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**14.02 Principles of Macroeconomics**  
**Problem Set 1 \*Solution\***  
**Fall 2004**

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**Part I. True/False/Uncertain**

Justify your answer with a short argument.

1. From 1960 to 2000, the US, EU, and Japan all have experienced similar rates of unemployment.

**False.**

All three regions have experienced drastically different rates of unemployment. [Tables 1-1, 1-2, 1-3] tell us that the US average unemployment rate for 1960-2000 was 6.1%, that of EU was 6.5%, and that of Japan was 2.0%. Even though the average rates of unemployment were similar in the US and EU, figure 1-5 shows that the unemployment rates were actually very different over this period.

2. GDP is the value of all goods and services produced in the economy.

**False.** (See page 22)

GDP = Gross Domestic Product

GDP = Value of **\* FINAL\*** goods & services produced in the economy.

3. The Phillips Curve describes the negative relationship between the change in unemployment rate and inflation.

**False.**

Phillips Curve (Modified Phillips Curve) (page 32-33) → negative relationship between the unemployment rate & the **CHANGE** in inflation (When the unemployment rate is low, inflation tends to increase.)

(We will revisit the Phillips Curve in chapter 8 again.)

4. Inflation is bad for the economy because goods and services are more expensive.

**Uncertain.** (page 33)

Inflation usually leads to distortions because all prices and wages do not rise proportionately during inflationary periods. So, inflation affects income distribution and may lead to uncertainties about the future which is considered not good. (If all prices rise proportionally it is called pure inflation and it would just be a minor inconvenience.)

5. The multiplier (Keynesian multiplier) is always greater than 1 if  $T = 0$  and  $G = 0$ .

**True.** (page 52)

$$\begin{aligned} \text{Goods Market Eqm} \quad \rightarrow \quad Y &= C + I + G \\ Y &= [c_0 + c_1 Y - c_1 T] + I + G \\ Y &= \left[ \frac{1}{1 - c_1} \right] [c_0 + I + G - c_1 T] \end{aligned}$$

$$\text{multiplier} \rightarrow \left[ \frac{1}{1 - c_1} \right]$$

$$\text{If } 0 < c_1 < 1 \rightarrow \left[ \frac{1}{1 - c_1} \right] > 1$$

If the marginal propensity to consume is less than 1, it means that people consume less than 100% of their disposable income. It also implies that the multiplier is greater than 1. The fact that  $T = 0$  and  $G = 0$  is irrelevant.

## Part II. NATIONAL ACCOUNTS (GDP, GDP DEFLATOR & CPI)

For part II, assume the following:

1. MIT is an autonomous country.
2. The only good/service produced at MIT is undergrad (freshmen) education.

1. Fill in the following:

year	# of MIT freshmen	Price (Tuition)	nominal GDP	real GDP (1950\$)	real GDP (2000\$)
1950	\$300	\$2,000	\$600,000	\$600,000	\$6,000,000
2000	\$900	\$20,000	\$18,000,000	\$1,800,000	\$18,000,000
2001	\$1,000	\$21,000	\$21,000,000	\$2,000,000	\$20,000,000
2002	\$1,100	\$23,000	\$25,300,000	\$2,200,000	\$22,000,000
2003	\$1,000	\$25,000	\$25,000,000	\$2,000,000	\$20,000,000
2004	\$1,200	\$28,000	\$33,600,000	\$2,400,000	\$24,000,000

How to calculate nominal GDP:  $\text{nominal GDP}_t = \text{quantity}_t * \text{price}_t$

How to calculate real GDP:  $\text{real GDP}_t = \text{quantity}_t * \text{price}_{\text{baseyear}}$

2. Find the growth rate of nominal GDP for 2002, 2003 and 2004.
3. Find the growth rate of real GDP (using 2000 \$) for 2002, 2003 and 2004.
4. Find the growth rate of real GDP (using 1950 \$) for 2002, 2003 and 2004.

	(2) answer	(3) answer	(4) answer
year	nominal GDP growth (%)	real GDP growth (1950\$) (%)	real GDP growth (2000\$) (%)
2001	16.7	11.1	11.1
2002	20.5	10.0	10.0
2003	-5.1	-9.1	-9.1
2004	40.0	20.0	20.0

How to calculate the growth rate:      Growth rate of  $X_t = \left( \frac{X_{(t)} - X_{(t-1)}}{X_{(t-1)}} \right) * 100$

5. Why are your answers in 2, 3 and 4 different/same?

The answer to 2 differs from that of 3 and 4. (page 24-26)

Nominal GDP is the sum of quantities of final goods produced times their current price. Therefore, nominal GDP increases over time for 2 reasons.

- (1) The production of goods increases over time (Quantity goes up)
- (2) The price of most goods also increase over time (Prices goes up).

Real GDP is constructed as the sum of the quantities of final goods times \*constant\* prices. (A base year is chosen). So, it tells us how the quantity of final goods changes over time. Only the change in quantity affects real GDP.

The answers to 3 and 4 are identical. The base year chosen is sort of like a choice of unit of measurement. For example, whether one measures one's weight in pounds or kilograms does not affect one's actual weight. Therefore, the choice of base year, does not affect the growth of real GDP.

6. Compute inflation using GDP deflator (using 2000\$) for 2002, 2003, 2004.

	(6) answer GDP deflator	inflation rate (%)
2000	100	
2001	105	5
2002	115	9.5
2003	120	4.3
2004	140	16.7

(page 30-31)

$$\text{GDP deflator} = \frac{n\text{GDP}_t}{\text{realGDP}_t} = P_t$$

$$\text{Inflation rate} = \left( \frac{P_{(t)} - P_{(t-1)}}{P_{(t-1)}} \right) * 100$$

7. Besides GDP deflator what other price indices are used in measuring inflation?

(page 31-32)

**GDP Deflator** = gives the average price of output  
(the final goods produced in the economy)

**CPI** = Consumer Price Index  
Average price of consumption (goods people consume)

**PPI** = Producer Price Index  
Prices of domestically produced goods in manufacturing, mining, agriculture, fishing, forestry, and electric utility industries.

8. Which one is the best? Why?

It is hard to say which one is better or more “correct” in measuring inflation. Each index gives us different information. It depends mostly on what you are interested in knowing. If one wants to know how the price level of goods produced in the US is changing, then the GDP deflator would give the most accurate picture. On the other hand, if one was interested in knowing how the price level of consumer goods was changing over time, then CPI would be the best.

### Part III. THE GOODS MARKET

(All units are millions of US dollars)

$$C = 500 + (0.5)Y_D$$

$$I = 100$$

$$T = 80$$

$$G = 200$$

1. Solve for the good market equilibrium. (Find equilibrium  $Y$ ,  $Z$ ,  $C$ , and  $Y_D$ .)

Total demand:  $Z = C + I + G$

Good market equilibrium:  $Y = Z$

So,  $Y = C + I + G$

Remember,  $Y_D = Y - T$  ( $Y_D =$  disposable income)

Substituting in:  $Y = 500 + (0.5)(Y - 80) + 100 + 200$

$$Y = (0.5)Y + 760$$

$$\mathbf{Y = 1520 \text{ (equilibrium output)}}$$

$$\mathbf{Y_D = 1520 - 80 = 1440 \text{ (disposable income)}}$$

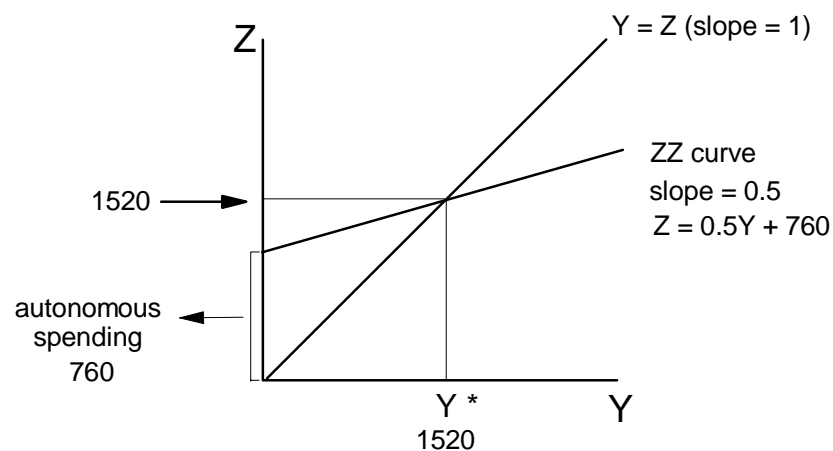
$$C = 500 + (0.5)(1440)$$

$$\mathbf{C = 1220 \text{ (equilibrium consumption)}}$$

$$Z = 1220 + 100 + 200$$

$$\mathbf{Z = 1520 \text{ (total demand)}}$$

2. Graph (with correct labels) equilibrium  $Y$  and  $Z$ .



3. Solve for private saving and public saving.

(page 58-60)

Private Saving :  $S = Y_D - C = 1440 - 1220 = 220$

Public Saving :  $(T - G) = (80 - 200) = -120$  (Budget Deficit)

Investment :  $I = S + (T - G) = \text{sum of private and public saving}$   
 $I = 220 - 120 = 100$

4. What is the value of marginal propensity to consume (mpc)? What does it mean?

(page 48-49)

mpc = marginal propensity to consume gives the effect of an additional dollar of disposable income on consumption. For example, if  $mpc = c_1 = 0.3$ , this means that \$0.30 of an additional \$1 of disposable income will be consumed, and \$0.70 will be saved.

In this problem,  $mpc = c_1 = 0.5$ . For every \$1 additional disposable income increase, \$0.50 will be consumed.

5. What is the value of marginal propensity to save (mps)?

(page 59)

**mps = (1 - c<sub>1</sub>)** = marginal propensity to save

6. What is the relationship between mpc and mps?

**mpc = 1 - mps**

7. Find the multiplier and autonomous spending. Explain what they mean.

Page (52-54)

Goods Market Eqm  $\rightarrow Y = C + I + G$   
 $Y = [c_0 + c_1 Y - c_1 T] + I + G$   
 $Y = \left[ \frac{1}{1 - c_1} \right] [c_0 + I + G - c_1 T]$

Multiplier  $\rightarrow \left[ \frac{1}{1 - c_1} \right] = \left( \frac{1}{1 - 0.5} \right) = 2$

Autonomous Spending  $\rightarrow [c_0 + I + G - c_1 T] = 760$

Autonomous spending is the part of demand for goods that does not depend on output. The multiplier tells us how much equilibrium output will change for a given change in autonomous spending. For example, if investment increases by 500, then the equilibrium output will rise by 1,000 ( $500 * 2$ ). Why? First, investment increases by 500. Then, this increase in  $I$  increases  $Z$  (total demand). When demand increases, production must also increase to maintain equilibrium. This means that  $Y$  increases. When  $Y$  increases,  $Y_d$  will increase. When disposable income increases,  $C$  increases.  $C$  increase will result in yet a higher  $Z$  since  $C$  is a part of  $Z$  (total demand). But, when  $Z$  increases,  $Y$  must also increase to match it if in equilibrium, and so on. This process continues. (Please see page 55 for detailed description)

8. Now, the government is facing a reelection and increases  $G$  from 200 to 240 (Fiscal expansion). Find the equilibrium demand, output, consumption, and disposable income, then graph. Why would the government want to do so?

When  $G$  increases by 40, then autonomous spending increases by 40. Since the multiplier is 2, the equilibrium output will increase by 80. Therefore, disposable income will rise by 80 and consumption will rise by 40 since  $mpc$  is 0.5.

In an election year, the government might increase  $G$  since fiscal expansion leads to higher income (and higher disposable income) and this gives an impression of favorable economic performance which might win more votes.

