seasonal adjustment, or the correction factors resulting from reconciliation processes with the input-output based annual benchmarks and the quarterly income and expenditure-based GDP are also stored in separate time series. This separation of time series ensures that values provided by the data sources remain intact and the estimated and reconciled data values can be revisited (changed and often removed) once corrections are received from the data supplier or the benchmark series are revised with a new release of the input-output tables.

Time series can also have five versions of data (published, current, revised, historical, and test) for each of their data point. The published data version holds the most recently published values. The current data version is the designated working environment for the ongoing production of monthly GDP. The revised data version is the designated working environment for the annual revision and the historical data version is used for introducing historical revisions. This last version is often used to test new methodologies.

Time series may have gaps, in other words, not all data points are present. When manipulating the data under such circumstances, subordinate data versions contribute missing data values according to an established order of precedence.

The data are either observed and received from external sources or are calculated from other series stored in the database. The computation uses methodologies which are defined by users. A methodology is a set of algebraic formulae. A formula can be applied to a range of time series covering sets of industries, geographic regions, subjects and commodities. Each methodology, and each formula in the methodology, has a time span in which it is active. It is possible to apply separate methodologies to different versions of the data. It is also possible to use more than one version of a methodology for non overlapping time periods covering the length of a time series. Detailed information relating to relevant methodologies is also attached to the identification of each time series.

Annex - 2

Monthly Gross Domestic Product by industry
- Data Source Diagram -

