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# 14.02 Principles of Macroeconomics

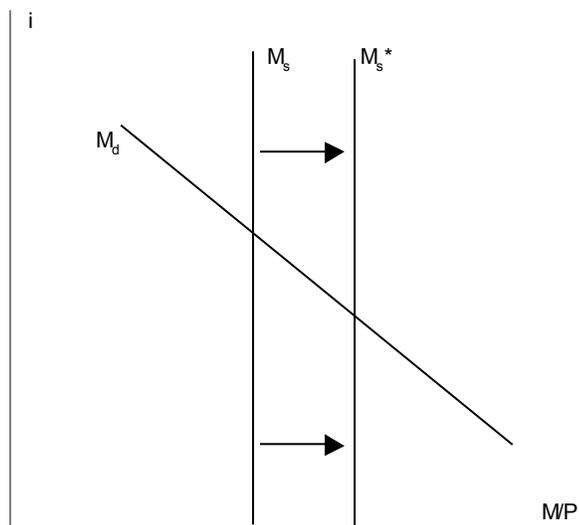
## Problem Set 1 Solutions

### Spring 2003

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#### Question 1 : Short answer

- (a) **TRUE.** Recall that in the basic model in Chapter 3, autonomous spending is given by  $c_0 + I + G - c_1T$ . So if  $G$  and  $T$  both fall by 1 unit, autonomous spending will fall by  $1 - c_1$  units. Since in equilibrium,  $Y$  is proportional to autonomous spending,  $Y$  will also fall.
- (b) **FALSE.** Even if poor people and rich people have the same marginal propensity to consume (this is the parameter  $c_1$  in the consumption function  $C = c_0 + c_1(Y-T)$ ), rich people will have higher consumption simply because their disposable income ( $Y-T$ ) is higher. So the statement does not follow logically.
- (c) **TRUE.** The government is 'purchasing' the services of the Naval officer (the officer is providing the service of helping to defend the US). So the salary of the officer is counted in GDP as part of  $G$  (government spending).
- (d) **FALSE.** A government pension is a transfer payment, and thus does not count towards GDP, since it is not a payment for goods or services. See the discussion on page 47 of Blanchard.
- (e) **TRUE.** When the central bank (eg. the Federal Reserve) buys government bonds in an open market operation, it is exchanging bonds for money, and thus increasing the size of the money supply. This will result in lower interest rates (see the below diagram):



- (f) **TRUE.** Since  $GDP = C + I + G + (X - IM)$ , it is possible for  $X$  and  $IM$  to both be larger than  $GDP$ , as long as the net trade balance  $(X - IM)$  is smaller than  $GDP$ . In fact, in Singapore, an important port involved in a lot of import-export activity, imports and exports are actually larger than  $GDP$ .
- (g) **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 very high inflation rates, nominal  $GDP$  per capita will be growing very quickly, even if the economy is in recession (ie. even if the real amount of goods and services the economy is producing is falling over time).

## Question 2: Understanding economic data

### I: NATIONAL ACCOUNTS

- (a) Below is a summary of the revenue, expenses and profits for each of the three firms:

	Revenue		Expenses			Profit
		Raw materials	Wages	Taxes	TOTAL	
<b>Nomar</b>	120	-	70	-	70	50
<b>Manny</b>	300	120	80	-	200	100
<b>Pedro</b>	500	300	70	40	410	90

- (b) GDP can be calculated in three equivalent ways:
- **Value of final goods and services:**  
\$500 (the final retail value of the bats)
  - **Sum of value added:**  
Value added by a firm is the final value of its good, minus the value of the intermediate goods used in production. ie:  
Nomar: \$120  
Manny: \$300 - \$120 = \$180  
Pedro: \$500 - \$300 = \$200  
TOTAL VALUE ADDED = \$120 + \$180 + \$200 = \$500
  - **Sum of incomes:**  
Total labor income = 70 + 80 + 70 = \$220  
Total profits (capital income) = 50 + 100 + 90 = \$240  
Indirect taxes = \$40  
TOTAL INCOME = \$220 + \$240 + \$40

As you can see, the answer is always the same: \$500.

- (c) From the calculation in part (b):

$$\begin{aligned}\text{Labor income} &= 220 / 500 = 44\% \text{ of GDP} \\ \text{Capital income} &= 240 / 500 = 48\% \text{ of GDP} \\ \text{Indirect taxes} &= 40 / 500 = 8\% \text{ of GDP}\end{aligned}$$

Comparing these percentages to the US income shares (see Table 2-1 at the top of page 24 of Blanchard) – indirect taxes are around the same as in the US (8% compared to 7%). But labor income is much lower than in the US (44 % of GDP compared to 65%), and capital income is correspondingly much higher (48% compared to 28%).

## II: UNEMPLOYMENT

(d) Unemployment rate =  $U/(U + L)$

where U is the number of people unemployed and looking for work, and L is the number of employed.

So unemployment rate =  $50 / (600 + 50) = 7.7 \%$

(e) New unemployment rate =  $30 / (620 + 30) = 4.6 \%$

(f) New unemployment rate =  $30 / (520 + 30) = 5.5 \%$

So the unemployment rate is higher than in part (e), but lower than part (d).

This comparison illustrates one drawback of the unemployment rate as a measure of the state of the labor market. Even though the economy is in a deep recession in part (f), the unemployment rate did not rise that much, because people gave up and stopped looking for work altogether, and therefore were no longer counted in the calculation of the unemployment rate. (Economists refer to this phenomenon as the ‘discouraged worker effect’.)

So it is generally inappropriate to think of the unemployment rate as a complete or comprehensive measure of the strength of the labor market. Other indicators (such as employment, hours worked etc.) are also important.

In practice, the unemployment rate does tend to move quite strongly with changes in output. And unemployment is still considered to be very useful, both as a measure of whether the economy is operating above or below its normal level of activity, and as a measure of social welfare (see the discussion on pages 28 and 29 of Blanchard)

## III: NOMINAL AND REAL DATA

Results of the calculations for parts (g) – (j) are presented in the below table:

	<b>Nominal GDP</b>	<b>Prices</b>	<b>Real GDP (1996 \$)</b>	<b>Nominal GDP growth</b>	<b>Inflation</b>	<b>Real GDP growth</b>
<b>1996</b>	260	100	260.0			
<b>1997</b>	279	103	270.9	7.3%	3.0%	4.2%
<b>1998</b>	299	107	279.4	7.2%	3.9%	3.2%
<b>1999</b>	342	115	297.4	14.4%	7.5%	6.4%
<b>2000</b>	379	122	310.7	10.8%	6.1%	4.5%
<b>2001</b>	388	125	310.4	2.4%	2.5%	-0.1%

- (g) The inflation rate is calculated as the percentage change in the price index: ie  $(P_t - P_{t-1})/P_{t-1}$ . See the second last column of the tables for the results.
- (h) To calculate real GDP in terms of 1996 dollars, take nominal GDP in each year, and divide it by the price level in each year. Then, multiply it by 100, because that's what the price level was in 1996.

[Note: Even if you didn't multiply by 100, you should still get the right answers when calculating GDP growth in part (i)]

- (i) See table for the quantitative answers. Nominal GDP growth is higher than real GDP growth. The reason is that inflation is positive, which inflates nominal GDP over time, but does not affect the calculation of real GDP.
- (j) High unemployment in 2001 would not be surprising. As Figure 2-4 in Blanchard shows, historically the unemployment rate has been negatively correlated with the change in the inflation rate. In 2001 the change in inflation was strongly negative, which would lead you to expect the unemployment rate in that year was also high.

[NOTE: This relationship between unemployment and inflation is called the "Phillips Curve". The different ways economists have thought about this relationship has played a very important role in shaping the evolution of macroeconomic theory. See Chapter 27 of Blanchard - "The Story of Macroeconomics" - for more details.]

Furthermore, increasing unemployment in 2001 would be consistent with the low output growth rate (-0.1%) observed in that year. As Figure 2-2 in Blanchard shows, there is a strongly negative relationship between GDP growth and the change in unemployment. (This relationship is called "Okun's Law").

[NOTE: Okun's Law makes a lot of sense when you think about it – if the economy grows very quickly, it is likely that more people will have to be hired to help produce all that extra output. Conversely if the economy grows slowly or not at all, there will probably be layoffs and less hiring.]

### Question 3 – The Goods Market

- (a) Taxation is very likely to be procyclical (ie. to increase when output increases), since the vast majority of tax revenue in the US is collected directly as some share of various types of income. eg. personal income taxes, taxes on corporate profits etc. And other types of taxes (like sales tax or property tax) will also be likely to fall during a recession, as people spend less and housing prices fall.

It also plausible to expect some areas of government spending to increase during a recession. For example: increased numbers of homeless and unemployed people might force the hiring of more social workers or employment counselors, or the construction of new homeless shelters, to maintain services at their previous levels. [IMPORTANT: Remember that spending on transfer payments, such as unemployment insurance, is not counted in G (see Blanchard page 47 for a discussion), and so extra spending on such payments would not be a reason for G to be higher during recessions.]

[NOTE: Factors which tend to make the budget balance automatically procyclical, are called *automatic stabilizers*. Implicit in this discussion is the assumption that the government does not adjust its taxation or spending *policies* during a recession. For example, the government might make a policy decision to cut employment of public servants during a recession to reduce the size of the budget deficit. Or it might increase income tax rates to recoup lost tax revenue].

- (b) 
$$\begin{aligned} Z &\equiv C + I + G \\ &= 3 + 0.9(Y - T) + 6 + 11 - 0.01 Y \\ &= 20 + 0.9(Y - 0.1Y) - 0.01 Y \\ &= 20 + 0.8 Y \end{aligned}$$

Since  $Z = Y$  in equilibrium, this means:

$$Y = 20 + 0.8 Y$$

Rearranging this expression to solve for Y gives us:

$$\begin{aligned} Y &= 20 / 0.2 = 20 \times 5 \\ &= 100 \end{aligned}$$

- (c) Investment falls by 2, and output falls by  $2 \times 5 = 10$ . There are two ways to see this. The first way (the long way!) would be to re-do the calculations in part (b) for the new level of investment. If you did this, you would find the new equilibrium Y would be 90 instead of 100.

The easier way is to note that the multiplier in this economy is 5. So a change of 1 in autonomous spending causes a change of 5 in Y. Remember that in part (b)

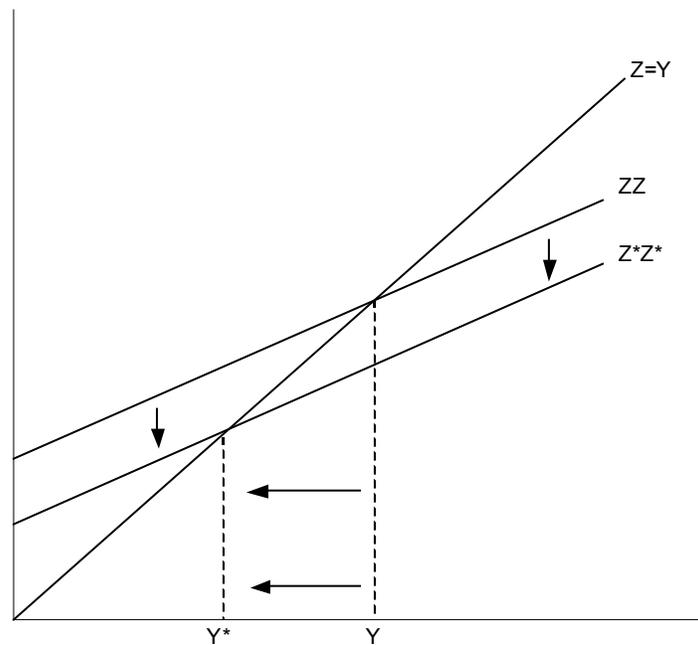
$$Y = 20 / 0.2 = 20 \times 5$$

When investment falls to 4, autonomous spending falls from 20 to 18, so  $Y = 18 \times 5 = 90$ .

Remember that  $T = 0.1 Y$ . So taxes fall from 10.0 to 9.0. Similarly  $G = 11 - 0.01 Y$ . So government spending increases from 10 to 10.1. Thus, the new budget balance is  $9.0 - 10.1 = -1.1$  (ie. a budget deficit of 1.1).

- (d) Yes, as discussed above, output  $Y$  falls more than  $I$  (10 compared to 2). The intuitive explanation is that the fall in investment affects other sectors of the economy. Output 'initially' falls by 2, this causes consumption to fall, which causes output to fall even further, which causes consumption to fall.... and so on.

Graphically:



As you can see from the diagram, output falls by much more than investment, reflecting the multiplier effects discussed above.

- (e) Let the tax rate we want to find be equal to  $x$ . By similar calculations to those in part (b):

$$\begin{aligned} Z &\equiv C + I + G \\ &= 3 + 0.9(Y - T) + 4 + 11 - 0.01 Y \\ &= 18 + 0.9(Y - xY) - 0.01 Y \\ &= 18 + (0.89 - 0.9x)Y \end{aligned}$$

In equilibrium,  $Z = Y$ , so:

$$Y = 18 + (0.89 - 0.9x)Y$$

Now, remember that we're trying to find the tax rate  $x$  so that  $Y = 100$  as in part (b). So substituting 100 into the above expression and solving for  $x$ , we get

$$x = (0.89 - 0.82) / 0.9 = 0.078.$$

So in other words the government would have to cut the tax rate from 10% to 7.8% to return  $Y$  to its previous level of 100.

(f) CALCULATING  $Y$  WHEN INVESTMENT = 6

Going through the same steps as in part (b):

$$\begin{aligned} Z &\equiv C + I + G \\ &= 3 + 0.9(Y - T) + 6 + T \\ &= 9 + 0.9(Y - 0.1Y) + 0.1Y \\ &= 9 + 0.91Y \end{aligned}$$

Since  $Z = Y$  in equilibrium, this means:

$$Y = 9 + 0.91Y$$

Rearranging this expression to solve for  $Y$  gives us:

$$\begin{aligned} Y &= 9 / 0.09 = 9 * 11.111 \\ &= 100 \end{aligned}$$

So we get the same answer for  $Y$  as in part (b)! The reason is that in part (b), it turned out that the budget balance was exactly equal to zero. So changing to a balanced budget policy wouldn't have made any difference to the economy, since the budget was in balance already.

RECALCULATING  $Y$  AFTER INVESTMENT FALLS FROM 6 TO 4:

The multiplier is now 11.11 instead of 5, so when investment falls from 6 to 4, output falls by  $11.111 * 2 = 22.22$ . So  $Y = 77.78$  after investment falls to 4.

Compare this to your answer in part (b). Remember that output started off at the same level ( $Y = 100$ ) in both cases. But under the old spending rule (when  $G = 11 - 0.01Y$ ), output only fell to 90, whereas now it falls all the way to 77.78.

Why is this? The reason is that under the previous spending rule, government spent more when investment fell. This helped to stimulate the economy, and reduce the

effects of the fall of investment on output. Now, the opposite happens. When investment falls, the government actually *cuts* spending (because  $G = T$ , and there is less tax revenue). This acts to exacerbate the effects of the decline in investment on the output produced by the economy.

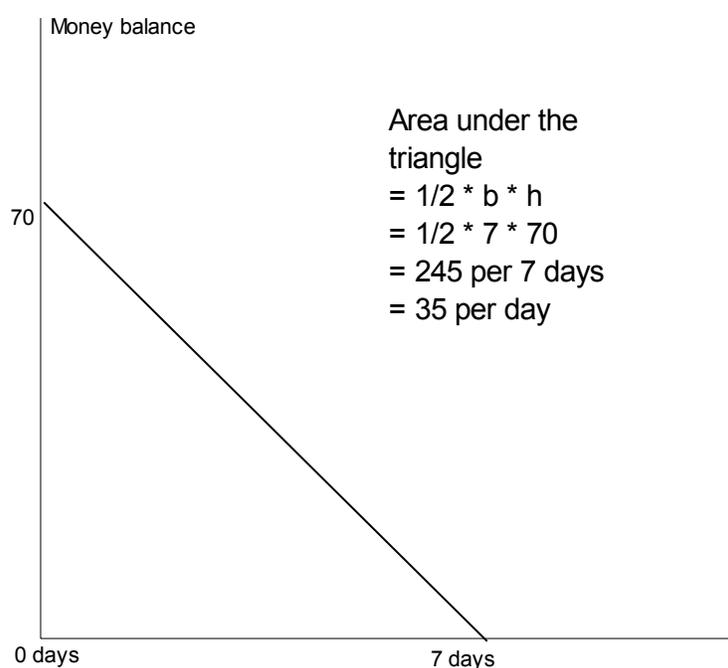
- (g) The analysis you have done suggests that balanced budget rules are probably not a good idea. The reason is that they make output more volatile. When something happens to the economy (such as the fall in investment you considered earlier), output changes by more than it would under a fiscal policy where the government ran a budget deficit during recessions, and a budget surplus during booms. You saw this directly - under the balanced budget rule, output fell more than twice as much following the decline in investment. [The argument is symmetric, if investment had *increased* by 2, output would have increased by more under the balanced budget rule].

There are other arguments (outside the scope of the model) to think a balanced budget rule might actually be a good idea. For example, it may be a good commitment device to control the size of the government and reduce wasteful government spending, since it takes the decision of how much to spend out of the hands of politicians. Proponents of balanced budget rules often justify their position using such arguments.

## Question 4 – Financial Innovation

- (a) Bert spends \$10 during the course of each day, and then takes out \$70 straight after he spends his last \$10. So his average money demand calculated at the end of each day is  $(70 + 60 + 50 + 40 + 30 + 20 + 10) / 7 = \$40$ .

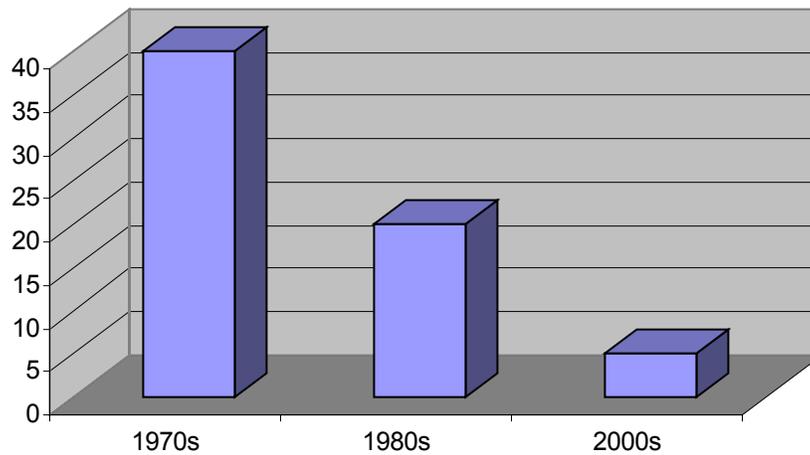
[NOTE: You might have interpreted the question as if Bert spent money continuously at a rate of \$10 a day until his wallet is empty, and then takes out \$70 from the bank. Under this spending pattern you would have found a slightly different answer - his average money demand would be  $(70 + 0) / 2 = \$35$ . One way to see this is via a diagram:



This interpretation of the question is also totally fine.]

- (b) Bert's money demand is now  $(30 + 20 + 10) / 3 = \$20$ , compared to \$40 before.
- (c) Bert's average money demand is now \$5. So a graph of his money demand over time would look like:

### Bert's money demand



Recall that velocity of money is given by  $V = PY / M(d)$ . So if everyone's money demand falls over time like Bert's, then money demand  $M(d)$  is falling, which means  $V$  is increasing. This is consistent with US experience over the past 40 years (see the graph on page 70 of Blanchard, which shows  $M/\$Y$  – the inverse of velocity – falling steeply over time in the US)

[Note: In this question, money has been defined just as cash – which is a quite narrow definition. Broader measures of money (such as M3) would also include the balance in Bert's bank accounts, which may not have fallen so rapidly over time.]