Chapter 8: GDP: Measuring Total Production and Income

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Learning Objectives

1. Gross Domestic Product Measures Total Production.
2. Does GDP Measure What We Want It to Measure?
3. Real GDP versus Nominal GDP.
4. Other Measures of Total Production and Total Income.
Macroeconomics: The study of the economy as a whole, including topics such as business cycle, economic growth, inflation, and unemployment.

When we want to study the overall economy-level actions of people and governments, the models and tools of macroeconomics become very useful.

Business cycle: Alternating periods of economic expansion and economic recession.

Expansion: The period of a business cycle during which total production and total employment are increasing.

Recession: The period of a business cycle during which total production and total employment are decreasing.

Economic growth: The ability of an economy to produce increasing quantities of goods and services.

Inflation rate: The percentage increase in the price level from one year to the next.
Measuring Total Production: Gross Domestic Product

- **Gross domestic product (GDP):** The market value of all final goods and services produced in a country during a period of time, typically one year.
  - GDP is measured using *market values*, not quantities. We measure production by taking the value, in dollar terms, of all the goods and services produced. We cannot add together the number of cars, haircuts, and all other goods and services without agreeing on a common way to measure them.
  - GDP includes only the market value of *final goods*.

- *Final* good or service: A good or service (G&S) purchased by a final user.
- *Intermediate* good or service: A good or service (G&S) that is an input into another good or service, such as a tire on a truck. To avoid double counting, we do not include the value of intermediate goods or services in calculating GDP.
(Conti.) 

**Gross domestic product (GDP)**

- GDP includes only *current production*. GDP includes only production that takes place during the indicated time period.
- E.g., if you buy a DVD in 2011, that DVD counts in 2011’s GDP. If you resell it in 2012, it will not count again in 2012. GDP counts only new goods and services. Used items were previously produced and counted, so don’t need to be counted again.
Example: Calculating GDP

Suppose that a very simple economy produces only four goods and services: eye examinations, pizzas, textbooks, and paper. Assume that all the paper in this economy is used in the production of textbooks. Use the information in the following table to compute GDP for the year 2013:

<table>
<thead>
<tr>
<th>Product</th>
<th>(1) Quantity</th>
<th>(2) Price per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye examinations</td>
<td>100</td>
<td>$50.00</td>
</tr>
<tr>
<td>Pizzas</td>
<td>80</td>
<td>10.00</td>
</tr>
<tr>
<td>Textbooks</td>
<td>20</td>
<td>100.00</td>
</tr>
<tr>
<td>Paper</td>
<td>2,000</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Add the value for each of the three final goods and services to find GDP. GDP = Value of eye examinations produced + Value of pizzas produced + Value of textbooks produced = $5,000 + $800 + $2,000 = $7,800.
There are two main conceptual ways to measure the total economic activity in an economy: total production or total income. When we measure one, we are also measuring the other.

- The value of total production = the value of total income.

Why? Everything that is produced and sold constitutes income for someone; so we have the choice of measuring the value of products produced and sold, or the value of incomes, and each is a valid way of measuring economic activity.

Four factors of production:

- Labor
- Capital
- Natural resources (e.g. land)
- Entrepreneurship.
(Conti.) Four corresponding categories of income: wages, interest, rent, and profit.

Governments also make payments for wages and interest to households in exchange for hiring workers and other factors.

Transfer payments: Payments by the government to individuals for which the government does *not* receive a G&S in return.
  - e.g., social security payments to retired and disabled people, unemployment insurance payments to unemployed workers.
In a very simple model of the economy, we could start with households and firms.

To measure overall economic activity, we could measure the amount of money that households spend on goods and services.

Or we could measure income to households.

**Figure 8.1**
The circular flow and the measurement of GDP
Let’s add in some more layers. We’ll start with government.

How does the government affect economic activity?

- It takes in taxes from households and firms.
- It uses those taxes to buy goods and services, and to make transfer payments—payments to households for which the government does not receive a good or service in return.

**Figure 8.1**

The circular flow and the measurement of GDP.
Some economic activity takes place between households, firms, and the rest of the world.

- Households buy goods and services from firms in other countries; these are known as *imports*.
- Firms sell goods and services to households in other countries; these are known as *exports*.
Finally, there are firms that deal specifically in flows of money; we label these firms the financial system.

- Households elect not to spend some of their income, and instead save it with financial system firms like banks.
- These financial system firms lend money to other firms and the government.

Figure 8.1
The circular flow and the measurement of GDP
Components of GDP

- The BEA divides its statistics on GDP into four major categories of expenditures: Consumption, Investment, Government purchases, and Net exports. Economists use these categories to understand why GDP fluctuates and to forecast future GDP.

- **Consumption (or Personal Consumption Expenditures):** Spending by households on goods and services, *not* including spending on new houses. In BEA statistics, consumption expenditures include:
  - expenditures on *services* (medical care, education, etc.).
  - expenditures on *nondurable goods* (food and clothing).
  - expenditures on *durable goods* (automobiles and furniture).
(Conti.)

- **Investment (Gross Private Domestic Investment):**
  1. Spending by firms on new factories, office buildings, machinery, and additions to inventories;
  2. spending by households and firms on new houses.

- Investment is divided into three categories:
  - *business fixed investment*: spending of firms on new factories, office buildings, etc.;
  - *residential investment*: spending of households on new houses;
  - *changes in business inventories*: goods that have been produced but not yet sold.
- **Government purchases**: Spending by *federal, state, and local governments* on G&S, e.g. teachers’ salaries, highways, etc.
  - This does not include transfer payments, since those do not result in immediate production of new goods and services.

- **Net exports**: the value of exports minus the value of imports. This difference might be positive or negative; in recent years, this has been negative in the U.S.
  - *exports*: The G&S produced in the U.S. that are purchased by foreign firms, consumers, and governments.
  - *imports*: G&S produced in foreign countries, but purchased by U.S. firms, consumers, and governments.

- An Equation for GDP (or GDP identity):
  \[ Y = C + I + G + NX \] (1)
Components of GDP in 2012

**Components of GDP (billions of dollars)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>$11,150</td>
</tr>
<tr>
<td>Durable goods</td>
<td>$1,203</td>
</tr>
<tr>
<td>Nondurable goods</td>
<td>2,567</td>
</tr>
<tr>
<td>Services</td>
<td>7,380</td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td>2,475</td>
</tr>
<tr>
<td>Business fixed investment</td>
<td>1,970</td>
</tr>
<tr>
<td>Residential investment</td>
<td>439</td>
</tr>
<tr>
<td>Change in business inventories</td>
<td>66</td>
</tr>
<tr>
<td><strong>Government purchases</strong></td>
<td>3,167</td>
</tr>
<tr>
<td>Federal</td>
<td>1,296</td>
</tr>
<tr>
<td>State and local</td>
<td>1,871</td>
</tr>
<tr>
<td><strong>Net Exports</strong></td>
<td>-547</td>
</tr>
<tr>
<td>Exports</td>
<td>2,196</td>
</tr>
<tr>
<td>Imports</td>
<td>2,743</td>
</tr>
<tr>
<td><strong>Total GDP</strong></td>
<td>$16,245</td>
</tr>
</tbody>
</table>

![Components of GDP in 2012](image)

**Figure 8.2** Components of GDP in 2012

Consumption is the largest component of GDP; within that, services are the largest component—almost half of GDP.

American net exports are negative, since the value of our imports exceeds the value of our exports.
The above table provides a more detailed breakdown and shows several interesting points:

- Consumer spending on services is greater than the sum of spending on durable and nondurable goods.
- Business fixed investment is the largest component of investment.
- Purchases by state and local governments are greater than purchases by the federal government.
- Imports are greater than exports, so net exports are negative.
Measuring GDP Using the Value-Added method

An alternative method to measure GDP is to measure the **value added**: the market value a firm adds to a product.

The final selling price of a product must equal the sum of the values added to the product at each stage of production.

The table below illustrates this method for a shirt sold on L.L.Bean’s web site.

<table>
<thead>
<tr>
<th>Firm</th>
<th>Value of Product</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton farmer</td>
<td>Value of raw cotton = $1</td>
<td>Value added by cotton farmer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 1</td>
</tr>
<tr>
<td>Textile mill</td>
<td>Value of raw cotton woven into cotton fabric = $3</td>
<td>Value added by cotton textile mill = ($3 − $1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 2</td>
</tr>
<tr>
<td>Shirt company</td>
<td>Value of cotton fabric made into a shirt = $15</td>
<td>Value added by shirt manufacturer = ($15 − $3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 12</td>
</tr>
<tr>
<td>L.L.Bean</td>
<td>Value of shirt for sale on L.L.Bean’s Web site = $35</td>
<td>Value added by L.L.Bean</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= ($35 − $15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 20</td>
</tr>
<tr>
<td></td>
<td><strong>Total Value Added</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>= $35</strong></td>
</tr>
</tbody>
</table>

**Table 8.1** Calculating value added
Shortcomings in GDP

- GDP has shortcomings, both in its measure of total production, and in its usefulness as a measure of well-being.

When the BEA calculates GDP, it does not include two types of production:

- **Household production**: Goods and services people produce for themselves that are not bought and sold in markets.
  - e.g., If a person has been caring for children, cleaning house, and preparing the family meals, the value of such services is not included in GDP.

- **Underground economy**: Buying and selling of G&S that is concealed from the government to avoid taxes or regulations or because the goods and services are illegal.
  - This may be 10% or more of the economy in the US. In some developing countries, more than half the workers may be in the underground economy.
(Conti.) The Value of Leisure Is Not Included in GDP. If Americans still worked 60-hour weeks as they typically did in 1890, GDP would be much higher than it is, but the well-being of the typical person would be lower because less time would be available for leisure activities.

- E.g., if an economic consultant decides to retire, GDP will decline while his well-being will increase if he values leisure more than the income he earns in the company.

GDP is not adjusted for pollution or other negative effects of production.

- Although GDP does not take into account negative effects of production, countries are known to devote more resources to reducing these effects as GDP increases.
(Conti.) GDP is not adjusted for *changes in crime* and other social problems.

- An increase in crime reduces well-being but may actually increase GDP if it leads to greater spending on police, security guards, and alarm systems.

The distribution of income. GDP Measures the Size of the Pie but Not How the Pie Is Divided Up GDP may not provide good information about the G&S consumed by the typical person.

Summary: A person’s well-being depends on many factors that are not taken into account in calculating GDP. In fact, improvements in many of these will result in lower GDP per capita.
Did World War II Bring Prosperity?

World War II was a period of extraordinary sacrifice and achievement by the “greatest generation.” But statistics on GDP may give a misleading indication of whether it was also a period of prosperity:

- Production was very high, but much of the production was of military goods—so people weren’t becoming more well-off.
- After the war, GDP fell; but the production of consumption goods rose rapidly.
Calculating Real GDP

- Since GDP is measured in “value” terms, we might have problems interpreting changes over time if prices change. Is an increase in GDP due to production increasing, or due to prices increasing?

- *Real GDP*: The value of final goods and services evaluated at *base year prices*.

- *Nominal GDP*: The value of final goods and services evaluated at *current year prices*.

- Real GDP *holds prices constant*: It is a better measure than nominal GDP for changes in the production of G&S from one year to the next.
One drawback to calculating real GDP using base-year prices is that, over time, prices may change relative to each other, distorting real GDP estimates more the further away the current year is from the base year.

To make the calculation of real GDP more accurate, in 1996, the BEA switched to using chain-weighted prices, and it now publishes statistics on real GDP in “chained (2005) dollars.” In this way, prices in each year are “chained” to prices from the previous year, and the distortion from changes in relative prices is minimized.
Calculating Real GDP: An Example

The table shows output and prices in 2009 and 2015.

Calculating the total value of output in 2009 gives:

\[ $3200 + $990 + $1350 = $5540. \]

To calculate real GDP in 2015, we use the prices from 2009.

- This gives real 2015 GDP in 2009 dollars of $6680.

Most prices increased from 2009 to 2015, so using nominal GDP would have yielded a higher figure: $7800.

- This highlights the need to use real GDP to avoid exaggerating growth.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye examinations</td>
<td>80</td>
<td>$40</td>
<td>100</td>
<td>$50</td>
</tr>
<tr>
<td>Pizzas</td>
<td>90</td>
<td>11</td>
<td>80</td>
<td>10</td>
</tr>
<tr>
<td>Textbooks</td>
<td>15</td>
<td>90</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>2015 Quantity</th>
<th>2015 Price</th>
<th>2009 Price</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye examinations</td>
<td>100</td>
<td>$40</td>
<td>80</td>
<td>$4,000</td>
</tr>
<tr>
<td>Pizzas</td>
<td>80</td>
<td>11</td>
<td>100</td>
<td>880</td>
</tr>
<tr>
<td>Textbooks</td>
<td>20</td>
<td>90</td>
<td>80</td>
<td>1,800</td>
</tr>
</tbody>
</table>
Comparing Real GDP and Nominal GDP

The current base year for calculating prices is 2009, so real and nominal GDP are equal in 2009.

Growth figures reported in the media are the growth in real GDP.

Since prices have generally increased since 2009, real GDP is less than nominal GDP, and the opposite is true before 2009.

Figure 8.3 Nominal GDP and real GDP: 1990-2012
Economists and policy-makers are interested in the price level. Stable prices are desirable because they allow households and firms to plan for the future appropriately.

**Price level**: A measure of the average prices of goods and services in the economy.

In order to know whether we are achieving price stability, we need to measure the price level. **GDP deflator**: A measure of the price level, calculated by dividing nominal GDP by real GDP, and multiplying by 100:

\[
\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100. \tag{2}
\]

Nominal GDP is equal to real GDP in the base year, so the value of the GDP price deflator will always be 100 in the base year.
Calculating the GDP Deflator

The table on the right gives the values of nominal and real GDP for 2011 and 2012.

We can use this to calculate the GDP deflator in each year:

<table>
<thead>
<tr>
<th>Formula</th>
<th>Applied to 2011</th>
<th>Applied to 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \text{GDP Deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100 ]</td>
<td>(( \frac{15,534 \text{ billion}}{15,052 \text{ billion}} )) \times 100 = 103</td>
<td>(( \frac{16,245 \text{ billion}}{15,471 \text{ billion}} )) \times 100 = 105</td>
</tr>
</tbody>
</table>

The GDP deflator increased from 103 to 105 between the two years. This is a 1.9% increase:

\[ \left( \frac{105 - 103}{103} \right) \times 100 = 1.9\% \]

So we say the price level rose 1.9% over this period.
National income accounting refers to the methods the BEA uses to track total production and total income in the economy. The statistical tables containing this information are called the *National Income and Product Accounts (NIPA)* tables.

**Gross National Product (GNP):** The value of final G&S produced by residents of the US, even if the production takes place outside of the US.

**National Income:** Calculated as GDP minus the consumption of fixed capital, or depreciation.

**Personal Income:** Income received by households including transfer payments or interest on gov. bonds.

- To calculate personal income, we subtract the earnings that corporations retain rather than pay to shareholders in the form of dividends.
- We also add in the payments received by households from the government in the form of transfer payments or interest on government bonds.
NIPA Measurements

The table and graph show the various measures of the national income accounts for the United States in 2012.

- National income must be smaller than GDP, since it is just GDP minus depreciation.
  
<table>
<thead>
<tr>
<th>Measure</th>
<th>Billions of dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>$16,245</td>
</tr>
<tr>
<td>GNP</td>
<td>16,498</td>
</tr>
<tr>
<td>National income</td>
<td>13,972</td>
</tr>
<tr>
<td>Personal income</td>
<td>13,744</td>
</tr>
<tr>
<td>Disposable personal income</td>
<td>12,246</td>
</tr>
</tbody>
</table>

Similarly, disposable personal income must be less than personal income, since it is just personal income minus taxes.

- Each measure is useful in different contexts.

**Figure 8.4** Measures of total production and total income, 2012
Total Production = Total Income

All production must be rewarded with income; so in theory, we could count either in order to calculate GDP.

- In practice, data limitations make us unlikely to come up with the same number; there will always be some statistical discrepancy.

The figure illustrates the division of income as measured by the BEA in 2012.

<table>
<thead>
<tr>
<th></th>
<th>Billions of dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages</td>
<td>$8,620</td>
</tr>
<tr>
<td>Interest</td>
<td>597</td>
</tr>
<tr>
<td>Rent</td>
<td>541</td>
</tr>
<tr>
<td>Profit</td>
<td>2,815</td>
</tr>
<tr>
<td>Profits of sole proprietors</td>
<td>1,225</td>
</tr>
<tr>
<td>Profits of corporations</td>
<td>1,591</td>
</tr>
<tr>
<td>Taxes, depreciation, and statistical discrepancy</td>
<td>3,668</td>
</tr>
</tbody>
</table>

Figure 8.5 The division of income, 2012
Common Misconceptions to Avoid

- Gross domestic product (GDP), Consumption, Investment, Government purchases, Net exports
- Final good or service, Intermediate good or service, Value added
- Nominal GDP, Real GDP, GDP deflator, Price level, Inflation rate
- Business cycle, Expansion, Recession