CHAPTER 2 The Data of Macroeconomics

Questions for Review

1. GDP measures the total income earned from the production of the new final goods and services in the economy, and it measures the total expenditures on the new final goods and services produced in the economy. GDP can measure two things at once because the total expenditures on the new final goods and services by the buyers must be equal to the income earned by the sellers of the new final goods and services. As the circular flow diagram in the text illustrates, these are alternative, equivalent ways of measuring the flow of dollars in the economy.
2. The consumer price index measures the overall level of prices in the economy. It tells us the price of a fixed basket of goods relative to the price of the same basket in the base year.
3. Statistics Canada classifies each person into one of the following three categories: employed, unemployed, or not in the labour force. The unemployment rate, which is the percentage of the labour force that is unemployed, is computed as follows:

$$\text{Unemployment Rate} = \frac{\text{Number of Unemployed}}{\text{Labor Force}} \times 100.$$

   Note that the labour force is the number of people employed plus the number of people unemployed.

4. Every month, Statistics Canada undertakes two surveys to measure employment. First, Statistics Canada surveys about 56,000 households (about 100,000 individuals in total) and thereby obtains an estimate of the share of people who say they are working. Statistics Canada multiplies this share by an estimate of the population to estimate the number of people working. The second survey that Statistics Canada conducts every month is the Survey of Employment, Payrolls and Hours (SEPH). Statistics Canada surveys about 15,000 business establishments and asks how many people they employ. Each survey is imperfect; so, the two measures of employment are not identical.

Problems and Applications

1. A large number of economic statistics are released regularly. These include the following:

   Gross Domestic Product—the market value of all final goods and services produced in a year.

   The Unemployment Rate—the percentage of the civilian labour force who do not have a job.

   Corporate Profits—the income of corporations after payments to workers and creditors. It gives an indication of the general financial health of the corporate sector.

   The Consumer Price Index (CPI)—a measure of the average price that consumers pay for the goods they buy; changes in the CPI are a measure of inflation.

   The Trade Balance—the difference between the value of goods exported abroad and the value of goods imported from abroad.

   In looking at the economic statistics, most people want to see a low and stable inflation rate around the target of the Bank of Canada of 1–3 percent, a low and stable unemployment rate of about 5-6 percent, and GDP growth in the 2–3-percent range. This indicates the economy is "healthy" and performing at its long-run average level. Looking at the economic statistics released in early 2017, the unemployment rate in Canada is stable at around 7 percent, the inflation rate was around 1.5

percent, and GDP growth in the third quarter of 2016 was – 3.5 percent. Canada is still recovering from the oil price shock that the country experienced in the middle of 2014.

2. Value added by each person is the value of the good produced minus the amount the person paid for the materials needed to make the good. Therefore, the value added by the farmer is $1.00 ($1 - 0 = $1). The value added by the miller is $2: she sells the flour to the baker for $3 but paid $1 for the flour. The value added by the baker is $3: she sells the bread to the engineer for $6 but paid the miller $3 for the flour. GDP is the total value added, or $1 + $2 + $3 = $6. Note that GDP equals the value of the final good (the bread).
3. When a woman marries her butler, GDP falls by the amount of the butler's salary. This happens because measured total income, and therefore measured GDP, falls by the amount of the butler's loss in salary. If GDP truly measured the value of all goods and services, then the marriage would not affect GDP since the total amount of economic activity is unchanged. Actual GDP, however, is an imperfect measure of economic activity because the value of some goods and services is left out. Once the butler's work becomes part of his household chores, his services are no longer counted in GDP. As this example illustrates, GDP does not include the value of any output produced in the home. Similarly, GDP does not include other goods and services, such as the imputed rent on durable goods (e.g., cars and refrigerators) and any illegal trade.
4. a. The airplane sold to the Royal Canadian Air Force counts as government purchases because the Air Force is part of the government.
   b. The airplane sold to Air Canada counts as investment because it is a capital good sold to a private firm.
   c. The airplane sold to Air France counts as an export because it is sold to a foreigner.
   d. The airplane sold to Amelia Earhart counts as consumption because it is sold to a private individual.
   e. The airplane built to be sold next year counts as investment. In particular, the airplane is counted as inventory investment, which is where goods that are produced in one year and sold in another year are counted.
5. Data on parts (a) to (e) can be downloaded from Cansim, Statistics Canada (http://www5.statcan.gc.ca/cansim/home-accueil?lang=eng) click on language preference and type Gross Domestic Product in the search box and select Table 380-0106). The data runs from 1981 to 2015. By dividing each component (a) to (e) by GDP at market price (2007 constant dollars) and multiplying by 100, we obtain the following percentages:

	1981	2000	2015
a. Household final consumption expt	49.9%	48.9%	57.4%
b. Gross fixed capital formation	17.9%	18.8%	22.6%
c. Government consumption purchases	25.5%	19.4%	19.6%
d. Net exports	2.8%	9.4%	–1.1%
e. Imports	14.2%	28.7%	33.5%

(Note: These data were downloaded on February 2, 2017 from Statistics Canada)

Among other things, we observe the following trends in the economy over the period 1981–2015:

(a) Household final consumption expenditures was around 50% of GDP in 1981 and 2000 and increased significantly to 57.5% in 2015.

(b) The share of GDP going to gross fixed capital formation increased from 1981 to 2015.

(c) The share going to government consumption purchases fell sharply from 1981 to 2015 from 25.5% to about 19.6% .

(d) Net exports, which were positive in 1981 and 2000 and became negative in 2015.

(e) Imports have grown rapidly relative to GDP from 14.2% in 1981 to 33.5% in 2015.

6. a. i. Nominal GDP is the total value of goods and services measured at current prices. Therefore,

$$\begin{aligned}
\text{Nominal GDP}_{2000} &= (P^{2000}_{\text{cars}} \times Q^{2000}_{\text{cars}}) + (P^{2000}_{\text{bread}} \times Q^{2000}_{\text{bread}}) \\
&= (\$50,000 \times 100) + (\$10 \times 500,000) \\
&= \$5,000,000 \ + \ \$5,000,000 \\
&= \$10,000,000. \\
\text{Nominal GDP}_{2010} &= (P^{2010}_{\text{cars}} \times Q^{2010}_{\text{cars}}) + (P^{2010}_{\text{bread}} \times Q^{2010}_{\text{bread}}) \\
&= (\$60,000 \times 120) + (\$20 \times 400,000) \\
&= \$7,200,000 + \$8,000,000 \\
&= \$15,200,000.
\end{aligned}$$

ii. Real GDP is the total value of goods and services measured at constant prices. Therefore, to calculate real GDP in 2010 (with base year 2000), multiply the quantities purchased in the year 2010 by the 2000 prices:

$$\begin{aligned}
\text{Real GDP}_{2010} &= (P^{2000}_{\text{cars}} \times Q^{2010}_{\text{cars}}) + (P^{2000}_{\text{bread}} \times Q^{2010}_{\text{bread}}) \\
&= (\$50,000 \times 120) + (\$10 \times 400,000) \\
&= \$6,000,000 + \$4,000,000 \\
&= \$10,000,000.
\end{aligned}$$

Real GDP for 2000 is calculated by multiplying the quantities in 2000 by the prices in 2000. Since the base year is 2000, real GDP_{2000} equals nominal GDP_{2000}, which is \$10,000,000. Hence, real GDP stayed the same between 2000 and 2010.

iii. The implicit price deflator for GDP compares the current prices of all goods and services produced to the prices of the same goods and services in a base year. It is calculated as follows:

$$\text{Implicit Price Deflator}_{2010} = \frac{\text{Nominal GDP}_{2010}}{\text{Real GDP}_{2010}}.$$

Using the values for Nominal GDP_{2010} and real GDP_{2010} calculated above:

$$\begin{aligned}\text{Implicit Price Deflator}_{2010} &= \frac{\$15,200,000}{\$10,000,000} \\ &= 1.52.\end{aligned}$$

This calculation reveals that prices of the goods produced in the year 2010 increased by 52 percent compared to the prices that the goods in the economy sold for in 2000. (Because 2000 is the base year, the value for the implicit price deflator for the year 2000 is 1.0 because nominal and real GDP are the same for the base year.)

iv. The consumer price index (CPI) measures the level of prices in the economy. The CPI is called a fixed-weight index because it uses a fixed basket of goods over time to weight prices. If the base year is 2000, the CPI in 2010 is an average of prices in 2010, but weighted by the composition of goods produced in 2000. The CPI_{2010} is calculated as follows:

$$\begin{aligned}\text{CPI}_{2010} &= \frac{(P_{\text{cars}}^{2010} \times Q_{\text{cars}}^{2000}) + (P_{\text{bread}}^{2010} \times Q_{\text{bread}}^{2010})}{(P_{\text{cars}}^{2000} \times Q_{\text{cars}}^{2000}) + (P_{\text{bread}}^{2000} \times Q_{\text{bread}}^{2000})} \\ &= \frac{(\$60,000 \times 100) + (\$20 \times 500,000)}{(\$50,000 \times 100) + (\$10 \times 500,000)} \\ &= \frac{\$16,000,000}{\$10,000,000} \\ &= 1.6.\end{aligned}$$

This calculation shows that the price of goods purchased in 2010 increased by 60 percent compared to the prices these goods would have sold for in 2000. The CPI for 2000, the base year, equals 1.0.

b. The implicit price deflator is a Paasche index because it is computed with a changing basket of goods; the CPI is a Laspeyres index because it is computed with a fixed basket of goods. From (6.a.iii), the implicit price deflator for the year 2010 is 1.52, which indicates that prices rose by 52 percent from what they were in the year 2000. From (6.a.iv.), the CPI for the year 2010 is 1.6, which indicates that prices rose by 60 percent from what they were in the year 2000.

If prices of all goods rose by, say, 50 percent, then one could say unambiguously that the price level rose by 50 percent. Yet, in our example, relative prices have changed. The price of

cars rose by 20 percent; the price of bread rose by 100 percent, making bread relatively more expensive.

As the discrepancy between the CPI and the implicit price deflator illustrates, the change in the price level depends on how the goods' prices are weighted. The CPI weights the price of goods by the quantities purchased in the year 2000. The implicit price deflator weights the price of goods by the quantities purchased in the year 2010. The quantity of bread consumed was higher in 2000 than in 2010, so the CPI places a higher weight on bread. Since the price of bread increased relatively more than the price of cars, the CPI shows a larger increase in the price level.

c. There is no clear-cut answer to this question. Ideally, one wants a measure of the price level that accurately captures the cost of living. As a good becomes relatively more expensive, people buy less of it and more of other goods. In this example, consumers bought less bread and more cars. An index with fixed weights, such as the CPI, overestimates the change in the cost of living because it does not take into account that people can substitute less expensive goods for the ones that become more expensive. On the other hand, an index with changing weights, such as the GDP deflator, underestimates the change in the cost of living because it does not take into account that these induced substitutions make people less well off.

7. a. The consumer price index uses the consumption bundle in year 1 to figure out how much weight to put on the price of a given good:

$$\begin{aligned} \text{CPI}^2 &= \frac{(P^2_{\text{red}} \times Q^1_{\text{red}}) + (P^2_{\text{green}} \times Q^1_{\text{green}})}{(P^1_{\text{red}} \times Q^1_{\text{red}}) + (P^1_{\text{green}} \times Q^1_{\text{green}})} \\ &= \frac{(\$2 \times 10) + (\$1 \times 0)}{(\$1 \times 10) + (\$2 \times 0)} \\ &= 2. \end{aligned}$$

According to the CPI, prices have doubled.

b. Nominal spending is the total value of output produced in each year. In year 1 and year 2, Abby buys 10 apples for \$1 each, so her nominal spending remains constant at \$10. For example,

$$\begin{aligned} \text{Nominal Spending}_2 &= (P^2_{\text{red}} \times Q^2_{\text{red}}) + (P^2_{\text{green}} \times Q^2_{\text{green}}) \\ &= (\$2 \times 0) + (\$1 \times 10) \\ &= \$10. \end{aligned}$$

c. Real spending is the total value of output produced in each year valued at the prices prevailing in year 1. In year 1, the base year, her real spending equals her nominal spending of \$10. In year 2, she consumes 10 green apples that are each valued at their year 1 price of \$2, so her real spending is \$20. That is,

$$\begin{aligned}\text{Real Spending}_2 &= (P^1_{\text{red}} \times Q^2_{\text{red}}) + (P^1_{\text{green}} \times Q^2_{\text{green}}) \\ &= (\$1 \times 0) + (\$2 \times 10) \\ &= \$20.\end{aligned}$$

Hence, Abby's real spending rises from \$10 to \$20.

d. The implicit price deflator is calculated by dividing Abby's nominal spending in year 2 by her real spending that year:

$$\begin{aligned}\text{Implicit Price Deflator}_2 &= \frac{\text{Nominal Spending}_2}{\text{Real Spending}_2} \\ &= \frac{\$10}{\$20} \\ &= 0.5.\end{aligned}$$

Thus, the implicit price deflator suggests that prices have fallen by half. The reason for this is that the deflator estimates how much Abby values her apples using prices prevailing in year 1. From this perspective, green apples appear very valuable. In year 2, when Abby consumes 10 green apples, it appears that her consumption has increased because the deflator values green apples more highly than red apples. The only way she could still be spending \$10 on a higher consumption bundle is if the price of the good she was consuming fell.

e. If Abby thinks of red apples and green apples as perfect substitutes, then the cost of living in this economy has not changed—in either year it costs \$10 to consume 10 apples. According to the CPI, however, the cost of living has doubled. This is because the CPI only takes into account the fact that the red apple price has doubled; the CPI ignores the fall in the price of green apples because they were not in the consumption bundle in year 1. In contrast to the CPI, the implicit price deflator estimates the cost of living has been cut in half. Thus, the CPI, a Laspeyres index, overstates the increase in the cost of living and the deflator, a Paasche index, understates it.

8. a. Real GDP falls because Canada's Wonderland does not produce any services while it is closed. This corresponds to a decrease in economic well-being because the income of workers and shareholders of Canada's Wonderland falls (the income side of the national accounts), and people's consumption of Canada's Wonderland falls (the expenditure side of the national accounts).

b. Real GDP rises because the original capital and labour in farm production now produce more wheat. This corresponds to an increase in the economic well-being of society, since people can now consume more wheat. (If people do not want to consume more wheat, then farmers and farmland can be shifted to producing other goods that society values.)

c. Real GDP falls because with fewer workers on the job, firms produce less. This accurately reflects a fall in economic well-being.

d. Real GDP falls because the firms that lay off workers produce less. This decreases economic well-being because workers' incomes fall (the income side), and there are fewer goods for people to buy (the expenditure side).

e. Real GDP is likely to fall, as firms shift toward production methods that produce fewer goods but emit less pollution. Economic well-being, however, may rise. The economy now produces less measured output but more clean air; clean air is not traded in markets and, thus, does not show up in measured GDP, but is nevertheless a good that people value.

f. Real GDP rises because the high-school students go from an activity in which they are not producing market goods and services to one in which they are. Economic well-being, however, may decrease. In ideal national accounts, attending school would show up as investment because it presumably increases the future productivity of the worker. Actual national accounts do not measure this type of investment. Note also that future GDP may be lower than it would be if the students stayed in school, since the future work force will be less educated.

g. Measured real GDP falls because fathers spend less time producing market goods and services. The actual production of goods and services need not have fallen, however. Measured production (what the fathers are paid to do) falls, but unmeasured production of child-rearing services rises.

9. As Senator Robert Kennedy pointed out, GDP is an imperfect measure of economic performance or well-being. In addition to the left-out items that Kennedy cited, GDP also ignores the imputed rent on durable goods such as cars, refrigerators, and lawnmowers; many services and products produced as part of household activity, such as cooking and cleaning; and the value of goods produced and sold in illegal activities, such as the drug trade. These imperfections in the measurement of GDP do not necessarily reduce its usefulness. As long as these measurement problems stay constant over time, then GDP is useful in comparing economic activity from year to year. Moreover, a large GDP allows us to afford better medical care for our children, newer books for their education, and more toys for their play. Finally, countries with higher levels of GDP tend to have higher levels of life expectancy, better access to clean water and sanitation, and higher levels of education. GDP is therefore a useful measure for comparing the level of growth and development across countries.

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 principles and 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 Web Site

The discussion of economic data can be made more interesting by encouraging students to use the data plotter and look at the series being discussed. In using the software, the students should be encouraged to look at the data early to try to familiarize themselves with the basic stylized facts. The transform data option on the plotter can be used to help the students gain an understanding of growth rates and percentage changes and to show them the distinction between real and nominal GDP.

Use of the Dismal Scientist Web Site

Use the Dismal Scientist Web site to download data for the past 40 years on nominal GDP and the components of spending (consumption, investment, government purchases, exports, and imports). 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 Since 1929
2-3 Chain-Weighted Real GDP
2-4 GDP and its components (Case Study)
2-5 Seasonal Adjustment (Case Study)
2-6 Measuring the Price of Light

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

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*.

➢ Figure 2-1

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.

➢ Supplement 2-1, "Measuring Output"

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.

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.

➢ Figure 2-2

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 any 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 final 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 to real GDP:

$$\text{GDP Deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}}$$

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 prices used a fixed base year for prices to compute real GDP. 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, availability and other reason. Sine 2001, Statistics Canada has changed its approach to indexing GDP. Instead of using a fixed base year for prices, Statistics Canada began using a moving base year. Previously, Statistics Canada used prices in a given year— 1997—to measure the value of goods produced in all years. Now, to measure the change in real GDP from, say, 2014 to 2015, Statistics Canada uses the prices in both 2014 and 2015. More precisely, the average prices in 2014 and 2015 is used to measure the real growth rare from 2014 t 2015. To measure the change in real GDP from 2015 to 2016, the average price in 2015 and 2016 is used. In this case, 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, to compare output between any two dates. The

Chain-weighted index is better than the old way of computing real GDP as the prices used are not outdated.

FYI: Two Arithmetic Tricks for Working with Percentage Changes

➢ Supplement 8-5, "Two Arithmetic Tricks for Working with Percentage Changes.."

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, DVD players, automobiles, and the like. Food, clothing, and other goods that last for short periods of time are classified as nondurable goods, whereas automobiles, DVD players, 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 doctor visits, 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, state, and local). It includes, most notably, defence expenditures, as well as spending on highways, bridges, 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* unemployment insurance payments, Social Security 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 3-5, "Economists' Terminology"

Economists use the term "investment" in a very precise sense. To the 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

➢ Table 2-1

For the year 2012, Canada's GDP equalled about $1.658 trillion, or about $47,500 per person. Approximately 57.5 percent of GDP was spent on consumption (about $923 billion). Investment

➢ Supplement 2-5, "Defining National Income"

was about 23.7 percent of GDP (about $393 billion), while government purchases were nearly 23.3 percent of GDP (about 387 trillion). Imports exceeded exports by $545 billion.

Other Measures of Income

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 U.S. 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*). The capital consumption allowance equalled about 16 percent of GNP in 2013. 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, 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.

➢ Supplement 2-6, "Seasonal Adjustment and the Seasonal Cycle"

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.

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

➢ Figure 2-3

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

$$\text{CPI} = \frac{\text{Current Price of Base-Year Basket of Goods}}{\text{Base-Year Price of Base-Year Basket of Goods}}$$

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

The CPI versus the GDP Deflator

The GDP deflator is a measure of the price of all goods produced in the United States 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 Stealth bombers. It does include the prices of imported goods that

➢ Supplement 2-4, "The Components of GDP"

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?

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 two 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.

A panel of economists recently studied the problem and concluded the CPI overstates inflation by about 1.1 percentage points per year. Statistics Canada has since made further changes in the way the CPI is calculated so that the bias is now believed to be less than 0.5 percentage point.

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 of about 56,000 households that Statistics Canada performs each month. The survey provides estimates of the number of people in the adult population (15 years and older) who are classified as either employed, unemployed, or not in the labour force:

$$POP = E + U + NL,$$

➢ Figure 2-4

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:

$$\text{Labour-Force Participation Rate} = L/POP.$$

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

$$e = E/L$$
$$u = U/L = 1 - e.$$

➢ Supplement 2-11, "Alternative Measures of Unemployment"

Case Study: Trends in Labour-Force Participation

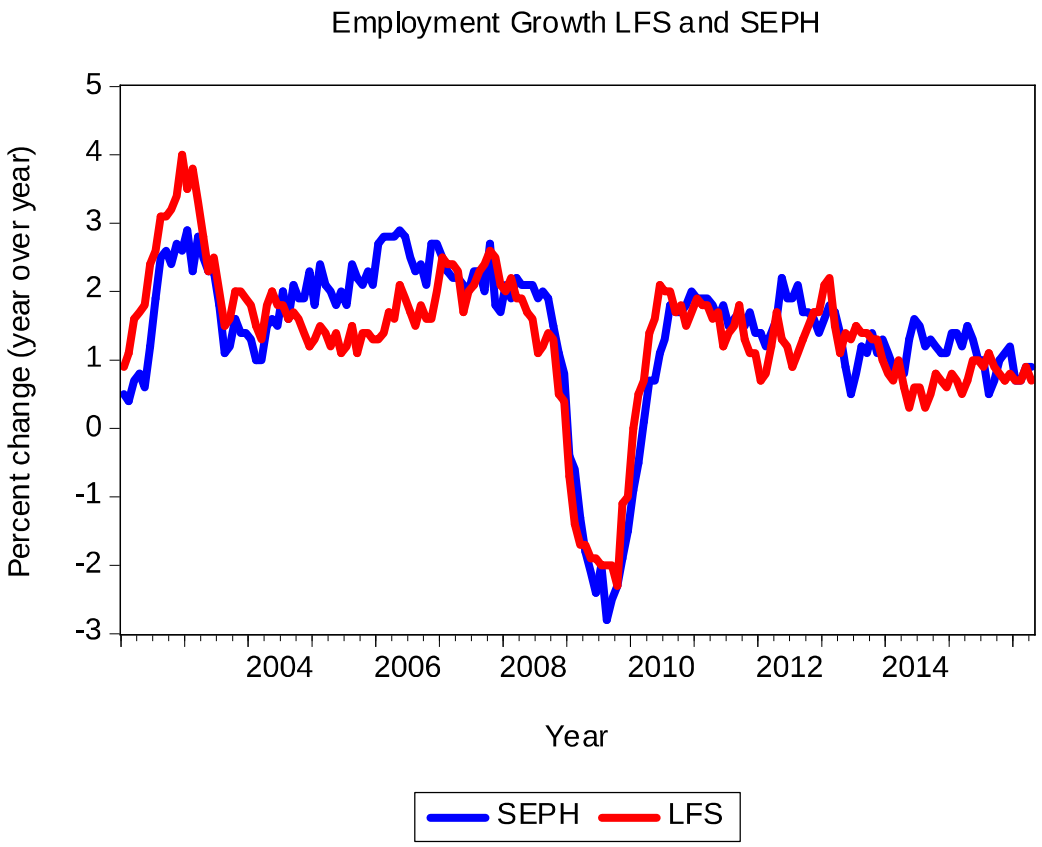
➢ Supplement 7-6, "Labour Force Participation"

The Canadian labour market has seen remarkable changes since the end of World War II. For example, the labour-force participation among women rose sharply, from 24 percent in 1953 to 76 percent in 1990, while among men it has declined from 96 percent to 93 percent during the same period. Many factors have contributed to the increase in women's participation, including new technologies such as clothes-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 work force. 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 greater prevalence of stay-at-home fathers.

For the most recent decade, the labour-force participation rate has declined for both men and women. 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 coming decades as the elderly share of the population continues to rise.

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). The Survey of Employment, Payrolls and Hours provides rich information about earnings, as well as the number of jobs and hour worked by industry at the national, provincial and territorial levels. The SEPH covers about 15,000 businesses that have at least one employee. Therefore, a self-employed person would be reported as working in the Labour Force Survey but would not be counted in the SEPH. Moreover, the Labour Force Survey does not count separate jobs but only reports if a person is working, whereas the SEPH counts every job. The SEPH is similar to the Establishment survey in the U.S. The employment growth rate as measured by the LFS and the SEPH do not differ very much. This is shown in the Figure below which shows employment growth from 2002 to 2016.



Unemployment, GDP and Okun's Law

➢ Figure 2-5

Okun's law relates the growth rate of output to the change in the unemployment rate.1 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 2 percentage points. The opposite holds for a fall in the unemployment rate, which is associated with a rise in economic growth above potential.
Okun's law is given by

$$\text{Change in the unemployment rate} = -0.5 \times \text{Change in real GDP} + 2$$

Okun's law implies that for every 1 percent change in real GDP, there is a half-percent change in the unemployment.

[1] 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.

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 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.

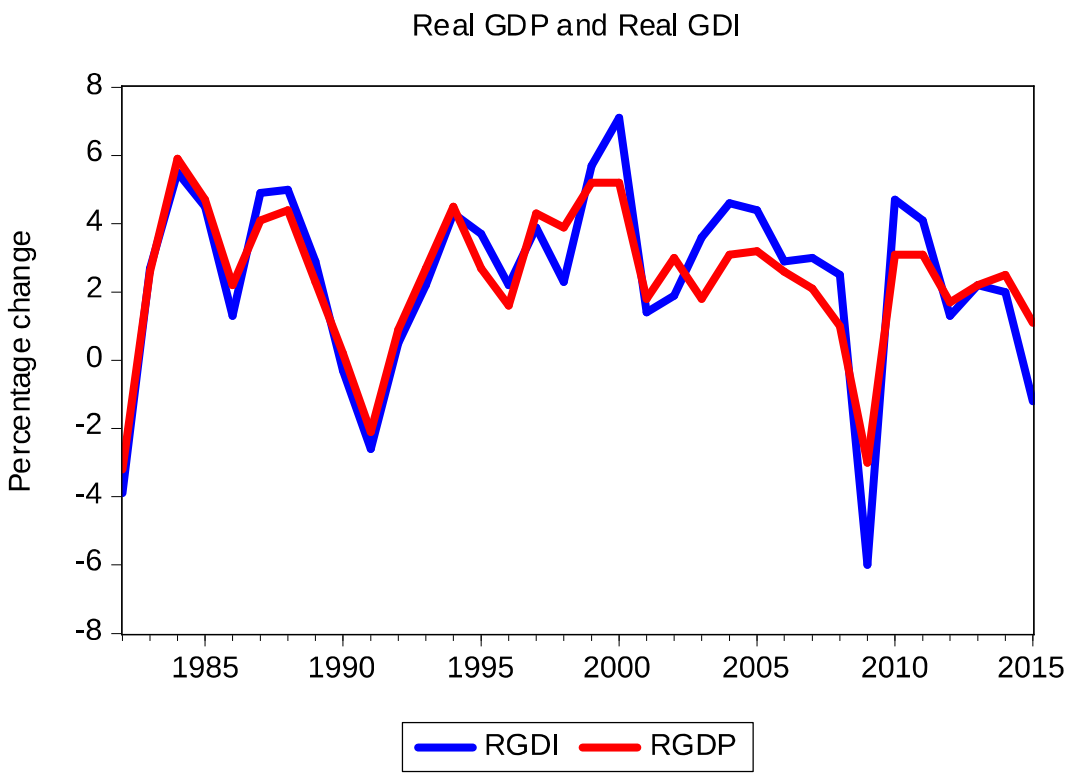
Since 1995, however, the statistical discrepancy became unusually persistent, even after revisions to historical data. Over the period 2000-2005, the economy grew 2.9 percent per year when measured using real GDP compared with 3.7 percent per year when measured using real GDI. Figure 1 shows annual average growth rates over successive five-year periods since 1982. As the figure illustrates, the difference in growth rates from the two measures has typically averaged close to zero.

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.[1] 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 for the late 1990s, despite several major revisions, has continued to be puzzling.

Figure 1 Comparing Measures of Economic Growth

[1] For additional discussion, see *The Economic Report of the President, 1997,* U.S. Government Printing Office, Washington, pp. 72–74. The *Report* argues that from its vantage point back in 1997, Okun's law seemed to fit better using GDI growth rather than GDP growth. Subsequent revisions and more data seem to have reversed this finding, as documented below.



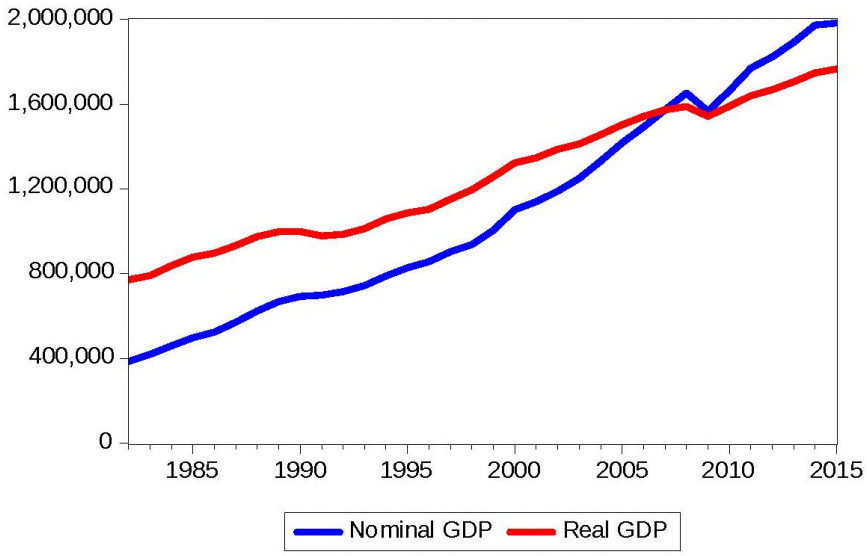
Source: Statistics Canada. Table 380-0101 - Gross national income and gross domestic income, annual (percent unless otherwise noted)

Note: Data are average annual percentage change over previous five years.

2-2 Canada Nominal and Real GDP Since 1982

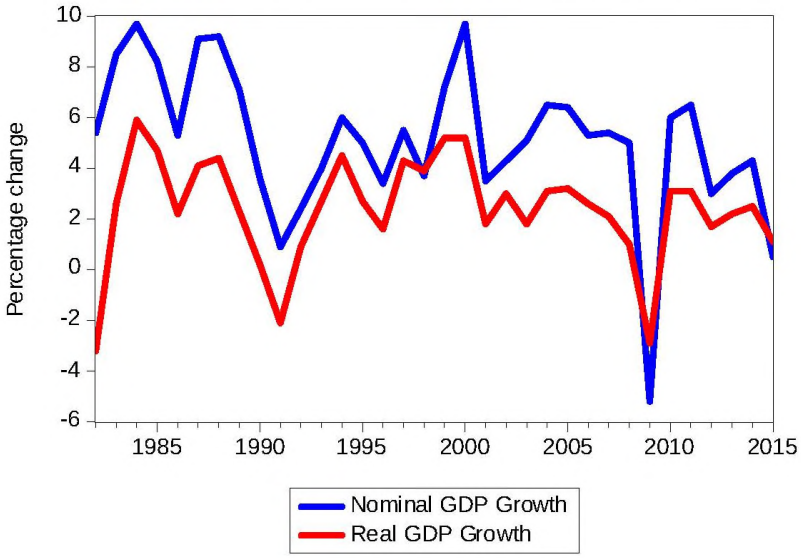
Figure 1 shows Canadian real GDP and nominal GDP between 1982 and 2015. Because real GDP is measured in chained 2007 dollars, the two series intersect in 2007. Figure 2 examines the annual percentage change in nominal and real GDP. Table 1 provides annual data for GDP and the GDP price index over the 1982–2015 period

Figure 1: Canada Real and Nominal GDP, 1982-2015 (million of dollars)



Source: Statistics Canada, Cansim Table 380-0064.

Figure 2: Canada Real and nominal GDP growth, 1982-2015



Source: Statistics Canada, Cansim Table 380-0102.

Table 1 Canada GDP: 1982–2015

	Levels			Growth Rates		
Year	Nominal GDP (millions of current dollars)	Real GDP (billions of chained 2007 dollars)	GDP Price Index (2007 = 100)	Nominal GDP (percent)	Real GDP (percent)	GDP Price Index (percent)
1982	386773	771385	46.1	-3.2	5.4	8.7
1983	419691	791430	50.1	2.6	8.5	5.8
1984	460243	838325	53	5.9	9.7	3.6
1985	498075	878012	54.9	4.7	8.2	3.3
1986	524450	896993	56.7	2.2	5.3	3.2
1987	571926	933738	58.5	4.1	9.1	4.8
1988	624401	975097	61.3	4.4	9.2	4.4
1989	669026	997758	64	2.3	7.1	4.8
1990	692997	999298	67.1	0.2	3.6	3.3
1991	699253	978056	69.3	-2.1	0.9	3.2
1992	716019	986692	71.5	0.9	2.4	1.5
1993	744608	1012891	72.6	2.7	4	1.2
1994	789507	1058405	73.5	4.5	6	1.5
1995	828973	1086746	74.6	2.7	5	2.3
1996	857023	1104254	76.3	1.6	3.4	1.7
1997	903902	1151514	77.6	4.3	5.5	1.2
1998	937295	1196213	78.5	3.9	3.7	-0.1
1999	1004456	1257976	78.4	5.2	7.2	1.8
2000	1102380	1323173	79.8	5.2	9.7	4.4
2001	1140505	1346604	83.3	1.8	3.5	1.7
2002	1189452	1387137	84.7	3	4.3	1.2
2003	1250315	1412137	85.7	1.8	5.1	3.3
2004	1331178	1455715	88.5	3.1	6.5	3.3
2005	1417028	1502318	91.4	3.2	6.4	3.2
2006	1492207	1541730	94.3	2.6	5.3	2.7
2007	1573532	1573532	96.8	2.1	5.4	3.3
2008	1652923	1589273	100	1	5	4
2009	1567365	1542396	104	-2.9	-5.2	-2.3
2010	1662130	1589956	101.6	3.1	6	2.9
2011	1769921	1639900	104.5	3.1	6.5	3.3
2012	1822808	1668524	107.9	1.7	3	1.2
2013	1892193	1705532	109.2	2.2	3.8	1.6
2014	1973043	1747709	110.9	2.5	4.3	1.8
2015	1983288	1766554	112.9	1.1	0.5	-0.5

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 has declined sharply over the years. If each computer sold in 2015 were valued at its 1987 price, real GDP would be biased upward. Likewise, if each computer sold in 1987 were valued at its 2015 price, real GDP in 1987 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 two 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 mismeasurement for recent years, Statistics Canada changed the base year was every five to ten 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 measurement 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.[2]

To understand the difference between fixed-weight growth rates and chain-weight 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 rises.

[2] 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.

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

$$\left(\frac{P_B^A Q_t^A + P_B^O Q_t^O}{P_B^A Q_{t-1}^A + P_B^O Q_{t-1}^O} - 1 \right) + 100,$$

where the superscript A refers to apples, the superscript O refers to oranges and the subscript B is the base year. Columns 2–6 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:

$$\left(\sqrt{\left(\frac{P_t^A Q_t^A + P_t^O Q_t^O}{P_t^A Q_{t-1}^A + P_t^O Q_{t-1}^O} \times \frac{P_{t-1}^A Q_t^A + P_{t-1}^O Q_t^O}{P_{t-1}^A Q_{t-1}^A + P_{t-1}^O Q_{t-1}^O} \right)} - 1 \right) \times 100 .$$

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-weight method.

Table 2 Growth Rate of Real Output Using 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

$$\text{RGDP}_t = \left(1 + \text{Growth}_t\right) \times \text{RGDP}_{t-1}$$

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:

$$\left(\sqrt{\left(\frac{P_t^A Q_t^A + P_t^O Q_t^O}{P_{t-1}^A Q_t^A + P_{t-1}^O Q_t^O} \times \frac{P_t^A Q_{t-1}^A + P_t^O Q_{t-1}^O}{P_{t-1}^A Q_{t-1}^A + P_{t-1}^O Q_{t-1}^O} \right)} - 1 \right) \times 100$$

The equation used to calculate the price index itself is:

$$\text{Price Index}_t = (1 + \text{Inflation Rate}_t) \times \text{Price Index}_{t-1}$$

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:

$$(1 + \text{Inflation Rate}_t) = (1 + \text{Growth Nominal GDP}_t)/(1 + \text{Growth}_t).$$

And, if one chooses a year in which to set real 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:

$$\text{Price Index}_t = \text{Nominal GDP}_t/\text{Chain-Weighted GDP}_t.$$

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

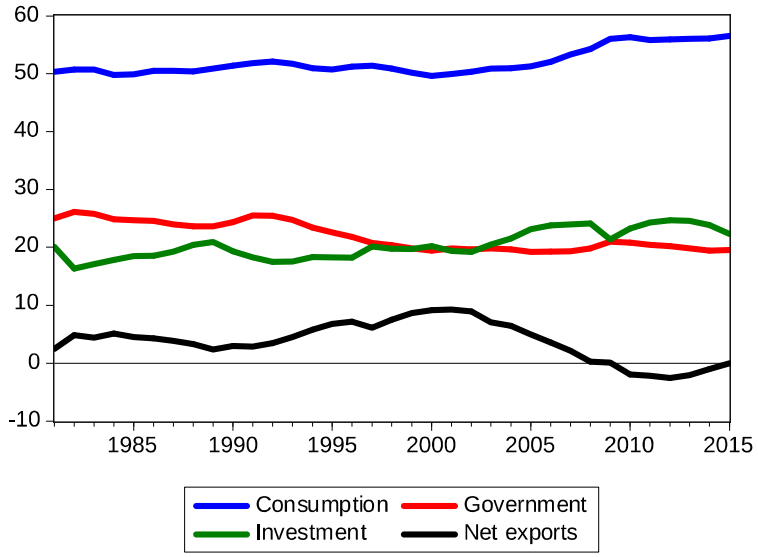
2-4 The Components of GDP

Table 1 and Figure 1 show the principal components of Canada's GDP between 1981 and 2015.

Table 1 Canada Nominal GDP and the Components of Expenditure: 1929–2013 (billions of dollars)

Year	GDP	Consumption	Investment	Government Purchases	Net Exports
1981	367121	192643	93180	78836	2830
1982	386773	206378	77341	89085	15026
1983	419691	226384	85196	95501	13659
1984	460243	246093	96834	101800	16118
1985	498075	268333	107674	110278	11583
1986	524450	289630	114175	116348	5123
1987	571926	313111	127375	123514	6878
1988	624401	338673	147358	132409	4926
1989	669026	365627	158560	143508	401
1990	692997	385706	148171	157310	1228
1991	699253	399512	135732	168543	-3689
1992	716019	412247	132030	175619	-2561
1993	744608	428341	138015	178438	144
1994	789507	445795	154562	179603	9159
1995	828973	461852	161171	180117	25803
1996	857023	482581	162747	178506	33585
1997	903902	513069	192425	180049	17186
1998	937295	534126	197939	186571	18097
1999	1004456	564045	208480	194737	35763
2000	1102380	600089	228009	211329	61923
2001	1140505	627551	225146	223291	64622
2002	1189452	665424	235626	236096	51576
2003	1250315	695313	256804	249646	47665
2004	1331178	727430	285616	259364	58510
2005	1417028	768649	321731	271178	54986
2006	1492207	811235	353130	288072	39954
2007	1573532	860349	377185	303708	33269
2008	1652923	899135	398891	326759	28464
2009	1567365	901170	345057	345137	-23146
2010	1662130	946350	391221	357791	-31860
2011	1769921	988577	428462	375141	-21228
2012	1822808	1020599	454381	384770	-35908
2013	1892193	1059398	466378	397632	-29739
2014	1973043	1106703	478227	406340	-18615
2015	1983288	1139931	468650	419848	-45812

Figure 1: Expenditure Components of Canadian GDP, 1981-2015 (percent of real GDP)



Source: Statistics Canada, Cansim Table 380-0064.

As Figure 1 illustrates, the GDP shares of consumption expenditure, private investment expenditure, and government purchases have been relatively constant since 1981. Consumption has remained between 50 and 60 percent while investment and government expenditure accounts for 20-30 percent of GDP.

As shown in Table 1, the sum of consumption, investment, government purchases, and net exports must always equal GDP when measured in current dollars. In Table 1 however, there is a small discrepancy between the sum of these components and GDP. This statistical discrepancy exists so that the expenditure based GDP matches the income-based GDP. 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 equalling the difference between real GDP and the sum of its components is included in Table 2, which reports real GDP and its components since 1980.

Table 2 Canada's Real GDP and the Components of Expenditure: 1981–2015 (millions of chained 2007 dollars)

Year	GDP	Consumption	Investment	Government Purchases	Net Exports	Residual
1981	796902	408875	160418	199421	20019	-835
1982	771385	398293	125884	201779	37201	-2090
1983	791430	408386	135318	203968	34904	-1998
1984	838325	424308	149580	208575	42677	-1094
1985	878012	445244	162470	216877	39456	370
1986	896993	460753	166343	220414	38235	-1413
1987	933738	479067	179819	223566	36055	1699
1988	975097	498980	199311	230094	32182	1617
1989	997758	516091	208907	235757	23395	1405
1990	999298	522993	192637	243481	29378	840
1991	978056	516930	178650	249217	27876	-1179
1992	986692	524806	172653	251244	34511	-1815
1993	1012891	534482	178165	250741	45256	-448
1994	1058405	549936	193887	247893	61304	519
1995	1086746	562216	198760	245433	74184	37
1996	1104254	578830	201445	240750	79388	-506
1997	1151514	607325	232362	239318	70436	1494
1998	1196213	623945	236352	243919	90169	715
1999	1257976	648679	248354	249199	109035	1792
2000	1323173	675031	267547	257764	120879	1247
2001	1346604	691570	261122	266540	124668	-124
2002	1387137	719293	266527	272571	123826	859
2003	1412137	738962	289425	280418	99422	1006
2004	1455715	761291	313821	285678	93492	285
2005	1502318	791221	347949	288716	74080	514
2006	1541730	824225	367423	296660	54624	-192
2007	1573532	860349	377185	303708	33269	-978
2008	1589273	885786	383387	315128	4459	-316
2009	1542396	886059	329105	323626	1116	-839
2010	1589956	917714	369464	330912	-30545	-1312
2011	1639900	938739	398383	335249	-36130	-956
2012	1668524	956714	412313	337586	-42173	-947
2013	1705532	979653	419784	338620	-35913	-1330
2014	1747709	1004466	417196	339711	-17913	343

Source: Statistics Canada, Cansim table 380-0064.

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

	Year 1			Year 2		
	Quantity	**Price**	**Expenditures**	**Quantity**	**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,

$$\begin{aligned} C^2 &= P^1_{\text{apples}} Q^2_{\text{apples}} + P^1_{\text{oranges}} Q^2_{\text{oranges}} \\ &= \$1{,}875{,}000. \end{aligned}$$

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

$$\begin{aligned} I^2 &= P^1_{\text{buildings}} Q^2_{\text{buildings}} + P^1_{\text{equipment}} Q^2_{\text{equipment}} \\ &= \$875{,}000. \end{aligned}$$

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

$$\begin{aligned} \text{Real GDP}^2 &= P^1_{\text{apples}} Q^2_{\text{apples}} + P^1_{\text{oranges}} Q^2_{\text{oranges}} + P^1_{\text{buildings}} Q^2_{\text{buildings}} + P^1_{\text{equipment}} Q^2_{\text{equipment}} \\ &= C^2 + I^2 \\ &= \$1{,}875{,}000 + \$875{,}000 \\ &= \$2{,}750{,}000. \end{aligned}$$

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:

$$C^2 = \sqrt{\left(\frac{P^1_{\text{apples}}Q^2_{\text{apples}} + P^1_{\text{oranges}}Q^2_{\text{oranges}}}{P^1_{\text{apples}}Q^1_{\text{apples}} + P^1_{\text{oranges}}Q^1_{\text{oranges}}}\right)\left(\frac{P^2_{\text{apples}}Q^2_{\text{apples}} + P^2_{\text{oranges}}Q^2_{\text{oranges}}}{P^2_{\text{apples}}Q^1_{\text{apples}} + P^2_{\text{oranges}}Q^1_{\text{oranges}}}\right)} \times C^1$$
$$= 1.2099 \times \$1{,}500{,}000$$
$$= \$1{,}814{,}850.$$

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:

$$I^2 = \sqrt{\left(\frac{P^1_{\text{buildings}}Q^2_{\text{buildings}} + P^1_{\text{equipment}}Q^2_{\text{equipment}}}{P^1_{\text{buildings}}Q^1_{\text{buildings}} + P^1_{\text{equipment}}Q^1_{\text{equipment}}}\right)\left(\frac{P^2_{\text{buildings}}Q^2_{\text{buildings}} + P^2_{\text{equipment}}Q^2_{\text{equipment}}}{P^2_{\text{buildings}}Q^1_{\text{buildings}} + P^2_{\text{equipment}}Q^1_{\text{equipment}}}\right)} \times I^1$$
$$= 0.8308 \times \$1{,}050{,}000$$
$$= \$872{,}340.$$

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:

$$GDP^2 = \sqrt{\left(\frac{P^1_{\text{a}}Q^2_{\text{a}} + P^1_{\text{O}}Q^2_{\text{O}} + P^1_{\text{b}}Q^2_{\text{b}} + P^1_{\text{e}}Q^2_{\text{e}}}{P^1_{\text{a}}Q^1_{\text{a}} + P^1_{\text{O}}Q^1_{\text{O}} + P^1_{\text{b}}Q^1_{\text{b}} + P^1_{\text{e}}Q^1_{\text{e}}}\right)\left(\frac{P^2_{\text{a}}Q^2_{\text{a}} + P^2_{\text{O}}Q^2_{\text{O}} + P^2_{\text{b}}Q^2_{\text{b}} + P^2_{\text{e}}Q^2_{\text{e}}}{P^2_{\text{a}}Q^1_{\text{a}} + P^2_{\text{O}}Q^1_{\text{O}} + P^2_{\text{b}}Q^1_{\text{b}} + P^2_{\text{e}}Q^1_{\text{e}}}\right)} \times \text{GDP}^1$$
$$= 1.0498 \times \$2{,}550{,}000$$
$$= \$2{,}676{,}990.$$

The residual is

$$= \$2{,}676{,}990 - (\$2{,}687{,}190)$$

LECTURE SUPPLEMENT

2-5 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.[1] Another decomposition involves removing the seasonal component from economic data. Sophisticated statistical techniques (known as *spectral analysis*) 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 adjuste*d 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.[2] 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 Miron decided instead to look at the seasonal component of the data.[3] 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 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.[4] Whereas seasonal and business cycles may be initially generated by different shocks, they may be driven by similar *propagation mechanisms.*[5]

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 for the *production-smoothing* model of inventories discussed in Chapter 17 of the textbook.

[1] 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.

[2] 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.

[3] R. Barsky and J. Miron, "The Seasonal Cycle and the Business Cycle," *Journal of Political Economy* 97 (June 1989): 503–34.

[4] See, in particular, the models of aggregate supply in Chapter 14 and Supplement 14-4, "Anticipated and Unanticipated Money."

[5] See Supplement 10-7, "Understanding Business Cycles II: Modelling Cycles."

ADDITIONAL CASE STUDY

2-6 Measuring the Price of Light

According to William Nordhaus, unmeasured changes in quality dramatically overestimate the true rise in the cost of living, as measured by the consumer price index (CPI).[1]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."

[1] 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).

Figure 1

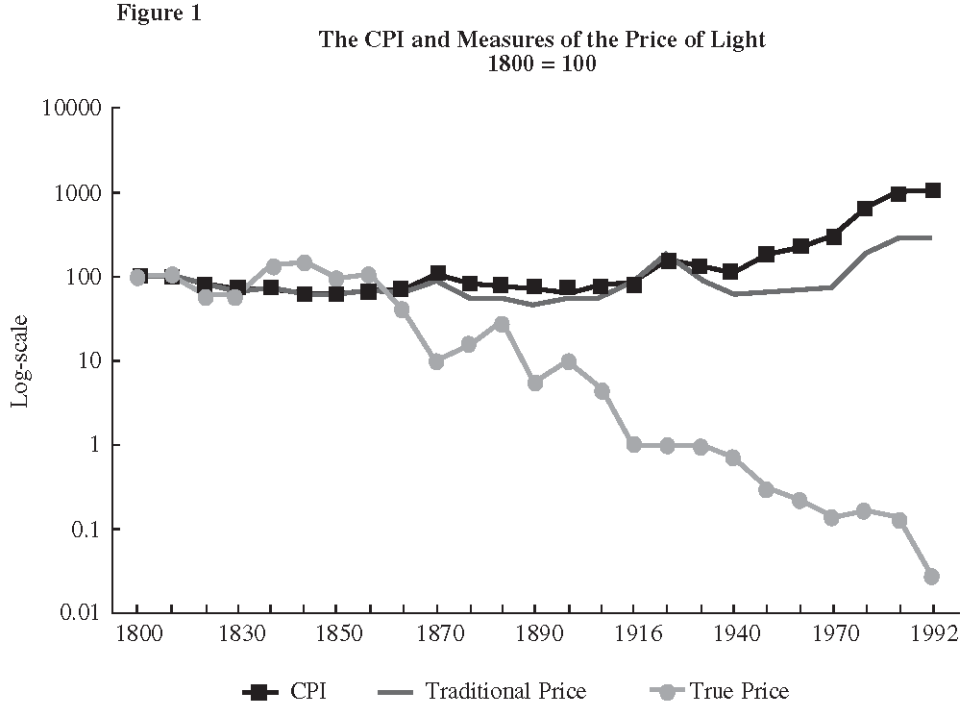


Table 1 True Price of Light (price per 1000 lumen hours)

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

2-7 Improving the CPI

Statistics Canada has made changes to the consumer price index in an effort to measure inflation more accurately. Some of these changes address the measurement problems discussed in Chapter 2 of the text and are part of an ongoing program at Statistics Canada to improve the CPI.[1] 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, 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's objective is to reflect changes in prices that Canadians face. The CPI has many uses. It is used by the government and the private sector as the main indicator that reflects changes in the cost of living for Canadians and hence as a benchmark to adjust nominal wages, the tax bracket and pensions. The CPI is also a very important variable for the Bank of Canada as its policy rate depends on the prevailing level of inflation. The CPI was introduced in Canada at the beginning of the 20th century. It has gone through several changes and updates since then. For example, when it was first introduced, the CPI was based on around 30 goods observed in a handful of cities across Canada. Today the CPI is based on the price of over thousands of goods representing all categories bought by Canadians across the country. The initiative that Statistics Canada started in 2009 led to improvements in the sample size, sample design, basket updates and quality adjustments.

First, since 2009, Statistics Canada has increased the number of prices collected over time. 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 over time has increased the number of prices collected from around 60,000 in 2010 to over 100,000 in 2015. Moreover, Statistics Canada has improved the procedures to update its sample of stores and items it surveys more rapidly. This helps ensure that new brands of products and new stores are included in the index more quickly than in the past. As the text points out, a greater variety of products may improve a consumer's welfare—something that the CPI as currently computed does not fully account for. But, in addition to this effect from increased variety, new products often experience a rapid decline in price 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, this sharp decline in price often 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, during which time their prices had fallen. As a result, inflation likely has been overstated in the past because of the delay in including new goods in the index.

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 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 will enable the CPI to incorporate more rapidly 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. But the

[1] 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, http://www.statcan.gc.ca/eng/about/er/cpi.

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.

ADDITIONAL CASE STUDY

2-8 The Billion Prices Project

The CPI is based on thousands of prices for individual goods and services that are collected each month by workers for the Bureau of Labour Statistics 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 five million items sold in 70 different countries. They then use these data to compute overall price indices for the 70 countries.[1]

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.

[1] See http://bpp.mit.edu for more details.

ADDITIONAL CASE STUDY

2-9 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.[1] The economists William 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.[2] 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."[3]

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.

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[1] See, for example, T. Scitovsky, *The Joyless Economy* (Oxford: Oxford University Press, 1976) and E. 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).

[2] W. Nordhaus and J. Tobin, "Is Growth Obsolete?" *Economic Growth: Fiftieth Anniversary Colloquium V*, National Bureau of Economic Research (New York: Columbia University Press, 1972), reprinted in J. Tobin, *Essays in Economics: Theory and Policy* (Cambridge, MA: MIT Press, 1985), 360–439.

[3] Ibid., 383.

CHAPTER 2

CANADIAN EDITION

MACROECONOMICS

N. GREGORY MANKIW ■ WILLIAM SCARTH

The Data of Macroeconomics

IN THIS CHAPTER, YOU WILL LEARN:

. . . the meaning and measurement of the most important macroeconomic statistics:

- gross domestic product (GDP)
- the consumer price index (CPI)
- the unemployment rate

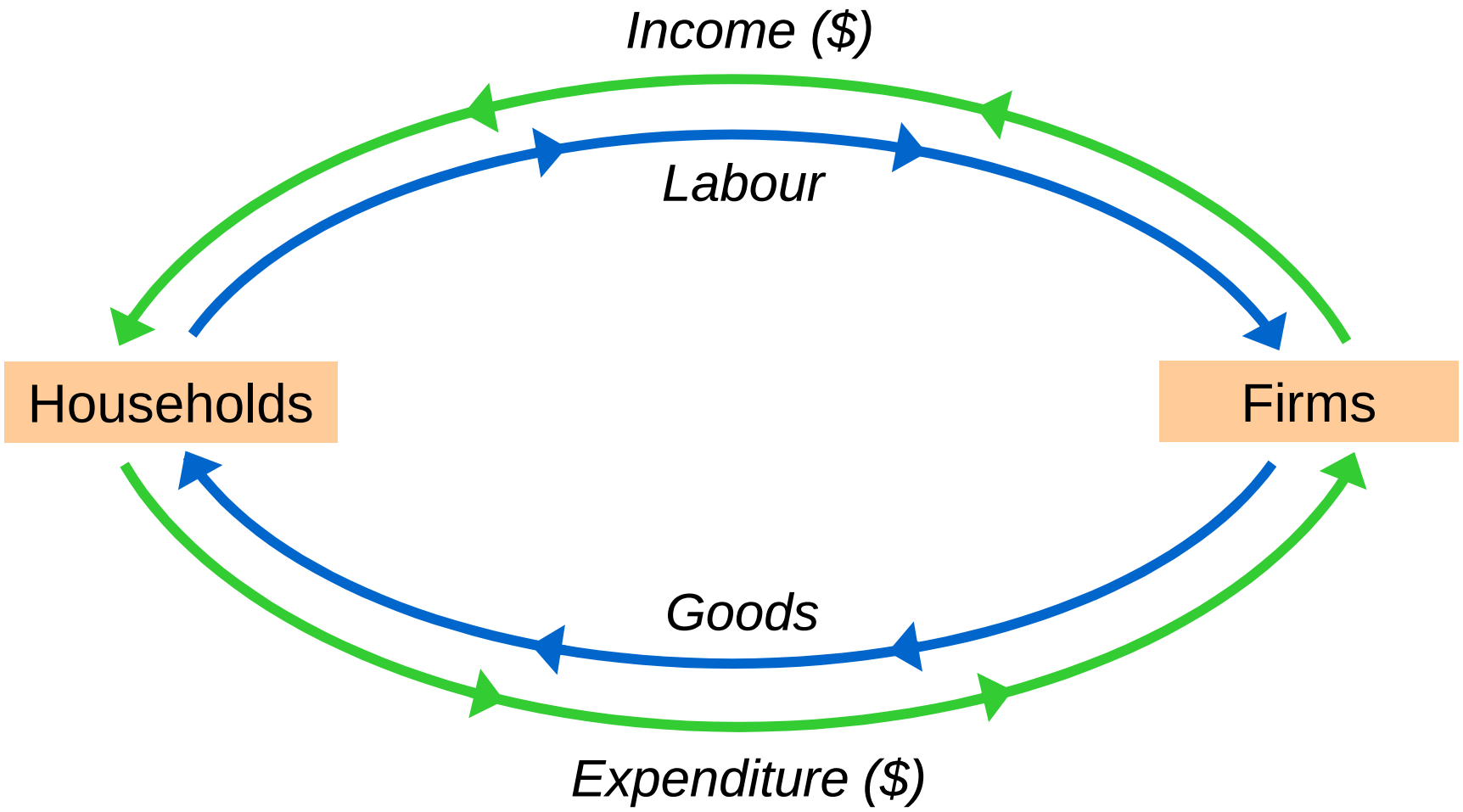
Gross Domestic Product: Expenditure and Income

Two definitions:

- Total expenditure on domestically produced final goods and services.
- Total income earned by domestically located factors of production.

Expenditure equals income because every dollar a buyer spends becomes income to the seller.

The Circular Flow



Value added

Value added: The value of output minus the value of the intermediate goods used to produce that output

NOW YOU TRY
Identifying value added

- A farmer grows a bushel of wheat and sells it to a miller for $1.00.
- The miller turns the wheat into flour and sells it to a baker for $3.00.
- The baker uses the flour to make a loaf of bread and sells it to an engineer for $6.00.
- The engineer eats the bread.

Compute value added at each stage of production and GDP.

Final goods, value added, and GDP

- GDP = value of final goods produced
  = sum of value added at all stages of production.
- The value of the final goods already includes the value of the intermediate goods, so including intermediate *and* final goods in GDP would be double counting.

The expenditure components of GDP

- consumption, ***C***
- investment, ***I***
- government spending, ***G***
- net exports, ***NX***

An important identity:

$$Y = C + I + G + NX$$

value of total output

aggregate expenditure

Consumption (C)

Definition: The value of all goods and services bought by households. Includes:

- ***Durable goods***
  last a long time.
  E.g., cars, home appliances
- ***Nondurable goods***
  last a short time.
  E.g., food, clothing
- ***Services***
  are intangible items purchased by consumers.
  E.g., dry cleaning, air travel

Canada Consumption, 2015

	$ billions	*% of GDP*
Consumption	998	56.5
Durables and Semi Durables	226	12.8
Nondurables	230	13.0
Services	543	30.7

Investment (I)

- Spending on capital, a physical asset used in future production
- Includes:
  - ***Business fixed investment***
    Spending on plant and equipment
  - ***Residential fixed investment***
    Spending by consumers and landlords on housing units
  - ***Inventory investment***
    The change in the value of all firms' inventories

Canada Investment, 2015

	$ billions	*% of GDP*
Investment	445	25.2
Business fixed	320	18.1
Residential	121	6.8
Inventory	4	0.2

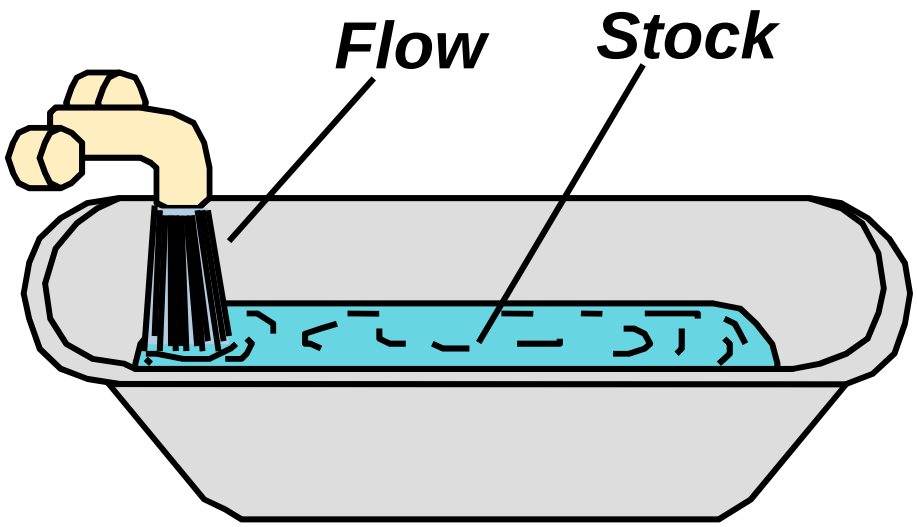
Investment vs. capital

Note: Investment is spending on new capital.

Example *(assumes no depreciation)*:

- 1/1/2016:
  Economy has $10 trillion worth of capital
- During 2016:
  Investment = $2 trillion
- 1/1/2017:
  Economy will have $12 trillion worth of capital

Stocks vs. Flows



A **stock** is a quantity measured at a point in time.

E.g., "Canada's capital stock was $10 trillion on January 1, 2016."

A **flow** is a quantity measured per unit of time.

E.g., "Canada's investment was $2 trillion during 2016."

Stocks vs. Flows: Examples

Stock	***Flow***
a person's wealth	a person's annual savings
# of people with university degrees	# of new university graduates this year
the govt debt	the govt budget deficit

NOW YOU TRY
Stock or Flow?

- The balance on your credit card statement
- How much time you spend studying
- The size of your MP3/iTunes collection
- The inflation rate
- The unemployment rate

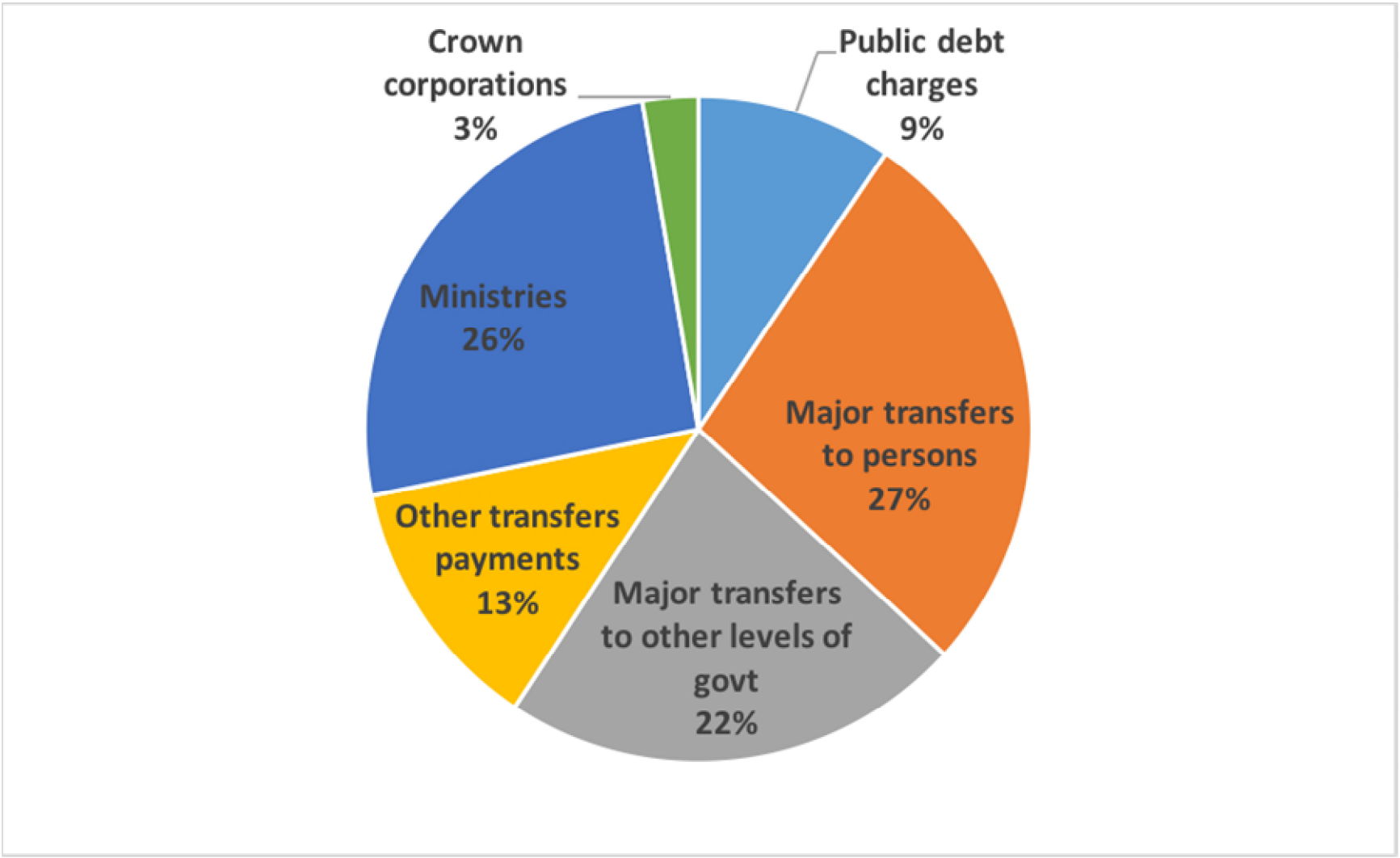
Government spending (G)

- **G** includes all government spending on goods and services.
- **G** excludes transfer payments (e.g., unemployment insurance payments) because they do not represent spending on goods and services.

Government spending (G)

- In Canada, government expenses can be broken down into three main categories: transfer payments to persons and other levels of government (about 50% of total spending), other program payments and public debt charges.
- Transfer payments to persons consist mostly of elderly benefits, child tax benefits and employment insurance benefits.

Canada's Government spending 2014-15



Net exports (NX)

- **NX** = exports – imports
  - **Exports**: the value of g&s sold to other countries
  - **Imports**: the value of g&s purchased from other countries
- Hence, NX equals net spending from abroad on our g&s

Canada Net Exports, 2015

	$ billions	% of GDP
Net exports of g&s	–1	0
Exports	573	32.4
Goods	489	27.7
Services	84	4.7
Imports	574	32.5
Goods	466	26.4
Services	108	6.1

NOW YOU TRY

An expenditure-output puzzle?

Suppose a firm:

- produces $10 million worth of final goods
- only sells $9 million worth

- Does this violate the
  expenditure = output identity?

Why output = expenditure

- Unsold output goes into inventory,
  and is counted as “inventory investment” . . .
  whether or not the inventory buildup was intentional.
- In effect, we are assuming that
  firms purchase their unsold output.

GDP:
An important and versatile concept

We have now seen that GDP measures:

- total income
- total output
- total expenditure
- the sum of value added at all stages in the production of final goods

GNP vs. GDP

- Gross **national** product (GNP):
  Total income earned by the nation's factors of production, regardless of where located.

- Gross **domestic** product (GDP):
  Total income earned by domestically-located factors of production, regardless of nationality.

  GNP – GDP = factor payments from abroad
  minus factor payments to abroad

- Examples of factor payments: wages, profits, rent, interest & dividends on assets

NOW YOU TRY

Discussion Question

In your country, which would you want to be bigger, GDP or GNP?

Why?

GNP vs. GDP in Select Countries, 2012

Country	*GNP*	*GDP*	*GNP – GDP (% of GDP)*
Bangladesh	127,672	116,355	9.7
Japan	6,150,132	5,961,066	3.2
China	8,184,963	8,227,103	-0.5
United States	16,514,500	16,244,600	1.7
India	1,837,279	1,858,740	-1.2
Canada	1,821,424	1,779,635	2.3
Greece	250,167	248,939	0.5
Iraq	216,453	215,838	0.3
Ireland	171,996	210,636	-18.3

GNP and GDP in millions of current U.S. dollars.

Real vs. nominal GDP

- GDP is the *value* of all final goods and services produced.
- **Nominal GDP** measures these values using current prices.
- **Real GDP** measures these values using the prices of a base year.

NOW YOU TRY

Real and nominal GDP

	2010		2011		2012	
	P	Q	P	Q	P	Q
good A	$30	900	$31	1,000	$36	1,050
good B	$100	192	$102	200	$100	205

- Compute nominal GDP in each year.
- Compute real GDP in each year using 2010 as the base year.

NOW YOU TRY
Answers

Nominal GDP *multiply Ps & Qs from same year*

2010: $46,200 = $30 × 900 + $100 × 192

2011: $51,400

2012: $58,300

Real GDP *multiply each year's Qs by 2010 Ps*

2010: $46,200

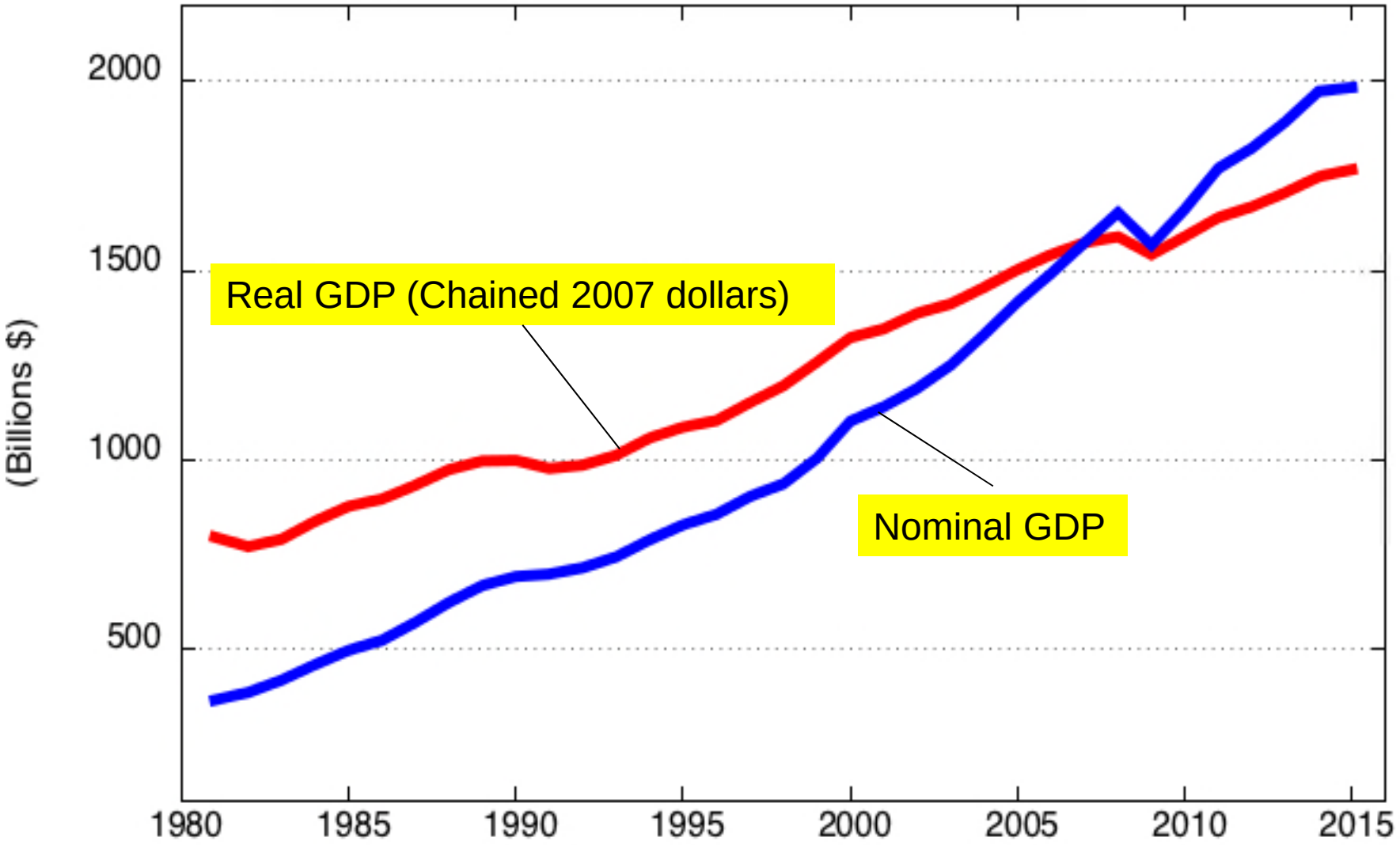
2011: $50,000

2012: $52,000 = $30 × 1050 + $100 × 205

Real GDP controls for inflation

- Changes in nominal GDP can be due to:
  - changes in prices
  - changes in quantities of output produced
- Changes in real GDP can only be due to changes in quantities because real GDP is constructed using constant base-year prices.

Canada Nominal and Real GDP, 1981-2015



GDP deflator

- **Inflation rate**: the percentage increase in the overall level of prices.
- One measure of the price level: **GDP deflator**

  Definition:

$$\text{GDP deflator} = 100 \times \frac{\text{Nominal GDP}}{\text{Real GDP}}$$

NOW YOU TRY

GDP deflator and the inflation rate

	Nom. GDP	Real GDP	GDP deflator	Inflation rate
2010	$46,200	$46,200		*n.a.*
2011	51,400	50,000		
2012	58,300	52,000		

- Use your previous answers to compute the GDP deflator in each year.
- Use GDP deflator to compute the inflation rate from 2010 to 2011 and from 2011 to 2012.

NOW YOU TRY
Answers

	Nom. GDP	Real GDP	GDP deflator	Inflation rate
2010	$46,200	$46,200	100.0	*n.a.*
2011	51,400	50,000	102.8	2.8%
2012	58,300	52,000	112.1	9.1%

Understanding the GDP deflator

Example with 3 goods

For good i = 1, 2, 3

P_{it} = the market price of good i in month t

Q_{it} = the quantity of good i produced in month t

$NGDP_t$ = Nominal GDP in month t

$RGDP_t$ = Real GDP in month t

Understanding the GDP deflator

$$\text{GDP deflator}_t = \frac{\text{NGDP}_t}{\text{RGDP}_t} = \frac{P_{1t}Q_{1t} + P_{2t}Q_{2t} + P_{3t}Q_{3t}}{\text{RGDP}_t}$$

$$= \left(\frac{Q_{1t}}{\text{RGDP}_t}\right)P_{1t} + \left(\frac{Q_{2t}}{\text{RGDP}_t}\right)P_{2t} + \left(\frac{Q_{3t}}{\text{RGDP}_t}\right)P_{3t}$$

The GDP deflator is a weighted average of prices.

The weight on each price reflects that good's relative importance in GDP.

Note that the weights change over time.

Two arithmetic tricks for working with percentage changes

1. For any variables X and Y,

percentage change in $(X \times Y)$

$\approx$ percentage change in X

+ percentage change in Y

Ex.: If your hourly wage rises 5% and you work 7% more hours, then your wage income rises approximately 12%.

Two arithmetic tricks for working with percentage changes

2. Percentage change in (***X/Y***)
≈ percentage change in ***X***
− percentage change in ***Y***

Ex.: GDP deflator = 100 × NGDP/RGDP.

If NGDP rises 9% and RGDP rises 4%,
then the inflation rate is approximately 5%.

Chain-weighted real GDP

- Over time, relative prices change, so the base year should be updated periodically.
- In essence, **chain-weighted real GDP** updates the base year every year, so it is more accurate than constant-price GDP.
- Your textbook usually uses constant-price real GDP because:
  - the two measures are highly correlated
  - constant-price real GDP is easier to compute

Consumer price index (CPI)

- A measure of the overall level of prices
- Published by Statistics Canada (StatsCan)
- Uses:
  - tracks changes in the typical household's cost of living
  - adjusts many contracts for inflation ("COLAs")
  - allows comparisons of dollar amounts over time

How Statistics Canada constructs the CPI

1. Survey consumers to determine composition of the typical consumer's "basket" of goods
2. Every month, collect data on prices of all items in the basket; compute cost of basket
3. CPI in any month equals

$$100 \times \frac{\text{Cost of basket in that month}}{\text{Cost of basket in base period}}$$

How Statistics Canada constructs the CPI

4. Movements in the price of the goods and services included in the CPI are weighted according to their relative importance in the total expenditures of consumers.

5. To estimate the price change experienced by Canadians, Statistics Canada obtains CPI price sample from different regions, goods and services, and from various types and locations of retail outlets.

2. Every month, collect data on prices of all items

NOW YOU TRY

Compute the CPI

Basket: 20 pizzas, 10 compact discs

Prices:

	pizza	CDs
2012	$10	$15
2013	11	15
2014	12	16
2015	13	15

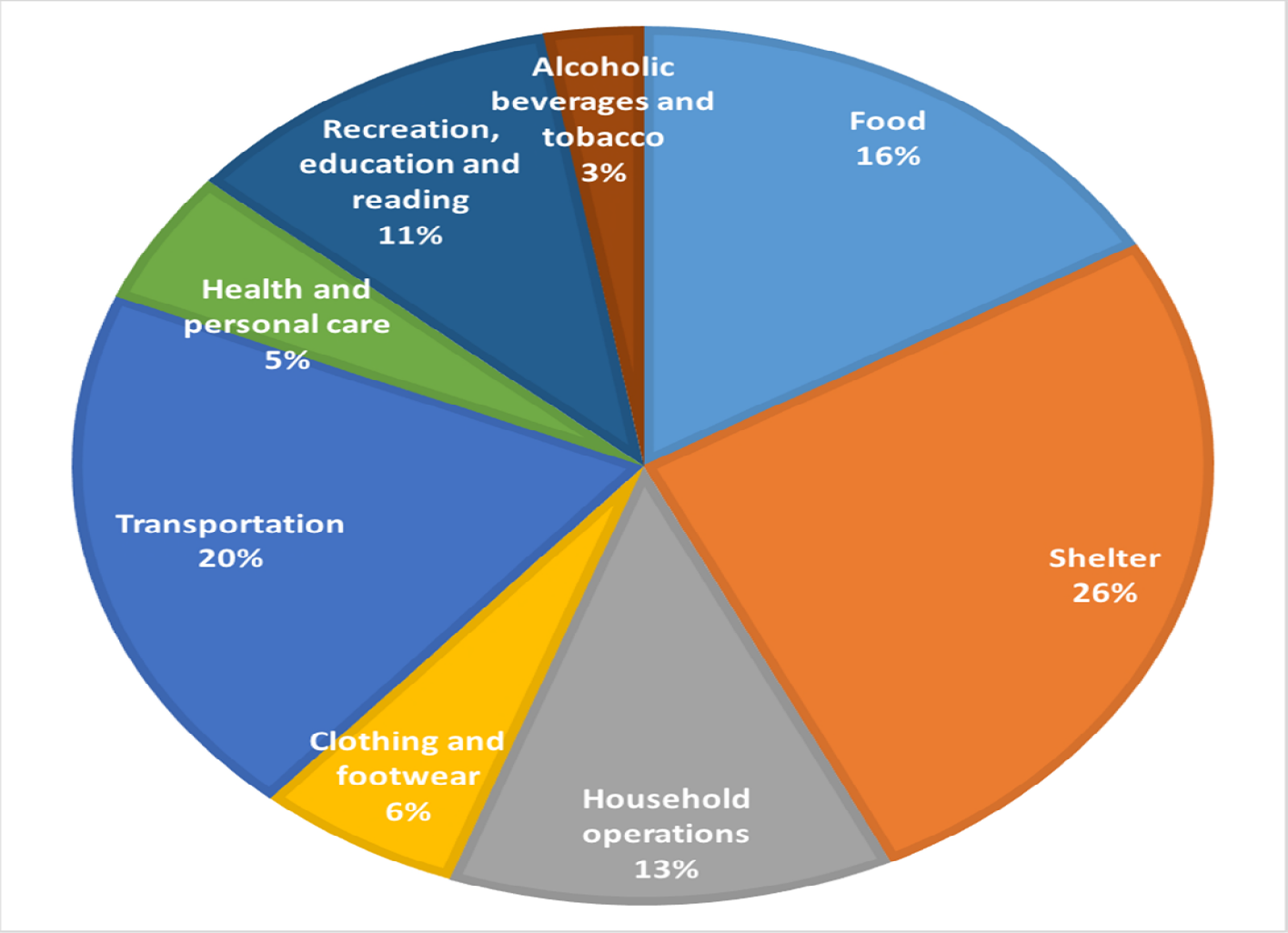
For each year, compute:

- the cost of the basket
- the CPI (use 2012 as the base year)
- the inflation rate from the preceding year

NOW YOU TRY
Answers

	Cost of basket	CPI	Inflation rate
2012	$350	100.0	*n.a.*
2013	370	105.7	5.7%
2014	400	114.3	8.1%
2015	410	117.1	2.5%

The composition of the CPI "basket"in Canada



Understanding the CPI

Example with 3 goods

For good i = 1, 2, 3

C_i = amount of good i in the CPI's basket

P_{it} = price of good i in month t

E_t = cost of the CPI basket in month t

E_b = cost of the basket in the base period

Understanding the CPI

$$\text{CPI in month } t = \frac{E_t}{E_b} = \frac{P_{1t}C_1 + P_{2t}C_2 + P_{3t}C_3}{E_b}$$

$$= \left(\frac{C_1}{E_b}\right) P_{1t} + \left(\frac{C_2}{E_b}\right) P_{2t} + \left(\frac{C_3}{E_b}\right) P_{3t}$$

The CPI is a weighted average of prices.

The weight on each price reflects that good's relative importance in the CPI's basket.

Note that the weights remain fixed over time.

Why the CPI may overstate inflation

- **Substitution bias**:
  The CPI uses fixed weights, so it cannot reflect consumers' ability to substitute toward goods whose relative prices have fallen.
- **Introduction of new goods**:
  The introduction of new goods makes consumers better off and, in effect, increases the real value of the dollar. But it does not reduce the CPI because the CPI uses fixed weights.
- **Unmeasured changes in quality**:
  Quality improvements increase the value of the dollar but are often not fully measured.

The size of the CPI's bias

- Research from the Bank of Canada suggests that the overall estimated bias in the Canadian CPI is about 0.5% per year.
- Estimates for the bias in the Canadian CPI is lower than the United States where the bias is estimated to be around 1%.

NOW YOU TRY

Discussion Questions

1. If your grandmother receives Old Age Security (OAS), how is she affected by the CPI's bias?
2. Where does the government get the money to pay OAS and Employment Insurance to recipients?
3. If you pay income and Employment Insurance taxes, how does the CPI's bias affect you?
4. Is the government giving your grandmother too much of a COLA?
5. How does your grandmother's "basket" differ from the CPI's? Does this affect your answer to Q4?

CPI vs. GDP deflator

Prices of capital goods:

- included in GDP deflator (if produced domestically)
- excluded from CPI

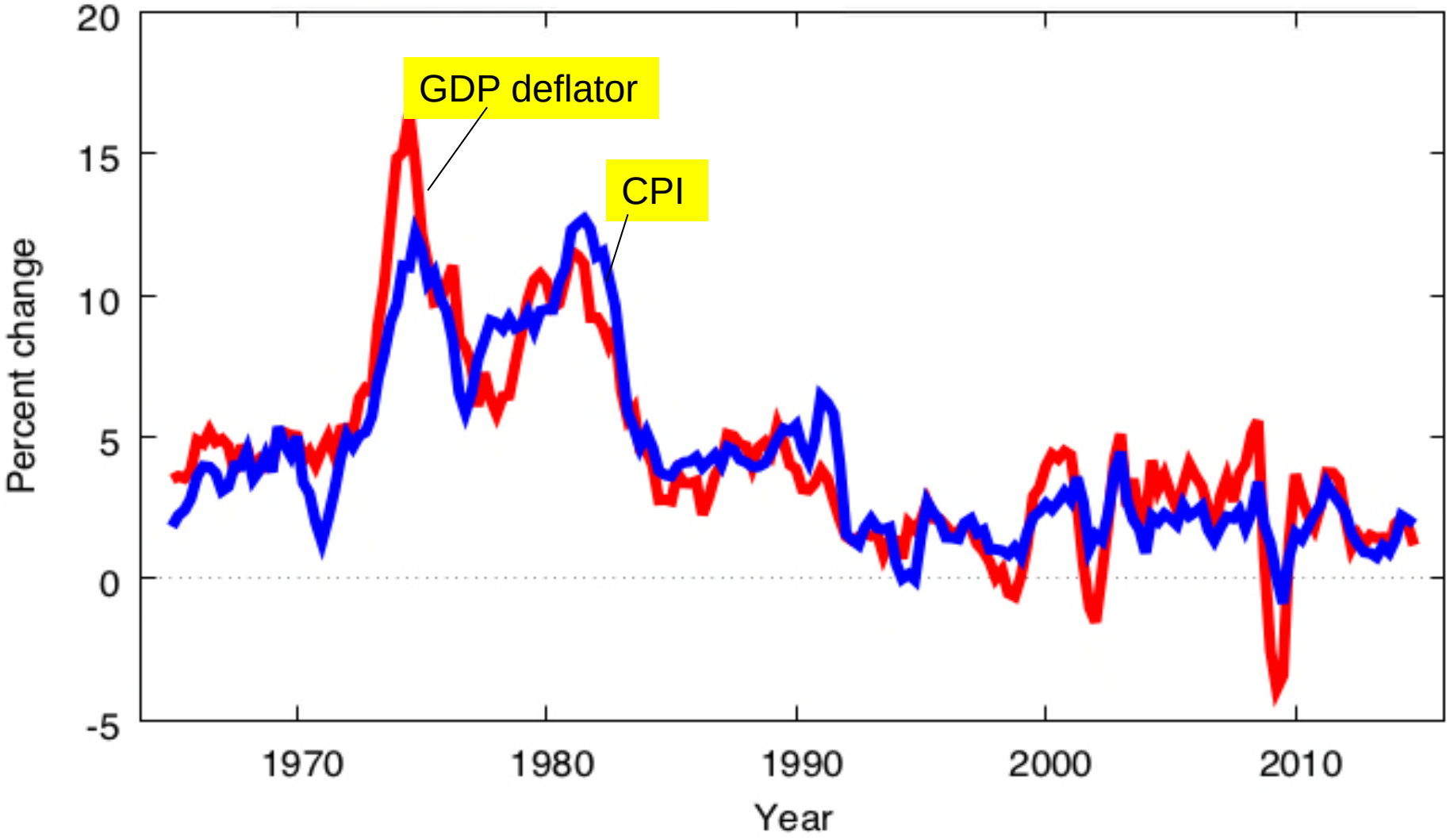
Prices of imported consumer goods:

- included in CPI
- excluded from GDP deflator

The basket of goods:

- CPI: fixed
- GDP deflator: changes every year

The inflation rate as measured by the GDP Deflator and the CPI, Canada



Categories of the population

- **Employed**
  working at a paid job
- **Unemployed**
  not employed but looking for a job
- **Labour force**
  the amount of labour available for producing goods and services; all employed plus unemployed persons
- **Not in the labour force**
  not employed, not looking for work

Two important labour force concepts

- **Unemployment rate**
  percentage of the labour force that is unemployed
- **Labour force participation rate**
  the fraction of the adult population that "participates" in the labour force, *i.e.* is working or looking for work

NOW YOU TRY

Computing labour statistics

Canada adult population by group, June 2016

Number employed	=	18.054 million
Number unemployed	=	1.326 million
Adult population	=	29.574 million

Calculate

- the labour force
- the unemployment rate
- the labour force participation rate

NOW YOU TRY
Answers

Data: ***E*** = 18.054, ***U*** = 1.326, ***POP*** = 29.574

- Labour force
  L = ***E*** + ***U*** = 18.054 + 1.326 = 19.38
- Unemployment rate
  U/L x 100% = (1.326/19.38) x 100% = 6.8%
- Labor force participation rate
  L/POP x 100% = (19.38/29.574) x 100% = 65.5%

NOW YOU TRY

Computing percentage changes

Suppose

- population increases by 1%
- labour force increases by 3%
- number of unemployed persons increases by 2%

Compute the percentage changes in the labour force participation and unemployment rates.

NOW YOU TRY
Answers

LFPR = L/POP

L increases 3%, POP increases 1%,
so LFPR increases 3% – 1% = 2%.

U rate = U/L

U increases 2%, L increases 3%,
so U-rate increases 2% – 3% = –1%.

Note: the changes in LFPR and U-rate are shown as a percent of their initial values, not in percentage points!
E.g., *if initial value of LFPR is 60.0%, a 2% increase would bring it to 61.2%, because 2% of 60 equals 1.2.*

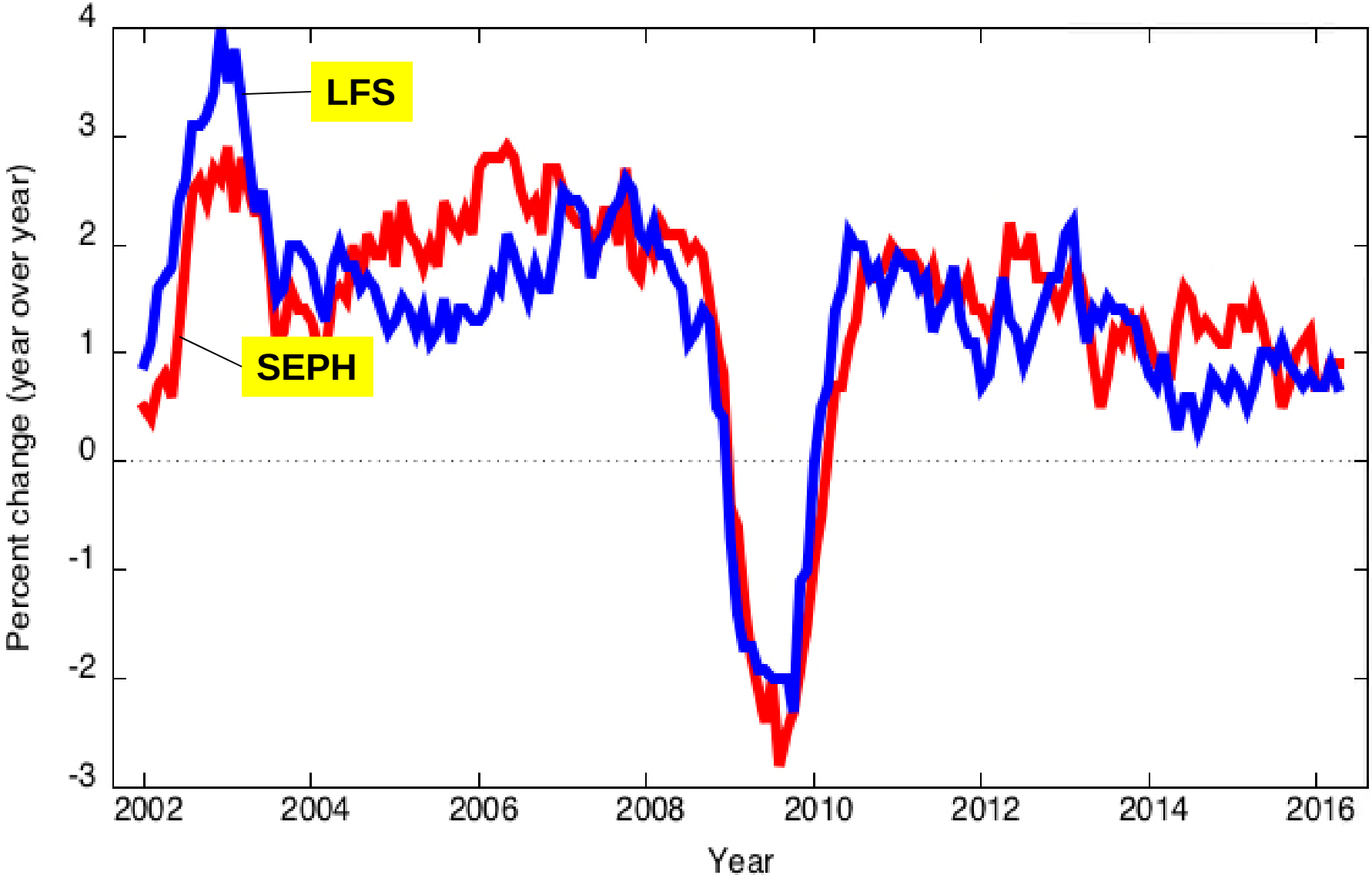
Labour Force Survey (LFS)

- Every month, Statistics Canada provides important data on the labour market, including the unemployment rate and the participation rate.
- These statistics come from the Labour Force Survey (LFS).
- The LFS is based on the responses of about 56,000 households or the responses of about 100,000 adults (aged 15 years and older).

The Survey of Employment, Payrolls and Hours (SEPH)

- The SEPH is another survey that Statistics Canada conducts to get more timely information on the labour market, especially on earnings, hours worked by industry at the national and provincial level.
- The SEPH provides greater details on earnings and non-farm industry employment compared to the LFS.

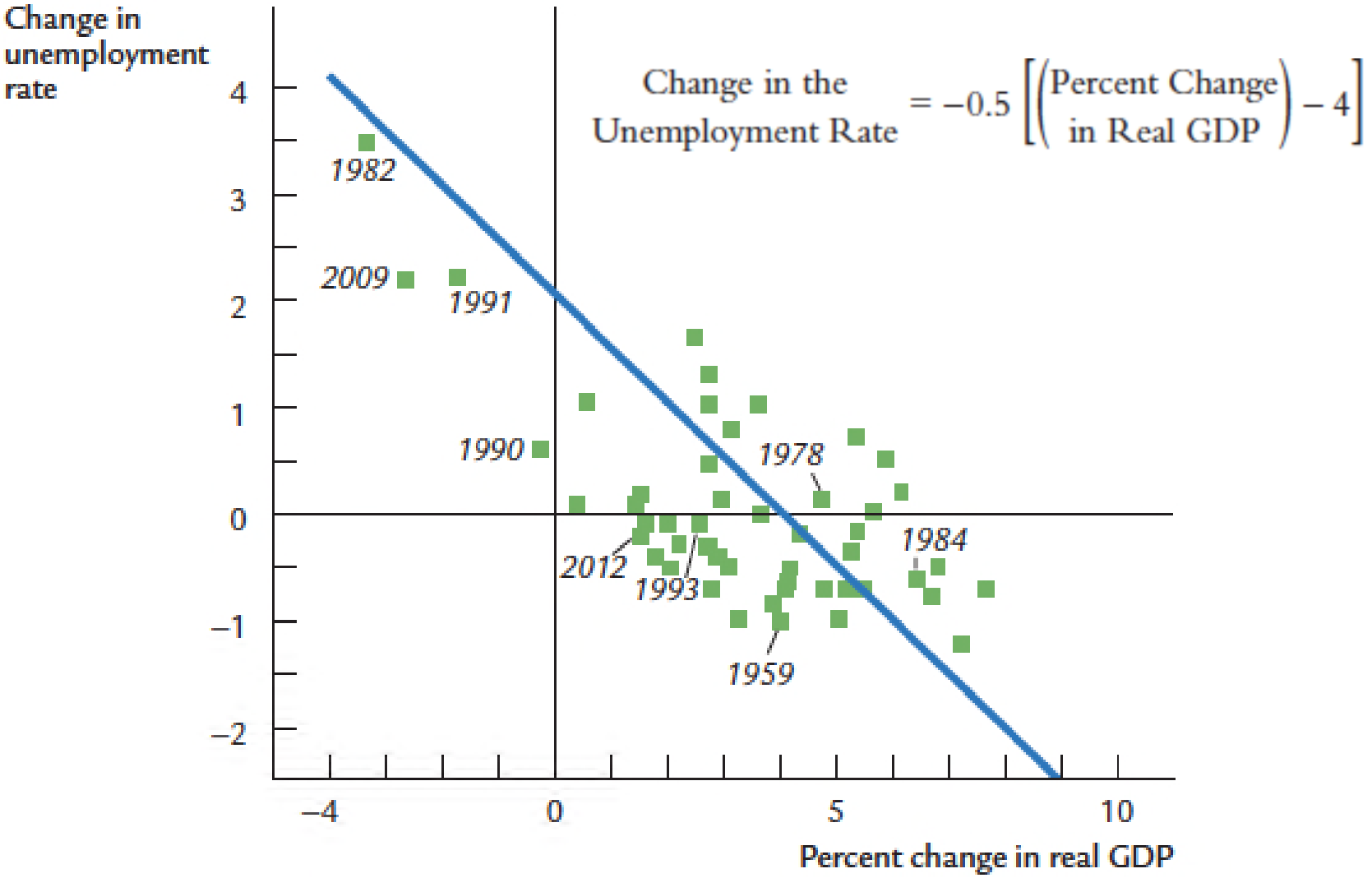
Employment growth LFS versus SEPH



Unemployment, GDP, and Okun's Law

- The negative relationship between unemployment and GDP is known as **Okun's law**.
- In Canada, Okun's law indicates that a one percent increase in real GDP leads to a half-percentage decrease in unemployment.

Okun's Law: Canada 1959-2012



CHAPTER SUMMARY

- Gross domestic product (GDP) measures both total income and total expenditure on the economy's output of goods & services.
- Nominal GDP values output at current prices; real GDP values output at constant prices. Changes in output affect both measures, but changes in prices only affect nominal GDP.
- GDP is the sum of consumption, investment, government purchases, and net exports.

CHAPTER SUMMARY

- The overall level of prices can be measured by either:
  - the consumer price index (CPI), the price of a fixed basket of goods purchased by the typical consumer, or
  - the GDP deflator, the ratio of nominal to real GDP.
- The unemployment rate is the fraction of the labour force that is not employed.