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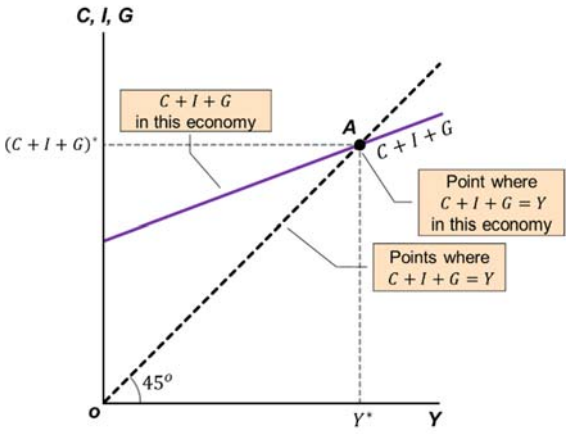
Practice Set 10 – KEY

Short-run GDP Fluctuations

This set contains problems for your own practice. It is highly recommended to work on the problems on your own. Do not just read the provided solutions. Instead, try to solve the problems and use the solutions only when you cannot continue on your own. Reading problems that someone else has solved has the same value for your preparation like watching someone else running a marathon on TV and then expecting to be able to run it, too. If you have questions on this set, please ask your section's teaching assistant.

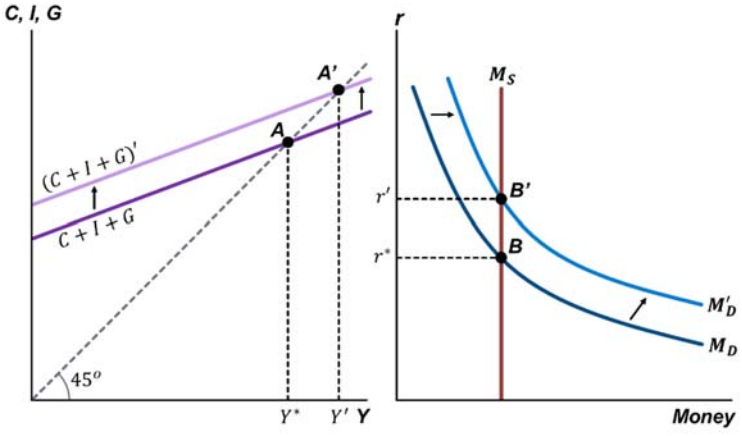
1. Explain why the intersection of the 45-degree line with the $C + I + G$ line is indeed where the equilibrium of the commodity market should be located.



The basic geometric property of the 45-degree line on a Cartesian graph is that it maps every point from the one axis to its equal point on the other axis. If, for instance, you take $x = 2$ on the horizontal axis and you reflect it on the 45-degree line, you will receive $y = 2$ on the vertical axis.

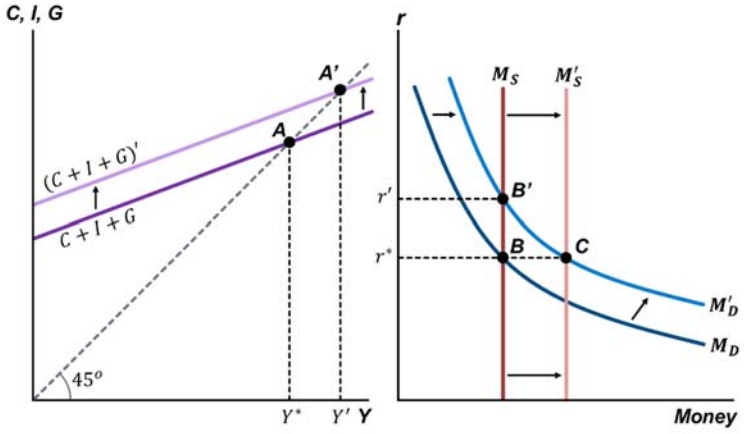
In the commodity market graph, we measure aggregate expenditure ($C + I + G$) on the vertical axis and the output (Y) on the horizontal axis. Along the $C + I + G$ line, it is possible that $C + I + G > Y$ as is the case with all points of the line on the left of A. Along those points, the commodity market is not at equilibrium because people want to buy more than what is produced. When this happens in reality, the shortage is covered with previous years' inventories (previous years' production surpluses). On the right of point A now, we have $C + I + G < Y$. This is also a disequilibrium situation where we have production surplus that increases inventories of firms. Exactly on point A, we have $C + I + G = Y$ because the $C + I + G$ line intersects with the 45-degree line. In this case, the commodity market is in equilibrium because expenditure is equal to output.

2. Explain the mechanism through which a shock on C, I or G can put pressure on the real interest rate.



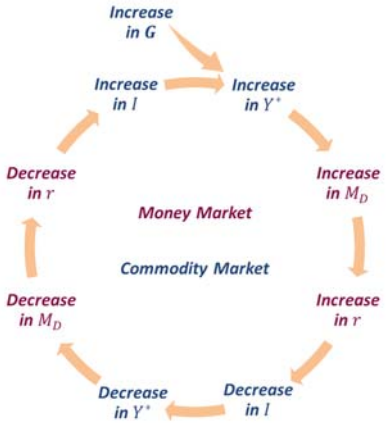
The question basically asks to explain the function of "link 1". Assume that the economy equilibrates at Y^* (point A) and r^* (point B). Assume, also, that C, I or G increase for some reason, such as households decided to consume more, or firms decided to invest more, or the government decided to spend more. Any of these three shocks constitutes an increase in the aggregate expenditure and it will cause the $C + I + G$ line to shift upwards. The stimulation in the expenditure will urge firms to produce more and total output will increase to Y' (point A'). As the economy now is wealthier in total, households and firms will need more money for their transactions. This will cause the money demand curve to shift upwards. Given that the money supply has not changed, money now becomes scarcer. This means that lenders can get away with charging a higher interest than before such as r'.

3. Explain how the Central Bank can stabilize a shock that was caused from C, I or G and block it from affecting the real interest rate in a scarce reserves framework.



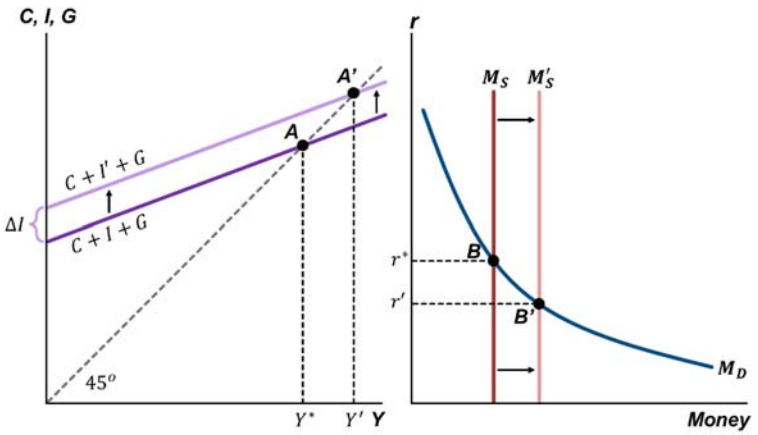
A shock that starts at the commodity market will be transmitted to the money market through "link 1". For instance, an increase in the expenditure will increase Y and raise the money demand, which will put pressure on the interest rate to increase because money has become scarcer. The Central Bank can address the problem of scarcity of money by simply increasing the money supply till the point where the equilibrium interest rate will be at r^* (point C) instead at r' (point B'). If, however, reserves were ample, the Central Bank would have simply set the real interest rate at $r^*$and money supply would adjust accordingly to M'_S as banks would have the ability to give more loans to address the higher demand for money.

4. Explain what will happen in a scarce reserve framework, if a shock that was caused from C, I or G is not blocked by the Central Bank.



A shock that started at the commodity market will be transmitted to the money market through the effect of output on money demand (link 1). If the shock is not stabilized in the money market with an adjustment of the money supply, the real interest rate will change. This will cause the shock to be re-transmitted to the commodity market through the effect of the interest rate on investment (link 2). The change in investment will again affect output and re-activate link 1. The shock will start bouncing between the two markets, every time smaller in magnitude till it eventually dies down after creating intense short-run fluctuations. An example of a chain of events that describes this vicious cycle after an Increase in G is: Increase in $Y^* \rightarrow$ Increase in $M_D \rightarrow$ Increase in $r \rightarrow$ Decrease in $I \rightarrow$ Decrease in $Y^* \rightarrow$ Decrease in $M_D \rightarrow$ Decrease in $r \rightarrow$ Increase in $I \rightarrow$ Increase in Y^*, and the circle will keep repeating in a spiral.

5. Explain how a decrease in the real interest rate can affect the real output.



Here we are asked to explain the function of "link 2". Assume that the economy equilibrates at Y^*(point A) and r^*(point B). Then, the Central Bank decides to lower the interest rate to r', which corresponds to money supply M'_S. At the lower interest rate, investors at the commodity market will want to undertake more investment projects as the opportunity cost of investing (the interest rate) has fallen and more investment projects are now more attractive than just saving that money in a bank. The increase in

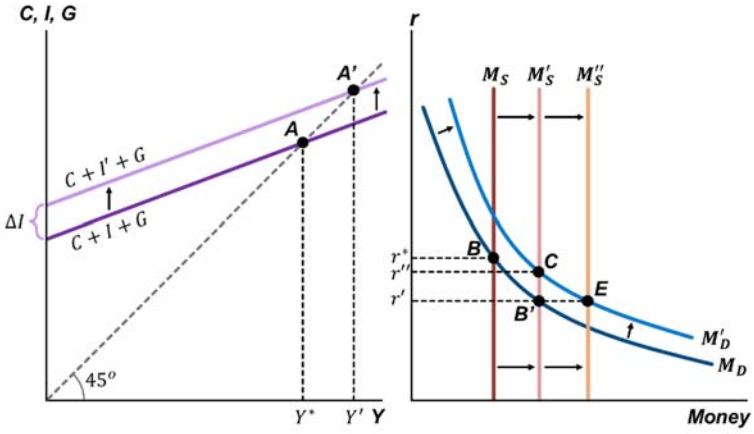
investment causes an increase in aggregate expenditure ($C + I + G$) in the economy. The aggregate expenditure line will shift up to the position $C + I' + G$, making the commodity market to equilibrate at point A', at the higher output level, Y'.

6. Explain how a shock that originated in the money market can be neutralized in the commodity market.

   The commodity market cannot effectively stabilize shocks. This would require the government to adjust G to prevent $C + I + G$ from changing every time C or I change. Such practice would be quite problematic for a number of reasons. First, G is usually decided once a year with the fiscal budget and any change to it would require discussion and approval by the parliament. This would take time and in the meanwhile the shock would have already affected the market. Second, G acts quite slowly in changing the demand in the economy and affecting the aggregate expenditure. Third and most important, the basic role of G is to fund public goods and conduct the redistribution of output. If we used G as a stabilization variable, this would imply that every time there was an increase in I, we would have to decrease the spending on education, defense, public healthcare etc., in order to stabilize the aggregate expenditure.

7. Explain why the Central Bank may have to adjust the money supply for a second time after it initially increased it in order to conduct expansionary monetary policy in a scarce reserves framework.

   This will be done in order to block an aftershock when it bounces back from the commodity market after the initial application of monetary policy. The Central Bank increases the money supply to M_S' in order to lower the interest rate to r', bringing the money market to point B'. As a result, the commodity market will react by moving to point A'. The change in output to Y', however, will cause money demand to shift to M_D' putting pressure on the interest rate to rebound to r'' at point C. However, the Central Bank can prevent this by further increasing the money supply to M_S'', which will bring the money market to point E, at which the interest rate remains at r' stabilizing the shock and preventing it from being transmitted further.



8. Assume that $C = 70 + 0.5(Y - T)$, $I = 300, G = 230$, $T = 0.2Y$ and $X = M$.

   (a) Show that the equilibrium income is $Y = 1{,}000$.

   We start from $Y = C + I + G$. Substituting $C, I,$ and G, we receive $Y = 70 + 0.5(Y - T) + 300 + 230$ or $Y = 600 + 0.5(Y - T)$. Substituting T, we receive $Y = 600 + 0.5(Y - 0.2Y)$ or $Y = 600 + 0.4Y$. Finally, solving for the equilibrium income, $Y = 600/0.6$ or $Y = 1{,}000$.

   (b) Show that if G is increased by 60 units, the equilibrium income will increase by 100 units.

   We start from $Y = C + I + G$. Substituting $C, I,$ and G, we receive $Y = 70 + 0.5(Y - T) + 300 + 290$ or $Y = 660 + 0.5(Y - T)$. Substituting T, we receive $Y = 660 + 0.5(Y - 0.2Y)$ or $Y = 660 + 0.4Y$. Finally, solving for the equilibrium income, $Y = 660/0.6$ or $Y = 1{,}100$. So, Y indeed increases by 100 units.

   (c) We know that $Y = C + I + G$. If G increased by only 60 units and C and I have not changed, how did Y increased by 100 units? Where are the additional 40 units of Y coming from?

   This "paradox" can be explained if we notice that the change in G causes an additional indirect effect on Y through C. In both (a) and (b), I was equal to 300 and indeed did not change. The same is not true

for C, though. Let us calculate an expression for consumption: $C = 70 + 0.5(Y - T)$ or $C = 70 + 0.5(Y - 0.2Y)$ or $C = 70 + 0.4Y$. So, we can see that C is affected by Y, which has grown after the increase in G. That is, when G was 230, consumption was $C = 70 + 0.4 \cdot 1{,}000 = 470$. When G became 290, consumption became $C = 70 + 0.4 \cdot 1{,}100 = 510$. So, the 60-unit increase in G caused an additional 40-unit increase in C. This explains why aggregate expenditure and income increased by $60 + 40 = 100$ units.

9. In the lecture, we considered an economy with

$$C = 100 + 0.75(Y - T),\ G = 220,\ I = 120,\ T = 0.2Y$$

and we concluded that $Y = 1{,}100$.

(a) What is the government budget deficit $G - T$ in this economy?

The deficit is $G - T = 220 - 0.2 \cdot 1{,}100 = 0$.

(b) What is the government budget deficit $G - T$ in this economy if G increases by 45 units, so that $Y \approx 1{,}213$?

The deficit is $G - T = 265 - 0.2 \cdot 1{,}213 \approx 22.5$.

(c) What is the government budget deficit $G - T$ in this economy if G does not increase but the taxation coefficient decreases to $t = 0.15$, so that $Y \approx 1{,}214$?

The deficit is $G - T = 220 - 0.15 \cdot 1{,}214 \approx 38$.

(d) What can you conclude for expansionary fiscal policy?

Expansionary fiscal policy requires either the government to spend more of the economy's income (G) or to decrease its revenues (T). Both tend to create budget deficits, which will be financed with government debt. That is, government will have to issue bonds or other securities to cover the deficit now. Those will eventually have to be paid back with interest from the future taxpayers' money. In this example, it seems that increasing government spending creates a similar stimulation to Y like decreasing taxation, yet the increase in government spending causes less deficit. This is NOT a general result. If you use other numbers in the model, you may observe the opposite.

10. A creditor provides a loan of $100 with interest rate 20% to a debtor. The debtor will invest the money in a project that has 10% probability to fail. If the project fails, the debtor will default on the loan not being able to pay anything back.

(a) What is the probability for the creditor to lose money from this loan?

Let us consider all possibilities: (i) If the debtor defaults, the creditor will have a loss of 100 dollars. This event has a probability of 10%. (ii) If the debtor does not default, the creditor will receive 120 dollars and will not lose money. This event has a probability of 90%. Thus, the only case that the creditor will lose money is (i), which has a probability of 10%.

(b) Assume now that this creditor provides 1,000 such loans to different debtors, who all invest in different projects that each has 10% probability to fail. If a project fails, the debtor who invested in it will default on the loan but this does not necessarily imply that all others will default. What is the probability for this creditor to lose money in total?

Here the probability of a debtor to default is independent of the probability the other debtors to default and debtors can default randomly. From the 'law of averages', we can deduce that around 100 out of 1,000 loans will default and around 900 will not default. Therefore, the creditor will lose around $100 \cdot 100 = 10{,}000$ dollars from the loans that are expected to default. The creditor will also earn 20 dollars from each of the 900 loans that will not default. Total earnings will be $20 \cdot 900 = 18{,}000$ dollars. Thus, the net earnings in this case for the creditor are $18{,}000 - 10{,}000 = 8{,}000$

dollars. This is an almost sure outcome; thus, we can answer that there is no reasonable probability to expect that this creditor will lose money. This principle is known as diversification.*

** The law of averages is a statistical tool which does not guarantee absolute certainty. Thus, it is still technically possible that the creditor will be really unlucky and 167 loans or more will default causing him to lose money. Any online binomial calculator would find the probability of this outcome to only 0.0001%. So, it is technically possible to lose money but reasonably unlikely.*

(c) Assume now that this creditor provides 1,000 such loans to different debtors, who all invest in the same project, which has 10% probability to fail. If the project fails, all debtors will default on their loans. What is the probability for this creditor to lose money in total?

Here the probability structure is very different from that in sub-task (b). All loans are connected to each-other, so that the creditor actually faces only two scenarios: (i) All 1,000 loans default together, with probability 10% because the project failed, or (ii) none of the loans defaults, with probability 90% because the project succeeded. This is as if you have only one loan which is equivalent to that of sub-task (a) but now for $\$100 \cdot 1{,}000 = 100{,}000$ *dollars instead of 100 dollars. Therefore, similarly to sub-task (a), the probability for the creditor to lose money is 10%. Since the probability of each loan to default is connected to whether the other loans will default or not, all eggs are in one basket and, thus, diversification does not work.*

11. *[Optional]* In the Solow model, we have seen that $S = I$. Is it the same in the "$Y = C + I + G$ model"?

Starting from $Y = C + I + G$*, we can write* $Y - C = I + G$*. Then, we can subtract* T *from both sides* $Y - C - T = I + G - T$*, where the left-hand-side equals the Saving (*S*) and* $G - T$*, at the right-hand-side, is the government deficit. Thus, we end up with* $S = I + (G - T)$*. From this equation, if we have* $G - T = 0$ *(because either the government's budget is balanced or we have no government at all and* $G = T = 0$*), we have* $S = I$ *as in the Solow model. The Solow model is a long-run growth model and it naturally assumes that over many years, total* G *will have to equal total* T*. The "*$Y = C + I + G$ *model" is a short-run model and the equation* $S = I + (G - T)$ *simply means that the total saving feeds the private investment and the government deficit. This is what actually happens in reality: our savings are invested (by us or the bank where we deposit them) in private firms or in government bonds.*

You are kindly requested to report any *typos, mistakes* or *proposals* for the improvement of this practice set key at kmarinakis@smu.edu.sg.