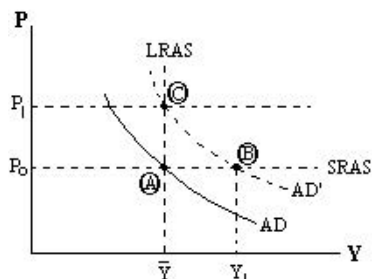


Chapter 10:

1. Questions For Review (p. 303).

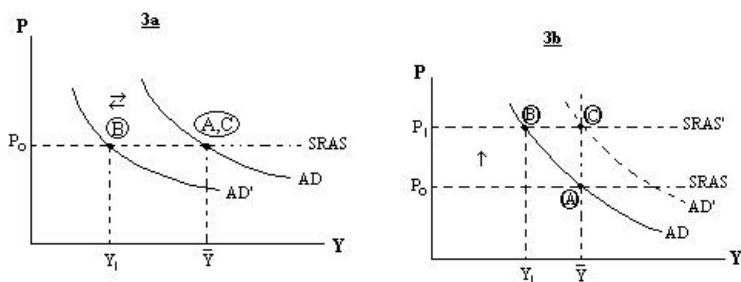
4. The answer is the same for an increase in money supply or government purchases. Start in long run equilibrium (point A). In the short run, aggregate demand AD will shift to the right, causing output to increase (to point B).<sup>1</sup> Since output  $Y$  is now above its natural rate  $\bar{Y}$ , prices  $P$  will rise in the long run, bringing spending and thus output back down to  $\bar{Y}$ . This is a movement along the AD curve (from point B to point C).



The idea here is that prices are sticky in the short run<sup>2</sup> but flexible in the long run. When output falls above (below)  $\bar{Y}$ , there is pressure for prices to increase (decrease), which they do after some period of inaction (stickiness).

2. Problems and Applications (p. 304).

- 3a. An exogenous fall in velocity shifts AD to the left (people are buying less with each dollar of money that they are holding). If the Fed increases the money supply (proportionally to the fall in velocity), AD will shift back to the right, and both output and prices will be stabilized in the short run (returned to their original values).



- 3b. An increase in the price of oil will cause the general price level to rise. Consequently, spending and thus output will fall. This is a movement along the AD curve (to point B). If the Fed is interested in stabilizing output in the short run, it can increase the money supply, shifting the AD to the right (to AD'). However, since the economy is now in equilibrium (point C), there is no pressure for the price level to change further, so the higher price level is locked in.

<sup>1</sup> In this chapter, we do not yet have a good model of AD. In the next chapter AD is modeled by IS-LM. In IS-LM, increasing the money supply shifts LM downward, while increasing government purchases shifts IS to the right. Both lead to an increase in equilibrium spending at current prices, and thus a shift of AD to the right.

<sup>2</sup> The short run is *defined* as the amount of time that it takes before prices adjust after a demand shock. How long is this in practice? Price and survey data indicate that most (though not all) firms typically take at least several months to change prices in response to changes in demand.

If the Fed wants to stabilize the general price level, it can only do so in the long run. It can do this by leaving the economy in recession (at point B) in the short run. In the long run, prices would fall, and the economy would return to its original equilibrium (point A).

Chapter 11:

4. Problems and Applications (p. 330).

2a. The planned expenditure line PE is given by

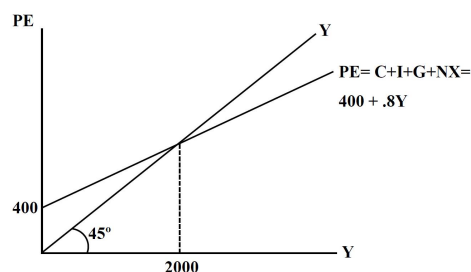
$$\begin{aligned} PE &= C + I + G + NX \\ &= [120 + .8(Y - 400)] + 200 + 400 + 0 \\ &= 400 + .8Y \end{aligned}$$

Notice that the Keynesian Cross multiplier is<sup>3</sup>

$$\text{multiplier} = \frac{1}{1 - \text{slope of PE}} = \frac{1}{0.2} = 5.0$$

2b. Setting planned expenditure  $PE$  equal to output  $Y$ , we get equilibrium output:

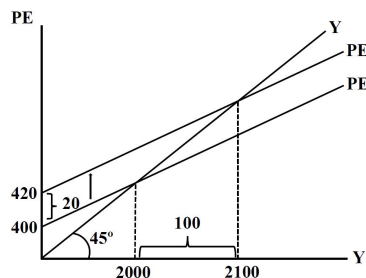
$$\begin{aligned} Y &= PE(Y) \\ &= 400 + .8Y \\ 0.2Y &= 400 \\ Y &= 2000 \end{aligned}$$



2c. You can replace  $G = 400$  with  $G = 420$  above and re-solve to get  $Y = 2100$ .<sup>4</sup> Alternatively, you can note that

$$\begin{aligned} \Delta Y &= \text{multiplier} \times \Delta G \\ &= 100 \end{aligned}$$

so equilibrium output has risen to 2100.

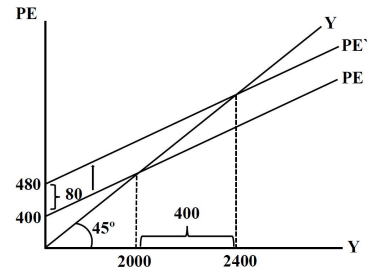


2d. Again, you can use the equilibrium condition to solve for the level of government purchases required to achieve equilibrium output of 2400, or you can use the multiplier to see how much of a change in government purchases is needed to increase output from 2000 to 2400. Try the first method first:

<sup>3</sup> Since the slope of PE in this problem is the MPC, the multiplier below could be written  $(1/(1-MPC))$ . Mankiw introduces this as the government purchases multiplier but it works for any vertical shift of PE (i.e., any change in autonomous spending) in this simple version of the Keynesian Cross model. When we alter the model below in parts h and i, so that the slope of PE is no longer the MPC, we will need to use the more general formula for the Keynesian Cross multiplier,  $(1/(1-\text{slope of PE}))$ .

<sup>4</sup>  $Y = 420 + .8Y$ .

$$\begin{aligned}
Y &= 0 + \bar{G} + .8Y \\
2400 &= 0 + \bar{G} + 1920 \\
\bar{G} &= 480
\end{aligned}$$



Now try the second method. To increase equilibrium output  $Y$  by 400, with a multiplier of 5, we need to increase government purchases by 80. Thus, government purchases must be increased to 480.

2e. If we wanted to cut taxes enough to increase equilibrium  $Y$  by 400, holding  $G$  constant, we would need:

$$\begin{aligned}
\Delta Y &= -\text{MPC} \cdot \text{multiplier} \cdot \Delta T \\
&= -.8 \cdot 5 \cdot \Delta T
\end{aligned}$$

so we would need  $\Delta T = -100$ . Note that the general Keynesian Cross multiplier in this problem is 5, and we could say that the “tax multiplier” here is -4 (which is  $-\text{MPC} \cdot \text{multiplier}$ ). Note also that the model graph for this problem is the same as in part **d**. The cut in taxes by 100 shifts up the PE curve by 80, which leads to an increase in  $Y$  of 400.

2f.

In the first round of the multiplier process we have an increase in spending ( $\Delta G$ ) of 20 which leads directly to an increase in production ( $\Delta Y$ ) of 20. This is also an increase in income. Consequently, there is a second round increase in consumption spending by  $0.8 * 20 = 16$ . This raises output (firms produce what consumers want to buy) and thus income, leading to a third round increase in consumption spending of  $.8 * 16 = 12.8$ , and so on.

Looking  $t$  rounds past the fiscal policy shock, output has thus increased by  $\Delta G \times (1 + .8 + .8^2 + .8^3 + \dots + .8^{t-1})$ . In the problem, I assume that each round of spending takes one month. Thus, after 4 months, output will have increased by about 59. Since output will eventually rise by 100, this means that we are about 60% of the way there after 4 months.

Round	$\Delta G$	$\Delta C$	$\Delta Y$
1	20	-	20.00
2	-	16.00	16.00
3	-	12.80	12.80
4	-	10.24	10.24
total			59.04

2g. As in **d** and **e**, you can use either the equilibrium condition or the multiplier to answer this question. We now have the additional requirement that any new government spending is financed by new taxes ( $\Delta G = \Delta T$ ). Since we currently have a balanced budget (from part **c**), this requirement implies that we need to keep  $G = T$  at their new values.

If we use the equilibrium condition, we want to solve for the level of government purchases and taxes required to achieve equilibrium output of 2400, keeping  $G = T$ .

$$\begin{aligned}
Y &= 320 + .8Y - .8\bar{T} + \bar{G} \\
&= 320 + .2\bar{T} + .8Y \\
.2 \cdot 2400 &= 320 + .2\bar{T} \\
\bar{T} &= 800
\end{aligned}$$

This says that we need to raise both government purchases and taxes by 400, so that both are 800.

Now try the second method. We want to increase equilibrium output  $Y$  by 400. Consider the multiplier on an equal increase of government purchases and taxes. An extra dollar of government purchases shifts PE upward by 1 dollar, while an extra dollar of taxes shifts PE downward by 80 cents (consumption falls directly by  $MPC \times \$1$ ). Thus, if we raise both government purchases and taxes by a dollar, equilibrium output increases by the (K-cross) multiplier times the net shift:  $5 \times .2 = 1$  dollar. Thus, we can raise output by 400 dollars, by raising  $\bar{G}$  and  $\bar{T}$  each by 400 dollars.

$$\begin{aligned}\Delta Y &= \text{multiplier} \times \Delta \bar{G} - \text{multiplier} \times (MPC \times \Delta \bar{T}) \\ \Delta \bar{T} &= \Delta \bar{G} \\ \Rightarrow \\ \Delta Y &= 5 \times \Delta \bar{G} - 4 \times \Delta \bar{G} \\ &= 1 \times \Delta \bar{G}\end{aligned}$$

Note that in parts **c** and **d** we raised government purchases without changing taxes. Thus, the extra government spending was *deficit financed*. In part **g**, the extra government spending is *tax financed*, rather than deficit financed. One way of stating the results above is that, in the present problem, the multiplier on deficit financed government purchases is five, while the multiplier on tax financed government purchases is one (which is the difference between the multipliers on  $\bar{G}$  and  $\bar{T}$  separately). Sometimes the latter multiplier is also referred to as the ‘balanced budget multiplier.’<sup>5</sup>

- 2h. In the U.S., net tax revenues  $T$  rise and fall with national income  $Y$  for several reasons. Corporate and personal income tax revenues are obviously increasing in national income. Further, a variety of transfer payments are decreasing in national income (fewer people are eligible for unemployment and welfare benefits during periods with high output and employment), and this also makes net taxes revenues (tax revenues net of transfer payments) vary positively with national income.

The planned expenditure line PE is now given by

$$\begin{aligned}PE &= 720 + .8(Y - .2Y) \\ &= 720 + .64Y\end{aligned}$$

The slope of the planned expenditure line PE is no longer the MPC, but rather the MPC times one-minus-the-tax-rate ( $MPC \cdot (1 - t)$ ). Consequently, the Keynesian Cross multiplier is now

$$\text{multiplier} = \frac{1}{1 - \text{slope of PE}} = \frac{1}{1 - .64} = 2.\bar{77}$$

The proportional tax reduces the slope of PE, since increases in income are now taxed and so lead to smaller increases in consumption. Since the slope is smaller, the multiplier for the Keynesian Cross model is also smaller than it was under a lump sum tax. Each round of induced consumption in the multiplier process is now smaller, leading to a smaller multiplied change in equilibrium output from an exogenous change in spending.

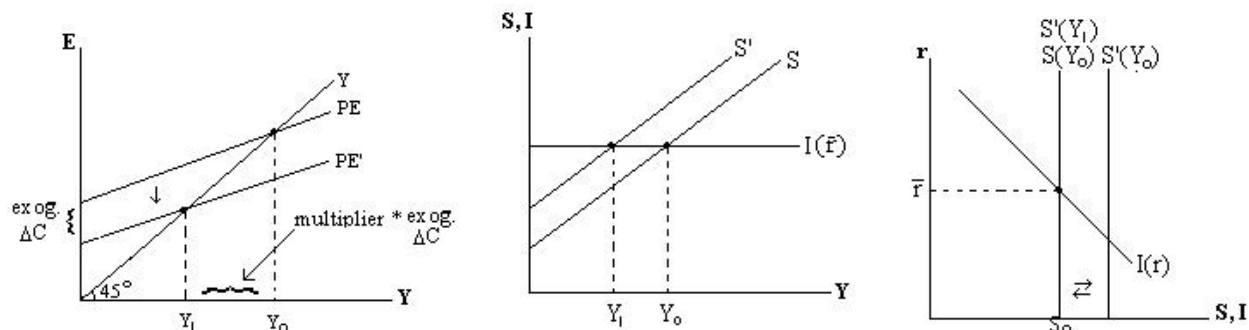
Notice that, with the proportional tax, increases in government purchases will now automatically be partly tax financed. As the extra government spending raises output  $Y$ , net tax revenues  $tY$  will automatically rise. However, this automatic increase in tax revenues will be smaller than the increase in government spending, as long as the MPC is less than one, so the budget deficit will grow unless taxes are raised directly.<sup>6</sup>

- 2i. The slope of PE is now 0.9, so the Keynesian Cross multiplier is now 10.

<sup>5</sup> Note that if  $\text{slope PE} \neq MPC$ , then the balanced budget multiplier would not be 1.

<sup>6</sup>  $\Delta T = t \cdot \Delta Y = t \cdot \left(\frac{1}{1 - MPC \cdot (1 - t)}\right) \Delta G$ .

- 4a. The autonomous (i.e., exogenous) fall in consumption shifts PE downward, reducing output through the multiplier process. Thus, the increase in ‘thriftiness’ on the part of consumers precipitates a recession. This appears, for example, to have been the case in 1990–91. (see figure below)
- 4b. National saving  $S$ , is  $Y - C - G$ . Since, in a closed economy, this must equal  $I$ , and  $I$  is unchanged,  $S$  must also be unchanged in equilibrium.



At the original equilibrium, consumers decided to save more and consume less. In the long run model of Chapter 3, output was fixed and interest rates were flexible, so the increase in saving would have depressed interest rates and stimulated investment spending. In the Keynesian Cross model, interest rates are fixed and output is flexible, so the fall in consumption depresses output (rather than interest rates) and investment spending is unchanged. As output and income falls, consumers reduce their consumption and saving. In Keynesian Cross equilibrium, we must run a large enough recession to drive saving back down to its original level.<sup>7</sup>

- 4c. Individuals in the economy attempted to increase their saving. However, collectively, this caused a recession, which lowered their income and wiped out the extra saving. The attempt to save more was self defeating. Keynes (in the 1930s) used this ‘paradox of thrift’ to illustrate that the macroeconomics is not merely microeconomics writ large. In the macroeconomy, the microeconomic behavior of consumers, firms, etc. produce general equilibrium (feedback) effects that can either reinforce or negate the microeconomic behavior.
- 4d. In the long run model of Chapter 3, the economy can not run a recession ( $Y$  is fixed). Therefore, the fall in consumption has no adverse effect, but rather forces an increase in other components of spending (drives up investment spending by driving down interest rates). Notice that in our long run and very long run models (Chapters 3,6,8,9) saving is a virtue, whereas in our short run models (Chapters 10,11,12,13) saving appears to be a vice.
5. Recall **2h** above. If net taxes are procyclical (rise and fall with  $Y$  over the business cycle), as they are in the U.S., then the budget deficit will be countercyclical. The deficit will get larger during recessions, as income tax revenues fall and more people qualify for transfer payments, and get smaller during expansions. If, during a recession, like that of 2007-09, the federal government decided (or was required by law) to keep the budget deficit from growing, then it would have to raise taxes, cut transfers, and/or cut government purchases during the recession. This would reduce spending further, making the recession worse.<sup>8</sup>

Another way of saying this is that the tax system in the U.S. acts as an *automatic stabilizer*. In terms of the Keynesian Cross model, an economy with proportional taxes will have a smaller multiplier (see **2h**) and so have less severe recessions following negative shocks to spending, than will an economy in

<sup>7</sup> Suppose that the initial fall in consumption (increase in saving) was 100. Then  $Y$  falls by  $1/(1-MPC)$  times 100. As a result of this fall in income, saving subsequently falls by  $(1-MPC)$  times the change in  $Y$ , or exactly 100.

<sup>8</sup> The federal budget deficit in the U.S. grew dramatically in 2009-10 due to the natural effects of the recession noted above and additionally due to stimulus packages and bailouts passed by Congress and the Bush and Obama administrations in an effort to fight the recession.

which tax revenues are held constant. Raising taxes during recessions to keep the budget deficit from growing temporarily would be destabilizing.

Consequently, many economists advocate a policy of trying to maintain a zero full employment (i.e., average) deficit, but allowing the deficit to continue to fluctuate over the business cycle (running deficits in recessions and surpluses in expansions). This would, at least in theory, produce desirable long run consequences (Chapters 3,6,8,9), while preserving the role of the tax system as an automatic stabilizer over the business cycle (Chapters 10,11,12,13).<sup>9 10</sup>

Chapter 12:

6. Problems and Applications (p. 359).

- 1a. An increase in the money supply depresses interest rates (LM shifts downward), as the public, which does not want to hold the extra money, converts it to interest bearing assets (e.g., bonds). The fall in interest rates stimulates spending (investment spending, as modeled) and thus output (via the multiplier process).

$$\begin{array}{ccccccc} \uparrow & & \uparrow & & \uparrow & & - \\ Y & = & C & + & I & + & G \end{array}$$

- 1b. An increase in government purchases is an increase in spending and so causes output to increase (IS shifts to the right by the Keynesian Cross multiplier times the increase in government purchases). However, as output and spending rise, interest rates are pushed up (the increase in spending raises money demand — the public wants to hold more money in order to make the extra purchases, so it liquidates interest bearing assets), which dampens the increase in spending (some investment spending is crowded out) and thus the expansion of output. In equilibrium, output increases by less than the increase predicted by the Keynesian Cross model, due to the increase in interest rates.

$$\begin{array}{ccccccc} \uparrow & & \uparrow & & \downarrow & & \uparrow \\ Y & = & C & + & I & + & G \end{array}$$

- 1c. The tax increase causes consumers to reduce their spending (IS shifts to the left by the Keynesian Cross multiplier times the initial decrease in consumption spending). As output falls, money demand falls, depressing interest rates, which in turn dampens the fall in spending (some investment spending is crowded in) and thus the magnitude of the recession.

$$\begin{array}{ccccccc} \downarrow & & \downarrow & & \uparrow & & - \\ Y & = & C & + & I & + & G \end{array}$$

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<sup>9</sup> Since the early 1980s, with the exception of the late 1990s, the U.S. has run substantial chronic federal budget deficits. Consequently, it entered the great recession in late 2007 with already high accumulated federal debt (about 60% of GDP). This debt position fueled political arguments against aggressively using fiscal stimulus to lean against the recession, and the resulting ARRA stimulus package was considered too small (at \$750 billion spent over three years) by some economists such as Paul Krugman. Greece, which entered the great recession with a government debt to GDP ratio of 125% found itself in a sovereign debt crisis as the recession dragged on, with interest rates on government bonds soaring starting in 2010, and was forced to adopt austerity measures (contractionary fiscal policy) in order to obtain bailouts from the IMF and EU in 2010 and 2011.

<sup>10</sup> Note that some of the debate about the value of fiscal stimulus during recessions has come from debates over the size of fiscal policy multipliers. If the multiplier is small, then the cost of incurring extra debt does not yield much of an short term benefit. While there is evidence that multipliers are larger during recessions than during normal economic times, there has been considerable debate about how large they are for specific times and places.

- 1d. Suppose that taxes and government purchases both rise by 10 billion. Then, IS shifts to the right by 10 billion (see **2g** above),<sup>11</sup> pushing up interest rates, so that the equilibrium increase in output is somewhat less than 10 billion.

$$\begin{array}{ccccccc} \uparrow & & \downarrow & & \downarrow & & \uparrow \\ Y & = & C & + & I & + & G \end{array}$$

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<sup>11</sup> We are assuming *slope PE = MPC*. If instead, *slope PE < MPC*, then the shift would be less than 10 billion, if *slope PE > MPC*, then the shift would be greater than 10 billion.