14.02 Principles of Macroeconomics
Problem Set 1
Fall 2005
Solution

Posted: Monday, September 12, 2005
Due: Wednesday, September 21, 2005

Part I. True/False/Uncertain
Justify your answer with a short argument.

1. Because of a natural disaster, the government purchases $100 million worth of bottled water and blankets. This increases GDP by $100 million.

UNCERTAIN.
When the government purchases goods or services, it counts as a part of G. Therefore, in the goods market model, when G increases by $100, GDP increases by at least $100 million. It increases by $100 million only if the multiplier is equal to one, meaning that the marginal propensity to consume is 0. If the marginal propensity to consumer is bigger than 0, which is a more realistic situation, then the multiplier is bigger than one and GDP increases by multiplier*$100 million.

2. Because of a natural disaster, the government increases unemployment insurance benefits payments to those who are affected. This increases GDP.

TRUE.
In the goods market model, an increase in unemployment insurance benefits amounts to a decrease in T (since T is taxes paid minus government transfers received by consumers). Thus, disposable income increases, which implies that consumption goes up and that GDP increases (with a multiplier effect).

3. The multiplier (Keynesian multiplier) is always less than 1 if T = 0, G = 0, and NX = 0.

FALSE.
Goods Market Eqm $\rightarrow$ $Y = C + I + G$

$$Y = [c_0 + c_1 Y - c_1 T] + I + G$$

$$Y = [\frac{1}{1 - c_1}] [c_0 + I + G - c_1 T]$$

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

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

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 1. The fact that T = 0, G = 0, and NX=0 is irrelevant.

4. It is impossible for real GDP increase to be coupled by a decrease of nominal GDP.

FALSE.
Real GDP changes only when the quantity of final goods and services produced changes. Nominal GDP changes when either the quantity and/or the price of final goods and services produced changes. So, it is possible for an economy to experience an increase of real GDP (if the quantity of final goods and services increase) but experience a decrease of nominal GDP (if the decrease in prices offsets the increase in quantity of goods and services).

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

Uncertain.

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.)

6. The growth rate of nominal GDP per capita is the best summary measure of changes in material living standards in a country over time.

FALSE.
Growth in nominal GDP per capita is not the best way of measuring changes in material living standards because it does not adjust for inflation. In an economy with a high inflation will experience an increase in nominal GDP even if the real amount of goods and services produced decreases. Real GDP per capital is a better measure of material living standards.

7. GDP deflator is the best measure of inflation.

FALSE.

GDP Deflator =	gives the average price of output (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.

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.

II. UNEMPLOYMENT

Total population:	1,000,000
Number of adults employed:	450,000
Number of unemployed adults:	90,000
Labor force:	500,000

1. Calculate the unemployment rate.

   L = N + U
   L = labor force
   N = number of employed
   U = number of unemployed (but who are looking)

   As many of you realized, the numbers of unemployed and employed adults don't add up to the labor force, implying that some of the unemployed are not counted as unemployed and in the labor force in the official statistics since these people are not looking for a job. (Sorry, the wording was not quite clear here – it would have been clearer to say that "Number of adults without a job" is 90,000).

   L = 500,000
   N = 450,000 ➔ U = 50,000
   Unemployment rate = 100 * (U/L)
   Unemployment rate = 100* (50,000/500,000) = 10%

2. If 200,000 migrate to a neighboring country, what happens to the unemployment rate?

   Depends on who migrated. If those not in the labor forces were the only ones who migrated, then the unemployment rate will not change. However, if either current employed or currently unemployed but who are looking for work migrated, then the rate will change.

3. If this country's unemployment rate decreases, what do we know about its real GDP?

   Not much. When somebody who is unemployed (but looking for work) gives up job search, that person drops out of the labor force. (We call them discouraged workers.) So, even if N and L stay the same, we could have a lower unemployment rate. In this case, real GDP is the same since the same number of people are working.

   If the drop in unemployment was caused by an in crease in N or decrease in U (unemployed finding work, so moving from U group to N group), then real GDP should increase since more people are working.

Part III. NATIONAL ACCOUNTS (GDP, GDP DEFLATOR & CPI)

For part II, assume the following:
1. MIT is a closed economy.
2. The only good/service produced at MIT is undergrad (freshmen) education.

1. Fill in the following:

year	# of MIT freshmen (quantity)	Price (Tuition)	nominal GDP	real GDP (1950$)	real GDP (2000$)
1950	100	$1,000	$100,000	$100,000	$2,000,000
2000	800	$20,000	$16,000,000	$800,000	$16,000,000
2001	1000	$21,000	$21,000,000	$1,000,000	$20,000,000
2002	1100	$22,000	$24,200,000	$1,100,000	$22,000,000
2003	1000	$24,000	$24,000,000	$1,000,000	$20,000,000
2004	1200	$31,000	$37,200,000	$1,200,000	$24,000,000

How to calculate nominal GDP: nominal GDP_t = $quantity_t$ * $price_t$
How to calculate real GDP: real GDP_t = $quantity_t$ * $price_{baseyear}$

2. Find the growth rate of nominal GDP for 2001, 2002, 2003, 2004.
3. Find the growth rates of real GDP (using 2000$) and (using 1950$) for 2001, 2002, 2003 and 2004.

year	nominal GDP growth (%)	real GDP growth (1950$) (%)	real GDP growth (2000$) (%)
2001	31.3	25.0	25.0
2002	15.2	10.0	10.0
2003	-0.8	-9.1	-9.1
2004	55.0	20.0	20.0

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

4. In this example, is the choice of base year important for calculating the growth rate of real GDP? Would your answer to this question change if the economy in this example produced more than one good?

No, the choice of base year is not important here. See answers to part 4.
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 finals goods changes over time and not price. Only the change in quantity affects real GDP.

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.

If there is only one good, the price drops out of the formula for the growth rate of real GDP:

Growth rate of $X_t = \left(\frac{P_b * Q_{(t)} - P_b * Q_{(t-1)}}{P_b * Q_{(t-1)}} \right) * 100 = \left(\frac{Q_{(t)} - Q_{(t-1)}}{Q_{(t-1)}} \right) * 100$, where $X_t = P_b * Q_t$

This is why the choice of base year doesn't matter. However, if there are two goods in the economy, real GDP is calculated as $X_t = P_{1b} * Q_{1t} + P_{2b} * Q_{2t}$, which implies that the prices don't drop out of the growth formula since P_{1b} and P_{2b} can of course be different. Thus, if there are more than two goods, the choice of base year does matter.

5. Compute inflation using GDP deflator (using 2000$) for 2001, 2002, 2003, 2004.

	GDP deflator	Inflation rate (%)
2000	100	
2001	105	5.0
2002	110	4.8
2003	120	9.1
2004	155	29.2

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GDP deflator $= \frac{nGDP_t}{realGDP_t} = P_t$

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

Part IV. THE GOODS MARKET (Closed Economy)
(All units are millions of US dollars)

$C = 220 + (0.6)Y_D$
$I = 50$
$T = 200$
$G = 250$
$NX = 0$

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

   Total demand: $Z = C + I + G$
   $Y_D = Y - T$ (Y_D = disposable income)

   $Z = 220 + (0.6)Y_D + 50 + 250$
   $Z = 520 + (0.6)*(Y - 200)$
   $Z = 400 + 0.6Y$

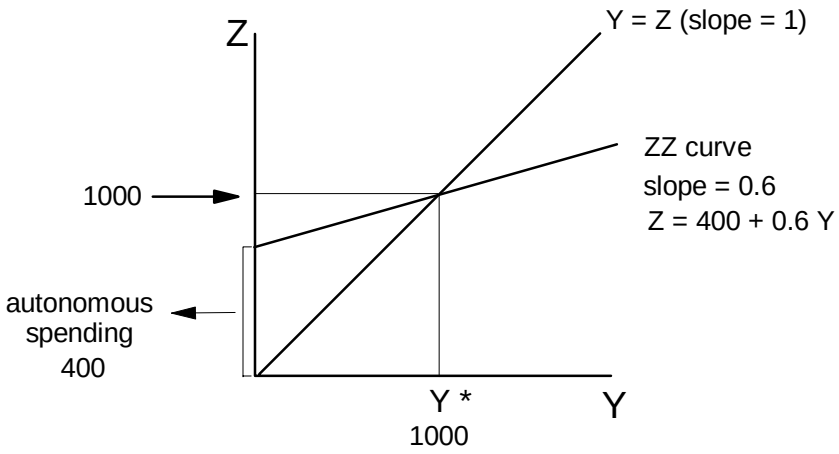
   Good market equilibrium: $Y = Z$ or $Y = C + I + G$

   Substituting in: $Y = 400 + 0.6Y$
   $0.4Y = 400$
   $Y = 1000$ (equilibrium output)

   $Y_D = 1000 - 200$
   $Y_D = 800$ (disposable income)

   $C = 220 + (0.6)(800)$
   $C = 700$ (equilibrium consumption)

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



3. Solve for private saving and public saving.

   Private Saving : $S = Y_D - C = 800 - 700 = 100$

   Public Saving : $(T - G) = (200 - 250) = -50$ (Budget Deficit of $50 million)

   Investment : $I = S + (T - G)$ = sum of private and public saving
   $I = 100 - 50 = 50$
   (Consumers can either lend to the government or the private sector (companies). When the government runs a budget deficit, it must borrow from consumers, so the budget deficit crowds out Investment. Here, consumers saved a total of $100 million, but $50 million was lend to the government, leaving only $50 million for the private sector.)

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

   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. mpc = coefficient on Y_D.

   In this problem, mpc = $c_1 = 0.6$. For every $1 additional disposable income increase, $0.60 will be consumed. Disposable income is the income after taxes.

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

   mps = $(1 - c_1)$ = marginal propensity to save
   mps = 1-0.6 = 0.4

6. What is the relationship between mpc and mps?

   mpc + mps = 1
   For another $1 income, you either save or consume.
   mpc = proportion you consume
   mps = the proportion you save
   Must add up to 1 (or 100%)

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

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

   Multiplier $\rightarrow$ $[\frac{1}{1 - c_1}] = (\frac{1}{1 - 0.6}) = 2.5$
   Autonomous Spending $\rightarrow$ $[c_0 + I + G - c_1 T] = 400$

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 1,250 (500 *2.5). 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 textbook for detailed description)

8. Now, in order to deal with a natural disaster, the government purchases $100 million worth of supplies. Find the new equilibrium demand, output, consumption, and disposable income, then graph. (Instead of calculating from scratch, try to reason out your answer from the original equilibrium calculations followed by a discussion of multiplier.)

   When G increases by 100, then autonomous spending increases by 100. Since the multiplier is 2.5, the equilibrium output will increase by 250. (ZZ and the 45^0 line will now intersect at 1250) Y* = 1250.

   Therefore, disposable income will rise by 250 since $Y_D = (Y-T)$.
   Consumption will rise by 150 since mpc is 0.6. 150 = 0.6 * (250)