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## Table of contents

Acknowledgements.....	4
Abstract.....	4
Historical Background.....	4
The Current Labour Productivity Program.....	6
Description of the data tables.....	6
Quarterly tables.....	6
Provincial and territorial tables.....	7
Foundation of the estimates.....	8
Methodology.....	8
Hours worked for all jobs.....	8
Output.....	9
Labour Productivity.....	10
Total labour compensation and unit labour cost.....	10
Statistical adjustments.....	11
Uses of the Provincial and Territorial Productivity Data.....	13
Main Users of the Provincial and Territorial Productivity Data.....	14
Provincial and territorial governments.....	14
Federal Government.....	14
Business leaders.....	14
The Bank of Canada.....	14
Researchers and academics.....	14
Others.....	14
Important points about Labour Productivity data by province and territory.....	15
Data availability and revisions.....	15
A brief review of recent projects and setting productivity perspective by economic region.....	16
Conclusion.....	16

# Labour productivity measurement at Statistics Canada

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## Abstract

This document focuses on the evolution of Statistics Canada's Labour Productivity Program, tracing its historical background, outlining its structure, as well as describing in detail the methodology and data sources used. It then discusses the various applications of provincial productivity data, identifies the main users of the statistics, and highlights the elements essential to their interpretation.

In addition, the document addresses the review process for quarterly and annual productivity measures and recent program improvements. It also touches on the challenge of extending productivity measures to economic regions in Canada. Finally, it concludes with a summary of the labour productivity data currently published by Statistics Canada, making it a valuable resource for students, journalists, analysts, researchers and the general public who wish to monitor, analyze and interpret trends in Canadian labour productivity.

## Historical Background

In 1949, Canada's Dominion Bureau of Statistics formed an interdepartmental committee on productivity analysis "to review the conceptual and measurement problems involved and the available data sources in Canada".<sup>1</sup> However, it took several years before resources were made available in the Bureau to provide statistical measures on the topic. In 1962-63 a seminar was held with other government departments and the Bank of Canada to work out the remaining conceptual and practical issues related to productivity measurement in Canada. The work culminated in April 1965 with the publication of a Reference Paper entitled "Indexes of Output per Person Employed and per Man-Hour in Canada, Commercial Non-agricultural Industries, 1947-63".

This Reference Paper marked the beginning of regularly published statistics on the productivity of the Canadian Economy. Of particular interest is the acknowledgment in the Foreword of the degree of international cooperation in this domain and how other countries contributed to the development of this work:

"The Dominion Bureau of Statistics would also like to acknowledge gratefully the advice received from statisticians and economists engaged in the preparation or use of productivity measures in a number of other countries, particularly the officials of the Bureau of Labor Statistics and the Department of Commerce of the United States. Over a number of decades, these agencies have built up an extremely broad and varied stock of experience in productivity and related measures which has been made freely available to the Bureau. The staffs of various official agencies in France, Germany, the Netherlands, Norway, Sweden, and the United Kingdom, among others, have also been most co-operative in exchanging views with the Bureau on these problems."<sup>2</sup>

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1. Dominion Bureau of Statistics, "Indexes of Output per Person Employed and per Man-Hour in Canada, Commercial Nonagricultural Industries, 1947-63", (Catalogue No. 14-501), Ottawa, 1965, Foreword.

2. Ibid.

The initial estimates in the Reference Paper covered three levels of industrial detail, namely: Commercial Non-agricultural industries, Manufacturing, and Non-manufacturing. These data were updated in January of 1967 with an extension of the data set back to 1946 and forward to 1965.<sup>3</sup> This year also saw the expansion of the industry breakdown to include Agricultural Industries in addition to the commercial and manufacturing series already published.

In addition to these aggregate measures, special studies were produced at a more detailed industry level, notably with the release of a report on textile mills, breweries, and pulp and paper mills in 1966,<sup>4</sup> followed by individual reports for petroleum refineries,<sup>5</sup> cement manufacturing,<sup>6</sup> and sugar refineries<sup>7</sup> in 1971 (these later three were published under the Bureau's new name, Statistics Canada).

The aggregated labour productivity data were produced regularly, and were gradually augmented with a breakdown between goods and services producing industries in 1970,<sup>8</sup> greatly expanded industry detail in 1988,<sup>9</sup> estimates of multifactor productivity in 1990,<sup>10</sup> and a KLEMS database in 1994<sup>11</sup> that provided information on the changes in various inputs – namely: capital (K), labour (L), energy (E), materials (M), and services (S) – useful for the analysis of changes in multifactor productivity. These dimensions were further expanded into the environmental domain in 2002 through a series of research papers on methods to incorporate Greenhouse Gas emissions into the productivity framework<sup>12,13</sup>, a topic which has recently come to the fore with the publication of an article by the Organisation for Economic Co-operation and Development (OECD) on this type of environmental extension to the general productivity framework. For more information on the multifactor productivity program and the measurement of multifactor productivity and KLEMS, see "[Multifactor productivity measurement at Statistics Canada](#)".

This document focuses exclusively on the labour productivity program and related statistics, and is a good complement to the previously mentioned document on the multifactor productivity measurement program.

In the early 2000s, a reference publication on productivity in Canada entitled "Productivity Growth in Canada" was produced. The publication enhances knowledge of productivity measures by providing information on the behavior of productivity in Canada at various levels of industrial detail. It also includes a number of empirical studies that provide a better understanding of the possible uses of productivity measures. For more information, consult "[Productivity Growth in Canada \(February 2001\)](#)" and "[Productivity Growth in Canada \(December 2002\)](#)".

As previously mentioned, the publication of labour productivity measures has therefore long been an important activity for Statistics Canada. This program of labour productivity measurement has evolved over the years, adapting particularly to changes in data availability and the needs of users. Labour productivity statistics garner much attention because they are key indicators of economic progress.

Combined with other economic indicators, labour productivity statistics provide a better understanding of the performance of the Canadian economy over time, in particular economic growth, and improvements in the labour market. Productivity gains are important because they are closely linked to higher economic growth, improved living standards for citizens, and increases in real wages over the long term. As Paul Krugman, a Nobel laureate

3. Dominion Bureau of Statistics, "Indexes of Output per Person Employed and per Man-Hour in Canada, Commercial Industries, 1946-65", (Catalogue No.14-201), Ottawa, 1967.
4. Dominion Bureau of Statistics, "Productivity Trends in Industry, 1947-61, Report No. 1, Indexes of Output per Person Employed and Per Man-Hour, 1947-61: Synthetic Textile Mills, Breweries, and Pulp and Paper Mills", (Catalogue No. 14-502), Ottawa, 1967.
5. Statistics Canada, "Productivity trends in industry, Indexes of output per person employed and per man-hour, Petroleum Refineries, 1959-1969", (Catalogue No. 14-504), Ottawa, 1971.
6. Statistics Canada, "Productivity trends in industry, Indexes of output per person employed and per man-hour, Cement Manufacturers, 1959-1969", (Catalogue No. 14-505), Ottawa, 1971.
7. Statistics Canada, "Productivity trends in industry, Indexes of output per person employed and per man-hour, Sugar Refineries, 1959-1969", (Catalogue No. 14-506), Ottawa, 1971.
8. Dominion Bureau of Statistics, "System of National Accounts, Productivity Studies, Aggregate Productivity Trends, 1946-68", (Catalogue No. 14-501), Ottawa, 1970.
9. Statistics Canada, "System of National Accounts, Aggregate Productivity Measures, 1985-1986", (Catalogue No. 15-204), Ottawa, 1988.
10. Statistics Canada, "System of National Accounts, Aggregate Productivity Measures, 1988", (Catalogue No. 15-204E), Ottawa, 1990.
11. Statistics Canada, "System of National Accounts, Aggregate Productivity Measures, 1992", (Catalogue No. 15-204E), Ottawa, 1994.
12. See, for example: Harchaoui, T.M., D. Kabrelyan, and R. Smith, (2002), "Accounting for Greenhouse Gases in the Standard Productivity Measure", Economic Analysis Series No. 7. (Catalogue No. 11F0027MIE), Statistics Canada, Ottawa.
13. Cárdenas Rodríguez, M., I. Hašćić, and M. Souchier. 2018. Environmentally Adjusted Multifactor Productivity: Methodology and Empirical Results for OECD and G20 Countries. OECD Green Growth Papers, no. 2018-02. Paris: OECD Publishing. See also the study by: Gu, W., J. Hussain, and M. Willox. 2019. Environmentally Adjusted Multifactor Productivity Growth for the Canadian Manufacturing Sector. Analytical Studies Branch Research Paper Series, no. 425. Statistics Canada Catalogue no. 11F0019M. Ottawa: Statistics Canada.

in economics, said: “*Productivity isn’t everything, but in the long run it is almost everything. A country’s ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker.*”<sup>14</sup>

## The Current Labour Productivity Program

The annual labour productivity program was expanded to quarterly estimates for the first time in 2000 with the [release of data from the first quarter of 1987 up to the third quarter of 2000](#).

The need for improved provincial statistics on labour productivity was identified through inter-governmental discussions in the 1990s, which led to a 1996 agreement between the Government of Canada and the provinces of Nova Scotia, New Brunswick, and Newfoundland.<sup>15</sup> The agreement required the combination of federal and provincial retail sales taxes into a new Harmonized Sales Tax (HST). Pooled revenues from the HST were to be collected centrally by the Canada Revenue Agency and allocated based on a formula developed by the federal Department of Finance using data from Statistics Canada’s Provincial and Territorial Economic Accounts data being used by the federal Department of Finance to allocate the pooled revenues. This legislation required improved data for the provinces and territories and led to an expansion of the provincial and territorial detail of Statistics Canada’s infrastructure and data holdings.<sup>16</sup> The labour productivity program was able to capitalize on these additional data sources and [release provincial and territorial statistics on labour productivity in 2002](#).

## Description of the data tables

Both quarterly estimates of productivity at the national level and annual estimates of productivity by province and territory continue to be produced and are available free of charge on Statistics Canada’s website under tables [36-10-0206-01](#), [36-10-0207-01](#), [36-10-0480-01](#), [36-10-0489-01](#), [36-10-0675-01](#) and [36-10-0676-01](#). The quarterly data at a national level are provided as indices and are seasonally adjusted, whereas the provincial and territorial data are provided as levels and are available only on an annual basis.

### Quarterly tables

Quarterly labour productivity data are published two months after the end of the reference period. The data are available on a seasonally adjusted basis and are published as indices to facilitate comparison with similarly published data from the U.S. Bureau of Labour Statistics ([the Productivity and Costs news release](#) ). The basic table dimensions for each of the quarterly tables are provided below.

#### **Indexes of business sector labour productivity, unit labour cost and related measures, seasonally adjusted; Table: 36-10-0206-01 (formerly CANSIM 383-0008)**

These data are published for the overall business sector, with no industrial breakdown. The series are indexed to the year 2017 (where 2017 = 100). The data are available from the first quarter of 1981 and cover the following series: real gross domestic product, total number of jobs, average hours worked, hours worked, labour productivity, total compensation per hour worked, unit labour cost, unit labour cost in U.S. dollars, unit non-labour payments, implicit price deflator, labour share, current dollar gross domestic product (GDP), total compensation, and non-labour payments. The specific definition of each of these variables is available as a footnote attached to each table element on the website, in addition to the details provided in the Methodology section below.

#### **Indexes of labour productivity and related measures, by business sector industry, seasonally adjusted; Table: 36-10-0207-01 (formerly CANSIM 383-0012)**

This table provides a more detailed industry breakdown of labour productivity and related measures. There are 16 main industry sectors of the total business sector, as well as three summary aggregations (i.e., total economy,

14. Paul Krugman, 1992, *The Age of Diminished Expectations: U.S. Economic Policy in the 1980s*, MIT Press, Cambridge, Mass., p. 9.

15. Royce, D., F. Hardy, and G. Beelen, (1998), “An Overview of the Project to Improve Provincial Economic Statistics”, Project to Improve Provincial Economic Statistics Technical Series no. 5, (Catalogue No. 68N0003XPB), Statistics Canada, Ottawa.

16. Ibid.

goods-producing businesses, and services-producing businesses). The measures produced for each industry sector comprise real gross domestic product, total number of jobs, average hours worked, hours worked, labour productivity, total compensation per hour worked, unit labour cost, and unit labour cost in U.S. dollars. As with the table 36-10-0206-01, data are available from the first quarter of 1981, and are indexed to the year 2017 (where 2017=100).

## Provincial and territorial tables

Provincial and territorial data on labour productivity and related measures are available as a preliminary estimate five months after the reference year, and as revised estimates 14 months after the reference year. Provincial and territorial data are only available on an annual basis and are published as levels rather than indices, to allow inter-provincial and inter-industry comparison. Overall, there are four data tables, the last two of which are new and represent an extension of the first two existing tables. The dimensions for each of the annual provincial tables are provided below.

The main differences between the first two provincial tables are the industry classification and the statistics presented. The first table uses a classification system consistent with the Supply and Use Tables, which is a modified version of the North American Industry Classification System (NAICS). The second table uses a NAICS-based classification that is consistent with that used for the publication of monthly GDP by industry. In terms of the data presented, the first table provides estimates of labour productivity and related variables, while the second focuses on the number of jobs, hours worked, and compensation for the detailed industry break-down.

As for the last two tables, they contain a set of experimental data on labour statistics by economic region and work schedule, and are relatively recent additions to the series of estimates related to the labour productivity data.

### Labour productivity and related measures by business sector industry and by non-commercial activity consistent with the industry accounts; Table:36-10-0480-01(formerly CANSIM 383-0033)

This table presents levels of labour productivity and related data for Canada's ten provinces and three territories, and at the national level. Data are presented by industry, with 230 detailed industries and an additional 92 aggregations of those industries (e.g., durable manufacturing, non-durable manufacturing, energy industries, etc.). The additional industry detail included in this table allows for the separation of activities of the non-profit and government sectors from the overall industry classification. The measures covered for each industry are similar to the annual data and comprise total number of jobs, hours worked for all jobs, annual average number of hours worked for all jobs, total compensation for all jobs, nominal value added, real value added, labour productivity, total compensation per hour worked, unit labour cost, unit labour cost in U.S. dollars, and labour share (i.e., the ratio of total compensation as a percentage of the nominal value added). The last element (labour share) is only available for benchmarked years following the publication of the provincial and territorial supply and use tables. The data are available beginning with the 1997 reference year, with real value added and labour productivity being chained to the 2017 reference year. It is useful to clarify that table 36-10-0480-01 is consistent with provincial and territorial supply and use tables (table 36-10-0478-01), as well as input-output multipliers or impact matrices (table 36-10-0594-01 at the national level and table 10-0595-01 at the provincial and territorial level).

### Labour statistics consistent with the System of National Accounts (SNA), by job category and industry; Table: 36-10-0489-01 (formerly CANSIM 383-0031)

This table presents data at the same level of geographical detail as the previous table with the addition of a category for Outside Canada. This latter category covers government employees working abroad. The level of industry detail is similar to the previous table, with 297 levels of detail including special aggregations, and 221 individually detailed industries. In contrast with the table 36-10-0480-01, the table 36-10-0489-01 does not distinguish between the business and non-business sectors and is therefore consistent with the tables published by the Industry Accounts Division, including: the provincial and territorial GDP by industry (table 36-10-0402-01) and the national GDP by industry (table 36-10-0434-01).

In terms of the variables presented, this table provides the following labour statistics: total number of jobs, hours worked for all jobs, annual average number of hours worked for all jobs, total compensation for all jobs, total compensation per job, and total compensation per hour worked. All but the last two of these statistics are further subdivided into employee and self-employed categories.

### **Labour statistics consistent with the System of Provincial and Territorial Economic Accounts, by economic regions, job category and work schedule; Table: 36-10-0675-01**

This table contains labour statistics by economic region and employment category. It presents the statistics for Canada's ten provinces (including their 76 economic regions) and three territories. The following labour statistics are included: total number of jobs, hours worked for all jobs, net international flows, and net regional flows.

### **Labour statistics consistent with the System of Provincial and Territorial Economic Accounts, by industry, job category and work schedule (full-time or part-time); Table: 36-10-0676-01**

This table contains labour statistics by work schedule (full-time or part-time). It presents data at the same level of geography and industry as the table 36-10-0489-01. In this table, the following labour statistics are included: number of paid workers jobs, number of self-employed jobs, hours worked of paid workers, hours paid to paid workers, hours worked of self-employed jobs, annual average number of hours worked for paid workers, annual average number of hours paid to paid workers, annual average number of hours worked for self-employed jobs, wages and salaries for paid workers, labour income of self-employed, paid workers' actual wage rate and paid workers' contractual wage rate.

## **Foundation of the estimates**

These estimates are founded on data available from a range of statistical systems maintained by Statistics Canada in general, and by the Macroeconomic Accounts more specifically. These statistical systems include the Business Register; the Labour Force Survey; the Survey of Employment, Payroll, and Hours; Public Sector Statistics; the Provincial and Territorial Supply and Use Tables; the quinquennial Censuses of Population and Agriculture; and various administrative data sources. These statistical systems all contribute to the ability of Statistics Canada to generate detailed labour productivity measures. Through the availability of detailed data on matters associated with labour productivity across Statistics Canada's statistical systems, and due to the broad recognition of the need for provincial and territorial statistics, the data produced through the labour productivity program at Statistics Canada is among the most detailed in the world. However, several other countries provide sub-national data on labour productivity on an experimental or regular basis, notably the United States ([BLS publishes experimental state-level labor productivity measures](#)), the United Kingdom ([Subregional productivity in the UK : June 2020 \(ONS\)](#)), Wales ([Sub-regional productivity](#)), and Australia ([experimental estimates of state productivity, ABS](#)). The section below outlines the basic methodology of the program and how it exploits and integrates these various sources of information.

## **Methodology**

Explained below are the main steps and processes used to produce the [quarterly labour productivity measures and related data at the national level](#). In each section, the primary data sources and key considerations are discussed. This section concludes with a description of the main differences between the quarterly national and annual provincial estimation processes.

## **Hours worked for all jobs**

Hours worked represents the total number of hours that a person devotes to work, whether paid or unpaid. Generally, this includes regular and overtime hours, coffee breaks, on-the-job training, as well as time lost due to momentary interruptions in production when the persons involved remain on the job. However, time lost due



to strikes or lockouts, to statutory holidays, vacations, as well as illness, maternity or other personal leave are all excluded from the total number of hours worked.

Quarterly estimates of labour input include two main categories of jobs:

- Jobs held by paid workers, which include paid jobs as well as jobs held by owners of incorporated businesses.
- Jobs occupied by self-employed workers, which comprise owners of an unincorporated business, own-account jobs, and unpaid family-related jobs.

The number of hours worked is calculated as the product of the number of jobs times the average hours worked that is collected by the [Labour Force Survey \(LFS\)](#).

The number of jobs in the business sector is obtained residually by subtracting all jobs occupied in non-business activities from the number of jobs in the total economy. An estimate of the number of jobs for the total economy is first produced from LFS estimates for Canadian provinces and territories, to which are added secondary jobs of workers with more than one job. Employees who hold a job but were not at work during the LFS reference week and have no right to compensation during their absence, are removed from the estimates. Finally, all workers in self-employed jobs who were not at work during the reference week are also excluded.

In the System of National Accounts, non-commercial activities comprise two main components: the government sector and non-profit institutions serving household sector. Estimates for the number of jobs estimates in the government sector come mainly from the [Survey of Employment, Payroll and Hours \(SEPH\)](#), specially, its BPS-PS<sup>17</sup> component. Estimates for the number of jobs in the non-profit institutions serving households mainly encompass social and community services including religious groups, philanthropic foundations, civic, professional, and other similar organizations.

Once the number of jobs for the business sector has been derived, the number of hours worked are calculated by multiplying each category of jobs by their respective average hours worked.

At the industry level, all data on average hours worked by industry and by category of worker are taken from the LFS. However, the industrial breakdown for the employee jobs is mainly from SEPH. Data from the LFS are directly used to estimate the employee jobs in agriculture, agricultural services, and fishing and hunting. In the case of the categories of jobs occupied by self-employed workers, the industrial detail is obtained by integrating information from the five-year censuses and the LFS.

Estimates for the number of jobs and hours worked by industry are then adjusted to their respective business sector totals of the number of jobs and hours worked, obtained residually from the total economy less the non-business sector.

Finally, to ensure consistency with the annual data from the labour productivity program, the quarterly indices of labour input are adjusted to their respective annual benchmarks, when available (i.e., upon the release of the first quarter indices for the business sector, and upon the release of the third quarter indices at the industry level).

## Output

Quarterly real value added (or real GDP) for productivity estimates in the business sector and its component industry detail is built-up using a chained Fisher volume index method.

For all quarterly estimates in the business sector, seasonally adjusted output growth rates are derived from chained Fisher volume indexes of GDP at market prices (expenditure-based), which are published by the National Economic Accounts Division ([National Gross Domestic Product by Income and by Expenditure Accounts](#)). These quarterly business sector estimates of real GDP are constructed after removing the value added of the government sector,

17. BPS-PS stands for Business Payroll survey for Public Sector

non-profit institutions, and the rental value of owner-occupied dwellings. Value added related to paid employees of private households is also removed. This approach is similar to that used for the quarterly measures of productivity in the United States.<sup>18</sup>

For all quarterly estimates by industry, the seasonally adjusted output growth rates are derived from the chained Fisher volume indexes of GDP at basic prices, which are published by the Industry Accounts Division ([Gross Domestic Product by Industry - National \(Monthly\) \(GDP\)](#)). The chained Fisher volume index is used in years for which final supply and use tables are available. For the most current years without these annual benchmarks, real GDP is based on a fixed-weight Laspeyres volume index.<sup>19</sup>

It should be noted that the GDP series in the business sector is at market prices, while the GDP by industry series is at basic prices. As the valuation of output in the business sector differs from that used at the industry level, these measures are not directly comparable.

## Labour Productivity

The productivity measures relate real output to labour input (hours worked). They estimate the change in the output per hour worked from one period to another. In other words, the growth of labour productivity is meant to estimate the efficiency with which the number of hours worked in all jobs in a given industry sector is used in production. Economic performance, as measured by labour productivity, must be interpreted carefully, since these estimates reflect changes in other inputs, in particular capital, and are in addition to growth in productive efficiency.

As a consequence of the use of different index numbers, and due to the different valuation of output measures (i.e., market prices for the aggregate of the business sector and basic prices for the major industrial sectors), the aggregation framework applied to the productivity accounts for the business sector as a whole is not entirely consistent with those that applied to the industrial sector detail.

## Total labour compensation and unit labour cost

Labour compensation measures the value of labour services used in the production process. This compensation consists of all payments in cash, or in-kind made by domestic producers to workers for services rendered – in other words, total payroll. It includes the compensation of employees consisting of wages and salaries (including bonuses, gratuities, taxable allowances, and retroactive wage payments) and supplementary labour income of paid workers (various contributions to employees), plus an imputed labour income for self-employed workers.

As was the case for estimating jobs, the labour compensation estimates in the business sector are obtained residually by subtracting the wages, salaries, and supplementary labour income for the non-business sector from labour compensation for the total economy.

The data on income for all paid jobs in the total economy and at the industry level are taken directly from the estimates of compensation of employees in the National Gross Domestic Product by Income and by Expenditure Accounts. Compensation of employees for self-employed workers is derived by imputation. This imputation is based on relative distance modelling (as observed in 5-year censuses) between compensation rates for self-employed workers and paid employees, which vary from one industry to another. No compensation of employees is imputed to unpaid family workers since by definition, they are not compensated for their work.

In all industrial sectors, labour compensation is comprised not only of wages and salaries, but also of employers' contributions to indirect benefits (such as the pension and insurances plans). These initial estimates are also obtained using Gross Domestic Product estimates within the Income Expenditure Accounts. For productivity measures, an additional industry distribution is applied.

18. Since October 1st, 2012, the output series reflect the capitalization of research and development activities and military weapons systems introduced by the Canadian System of National Economic Accounts. This change brought Canada in line with the United States, thereby improving the comparability of the measures of productivity with those published by the U.S. Bureau of Labor Statistics.

19. It should be noted that quarterly estimates of GDP used in the productivity measures for service-producing businesses and for the real estate, rental and leasing industry exclude the rental value of owner-occupied dwellings as there are no data on the number of hours that homeowners spend on dwelling maintenance services. Private households are also excluded from other business services – the industry grouping to which they would normally be associated.

Compensation per hour worked (or hourly compensation) is calculated as the ratio between the total compensation for all jobs and the number of hours worked.

Unit labour cost is the labour cost per unit of output, which is calculated as current dollar labour compensation divided by real value added. It is also equal to the ratio of labour compensation per hour worked (hourly compensation) and labour productivity. In other words, unit labour cost is the combined result of changes in hourly compensation in current dollars and labour productivity. Unit labour cost increases when labour compensation per hour worked increases more rapidly than labour productivity. This indicator is widely used to measure inflation pressures resulting from wage growth.

The unit labour cost in U.S. dollars is equivalent to the ratio of the Canadian unit labour cost to the exchange rate. The latter corresponds to the U.S. dollar value, expressed in Canadian dollars. The exchange rate is based on the monthly average.

Relative unit cost is an often-used concept for determining Canadian businesses' competitiveness compared to a foreign competitor. The relative unit cost is defined as the difference between the rate of growth of Canada's unit labour cost and that of a foreign country, with these costs expressed in a common currency for purposes of comparison.

## Statistical adjustments

Numerous adjustments are required to ensure that the presented time series provide information that can be accurately interpreted. These adjustments are detailed below.

### Seasonal Adjustment<sup>20</sup>

Economic time series observed monthly or quarterly often show seasonal patterns that repeat every year during the same month or quarter. Seasonal patterns are changes that occur regularly during a year. They relate to the seasons, sociological patterns, and the rhythm of human activity.

All necessary basic variables for productivity analyses (such as hours worked, number of jobs, output and compensation) are seasonally adjusted using Statistics Canada's X-12-ARIMA (autoregressive integrated moving average) program (for more information, see "[Seasonal adjustment and trend-cycle estimation](#)"). Seasonal adjustment consists of removing the combined seasonal and calendar effects from the series, and it therefore helps to highlight the most relevant fluctuations from an economic point of view. A series that is affected by seasonal fluctuations presents little interest or benefit for economic interpretation since these fluctuations mask real trends.

Seasonal adjustment is generally made for two main categories of workers (paid workers and self-employed workers) at the industry level, and the seasonally adjusted aggregates of number of jobs and hours worked are obtained through a summation process. In the hours worked series for the total economy, the class of paid workers is split between employees and the unincorporated self-employed, which facilitates the reconciliation with the data published by the LFS.

### Regression models to adjust for reference week effects and holiday effects on hours worked

The definition of the LFS reference week (usually the week with the 15th day of the month) implies that the actual dates of the week vary from year to year. This variability may impact the month-to-month change in hours worked estimates. In addition, hours worked are affected by variability in the dates of the reference week, combined with the presence of fixed (Thanksgiving, Remembrance Day) or moving (Easter Friday and Easter Monday) holidays. Specifically, in some years, holidays may occur during the reference week, reducing work hours during that week. This variability could introduce significant fluctuations in estimates of hours worked, and it is therefore removed from the series prior to seasonal adjustment.

20. For more information on seasonal adjustment, see [Seasonally adjusted data – Frequently asked questions](#).

To remove reference week effects and holiday effects, hours worked series are the subject of a priori adjustments. These corrections remove the effects attributable to the situations where the 15th of the month falls relatively early or late for the reference week and the situations where some holidays fall outside the reference week.

These effects are estimated by the seasonal adjustment method X-12-ARIMA using appropriate regression specifications with ARIMA residuals.<sup>21</sup>

## Benchmark adjustment

As a result of using different data sources and methodologies, the annual values (number of jobs, hours worked, GDP, compensation) and the yearly totals of the independently produced quarterly estimates are not identical. For instance, some components of labour statistics are processed only on an annual basis such as the employment of populations living in the territories and on-reserve, and the international flows of workers, *etc.* However, this difference between the two sets of estimates is eliminated by integrating annual benchmark values into the quarterly estimates. This reconciliation process, called benchmarking, generates a series which mirrors the trends in the original quarterly series as closely as possible, but which also sums to the annual benchmarks. In other words, this procedure will restore coherence between time series data of the same target variable measured at different frequencies (*e.g.*, quarterly and annually). Statistics Canada uses an in-house SAS benchmarking procedure for this purpose.

## Raking procedure used in seasonal adjustment

Seasonally adjusted estimates of the total number of jobs and hours worked for the business sector are derived by subtracting adjusted estimates for the non-business sector from those of the total economy. The resulting overall estimate is used as a quarterly benchmark for other seasonally adjusted series by industry. For example, hours worked estimates by industry are adjusted independently and then re-adjusted so that their total sums to the overall quarterly benchmark, while maintaining consistency with the annual detail. This procedure is known as “raking”. Statistics Canada uses an in-house SAS procedure to carry-out this raking process.

## Revisions to the quarterly series

Statistical revisions are carried out to incorporate the most recent information from quarterly and annual surveys, taxation statistics, public accounts, censuses, *etc.*, as well as from the annual benchmarking process to the Supply and Use Tables.

## Provincial and territorial estimates

As with the quarterly estimation process, for more information on the provincial and territorial program, see “[Labour Productivity Measures - Provinces and Territories \(Annual\)](#)”. In essence, the series by province and territory use similar data sources as the quarterly national series, with additional information incorporated to provide a split between self-employed and employee jobs. Tax, census, and other demographic data are essential to provide the required details by province and territory. The provincial and territorial estimates are adjusted to benchmark values from the provincial and territorial supply and use tables when finalized.

## Production cycle

Quarterly labour productivity estimates and related measures are released four times per year. As shown above, the estimates are produced from various data sources, and they are often revised as a result of the updates to source data, methodologies, and seasonal adjustment.

Data are released within 65-70 days after the reference period. In the third quarter of each year, following the revision process for the quarterly national GDP, revisions cover the three preceding years. The benchmarked estimates are

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21. For more details, see Chen, Z-G, H. Fung, T.A. Baldé, and B. Quenneville, (2006), “Reference-week adjustment of Labour Force Series with X12-ARIMA”, American Statistical Association Proceedings 2006: Business and Economic Statistics Section, Washington, pp. 939-946.

not normally revised again except when periodic comprehensive revisions are carried out to incorporate the latest international concepts, classifications, and estimation methods.

The provincial labour productivity data and related measures are published twice each year. Data are released in February that provide revised estimates based on the benchmark to the most recently published provincial and territorial Supply and Use Tables. The benchmark year and subsequent years are revised with the February release. In May, preliminary estimates are published for the previous reference year.

## Uses of the Provincial and Territorial Productivity Data

The provincial and territorial productivity data are well suited to examine a very wide range of issues. The data are useful for analyzing both the relative contribution of provinces and territories to productivity growth at the national level, as well as the contribution of key industry sectors to the percentage change in provincial and territorial productivity in the business sector for a given period. For example, in 2017,<sup>22</sup> business productivity in Canada grew by 2.2% and productivity growth by province ranged from 0.8% in British Columbia to 8.5% in Newfoundland and Labrador. However, with a 1.9% increase in productivity, Ontario (+0.77 percentage points) was the largest contributor to national growth, due to the large size of its economy. Alberta accounted for 0.55 percentage points of the national increase, followed by Quebec (+0.28 percentage points).

From an industry perspective in 2017, in the context of higher oil prices, the mining and oil and gas extraction sector contributed half (+1.4 percentage points) of the business productivity growth in Alberta, while other industry sectors contributed the remaining half.

Provincial and territorial productivity data can also be used to quantify the contribution of productivity to long-term economic growth and living standards for each province or territory. It is well known that there is a strong link between these two important economic indicators and labour productivity.

Economic growth in a province or territory – as measured by real GDP growth – must come either from growth in hours worked and/or from growth in productivity. In other words, output will increase if hours worked are higher or if workers produce more per hour worked. For example, between 2010 and 2019, business labour productivity in Quebec grew 1.2% a year on average, accounting for just over half of the 2.2% annual average growth in real GDP of businesses in the province. The remainder is attributable to hours worked, which increased at an annual average rate of 0.9%.

A similar decomposition can be done between improvements in the standard of living of a province or territory and productivity growth. Standard of living – often measured by real GDP per capita growth – is determined by two factors: productivity growth and changes in hours worked per capita.

Productivity data also allow for comparisons of the competitiveness of businesses across provinces. Unit labour costs – or labour costs per unit of output – are frequently used to measure the competitiveness of businesses. Two factors affect unit labour costs in provincial businesses: hourly compensation, which when increased leads to higher unit labour costs; and increases in productivity that tend to reduce them. By balancing unit labour cost increases, productivity growth also reduces inflationary pressure on prices. In order to improve their competitive position, businesses will therefore seek reductions in unit labour costs through further productivity gains while monitoring wage trends. For example, in 2018, among the provinces, the slowest growth in unit labour costs of businesses was in the oil-producing provinces, including: Newfoundland and Labrador (+0.7%), Alberta (+1.0%), and Saskatchewan (+1.1%).

One can also use productivity data to compare the long-term trends in labour productivity across provinces. For example, during the 2010 to 2019 period, British Columbia led the provinces with an annual average growth of 1.7% in business productivity.

22. Data for 2017 are presented here as that is the most current benchmark available to the published Supply and Use Tables (projected estimates are currently available to 2020). The 2018 supply and use tables will be released in November of 2021, and updated labour productivity data benchmarked to those tables will be released in February 2022 with a flash estimate for 2021 released in May of 2022.

## Main Users of the Provincial and Territorial Productivity Data

Many users track the provincial and territorial labour productivity estimates (including the underlying series) in the business sector and individual industrial sectors. They generally want to look behind the statistics to understand the dynamics and determinants of productivity growth. Combined with other indicators, such as the unemployment rate, other employment data, and the consumer price index, productivity estimates provide a comprehensive picture of the provincial and territorial economies and labour markets. The main users of these data are:

### Provincial and territorial governments

Provincial (or territorial) governments are interested in assessing provincial (or territorial) productivity measures relative to other provinces (or territories) in the country, as they have an impact on provincial (or territorial) economic growth and living standards over the long term. They also use productivity data to guide fiscal policy decisions and to forecast tax revenues and the cost of programs such as health care and education. Comparisons of productivity and unit labour cost data between provinces are used by provincial government policy makers to assess the competitiveness of businesses within a province.

### Federal Government

In general, productivity estimates assist economic policy makers in assessing current economic activity and in economic analysis. Policy makers, such as the department of Finance Canada, use productivity statistics to measure the health of the national and provincial economies and to guide fiscal policy decisions. Finance Canada also uses assessments of productivity growth trends to estimate future economic output, employment, and the ability of the economy to support government spending. Other departments such as Innovation, Science and Economic Development Canada are interested in managing the drivers of productivity growth (e.g., through investment, innovation, and skills) and improving the competitiveness of industries in the business sector.

### Business leaders

Business leaders use productivity estimates by industry to determine whether their business is as productive or competitive as others in their industrial sector. To do this, they monitor their own performance and forecast employment and price trends in their industry and in the economy at the national and provincial levels. They also track changes in labour costs per unit of output and competitiveness in their industrial sector.

### The Bank of Canada

The Bank of Canada uses unit labour costs data to measure inflationary pressure in the national economy and its regions. It also uses productivity analysis to guide monetary policy decisions.

### Researchers and academics

Productivity analysis is often used in articles and presentations on economic performance at the national, provincial, and territorial levels. Relationships between productivity, wages, prices, and employment have already been studied extensively and academic institutions have dedicated economic labs focused on productivity measures.

### Others

Productivity data by industry also assist private sector analysts (such as commercial banks and stock brokerages) who need to assess the risks and opportunities associated with doing business in particular industries, provinces, and territories. In addition, private sector analysts rely on productivity estimates as part of their overall assessment of the national, provincial, and territorial economies and the ability of industries to compete on an interprovincial and international basis. The Canadian public also uses these data to help inform their general understanding of economic performance and outlook.

## Important points about Labour Productivity data by province and territory

Among other things, the provincial and territorial productivity data allow analysis of a province's labour productivity performance relative to other provinces and by industry over a given reference period. This is also the case for data by territory. The following points along with other information should be considered when analysing and interpreting these estimates.

- Economic performance, as measured by labour productivity, must be interpreted carefully, as these data reflect changes in other inputs, in particular capital (machinery and equipment, structures), in addition to the efficiency growth of the production process (technological innovation).
- Provincial and territorial measures of labour productivity and related variables - such as output, number of jobs, hours worked, compensation and unit labour cost - are consistent with the concepts of the Canadian System of Macroeconomic Accounts. Compared to the total economy, the business sector does not include the value added of the government sector, non-profit institutions, and the imputed rent for owner-occupied dwellings. In particular, it is from the real estate, rental and leasing industry — part of the services-producing business sector— that the imputed rent for owner-occupied dwellings is removed, as there are no data on the number of hours that homeowners spend on dwelling maintenance services.
- In order to provide more complete assessments of the provincial and territorial economy, productivity estimates must be combined with a set of other measures, such as output growth, growth in hours worked and employment, unemployment, investment, and profitability.
- Provincial and territorial measures of labour productivity may vary significantly, given the change in industrial composition by province and territory. In fact, growth in labour productivity is often influenced by the degree of diversity in the industrial structure of a given region. As a result, labour productivity tends to be more volatile in the smaller provinces.
- Real output (used to measure productivity) is based on the value added (or GDP) measured at basic prices in the provincial and territorial data, (not at market prices as in the national quarterly data), which is consistent with the detailed data by industry. In addition, the provincial and territorial GDP by industry data at basic prices are chained volume estimates with 2017 as their reference year.

## Data availability and revisions

Estimates of provincial–territorial productivity by industry and related variables are released twice a year. Preliminary estimates are released five months after the reference year (usually in May of the current year), while revised estimates are released in February of the following year. With the February release, revisions are generally made to the previous three years' estimates in conjunction with Statistics Canada's [National Accounts revision process](#). Occasionally, there are historical revisions due to conceptual, methodological and classification changes, for example changes to NAICS or to the reference year for the indices.

Preliminary productivity data for the provinces and territories are produced on the basis of preliminary GDP and hours worked estimates by industry, which are subsequently revised when additional and more precise data sources become available. In general, the regular revisions to preliminary estimates extend back three years.

The statistical revisions to provincial and territorial GDP by industry reflect the incorporation of the most current data, including survey results, administrative data, public accounts, and annual Supply and Use Tables. These tables integrate data from sources available to Statistics Canada into a rigorous accounting framework. They represent the most detailed, coherent accounting system for the structure of the Canadian economy and are considered the most accurate benchmarks on which to base estimates. The Supply and Use tables are calculated at the national and provincial/territorial levels, and they are available about two and a half years after the end of the reference year. In the release of revised data, new benchmark values from the Supply and Use Tables for the reference year are incorporated into the provincial and territorial GDP.

In addition, the labour productivity estimates are revised as new information on hours worked becomes available (improving the first estimates of employment and hours worked that are made using the Labour Force Survey and the Survey of Employment, Payrolls and Hours).

Prior to each release, a work in progress process is used to share data with provincial and territorial statistical coordinators for their input. This feedback from provincial and territorial statistical offices is important to ensure the highest quality data possible for each region.

## A brief review of recent projects and setting productivity perspective by economic region

As can be seen from the process described above, Statistics Canada's Labour Productivity Program is constantly evolving. Recent projects to improve the program are described below.

As part of an effort to increase the relevance of provincial and territorial data, two new tables - which are already mentioned in the preceding section and contain an experimental data set of labour statistics by economic region and work schedule - were released on [May 20, 2022](#). More specifically, these new tables represent an extension of table 36-10-0489-01. The first table ([36-10-0675-01](#)) contains labour statistics by economic region and job category. The data in this table also include the mobility of workers between Canada and the United States (international flows) and between economic regions of Canada (interregional flows). The second table ([36-10-0676-01](#)) contains labour statistics by work schedule (full-time or part-time). For employees, this new table also contains estimates of hours paid compared with hours worked.

Labour productivity and related measures are only available at the national, provincial, and territorial level. The challenge now is to be able to extend these measures to the level of Canada's economic regions in the context of future work. These estimates will be used to compare the relative position and economic performance of different regions. As a reminder, the productivity of an economy is evaluated using the measure of real GDP and that of hours worked. At the regional level, estimates of hours worked are now available and can be found in table 36-10-0675-01. However, real GDP estimates for economic regions are currently unavailable, highlighting the need for their development in order to estimate productivity by economic region.

## Conclusion

This document has presented an overview of the labour productivity program at Statistics Canada and the related measures that have been produced. The labour productivity program uses a set of integrated data sources produced by the System of National Economic Accounts, and continually adapts to the changing needs of users.

This document can be of interest to university students, journalists, analysts, and researchers interested in the measurement of labour productivity in Canada.

Statistics Canada produces quarterly and annual estimates of labour productivity as part of a regular production process. Quarterly estimates are published at the national level, while annual estimates are published at both the national and provincial/territorial levels. The six data tables described previously in the document are summarized in the table below. Obviously, this overview table does not cover multifactor productivity data.



**Table 1**  
**Summary of data tables on labour productivity and related measures currently published by Statistics Canada**

<b>Data table numbers and their titles</b>	<b>Geography</b>	<b>Frequency</b>
<a href="#">36-10-0206-01</a> Indexes of business sector labour productivity, unit labour cost and related measures, seasonally adjusted	National	Quarterly
<a href="#">36-10-0207-01</a> Indexes of labour productivity and related measures, by business sector industry, seasonally adjusted	National	Quarterly
<a href="#">36-10-0480-01</a> Labour productivity and related measures by business sector industry and by non-commercial activity consistent with the industry accounts	National, Provinces, and Territories	Annual
<a href="#">36-10-0489-01</a> Labour statistics consistent with the System of National Accounts (SNA), by job category and industry	National, Provinces, Territories, and Outside Canada	Annual
<a href="#">36-10-0675-01</a> Labour statistics consistent with the System of Provincial and Territorial Economic Accounts, by economic regions, job category and work schedule	Provinces, territories, and economic regions	Annual
<a href="#">36-10-0676-01</a> Labour statistics consistent with the System of Provincial and Territorial Economic Accounts, by industry, job category and work schedule (full-time or part-time)	National, Provinces, and Territories	Annual