CHAPTER 6(26)

*Modern Principles of Economics:*

# GDP and the Measurement of Progress

## Facts and Tools

1. According to Table 26.1, what country has the highest GDP? What country on the list has the highest GDP per person? What countries on the list have the *second-*highest GDP and the *second-*highest GDP per person?

### Solution

1. The United States has the highest GDP, with $14,447, and the highest GDP per capita. The second-highest GDP is in China with $10,807, but the second-highest GDP per person is in Canada, with $46,569.

2. What is included in GDP: all goods, all services, or both?

### Solution

2. Both.

3. What happened to spending on medical services and recreational activities since 1950?

### Solution

3. Spending on medical services and recreation has increased by more than 10 times since 1950. Clearly, we are a service economy.

4. Police officer: “I pulled you over for speeding. You were going 80 miles per hour.”

Driver: “But that’s impossible, officer! I’ve only been driving for 15 minutes!”

The government reports GDP numbers every quarter. How does this story illustrate the meaning of “GDP per year” when the GDP number gets reported every three months?

### Solution

4. Your speedometer measures how far you would travel if, hypothetically, you trav­eled at that speed for a whole hour. Similarly, when GDP gets reported for a given quarter, the government reports a number that is four times the actual number: It reports “GDP per year” just as the speedometer reports “miles per hour.”

5. Calculate the annual growth rate of nominal GDP in the following examples:

Nominal GDP in 1930: $97 billion. Nominal GDP in 1931: $84 billion.

Nominal GDP in 1931: $84 billion. Nominal GDP in 1932: $68 billion.

Nominal GDP in 2000: $9,744 billion. Nominal GDP in 2001: $10,151 billion.   
(*Source:* Historical Tables, Budget of the United States Government, *Congressional Budget Office*)

### Solution

5. 1930 to 1931 nominal GDP growth rate: ($84 billion − $97 billion)/$97 billion = −0.134 = −13.4%

1931 to 1932 nominal GDP growth rate: ($68 billion − $84 billion)/$84 billion = −0.190 = −19.0%

2000 to 2001 nominal GDP growth rate: ($10,151 billion – $9,744 billion)/$9,744 billion = 0.042 = +4.2%

6. Are the following included in U.S. GDP? Briefly explain why or why not:

a. Used cars sold at a used car store   
b. Your used car sold at your cousin’s garage sale   
c. Wine made in Napa Valley at a vineyard owned by Australians   
d. Wine made in Australia at a vineyard owned by Americans   
e. The price paid by a French tourist when staying at a San Francisco hotel   
f. The price paid by an American tourist staying at a Paris hotel   
g. A ticket for a Lakers game

### Solution

6. a. No. Used items aren’t “produced” during that year so they are not included in GDP.   
b. No. Used items don’t count, and because of measuring problems, the services of people who sell items at garage sales are not included in GDP either.   
c. Yes. What matters is where it’s made, not whether an Australian company owns the factory.   
d. No. What matters is where it’s made, not whether an American company owns the factory.   
e. Yes. The transaction made in the country itself! So, technically, it counts as an “exported service.”   
f. No. GDP is about production in the country. This service transaction occurred in France. So, if we are considering U.S. GDP, it will not be included in GDP.   
g. Yes. Entertainment services are part of the country’s income and to be included in GDP.

7. By definition, is nominal GDP higher than real GDP?

### Solution

7. No. The “price level” is just a number. The exact number is arbitrary so long as we use the same system to compare real GDP in different years. We could say that the price level in year one is 100 and calculate that in year 10 the price level is 200, for ex­ample, or we could say that the price level in year one is 7 and calculate that in year 10 it is 14. It’s the same idea as with temperature; we can measure in the Fahrenheit scale or Celsius scale so long as when we compare two temperatures, we use the same scale. Bottom line is that nominal GDP could be higher or lower than real GDP, depending on how we define the price level.

8. In the last 20 years, have recessions been getting more frequent or less frequent than they used to be?

### Solution

8. Less frequent.

9. According to the National Bureau of Economic Research, which of the following are “normally” part of the definition of a recession?

A fall in nominal income   
A fall in employment   
A fall in real income   
A fall in the price level

### Solution

9. A fall in employment and a fall in real income are part of the official definition of a recession, while a fall in prices is not. Declines in real things like jobs and spending power are what matter for defining a recession.

If, for example, the dollars in your paycheck fall, but the price of the things you buy falls by even more, then you’ve got a rise in your real income. The NBER won’t call that a recession.

10. Looking back over the last 10,000 years of human history, which is more “normal”: For GDP per capita to grow or for GDP per capita to stay about the same?

### Solution

10. It’s normal in human history for GDP per capita to stay about the same, although admittedly, it’s closer to 1/6.

11. Using the Federal Reserve Economic Data (FRED) database (<https://fred.stlouisfed.org/>) find Real US GDP. Adjust the dates to focus in on the years 2005 to 2016. The recession in 2008–2009 will be highlighted in gray. Looking at the quarterly data (click edit graph and modify frequency to Quarterly if the data is not already presented quarterly.)

a. What was the highest level of real GDP prior to the recession?

b. In what year and quarter did U.S. real GDP first exceed its pre-recession level?

### Solution

11. a.

A graph shows the real gross domestic product with billions of chained 2009 dollars on the vertical axis and years on the horizontal axis.
The approximate data are as follows. The curve begins at 14,200 in 2005 and shows a gradual increase to 14,950 in 2008 and then shows a drop to 14,320 in 2009 and again shows a gradual increase and ends at 14,650 in 2016. The curve shows mild crests and troughs along its length. The recession period is shaded between the years, 2008 and 2009. 

The highest level of real GDP prior to the recession was $14,991.8 billion in Q4 of 2007.

b. U.S. real GDP exceeded its pre-recession level only in Q3 of 2011 when it reached $15,021.1 billion.

12. Using the Federal Reserve Economic Data (FRED) database (<https://fred.stlouisfed.org/>), let’s sum up real GDP using its components. Recall that GDP = *C* + *I* + *G* + Net Exports, so start by finding “Real personal consumption expenditures” (*C*), use the “Billions of Chained 2009 Dollars, Quarterly, Seasonally Adjusted Annual Rate” series. Now click Add Line and find a similar series for real investment (*I*). Now click Add Line again and look for Real Government Consumption Expenditures and Gross Investment (*G*), again in billions of dollars. Now click on Add Line one more time and look for real Net Exports (*NX*) (the last series is only available in this form since 1999).

a. Graph the result.

b. In the 2009 recession which series fell by the most?

c. In the first quarter of 2010, what share of GDP was made up by Consumption? Note that you should *not* have to look up a separate GDP figure to make this calculation.

### Solution

12. a.

A graph shows the components of real gross domestic product with billions of chained 2009 dollars on the vertical axis and years on the horizontal axis.
The approximate data are as follows. The curve that represents real personal consumption expenditures begins at 7,900 in 1998 and shows a gradual increase and ends at 11,800 in 2016. The curve that represents real gross private domestic investment begins at 2,000 in 1998 and shows a gradual increase and ends at 3,000 in 2016. The curve that represents real government convention expenditures and gross investment begins at 2,100 in 1998 and shows a gradual increase and ends at 3,000 in 2016. The curve that represents real net exports of goods and services begins at 0 in 1998 and ends at 0 in 2016 with mild deviations throughout its length.

b. Investment. During the 2008–2009 recession consumption fell slightly, government purchases and government investment increased slightly, net exports increased but were still negative. The biggest fall was in Investment, which is typical for a recession.

c. 67.9%. *GDP* = *C* + *I* + *G* + *NX* which in the first quarter of 2010 was:

9917.7 *C*

2012.9 *I*

3084.3 *G*

−408.8 *NX*

14606.1 *GDP*

67.90108 *C/G* × 100

13. What is the national spending identity? This identity is very important in macro-economics. It is as important as basic anatomy in medical school: You won’t be able to cure anyone until you know what’s inside a person.

### Solution

13. *Y* = *C* + *I* + *G* + *NX*, or gross domestic product equals consumption plus invest­ment plus government purchases plus net exports.

## Thinking and Problem Solving

14. Calculate GDP in this simple economy:

Consumer purchases: $100 per year   
Investment purchases: $50 per year   
Government purchases: $20 per year   
Total exports: $50 per year   
Total imports: $70 per year

### Solution

14. *Y* = *C* + *I* + *G* + *NX* = $100 + $50 + $20 + ($50 − $70) = $150 per year

15. Since World War II, who were the only three recession-free U.S. presidents? (We’ll revisit the question of how presidents matter for the economy in later chapters.)

### Solution

15. John F. Kennedy, Lyndon B. Johnson, and Bill Clinton

16. We noted that “government purchases” don’t include all government spending. A big part of what the U.S. government does is transfer money from one person to another. Social security (payments to retirees), and Medicare and Medicaid (paying for medical care for the elderly and the poor) make up most of these “government transfers.” We’ll look into this in more detail in the chapter on the Federal Budget, but right now, let’s see how big “government transfers” are and how fast they’ve grown in the federal government’s budget. The figures in this table are all in non-inflation-adjusted dollars. Complete the table.

A table with three rows and four columns shows the federal transfers.
The data are as follows. In the year 1950, the total federal transfers are 10.3 billion dollars, the total federal spending is 47 billion dollars, and the transfers as percent of spending is unfilled; In the year 2016, the total federal transfers are 1,961 billion dollars, the total federal spending is 4,023 billion dollars, and the transfers as percent of spending column is unfilled; the growth rate in percentage row  for the above years is unfilled.

### Solution

16. Transfers as percent of spending in 1950: 21.9%   
Transfers as percent of spending in 2016: 48.7%   
Growth in transfers: 18,938%   
Growth in federal spending: 8,459%

17. Let’s figure out GDP for Robinson Crusoe.

a. Initially he is stuck on an island without the wisdom and local knowledge of Friday. Because Crusoe is a proper Englishman, he wants to keep his accounts. This year, he catches and eats 2,000 fish valued at one British pound (£) each, grows and eats 4,000 coconuts valued at £0.5 each, and makes 2 huts (housing) valued at £200 each.

If government purchases are zero and there is no trade, what is *C* for Crusoe? What is *I*? What is *Y*? (We are going to start using those letters as if they mean something: See question 13 in the previous section.)

b. One year, he learns of a tribe on a nearby island who are willing to trade with him: If he gives fish, they give clams. He produces just as much as before, but he trades 500 of the 2,000 fish and receives 10,000 clams valued at 5 clams per British pound. What is the British pound value of the exported fish? Of the imported clams? What are *C*, *I*, and *NX* now? What is GDP now?

c. The following year, Crusoe produces the same as in every other year, but a tribe on the other side of the island steals his two huts after he makes them, and gives him nothing in return. So he exports, but does not import at all. What are *C*, *I*, *NX,* and *Y* now?

d. In Crusoe’s final year on the island, he produces the same as in every other year (he’s a reliable worker), but a new shipwreck washes up on his island containing a clock worth £3, a new shirt worth £2, and a copy of Milton’s *Paradise Lost* and Shakespeare’s complete works, each worth £1. Treat these as imported consumer goods. What is GDP this year? (*Note:* Emphasize the “P” in GDP when considering your answer.) What are *C*, *I*, *NX*, and *Y* this year? (*Note:* One of the four is bigger than usual, one is negative.)

e. Is Crusoe probably happy about what happens in question 17c? Is he probably happy about what happens in question 17d? Keep these answers in mind for when we discuss the economics of trade later on.

### Solution

17. a. *Y* = £4,400: £2,000 + £2,000 + £400. *C* = £4,000, *I* = £400.

b. The fish are worth £500, the clams are worth £2,000. *C* = £1,500 + £2,000 + £2,000 = £5,500. *I* = £400, *NX* = £500 − £2,000 = £1,500 GDP = 4,400.

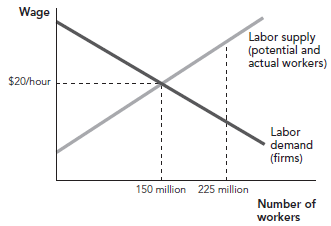
c. Production (GDP) is still the same! But he now has no investment: That be­comes an export. *C* = £4,000, *I* = 0, and *NX* = £400.

d. As always, GDP is £4,400. But now *C* = £4007, *I* = £400, and *NX* = −£7. Note that all of the washed-up goods are consumer goods, but they are all “imported,” so we have to make sure they don’t show up in the final GDP value!

e.Crusoe is unhappy in question 5c: Those exports give him nothing in return. He is probably happier about question 5d: Importing stuff gives him more to consume, plus he gets to consume new things that he values more.

18. Let’s think about an economically sound way to measure the value of leisure. To keep this simple, we’ll just think about the value of leisure to people who *could* work but who decide to stay home. Also, we won’t think about how much *actual* workers value their free time, or how much children and retirees value their time.

In a standard supply and demand labor model, firms “demand” labor while workers “supply” labor. Let’s think about a labor market that is in equilibrium, with a wage of $20 per hour (close to the U.S. average) and with 150 million Americans working out of a total of 225 million working-age Americans.



a. According to this simplified model of the U.S. economy, some workers *would* work if the wage were higher, but at the current wage, they’d rather stay home and watch reruns of *Seinfeld* or (don’t let this be you!) *Two and a Half Men*. For the workers who are right on the margin between working and not working, what would their wage be if wages rose ever so slightly and they went to work?

b. Let’s use this wage as a shorthand for how much nonworkers value their time. After all, the “opportunity cost” of their free time must be at least this high, because otherwise they’d take a job. Now, let’s calculate a GDP measure that adds in a rough estimate of the value enjoyed by these nonworkers. We’ll use the following identity, and we’ll round the value of nominal GDP to $14 trillion (close to the actual 2008 level).

Leisure-augmented GDP = Regular GDP + Total monetary value of leisure

If the average working person works 2,000 hours per year (that’s a 40-hour week for 50 weeks a year), then what is the leisure- augmented value of U.S. GDP?

### Solution

18. a. $20 per hour or if you like $20.01, but we will use $20.

b. $14 trillion + 75 million × $20 × 2,000 hours = $17 trillion.

19. The underground economy and other nonpriced production make it hard to ac­curately measure the precise level of GDP. But GDP could still be very accurate for measuring changes in the economy. If Janet Yellen, the Federal Reserve chairman, is trying to find out whether the U.S. economy has gone into a recession, are the difficul­ties of measuring nonpriced production likely to be important problems for his purpos­es? How is this like always wearing your shoes when you step on the bathroom scale?

### Solution

19. No, the underground economy doesn’t necessarily pose a problem for Chairman Yellen. It’s about the same size, year in and year out, so it’s like measuring tem­perature in Centigrade versus Fahrenheit: If all you care about is whether it’s getting hotter or getting cooler, either thermometer will work just fine. Again, it’s like going on the bathroom scale with your shoes on: As long as you always wear your shoes, you can still tell whether you’re gaining or losing weight every week.

20. a. U.S. GDP is approximately $18 trillion and the U.S. population is approximately 320 million. If GDP were divided equally among the U.S. population what would each person get? If you and your nine best friends took almost all U.S. GDP for yourself but gave $3,000 per person to everyone else, how much would you get each year, just for yourself?

b. More seriously, there are currently about 229,000 U.S. taxpayers who earn more than $1.5 million per year. If you could take their money and divide it up equally among the U.S. population of 320 million other Americans, how much money could you give each person? Note that $1.5 million is the cutoff. On average this group earns about $4.4 million per year so use that number in your calculations.

c. How can large numbers of people get rich? Comment on economic growth versus redistribution.

### Solution

20. a. Approximately $56 thousand, U.S. GDP per capita. Giving $3,000 to each of 320 million people would cost you $960 billion—call it 1 trillion. U.S. GDP is $18 trillion, which would leave you and your 9 friends with a little less than $1.7 trillion each!

b. 229,000 × 4.4 million = $1,007,600,000,000 (about 1 trillion). Dividing that by 320 million we have $3,148.

c. Question a shows that a small number of people can get very rich by taking from a large group of people. That’s why it can pay to be a dictator, even in a relatively poor country. Question b shows that large numbers of people can’t get rich by redistributing income from a relatively small group of people. An extra $3,148 isn’t bad, but compared to GDP per capita of $56 thousand,

it’s not a huge number either. At U.S. levels of economic growth of 2.5% per year it’s just over two years of ordinary income growth. Moreover, you could only do the redistribution once. After the first redistribution people would have much less incentive to earn more than $1.5 million. The lesson here is that the only way that *large* numbers of people can become rich is through economic growth. Redistribution can help with extreme poverty but it cannot make large numbers of people rich.

(Data [2014] can be found from the IRS https://www.irs.gov/uac/soi-tax-stats-individual-statistical-tables-by-size-of-adjusted-gross-income.)

21. Let’s sum up some basic facts of U.S. economic history with numbers:

a. First, let’s measure the size of the Great Depression:

Real GDP in 1929 Real GDP in 1933   
(peak): $323 billion (trough): $206 billion   
Price level in 1929: 33 Price level in 1933: 24

Calculate the percent change in real GDP and the percent change in the price level from 1929 to 1933. First, calculate the total change, and then divide it by the number of years to get the more typical measure of “percent per year.” (*Note:* This is four full years, not three or five.)

b. Second, let’s measure how much the economy grew from the lowest depths of the Depression to the peak of World War II’s economic boom:

Real GDP in 1933 Real GDP in 1945  
(trough): $206 billion $596 billion   
Price level in 1933: 24 Price level in 1945: 38

Again, first calculate the total change, and then divide it by the number of years to get the more typical measure of “percent per year.”

c. Finally, let’s see if a growing economy must mean growing prices:

Real GDP in 1870 Real GDP in 1900   
$36 billion $124 billion   
Price level in 1870: 22 Price level in 1900: 16

Calculate the total and annual growth rates as before. (*Note:* The price level fell fairly smoothly across these three decades, a time when the economy grew rapidly and many great American novels were written about life in the growing cities.)

(*Source:* Gordon, Robert J. ed., *The American Business Cycle: Continuity and Change.* Cambridge, MA, National Bureau of Economic Research, 1986.)

### Solution

21. a. Real GDP fell by 36%, and the price level fell by 27%; a 9% per year fall in real GDP, and a 6.75% fall in prices per year.

b. 189% and 58%; annually it’s 16% and 5%.

c. 244% and −27%; annually it’s 8% and −1%. (After calculating, the value of annual price growth is −27%/29 = −0.93. It is not an exact −1%.) So prices can indeed fall during long periods of economic growth. Worth keeping in mind for later.

22. What is the difference between a nation’s *wealth* and its *GDP*? How are the two related?

### Solution

22. Wealth is a nation’s stock of useful goods and resources at a given point in time. GDP is the flow of goods and services and thus is the annual addition to this stock.

## Challenges

23. Consider the following claim:

*Europeans have strong labor unions, so their workers get a bigger share of the pie than American workers.*

Let’s use the FRED economic database (<https://fred.stlouisfed.org/>) to examine this claim. Search for Share of Labor Compensation in GDP at Current National Prices for United States. Click on the starting date and change it to 1990 (The data for other countries is not always very good before 1990.) Now click Add Line and search for Share of Labor Compensation Germany. You should find the same series for Germany, click on it and then Add Data Series. Follow the same procedure to add a line for the Share of Labor Compensation in GDP in Italy.

It is true that Europeans have stronger labor unions than Americans, but is the claim we began with true? What does our analysis of the data tell us about what strong unions and labor regulation can and can’t do?

### Solution

23.

A graph shows share of labour compensation in GDP at current national prices for United States, Germany, and Italy with ratio on the vertical axis and year on the horizontal axis.
The approximate data are as follows. The share of labour compensation in GDP at current national prices for Germany begins at 0.675 in 1990 and shows a gradual increase to 0.685 in 1992 and then shows a decrease to 0.645 in 1998 and again shows an increase to 0.66 in 2000 and then shows a decrease to 0.584 in 2007 and again shows an increase and ends at 0.62 in 2014. The share of labour compensation in GDP at current national prices for United States begins at 0.42 in 1990 and shows an increase to 0.642 in 1998 and then shows a decrease and ends at 0.604 in 2016.  The share of labour compensation in GDP at current national prices for Italy begins at 0.584 in 1990 and shows a decrease to 0.54 in 1995 and then shows a gradual increase and ends at 0.54 in 2016.  All the curves have mild crests and troughs throughout their lengths. Three shaded portions which indicate recession are shown between the years 1990 and 1991, 2001 and 2002, and 2008 and 2009.

You should have produced a graph like the one below. Labor compensation in the United States and Germany is about the same, especially since 2000 and labor compensation in the United States is higher than in Italy.

What this suggests is that in the big picture it’s may not be easy for labor unions or labor regulations to dramatically increase the share of GDP that flows to labor. Understanding the forces that determine labor’s share of GDP is a difficult and important question that is not well understood. Moreover, you should take these data with a grain of salt. Labor compensation, for example, includes benefits as well as wages and correctly accounting for benefits such as health insurance isn’t easy, especially since how health insurance is paid for differs dramatically between Italy, Germany and the United States. The lesson is that even seemingly sensible claims should be tested against the data.

24. During World War II, the government did a good job measuring nominal GDP. But if the price level was calculated incorrectly, we might get a completely wrong idea about what happened with real GDP. During World War II, price ceilings were in place. That means that some things that would’ve been expensive were artificially cheap instead. Within a few years of the war’s end, price controls finally ended, and the price level spiked up about 20%. If the true price level *during the war* was actu­ally 20% higher than reported, would that mean that real GDP is higher than the official number in question 21b in the previous section, lower than that number, or is it still the same as that number?

### Solution

24. If the true price level during the war was 20% higher, then real GDP was lower than we think. In other words, the growth rate in real GDP in 1945 is much too high. In addition, munitions were added to GDP during the war. True, that is part of gross domestic production but it’s not the same as the production of consumer items, so GDP during the war also exaggerates the standard of living.

25. If U.S. government statistics counted education spending as part of investment, which would rise, which would fall, and which of the following would remain unchanged? (*Note:* You might use rise, fall, and unchanged more than once each or you might not.)

Consumption   
Investment   
Gross domestic product

### Solution

25. Consumption would fall, investment would rise, and GDP would remain unchanged.

26. If U.S. government statistics counted people who are receiving unemployment benefits as people who are “government employees” hired to “search for work,” which of the following would rise, which would fall, and which would remain unchanged? (*Note:* You might use rise, fall, and unchanged more than once each or you might not.)

Consumption   
Government purchases   
Gross domestic product

### Solution

26. Consumption would stay the same, government purchases would rise, and GDP would rise.

27. According to legend, some government employees do very little work. If this leg­end is true enough to be important, then we may be measuring GDP incorrectly. Officially, we say that these are “employed workers,” but to a great extent these “employees” are really unemployed in any useful task; they are receiving transfer payments and watching YouTube for 40 hours per week. If instead government statistics counted these YouTube-watching government employees as simply retired or unemployed, which of the following would rise, which would fall, and which would remain unchanged? (*Note:* You might use rise, fall, and unchanged more than once each or you might not.)

Consumption   
Government purchases   
Gross domestic product

### Solution

27. Consumption would remain unchanged, government purchases would fall, and GDP would fall.