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Chapter 2
Measurement

■ Teaching Goals

Students must understand the importance of measuring aggregate economic activity. Macroeconomists produce theories that provide useful insights and policy conclusions. To be credible, such theories must produce hypotheses that evidence could possibly refute. Macroeconomic measurement provides such evidence. Without macroeconomic measurements, macroeconomics could not be a social science, and would rather consist of philosophizing and pontificating. Market transactions provide the most simple and direct measurements. Macroeconomists' most basic measurement is Gross Domestic Product (GDP), the value of final, domestically marketed output produced during a given period of time.

In the United States, the Commerce Department's National Income and Product Accounts provide official estimates of GDP. These accounts employ their own set of accounting rules to ensure internal consistency and to provide several separate estimates of GDP. These separate estimates are provided by the product accounts, the expenditure accounts, and the income accounts. The various accounting conventions may, at first glance, be rather dry and complicated. However, students can only easily digest the material in later chapters if they have a good grounding in the fundamentals.

GDP changes through time because different amounts of goods and services are produced, and such goods and services are sold at different prices. Standards of living are determined by the amounts of goods and services produced, not by the prices they command in the market. While GDP is relatively easy to measure, the decomposition of changes in real GDP into quantity and price components is much more difficult. It is easy to separately measure the number of apples sold and the price of each apple. Because macroeconomics deals with aggregate output, the differentiation of price and quantity is much less easily apparent. It is important to emphasize that while there may be more or less reasonable approaches to this problem, there is no unambiguous best approach. Since many important policy discussions involve debates about output and price measurements, it is very important to understand exactly how such measurements are produced.

■ Classroom Discussion Topics

Much of this material is best learned by example. Rather than simply working through the examples from the text or making up your own, the material may resonate better if the students come up with their own examples. They can start by picking a single good, and by the choice of their numbers they provide their own implied decomposition of output into wage and profit income. Later on, encourage them to suggest intermediate input production, inventory adjustments, international transactions, a government sector, and so on. Such an exercise may help assure them that the identities presented in the text are more than simply abstract constructions.

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If many of your students are familiar with accounting principles, it may also be useful to present the National Income and Product Account with the "T" accounts, and to highlighting how all income is an expense elsewhere. Make one account for each of the firms, one for the household, and one for the government. Add another account for the rest of the world when discussing the example with international trade. This procedure can highlight how some entities can be inferred from others because accounting identities must hold. It makes it also easier to determine consumption for some student Social Security benefits are indexed to the Consumer Price Index. Explain with an example exactly how these adjustments are made. Ask the students if they think that this procedure is "fair." Another topic of concern is the stagnation in the growth of measured real wages. Real wages are measured by dividing (for example) average hourly wages paid in manufacturing by the consumer price index. Ask students if measured changes in real wages confirm or conflict with their general beliefs about whether the typical worker is better or worse off today than 10 or 20 years ago. How does possible mis-measurement of prices reconcile any apparent differences between casual impressions and statistical evidence?

The text discusses why unemployment may or may not be a good measure of labor market tightness. Another interpretation of the unemployment rate is as a measure of economic welfare – welfare goes down as unemployment goes up. Ask the students if they agree with this interpretation. Does the unemployment rate help factor in considerations like equal distribution of income? How can the unemployment rate factor in considerations like higher income per employed worker? Discuss possible pros and cons of using unemployment rather than per capita real GDP as a measure of well-being. Can unemployment be too low? Why or why not?

■ Outline

I. Measuring GDP: The National Income and Product Accounts
- A. What Is GDP and How Do We Measure It?
- B. The Product Approach
- C. The Expenditure Approach
- D. The Income Approach
- E. Gross National Product (GNP)
- F. What Does GDP Leave Out?
- G. Expenditure Components
  - 1. Consumption
  - 2. Investment
  - 3. Net Exports
  - 4. Government Expenditures

II. Nominal and Real GDP and Price Indices
- A. Real GDP
- B. Measures of the Price Level
  - 1. Implicit GDP Price Deflator
  - 2. Consumer Price Index (CPI)
- C. Problems Measuring Real GDP and the Price Level

III. Savings, Wealth, and Capital

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A. Stocks and Flows

B. Private Disposable Income and Private Sector Saving

1. $Y^d = Y + NFP + TR + INT - T$
2. $S^p = Y^d - C$

C. Government Surpluses, Deficits, and Government Saving

1. $S^g = T - TR - INT - G$
2. $D = -S^g$

D. National Saving: $S = S^p + S^g = Y + NFP - C - G$

E. Saving, Investment, and the Current Account

1. $S = I + NX + NFP$
2. $CA = NX + NFP \Rightarrow S = I + CA$

F. Capital Stock

1. $\text{S} \Rightarrow \Delta\text{Wealth}$
2. $I \Rightarrow \Delta K$
3. $CA \Rightarrow \text{Claims on Foreigners}$

IV. Labor Market Measurement

A. BLS Categories

1. Employed
2. Unemployed
3. Not in the Labor Force

B. The Unemployment Rate

$$\text{Unemployment Rate} = \frac{\text{Number unemployed}}{\text{Labor force}}$$

C. The Participation Rate

$$\text{Participation Rate} = \frac{\text{Labor force}}{\text{Total working age population}}$$

D. The Employment/Population Ratio

$$\text{Employment/Population Ratio} = \frac{\text{Total employment}}{\text{Total working age population}}$$

E. Unemployment and Labor Market Tightness

■ Learning Objectives

1. Construct measures of gross domestic product using the product approach, the expenditure approach, and the income approach.
2. State the importance of each expenditure component of GDP, and the issues associated with measuring each.
3. Construct real and nominal GDP, and price indices, from data on quantities and prices in different years.
4. State the key difficulties in measuring GDP and the price level.

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5. State the accounting relationships among savings and income in the private and public sectors, and explain the importance of these relationships for wealth accumulation.
6. Construct the key labor market measures from the household survey data.

■ Solutions to End-of-Chapter Problems

1. Product accounting adds up value added by all producers. The wheat producer has no intermediate inputs and produces 30 million bushels at $3/bu. for $90 million. The bread producer produces 100 million loaves at $3.50/loaf for $350 million. The bread producer uses $75 million worth of wheat as an input. Therefore, the bread producer's value added is $275 million. Total GDP is therefore $90 million + $275 million = $365 million.

   Expenditure accounting adds up the value of expenditures on final output. Consumers buy 100 million loaves at $3.50/loaf for $350 million. The wheat producer adds 5 million bushels of wheat to inventory. Therefore, investment spending is equal to 5 million bushels of wheat valued at $3/bu., which costs $15 million. Total GDP is therefore $350 million + $15 million = $365 million.

2. Coal producer, steel producer, and consumers.

   (a) (i) Product approach: Coal producer produces 15 million tons of coal at $5/ton, which adds $75 million to GDP. The steel producer produces 10 million tons of steel at $20/ton, which is worth $200 million. The steel producer pays $125 million for 25 million tons of coal at $5/ton. The steel producer's value added is therefore $75 million. GDP is equal to $75 million + $75 million = $150 million.

   (ii) Expenditure approach: Consumers buy 8 million tons of steel at $20/ton, so consumption is $160 million. There is no investment and no government spending. Exports are 2 million tons of steel at $20/ton, which is worth $40 million. Imports are 10 million tons of coal at $5/ton, which is worth $50 million. Net exports are therefore equal to $40 million –$50 million = –$10 million. GDP is therefore equal to $160 million + (–$10 million) = $150 million.

   (iii) Income approach: The coal producer pays $50 million in wages and the steel producer pays $40 million in wages, so total wages in the economy equal $90 million. The coal producer receives $75 million in revenue for selling 15 million tons at $15/ton. The coal producer pays $50 million in wages, so the coal producer's profits are $25 million. The steel producer receives $200 million in revenue for selling 10 million tons of steel at $20/ton. The steel producer pays $40 million in wages and pays $125 million for the 25 million tons of coal that it needs to produce steel. The steel producer's profits are therefore equal to $200 million – $40 million – $125 million = $35 million. Total profit income in the economy is therefore $25 million + $35 million = $60 million. GDP therefore is equal to wage income ($90 million) plus profit income ($60 million). GDP is therefore $150 million.

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(b) There are no net factor payments from abroad in this example. Therefore, the current account surplus is equal to net exports, which is equal to (–$10 million).

(c) As originally formulated, GNP is equal to GDP, which is equal to $150 million. Alternatively, if foreigners receive $25 million in coal industry profits as income, then net factor payments from abroad are (–$25 million), so GNP is equal to $125 million.

3. Wheat and Bread

(a) Product approach: Firm A produces 50,000 bushels of wheat, with no intermediate goods inputs. At $3/bu., the value of Firm A's production is equal to $150,000. Firm B produces 50,000 loaves of bread at $2/loaf, which is valued at $100,000. Firm B pays $60,000 to firm A for 20,000 bushels of wheat, which is an intermediate input. Firm B's value added is therefore $40,000. GDP is therefore equal to $190,000.

(b) Expenditure approach: Consumers buy 50,000 loaves of domestically produced bread at $2/loaf and 15,000 loaves of imported bread at $1/loaf. Consumption spending is therefore equal to $100,000 + $15,000 = $115,000. Firm A adds 5,000 bushels of wheat to inventory. Wheat is worth $3/bu., so investment is equal to $15,000. Firm A exports 25,000 bushels of wheat for $3/bu. Exports are $75,000. Consumers import 15,000 loaves of bread at $1/loaf. Imports are $15,000. Net exports are equal to $75,000 – $15,000 = $60,000. There is no government spending. GDP is equal to consumption ($115,000) plus investment ($15,000) plus net exports ($60,000). GDP is therefore equal to $190,000.

(c) Income approach: Firm A pays $50,000 in wages. Firm B pays $20,000 in wages. Total wages are therefore $70,000. Firm A produces $150,000 worth of wheat and pays $50,000 in wages. Firm A's profits are $100,000. Firm B produces $100,000 worth of bread. Firm B pays $20,000 in wages and pays $60,000 to Firm A for wheat. Firm B's profits are $100,000 – $20,000 – $60,000 = $20,000. Total profit income in the economy equals $100,000 + $20, 000 = $120,000. Total wage income ($70,000) plus profit income ($120,000) equals $190,000. GDP is therefore $190,000.

4. Price and quantity data are given as the following.

Year 1

Good	**Quantity**	**Price**
Computers	20	$1,000
Bread	10,000	$1.00

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Year 2		
Good	**Quantity**	**Price**
Computers	25	$1,500
Bread	12,000	$1.10

(a) Year 1 nominal GDP $= 20 \times \$1{,}000 + 10{,}000 \times \$1.00 = \$30{,}000$.

Year 2 nominal GDP $= 25 \times \$1{,}500 + 12{,}000 \times \$1.10 = \$50{,}700$.

With year 1 as the base year, we need to value both years' production at year 1 prices. In the base year, year 1, real GDP equals nominal GDP equals $30,000. In year 2, we need to value year 2's output at year 1 prices. Year 2 real GDP $= 25 \times \$1{,}000 + 12{,}000 \times \$1.00 = \$37{,}000$.

The percentage change in real GDP equals ($37,000 – $30,000)/$30,000 □ 23.33%.

We next calculate chain-weighted real GDP. At year 1 prices, the ratio of year 2 real GDP to year 1 real GDP equals g_1 = ($37,000/$30,000) = 1.2333. We must next compute real GDP using year 2 prices. Year 2 GDP valued at year 2 prices equals year 2 nominal GDP = $50,700. Year 1 GDP valued at year 2 prices equals (20 × $1,500 + 10,000 × $1.10) = $41,000. The ratio of year 2 GDP at year 2 prices to year 1 GDP at year 2 prices equals g_2 = ($50,700/$41,000) = 1.2367. The chain-weighted ratio of real GDP in the two years therefore is equal to $g_c = \sqrt{g_1 g_2} = 1.23496$. The percentage change chain-weighted real GDP from year 1 to year 2 is therefore approximately 23.5%.

If we (arbitrarily) designate year 1 as the base year, then year 1 chain-weighted GDP equals nominal GDP equals $30,000. Year 2 chain-weighted real GDP is equal to (1.23496 × $30,000) = $37,048.75.

(b) To calculate the implicit GDP deflator, we divide nominal GDP by real GDP, and then multiply by 100 to express as an index number. With year 1 as the base year, base year nominal GDP equals base year real GDP, so the base year implicit GDP deflator is 100. For the year 2, the implicit GDP deflator is ($50,700/$37,000) × 100 = 137.0. The percentage change in the deflator is equal to 37.0%.

With chain weighting, and the base year set at year 1, the year 1 GDP deflator equals ($30,000/$30,000) × 100 = 100. The chain-weighted deflator for year 2 is now equal to ($50,700/$37,048.75) × 100 = 136.85. The percentage change in the chain-weighted deflator equals 36.85%.

(c) We next consider the possibility that year 2 computers are twice as productive as year 1 computers. As one possibility, let us define a "computer" as a year 1 computer. In this

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case, the 25 computers produced in year 2 are the equivalent of 50 year 1 computers. Each year 1 computer now sells for $750 in year 2. We now revise the original data as:

Year 1		
Good	**Quantity**	**Price**
Year 1 Computers	20	$1,000
Bread	10,000	$1.00

Year 2		
Good	**Quantity**	**Price**
Year 1 Computers	50	$750
Bread	12,000	$1.10

First, note that the change in the definition of a "computer" does not affect the calculations of nominal GDP. We next compute real GDP with year 1 as the base year. Year 2 real GDP in year 1 prices is now $50 \times \$1{,}000 + 12{,}000 \times \$1.00 = \$62{,}000.$ The percentage change in real GDP is equal to ($62,000 – $30,000)/$30,000= 106.7%.

We next revise the calculation of chain-weighted real GDP. From above, g_1 equals ($62,000/$30,000) = 206.67. The value of year 1 GDP at year 2 prices equals $26,000. Therefore, g_2 equals ($50,700/$26,000) = 1.95. The percentage change chain-weighted real GDP from year 1 to year 2 is therefore 100.75%.

If we (arbitrarily) designate year 1 as the base year, then year 1 chain-weighted GDP equals nominal GDP equals $30,000. Year 2 chain-weighted real GDP is equal to (2.0075 × $30,000) = $60,225. The chain-weighted deflator for year 1 is automatically 100. The chain-weighted deflator for year 2 equals ($50,700/$60,225) × 100 = 84.18. The percentage rate of change of the chain-weighted deflator equals −15.8%.

When there is no quality change, the difference between using year 1 as the base year and using chain weighting is relatively small. Factoring in the increased performance of year 2 computers, the production of computers rises dramatically while its relative price falls. Compared with earlier practices, chain weighting provides a smaller estimate of the increase in production and a smaller estimate of the reduction in prices. This difference is due to the fact that the relative price of the good that increases most in quantity (computers) is much higher in year 1. Therefore, the use of historical prices puts more weight on the increase in quality-adjusted computer output.

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5. Price and quantity data are given as the following:

Year 1

Good	Quantity (million lbs.)	Price (per lb.)
Broccoli	1,500	$0.50
Cauliflower	300	$0.80

Year 2

Good	Quantity (million lbs.)	Price (per lb.)
Broccoli	2,400	$0.60
Cauliflower	350	$0.85

(a) Year 1 nominal GDP = Year 1 real GDP $= 1{,}500 \text{ million} \times \$0.50 + 300 \text{ million} \times \$0.80 =$ $990 million.

Year 2 nominal GDP $= 2{,}400 \text{ million} \times \$0.60 + 350 \text{ million} \times \$0.85 = \$1{,}730.5 \text{ million}$

Year 2 real GDP $= 2{,}400 \text{ million} \times \$0.50 + 350 \text{ million} \times \$0.80 = \$1{,}450 \text{ million.}$

Year 1 GDP deflator equals 100.

Year 2 GDP deflator equals ($1,730.5/$1,450) × 100 = 119.3.

The percentage change in the deflator equals 19.3%.

(b) Year 1 production (market basket) at year 1 prices equals year 1 nominal GDP □ $990 million. The value of the market basket at year 2 prices is equal to
$1{,}500 \text{ million} \times \$0.60 + 300 \text{ million} \times \$0.85$ =$1,050 million.

Year 1 CPI equals 100.

Year 2 CPI equals ($1,050/$990) × 100 □ 106.1.

The percentage change in the CPI equals 6.1%.

The relative price of broccoli has gone up. The relative quantity of broccoli has also gone up. The CPI attaches a smaller weight to the price of broccoli, and so the CPI shows less inflation.

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6. Corn producer, consumers, and government.

(a) (i) Product approach: There are no intermediate goods inputs. The corn producer grows 30 million bushels of corn. Each bushel of corn is worth $5. Therefore, GDP equals $150 million.

(ii) Expenditure approach: Consumers buy 20 million bushels of corn, so consumption equals $100 million. The corn producer adds 5 million bushels to inventory, so investment equals $25 million. The government buys 5 million bushels of corn, so government spending equals $25 million. GDP equals $150 million.

(iii) Income approach: Wage income is $60 million, paid by the corn producer. The corn producer's revenue equals $150 million, including the value of its addition to inventory. Additions to inventory are treated as purchasing one's own output. The corn producer's costs include wages of $60 million and taxes of $20 million. Therefore, profit income equals $150 million – $60 million – $20 million = $70 million. Government income equals taxes paid by the corn producer, which equals $20 million. Therefore, GDP by income equals $60 million +$70 million + $20 million = $150 million.

(b) Private disposable income equals GDP ($150 million) plus net factor payments (0) plus government transfers ($5 million is Social Security benefits) plus interest on the government debt ($10 million) minus total taxes ($30 million), which equals $135 million. Private saving equals private disposable income ($135 million) minus consumption ($100 million), which equals $35 million. Government saving equals government tax income ($30 million) minus transfer payments ($5 million) minus interest on the government debt ($10 million) minus government spending ($5 million), which equals $10 million. National saving equals private saving ($35 million) plus government saving ($10 million), which equals $45 million. The government budget surplus equals government saving ($10 million). Since the budget surplus is positive, the government budget is in surplus. The government deficit is therefore equal to (–$10 million).

7. Price controls.

Nominal GDP is calculated by measuring output at market prices. In the event of binding price controls, measured prices equal the controlled prices. However, controlled prices reflect an inaccurate measure of scarcity values. Nominal GDP is therefore distorted. In addition to distortions in nominal GDP measures, price controls also inject an inaccuracy into attempts to decompose changes in nominal GDP into movements in real GDP and movements in prices. With price controls, there is typically little or no change in white market prices over time. Alternatively, black market or scarcity value prices typically increase, perhaps dramatically. Measures of prices (in terms of scarcity values) understate inflation. Whenever inflation measures are too low, changes in real GDP overstate the extent of increases in actual production.

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8. Underground economy.

Transactions in underground economy are performed with cash exclusively, to exploit the anonymous nature of currency. The Fed always knows how much currency in total is outstanding, so if we can measure the amount of currency held abroad, we know how much is held domestically. If we then obtain a measure of how much currency is needed to support regular transactions, we can infer how much currency is supporting underground transactions, and therefore determine a measure of underground economic activity.

9. "Questionable financial activity" is essentially theft. If someone steals, there is no contribution to GDP as something is simply transferred from one individual to another. Possibly worse, the time and effort of the thief is pure waste for society, as that time and effort could be used in producing goods and services. Some financial activity could be wasteful in the same way. If workers in financial firms spend their time and effort in designing financial products for the purpose of hiding malfeasance, or to convince ill-informed consumers that such products are something they are not, that time and effort is counted as contributing to GDP, when it should not be.

10. The dollar value of a transaction need not all be a contribution to GDP. Indeed, typically only a fraction of any given transaction in the economy actually represents something we should add to GDP. For example, the production of a given good could involve many stages, with each stage of production done in a different firm. At each stage of production, the intermediate good gets passed on to the next firm in the production process, and a transaction takes place. From this chapter, we know that we only count the value-added at each stage of production toward GDP. Similarly, the financial sector contributes to GDP, but the dollar value of every financial transaction is not counted toward GDP, and rightly so. If the Bank of America makes a payment of $10 million to J.P. Morgan Chase, that payment represents the settlement of a debt between the two institutions. What is actually provided, in terms of financial goods and services, could be very small when measured correctly.

11. $S^p - 1 = CA + D$

(a) By definition:

$$S^p = Y^d - C = Y + NFP + TR + INT - T - C$$

Next, recall that $Y = C + I + G + NX.$ Substitute into the equation above and subtract I to obtain:

$$S^p - I = C + I + G + NX + NFP + TR + INT - T - C - I$$

$$= (NX + NFP) + (G + INT + TR - T)$$

$$= CA + D$$

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(b) Private saving, which is not used to finance domestic investment, is either lent to the domestic government to finance its deficit (*D*), or is lent to foreigners (*CA*).

12. The answers to parts (a) and (b) are in the table.

Year	Capital when initial capital = 80	Capital when initial capital = 100
0	80	100
1	82.0	100
2	83.8	100
3	85.4	100
4	86.9	100
5	88.2	100
6	89.4	100
7	90.4	100
8	91.4	100
9	92.3	100
10	93.0	100

In the first case, where the initial quantity of capital was 80, with a constant quantity of investment each period, the quantity of capital increases over time, but at a decreasing rate (note that the increment to the capital stock gets smaller each period). This happens because, as the capital stock grows, the total amount of capital that depreciates each period increases. The quantity of capital appears to be converging to some quantity, but what is this quantity? When the quantity of capital is initially 100, then the capital stock stays at 100 indefinitely, as long as investment is 10 each period. This is because, when the capital stock is 100, the total quantity of depreciation each period when the depreciation rate is 10% is 10, so new investment just replaces the capital that depreciates each period. Here 100 is what we would call the "steady state" quantity of capital. Steady states are useful when we study economic growth in Chapters 7 and 8.

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13. Assume the following:

$$D = 10$$
$$INT = 5$$
$$T = 40$$
$$G = 30$$
$$C = 80$$
$$NFP = 10$$
$$CA = -5$$
$$S = 20$$

(a)
$$Y^d = S^p + C$$
$$= S + D + C$$
$$= 20 + 10 + 80 = 110$$

(b)
$$D = G + TR + INT - T$$
$$TR = D - G - INT + T = 10 - 30 - 5 + 40 = 15$$

(c)
$$S = GNP - C - G$$
$$GNP = S + C + G = 20 + 80 + 30 = 130$$

(d)
$$GDP = GNP - NFP = 130 - 10 = 120$$

(e)
$$\text{Government Surplus} = S^g = -D = -10$$

(f)
$$CA = NX + NFP$$
$$NX = CA - NFP = -5 - 10 = -15$$

(g)
$$GDP = C + I + G + NX$$
$$I = GDP - C - G - NX = 120 - 80 - 30 + 15 = 25$$

14. As the unemployment rate is 5% and there are 2.5 million unemployed, it must be that the labor force is 50 million (2.5/0.05). Thus, the participation rate is 50% (50/100), the labor force 50 million, the number of employed workers 47.5 million (50 – 2.5), and the employment/population ratio is 47.5% (47.5/100).

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Chapter 2

Measurement

Macroeconomics

6th Edition

Stephen D. Williamson

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Learning Objectives, Part I

2.1 Construct measures of gross domestic product using the product approach, the expenditure approach, and the income approach.

2.2 State the importance of each expenditure component of GDP, and the issues associated with measuring each.

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Learning Objectives, Part II

2.3 Construct real and nominal GDP, and price indices, from data on quantities and prices in different years.

2.4 State the key difficulties in measuring GDP and the price level.

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Learning Objectives, Part III

2.5 State the accounting relationships among savings and income in the private and public sectors, and explain the importance of these relationships for wealth accumulation.

2.6 Construct the key labor market measures from the household survey data.

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Measuring GDP: The National Income and Product Accounts (NIPA)

- GDP Measured Using: (i) the *product approach*; (ii) the *expenditure approach*; (iii) the *income approach.*
- Show how this is done using an example.

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National Income Accounting Example

- Fictional Island Economy
- Coconut Producer, Restaurant, Consumers, Government

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Table 2.1
Coconut Producer

Table 2.1 Coconut Producer	
Total Revenue	$20 million
Wages	$5 million
Interest on Loan	$0.5 million
Taxes	$1.5 million

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Table 2.2
Restaurant

Table 2.2 Restaurant

Total Revenue	$30 million
Cost of Coconuts	$12 million
Wages	$4 million
Taxes	$3 million

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Table 2.3
After-Tax Profits

Table 2.3 After-Tax Profits

Coconut Producer	$13 million
Restaurant	$11 million

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Table 2.4
Government

Table 2.4 Government	
Tax Revenue	$5.5 million
Wages	$5.5 million

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Table 2.5
Consumers

Table 2.5 Consumers

Wage Income	$14.5 million
Interest Income	$0.5 million
Taxes	$1 million
Profits Distributed to Producers	$24 million

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Table 2.6
GDP Using the Product Approach

Table 2.6 GDP Using the Product Approach

Value added - coconuts	$20 million
Value added - restaurant food	$18 million
Value added - government	$5.5 million
GDP	$43.5 million

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Table 2.7
GDP Using the Expenditure Approach

Table 2.7 GDP Using the Expenditure Approach

Consumption	$38 million
Investment	0
Government Expenditures	$5.5 million
Net Exports	0
GDP	$43.5 million

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Table 2.8
GDP Using the Income Approach

Table 2.8 GDP Using the Income Approach

Wage Income	$14.5 million
After-tax profits	$24 million
Interest Income	$0.5 million
Taxes	$4.5 million
GDP	$43.5 million

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Table 2.9
Gross Domestic Product for 2015

Component of GDP	$Billions	% of GDP
GDP	$17,937.8	100.0
Consumption	$12,267.9	68.4
Investment	$3,017.8	16.8
Net Exports	-$531.9	-3.0
Government Expenditures	$3,184.0	17.8

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Problems in Measuring GDP

- Economic activity in the *underground economy* cannot be measured directly – this activity might be measured indirectly by accounting for the use of currency.
- Government production is difficult to measure, as the output (for example defense services) is typically not sold in the market.

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Nominal and Real GDP and Price Indices

- Price Index: Weighted average of a set of observed prices that gives a measure of the *price level.*
- Price indices allow us to measure the *inflation rate* – the rate of change in the price level.
- A measure of the inflation rate allows us to determine how much of an increase in GDP is *nominal* and how much is *real.*

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Table 2.10
Data for Real GDP Example

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	Apples	Oranges
Quantity in Year 1	$Q_1^a = 50$	$Q_1^o = 100$
Price in Year 1	$P_1^a = \$1.00$	$P_1^o = \$0.80$
Quantity in Year 2	$Q_2^a = 80$	$Q_2^o = 120$
Price in Year 2	$P_2^a = \$1.25$	$P_2^o = \$1.60$

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Figure 2.1
Nominal GDP and Chain-Weighted Real GDP

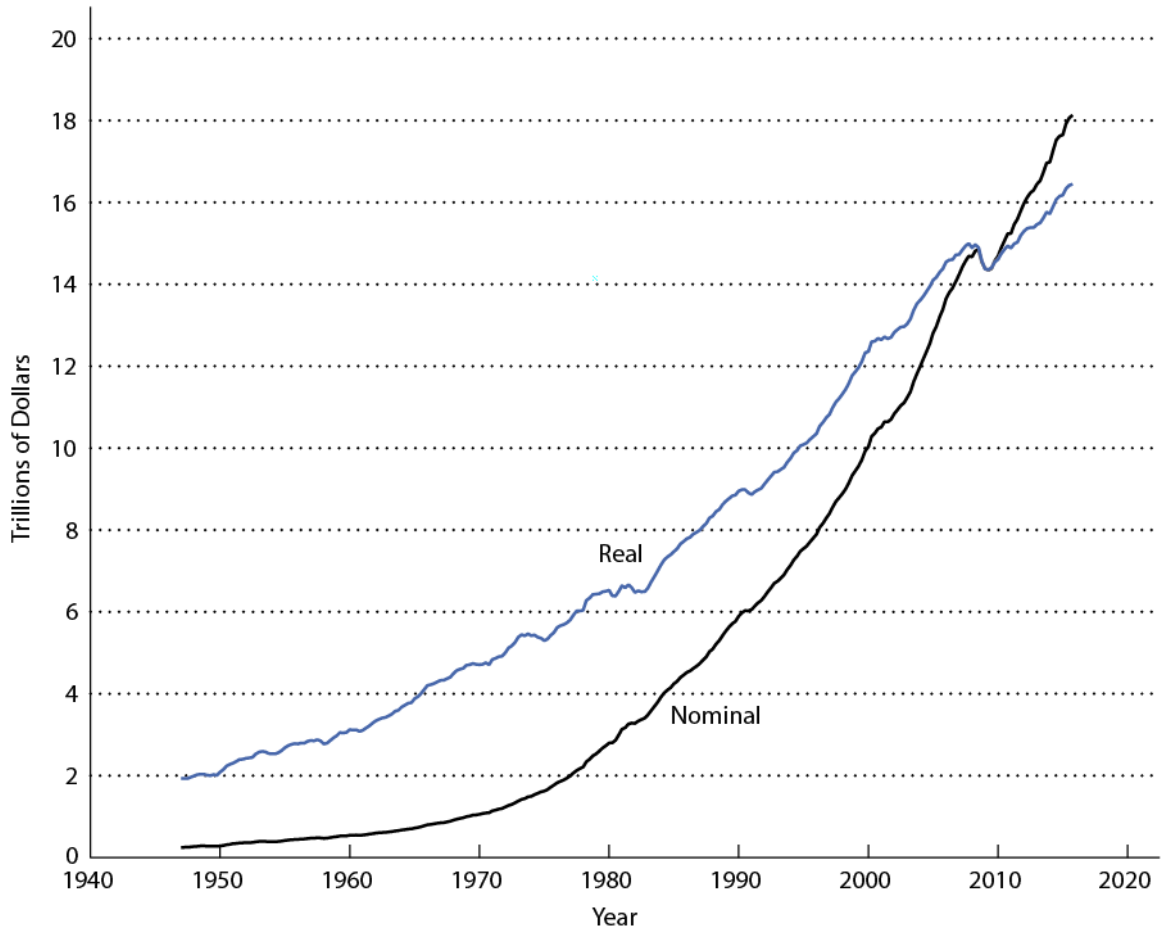

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Table 2.11
Implicit GDP Price Deflators, Example

Table 2.11 Implicit GDP Price Deflators, Example

	Year 1	Year 2	% Increase
Year 1 = base year	100	165.9	65.9
Year 2 = base year	58.4	100	71.2
Chain-weighting	100	168.5	68.5

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Figure 2.2
Inflation Rate Calculated from the CPI and from the Implicit GDP Price Deflator

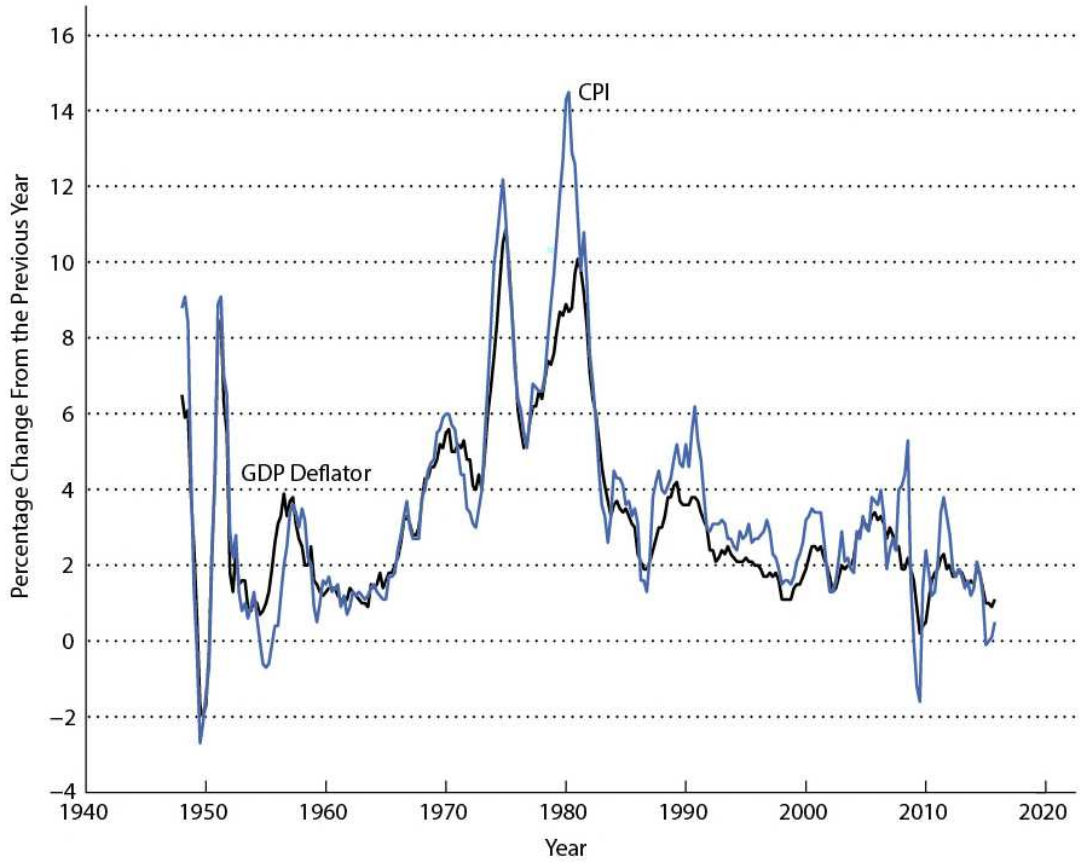

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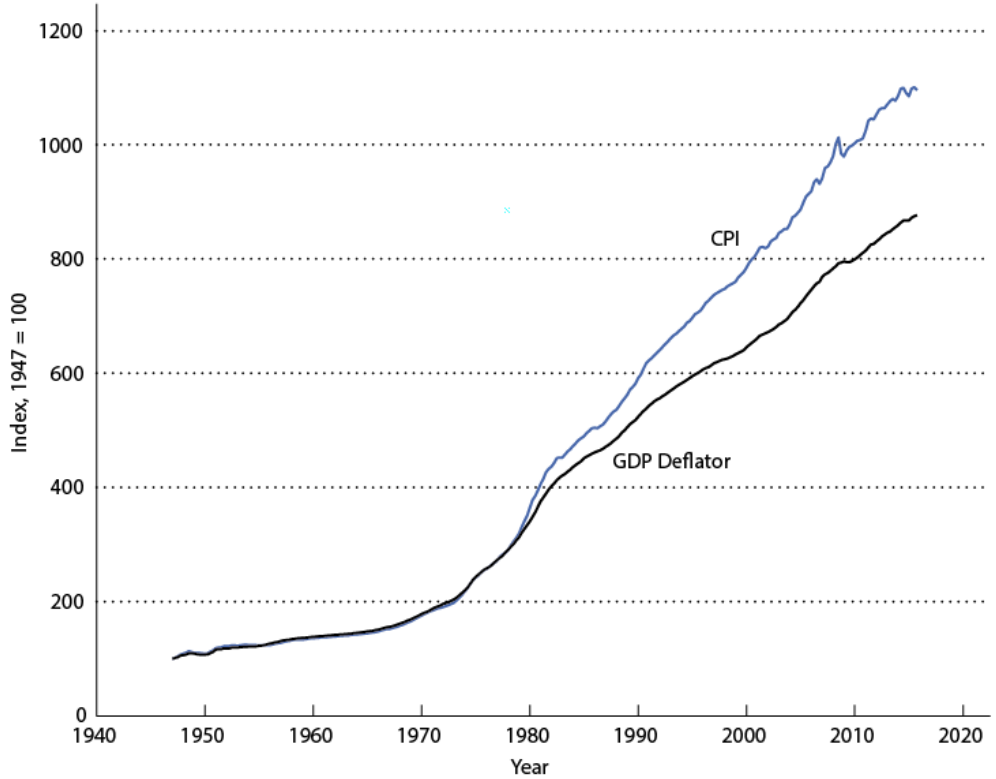
Figure 2.3
The Price Level as Measured by the CPI and the Implicit GDP Price Deflator



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Problems in Measuring Real GDP and the Price Level

- The relative prices of goods change over time – a problem for CPI measurement.
- The quality of goods and services changes over time.
- New goods and services are introduced, and some goods and services become obsolete.

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Savings, Wealth, and Capital: Part I

- Private Disposable Income:

$$Y^d = Y + NFP + TR + INT - T$$

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Savings, Wealth, and Capital: Part II

- Private Sector Saving:

$$S^p = Y^d - C = Y + NFP + TR + INT - T - C$$

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Savings, Wealth, and Capital: Part III

- Government Saving = - Government Deficit:

$$S^g = T - TR - INT - G$$

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Savings, Wealth, and Capital: Part IV

- National Saving = Private Saving + Government Saving:

$$S = S^p + S^g = Y + NFP - C - G$$

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Savings, Wealth, and Capital: Part V

- National savings is reflected in investment (new capital stock) plus the current account surplus (acquisition of claims on foreigners):

$$S = I + NX + NFP = I + CA$$

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Labor Market Measurement

- The Bureau of Labor Statistics monthly household survey divides the working-age population into three groups:
  - Employed
  - Unemployed
  - Not in the Labor Force
- Labor force = employed + unemployed

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Three Key Labor Market Measures

$$Unemployment\ Rate = \frac{number\ unemployed}{labor\ force}$$

$$Participation\ Rate = \frac{labor\ force}{working\ age\ population}$$

$$Emp - Pop\ Ratio = \frac{employment}{working\ age\ population}$$

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