CHAPTER 2

# The Data of Macroeconomics

## Notes to the Instructor

### Chapter Summary

Chapter 2 is a straightforward chapter on economic data that emphasizes real GDP, the consumer price index, and the unemployment rate. This chapter contains a standard discussion of GDP and its components, explains the different measures of inflation, and discusses how the population is divided among the employed, the unemployed, and those not in the labour force. This chapter also introduces the circular flow and the relationship between stocks and flows.

### Comments

Students may have seen this material in first-year classes, so it can often be covered quickly. I prefer not to get involved in the details of national income accounting; my aim is to get students to understand the sort of issues that arise in looking at economic data and to know where to look if and when they need more information. From the point of view of the rest of the course, the most important things for students to learn are the identity of income and output, the distinction between real and nominal variables, and the relationship between stocks and flows.

### Use of the Statistics Canada Website

Use the Statistics Canada website ([www150.statcan.gc.ca/n1/en/type/data](https://www150.statcan.gc.ca/n1/en/type/data)) to download data on nominal GDP and the components of spending (consumption, investment, government purchases, exports, and imports). The data series start in the first quarter of 1961. Compute the shares of spending accounted for by each component. Discuss how the shares have changed over time.

### Chapter Supplements

This chapter includes the following supplements:

2-1 Measuring Output

2-2 Nominal and Real GDP

2-3 Chain-Weighted Real GDP

2-4 The Components of GDP (Case Study)

2-5 Revisions to the Canadian System of Macroeconomic Accounts

2-6 Seasonal Adjustment and the Seasonal Cycle

2-7 Measuring the Price of Light

2-8 Improving the CPI

2-9 The Billions Prices Project

2-10 Alternative Measures of Unemployment

2-11 Improving the National Accounts

## Lecture Notes

### Introduction

An immense amount of economic data is gathered on a regular basis. Every day, newspapers, radio, television, and the Internet inform us about some economic statistic or other. Although we cannot discuss all these data here, it is important to be familiar with some of the most important measures of economic performance.

### 2-1 Measuring the Value of Economic Activity: Gross Domestic Product

The single most important measure of overall economic performance is *gross domestic product* (*GDP*), which aims to summarize all economic activity over a period of time in terms of a single number. GDP is a measure of the economy’s total output *and* of total income. Macroeconomists use the terms *output* and *income* interchangeably, which seems somewhat mysterious. The reason is that, for the economy as a whole, total production equals total income. Our first task is to explain why.

#### Income, Expenditure, and the Circular Flow

* Figure 2-1

Suppose that the economy produces just one good—bread—using labour only. (Notice what we are doing here: We are making simplifying assumptions that are obviously not literally true to gain insight into the working of the economy.) We assume that there are two sorts of economic actors—households and firms (bakeries). Firms hire workers from the households to produce bread and pay wages to those households. Workers take those wages and purchase bread from the firms. These transactions take place in two markets—the *goods market* and the *labour market*.

* Supplement 2-1 Measuring Output

GDP is measured by looking at the flow of dollars in this economy. The *circular flow of income* indicates that we can think of two ways of measuring this flow—by adding up all incomes or by adding up all expenditures. The two will have to be equal simply by the rules of accounting. Every dollar that a firm receives for bread either goes to pay expenses or else increases profit. In our example, expenses simply consist of wages. Total expenditure thus equals the sum of wages and profit.

#### FYI: Stocks and Flows

Goods are not produced instantaneously; production takes time. Therefore, we must have a period of time in mind when we think about GDP. For example, it does not make sense to say a bakery produces 2,000 loaves of bread. If it produces that many in a day, then it produces 4,000 in two days, 10,000 in a (five-day) week, and about 130,000 in a quarter. Because we always have to keep a time dimension in mind, we say that GDP is a flow. If we measured GDP at any tiny instant of time, it would be almost zero.

* Figure 2-2

Other variables can be measured independent of time—we refer to these as *stocks.* For example, economists pay a lot of attention to the factories and machines that firms use to produce goods. This is known as the *capital stock*. In principle, you could measure this at any instant of time. Over time this capital stock will change because firms purchase new factories and machines. This change in the stock is called *investment*; it is a flow. Flows are changes in stocks; stocks change as a result of flows. In understanding the macroeconomy, it is often crucial to keep the distinction between stocks and flows in mind. A classic example of the stock–flow relationship is that of water flowing into a bathtub.

#### Rules for Computing GDP

Naturally, the measurement of GDP in the economy is much more complicated in practice than our simple bread example suggests. There are a number of technical details of GDP measurement that we ignore, but a few important points should be mentioned.

First, what happens if a firm produces a good but does not sell it? What does this mean for GDP? If the good is thrown out, it is as if it were never produced. If one fewer loaf of bread is sold, then both expenditure and profits are lower. This is appropriate, since we would not want GDP to measure wasted goods. Alternatively, the bread may be put into *inventory* to be sold later. Then the rules of accounting specify that it is as if the firm purchases the bread from itself. Both expenditure and profit are the same as if the bread were sold immediately.

Second, what happens if there is more than one good in the economy? We add up different commodities by valuing them at their *market price*. For each commodity, we take the number produced and multiply by the price per unit. Adding this over all commodities gives us total GDP.

Many goods are *intermediate goods*—they are not consumed for their own sake but are used in the production of other goods. Sheet metal is used in the production of cars; beef is used in the production of hamburgers. The GDP statistics include only *final goods*. If a miller produces flour and sells that flour to a baker, then only the sale of bread is included in GDP. An alternative but equivalent way of measuring GDP is to add up the *value added* at all stages of production. The value added of the miller is the difference between the value of output (flour) and the value of intermediate goods (wheat). The sum of the value added at each stage of production equals the value of the final output.

Finally, we need to take account of the fact that not all goods and services are sold in the marketplace. To include such goods, it is necessary to calculate an *imputed value*. An important example is owner-occupied housing. Since rent payments to landlords are included in GDP, it would be inconsistent not to include the equivalent housing services that homeowners enjoy. It is thus necessary to impute a value of housing services, which is simply like supposing that homeowners pay rent to themselves. Imputed values are also calculated for the services of public servants; they are simply valued by the wages that they are paid.

#### Real GDP Versus Nominal GDP

Valuing goods at their market price allows us to add different goods into a composite measure but also means we might be misled into thinking we are producing more if prices are rising. Thus, it is important to correct for changes in prices. To do this, economists value goods at the prices at which they sold in some given year. For example, we might measure GDP at 2007 prices (often referred to as measuring GDP in 2007 dollars). This is then known as real GDP. GDP measured at current prices (in current dollars) is known as nominal GDP. The distinction between real and nominal variables arises time and again in macroeconomics.

#### The GDP Deflator

The *GDP deflator* is the ratio of nominal GDP to real GDP:

GDP Deflator equals Nominal GDP over Real GDP..

The GDP deflator measures the price of output relative to prices in the base year, which we denote by *P*. Hence, nominal GDP equals *PY*.

#### Chain-Weighted Measures of Real GDP

* Supplement 2-3 Chain-Weighted Real GDP

One of the assumptions the textbook has made so far is to treat the base year for prices to compute real GDP as fixed. However, as prices change frequently, it would be wrong to use this approach. Prices of goods must be updated regularly to reflect changes in quality and availability. Since 2001, Statistics Canada has changed its approach to indexing GDP. Its current approach is known as the chain-weighted approach of computing GDP. Instead of using a fixed base year for prices, for example, the year 1997, to measure the value of goods produced in all years, it is now using a moving base year. Under the chain-weighted approach, two base years are used to calculate the growth rate for each period. For example, to measure the growth rate of real GDP in 2017, Statistics Canada will first compute the growth rate for 2017 using 2016 as the base year, and the growth rate for 2017 using 2017 as the base year, and then average the two growth rates to obtain the chain-weighted growth rate for 2017. To measure the change in real GDP in 2018, it uses the average growth rate computed using 2017 as the base year, and 2018 as the base year, and so on. Under the chain-weighted approach, the base year changes continuously over time. These various year-to-year growth rates are put together to form a chain; hence, the name “chain-weighted.” The chain-weighted index eliminates some of the problems associated with the fixed-base approach such as using outdated prices or using an arbitrary year as a base.

#### FYI: Two Helpful Hints for Working with Percentage Changes

* Supplement 8-5 Growth Rates, Logarithms and Elasticities

The percentage change of a product in two variables equals (approximately) the sum of the percentage changes in the individual variables. The percentage change of the ratio of two variables equals (approximately) the difference between the percentage change in the numerator and the percentage change in the denominator.

#### The Components of Expenditure

Although GDP is the most general measure of output, we also care about what this output is used for. National income accounts thus divide total expenditure into four categories, corresponding approximately to who does the spending, in an equation known as the national income identity,

Y = C + I + G + NX,

where *C* is consumption, *I* is investment, *G* is government purchases, and *NX* is net exports, or exports minus imports. Consumption is expenditure on goods and services by households; it is thus the spending that individuals carry out every day on food, clothes, movies, TVs, automobiles, and the like. Food, clothing, and other goods that last for short periods of time are classified as nondurable goods, whereas automobiles, TVs, and similar goods are classified as durable goods. (The distinction is somewhat arbitrary: A good pair of hiking boots might last for many years, while the latest laptop computer might be out of date in a matter of months!) The third category of consumption, known as services, includes the purchase of intangible items, such as legal advice and haircuts.

Investment is for the most part expenditure by firms on factories, machinery, and intellectual property products; this is known as *business fixed investmen*t. We noted earlier that goods put into inventory by firms are counted as part of expenditure; they are classified as *inventory investment.* This can be negative if firms are running down their stocks of inventory rather than increasing them. A third component of investment spending is actually carried out by households and landlords—*residential fixed investment*. This is the purchase of new housing.

The third category of expenditure corresponds to purchases by government (at all levels—federal, provincial, and municipal). It includes spending on highways, bridges, infrastructure, and so forth. It is important to realize that it includes only spending on goods and services that make up GDP. This means that it *excludes employmen*t-insurance payments, Old Age Security and other pension payments, and other *transfer payments.* When the government pays transfers to individuals, there is an indirect effect on GDP only, to the extent that individuals take those transfer payments and use them for consumption.

Finally, some of the goods that we produce are purchased by foreigners. These purchases represent another component of spending—exports—that must be added in. But, conversely, expenditures on goods produced in other countries do not represent purchases of goods that we produce. Since the idea of GDP is to measure total production in our country, imports must be subtracted. Net exports simply equal exports minus imports.

#### FYI: What Is Investment?

* Supplement 3-4 Economists Terminology

Economists use the term *investment* in a very precise sense. To an economist, investment means the purchase of newly created goods and services to add to the capital stock. It does not apply to the purchase of already existing assets, since this simply changes the ownership of the capital stock.

#### Case Study: GDP and Its Components

* Supplement 2-5, “Revisions to the Canadian System of Macroeconomic Accounts”
* Table 2-1

In 2018, Canadian GDP equalled about $2 trillion, or nearly $55,000 per person. Approximately 58 percent of GDP was spent on consumption (about $1.2. trillion). Private investment was about 19 percent of GDP (about $378 billion), while government purchases were nearly 24 percent of GDP (about $478 billion). Both imports and exports represented about 31 percent of GDP and imports exceeded exports by about $8 billion. Hence, in 2018, net exports in Canada were negative.

#### Other Measures of Income

* Supplement 2-6 Seasonal Adjustment and the Seasonal Cycle

There are other measures of income apart from GDP. The most important are as follows: *gross national product* (*GNP*) equals GDP minus income earned domestically by foreign nationals plus income earned by Canadian nationals in other countries; *net national* *product* (*NNP*) equals GNP minus a correction for the *depreciation*, or wear and tear, of the capital stock (*consumption of fixed capital*). Depreciation equalled about 16.7 percent of GDP in 2018 Net national product is approximately equal to *national income*. The two measures differ by a small amount known as the *statistical discrepancy*, which reflects differences in data sources that are not completely consistent. By adding dividends, transfer payments, and personal interest income and subtracting indirect business taxes, corporate profits, employment insurance, other social insurance contributions, and net interest, we move from national income to *personal income*. Finally, if we subtract income taxes and nontax payments, we obtain *disposable personal income*. This is a measure of the after-tax income of consumers. Most of the differences among these measures of income are not important for our theoretical models, but we do make use of the distinction between GDP and disposable income.

#### Seasonal Adjustment

Many economic variables exhibit a seasonal pattern—for example, GDP is lowest in the first quarter of the year and highest in the last quarter. Such fluctuations are not surprising since some sectors of the economy, such as construction, agriculture, and tourism, are influenced by the weather and the seasons. For this reason, economists often correct for such seasonal variation and look at data that are seasonally adjusted.

### 2-2 Measuring the Cost of Living: The Consumer Price Index

We noted earlier the difference between real and nominal GDP: real GDP takes GDP measured in dollars—nominal GDP—and adjusts for inflation. There are two basic measures of the inflation rate: the percentage change in the GDP deflator and the percentage change in the *consumer price index* (*CPI*).

#### The Price of a Basket of Goods

The percentage change in the consumer price index is a good measure of inflation as it affects the typical household. The CPI is calculated on the basis of a typical “basket of goods,” based on a survey of consumers’ purchases. The point of having a basket of goods is that price changes are weighted according to how important the good is for a typical consumer. If the price of bread doubles, that will have a bigger effect on consumers than if the price of matches doubles because consumers spend more of their income on bread than they do on matches. The CPI is defined as

CPI equals Current Price of Base-Year Basket of Goods over Base-Year Price of Base-Year Basket of Goods.

* Supplement 2-4, “The Components of GDP”

Like the GDP deflator, the CPI is a measure of the price level *P*.

#### How the CPI Compares to the GDP and PCE Deflators

* Figure 2-3

The GDP deflator is a measure of the price of all goods produced in Canada that go into GDP. In particular, the GDP deflator accounts for changes in the price of investment goods and goods purchased by the government, which are not included in the CPI. It is, thus, a good measure of the price of “a unit of GDP.” The CPI is a poorer measure of the price of GDP, but it provides a better measure of the price level as it affects the average consumer. Since the CPI measures the cost of a typical set of consumer purchases, it does not include the prices of, say, earthmoving equipment or equipment for the Canadian army. It does include the prices of imported goods that consumers purchase, such as Japanese televisions. Both of these factors make the CPI differ from the GDP deflator.

A final difference between these two measures of inflation is more subtle. The CPI is calculated on the basis of a fixed basket of goods, whereas the GDP deflator is based on a changing basket of goods. For example, when the price of apples rises and consumers purchase more oranges and fewer apples, the CPI does not take into account the change in quantities purchased and continues to weight the prices of apples and oranges by the quantities that were purchased during the base year. The GDP deflator, by contrast, allows the basket of goods to change over time as the composition of GDP changes. Thus, the CPI “overweights” products whose prices are rising rapidly and “underweights” products whose prices are rising slowly, thereby overstating the rate of inflation. By updating the basket of goods, the GDP deflator captures the tendency of consumers to substitute away from more expensive goods and toward cheaper goods. The GDP deflator, however, may actually understate the rate of inflation because people may be worse off when they substitute away from goods that they really enjoy—someone who likes apples much better than oranges may be unhappy eating fewer apples and more oranges when the price of apples rises.

#### Does the CPI Overstate Inflation?

* Supplement 2-7, “Measuring the Price of Light”
* Supplement 2-8, “Improving the CPI”

Many economists believe that changes in the CPI are an overestimate of the true inflation rate. We already noted that the CPI overstates inflation because consumers substitute away from more expensive goods. There are three other considerations:

* *New Goods* When producers introduce a new good, consumers have more choices and can make better use of their dollars to satisfy their wants. Each dollar will, in effect, buy more for an individual, so the introduction of new goods is like a decrease in the price level. This value of greater variety is not measured by the CPI.
* *Quality Improvements* Likewise, an improvement in the quality of goods means that each dollar effectively buys more for the consumer. An increase in the price of a product thus may reflect an improvement in quality and not simply a rise in cost of the “same” product. Statistics Canada makes adjustments for quality in measuring price increases for some products, including autos, but many changes in quality are hard to measure. Accordingly, if over time the quality of products and services tends to improve rather than deteriorate, then the CPI probably overstates inflation.
* *Competition from Discount, Online Retailers and Large Outlets* Competition from large and online discount retailers has resulted in lower prices paid by consumers in Canada on various goods and services. These effects, if not fully captured, will lead to CPI to overstate the true cost of living.
* Supplement 2-9 “The Billion Prices Project”

Research from the Bank of Canada suggests that because of these different sources of bias, the CPI overstates inflation by about 0.5 percentage points.[[1]](#footnote-1)

### 2-3 Measuring Joblessness: The Unemployment Rate

Finally, we consider the measurement of unemployment. Employment and unemployment statistics are among the most watched of all economic data, for a couple of reasons. First, a well-functioning economy will use all its resources. Unemployment may signal wasted resources and, hence, problems in the functioning of the economy. Second, unemployment is often felt to be of concern since its costs are very unevenly distributed across the population.

#### The Labour Force Survey

Statistics Canada calculates the unemployment rate and other statistics that economists and policymakers use to gauge the state of the labour market. These statistics are based on results from the Labour Force Survey; a survey of about 56,000 households that Statistics Canada conducts every month. The survey provides estimates of the number of people in the adult population (ages 15 years and older) who are classified as either employed, unemployed, or not in the labour force. It also provides a variety of other labour-related issues and statistics, such as unemployment for different regions, provinces, ages, and population groups.

* Figure 2-4

POP = E + U + NL,

where *POP* is the population, *E* is the employed, *U* is the unemployed, and *NL* is those not in the labour force. Thus, we have

L = E + U,

where *L* is the *labour force*. The *labour-force participation rate* is the fraction of the population in the labour force:

Labour-Force Participation Rate = L/POP.

* Supplement 2-10, “Alternative Measures of Unemployment”

The employment rate (*e*) and *unemployment rate* (*u*) are given by

e = E/L

u = U/L = 1 – e.

#### Case Study: Men, Women, and Labour-Force Participation

* Supplement 8-6, “Labour-Force Participation”

The Canadian labour market has seen significant changes since the 1970s. In 1976, about 45 percent of women aged 15 and older participated in the labour market. The labour-force participation for women grew rapidly after that, reaching over 61 percent in 2018. On the other hand, the male labour-force participation rate fell from 78 percent to 70 percent during the same period. Many factors have contributed to the increase in women’s participation, including new technologies such as electrical appliances (washing machines, dishwashers, refrigerators, etc.), which reduced the time needed for household chores; fewer children per family; and changing social and political attitudes toward women in the workforce. For men, the decline has been due to earlier and longer periods of retirement, more time spent in school (and out of the labour force) for younger men, and a higher prevalence of stay-at-home fathers.

* Figure 2-5

Since 2010, the labour-force participation rate has declined for both men and women. The decline for women is minimal (about 1 percentage point) and only occurred in recent years whereas the decline for men is more pronounced (about 2 percentage points) and has lingered. Part of this is due to the beginning of retirement for the baby-boom generation and part is due to the slow economic recovery following the financial crisis of 2008 to 2009. Some economists predict that the labour-force participation rate will decline further over the coming decades. The reason is demographic. People today are now living longer and having fewer children than previous generations. The increasing share of the elderly and retired population over time will reduce the economy’s labour-force participation rate.

#### The Survey of Employment, Payrolls, and Hours

In addition to the Labour Force Survey (LFS), every month, Statistics Canada conducts several other surveys to obtain timely information about the labour market. The Survey of Employment, Payrolls, and Hours (SEPH), Employment Insurance Statistics (EIS), Job Vacancy Statistics (JVS) and the Job Vacancy and Wage Survey (JVWS) are examples of surveys that Statistics Canada regularly conducts to obtain important information about the labour market in Canada. The SEPH is similar to the Establishment Survey in the United States. It provides rich information about earnings, as well as the number of jobs and hours worked by industry at the national, provincial, and territorial levels. The SEPH is based on administrative and payroll data gathered from taxes that companies pay to the Canada Revenue Agency. The SEPH covers about 15,000 businesses that have at least one employee and provides a raw count of the number of people who are on the payroll of these firms.

There are several differences between the LFS and the SEPH; for example, the LFS counts a self-employed person as working, but the SEPH would not. Another difference is that the LFS only reports if a person is working or not, whereas the SEPH counts every job each individual person has. Thus, a person who holds two jobs would be counted as one employed person in the LFS, but as two in the SEPH. Despite these differences, the employment growth rate as measured by the LFS and the SEPH does not differ very much. Figure 2.6 shows the employment growth rate as measured by the LFS and SEPH from 2002 to 2018.

* Figure 2-6

### 2-4 Conclusion: From Economic Statistics to Economic Models

* Supplement 2-12, “Improving the National Accounts”

This chapter has explained how we measure real GDP, prices, and unemployment. These are important economic statistics, since they provide an indication of the overall health of the economy. The task of macroeconomics, however, is not just to describe the data and measure economic performance but also to explain the behaviour of the economy. This is the subject to which we turn in subsequent chapters.

## LECTURE SUPPLEMENT

### 2-1 Measuring Output

As discussed in the text, we can measure the value of national output either by adding up all of the spending on the economy’s output of goods and services or by adding up all of the incomes generated in producing output. This basic equivalence between output and income allows us to develop the national income accounting identities relating saving, investment, and net exports that are presented in Chapters 3 and 6.

Although the text uses the term gross domestic product (GDP) to refer to both the spending measure and the income measure of total output, the national income accounts in fact provide two separate measures of total output. In the national income accounts, GDP is measured by adding up spending on domestically produced goods and services. A separate quantity, known as gross domestic income (GDI), is measured by adding up income generated in producing domestic output. In theory, these measures should be the same. In practice, however, a measurement error—known as the statistical discrepancy—means that GDP and GDI usually differ by a small amount. Typically, the discrepancy averages close to zero over longer periods of time and tends to become smaller as the data are revised.

Since 2000, however, the statistical discrepancy became unusually persistent, even after revisions to historical data. Over the period 2000–2008, the economy grew 2.6 percent per year when measured using real GDP compared with 3.5 percent per year when measured using real GDI. Figure 1 shows the annual average growth rates of real gross domestic product and real gross domestic income since 1980. As the figure illustrates, the difference in growth rates from the two measures has typically averaged close to zero until the early 2000s. These two measures have since shown some pronounced differences at times.

#### Which Measure Is More Accurate for the Mid- to Late 1990s?

Both the spending and income sides of the national accounts are measured with error because significant portions of the data are estimates based on extrapolations from other indicators and trends.[[2]](#footnote-2) As more complete data become available, Statistics Canada revises its estimates of GDP and GDI. Generally, these annual and multiyear revisions replace more of the spending-side estimates with detailed source data than the income-side estimates, which often continue to be based on incomplete data. When tax returns and census data become available, usually with a lag of many years, income estimates would be expected to improve. But because these data for income remain far from complete, GDP would still be the more accurate measure, although the discrepancy between the two probably would shrink. The persistence of the difference since the early 2000s, despite several revisions, has continued to be puzzling.

Another way of gauging the accuracy of GDP compared with GDI is to consider which measure fits better with well-known economic relationships that have typically held in the past. One such relationship is Okun’s law, a rule of thumb discussed in Chapter 10 that relates the growth rate of output to the change in the unemployment rate.[[3]](#footnote-3) In particular, Okun’s law states that a rise in the unemployment rate of 1 percentage point sustained for a year is associated with a decline in economic growth below its long-run potential rate by about 3 percentage points. The opposite holds for a fall in the unemployment rate, which is associated with a rise in economic growth above potential.

Over the period 2000–2008, the unemployment rate declined by 0.7 percentage points, from 6.8 percent to 6.1 percent. The decline on average was about 0.1 percentage point per year over this nine-year period. Using the equation for Okun’s law given in Chapter 10, we find that output growth per year would have been predicted to be:

Percentage Change in Output

= 2.88 – 3 × Change in Unemployment Rate

= 2.88 – 3 × (–0.1)

= 3.18%,

just below the 3.5 percent growth rate of GDI and above the 2.6 percent growth rate of GDP. But, if we adjust Okun’s law for a (conservative) 0.32 percentage point step-up in long-run productivity growth during the beginning to late 2000s (productivity growth is discussed in Chapter 9), then we obtain:

Percentage Change in Output = 3.2 – 3 × (–0.1) = 3.5 percent,

and Okun’s law would exactly match the GDI growth rate of 3.5 percent.

Regardless of whether it is GDP or GDI that in the end turns out to provide a more accurate view of growth during the 2000s, our understanding of the qualitative picture is the same. The economy expanded from 2000–2008 before going into recession in 2009—a topic to which we will return in later chapters.

Figure 1 Comparing Measures of Economic Growth

A graph shows two oscillating curves to measure the inflation rate for Real G D P and Real G D I.
The horizontal axis represents year and ranges from 1981 to 2017 in interval of 4 years.  The vertical axis represents year over year growth rate (percent) and ranges from negative 8 to 8 in increments of 2. A horizontal line is drawn from the point 0 on the vertical axis and extends toward the right.  An oscillating curve labeled Real G D P starts at the point (1980, 2.1), rises, falls and extends for further years and ends at (2018, 2). The highest rate is recorded as 6 percent in between the year 1981 to 1985, and the lowest rate is recorded as negative 2.5 percent at the year 2009. 
The curve labeled Real G D I starts at the point (1980, 2.2) rises, falls and extends for further years and ends at (2018, 2). The highest rate is recorded as 7 percent between the years 1997 to 2001, and the lowest rate is recorded as negative 6 percent at the year 2009. The two curves closely mirror each other.

Note: Source: Statistics Canada, Table: 36-10-0104-01.

## LECTURE SUPPLEMENT

### 2-2 Canada Nominal and Real GDP Since 1961

Figure 1 shows real GDP and nominal GDP between 1961 and 2018. Because real GDP is measured in chained 2012 dollars, the two series intersect in 2012. Figure 2 examines the annual percentage change in nominal and real GDP. Table 1 provides annual data for GDP and the GDP price index over the 1961–2018 period.

*A graph shows two curves for Real and Nominal G D P rate from the year 1961 to 2018 in millions of dollars.
The horizontal axis represents year and ranges from 1961 to 2017 in intervals of 8 years, and the vertical axis represents amount in millions of dollars and ranges from 0 dollars to 2,400,000 dollars in increments of 400,000 dollars. An oscillating curve labeled Real G D P (in 2012 dollars) starts at the point (1961, 399,998 dollars) rises gradually throughout the years and end at (2017, 2,000, 001). The curve labeled Nominal G D P starts at the point (1961, 0 dollar) rises gradually to the point (2009, 1,700,000), falls and again rises and ends at (2017, 2,200,000).*Source: Statistics Canada, Table 3610010401: Gross domestic product, expenditure-based, Canada, quarterly (x 1,000,000).A graph shows two oscillating curves for Real and Nominal G D P growth rate from the year 1961 to 2018. 
The horizontal axis represents year and ranges from 1961 to 2017 in interval of 8 years.  The vertical axis represents year over year growth rate (percent) and ranges from negative 10 to 25 in increments of 5 percent. A horizontal line is drawn from the point 0 on the vertical axis extends toward right.  
An oscillating curve labeled Real G D P starts at the point (1962, 9), falls, oscillates and extends for further years and ends at (2017, 2). The highest peak lies at 8 percent between the years 1969 to 1977, and the lowest point lies at negative 4.5 percent between the years 1977 to 1985. 
The curve labeled Nominal G D I starts at the point (1962, 10), rises, falls and extends for further years and ends at (2017, 2). The highest peak lies at 21 percent between the years 1969 to 1977, and the lowest peak of the curve lies at negative 7.5 percent at the year 2009. The two curves closely mirror each other.

Source: Statistics Canada, Table 3610010401: Gross domestic product, expenditure-based, Canada, quarterly (x 1,000,000).

Table 1 Canada GDP: 1961–2018

|  | **Levels** |  |  | **Growth Rates** |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Nominal GDP (millions of current dollars)** | **Real GDP (millions of chained 2012 dollars)** | **GDP Price Index**  **(2009 = 100)** | **Nominal GDP (percent)** | **Real GDP (percent)** | **GDP Price Index (percent)** |
| 1961 | 42,099 | 355,592 | 11.84 |  |  |  |
| 1962 | 45,816 | 381,996 | 11.99 | 8.83 | 7.43 | 1.31 |
| 1963 | 49,302 | 402,431 | 12.25 | 7.61 | 5.35 | 2.14 |
| 1964 | 54,067 | 429,164 | 12.60 | 9.66 | 6.64 | 2.83 |
| 1965 | 59,658 | 456,273 | 13.08 | 10.34 | 6.32 | 3.79 |
| 1966 | 66,810 | 486,865 | 13.72 | 11.99 | 6.70 | 4.95 |
| 1967 | 71,912 | 501,916 | 14.33 | 7.64 | 3.09 | 4.41 |
| 1968 | 78,569 | 526,989 | 14.91 | 9.26 | 5.00 | 4.06 |

(Continued on next page)

|  | **Levels** |  |  | **Growth Rates** |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Nominal GDP (billions of current dollars)** | **Real GDP (billions of chained 2009 dollars)** | **GDP Price Index**  **(2012 = 100)** | **Nominal GDP (percent)** | **Real GDP (percent)** | **GDP Price Index (percent)** |
| 1969 | 86,518 | 553,578 | 15.63 | 10.12 | 5.05 | 4.83 |
| 1970 | 93,236 | 569,964 | 16.36 | 7.76 | 2.96 | 4.67 |
| 1971 | 101,768 | 592,594 | 17.17 | 9.15 | 3.97 | 4.98 |
| 1972 | 113,624 | 625,243 | 18.17 | 11.65 | 5.51 | 5.82 |
| 1973 | 133,080 | 667,984 | 19.92 | 17.12 | 6.84 | 9.63 |
| 1974 | 158,306 | 689,896 | 22.95 | 18.96 | 3.28 | 15.18 |
| 1975 | 178,045 | 699,976 | 25.44 | 12.47 | 1.46 | 10.85 |
| 1976 | 206,007 | 741,126 | 27.80 | 15.71 | 5.88 | 9.28 |
| 1977 | 227,579 | 766,607 | 29.69 | 10.47 | 3.44 | 6.80 |
| 1978 | 252,044 | 794,845 | 31.71 | 10.75 | 3.68 | 6.82 |
| 1979 | 287,573 | 824,343 | 34.89 | 14.10 | 3.71 | 10.01 |
| 1980 | 322,747 | 842,112 | 38.33 | 12.23 | 2.16 | 9.86 |
| 1981 | 368,355 | 871,396 | 42.27 | 14.13 | 3.48 | 10.30 |
| 1982 | 388,176 | 843,613 | 46.01 | 5.38 | -3.19 | 8.85 |
| 1983 | 421,311 | 865,559 | 48.68 | 8.54 | 2.60 | 5.78 |
| 1984 | 461,980 | 916,708 | 50.40 | 9.65 | 5.91 | 3.53 |
| 1985 | 500,020 | 960,138 | 52.08 | 8.23 | 4.74 | 3.34 |
| 1986 | 526,622 | 980,720 | 53.70 | 5.32 | 2.14 | 3.11 |
| 1987 | 574,327 | 1,020,658 | 56.27 | 9.06 | 4.07 | 4.79 |
| 1988 | 626,885 | 1,065,671 | 58.83 | 9.15 | 4.41 | 4.54 |
| 1989 | 671,567 | 1,090,366 | 61.59 | 7.13 | 2.32 | 4.70 |
| 1990 | 695,487 | 1,092,150 | 63.68 | 3.56 | 0.16 | 3.39 |
| 1991 | 701,,761 | 1,069,369 | 65.62 | 0.90 | -2.09 | 3.05 |
| 1992 | 718,423 | 1,079,000 | 66.58 | 2.37 | 0.90 | 1.46 |
| 1993 | 747,025 | 1,107,710 | 67.44 | 3.98 | 2.66 | 1.29 |
| 1994 | 791,959 | 1,157,497 | 68.42 | 6.02 | 4.49 | 1.46 |
| 1995 | 831,594 | 1,188,657 | 69.96 | 5.00 | 2.69 | 2.25 |
| 1996 | 859,805 | 1,207,901 | 71.18 | 3.39 | 1.62 | 1.75 |
| 1997 | 906,897 | 1,259,594 | 72.00 | 5.48 | 4.28 | 1.15 |
| 1998 | 940,536 | 1,308,695 | 71.87 | 3.71 | 3.90 | -0.18 |
| 1999 | 1,007,914 | 1,376,236 | 73.24 | 7.16 | 5.16 | 1.90 |
| 2000 | 1,106,059 | 1,447,509 | 76.41 | 9.74 | 5.18 | 4.33 |
| 2001 | 1,144,533 | 1,473,406 | 77.68 | 3.48 | 1.79 | 1.66 |
| 2002 | 1,193,687 | 1,517,856 | 78.64 | 4.29 | 3.02 | 1.24 |
| 2003 | 1,254,739 | 1,545,191 | 81.20 | 5.11 | 1.80 | 3.26 |
| 2004 | 1,335,723 | 1,592,896 | 83.86 | 6.45 | 3.09 | 3.27 |
| 2005 | 1,421,572 | 1,643,915 | 86.47 | 6.43 | 3.20 | 3.12 |
| 2006 | 1,496,572 | 1,687,225 | 88.70 | 5.28 | 2.63 | 2.57 |
| 2007 | 1,577,662 | 1,722,197 | 91.61 | 5.42 | 2.07 | 3.28 |
| 2008 | 1,657,042 | 1,739,551 | 95.26 | 5.03 | 1.01 | 3.98 |

|  | **Levels** |  |  | **Growth Rates** |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Nominal GDP (billions of current dollars)** | **Real GDP (billions of chained 2009 dollars)** | **GDP Price Index**  **(2012 = 100)** | **Nominal GDP (percent)** | **Real GDP (percent)** | **GDP Price Index (percent)** |
| 2009 | 1,571,334 | 1,688,610 | 93.05 | -5.17 | -2.93 | -2.31 |
| 2010 | 1,666,047 | 1,740,779 | 95.71 | 6.03 | 3.09 | 2.85 |
| 2011 | 1,774,063 | 1,795,559 | 98.80 | 6.48 | 3.15 | 3.23 |
| 2012 | 1,827,202 | 1,827,202 | 100.00 | 3.00 | 1.76 | 1.21 |
| 2013 | 1,902,247 | 1,869,779 | 101.74 | 4.11 | 2.33 | 1.74 |
| 2014 | 1,994,892 | 1,923,413 | 103.72 | 4.87 | 2.87 | 1.95 |
| 2015 | 1,990,439 | 1,936,683 | 102.78 | -0.22 | 0.69 | -0.91 |
| 2016 | 2,028,223 | 1,958,124 | 103.58 | 1.90 | 1.11 | 0.78 |
| 2017 | 2,141,508 | 2,016,448 | 106.20 | 5.59 | 2.98 | 2.53 |
| 2018 | 2,217,539 | 2,053,423 | 107.99 | 3.55 | 1.83 | 1.69 |

Source: Statistics Canada, Table 3610010401: Gross domestic product, expenditure-based, Canada, quarterly (x 1,000,000).

## LECTURE SUPPLEMENT

### 2-3 Chain-Weighted Real GDP

Until 2001, Statistics Canada calculated real GDP and, hence, the growth rate of the economy by valuing goods and services at the prices prevailing in a fixed year, known as the *base* *year*. Most recently, 1982 was used as the base year. Thus, real GDP in 1995 was calculated by valuing all goods and services produced in 1995 at the prices they sold for in 1982. Similarly, real GDP in 1950 was calculated by valuing all goods and services produced in 1950, using the prices they sold for in 1982. This method of calculating real GDP is known as a *fixed-weight measure*.

Two major problems are associated with fixed-weight measures of real GDP. First, economic growth may be mismeasured due to substitution bias. Second, attempts to reduce this bias for recent years by periodically updating the base year lead to revisions of historical growth rates.

Substitution bias occurs because the prices of goods and services for which output grows rapidly tend to decline relative to the prices of goods and services for which output grows slowly. By using fixed-price weights from a base year in the past, we overweight rapidly growing sectors with prices that are too high compared to current prices and underweight slowly growing sectors with prices that are too low. Overall, this leads to an upward bias in the rate of GDP growth that becomes progressively worse over time. Likewise, moving back in time over years prior to the base year, GDP growth is understated because those goods and services with rapid output growth are underweighted compared to current prices, and those goods and services with slow output growth are overweighted.

The most widely cited example of substitution bias is computers. The price of computers (holding quality fixed) has declined rapidly, and the quantity produced has risen sharply. The price of a small mainframe computer was US$800,000 in 1977. The same computer cost US$80,000 in 1987 and US$30,000 in 1995.[[4]](#footnote-4) If each computer sold in 1995 were valued at its 1987 price, real GDP would be biased upward. Likewise, if each computer sold in 1977 were valued at its 1987 price, real GDP in 1977 would be biased downward.

Substitution bias not only produces a mismeasurement of real output, but it also can result in a mismeasurement of the relative importance of the components of output: consumption, investment, government expenditures, and net exports. Computers are primarily counted as an investment good in the national accounts. Thus, the rapid increase in the output of computers over the past three decades would lead to an overstatement of the contribution of investment to GDP growth in the years after the base year and an understatement of the contribution of investment to growth in the years prior to the base year.

To reduce the extent of these mismeasurements, Statistics Canada changed the frequency it updated the base year from every 10 years to every five years. Changing the base year, however, affects the measurement of economic growth in all years. While moving the base year forward provides a more accurate measure of current growth, it worsens the underestimation of growth in early years.

In 2001, rather than updating the base year, Statistics Canada switched the method it used to calculate economic growth because of the substitution bias and rewriting of history that occurred with a fixed-weight measure. Real GDP growth in any year, *t*, is now calculated using prices from year *t* and *t* – 1. This method minimizes the substitution bias because recent prices are used and eliminates the historical revisions that occurred when the base year was updated.[[5]](#footnote-5)

To understand the difference between fixed-weight growth rates and chain-weighted growth rates, consider the following example, using the apple-and-orange economy. Table 1 shows the quantities and prices of apples and oranges from 2008 to 2012. Over this period the price of apples is rising, while the price of oranges is falling, and the consumption of oranges relative to apples is rising.

Table 1 Output and Prices of Apples and Oranges

|  | **Apples** |  | **Oranges** |  |
| --- | --- | --- | --- | --- |
| **Year** | **Quantity** | **Price** | **Quantity** | **Price** |
| 2008 | 100 | $0.25 | 50 | $0.50 |
| 2009 | 102 | 0.28 | 55 | 0.48 |
| 2010 | 103 | 0.32 | 60 | 0.45 |
| 2011 | 104 | 0.34 | 65 | 0.44 |
| 2012 | 105 | 0.36 | 70 | 0.42 |

Table 2 calculates the growth rates of real GDP on a year-to-year basis from 2008 to 2012. Using a fixed-weight measure, the percentage growth rate of real GDP from year *t* – 1 to year *t* is given by the formula

Open parenthesis open parenthesis P subscript B to the power of A Q subscript t to the power of A plus P subscript B to the power of O Q subscript t to the power of O over P subscript B to the power of A Q subscript t minus 1 to the power of A plus P subscript B to the power of O Q subscript t minus 1 to the power of O close parenthesis minus 1 close parenthesis plus hundred.,

where the superscript A refers to apples, the superscript O refers to oranges, and the subscript B is the base year. Columns 2–6 of Table 2 indicate how the year-to-year growth rates vary as the base year changes. For example, the growth of real GDP between 2008 and 2009 varies from 4.9 percent to 6.0 percent, depending on which year is used as the base for prices. Note that the farther away from the base, the greater the difference in growth rates. This explains why using 2008 prices or 2012 prices for the weights provides the extremes for the growth rates.

The chain-weight method of calculating the percentage real growth rate between any two years *t* – 1 and *t* is given by the formula

Open parenthesis square root of open parenthesis P subscript t to the power of A Q subscript t to the power of A plus P subscript t to the power of O Q subscript t to the power of O over P subscript t to the power of A Q subscript t minus 1 to the power of A plus P subscript t to the power of O Q subscript t minus 1 to the power of O times P subscript t minus 1 to the power of A Q subscript t to the power of A plus P subscript t minus 1 to the power of O Q subscript t to the power of O over P subscript t minus 1 to the power of A Q subscript t minus 1 to the power of A plus P subscript t minus 1 to the power of O Q subscript t minus 1 to the power of O close parenthesis minus one close parenthesis times 100..

This method produces a growth rate that is the geometric average of the growth rates using year *t* – 1 and year *t*. The growth rate of real GDP between 2011 and 2012 was 4.0 percent using prices in 2011 for the weights and 3.8 percent using prices in 2012 for the weights. The geometric average of these two growth rates is 3.9 percent, the growth rate given by the chain-weighted method.

#### Table 2 Growth Rate of Real Output Using the Fixed-Weight or Chain-Weight Method

|  | **2008 Base** | **2009 Base** | **2010 Base** | **2011 Base** | **2012 Base** | **Chain Weight** |
| --- | --- | --- | --- | --- | --- | --- |
| 2008–09 | 6.0% | 5.7% | 5.3% | 5.1% | 4.9% | 5.8% |
| 2009–10 | 5.2 | 4.9 | 4.5 | 4.3 | 4.1 | 4.7 |
| 2010–11 | 4.9 | 4.6 | 4.3 | 4.1 | 3.9 | 4.2 |
| 2011–12 | 4.7 | 4.4 | 4.1 | 4.0 | 3.8 | 3.9 |

Using the chain-weight method, real GDP is calculated as

Equation states RGDP subscript t equals open parenthesis 1 plus Growth subscript 1 close parenthesis times RGDP subscript t minus 1.,

where Growth*t* is the growth rate from year *t* – 1 to year *t*. Some year must be chosen for which real GDP is set equal to nominal GDP (for U.S. GDP, the BEA currently uses 2009).

Calculating the chain-weight price index is similar to the process for calculating real GDP. The percentage growth rate of prices in the apple and orange economy is given by

Equation states open parenthesis square root of open parenthesis P subscript t to the power of A Q subscript t to the power of A plus P subscript t to the power of O Q subscript t to the power of O over P subscript t minus 1 to the power of A Q subscript t to the power of A plus P subscript t minus 1 to the power of O Q subscript t to the power of O times P subscript t to the power of A Q subscript t minus 1 to the power of A plus P subscript t to the power of O Q subscript t minus 1 to the power of O over P subscript t minus 1 to the power of A Q subscript t minus 1 to the power of A plus P subscript t minus 1 to the power of O Q subscript t minus 1 to the power of O close parenthesis minus one close parenthesis times 100..

The equation used to calculate the price index itself is

Price Index*t* = (1 + Inflation Rate*t*) × Price Index*t*–1,

where the inflation rate is the rate of change in prices from year *t* – 1 to year *t*.

The chain-weighted measures of real GDP and the price index also have the property that 1 plus the growth of nominal GDP divided by 1 plus the growth of real GDP will equal 1 plus the inflation rate:

(1 + Inflation Rate*t*) = (1 + Growth Nominal GDP*t*)/(1 + Growth*t*).

And, if one chooses a year in which to set real GDP and nominal GDP equal, the chain-weighted price index will equal the ratio of nominal GDP to chain-weighted GDP—just as it did for the fixed-weight measures of output and prices:

Price Index*t* = Nominal GDP*t*/Chain-Weighted GDP*t*.

Accordingly, the “arithmetic tricks” discussed in the text for approximating the percentage change in nominal GDP will also work for chain-weighted measures of GDP and prices.

## CASE STUDY EXTENSION

### 2-4 The Components of GDP

Table 1 and Figure 1 show the principal components of Canada’s GDP between 1961 and 2018.

#### Table 1 Canada Nominal GDP and the Components of Expenditure: 1961–2018 (millions of dollars)

| Year | GDP | Consumption | Investment | Government  Purchases | Net Exports |
| --- | --- | --- | --- | --- | --- |
| 1961 | 42,099 | 26,136 | 7,161 | 9,070 | -268 |
| 1962 | 45,816 | 28,102 | 7,971 | 9,909 | -166 |
| 1963 | 49,302 | 29,860 | 8,599 | 10,584 | 259 |
| 1964 | 54,067 | 32,,001 | 10,083 | 11,466 | 517 |
| 1965 | 59,658 | 34,664 | 12,293 | 12,884 | -183 |
| 1966 | 66,810 | 37,758 | 14,072 | 15,101 | -121 |
| 1967 | 71,912 | 40,989 | 13,328 | 17,059 | 536 |
| 1968 | 78,569 | 44,809 | 14,126 | 18,921 | 713 |
| 1969 | 86,518 | 49,217 | 16,503 | 20,967 | -169 |
| 1970 | 93,236 | 51,317 | 16,106 | 23,789 | 2,024 |
| 1971 | 101,768 | 55,779 | 18,127 | 26,550 | 1,312 |
| 1972 | 113,624 | 63,135 | 20,688 | 29,151 | 650 |
| 1973 | 133,080 | 72,476 | 26,499 | 32,669 | 1,436 |
| 1974 | 158,306 | 84,838 | 33,833 | 39,788 | -153 |
| 1975 | 178,045 | 97,565 | 36,229 | 47,686 | -3,435 |
| 1976 | 206,007 | 111,161 | 43,128 | 53,557 | -1,839 |
| 1977 | 227,579 | 122,367 | 45,832 | 60,180 | -800 |
| 1978 | 252,044 | 137,360 | 49,196 | 64,944 | 544 |
| 1979 | 287,573 | 153,433 | 61,640 | 71,303 | 1,197 |
| 1980 | 322,747 | 171,917 | 64,493 | 80,885 | 5,452 |
| 1981 | 368,355 | 193,886 | 79,527 | 92,489 | 2,453 |
| 1982 | 388,176 | 207,133 | 62,187 | 104,239 | 14,617 |
| 1983 | 421,311 | 227,403 | 69,571 | 111,126 | 13,211 |
| 1984 | 461,980 | 247,683 | 79,763 | 118,871 | 15,663 |
| 1985 | 500,020 | 270,838 | 88,466 | 129,486 | 11,230 |
| 1986 | 526,622 | 291,340 | 95,068 | 135,455 | 4,759 |
| 1987 | 574,327 | 316,932 | 107,741 | 143,148 | 6,506 |
| 1988 | 626,885 | 342,546 | 125,907 | 153,860 | 4,572 |
| 1989 | 671,567 | 369428 | 135,033 | 167,035 | 71 |
| 1990 | 695,487 | 389,,082 | 122,506 | 182,975 | 924 |
| 1991 | 701,761 | 401,301 | 109,828 | 194,447 | -3,815 |
| 1992 | 718,423 | 413,427 | 106,134 | 201,515 | -2,653 |
| 1993 | 747,025 | 430,491 | 112,203 | 204,250 | 81 |
| 1994 | 791,959 | 448,675 | 127,117 | 207,048 | 9,119 |
| 1995 | 831,594 | 464,399 | 133,421 | 207,867 | 25,907 |
| 1996 | 859,805 | 484,858 | 135,713 | 205,540 | 33,694 |
| 1997 | 906,897 | 517,118 | 166,155 | 206,319 | 17,305 |
| 1998 | 940,536 | 537,634 | 171,173 | 213,337 | 18,392 |
| 1999 | 1,007,914 | 568,622 | 178,258 | 224,959 | 36,075 |
| 2000 | 1,106,059 | 604,467 | 195,795 | 243,543 | 62,254 |
| 2001 | 1,144,533 | 630,918 | 189,140 | 259,297 | 65,178 |
| 2002 | 1,193,687 | 669,803 | 197,539 | 274,183 | 52,162 |
| 2003 | 1,254,739 | 700,012 | 216,935 | 289,515 | 48,277 |
| 2004 | 1,335,723 | 731,603 | 242,238 | 302,742 | 59,140 |
| 2005 | 1,421,572 | 773,046 | 273,074 | 319,835 | 55,617 |
| 2006 | 1,496,572 | 814,809 | 300,196 | 341,006 | 40,561 |
| 2007 | 1,577,662 | 862,924 | 318,107 | 362,786 | 33,845 |
| 2008 | 1,657,042 | 902,353 | 333,341 | 392,309 | 29,039 |
| 2009 | 1,571,334 | 903,731 | 272,980 | 417,214 | -22,591 |
| 2010 | 1,666,047 | 948,343 | 310,740 | 438,272 | -31,308 |
| 2011 | 1,774,063 | 991,065 | 351,933 | 451,670 | -20,605 |
| 2012 | 1,827,202 | 1,023,203 | 378,240 | 460,911 | -35,152 |
| 2013 | 1,902,247 | 1,064,937 | 400,457 | 467,197 | -30,344 |
| 2014 | 1,994,892 | 1,113,165 | 423,299 | 477,103 | -18,675 |
| 2015 | 1,990,439 | 1,149,398 | 398,342 | 491,905 | -49,206 |
| 2016 | 2,028,223 | 1,186,628 | 388,967 | 501,346 | -48,718 |
| 2017 | 2,141,508 | 1,244,091 | 423,366 | 523,703 | -49,652 |
| 2018 | 2,217,539 | 1,292,285 | 425,005 | 547,384 | -47,135 |

Source: Statistics Canada, CANSIM Table 36-10-0104-01.

*A graph shows four oscillating curves each representingts an expenditure component of Canadas G D P from the year 1961 to 2017. 
The horizontal axis represents year and ranges from 1961 to 2017 in intervals of 8 years. The vertical axis represents the G D P rate in percent and ranges from negative 10 percent to 70 percent. 
The curve labeled Net exports starts at the point (1961, 0 percent), rises and falls and extends for further years. The highest percent for the curve lies at (2001, 6 percent). 
The curve labeled Government purchases starts at the point (1961, 18 percent), gradually rises, falls and extends for further years. The highest percent for the curve lies at (1992, 25 percent). 
The curve labeled Investment starts at the point (1961, 22 percent) rises and falls and extends for further years. The highest percent for the curve lies at (1965, 28 percent). 
The curve labeled Consumption starts at the point (1961, 62 percent) gradually falls and extends for further years. The highest percent for the curve lies at (1961, 62 percent).  The consumption percent for further years lie between 50 and 60 percent. *

Change hyphen in heading text “1961-2018” to en-dash

*Source:* Statistics Canada, CANSIM Table 36-10-0104-01.Data are expressed as a percentage of GDP.

As Figure 1 illustrates, the GDP shares of consumption expenditure, private investment expenditure, and government purchases have been relatively constant over the past since 1961. The share of consumption has remained between 55 percent and 60 percent while investment accounts for around 22 percent of GDP. The share of government purchases has slightly increased over time from about 16 percent in 1961 to around 20 percent in 2018. As shown in Table 1, the sum of consumption, investment, government purchases, and net exports must always equal GDP when measured in current dollars. Under the old fixed-weight method of calculating real GDP, it was also true that real GDP was equal to the sum of its spending components, provided they were measured in real terms using the same base year. Under the new chain-weight system, however, the components of real spending no longer sum to real GDP, and so a residual equaling the difference between real GDP and the sum of its components is included in Table 2, which reports real GDP and its components since 1981.

Table 2 Canada Real GDP and the Components of Expenditure: 1981–2018 (billions of chained 2012 dollars)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **GDP** | **Consumption** | **Investment** | **Government** | **Net** | **Statistical** |
|  |  |  |  | **Purchases** | **Exports** | **Discrepancy** |
| 1981 | 870,581 | 436,176 | 151,525 | 252,917 | 23,570 | -912 |
| 1982 | 842,617 | 424,883 | 111,782 | 256,367 | 41,716 | -2,283 |
| 1983 | 864,577 | 435,651 | 122,383 | 259,126 | 39,419 | -2,183 |
| 1984 | 915,765 | 452,620 | 137,212 | 265,676 | 48,108 | -1,195 |
| 1985 | 959,128 | 474,959 | 148,593 | 277,976 | 44,830 | 404 |
| 1986 | 979,840 | 491,510 | 153,276 | 281,538 | 43,677 | -1,543 |
| 1987 | 1,020,008 | 511,047 | 167,696 | 285,547 | 41,473 | 1,856 |
| 1988 | 1,065,184 | 532,282 | 187,479 | 294,841 | 37,678 | 1,767 |
| 1989 | 1,089,927 | 550,541 | 195,843 | 303,504 | 28,412 | 1,535 |
| 1990 | 1,091,641 | 557,905 | 175,428 | 314,470 | 34,908 | 918 |
| 1991 | 1,068,413 | 551,440 | 158,142 | 322,639 | 33,377 | -1,288 |
| 1992 | 1,077,860 | 559,847 | 152,099 | 324,372 | 40,687 | -1983 |
| 1993 | 1,106,481 | 570,169 | 158,161 | 324,122 | 52,507 | -489 |
| 1994 | 1,156,190 | 586,647 | 174,298 | 322,158 | 70,081 | 567 |
| 1995 | 1,187,141 | 599,746 | 180,183 | 319,156 | 84,173 | 41 |
| 1996 | 1,206,267 | 617,471 | 183,595 | 312,873 | 90,004 | -553 |
| 1997 | 1,257,896 | 647,883 | 219,915 | 309,009 | 81,050 | 1,632 |
| 1998 | 1,306,721 | 665,615 | 223,703 | 314,721 | 102,549 | 781 |
| 1999 | 1,374,179 | 691,999 | 232,700 | 325,070 | 123,284 | 1,957 |
| 2000 | 1,445,398 | 720,112 | 252,642 | 336,309 | 136,535 | 1,362 |
| 2001 | 1,470,999 | 737,759 | 240,002 | 351,165 | 140,286 | -136 |
| 2002 | 1,515,277 | 767,335 | 244,337 | 359,795 | 139,494 | 939 |
| 2003 | 1,542,578 | 788,314 | 268,085 | 370,570 | 113,526 | 1,099 |
| 2004 | 1,590,186 | 812,129 | 291,716 | 379,824 | 107,715 | 312 |
| 2005 | 1,641,090 | 844,059 | 324,168 | 388,643 | 87,372 | 56,2 |
| 2006 | 1,684,145 | 879,270 | 342,791 | 400,426 | 66,869 | -209 |
| 2007 | 1,718,880 | 917,800 | 349,935 | 412,614 | 44,377 | -1,068 |
| 2008 | 1,736,086 | 944,939 | 353,122 | 428,806 | 13,478 | -345 |
| 2009 | 1,684,881 | 945,227 | 286,340 | 445,140 | 8,803 | -917 |
| 2010 | 1,736,820 | 978,989 | 322,238 | 462,104 | -24,188 | -1,433 |
| 2011 | 1,791,389 | 1,001,428 | 361,011 | 460,578 | -29,708 | -1,044 |
| 2012 | 1,822,808 | 1,020,599 | 378,240 | 460,911 | -35,908 | -1,035 |
| 2013 | 1,865,095 | 1,047,260 | 400,000 | 453,607 | -34,538 | -108 |
| 2014 | 1,918,419 | 1,074,243 | 405,818 | 453,261 | -14,056 | -504 |
| 2015 | 1,931,354 | 1,098,673 | 372,204 | 459,551 | 2,428 | -1,352 |
| 2016 | 1,952,608 | 1,123,213 | 354,847 | 465,060 | 10,665 | -1,122 |
| 2017 | 2,010,894 | 1,162,672 | 378,307 | 477,811 | -8,288 | -44 |

Source: Statistics Canada, CANSIM Table 36-10-0222-01.

To understand why a chain-weight method violates the identity *Y* = *C* + *I* + *G* + *NX*, consider the following simple example. Consumption consists of two goods: apples and oranges. Investment consists of buildings and equipment. There are no government expenditures, exports, or imports. The quantity and price of each good in years 1 and 2 and nominal expenditures are given in Table 3. Nominal GDP was $2.6 million in year 1 and $2.8 million in year 2. In each year, nominal GDP equalled consumption plus investment expenditures.

Table 3 Calculating GDP and Its Components

|  | **Quantity** | **Year 1  Price** | **Expenditures** | **Quantity** | **Year 2  Price** | **Expenditures** |
| --- | --- | --- | --- | --- | --- | --- |
| Apples | 4,000,000 | $.25 | $1,000,000 | 3,500,000 | $.28 | $980,000 |
| Oranges | 1,000,000 | $.5 | $500,000 | 2,000,000 | $.4 | $800,000 |
| **Consumption** |  |  | **$1,500,000** |  |  | **$1,780,000** |
| Buildings | 5 | $200,000 | $1,000,000 | 4 | $225,000 | $900,000 |
| Equipment | 10 | $5,000 | $50,000 | 15 | $4,750 | $71,250 |
| **Investment** |  |  | **$1,050,000** |  |  | **$971,250** |
| **GDP** |  |  | **$2,550,000** |  |  | **$2,751,250** |

Calculating real GDP under the fixed-weight method in this economy is easy. Suppose year 1 is the base year. Then real consumption and investment are $1.5 million and $1.1 million, respectively, in year 1, and real GDP is $2.6 million. In year 2, real consumption is calculated by valuing the quantity of apples and the quantity of oranges at their year 1 prices. Thus,

Equation states, C squared equals P subscript apples to the power of 1 Q subscript apples to the power of 2 plus P subscript oranges to the power of 1 Q subscript oranges to the power of 2 equals 1,875,000 dollars.

Real investment in year 2 is calculated by valuing the quantity of buildings and the quantity of equipment at their year 1 prices. Thus,

Equation states, I squared equals P subscript buildings to the power of 1 Q subscript buildings to the power of 2 plus P subscript equipment to the power of 1 Q subscript equipment to the power of 2 equals 875,000 dollars.

Real GDP in year 2 is calculated by valuing the quantity of each good produced at its price in year 1. Thus,

Equation states, Real GDP squared equals P subscript apples to the power of 1 Q subscript apples to the power of 2 plus P subscript oranges to the power of 1 Q subscript oranges to the power of 2 plus P subscript buildings to the power of 1 Q subscript buildings to the power of 2 plus P subscript equipment to the power of 1 Q subscript equipment to the power of 2 equals C squared plus I squared equals 1,875,000 dollars plus 875,000 dollars equals 2,750,000 dollars.

From the above formula, it is clear that the sum of real consumption and real investment will always equal real GDP.

The chain-weight method of calculating real GDP is not so simple, and the components do not necessarily add up to total GDP. We calculate the components of GDP using the same approach shown in Supplement 2-4 for calculating chain-weighted GDP. For example, to compute real consumption, we begin by setting it equal to its nominal value in year 1. Real consumption in year 2 then equals consumption in year 1 multiplied by the geometric average of the growth rates of consumption measured using prices from year 1 and using prices from year 2:

Equation states, C squared equals square root of open parenthesis P subscript apples to the power of 1 Q subscript apples to the power of 2 plus P subscript oranges to the power of 1 Q subscript oranges to the power of 2 over P subscript apples to the power of 1 Q subscript apples to the power of 1 plus P subscript oranges to the power of 1 Q subscript oranges to the power of 1 close parenthesis open parenthesis P subscript apples to the power of 2 Q subscript apples to the power of 2 plus P subscript oranges to the power of 2 Q subscript oranges to the power of 2 over P subscript apples to the power of 2 Q subscript apples to the power of 1 plus P subscript oranges to the power of 2 Q subscript oranges to the power of 1 close parenthesis times C to the power of one equals 1.2099 times 1,500,000 dollars equals 1,814,850 dollars.

Similarly, real investment in year 2 is equal to real investment in year 1 multiplied by the geometric average of the growth rates of investment measured using prices from year 1 and using prices from year 2:

Equation states, I squared equals square root of open parenthesis P subscript buildings to the power of 1 Q subscript buildings to the power of 2 plus P subscript equipment to the power of 1 Q subscript equipment to the power of 2 over P subscript buildings to the power of 1 Q subscript buildings to the power of 1 plus P subscript equipment to the power of 1 Q subscript equipment to the power of 1 close parenthesis open parenthesis P subscript buildings to the power of 2 Q subscript buildings to the power of 2 plus P subscript equipment to the power of 2 Q subscript equipment to the power of 2 over P subscript buildings to the power of 2 Q subscript buildings to the power of 1 plus P subscript equipment to the power of 2 Q subscript equipment to the power of 1 close parenthesis times I to the power of 1 equals 0.8308 times 1,050,000 dollars equals 872,340 dollars.

The formula used to calculate real GDP under the chain-weight method is not the sum of the formulas used to calculate the components (as is the case under a fixed-weight calculation). Therefore, the components do not sum to GDP. The formula for real GDP in year 2 is

Equation states, GDP squared equals square root of open parenthesis P subscript a to the power of 1 Q subscript a to the power of 2 plus P subscript O to the power of 1 Q subscript O to the power of 2 plus P subscript b to the power of 1 Q subscript b to the power of 2 plus P subscript e to the power of 1 Q subscript e to the power of 2 over P subscript a to the power of 1 Q subscript a to the power of 1 plus P subscript O to the power of 1 Q subscript O to the power of 1 plus P subscript b to the power of 1 Q subscript b to the power of 1 plus P subscript e to the power of 1 Q subscript e to the power of 1 close parenthesis open parenthesis P subscript a to the power of 2 Q subscript a to the power of 2 plus P subscript O to the power of 2 Q subscript O to the power of 2 plus P subscript b to the power of 2 Q subscript b to the power of 2 plus P subscript e to the power of 2 Q subscript e to the power of 2 over P subscript a to the power of 2 Q subscript a to the power of 1 plus P subscript O to the power of 2 Q subscript O to the power of 1 plus P subscript b to the power of 2 Q subscript b to the power of 1 plus P subscript e to the power of 2 Q subscript e to the power of 1 close parenthesis times GDP to the power of 1 equals 1.0498 times 2,550,000 dollars equals 2,676,990 dollars.

The residual is

Equation states, GDP squared minus open parenthesis C squared plus I squared close parenthesis equals 2,676,990 dollars minus open parenthesis 1,814,850 dollars plus 872,340 dollars close parenthesis equals 2,676,990 dollars minus open parenthesis 2,687,190 dollars close parenthesis equals negative 10,220 dollars.

In Table 2, the residual is larger in earlier years and also exhibits sharper swings between years. Because the residual tends to grow in size and variability as one moves away in time from the year in which the nominal and real series are linked, the chain-weighted GDP and its components are not very useful for comparing the relative shares of different real spending components in years distant from the link date. In gauging the comparative size of spending components, the nominal shares shown in Figure 1 are much more appropriate measures.

## ADDITIONAL CASE STUDY

### 2-5 Revisions to the Canadian System of Macroeconomic Accounts

Annual revisions to the Canadian System of Macroeconomic Accounts are conducted by Statistics Canada as new estimation methods are employed, and as more current information from surveys, censuses, and administrative data are included. These annual revisions usually focus on the most recent estimates of the National Accounts (the last three years).

From time to time, Statistics Canada also conducts more comprehensive revisions of the Canadian System of Macroeconomic Accounts (CSMA). These thorough revisions are necessary to reflect new research, methodologies, changes in international accounting standards, and classification systems, and also to ensure that the Canadian National Accounts are harmonized with the national accounts of other countries for comparison purposes. In the past, these thorough revisions occurred every 10 to 15 years. However, in 2015, Statistics Canada decided that these comprehensive revisions would be made on a more regular basis.

Two factors prompted this important change. First, the CSMA needed to be updated more frequently to reflect rapid changes in the economy, particularly changes in the composition of the economy. For the CSMA to remain a crucial and valid source of information on the current state of the Canadian economy for policymakers, it has to keep up with and reflect important and rapid changes in the economy. Second, it was essential to align the CSMA with new international standards to ensure that the National Accounts could be compared to other countries.

These changes included incorporating natural resource wealth in the national balance sheet, using more detailed estimates of government revenues, outlays, and assets and liabilities, re-estimating the capital stock, reclassifying expenditures on intellectual property as capital investments rather than spending on intermediate goods, and redefining the treatment of defined benefit pension plans. As the economy continues to evolve, ensuring that the CSMA incorporates all these new changes remains an essential priority for Statistics Canada as the System of National Accounts contain vital information for economists and policymakers.

## LECTURE SUPPLEMENT

### 2-6 Seasonal Adjustment and the Seasonal Cycle

Economists use various techniques to describe economic data. One set of techniques involves decomposing data series into constituent subseries that can be added together to give the total series. As an example, economists often separate GDP into a long-run, or *trend*, component and a short-run, or *business cycle*, component.[[6]](#footnote-6) Another decomposition involves removing the seasonal component from economic data. Sophisticated statistical techniques (known as *spectral analysis and filtering*) are used to carry out these decompositions. We can thus take a data series (say, for GDP), detrend it, and then divide it into a seasonal series and a *seasonally adjusted* cyclical series. The overall series for GDP would then be the sum of a long-run trend, a shorter-run cyclical component, and a very short-run seasonal component.[[7]](#footnote-7) Most investigations of business cycles carry out just such a decomposition and focus on the seasonally adjusted cyclical component of different economic data series. The fact that these data series exhibit certain regularities is the primary motivation for the study of business cycles in Part IV of the textbook.

Robert Barsky and Jeffrey A. Miron decided instead to look at the seasonal component of the data for the U.S. economy.[[8]](#footnote-8) Interestingly, they found that the same sort of regularities that are observed in business cycle data also show up in seasonal data. Moreover, they found that seasonal fluctuations are significant in the sense that they account for much of the variation in detrended data. Seasonal fluctuations were found in all major components of U.S. GDP.

All major components of GDP, with the exception of fixed investment, display the same seasonal pattern: a large decline in the first quarter, small declines in the second and third quarters, and a large increase in the fourth quarter. Fixed investment shows declines in the first and fourth quarters and increases in the second and third quarters. An obvious explanation of seasonal variation is weather but, with the exception of the fixed investment series, it is difficult to reconcile seasonal patterns with this explanation. Other key findings are that, just as in business cycle data, money is *procyclical* (that is, money and output movements are positively correlated), as is labour productivity. Similarly, prices exhibit much less variation than quantities in seasonal data, as they do in business cycle data. Sales and production are also correlated at a seasonal as well as a cyclical level.

Barsky and Miron argue that the similarity of seasonal and business cycles suggests that we should look for similar explanations of the two phenomena. Moreover, since many of the forces behind seasonal fluctuations can clearly be anticipated (there is a spending shock as a result of Christmas shopping at the same time every year), the distinction between anticipated and unanticipated shocks may not be as important for the business cycle as some theories suggest.[[9]](#footnote-9) Whereas seasonal and business cycles may be initially generated by different shocks, they may be driven by similar *propagation mechanisms*.[[10]](#footnote-10)

The finding that money is procyclical in seasonal data indicates that the causal relationship runs from output to money and not vice versa (since monetary expansions presumably do not cause Christmas). The view that money may be endogenous at the *cyclical* level is important to real-business-cycle theory. Finally, the seasonal correlation between production and sales raises questions about whether firms use inventories to smooth their production in the face of volatile sales.

## ADDITIONAL CASE STUDY

### 2-7 Measuring the Price of Light

According to William D. Nordhaus, unmeasured changes in quality dramatically overestimate the true rise in the cost of living, as measured by the consumer price index (CPI).[[11]](#footnote-11) Nordhaus uses a simple example of estimating the price of light to illustrate the importance of quality changes and the effect that not accounting for these changes can have on the measurement of inflation. Nordhaus traces the use of artificial light from fire to fat-burning lamps to candles to kerosene lamps to the electric light bulb.

There are two ways to measure the price of light. The first, which Nordhaus refers to as the traditional way, is to measure the price of the good that provides light. Whether that light was provided by a kerosene lamp as in the 1800s or a fluorescent bulb of today is irrelevant. The second method is to measure the price of the service that the light provides. The service provided by light is illumination, which is measured by lumen hours per thousand Btus. As Figure 1 indicates, the traditional price of light has risen sharply between 1800 and today but at a lower rate than overall consumer prices. The price of light has tripled in the last 190 years, while consumer prices have risen tenfold. If, rather than measuring the price of a good that produces light, one measures the price of a lumen hour of light, the results are very different. This “true price” of light has declined precipitously since 1800. The nominal price of 1000 lumen hours of light has declined from $0.40 in 1800 to $0.03 in 1900 to nearly $0.001 in 1992, as shown in Table 1. The real price has fallen even more, from $4.30 in 1800 to $0.43 in 1900 to nearly $0.001 in 1992. Comparing the real price of light as measured by the traditional and true price indexes, Nordhaus states that the traditional price of light overestimates the true price by a factor of 900 over the period 1800–1992, or 3.6 percent per year.

If the overestimation of the price of light is indicative of the overestimation of the prices of other goods that have experienced quality improvements, then the consumer price index is clearly biased upward. Furthermore, if such a bias exists, then our estimates of real wages are also biased. Based on the CPI, real wages of a worker today are 13 times higher than those of a worker in 1800. However, using a quality-adjusted measure of inflation, real wages are anywhere from 58 to 970 times higher today than in 1800. Such estimates, according to Nordhaus, indicate that we have “greatly underestimated quality improvements and real-income growth while overestimating inflation and the growth in prices.”

: A line graph shows the variation of the log-scale values of the CPI and measures of the price of light 1800=100 through the years 1800 to 1992 in log values.
The vertical axis identifies log-scale and the horizontal axis identifies years from 1800 to 1992. The lines represented are CPI, traditional price and true price.
The line representing CPI begins at log 100 in the year 1800 and maintains approximately the same value until the year 1965 and rises to log 200 in the year 1870, it maintains the same value till the year 1920 and increases to about log 500 in the year 1922, the line exponentially decreases and increases through the years 1922 to 1970 where it reaches 600, and thereon increases to log 1000 beyond the year 1992.
The line representing traditional price begins at log 100 in the year 1800, and thereafter follows a similar pattern as of the CPI line. There is a slight decrease in the years 1875 to 1916 where the log value is at 90. The line again follows the same trend as of CPI and changes in the year 1940 where log value is at 80, the line thereafter reaches log 75 in the year 1970 and rises to 300in the year 1992 and remains constant beyond the year 1992.  
The line representing true price begins at log 100 in the year 1800 and rises to log 200 in the year 1842, it drastically falls to log 9 at in the year 1870 and increases back to log 50 in the year 1979, it slopes down to 8 in the year 1914 and thereon steeply drops to 0.3 in the year 1989. It makes a sharp bend to 0.004 beyond the year 1992.
All data in the graph are approximate.


Add comma to 10000 – “10,000”

Table 1 True Price of Light (price per 1000 lumen hours)

Add comma to 1000 – should be 1,000

| **Year** | **Current Price (cents)** | **Real (1992) Price (cents)** |
| --- | --- | --- |
| 1800 | 40.29 | 429.63 |
| 1818 | 40.87 | 430.12 |
| 1827 | 18.63 | 249.99 |
| 1830 | 18.32 | 265.66 |
| 1835 | 40.39 | 596.09 |
| 1840 | 36.94 | 626.77 |
| 1850 | 23.20 | 397.36 |
| 1855 | 29.78 | 460.98 |
| 1860 | 10.96 | 176.51 |
| 1870 | 4.04 | 41.39 |
| 1880 | 5.04 | 65.99 |
| 1883 | 9.23 | 127.79 |
| 1890 | 1.57 | 23.24 |
| 1900 | 2.69 | 42.90 |
| 1910 | 1.38 | 19.55 |
| 1916 | 0.85 | 4.28 |
| 1920 | 0.63 | 4.23 |
| 1930 | 0.51 | 4.10 |
| 1940 | 0.32 | 3.09 |
| 1950 | 0.24 | 1.35 |
| 1960 | 0.21 | 0.94 |
| 1970 | 0.18 | 0.61 |
| 1980 | 0.45 | 0.73 |
| 1990 | 0.60 | 0.63 |
| 1992 | 0.12 | 0.12 |

## LECTURE SUPPLEMENT

### 2-8 Improving the CPI

Over the years, Statistics Canada has made changes to the Consumer Price Index (CPI) in an effort to measure inflation more accurately. Some of these changes address the measurement problems discussed in Chapter 2 of the textbook and are part of an ongoing program at Statistics Canada to improve the CPI.[[12]](#footnote-12) In 2009, Statistics Canada started a five-year $45 million initiative to improve the CPI. The initiative was focused on changes in the sample size and the representative basket, but also on some of the inherent biases associated with computing the CPI such as the substitution bias and the introduction of new goods.

## CPI Enhancement Initiative 2008–2009 to 2012–2013

The CPI reflects changes in prices that Canadians face. It has many uses. Among its most important purposes, the government and the private sector use the CPI to determine changes in the cost of living for Canadians and, hence, it serves as a benchmark to adjust nominal wages, tax brackets, and pensions. The Bank of Canada targets inflation as measured by the CPI between 1 percent and 3 percent. It uses the CPI data published by Statistics Canada to adjust its policy rate to meet its objective of low and stable inflation.

The CPI was introduced in Canada at the beginning of the twentieth century. It has gone through several changes and updates since then. For example, when it was first introduced, the CPI was constructed using around 30 goods observed in a handful of cities across Canada. Today, the CPI is calculated using the price of several thousand goods representing all categories bought by Canadians across the country.

The number of initiatives that Statistics Canada initiated in 2009 led to improvements in the sample size, sample design, basket updates, and quality adjustments. As the size and consumption habits of Canadians change over time, the sample size of some products in the CPI may no longer reflect the spending habits of Canadians. To address this shortcoming, Statistics Canada increased the number of prices that are collected over time from around 60,000 in 2010 to over 100,000 in 2015. Moreover, Statistics Canada has taken a more proactive approach to update the sample of stores and items it surveys on a monthly basis. This has helped ensure that new brands of products and new stores are included in the index more quickly than in the past.

New products often experience rapid declines in prices in the years immediately following their introduction to the marketplace. Because new products traditionally have taken many years to be included in the CPI basket, the decline in prices that are frequently seen was not factored into overall inflation. For example, VCRs, microwave ovens, and personal computers were not included in the index for many years after they first appeared in stores. As a result, inflation was very likely overstated in the past because of the delay in including new goods in the index. As the textbook points out, a greater variety and better quality of products may improve the welfare of consumers; something that the CPI, as currently computed, does not fully account for.

Second, Statistics Canada has adopted a new policy of updating the basket more frequently. Until 2010, the CPI basket was updated every four years. Because of production lags in the collection of data; the weights used in each basket came from the average expenditure pattern of consumers 18 months previous to the year the expenditure data was collected. As a result of this delay, the basket became outdated over time and did not appropriately reflect the most recent spending habits of Canadians. Starting in 2014, the weights in the CPI basket are now updated every two years based on the average expenditure pattern 12 months prior to the year the expenditure data is collected. This update enables the CPI to incorporate more rapid changes in the spending habits of Canadians.

Third, Statistics Canada is developing new methodologies to distinguish between pure price changes and price changes that reflect changes in the quality of products. Some economists believe that mismeasurement of improvements in quality is the single largest source of upward bias in the CPI. However, the quality bias can work both ways as others have pointed out that deterioration in quality may have occurred for some products. In 2014, about 37 percent of the products in the CPI were quality-adjusted. Over time, Statistics Canada has increased coverage to broader categories, such as furniture, electronics, and appliances.

Given the many uses the CPI has for businesses, governments, and policymakers, it is imperative that Statistics Canada continues to improve how changes in the cost of living are measured.

## ADDITIONAL CASE STUDY

### 2-9 The Billion Prices Project

In the United States, the CPI is based on thousands of prices for individual goods and services that are collected each month by workers for the Bureau of Labor Statistics (the U.S. statistical agency responsible for the collection of CPI data) who visit retail stores. Two researchers recently proposed another way to gather price data. MIT economists Alberto Cavallo and Roberto Rigobon use the Internet to track prices charged by 300 online retailers for about 5 million items sold in 70 different countries. They then use these data to compute overall price indexes for the 70 countries.[[13]](#footnote-13)

One problem with this approach is that it only includes goods and not services. One benefit is that the data collection is done automatically and quickly by computer and thus can be performed daily, unlike the CPI, which is produced only monthly. The researchers find that the daily price index for the United States tracks the CPI relatively closely, but this is not the case for all countries. For example, in Argentina the new data have shown inflation to be considerably higher than the official statistics. Some have argued this is evidence that the Argentine government manipulates inflation statistics so it will pay less on inflation-indexed government bonds.

## LECTURE SUPPLEMENT

### 2-10 Alternative Measures of Unemployment

The textbook defines unemployment as the percentage of the labour force unemployed at a particular time. The labour force consists of individuals ages 15 and over who currently have a job (the employed) or do not have a job but are actively seeking work (the unemployed). An individual who does not have a job and is not looking for work is not considered part of the labour force. The unemployment rate that is widely discussed in the press and by policymakers is known as the official unemployment rate. Many economists believe that the official unemployment rate may not give a complete and accurate picture of the labour market in Canada. The official unemployment rate captures only one type of slack in the labour market.

For this reason, Statistics Canada also calculates and publishes seven other supplementary measures of labour underutilization in Canada:

R1: Unemployed one year or more

R2: Unemployed three months or more

R3: Comparable to the United States rate (adjusts the official unemployment rate to make it comparable to the United States)

R4: Official rate

R5: R4 plus discouraged workers (discouraged workers are those who wanted and were available to work, but who did not look because they thought none was available)

R6: R4 plus those waiting for job confirmation (includes those on recall, and those waiting for replies and long-term future starts)

R7: R4 plus involuntary part-timers

R8: R4 plus R5, plus R6, plus a portion of R7

R4 is known as the *official unemployment rate* and corresponds to the definition of the unemployment rate given in the text. R1 and R2 examine a subset of the unemployed as a percentage of the labour force. R1 provides a measure of the long-term unemployed, while R2 concentrates on those who previously held jobs but are now unemployed. R1 typically follows a different pattern as the official rate (R4) whereas R2 tends to track the official rate more closely than R1. R3 adjusts the official unemployment rate to make it directly comparable with the United States since there are differences between how the United States and Canada calculate the unemployment rate.

Figure 1 shows the unemployment rate as measured by R1, R2, R3, and R4 over the period 1976–2018. All of these different measures of unemployment are correlated as they tend to increase during a recession (as in the early1980s, the early 1990s, and during the 2008–2009 financial crisis) and fall when the Canadian economy is doing well.

The remaining four measures of labour underutilization expand the concept of unemployment and the labour force to include those who are not currently searching for work or who are working fewer hours than desired. R6 includes workers who are waiting to be recalled by a previous employer, waiting to hear from an employer, or who have a job lined up that starts in five weeks or more. R7 includes workers who have re-entered the labour force but feel that they do not work enough hours.

As shown in Figure 2, these three measures follow the cyclical pattern of the official unemployment rate (R4), falling during the expansion of the 1990s and most of the 2000s, and rising during the recession of 2008–2009.

A graph shows four oscillating curves each representings Supplementary unemployment rates from the year 1997 to 2018
The horizontal axis represents year and ranges from 1977 to 2017 in intervals of 8 years. The vertical axis represents the rate percent and ranges from 0 percent to 14 percent in increments of 2 percent. The curve R 5 starts from the point (1997, 9.7 percent) rises and falls, extends for further years. The highest peak for R 5 lies at (2009, 8.5 percent), and the lowest peak lies at 6 percent in between the years 2005 to 2009. The curve R 6 starts at the point (1997, 9.8 percent) gradually rises and falls and extends for further years. The highest peak for R 6 lies at (2009, 9 percent), and the lowest peak lies at 6.9 percent in between the years 2005 to 2009. The curve R 7 starts at the point (1997, 12.1 percent) rises and falls and extends for further years. The highest peak for R 7 lies at (2009, 10.9 percent), and the lowest peak lies at 8 percent between the years 2005 to 2009. The curve R 8 starts at the point (1997, 13.1 percent) rises, oscillates and extends for further years. The highest percent for R 8 lies at (2009, 11.6 percent), and the lowest peak lies at 8.8 percent between the years 2005 to 2009. 

*Source: Statistics Canada, Cansim Table 14-10-0077-01*

*A graph shows four oscillating curves each representings official and supplement unemployment rates from the year 1976 to 2018.
The horizontal axis represents year and ranges from 1977 to 2017 in intervals of 8 years. The vertical axis represents the rate percent and ranges from 0 percent to 14 percent in increments of 2 percent. The curve R 1 starts from the point (1976, 0 percent) rises and falls, extends for further years. The highest peak for R 1 lies at (1993, 2 percent), and the lowest peak lies at (1977, 0 percent). The curve R 2 starts at the point (1976, 2.8 percent) gradually rises and falls and extends for further years. The highest peak for R 2 lies at (1983, 6 percent) and (1993, 6 percent), and the lowest peak lies at 1.9 percent in between the years 2001 to 2009. The curve R 3 starts at the point (1976, 7 percent) rises and falls and extends for further years. The highest peak for R 3 lies at (1983, 11 percent), and the lowest peak lies at 5.1 percent between the years 2001 to 2009. The curve R 4 starts at the point (1976, 7 percent) rises, oscillates and extends for further years. The highest percent for R 4 lies at (1983, 12 percent), and the lowest peak lies at 6 percent between the years 2001 to 2009. *

*Source:* Statistics Canada, CANSIM Table 14-10-0077-01**.**

## ADDITIONAL CASE STUDY

### 2-11 Improving the National Accounts

Economists have long been aware that the statistics in the national accounts are imperfect. Some of these imperfections simply have to do with the difficulties of precisely defining and/or measuring the variables that economists care about. Some critics charge, however, that there are *fundamental* problems with the system of national accounts. One set of arguments challenges the presumption that measures of income, such as gross domestic product, tell us anything useful about individuals’ welfare or overall well-being. Another set of arguments holds that the national accounts are dangerously misleading because they fail to take account of the depletion of natural resources and other environmental concerns.

In the late 1960s and early 1970s, a number of commentators questioned the desirability of economic growth—that is, increasing GDP—because they felt that increases in GDP did not reflect increases in welfare.[[14]](#footnote-14) The economists William D. Nordhaus and James Tobin acknowledged this possibility and, in a paper written in 1972, attempted to construct a *measure of economic welfare* (*MEW*) that adjusted for some of the differences between GDP and welfare.[[15]](#footnote-15) Their aim was to construct “a comprehensive measure of the annual real consumption of households,” where consumption “is intended to include all goods and services, marketed or not … and allowance is to be made for negative externalities, such as those due to environmental damage.”[[16]](#footnote-16)

This ambitious new measure thus focused on consumption. It added some components of government expenditures, such as recreation outlays, to private consumption, but not others, such as national defence (termed a “regrettable”). It reclassified some elements of private consumption (such as education and health expenditures and consumption of durables) as investment and subtracted other components, such as personal business expenses. Nordhaus and Tobin also added in an *imputed value* for leisure and other nonmarket uses of time.

The two most important of the many adjustments Nordhaus and Tobin made were the exclusion of regrettables (which they found to be an increasing fraction of GDP) and the imputations for leisure and nonmarket work. The latter correction proved to be sensitive to different assumptions about the effects of technical progress (technical progress allows us to produce more goods per hour; does it also increase our enjoyment of an hour of leisure time?). As a result, Nordhaus and Tobin could not come to a definitive conclusion about whether conventional measures of economic growth understated or overstated growth in welfare. Nevertheless, they were able to conclude that the picture of long-run economic growth conveyed by the national accounts is reasonably accurate; their corrected measures of welfare all indicated long-run growth in economic well-being.

The appropriate treatment in national income accounting of natural resources and other environmental concerns was also addressed by Nordhaus and Tobin and has received increased attention in recent years. The basic idea is that the national accounts should adjust for environmental degradation and for changes in the stocks of natural resources.

In recent work, Charles I. Jones and Peter J. Klenow propose a summary statistic for the welfare of a country’s population. Their measure considers consumption, leisure, life expectancy, and inequality as factors influencing a society’s well-being. Although GDP per capita is highly correlated with their welfare measure, they still find economically important differences. In particular, their measure shows a much larger gap between the richest and poorest countries compared with GDP per capita.[[17]](#footnote-17)

1. More details are contained in the Bank of Canada article, “Measurement Bias in the Canadian Consumer Price Index: An Update,”

   [www.bankofcanada.ca/wp-content/uploads/2012/08/boc-review-summer12-sabourin.pdf](https://www.bankofcanada.ca/wp-content/uploads/2012/08/boc-review-summer12-sabourin.pdf) [↑](#footnote-ref-1)
2. For additional discussion, see the “Report by the Commission on the Measurement of Economic Performance and Social Progress” by Joseph E. Stiglitz, Amartya Sen, and Jean-Paul Fitoussi. The reports can be downloaded at: <https://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report> [↑](#footnote-ref-2)
3. Arthur M. Okun, “Potential GNP: Its Measurement and Significance,” in *Proceedings of the Business and Economics Statistics Section*, American Statistical Association (Washington, DC: American Statistical Association, 1962), pp. 98–103; reprinted in Arthur M. Okun, *Economics for Policymaking* (Cambridge, MA: MIT Press, 1983), pp. 145–158. [↑](#footnote-ref-3)
4. J. Steven Landefeld and Robert P. Parker, “Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA’s New Featured Measures of Output and Prices,” *Survey of Current Business*, July 1995. [↑](#footnote-ref-4)
5. Historical revisions to the GDP data, however, may still occur because new sources of information often become available only after initial estimates of GDP are constructed (sometimes after several years) and because new statistical methods for measuring and estimating the components of GDP may be developed. [↑](#footnote-ref-5)
6. There are, in turn, a number of different ways to detrend data. See Supplement 10-2, “Understanding Business Cycles I: The Stylized Facts,” for related discussion. [↑](#footnote-ref-6)
7. In the terminology of spectral analysis, these are referred to as different frequencies. Roughly speaking, short-run fluctuations occur at high frequencies, and long-run fluctuations occur at low frequencies. [↑](#footnote-ref-7)
8. Robert Barsky and Jeffrey A. Miron, “The Seasonal Cycle and the Business Cycle,” *Journal of Political Economy* 97 (June 1989): 503–34. [↑](#footnote-ref-8)
9. See, in particular, the models of aggregate supply in Chapter 14 and Supplement 14-4, “Anticipated and Unanticipated Money.” [↑](#footnote-ref-9)
10. See Supplement 10-8, “Understanding Business Cycles II: Modeling Cycles.” [↑](#footnote-ref-10)
11. William D. Nordhaus, “Do Real Output and Real Wage Measures Capture Reality? The History of Lighting Suggests Not,” *Cowles Foundation Discussion Paper no. 1078* (September 1994). [↑](#footnote-ref-11)
12. For further detail on the changes discussed in this supplement, see, “The Consumer Price Index and the CPI Enhancement Initiative 2008–2009 to 2012–2013,” Statistics Canada, www.statcan.gc.ca/eng/about/er/cpi. [↑](#footnote-ref-12)
13. See [http://bpp.mit.edu](http://bpp.mit.edu/) for more details. [↑](#footnote-ref-13)
14. See, for example, Tibor Scitovsky, *The Joyless Economy* (Oxford: Oxford University Press, 1976) and Ezra J. Mishan, *The Costs of Economic Growth* (Harmondsworth: Penguin, 1969). A recent observation along these lines, concerning the economic reforms in the Soviet Union, is the following: “Remember, even though it won’t show up positively on the national statistics, a 10 percent reduction in tanks accompanied by a 5 percent increase in making goods that people want is a real gain for society.” (Editorial, *Manchester Guardian Weekly*, July 21, 1991.) [↑](#footnote-ref-14)
15. William D. Nordhaus and James Tobin, “Is Growth Obsolete?” *Economic Growth: Fiftieth Anniversary Colloquium V*, National Bureau of Economic Research (New York: Columbia University Press, 1972), reprinted in James Tobin, *Essays in Economics: Theory and Policy* (Cambridge, MA: MIT Press, 1985), 360–439. [↑](#footnote-ref-15)
16. Ibid., 383. [↑](#footnote-ref-16)
17. Charles I. Jones and Peter J. Klenow, “Beyond GDP? Welfare across Countries and Time,” *American Economic Review 2016, 106(9)*, pp. 2426–2457*.* [↑](#footnote-ref-17)