

For the questions below, include the IS/LM/FX diagram to illustrate the effects of the shock. All curves and equilibria points (e.g., point A and B) must be clearly labeled for full credit. Assume  $MPC_F = 0$ . You must state the effect of the shock on the following variables (increase, decrease, no change, or ambiguous):  $Y, i, E, C, I, CA$ .

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## 1 Preliminary: Money Supply Increases

This is just a preliminary question, since we'll be moving around the money supply a lot in later questions. Anyway... show what happens when the money supply increases.

**Solution.** Draw the money market, IS/LM, and FX markets in a general equilibrium. Call the output equilibrium  $Y_1$ . Now increase the money supply. Because  $P = \bar{P}$  is fixed in the short run, the real money supply increases. For this level of  $Y_1$ , and therefore for the same  $L(i, Y_1)$  money demand curve, the interest rate falls.

This same logic would follow for any level of  $Y$ . The takeaway is this: we have a lower interest rate for every level of  $Y$ , therefore we have a lower LM curve. Or more bluntly: an increase in the money supply **shifts LM to the right/down**. (Likewise, a decrease in the money supply shifts LM to the left/up.)

This is essential is understanding central bank behavior: it will use its influence over the money supply in order to adjust LM to meet some objective it has in mind (e.g. to fix an exchange rate).

## 2 Government Spending Increases

(a) The exchange rate is allowed to float and there is no stabilization policy.

**Solution.** I'm going to explain this one – and only this one – in all of its gory detail; remaining questions will take “intermediate/crowding out effects” as a given. I recommend drawing the “intermediate steps” lightly, and I indicate when to do so. If you can understand the mechanics without drawing the intermediate steps, then you don't need to draw them (which is why I don't draw them aside from this part).

First set up all four markets in equilibrium.

- The top graph should be  $D = C + I + G + CA$  and the  $45^\circ$  line. The intersection gives you the level of output where supply  $Y$  equals demand  $D$ . Call that  $Y_1$ .
- The bottom-center graph should have the downward-sloping IS curve and upward-sloping LM curve intersecting at  $Y_1$  and some equilibrium interest rate, call it  $i_1$ .
- The bottom-left graph is the money market graph. Money demand  $L(i, Y)$  should intersect  $MS_1$  at  $i_1$ , so trace  $i_1$  over from the IS-LM graph.
- The bottom-right graph is the foreign return graph. So draw the downward-sloping FR curve. The equilibrium exchange rate  $E_1$  occurs where  $i_1$  intersects FR, so trace  $i_1$  over from the IS-LM graph again.

Now we're going to increase  $G$ .

- (Draw this lightly.) Shift the  $D$  curve up because  $D = C + I + G \uparrow + CA$ . Now it intersects the  $45^\circ$  line at a higher level of output. (This is the lighter grey line in the Canvas solution.)
- (Draw this lightly.) Because  $Y$  has increased, so has the demand for money balances, so  $L(i, Y)$  shifts to the right. This causes the interest rate to increase and the exchange rate to fall.
- But wait... when the interest rate increases, investment falls; and when the exchange rate decreases, exports will fall and imports will increase, so  $CA$  will fall... and therefore  $D$  shifts back down *partially*. (This is the blue line in the Canvas solution.) This is the **crowding out** effect.

(Draw this one.) We assume partial crowding out, which is why  $D$  doesn't go all the way back down to its initial position: there is still a modest increase in  $D$ , albeit by less than  $\Delta G$ ; and therefore an upward shift of  $L(i, Y)$ . This gives us higher  $Y_2$ , higher  $i_2$ , and lower  $E_2$  in equilibrium. This manifests as a **rightward shift of the IS curve**.

Synopsis: The initial shock was an upward movement of demand for goods and services, so IS shifts to the right; there is no change to LM because neither the money

supply nor  $L$  change.<sup>1</sup>  $Y$ ,  $C$ , and  $i$  have increased;  $I$ ,  $E$ , and  $CA$  have fallen.

(b) The exchange rate is fixed and there is no stabilization policy.

**Solution.** Okay, let's do the concise versions now.

Start at a new initial equilibrium, as usual. Here's how I think about it, step by step.

- Is an increase in government spending a shock to the goods market, or to the money market? The goods market, so we're thinking IS curve.
- Does the increase in government spending suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**.
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .
- Higher  $i$  implies lower  $E$ .
- But wait...  $E$  is supposed to be fixed. To get back to the original  $E$ , we have to get back to the original  $i$ . The central bank can achieve this by **shifting LM to the right** through an increase in the money supply.

In conclusion:  $Y$  increases even more,  $i$  is unchanged,  $E$  is unchanged,  $C$  increases even more,  $I$  is unchanged, and  $CA$  is unchanged.

(c) The exchange rate is floating, the central bank uses monetary policy to stabilize  $Y$ .

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in government spending a shock to the goods market, or to the money market? The goods market, so we're thinking IS curve.
- Does the increase in government spending suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**.
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .
- But wait...  $Y$  is supposed to be fixed. The central bank can achieve this by **shifting LM to the left** through a decrease in the money supply.

In conclusion:  $Y$  is unchanged,  $i$  is even higher,  $E$  is even lower,  $C$  is unchanged,  $I$  is even lower, and  $CA$  is even lower.

### 3 How to Shift IS/LM in General

Here is a (hopefully) useful heuristic about how to shift: ask yourself 1) is it the goods market or the money market, and 2) is it expansionary or contractionary? Provided it's not due to a change in  $i$  or  $Y$  (which would imply movement along, rather than shift):

<sup>1</sup>Only the arguments of  $L(i, Y)$  change, but not the function  $L$  itself.

- Any shock in the goods market that increases demand is expansionary (increase in  $C + I + G + CA$ ), so you shift IS to the right (i.e. in the direction of higher  $Y$ ).
- Any shock in the goods market that decreases demand is contractionary (decrease in  $C + I + G + CA$ ), so you shift IS to the left (i.e. in the direction of lower  $Y$ ).
- Any shock in the money market that results in a lower interest rate is expansionary (increase in money supply, lower money demand), so you shift LM to the right.
- Any shock in the money market that results in a higher interest rate is contractionary (decrease in money supply, higher money demand), so you shift LM to the left.

## 4 Consumer Confidence Decreases

- (a) The exchange rate is allowed to float and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

When consumer confidence decreases, consumption decreases: the shock is  $C \downarrow$ . (Note that the decrease is unrelated to a change in  $Y$  or  $i$ .)

- Is an decrease in consumption a shock to the goods market, or to the money market? The goods market, so we're thinking IS curve.
- Does the decrease in consumption suggest higher or lower  $Y$  in the goods market? Lower  $Y$ , so we're **shifting IS to the left**.
- Shifting IS to the left implies lower  $Y$  and lower  $i$ .
- Lower  $i$  implies higher  $E$ , and therefore higher  $I$  and higher  $CA$ .

In conclusion:  $Y$ ,  $C$ , and  $i$  have fallen;  $I$ ,  $E$ , and  $CA$  have increased.

- (b) The exchange rate is fixed and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

- Is an decrease in consumption a shock to the goods market, or to the money market? The goods market, so we're thinking IS curve.
- Does the decrease in consumption suggest higher or lower  $Y$  in the goods market? Lower  $Y$ , so we're **shifting IS to the left**.
- Shifting IS to the left implies lower  $Y$  and lower  $i$ .
- Lower  $i$  implies higher  $E$ .
- But wait...  $E$  is supposed to be fixed. To get back to the original  $E$ , we have to get back to the original  $i$ . The central bank can achieve this by **shifting LM to the left** through a decrease in the money supply.

In conclusion:  $Y$  decreases even more,  $i$  is unchanged,  $E$  is unchanged,  $C$  decreases even more,  $I$  is unchanged, and  $CA$  is unchanged.

- (c) The exchange rate is floating, the central bank uses monetary policy to stabilize  $Y$ .

**Solution.** Start at a new initial equilibrium, as usual.

- Is an decrease in consumption a shock to the goods market, or to the money market? The goods market, so we're thinking IS curve.
- Does the decrease in consumption suggest higher or lower  $Y$  in the goods market? Lower  $Y$ , so we're **shifting IS to the left**.
- Shifting IS to the left implies lower  $Y$  and lower  $i$ .
- But wait...  $Y$  is supposed to be fixed. The central bank can achieve this by **shifting LM to the right** through an increase in the money supply.

In conclusion:  $Y$  is unchanged,  $i$  is even lower,  $E$  is even higher,  $C$  is unchanged,  $I$  is even higher, and  $CA$  is even higher.

## 5 Money Demand Increases

- (a) The exchange rate is allowed to float and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in money demand a shock to the goods market, or to the money market? The money market, so we're thinking LM curve.
- Does the increase in money demand suggest higher or lower  $i$  in the money market? Higher  $i$ , so we're **shifting LM up**.
- Shifting LM up implies lower  $Y$  and higher  $i$ .
- Higher  $i$  implies lower  $E$ ; so  $I$  and  $CA$  fall.

$Y$  is lower,  $i$  is higher,  $E$  is lower,  $C$  is lower,  $I$  is lower, and  $CA$  is lower.

- (b) The exchange rate is fixed and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in money demand a shock to the goods market, or to the money market? The money market, so we're thinking LM curve.
- Does the increase in money demand suggest higher or lower  $i$  in the money market? Higher  $i$ , so we're **shifting LM up**.
- Shifting LM up implies lower  $Y$  and higher  $i$ .

- Higher  $i$  implies lower  $E$ .
- But wait...  $E$  is supposed to be fixed. To get back to the original  $E$ , we have to get back to the original  $i$ . The central bank can achieve this by **shifting LM down** through an increase in the money supply.

In conclusion: LM moved up and then the central bank moved it back down. Nothing has really changed. Incroyable.

- (c) The exchange rate is floating, the central bank uses monetary policy to stabilize  $Y$ .

**Solution.** The previous part also stabilizes  $Y$ , so no need for any extra analysis here.

## 6 Foreign Output Increases

- (a) The exchange rate is allowed to float and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in foreign output a shock to the goods market, or to the money market? The goods market – foreign country demands more home country exports, specifically – so we're thinking IS curve.
- Does the increase in exports suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**.
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .
- Higher  $i$  implies lower  $E$ ; so  $I$  and CA fall.

In conclusion:  $Y$  is higher,  $i$  is higher,  $E$  is lower,  $C$  is higher,  $I$  is lower.

CA is more complicated, however. The initial shock suggests higher CA through higher exports, but the currency appreciation suggests lower CA since home goods are now more expensive to foreigners. Therefore the change in CA is ambiguous.

- (b) The exchange rate is fixed and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in foreign output a shock to the goods market, or to the money market? The goods market – foreign country demands more home country exports, specifically – so we're thinking IS curve.
- Does the increase in exports suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**.
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .

- Higher  $i$  implies lower  $E$
- But wait...  $E$  is supposed to be fixed. To get back to the original  $E$ , we have to get back to the original  $i$ . The central bank can achieve this by **shifting LM to the right** through an increase in the money supply.

In conclusion:  $Y$  is even higher,  $i$  is unchanged,  $E$  is unchanged,  $C$  is even higher,  $I$  is unchanged, and  $CA$  is higher.

(c) The exchange rate is floating, the central bank uses monetary policy to stabilize  $Y$ .

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in foreign output a shock to the goods market, or to the money market? The goods market – foreign country demands more home country exports, specifically – so we're thinking IS curve.
- Does the increase in exports suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**.
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .
- But wait...  $Y$  is supposed to be fixed. The central bank can achieve this by **shifting LM to the left** through a decrease in the money supply.

In conclusion:  $Y$  unchanged,  $i$  is even higher,  $E$  is even lower,  $C$  is unchanged,  $I$  is even lower. The change in  $CA$  is still ambiguous for the same reason.

## 7 Expected Depreciation

(a) The exchange rate is allowed to float and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in expected depreciation a shock to the goods market, or to the money market? It shifts FR up, which implies depreciation now, and therefore an increase in exports. That's the goods market, so we're thinking IS curve.
- Does the increase in exports suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**. (Hint: make the shift in IS small relative to the shift in FR, or else things will get wacky.)
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .
- Higher  $i$  but with higher FR implies higher  $E$ ; so investment falls,  $CA$  increases.

In conclusion:  $Y$  is higher,  $i$  is higher,  $E$  is higher,  $C$  is higher,  $I$  is lower,  $CA$  is higher.

(b) The exchange rate is fixed and there is no stabilization policy.

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in expected depreciation a shock to the goods market, or to the money market? It shifts FR up, which implies depreciation now, and therefore an increase in exports. That's the goods market, so we're thinking IS curve.
- Does the increase in exports suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**. (Hint: make the shift in IS small relative to the shift in FR, or else things will get wacky.)
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .
- Higher  $i$  but with higher FR implies higher  $E$ .
- But wait...  $E$  is supposed to be fixed. In order to get back to the original  $E_1$ , the economy must be at a higher equilibrium  $i$ . The central bank can achieve this by decreasing the money supply, which **shifts LM to the left**.

The exchange rate is unaffected, so CA is unaffected. The interest rate is higher, so  $I$  falls. There has been no exogenous shock to  $C$  or  $G$ ... so it must be the case that  $Y$  has fallen, and therefore  $C$  has fallen.

(c) The exchange rate is floating, the central bank uses monetary policy to stabilize  $Y$ .

**Solution.** Start at a new initial equilibrium, as usual.

- Is an increase in expected depreciation a shock to the goods market, or to the money market? It shifts FR up, which implies depreciation now, and therefore an increase in exports. That's the goods market, so we're thinking IS curve.
- Does the increase in exports suggest higher or lower  $Y$  in the goods market? Higher  $Y$ , so we're **shifting IS to the right**. (Hint: make the shift in IS small relative to the shift in FR, or else things will get wacky.)
- Shifting IS to the right implies higher  $Y$  and higher  $i$ .
- But wait...  $Y$  is supposed to be fixed. In order to get back to the original  $Y_1$ , the central bank can achieve this by **shifting LM to the left** through a decrease in the money supply.
- This results in a higher interest rate and a higher exchange rate.

$Y$  unchanged,  $i$  is higher,  $E$  is higher,  $C$  is unchanged,  $I$  is lower, CA is higher.