

I. Measuring Output: GDP

As was mentioned earlier, the ability to estimate the amount of production in an economy is an important one in macroeconomics. The variable used to estimate production is called **Gross Domestic Product (GDP)**. GDP simultaneously measures both the total production in an economy and the amount of income earned in an economy. GDP is also important because it is frequently used as a measure of well being. Developed countries such as the United States have GDP per person that is 35 to 40 times greater than GDP per person in several sub-Saharan countries.

A. GDP: The Definition

Gross Domestic Product has a very precise definition that allows you to tell whether or not a transaction is part of GDP. It is very important that you learn this exact definition.

GDP is the total market value of all the **final** goods and services produced **within an economy** in a **given year**.

Here are some of the key takeaways you should get out of the definition.

1. **“FINAL GOODS AND SERVICES”**: GDP only includes the value of the finished product that is sold. The value of any inputs or goods that were used up in the production process (**intermediate goods**) is not included in GDP. The reason we don't include intermediate goods is that it is assumed that the value of production is already included in the final price of the end good.

Example: Suppose that McDonald's sells a Big Mac for \$2.50. Since this is the final good the \$2.50 would be included in GDP. However, suppose a cattle rancher sold the beef patty to McDonald's for \$1. The patty is an intermediate good and thus the \$1 is not included in GDP.

2. **“WITHIN AN ECONOMY”**: GDP only includes the value of products that are produced within the borders of an economy.

Example: A Mexican national who works in the United States would see his income included in U.S. GDP because his work occurred within the country. On the other hand, if Ford Motor Company opened a car factory in Mexico, the value of the production of the factory would not be included in U.S. GDP even though Ford is an American company.

3. **“IN A GIVEN YEAR”**: GDP only includes the value of new goods that are produced during the current year. This part of the definition would exclude all used goods that are bought and sold in the economy. The reason why is that these goods were previously counted in an earlier year’s GDP measure and we would not want to count it again.

Example: A new house built this year would be included in GDP calculations, but a house built in 1998 sold this year would not be included in GDP.

B. GDP: The Components

Now that we have a basic idea of what is and is not included in GDP, we can now categorize each transaction. GDP can be broken down into 4 broad categories. These categories are:

1. Consumption (C): These are purchases by consumers. Consumption can further be broken down as:

- Durables: Things that last for several years (think refrigerators or cars)
- Nondurables: Things that don’t last that long (think food, toilet paper)

2. Investment (I): These are purchases by firms. There are three main types of investment.

- New factories and machines (firms)
- New Housing (households)
- Inventories (firms)

3. Government (G): Purchases by government. This component includes purchases of goods as well as services. Important components **not** included are **transfer payments** (Social Security, welfare, food stamps, etc...). The reason why transfer payments are not included is because nothing is actually being produced when the government transfers funds from one group (taxpayers) to another group (elderly receipts of social security).

4. Net Exports (NX): This component is simply the difference between the exports of a country (the amount of domestic goods sold abroad) minus the imports (the amount of foreign goods purchased domestically).

In the end we can write GDP as follows:

$$\boxed{GDP = C + I + G + NX}$$

C. Other Measures of National Accounting

While GDP is the widely accepted measure of national accounting, there are several other measures that you should be familiar with.

1. Gross National Product (GNP): GNP differs from GDP in that it measures the total production of **nationals** in a given year. That is the value of all production by American workers and firms, regardless of location would be included in U.S. GNP. For example, an American who works in France would be included in U.S. GNP (but not US GDP).

Similarly, a U.S. firm that has a factory in India would see the value of the factory's production included in U.S. GNP. For most countries, the difference between GDP and GNP is not large. However, there are some countries with a large percentage of its nationals living abroad (or who employ a high number of foreign workers) such that large differences can occur.

2. **Net National Product:** This measure is just GNP minus depreciation. Depreciation is the wear and tear of machinery.

3. **National Income:** Net National Product minus some statistical discrepancies. What is important here is that approximately 2/3 (65%) of national income is comprised of the income of workers.

D. Calculating GDP

Up until now we have learned the components of GDP, now we focus on how to quantify the value of these transactions. As you recall from the definition of GDP, we measure the **total market value** of all goods and services produced in an economy.

Suppose we were asked to calculate the GDP of a very simple economy that produces only 2 goods. Calculating the GDP for this economy would be very straightforward. We would see how much of Good 1 was produced in the current year and multiply by the current price (to get the market value of Good 1) and then do the same for Good 2. Thus the formula for calculating GDP for 2 goods is

$$\text{GDP} = (P_{\text{Good1}} \times Q_{\text{Good1}}) + (P_{\text{Good2}} \times Q_{\text{Good2}})$$

However, most economies produce millions of goods in a given year. But the principle is still the same. In general, the formula for calculating GDP for N number of goods is:

$$\text{GDP} = (P_{\text{Good1}} \times Q_{\text{Good1}}) + (P_{\text{Good2}} \times Q_{\text{Good2}}) + (P_{\text{Good3}} \times Q_{\text{Good3}}) + \dots + (P_{\text{GoodN}} \times Q_{\text{GoodN}})$$

Consider the following example:

Suppose that Canada produces only two types of goods: Hockey Sticks and Celine Dion CDs. In the following table are data for 2008:

	Price of 1 Hockey Stick	Quantity of Hockey Sticks Produced	Price of Celine Dion CDs	Quantity of Celine Dion CDs
2008	\$10	1000	\$5	5000

Calculate the GDP for Canada in 2008.

This GDP where we simply multiply current production by current prices is called **Nominal GDP**. In actuality, economists don't often use Nominal GDP in measuring

output. The reason can best be seen in an example. Continuing with our Canadian obsession, suppose that in 2009 the prices of all goods doubled while production stayed the same:

	Price of 1 Hockey Stick	Quantity of Hockey Sticks Produced	Price of Celine Dion CDs	Quantity of Celine Dion CDs
2008	\$10	1000	\$5	5000
2009	\$20	1000	\$10	5000

What is the Nominal GDP for Canada in 2009? Comparing your answer to 2008 GDP you find that Nominal GDP has doubled in 1 year. But it should be clear that Canada is not twice as better off in 2009 than in 2008. In fact, most would argue that Canada is worse off because they have experienced a doubling of prices with no increase in output production. Increases in Nominal GDP can give a very misleading picture about the well being of a population. We therefore need an alternative measure of GDP.

Real GDP uses base year prices when calculating GDP. There is some arbitrary year that is called the base year and GDP is calculated using the prices of goods and services of that year. Thus any changes in Real GDP from one year to the next would only occur because of changes in the production level (since prices are fixed over time).

In general for N goods, the formula for Real GDP is:

$$\text{Real GDP} = (P_{1\text{BaseYr}} \times Q_1) + (P_{2\text{BaseYr}} \times Q_2) + \dots + (P_{N\text{BaseYr}} \times Q_N)$$

Note that the choice of base year is completely arbitrary. You'll get different values of GDP depending on what base year you choose. In order to mitigate this problem, a chain-weighted index is used. This index takes the average of prices over several years and uses that as the base price level. However, for this course we'll generally ignore this problem.

E. Using GDP to Measure Inflation

From our definitions of Real GDP vs. Nominal GDP we see that the only difference between the two is that Real GDP uses a base year price while Nominal GDP uses today's current price. Thus any difference between the two variables would measure the change of prices from the base year to the current year. Macroeconomists use the ratio of Nominal GDP to Real GDP as a way to measure how fast prices have changed over time. This is known as the **GDP Deflator**

Formally the equation is written as:
$$\text{GDP-Deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100$$

F. Shortfalls of Using GDP

While GDP is certainly a helpful measure of gauging the well-being of a country it does have its limitations.

1. GDP does not measure household production (i.e. cooking, cleaning, taking care of children).
2. GDP does not measure leisure. Individuals value leisure and perhaps an economy where people work 35 hours per week (such as France) might have a higher level of well-being than the United States even though France have a lower GDP per capita.
3. GDP does not include the underground economy. GDP measures only transactions that occur in the open. Any transactions that are either “under the table” or completely illegal will not be included in GDP measures.
4. It does not account for environmental damage. A factory that produces steel will have its output included in GDP, but the damage it might have caused to the air or river would not be factored in to GDP calculations.

II. Measuring Prices (CPI)

A. The Consumer Price Index

When we talked about GDP we saw that we could measure the increase in prices by using the GDP deflator. There is an alternative way to measure price increases called the **Consumer Price Index (CPI)**.

CPI measures the change in the value of a fixed basket of goods purchased by a typical consumer. A base year is chosen (just like for Real GDP the base year is arbitrary) and whatever an average consumer purchased in that year comprises the fixed basket.

Formally the CPI is calculated as follows:

$$\text{CPI} = \frac{\text{Value of the fixed basket in the current year}}{\text{Value of the fixed basket in the base year}} \times 100$$

B. CPI vs. GDP-Deflator

We have two ways of measuring prices. What are the differences between them?

1. The GDP deflator by definition will not include any price changes of imports. Recall that GDP measures only domestically produced goods and services. It's not unreasonable to assume that a typical consumer will purchase some foreign goods (such as wine, televisions, cars, etc...). CPI index will be able to capture any price changes in imports.

2. A problem with the fixed basket approach of the CPI is that it does not allow the consumers to adjust for quantity purchased if prices go up. If the price of a good goes up, consumers might purchase less of that good in response. In such cases the CPI will overstate the impact of the prices. GDP deflator on the other hand takes into account both quantity changes.
3. Another problem with the fixed basket approach is that new products are not immediately included in the CPI. Suppose that the consumer price index base year was 1999. In 2009 goods such as iPods, GPS devices, Blu-Ray discs are being purchased by typical consumers and any price changes in those goods would affect consumers. However, since our base year is 1999 the CPI would not show any change if the prices of those goods went up since those goods didn't even exist 10 years ago.
4. The CPI index does not adjust for quality. A computer and a car that was purchased that comprised a fixed basket 10 years ago is not the same thing as a computer and a car purchased today. Any price increases would not take into account the quality improvement and thus CPI would overstate the true increase in prices.

C. Inflation Rate

Whether we use GDP-deflator or CPI Index to measure prices, the formula to measure inflation is the same for both.

$$\text{Inflation Rate} = \frac{\text{New Price Index} - \text{Old Price Index}}{\text{Old Price Index}}$$