

Lecture 2: Measuring Output

I. OVERVIEW

- The goal of the next two lectures is to understand what measures are commonly used to measure price and quantity (output) for the entire economy, understand how these aggregate measures of price and quantity are constructed and identify some of their shortcomings.
- A comprehensive set of accounts for the entire economy is available in the National Income and Product Accounts (NIPA), published by the Department of Commerce. We will not try to study the NIPA in great deal, instead we will focus on understanding how a few key measures of output are constructed and in doing so, learn more about what these measures fail to capture.
- Even though the study of National Income Accounts seems boring, it is important for us to have a good overview of the strengths and weaknesses of the process. Similarly it is important for countries to have good national income accounts; a country that has bad national income accounts opens the door to questionable and potentially harmful policy recommendations from those who study the data.

II. MEASURING THE SIZE OF THE ECONOMY

Gross Domestic Product (GDP)

- Generally accepted by economists as the best measure of an economy's production of goods and services in a particular year. GDP is the dollar value of new goods and services produced in the domestic economy during the particular time period.
- Note that GDP only counts goods and services that are newly produced during a specific time period within the country's borders; used goods do not count towards GDP, nor do goods produced in foreign countries.
- How can we obtain a dollar value for goods and services? We use market prices to calculate the value of goods and services. GDP computed using market prices is often referred to as **Nominal GDP**.
- Consider an economy with only 2 goods: chocolate bars and pints of ice cream.

Year	Price of ice cream	Quantity of ice cream produced	Price of chocolate	Quantity of chocolate produced
1998	\$3.50	3000	\$1.00	1500
1999	\$4.25	3000	\$1.25	1000

$$\text{GDP}_{1998} = \$3.50 * 3000 + \$1 * 1500 = \$12,000$$

$$\text{GDP}_{1999} = \$4.25 * 3000 + \$1.25 * 1000 = \$14,000$$

Real Gross Domestic Product (Real GDP)

- In 1988 U.S. GDP was \$5205 billion while in 1998 U.S. GDP was \$8681 billion. We can conclude that the value of goods produced in the U.S. economy increased by 51% over those 10 years. Does this mean that production increased by 51% over that 10-year period?
- The answer is no. Remember that we value output using the market prices of goods. So changes in the price of goods will affect the value of GDP without any underlying change in production. Since there is a tendency for prices to rise in the economy: inflation, we need to correct for inflation to best compare changes in production over time.

- The measure of output that corrects for inflation is known as Real GDP. Instead of using current market prices to calculate current GDP, we use some base year's prices to calculate the dollar value of goods and services produced in the economy in a given year.
- If we compared Real GDP in 1988 and 1998 for the U.S. economy (in 1992 dollars, i.e. using 1992 as a base year) we find that

1988 GDP in 1992 prices	\$5902 billion	1998 GDP in 1992 prices	\$8191 billion
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 (This is only a 32.7% increase which is smaller than the previously calculated 51% increase.)
- Real GDP is the best measure of the output of an economy over a period of time.
- We can get an idea about how to calculate Real GDP using our chocolate/ice cream economy.

Real GDP ₁₉₉₈ (1998 base year)	= \$3.50*3000 + \$1*1500 = \$12,000
Real GDP ₁₉₉₉ (1998 base year)	= \$3.50*3000 + \$1*1000 = \$11,500 [reflects the fact that output fell!]

GDP Per Capita

- Even though the value of goods produced in the U.S. economy increased by 51% over those 10 years. However, the number of people living in the United States also increased over that time period. So to get a better understanding about the well being of individuals in the country, we look at GDP per-capita.
- GDP per capita is the value of all goods and services produced per person in the economy. It is calculated as $\frac{GDP}{Population}$. GDP per-capita is also referred to as GDP per person.
- On average, GDP per capita is a measure of the material well being of individuals in the economy. People living in a country with high GDP per capita are likely to have more material possessions; food, clothing, cars, electronics etc.
- GDP per capita is also a better measure of comparing the well being of people across countries with different populations. For example, India's GDP is 11 times higher than Norway's but GDP per capita in Norway is about 70 times as high as India's.

Gross National Product (GNP)

- Some countries use Gross National Product as the measure of output. The U.S. also used GNP as its measure of output for a substantial period of time. GNP is the dollar value of new goods and services produced by domestic nationals and firms.
- So GNP for the U.S. would include all goods and services produced in other countries by U.S. citizens and companies but would exclude goods and services produced within the U.S. economy by foreign nationals and firms. $GNP = GDP - \text{values of new goods produced in the U.S. by foreign entities} + \text{value of new goods produced abroad by U.S. entities}$.
- For the U.S. presently GDP exceeds GNP; foreigners produce more in the U.S. economy than U.S. entities produce on foreign countries. Curiously enough, the switch from GNP to GDP occurred at roughly the same time that GDP began to exceed GNP.

III. CALCULATING GDP

- There are three methods of calculating GDP, all of which give the equivalent value for GDP. The three approaches are:

1. Spending Method: Add up expenditures by consumers, firms, the government and foreigners on goods and services made in the domestic economy.
2. Value-added Method Add up the value of goods at each stage of production in the economy.
3. Income Method Add up income of all workers, firms and other organizations in the economy.

1. The Spending Method of Calculating GDP

- In order to calculate GDP using the spending method, total expenditures in the economy are divided into four categories: consumption (C), investment (I), government purchases (G) and net exports (NX); net exports equal exports – imports ($NX = X - M$).

$$GDP = C + I + G + NX$$

- In order to avoid double counting, we only add up expenditures on final goods and services. Final goods and services do not undergo further processing, i.e. they are neither resold nor used as inputs for producing other goods and services during the period they were produced.
- Example: Jamba Juice buys ice, yogurt, vitamin powder and frozen fruit to make smoothies that are sold to the public. When Jamba Juice purchases ice from Ices Unlimited, that purchase does not count towards GDP. Why? Because the price that they sell the smoothie for already contains the value of the ice.
- Similarly the purchase of 1000 gallons of gas from Chevron by the gas station down the street does not count towards GDP. Why? The 1000 gallons of gas will be resold to the public, so the initial purchase of gas was not expenditure on final goods. Otherwise we will count each gallon of gas twice: once when the gas station purchased it from Chevron and second when I purchased it from the gas station.

- The categories of expenditure are as follows:

Consumption (68% of GDP): spending on goods and services by households. Consumption is categorized as

- 1) **Durables:** goods that provide consumption services over time (TVs, cars or refrigerators.)
- 2) **Non-durables:** food, clothing or gasoline.
- 3) **Services** (haircuts, medical care)

Investment (15% of GDP): spending by firms on plants, equipment and inventories as well as spending by households on housing. Investment is the amount of new capital added to the existing capital stock. Investment can be broken down into 3 categories:

1. **Fixed business** (new equipment, structures).
 2. **Fixed residential** (new housing).
 3. **Inventories** (goods that have not yet been produced or been produced but not yet sold).
- Education is not considered part of investment instead it is categorized as a consumption of a service.
 - Portfolio investment (buying/selling stocks) does NOT count as investment for the overall economy: one individual's investment is another's disinvestment.

Government Purchases (18.75% of GDP): Spending by Federal, state and local governments on new goods and services.

- Mostly consists of purchases by the military: soldier services, aircraft, weapons etc., building of highways, roads, bridges by state governments and spending on education and police forces by local governments.

- Government purchases do NOT include the value of transfer payments: social security and welfare payments, Medicare payments etc. These are counted as part of government spending or government outlays but do not count towards production since no new goods are produced: merely a transfer from one group of people to another.

Net Exports (NX)=Exports(X)-Imports(M) [X=11% of GDP, M=12.50% of GDP]

- Exports (X) Goods and services produced in the U.S. sold to foreigners, Imports are goods and service produced by foreigners sold to U.S. firms and consumers.
- Why subtract off M? Because they are already added into the C, I and G categories. This avoids counting goods and services that are not produced in the United States.
- **Timing Complications:** Occasionally, there are complications to the above methodology.
- Goods that are purchased this year either for use as inputs in production or for resale next year WILL be counted as final goods expenditure for this year; GDP must capture the value of all goods produced this year.
- For example, if Amazon.com buys \$100,000 of books from Addison-Wesley on Dec. 31st 1999 for resale in the year 2000, Amazon's purchase counts towards GDP in 1999. In what category? The purchase of books by Amazon would be counted as inventory investment for 1999.
- When the book is sold next year, inventory investment for 2000 will go down by 1 book and consumption for 2000 will go up by 1 book; the sale of the book does not mistakenly get reflected as production in 2000.

2. The Value-added Method of Calculating GDP

- The basic idea of the value-added approach is to calculate the value of production at each stage. This avoids the double counting of goods that are used as intermediate inputs. Practically this is done by calculating Value-added = revenue - cost of intermediate inputs at each stage of production. So in our Jamba Juice example, the value added by Jamba Juice equals
Price of Jamba Juice – cost of ice – cost of fruit – cost of vitamin powder – cost of yogurt.
- The ice manufacturer's value added = revenue from selling ice to Jamba Juice – cost of water – cost of electricity. The fruit manufacturer's value added = revenue earned by selling fruit to Jamba Juice – cost of fertilizer – cost of seeds etc.
- It is important to realize that payments to labor and capital, i.e. salaries and rental cost of machines are not subtracted from revenue. Labor and capital are what contribute to value added. This leads us into the third method of calculating GDP.

3. The Income Method of Calculating GDP

- In this method, GDP is computed by adding up the income of firms, consumers, proprietors and the government.
- Intuitively, this method should give you the same answer as the spending method because one person's expenditure is another's income.