

Lecture 3: Measuring Prices

I. OVERVIEW

- The last lecture examined how output for the whole economy is measured. Today's lecture describes how to measure the price level for the whole economy.
- Today's lecture describes how to compute the price level of the economy: a measure of the prices of all the goods in the economy and how to compute inflation: a measure of how fast the price level is changing.

II. MEASURING THE PRICE LEVEL

The GDP Deflator

- The GDP deflator is a measure of the prices of all the goods and services produced in the domestic economy.
- The GDP deflator is calculated as follows: $\text{GDP deflator} = \frac{\text{NOMINAL GDP}}{\text{REAL GDP}}$. So the GDP deflator essentially takes the output produced in a given year and compares the value of that output using that year's prices to the value of the output using some base year's prices.
- Because we are valuing the identical amount of goods and services using two different sets of prices, the GDP deflator is essentially comparing the price level in the current year to the price level in the base year.
- Note that the base year's deflator is equal to 1. Why? Real and nominal GDP are identical in the base year. So a value of 1.05 for the GDP deflator in 1999, using 1997 a base year, implies that the price level in 1999 is 5% higher than the value in 1997.
- Sometimes, you see the value of the deflator in the base year expressed as 100. In that case the deflator is being calculated as $\frac{\text{NOMINAL GDP}}{\text{REAL GDP}} * 100$
- Why is the GDP deflator a measure of the price level of goods and services produced in the domestic economy? The simplest way to see this is to think of a world in which there is only 1 good produced: chocolate (CH).
- In 1999, the GDP deflator for this wonderful country, using 1998 as a base year, is given by $\text{GDP Deflator}_{1999} = \frac{\text{Nominal GDP}_{1999}}{\text{Real GDP}_{1999}} = \frac{P_{CH}^{99} * Q_{CH}^{99}}{P_{CH}^{98} * Q_{CH}^{99}} = \frac{P_{CH}^{99}}{P_{CH}^{98}}$. So the GDP deflator tells us what the price of chocolate is in 1999 relative to its value in the base year, 1998. Since chocolate was the only good produced, the deflator is a measure of the price level of all the goods and services produced in the economy.
- The analysis becomes slightly more complicated in the case of an economy with more than 1 good. Let's return to the economy with two goods, chocolate (CH) and ice cream (IC) that we discussed yesterday.

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

- For this economy, the measure of the domestic price level in 1999, relative to the base level of 1 in 1998 is given by GDP Deflator $_{1999} = \frac{\text{Nominal GDP}_{1999}}{\text{Real GDP}_{1999}} = \frac{P_{IC}^{99} * Q_{IC}^{99} + P_{CH}^{99} * Q_{CH}^{99}}{P_{IC}^{98} * Q_{IC}^{99} + P_{CH}^{98} * Q_{CH}^{99}}$.
- Notice that this is more complicated than the one good case, however, the underlying logic is similar. All we are doing is weighting the prices of each good by the quantity sold. Since more ice cream is produced in this economy than chocolate, changes in the price of ice cream should have more of an impact on the overall price level than changes in the price of chocolate would.
- So the value of the GDP deflator for this economy is $\frac{\$4.25 * 3000 + \$1.25 * 1000}{\$3.50 * 3000 + \$1 * 1000} = \frac{\$14000}{\$11500} = 1.21739$, which means that prices in 1999 are 21.739% higher than in 1998.

The Consumer Price Index

- The Consumer Price Index (CPI) is a widely used measure of the cost of living faced by consumers. The CPI measures the price of a fixed “basket” of goods and services that is consumed by the typical consumer. Often, the CPI is expressed as the price of a basket of goods relative to the price of that basket in a base year.
- Let’s return to the two good chocolate-ice cream economy. Suppose that the typical consumer in this country consumes 1 bar of chocolate and 2 pints of ice cream every week. So the representative basket will consist of 2 pints of ice cream and 1 bar of chocolate.
- The CPI for 1999, using 1998 as a base year, is $CPI_{99} = \frac{P_{IC}^{99} * 2 + P_{CH}^{99} * 1}{P_{IC}^{98} * 2 + P_{CH}^{98} * 1} = \frac{\$4.25 * 2 + \$1.25}{\$3.50 * 2 + \$1} = 1.21875$. So the price of a representative basket of goods has increased by 21.875 % from 1998 to 1999.
- There are several key differences between the CPI and the GDP Deflator.
 - The CPI measures the price of a fixed basket of goods while the deflator measures a changing basket of goods.
 - In practice, the representative basket of goods is revised only infrequently. So new products that replace old products may not get priced into the basket. For example, if the CPI basket was created the year before CD players were invented, only the prices of a tape player and tapes will be contained in the CPI; the prices of a CD player and CD’s will be omitted.
 - On the other hand, the deflator measures the price of all goods and services produced in the economy. So if consumers buy more CD players and fewer tape players, changes in the price of CD players will have a greater impact on the GDP deflator.
 - The CPI contains only consumption goods and does not contain the prices of goods used in production or the prices of investment goods.
 - Because the CPI measures the price of a basket of goods that a typical consumer purchases, it omits the prices of other goods that are important components of the economy. So the prices of machines, industrial equipment, medical supplies etc. will not affect the CPI.
 - The CPI contains the price of imported goods while the deflator only contains prices of domestic goods.
 - The typical consumer’s representative basket of goods and services will include some imported items. Changes in the prices of these goods affect the CPI but not the GDP deflator.

The Producer Price Index

- One of the limitations of the Consumer Price Index (CPI) in examining the price level of the entire economy is that it only looks at the price of a basket of goods and services consumed by a consumer.
- The Producer Price Index (PPI) is a measure of the production costs faced by producers relative to a base year. So the PPI computes the relative price of raw materials, like metals, oil, grains etc. and intermediate inputs.
- The PPI is useful because it can help predict changes in the CPI and the GDP deflator. Increases in the price of raw materials would imply that producers have to incorporate the higher prices in the goods that they produce thus raising CPI and the GDP deflator.
- In this class, we will use the CPI and the GDP deflator as the primary measures of the price level and pay relatively little attention to the PPI.

III. INFLATION

- The CPI and the GDP deflator both measure the price level. Inflation is the % change in the price level. We calculate inflation from 1 year to the next by looking at the % change in the GDP deflator or the CPI. (The CPI is more commonly used)
- The primary difference between calculating inflation using the CPI and calculating inflation using the deflator is that the first measure incorporates changes in the prices of foreign goods while the second measure only looks at changes in the price of domestic goods. So either measure can be informative depending on the issue being studied.
- How do we calculate percentage changes? From one year to the next, the calculation is easy. For example if the GDP deflator in 1998 was 1 and the GDP deflator in 1999 was 1.217 then the inflation rate from 1998 to 1999 would be $\frac{1.217 - 1}{1} = 0.217 = 21.7\%$.
- Calculating the average rate of inflation over a period of time is a little more complicated. Suppose that the deflator in 1989 was 0.738 and the deflator in 1999 was 1.217. Then we can calculate the average annual rate of inflation as $\left(\frac{1.217 - 0.738}{0.738} \right) / 10 = 0.0650 = 6.5\%$. Economists also often calculate the average rate of inflation as $\frac{\ln(1.217) - \ln(0.738)}{10} = 0.050 = 5\%$. Even though the two methods give different answers for this example, either one is acceptable for calculating inflation rates for the purposes of this class.

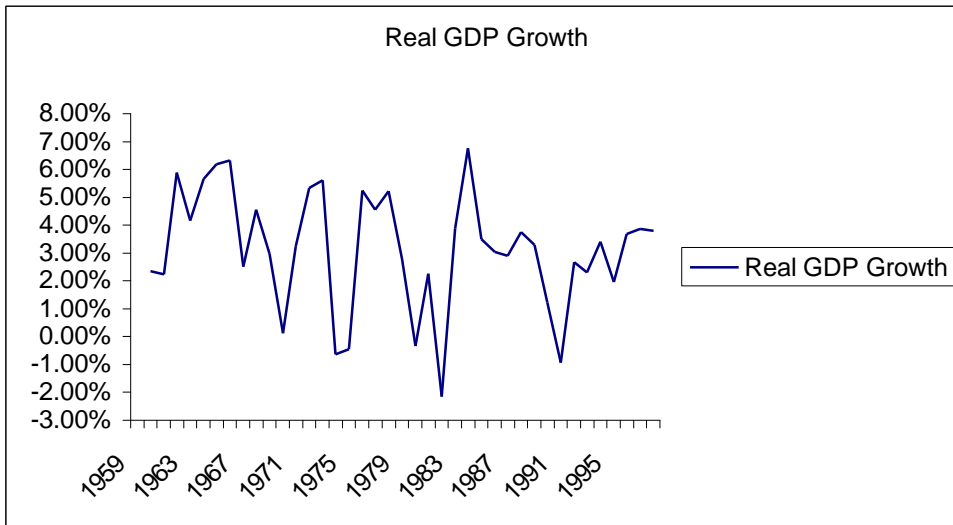
IV. THE HISTORICAL PATHS OF OUTPUT AND PRICES

Path of Output

- Now that we have described how the measures of price and quantity for the economy are constructed, let's examine the time path of these measures, over the last 40 years. The graph below is what I showed you on the first day of class. It shows the growth rate of Real GDP: i.e. by % rate of change of Real GDP
- We can see that Real GDP has grown at a positive rate over the last 40 years with 6 economic downturns during which Real GDP fell. These episodes are known as recessions and they occurred in 1960-61, 1969-70, 1973-75, 1980, 1982-83 and 1990-91.

- The length and severity of these recessions were

1960-61:	10 months	1.2% decline in Real GDP
1969-70:	11 months	1% decline in Real GDP
1973-75:	16 months	4.9% decline in Real GDP [Oil Shock I]
1980:	6 months	2.5% decline in Real GDP [Oil Shock II]
1981-82:	16 months	3% decline in Real GDP
1990-91:	8 months	1.4% decline in Real GDP



- In comparison, the Great Depression lasted almost 36 months and causes a 32% fall in Real GDP. Note also that the current expansion has been running for almost 96 months now, surpassing the 1960's expansion.

Path of Inflation

- Inflation seems to broadly increase between 1960 and 1980 and broadly decline from 1980 onwards. Substantial spikes in inflation appear preceding recessions and drops in inflation appear during and after recessions. We will try to explain why this type of relationship between prices and output can exist.
- Finally, while inflation has not approached zero in the last 40 years, the recent years are characterized by low and steady inflation. Is there a link between the low and steady inflation and the sustained boom? Another issue we will explore during this class.

