Canadian Quarterly Productivity Accounts

Technical Notes

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Quarterly series on labour productivity growth and related variables were published for the first time on December 20, 2000 for the aggregate business sector and on December 13, 2003 for its constituent industries (15 two-digit NAICS industries) and two sectors (goods and services), as well as for the total economy and the non-business sector.

The seasonally adjusted statistical series for the total economy, business sector and non-business sector begins at the first quarter of 1981, while those at industry level are available only back to the first quarter of 1997. These quarterly estimates are meant to help those who are focused on analysis of the short-term relationship between real output, employment, hours worked and compensation.

Quarterly estimates of productivity for the total economy, business sector and by industry are derived from a Fisher-chained index of gross domestic product (GDP), or of value added.

The output quarterly growth of the **business sector** is constructed using a Fisher-chained index, after excluding all non-commercial activities from the GDP as well as the rental value of owner-occupied dwellings. Corresponding exclusions are also made for labour compensation and hours worked, to make output and labour input data consistent with one another. In 2000, the GDP estimate for the business sector accounted for roughly 78% of the Canadian economy.

The output quarterly growth **for each industry** is also constructed from Fisher-chained estimates of GDP. However, real GDP data for the most current years are based on a Laspeyres index formula. All quarterly estimates by industry are available for two-digit NAICS industries, the goods-producing business sector and the services-producing business sector. An output estimate for the **non-business sector**, which includes the implicit rental value of owner-occupied dwellings, is also available.

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.

Labour input quarterly estimates make the distinction between two main categories of workers:

- Employee jobs, which include jobs held by an employer of an incorporated enterprise.
- Jobs occupied by self-employed workers which comprise employers 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 based on the actual hours variable collected by the Labour Force Survey.

The number of jobs in the business sector is obtained residually by subtracting all jobs occupied in non-commercial activities from the number of jobs in the total economy. An estimate of the number of jobs for the overall economy is first produced based on Labour Force Survey (LFS)

estimates to which we add the number of jobs occupied by military personnel. Employment estimates from the LFS have to be transformed to be coherent with National Accounts concepts. To proceed, we add the number of multiple job holders and we remove all employees who hold a job but were not at work during the LFS reference week, and have no right to compensation during their absence. 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 comprised two main components: the government sector and non-profit institutions servicing households. The number of job estimates for the government sector comes from the Public Institutions Division. Estimates for non-profit institutions servicing households mainly encompass social and community services including religious groups, philanthropic foundations, civic, professional and other similar organizations.

Once we have residually obtained the number of jobs estimates for the business sector, we calculate the number of hours worked by multiplying each component of jobs by their respective average hours worked.

In general, all employee jobs estimates used to produce quarterly data by industry are based on a combination of data from household surveys and establishment surveys. More precisely, they are obtained from the geometric mean of employee jobs from the Labour Force Survey (LFS) with their equivalent from the Survey of Employment, Payroll and Hours (SEPH). This approach based on the geometric mean has the advantage of reducing the impact of extreme values. The other employment categories as well as average hours worked for any worker category are taken from the Labour Force Survey. Industry estimates for the number of jobs and for hours worked are then adjusted to their respective business sector total of jobs and hours worked, obtained residually from the total economy benchmark minus the non-commercial estimate.

Finally, to ensure consistency with the annual data from the labour productivity database, the quarterly indices of labour input are adjusted to their respective annual benchmarks when they become available. A new yearly benchmark became available at the business sector level upon the release of the first quarter indices for the business sector, and upon the release of the third quarter indices in the case of industry detail.

Output

A Fisher-chained index method that builds up the real value added (or real GDP) in the business sector and its component two-digit industries is used to produce quarterly estimates, for productivity measurement.

For all quarterly estimates in the business sector, the seasonally adjusted output growth rates are derived from Fisher-chained index estimates of ***GDP at market prices*** *(expenditure-based)* published by the Quarterly Income and Expenditure Accounts Division. These business sector quarterly estimates of Real GDP are constructed after removing the value added of the government sector, non-profit institutions, statistical error, and the rental value of owner-occupied dwellings. This approach is similar to that used for the quarterly productivity measures of the business sector in the United States.

Output series now reflect the capitalization of software expenditures introduced by the Canadian System of National Accounts on May 31, 2001.This change in the treatment of business software expenditures as an investment has been incorporated in all quarterly productivity series back to 1987. This change brings Canada in line with the United States, thereby improving the comparability of the measure of productivity with that published by the *Bureau of Labor Statistics*.

For all quarterly estimates by industry, the seasonally adjusted output growth rates are derived from the Fisher- chained estimates of ***GDP at basic prices*** published by the Industry Measures and Analysis Division. The Fisher-chained index was used in years for which final input-output tables were available. For the most current years or annual post-benchmarks, the real GDP is based on a Laspeyres index formula. GDP quarterly estimates of productivity measures for

businesses producing services and for finance, real estate and company management exclude the rental value of owner occupied dwellings.

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

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 productivity is meant to estimate the efficiency with which the number of hours worked in all jobs involved in one 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 addition to growth in productive efficiency.

It is important to note that in the quarterly estimation of business sector productivity, a Fisher-chained index *of* ***GDP at market prices*** *(expenditure-based)* is used as the measure of output. However, in the quarterly productivity estimates for the industries of the business sector, a Fisher-chained index of ***GDP at basic prices*** for each industry is used as the measure of output up to the last year's benchmark for which final input-output tables are available, followed by a Laspeyres index formula for the most recent years. The output indicator — that which is used in the productivity measures — disregards the rental value of owner-occupied dwellings

As a consequence of the use of different index numbers and of the different valuation of output measures — *market prices* for the aggregate of the business sector and *basic prices* of the industry aggregates — the aggregation framework of productivity accounts for the business sector as a whole is not entirely consistent with those that are detailed by industry. Moreover, the estimates in the business sector as a whole incorporate the adjustments of new benchmarks to the first quarter of each year in the last four years. In comparison, the real GDP by industry incorporates the detail of those revisions over the third quarter.

Total labour compensation and unit labour cost

Labour compensation measures the value of services of labour entering 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 labour income 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 industry level are taken directly from the estimates of labour income by the Income and Expenditure Accounts Division. However, labour income for self-employed workers is established by imputation. The imputation is based on the assumption that the hourly income for the labour of self-employed workers is the same as that of a paid worker in the same year and the same industry.

No income is imputed to unpaid family workers since their number is negligible in most industries.

Labour compensation for the non-business sector is comprised of two main components: wages, salaries and supplementary labour income from government institutions and that from persons. These estimates are also obtained from Income and Expenditure Accounts Division.

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

Unit labour cost is the labour cost per unit of output. It is calculated as 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, it is the joint result of changes in hourly compensation and productivity: unit labour cost increases when labour compensation per hour worked increases more rapidly than labour productivity. It is widely used to measure inflation pressures arising 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 quarterly average noon spot rates of the last day of the month.

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

- **Seasonal Adjustment**

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 given period of time. They relate to the seasons, sociological patterns and the rhythm of human activity.

All quarterly series (jobs, hours worked, GDP, income) are seasonally adjusted. A seasonally adjusted series is manipulated to eliminate the effect of seasonal variations. A series that is affected by seasonal fluctuations presents little interest or benefit for economic interpretation since these fluctuations substantially mask cyclical trends.

Seasonally adjusted series are estimated on the basis of past experience from a method called X-11 ARIMA developed at Statistics Canada (Ottawa, 1988).

- **Benchmark adjustment**

As a result of using different data sources and methodologies, the annual values (jobs, hours worked, GDP, compensation) and the yearly totals of the independently produced quarterly estimates are not identical. However, this difference between the two sets of estimates is eliminated by integrating the annual benchmark values into the quarterly estimates. This blending process, called benchmarking, generates a series which moves as much as possible with the original quarterly series and sums to the annual benchmarks.

If the differences between the yearly sums of quarterly values and the annual benchmarks were constant, the yearly discrepancy could be distributed among the quarters by simply applying a fixed ratio. The discrepancy, however, is not constant year after year, so that such calculation would introduce significant breaks between the fourth quarter of year t and the first quarter of year

t+1. To avoid such artificial discontinuities, a quadratic minimization procedure[1] is used to find a series that runs as parallel as possible to the original series but whose annual totals equal the annual benchmark figures. Finding such a series amounts to keeping the quarterly differences as close to the original quarterly series as the annual adding-up constraints allow.

[1] This procedure is sometimes called the Denton-Cholette Method. For more detail about the method, see Cholette, P.A. (1984): Adjusting sub-annual series to yearly benchmarks. *Survey Methodology*, 10, 35-49.