Appendix IIa - GDP by Industry: Overview

1. Gross Domestic Product by Industry at Basic Prices, in Constant Dollars

Definition

Gross Domestic Product (GDP) by industry at basic prices is a measure of the economic production which takes place within the geographical boundaries of Canada. As the name suggests, it is designed to show the industrial distribution of total output. GDP for a single industry is also referred to as net output, or value added. It is equal to the total value of production by the industry (gross output) less the value of inputs purchased from other industries or imported (intermediate inputs). Primary factors of production, such as labour and capital, produce gross output by adding value to the intermediate inputs. Value added can therefore also be derived as the remuneration to the primary factors of production, that is as the sum of labour income, depreciation, and profits. GDP at basic prices for the economy as a whole, is the sum of net output, or value added, for all industries. Summing net rather than gross outputs avoids double counting the output of one industry which is an intermediate input to another.

The term "gross" in Gross Domestic Product means that capital consumption costs, that is the costs associated with the depreciation of capital assets (buildings, machinery and equipment), are included.

"Constant dollars" means that the estimates are valued at the prices that prevailed in some base year rather than those of the current year. As a result, changes in the estimates of value added by industry reflect changes in the physical volume of production, and do not reflect changes that are simply due to price fluctuations. With this publication, the base year for constant price estimates is 1997 (see section 2.2).

"By industry" implies a classification system. The North American Industrial Classification System (NAICS) replaced the Standard Industrial Classification (SIC) with the release of July 2001 data (see Section 3).

2. Major Changes and Differences Between Industry-Based and Expenditure-Based GDP

2.1 Differences in Objectives

The Canadian System of National Accounts (CSNA) publishes two constant dollar subannual measures of Gross Domestic Product: (1) the monthly GDP by industry and (2) the quarterly expenditure-based GDP. Both measures are designed to measure total production in Canada, but serve different analytical purposes. GDP by industry provides information about the sources of output, while the expenditure-based GDP shows the disposition of output among the various categories of final demand. The two series yield similar results, but because of conceptual, statistical and methodological differences, they are not identical.

2.2 Rebasing and Deflation Methods: Fixed-Weighted Laspeyres versus Chain-Weighted Fisher

In order to analyse the behaviour of GDP independently of the influence of price changes, GDP is calculated for each industry in constant prices. Constant price measures inform about the volume of goods and services produced, independently of changes in prices. Such series are generally calculated by choosing a reference period in the past, called the base year, and valuing current production of goods and services in the prices of that year.

With the release of the July 2001 data, a new base year was adopted. The year 1997 (previously 1992) became the new base year for the constant dollar estimates.

Currently, real GDP by industry estimates are calculated using a Laspeyres formula chained periodically. The Laspeyres formula is fixed-weighted using weights based on some fixed point in the past. This formula basically adds up the volume changes in GDP by using the price levels of the base year as the weights. It is chained by changing the base year periodically. The base years are 1961, 1971, 1981, 1986, 1992 and 1997. Each time span is added up in its own base year prices and then the spans are linked together by measuring each base year on two price levels (old base and new base) and using the ratio of the two to link them together. One of the effects of linking together series in this manner is the loss of additivity in the period prior to the new base year (i.e., prior to 1997, aggregates will not generally be equal to the sum of their components).

The selection of the base year can have significant consequences, as different base years may yield different growth rates in total GDP and other aggregates. Consider an industry whose output price has declined relative to that of other industries, between two years. The contribution of this industry to total output will be larger when valued in prices of the earlier period since the relative price was larger in that period, and movements in this industry will have more impact on movements in total output. If the industry is growing faster than average, valuing output in prices of the earlier period will result in a total GDP measure that grows faster than it would were output valued in prices of the later period.

Ideally the base year is a typical year, followed by a number of years in which the relative prices of commodities remain stable. In a dynamic economy, however, relative prices constantly shift due to such factors as uneven technological developments in different industries, variations in productivity, shifts in consumer demand, cycles in economic growth and so on. The more remote a base year becomes in time, the more today's relative prices will have changed compared to those of the base year, and the less prices of the base year will be relevant for the current period. The usefulness of constant price estimates therefore diminishes as we move away from the base year. The rate of obsolescence depends on the degree of relative price change.

Recently, with the rapid expansion of the Information and Communication Technology (ICT) industries in Canada, the current Laspeyres volume measure has produced significantly biased results. Growth has been overestimated because prices of equipment and services related to this fast-growing sector of the economy have declined dramatically since the base year 1992 because of rapid technological change. The Laspeyres index measures changes in GDP by adding up the quantities produced of these commodities using 1992 price levels as weights. This is the equivalent of giving these commodities roughly four times the weight they would have at price levels of 2000. This over-weighting of the Laspeyres index, called "substitution bias", is why the Laspeyres formula produces a growth rate of GDP that is at the upper limit of possible measures. It does not compensate for substitution to lower-priced commodities.

Changing the index formula to a Paasche index, where current prices would always be used as a weight base, is not a solution. This results in a bias opposite to that of the Laspeyres, with a tendency to understate growth in GDP as ICT prices fall monotonically. Growth in the base year would be measured using current prices, which is as faulty as the reverse. So with a Laspeyres index producing an upper bound to measurement of economic growth and a Paasche index producing the lower bound, the Fisher index, which is the geometric average of the two, follows a more stable middle path.

The expenditure-based quarterly GDP adopted a quarterly chained Fisher index as the official measure of economic growth at the time of their annual revision in May 2001. The new Fisher formula, which is the middle ground between the Laspeyres and the Paasche, is rebased each quarter in order to minimize the bias introduced by dispersion.

In order to produce chained Fisher indices for the industry-based GDP measures, extensive development work is required that will take place between now and the Fall of 2003. In the interim, steps will be taken to improve the timeliness of rebasing in an effort to retain reasonable comparability between the expenditure- and industry-based measures. Provincial GDP by industry measures (annual) will also be rebased to 1997 for the 2001 Fall release, and will be converted to an annual chained Fisher in two years, in tandem with the expenditure-based Provincial GDP estimates.

2.3 Market Price and New Basic Prices Valuation

Because expenditure-based GDP is viewed from the perspective of purchasers, the analysis is concerned with final demand categories such as personal expenditure, government expenditure, capital formation, and exports and imports. Output is valued at *market prices*, which reflect what purchasers actually pay for the goods and services. Market price valuation includes indirect taxes such as sales and excise taxes, licences, property taxes, etc., and excludes subsidies.

Since its inception, GDP by industry has been measured at *factor cost*. This measure differed from the *market price* measure by its exclusion of taxes on production (formerly called indirect taxes) and the inclusion of subsidies. While the *market price* measure represents the value of GDP as paid for by final consumers, the *factor cost* measure took the point of view of producers.

With this revision, value added is no longer measured at *factor cost*, but instead at *basic prices*. This new measure adds to the factor cost measure some taxes on production (such as property and payroll taxes, but <u>not</u> federal or provincial sales taxes), and subtracts some subsidies (such as labour-related subsidies, but <u>not</u> product-related subsidies). The end result is that the new basic prices measure of GDP stands somewhere in between the lower and upper bounds defined by the *factor cost* and *market price* measures, respectively.

The difference between the three measures can be illustrated using data from the 1997 Input-Output tables in constant prices for total GDP.

1. Value of output at modified basic prices for total economy (in billions):   1664
2. Plus value of subsidies on products   8
3. Less value of intermediate goods at purchasers' prices (including taxes)   855
         equals
4**. Gross Domestic Product at basic prices**   **817**
5. Less other taxes on production (i.e., excluding taxes on products)   49
6. Plus other subsidies on production   1
         equals
7. **Gross Domestic Product at factor cost**   **769**
8. Plus net taxes on production (taxes less subsidies)   116
         equals
9. **Gross Domestic Product at market prices**   **885**

Indirect taxes fall more heavily on some products (for example liquor or tobacco) than on others, and consequently the contribution of specific industries to total GDP is more accurate if such taxes are not taken into consideration. GDP by industry is therefore estimated at basic prices.

2.4 Statistical Differences

The estimates of monthly GDP by industry and the quarterly expenditure-based GDP are built up somewhat independently. The estimates are prepared using various data sources which, in addition to being weighted differently, also result from different estimation methods. For example, the industry-based estimates do not rely on data for exports but are based on manufacturers' shipments data. The expenditure-based estimates of GDP use exports, but not shipments. Since exports by manufacturers must have been shipped, both systems will reflect the same underlying activity. However, since they do so via different statistical vehicles, there will be statistical differences between the two systems.

3. Other Major Changes Introduced with this Revision

3.1 Classification: Adoption of the North American Industrial Classification System (NAICS)

With the September 2001 release, the 1997 North American Industry Classification System (NAICS-1997) replaced the 1980 Standard Industrial Classification (SIC-1980). NAICS is an industry classification system developed by the statistical agencies of Canada, Mexico and the United States. Created against the background of the North American Free Trade Agreement, it was designed to provide common definitions of the industrial structure and a common statistical framework to facilitate the analysis of the three economies. The adoption of a common system ensures that statistical agencies in the three countries can produce information on inputs and outputs, industrial performance, productivity, unit labour costs, employment, and other statistics that reflect structural changes occurring in the three economies.

NAICS is based on a production-oriented or supply-based conceptual framework. This means that producing establishments are grouped into industries according to similarity in the production processes (i.e., the similarity of input structures, labour skills, etc.) used to produce goods and services. This is a marked departure from previous classifications systems, where the guiding principle in delineating industry boundaries was the commodity itself (i.e., establishments were grouped together based on which commodities they produced or, alternately, the end use to which they were put). For example, under the SIC-1980, manufacturing of motor vehicle plastic parts (SIC 3256) was a subdivision of motor vehicle parts production (SIC 325), because of similarity of product/end use. However, under

NAICS-1997, Motor Vehicle Plastic Parts Manufacturing (NAICS 326193) has been classified under Plastic Product Manufacturing (NAICS 3261), reflecting the shared similarity of production process, which involves the extensive use of compression, extrusion and injection moulding techniques.

The numbering system that has been adopted is a six-digit code, of which the first five digits are used to describe the NAICS levels that will be used by the three countries to produce comparable data. The first two digits designate the sector, the third digit designates the subsector, the fourth digit designates the industry group and the fifth digit designates industries. The sixth digit is used to designate national industries. The Canadian version of NAICS consists of 20 sectors, 99 subsectors, 321 industry groups, 734 industries and 921 national industries. The 20 sectors are listed below.

Sectors

11	Agriculture, forestry, fishing and hunting
21	Mining and oil and gas extraction
22	Utilities
23	Construction
31-33	Manufacturing
41	Wholesale trade
44-45	Retail trade
48-49	Transportation and warehousing
51	Information and cultural industries
52	Finance and insurance
53	Real estate and rental and leasing
54	Professional, scientific and technical services
55	Management of companies and enterprises
56	Administrative and support, waste management and remediation services
61	Educational services
62	Health care and social assistance
71	Arts, entertainment and recreation
72	Accommodation and food services
81	Other services (except public administration)
91	Public administration

The Canadian System of National Accounts only publishes 19 of these sectors. The twentieth, Sector 55 (Management of Companies and Enterprises) has, for reasons of historical continuity and data quality, been grouped together with Sectors 52 and 53 into an aggregate called Finance, Insurance and Real Estate.

Monthly GDP estimates are compiled back to 1981. At the lowest level of aggregation of the current industrial classification framework, it is not always possible to have an homogeneous series from 1981 to the present. Data gaps as well as changes in the industry classifications of 1980 and 1997 are responsible for this.

With the introduction of the new 1997 NAICS, establishments are sometimes reclassified from one industry to another. Thus a NAICS industry with a name similar to that of the 1980 SIC may have a somewhat different composition in terms of establishments.

In some cases the differences will be small, and in others large. In general there is greater such definitional discontinuity at lower levels of industrial dis-aggregation than at higher levels. For some purposes it is useful to have definitional continuity at as low a level of dis-aggregation as possible. For this reason, special industry groupings that provide relatively good continuity were created back to 1981. These groupings are identified with an asterisk (*) in Appendix I.

Special attention was given in NAICS to developing classifications for new and emerging industries, services industries in general, and industries engaged in the production of advanced technologies. As much as possible, time series continuity was maintained. However, owing to fundamental changes in the economy, to the classification's strong production orientation and to proposals from data users, this has not always been possible. There are such aggregates including goods producing industries, services producing industries, industrial production and others. They are identified in Appendix I with an industry code prefixed by a ''T''.

3.2 Capitalization of Software

All spending by businesses and governments on software is now treated as a capital expenditure. Previously, only a small portion, less than 20% of these expenditures, was treated as such. This will be a net addition to GDP, both in level and in growth, in the years in which software expenditures grow faster than other components of final expenditure. Treating software as a capital expenditure has been introduced by most countries, including the United States, within the last couple of years.

3.3 Treatment of Rent Paid by Farmers

Another conceptual change concerns the treatment of *rent* in the Crop Production Industry. Previously, the *rent* paid by farmers was considered as an intermediate input; now it is treated as mixed income, which is a primary input (i.e., part of GDP). This treatment conforms more closely to the international standards as described in System of National Accounts 1993. The end result of this change is to increase GDP in the Crop Production Industry. However, this is offset by a decrease in the GDP of the Lessors of Real Estate Industry, where the aforementioned output of rent was formerly classified. This redistribution of output, which has no net effect at the level of the total economy, brings land use for agriculture in line with the treatment of royalties on natural resources.

4. Methodological Overview: GDP by Industry

4.1 Annual Benchmarks

For all but the most recent two years, the annual estimates of GDP by industry are derived within the framework of the Input-Output accounts by subtracting the intermediate inputs from the gross output of industries. The data sources are typically annual surveys or censuses. For the most recent two full years and part of the current year, GDP is estimated using the monthly methodology described below.

4.2 Monthly Estimates

On a monthly basis information on industry activity, especially the consumption of inputs, is not as complete as it is annually. As a result, the monthly values of GDP by industry are projections, estimated using proxy indicators such as gross output or employment, usually obtained from monthly surveys (see Appendix IIb). The main assumption inherent in the monthly projector system is that the relationship between inputs and outputs changes slowly enough that it can be regarded as constant over short spans of time. This assumption will be true if both technology and the product mix change slowly. It is therefore more useful for projecting GDP over short time spans than over long ones, and at lower levels of industrial disaggregation, where product mix is relatively homogenous and stable. Prices of inputs and outputs do not necessarily evolve at the same pace during a given period. As a result, the relationship between inputs and gross output can be distorted at current prices. For that reason, the assumption above only applies to the calculation of GDP at constant prices.

4.3 Benchmarking

This is the process by which monthly estimates are adjusted to the new benchmark levels. Since the monthly estimates are projections, they are adjusted to sum to the annual benchmark levels once they become available. This adjustment is based on a quadratic minimization technique, which preserves the month-to-month movements in the original series as much as possible, subject to the constraint that the monthly estimates sum to the annual benchmarks.

4.4 Seasonal Adjustment

To aid interpretation of economic developments the estimates of GDP by industry are seasonally adjusted and are published in both seasonally adjusted and unadjusted forms. Seasonal adjustment removes movements caused by repetitive climatic or institutional events, thereby making the underlying activity more apparent.

The seasonal adjustment technique relies heavily on the use of moving averages, that become less reliable towards the end of the series. To minimize this problem, the series are projected one more year so that the last real data point is 12 months from the end point of the extended series. An ARIMA (autoregressive integrated moving average) model is used for this purpose.

4.5 Trading-Day Adjustment

In many monthly economic time series a significant portion of the monthly growth rate is associated with differences in the composition of calendar months. For example, the volume of production usually varies with the different days of the week, and since consecutive months contain different combinations of days, a significant portion of the month-to-month changes may be caused strictly by the calendar. To give a more precise idea of economic developments, the calendar months are put on an equalized basis. This is done by applying a smoothing procedure, known as trading-day adjustment. Trading-day adjustment alters the distribution of monthly output to reflect changes in production that would occur if all months contained the same number and type of days.

5. Dissemination Vehicles

5.1 The *Daily*/CANSIM

As with many Statistics Canada series, the monthly estimates of GDP are officially released to the public simultaneously through the Statistics Canada *Daily* Bulletin and CANSIM II(Statistics Canada's machine-readable database). The CANSIM II database is available on Internet at the following address: www.statcan.ca. The estimates are published approximately 60 days after the end of the reference month. Data can also be obtained directly from the division on diskette, print-out or other.

Reference month		Release dates
August	2001	October 31, 2001
September	**2001**	**November 30, 2001***
October	2001	December 24, 2001
November	2001	January 31, 2002
December	**2001**	**February 28, 2002***
January	2002	March 28, 2002
February	2002	April 30, 2002
March	**2002**	**May 31, 2002***
April	2002	June 28, 2002
May	2002	July 31, 2002
June	**2002**	**August 30, 2002***
July	2002	September 30, 2002
August	2002	October 31, 2002
September	**2002**	**November 29, 2002***
October	2002	December 24, 2002
November	2002	January 31, 2003
December	**2002**	**February 28, 2003***

* The quarterly income and expenditure-based GDP at market price will also be released on these dates. Release dates for the upcoming year are published, along with those for other major economic indicators, in December.

The data on CANSIM II appear in greater industrial detail than in the *Daily* and are also in both seasonally adjusted and in seasonally unadjusted form. They are available historically from January 1981, and may be retrieved from the following tables (see Appendix III):

Frequency and adjustment of data	Main tables	Special aggregations
Annual	3790017	3790020
Quarterly (seasonally adjusted and unadjusted)	3790018	3790021
Monthly (seasonally adjusted and unadjusted)	3790019	3790022

Information can also be obtained by calling any Statistics Canada regional office or Industry Measures and Analysis Division (1-800-877-IMAD).

5.2 Publication

The monthly, quarterly and annual constant price estimates of Gross Domestic Product by industry are published in *Gross Domestic Product by Industry,* Statistics Canada, Catalogue no. 15-001-XIE, available approximately five working days after the data have been released. This publication contains seasonally adjusted data extending back to 1997, the current base year.