

# Assignment #3\*

Econ 102: Introductory Macroeconomics

March 9, 2010

**Directions:** Turn in the homework to your TA's box before lecture. Please legibly write your name, TA name, and section number on the front of the homework. Write your name as it appears on your ID. Late homework is not be accepted. Please show your work in a readable and organized way. Good luck!

## 1 Measuring Output

You are provided with the following information about an economy that produces three final goods: almonds, bicycles, and computers. The currency in use is the US Dollar (\$US).

Table 1: Price and Quantity Data on Final Goods

Year	Almonds		Bicycles		Computers	
	Price	Quantity	Price	Quantity	Price	Quantity
1980	\$1	10,000	\$10	4,000	\$700	130
1990	\$1.5	15,000	\$14	3,200	\$450	900
2000	\$2.25	12,500	\$22	1,700	\$225	6,000

### 1.1 Compute nominal GDP in 1980, 1990, and 2000. Do you observe a trend in the data?

Let  $i$  index the final goods;  $i = 1$  almonds,  $i = 2$  bicycles,  $i = 3$  computers.

$$\begin{aligned} NGDP_{1980} &= \sum_{i=1}^3 P_{i,1980} Q_{i,1980} \\ &= (P_{almonds,1980})(Q_{almonds,1980}) + (P_{bicycles,1980})(Q_{bicycles,1980}) + (P_{computers,1980})(Q_{computers,1980}) \\ &= (\$1)(10,000) + (\$10)(4,000) + (\$700)(130) \\ &= \$10,000 + \$40,000 + \$91,000 \\ NGDP_{1980} &= \$141,000 \end{aligned}$$

$$\begin{aligned} NGDP_{1990} &= \sum_{i=1}^3 P_{i,1990} Q_{i,1990} \\ &= (\$1.5)(15,000) + (\$14)(3,200) + (\$450)(900) \\ &= \$22,500 + \$44,800 + \$405,000 \\ NGDP_{1990} &= \$472,300 \end{aligned}$$

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$$\begin{aligned}
NGDP_{2000} &= \sum_{i=1}^3 P_{i,2000} Q_{i,2000} \\
&= (\$2.25)(12,500) + (\$22)(1,700) + (\$225)(6,000) \\
&= \$28,125 + \$37,400 + \$1,350,000 \\
NGDP_{2000} &= \$1,415,525
\end{aligned}$$

The trend is clearly upward, and the growth looks exponential.

## 1.2 Compute the growth rate of nominal GDP from 1980-1990 and 1990-2000.

$$\begin{aligned}
\% \Delta NGDP_{1980-1990} &= \frac{NGDP_{1990} - NGDP_{1980}}{NGDP_{1980}} (100) \\
&= \frac{\$472,300 - \$141,000}{\$141,000} (100) \\
\% \Delta NGDP_{1980-1990} &= 234.96\% \\
\% \Delta NGDP_{1990-2000} &= \frac{NGDP_{2000} - NGDP_{1990}}{NGDP_{1990}} (100) \\
&= \frac{\$1,415,525 - \$472,300}{\$472,300} (100) \\
\% \Delta NGDP_{1990-2000} &= 199.71\%
\end{aligned}$$

## 1.3 Using 1980 as the base year, compute real GDP in 1980, 1990, and 2000. Compute the growth rate of real GDP from 1980-1990 and 1990-2000. Do you observe a trend in the data?

$$\begin{aligned}
RGDP_{1980} &= \sum_{i=1}^3 P_{i,1980} Q_{i,1980} \\
&= NGDP_{1980} \\
RGDP_{1980} &= \$141,000 \\
RGDP_{1990} &= \sum_{i=1}^3 P_{i,1980} Q_{i,1990} \\
&= (\$1)(15,000) + (\$10)(3,200) + (\$700)(900) \\
RGDP_{1990} &= \$677,000 \\
RGDP_{2000} &= \sum_{i=1}^3 P_{i,1980} Q_{i,2000} \\
&= (\$1)(12,500) + (\$10)(1,700) + (\$700)(6,000) \\
RGDP_{2000} &= \$4,229,500 \\
\% \Delta RGDP_{1980-1990} &= \frac{\$677,000 - \$141,000}{\$141,000} (100) = 380.14\%
\end{aligned}$$

$$\% \Delta RGDP_{1990-2000} = \frac{\$4,229,500 - \$677,000}{\$677,000}(100) = 524.74\%$$

Again, the trend in real GDP is upward with exponential growth.

- 1.4 Using 2000 as the base year, compute real GDP in 1980, 1990, and 2000. Compute the growth rate of real GDP from 1980-1990 and 1990-2000. Do your estimated growth rates agree with those from the previous part? Why or why not?**

$$\begin{aligned} RGDP_{1980} &= \sum_{i=1}^3 P_{i,2000} Q_{i,1980} \\ &= (\$2.25)(10,000) + (\$22)(4,000) + (\$225)(130) \\ RGDP_{1980} &= \$139,750 \end{aligned}$$

$$\begin{aligned} RGDP_{1990} &= \sum_{i=1}^3 P_{i,2000} Q_{i,1990} \\ &= (\$2.25)(15,000) + (\$22)(3,200) + (\$225)(900) \\ RGDP_{1990} &= \$306,650 \end{aligned}$$

$$\begin{aligned} RGDP_{2000} &= \sum_{i=1}^3 P_{i,2000} Q_{i,2000} \\ &= NGDP_{2000} \\ RGDP_{2000} &= \$1,415,525 \end{aligned}$$

$$\% \Delta RGDP_{1980-1990} = \frac{\$306,650 - \$139,750}{\$139,750}(100) = 119.43\%$$

$$\% \Delta RGDP_{1990-2000} = \frac{\$1,415,525 - \$306,650}{\$306,650}(100) = 361.61\%$$

The estimated growth rates do not agree. Real GDP growth rates depend on the specification of the base year because the base year determines relative prices, which are used to weight the quantities.

- 1.5 Using 1980 as the base year, compute the GDP deflator for 1980, 1990, and 2000. Compute the growth rate of GDP deflator from 1980-1990 and 1990-2000. Is this economy experiencing inflation or deflation? How do you interpret the growth rate of the GDP deflator?**

$$(GDP \ deflator)_{1980} = \frac{NGDP_{1980}}{RGDP_{1980}}(100) = \frac{\$141,000}{\$141,000}(100) = 100$$

$$(GDP \ deflator)_{1990} = \frac{NGDP_{1990}}{RGDP_{1990}}(100) = \frac{\$472,300}{\$677,000}(100) = 69.76$$

$$(GDP \ deflator)_{2000} = \frac{NGDP_{2000}}{RGDP_{2000}}(100) = \frac{\$1,415,525}{\$4,229,500}(100) = 33.47$$

$$\% \Delta (GDP \ deflator)_{1980-1990} = \pi_{1980-1990} = \frac{69.76 - 100}{100}(100) = -30.24\%$$

$$\% \Delta(\text{GDP deflator})_{1990-2000} = \pi_{1990-2000} = \frac{33.47 - 69.76}{69.76}(100) = -52.03\%$$

Deflation is occurring from 1980-2000. The growth rate of the GDP deflator is interpreted as the inflation rate,  $\pi$ .  $\pi < 0 \Rightarrow$  deflation.

**1.6 Using 2000 as the base year, compute the GDP deflator for 1980, 1990, and 2000. Compute the growth rate of GDP deflator from 1980-1990 and 1990-2000. Do your estimates agree with those from the previous part? Why or why not?**

$$(\text{GDP deflator})_{1980} = \frac{NGDP_{1980}}{RGDP_{1980}}(100) = \frac{\$141,000}{\$139,750}(100) = 100.89$$

$$(\text{GDP deflator})_{1990} = \frac{NGDP_{1990}}{RGDP_{1990}}(100) = \frac{\$472,300}{\$306,650}(100) = 154.02$$

$$(\text{GDP deflator})_{2000} = \frac{NGDP_{2000}}{RGDP_{2000}}(100) = \frac{\$1,415,525}{\$1,415,525}(100) = 100$$

$$\% \Delta(\text{GDP deflator})_{1980-1990} = \pi_{1980-1990} = \frac{154.02 - 100.89}{100.89}(100) = 52.65\%$$

$$\% \Delta(\text{GDP deflator})_{1990-2000} = \pi_{1990-2000} = \frac{100 - 154.02}{154.02}(100) = -35.07\%$$

The estimated inflation rates do not agree. Since real GDP depends on the base year, so does the GDP deflator; this implies that the inflation rates will differ.

**1.7 Briefly discuss how real GDP (as a measure of output) depends on the base year. Does the base year matter?**

Relative prices in the base year are used as weights on the quantities for all years that real GDP is calculated. Because relative prices vary from year to year, we expect that real GDP will change as the base year changes. For example, let's assume that housing prices are very high in the base year we choose (such as the peak of the real estate bubble in 2007). If this is the case, real GDP puts high weight on housing and relatively lower weight on all other goods, which increases the importance of the housing market in calculating output. It is best to choose an average or "representative" year as the base year for computing real GDP.

## 2 Building a Price Index

Table 2 lists the average prices faced by consumers (from 1980-2000) across five categories of household expenditure: housing, clothing, fuel, food, and entertainment.

Table 2: Price Data on Consumer Goods

Year	Average Prices				
	Housing	Clothing	Fuel	Food	Entertainment
1980	\$100,000	\$40	\$5	\$250	\$10
1990	\$125,000	\$50	\$2.2	\$325	\$17
2000	\$300,000	\$35	\$3.5	\$500	\$53

When calculating market basket expenditure, the Bureau of Labor Statistics wants you to use the following weights (fixed quantities) for each category of expenditure given in Table 3. The weights do not change over time. Given market basket expenditure in each year, you can compute the Consumer Price Index (CPI).

Table 3: CPI Weights

Category	Weight
Housing	0.1
Clothing	0.1
Fuel	0.15
Food	0.55
Entertainment	0.1

### 2.1 Compute market basket expenditure in 1980, 1990, and 2000.

$$Expenditure_{1980} = (0.1)(\$100,000) + (0.1)(\$40) + (0.15)(\$5) + (0.55)(\$250) + (0.1)(\$10) = \$10,143.3$$

$$Expenditure_{1990} = (0.1)(\$125,000) + (0.1)(\$50) + (0.15)(\$2.2) + (0.55)(\$325) + (0.1)(\$17) = \$12,685.8$$

$$Expenditure_{2000} = (0.1)(\$300,000) + (0.1)(\$35) + (0.15)(\$3.5) + (0.55)(\$500) + (0.1)(\$53) = \$30,284.3$$

### 2.2 Using 1980 as the base year, compute the CPI for 1980, 1990 and 2000. Compute the growth rate of the CPI from 1980-1990 and 1990-2000. How do you interpret the growth rate of the Consumer Price Index?

$$CPI_{1980} = \frac{Expenditure_{1980}}{Expenditure_{base}}(100) = \frac{Expenditure_{1980}}{Expenditure_{1980}}(100) = \frac{\$10,143.3}{\$10,143.3}(100) = 100$$

$$CPI_{1990} = \frac{Expenditure_{1990}}{Expenditure_{1980}}(100) = \frac{\$12,685.8}{\$10,143.3}(100) = 125.07$$

$$CPI_{2000} = \frac{Expenditure_{2000}}{Expenditure_{1980}}(100) = \frac{\$30,284.3}{\$10,143.3}(100) = 298.57$$

$$\% \Delta CPI_{1980-1990} = \pi_{1980-1990} = \frac{CPI_{1990} - CPI_{1980}}{CPI_{1980}}(100) = \frac{125.07 - 100}{100}(100) = 25.07\%$$

$$\% \Delta CPI_{1990-2000} = \pi_{1990-2000} = \frac{298.57 - 125.07}{125.07}(100) = 138.72\%$$

The growth rate of the CPI is interpreted as the inflation rate,  $\pi$ . The growth rate of the CPI does not necessarily equal the growth rate of the GDP deflator.

**2.3 Using 1990 as the base year, compute the CPI for 1980, 1990 and 2000. Compute the growth rate of the CPI from 1980-1990 and 1990-2000. Do your estimates agree with those from the previous part? Why or why not?**

$$CPI_{1980} = \frac{Expenditure_{1980}}{Expenditure_{base}}(100) = \frac{Expenditure_{1980}}{Expenditure_{1990}}(100) = \frac{\$10,143.3}{\$12,685.8}(100) = 79.96$$

$$CPI_{1990} = \frac{Expenditure_{1990}}{Expenditure_{1990}}(100) = \frac{\$12,685.8}{\$12,685.8}(100) = 100$$

$$CPI_{2000} = \frac{Expenditure_{2000}}{Expenditure_{1990}}(100) = \frac{\$30,284.3}{\$12,685.8}(100) = 238.72$$

$$\% \Delta CPI_{1980-1990} = \pi_{1980-1990} = \frac{CPI_{1990} - CPI_{1980}}{CPI_{1980}}(100) = \frac{100 - 79.96}{79.96}(100) = 25.07\%$$

$$\% \Delta CPI_{1990-2000} = \pi_{1990-2000} = \frac{238.72 - 100}{100}(100) = 138.72\%$$

The inflation rate estimates using 1990 as the base year agree with those from the previous part. The base year does not matter when computing inflation rates from the CPI.

**2.4 Using 2000 as the base year, compute the CPI for 1980, 1990 and 2000. Compute the growth rate of the CPI from 1980-1990 and 1990-2000. Do your estimates agree with those from the previous parts? Why or why not?**

$$CPI_{1980} = \frac{Expenditure_{1980}}{Expenditure_{base}}(100) = \frac{Expenditure_{1980}}{Expenditure_{2000}}(100) = \frac{\$10,143.3}{\$30,284.3}(100) = 33.49$$

$$CPI_{1990} = \frac{Expenditure_{1990}}{Expenditure_{2000}}(100) = \frac{\$12,685.8}{\$30,284.3}(100) = 41.\bar{8}$$

$$CPI_{2000} = \frac{Expenditure_{2000}}{Expenditure_{2000}}(100) = \frac{\$30,284.3}{\$30,284.3}(100) = 100$$

$$\% \Delta CPI_{1980-1990} = \pi_{1980-1990} = \frac{CPI_{1990} - CPI_{1980}}{CPI_{1980}}(100) = \frac{41.\bar{8} - 33.49}{33.49}(100) = 25.07\%$$

$$\% \Delta CPI_{1990-2000} = \pi_{1990-2000} = \frac{100 - 41.\bar{8}}{41.\bar{8}}(100) = 138.72\%$$

The inflation rate estimates using 2000 as the base year agree with those from the previous parts. Again, the base year does not matter when computing inflation rates from the CPI.

**2.5 Briefly discuss how the growth rate of the CPI depends on the base year. Does the base year matter?**

The growth rate of the CPI does not depend on the choice of base year. The CPI growth rate depends only on the relative market basket expenditure levels in each year, and those relative expenditure levels do not change when the base year changes. In other words, the base year does not matter when computing inflation rates based on the CPI.

### 3 Labor Market Outcomes

The following data on the labor market have been provided to you by the US Bureau of Labor Statistics. Due to an error in the transfer, the database has been corrupted and some entries are missing.

Table 4: US Labor Force

Adult Population (N)	200	N, % Female	52%	N, % Male	
Labor Force (LF)	155	LF, % Female		LF, % Male	60%
Employed (E)	130	E, % Female	45%	E, % Male	
Unemployed (U)		U, % Female		U, % Male	

#### 3.1 Complete Table 4.

$$U = LF - E = 155 - 130 = 25$$

$$N_{male} = 100\% - 52\% = 48\%$$

$$LF_{female} = 100\% - 60\% = 40\%$$

$$E_{male} = 100\% - 45\% = 55\%$$

$(0.52)(200) = 104$  females,  $(0.4)(155) = 62$  females in the labor force,  $(0.45)(130) = 58.5$  employed females  
 $\Rightarrow 62 - 58.5 = 3.5$  unemployed females.

$$U_{female} = \frac{3.5}{25}(100) = 14\%$$

$$U_{male} = 100\% - 14\% = 86\%$$

Adult Population (N)	200	N, % Female	52%	N, % Male	48%
Labor Force (LF)	155	LF, % Female	40%	LF, % Male	60%
Employed (E)	130	E, % Female	45%	E, % Male	55%
Unemployed (U)	25	U, % Female	14%	U, % Male	86%

#### 3.2 What is the US unemployment rate? What is the unemployment rate for females? What is the unemployment rate for males?

$$UR = \frac{U}{LF}(100) = \frac{25}{155}(100) = 16.13\%$$

$$UR_{female} = \frac{U_{female}}{LF_{female}}(100) = \frac{(0.14)(25)}{(0.4)(155)}(100) = \frac{3.5}{62}(100) = 5.64\%$$

$$UR_{male} = \frac{U_{male}}{LF_{male}}(100) = \frac{(0.86)(25)}{(0.6)(155)}(100) = \frac{21.5}{93}(100) = 23.12\%$$

**3.3** What is the US labor force participation rate? What is the labor force participation rate for females? What is the labor force participation rate for males?

$$LFPR = \frac{LF}{N}(100) = \frac{155}{200}(100) = 77.5\%$$

$$LFPR_{female} = \frac{LF_{female}}{N_{female}}(100) = \frac{(0.4)(155)}{(0.52)(200)}(100) = \frac{62}{104}(100) = 59.61\%$$

$$LFPR_{male} = \frac{LF_{male}}{N_{male}}(100) = \frac{(0.6)(155)}{(0.48)(200)}(100) = \frac{93}{96}(100) = 96.87\%$$



## 4 Historical US Unemployment

The following table lists the US unemployment rate from 1933-1945.

Table 5: US Unemployment Rate (% of LF)

Year	UR
1933	24.9
1934	21.7
1935	20.1
1936	16.9
1937	14.3
1938	19
1939	17.2
1940	14.6
1941	9.9
1942	4.7
1943	1.9
1944	1.2
1945	1.9

**4.1 The unemployment rate before 1941 is much higher than the rate from 1941-1945. What do you think is the main component of unemployment from 1933 to 1940 (frictional, structural, cyclical, etc.)?**

*Cyclical unemployment due to the Great Depression. The persistent US (aggregate) unemployment spell ended due to entry into World War II and the wartime economy.*

**4.2 Is it possible to maintain a zero unemployment rate after 1945? Why or why not?**

*Zero unemployment is not currently attainable; frictional unemployment will always exist with the present labor market matching technology that pairs idle workers with hiring firms (search process).*

**4.3 Assume that the US adult population over this period is constant at 100 million and the labor force participation rate is fixed at 80%. Calculate the number of unemployed persons in the US from 1933-1945.**

$$LF = LFPR(N) = (0.8)(100 \text{ million}) = 80 \text{ million}$$

$$U_t = UR_t(LF) = UR_t(80 \text{ million})$$

Year	UR (%)	U (millions)
1933	24.9	19.92
1934	21.7	17.36
1935	20.1	16.08
1936	16.9	13.52
1937	14.3	11.44
1938	19	15.2
1939	17.2	13.76
1940	14.6	11.68
1941	9.9	7.92
1942	4.7	3.76
1943	1.9	1.52
1944	1.2	0.96
1945	1.9	1.52

**4.4 After 1945, suppose that the government implements a preferential tax scheme for women that encourages entry into the labor force. Briefly discuss the possible effects on the unemployment rate and the labor force participation rate.**

*Provided that more females are entering the labor force, both the unemployment rate and the labor force participation rate will increase (holding the rates of job creation/destruction constant).*