Macro Problem Set 5 Solutions

Q1

A.

The interest rate is the opportunity cost of holding money. If the interest rate rises, the amount of money demanded should fall, i.e.., the coefficient of r should be negative. Also, the amount of money demanded rises with output as more transactions are needed. The coefficient of Y should be positive. Thus, the coefficients in the given money demand equation have the expected signs.

B.

Given that $Y = 12{,}000$, the money demand equation is as follows.

$$M = 750 + 0.1(12{,}000) - 5{,}000r$$
$$= 1{,}950 - 5{,}000r$$

Let r^* be the equilibrium interest rate. When the money market is in equilibrium, the money demand and money supply equations intersect.

$$1{,}200 = 1{,}950 - 5{,}000r^*$$

$$r^* = \frac{1{,}950 - 1{,}200}{5{,}000} = 0.15$$

Thus, that the equilibrium interest rate is 15 percent is verified.

C.

Given now that $Y = 9{,}000$, the money demand equation is as follows.

$$M = 750 + 0.1(9{,}000) - 5{,}000r$$

$$= 1{,}650 - 5{,}000r$$

The money demand curve shifts left by 1,950 – 1,650 = $300.

When the money market reaches its new equilibrium,

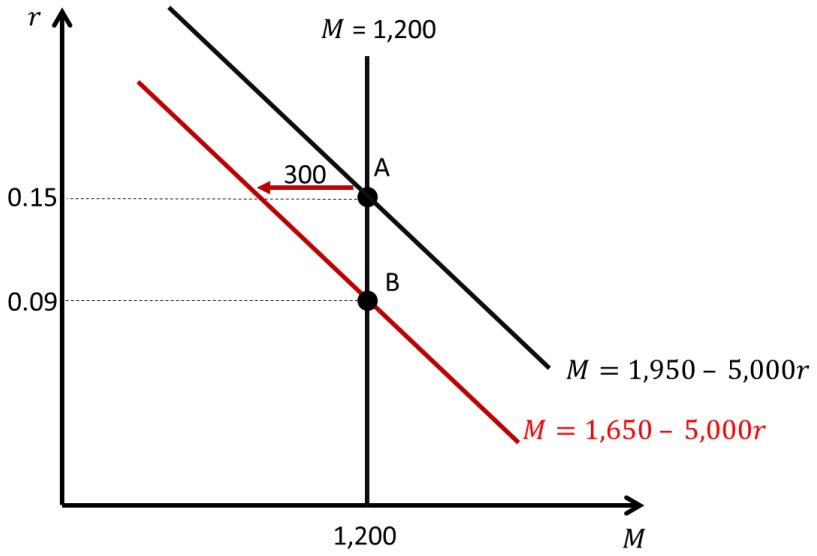
$$1{,}200 = 1{,}650 - 5{,}000r^*$$

$$r^* = \frac{1{,}650 - 1{,}200}{5{,}000} = 0.09$$

The equilibrium interest rate falls to 9 percent.

The diagram below shows the money market. Initially the money market is in equilibrium at A (1,200, 0.15). With the fall in output, the money demand curve shifts left. Consequently,

the money market moves to a new equilibrium B (1,200, 0.09) with a lower equilibrium interest rate.



D.

The money supply curve shifts right by \$250.

When the money market reaches its new equilibrium,

$$1{,}450 = 1{,}950 - 5{,}000r^*$$

$$r^* = \frac{1{,}950 - 1{,}450}{5{,}000} = 0.10$$

The equilibrium interest rate falls to 10 percent. The depiction of the money market is left to students as an exercise.

Q2

A.

The aggregate expenditure equation is obtained as follows:

$$\begin{aligned} AE &= C + I^P + G + NX \\ &= [1{,}000 - 1{,}000r + 0.8(Y - 500)] + [1{,}300 - 3{,}000r] + [1{,}000] + [100] \\ &= 3{,}000 - 4{,}000r + 0.8Y \end{aligned}$$

Planned investment and autonomous consumption expenditures both fall when the interest rate rises. Thus, the sign on r should be negative, which is indeed the case. The sign on Y is positive, as expected from a positive marginal propensity to consume.

B.

Let Y^* be the equilibrium output level. When the goods market is in equilibrium,

$$Y^* = 3{,}000 - 4{,}000r + 0.8Y^*$$
$$Y^* = \frac{1}{1-0.8}(3{,}000 - 4{,}000r)$$

If the interest rate is 0.15, then $Y^* = \frac{1}{1-0.8}(3{,}000 - 4{,}000(0.15))$ = \$12,000, verified.

C.

$\Delta Y^* = \frac{1}{1-0.8}$ x (–\$600) = –\$3,000. Thus, equilibrium output falls by \$3,000 to reach \$9,000.

Q3

A.

We have already worked out what happens to the equilibrium interest rate when output falls from \$12,000 to \$9,000 in Q1C! The equilibrium interest rate falls to 0.09, i.e., 9 percent.

B.

However, if the equilibrium interest rate falls from 0.15 to 0.09, a drop of 0.06, aggregate expenditure rises by 4,000 x (0.06) = 240 (\$). This in turn will lead equilibrium output to rise by $\frac{1}{1-0.8}$ x 240 = 1,200 (\$) to reach \$10,200.

Note: the fall in interest rate has weakened the impact of the initial \$600 negative demand shock.

C.

If equilibrium output is now \$10,200, following the same steps in Q1 (left as an exercise), one obtains that the equilibrium interest rate rises to 0.114, i.e., 11.4 percent.

D.

Ultimately, Y^* and r^* will settle on equilibrium values that clear both the goods market and the money market. The ultimate fall in Y^* will be smaller than \$3,000.

When the interest rate is assumed to be unchanged, the expenditure multiplier in the Keynesian model is $\frac{1}{1-0.8}$ = 5. When the money market is included, and all the interactions have been accounted for, the equilibrium interest rate will be lower than 0.15 but higher

than 0.09, and equilibrium output will be higher than \$9,000 but lower than \$10,200. The expenditure multiplier will thus be smaller than 5.

Enrichment:

The following is **enrichment material, not required for EC1101E**, and is left for those looking ahead to EC2102 Macroeconomics[1].

One can use the equations given to obtain values of Y^* and r^* when both markets reach equilibrium.

In Q2B we obtained the equation for goods market equilibrium, which shows that Y^* depends on r:

Goods market equilibrium: $Y^* = \frac{1}{1-0.8}(3{,}000 - 4{,}000r)$

We can rework Q1B to obtain the equation for money market equilibrium, which shows that r^* depends on Y:

Money market equilibrium: $r^* = \frac{750+0.1Y-1{,}200}{5{,}000} = \frac{0.1Y-450}{5{,}000}$

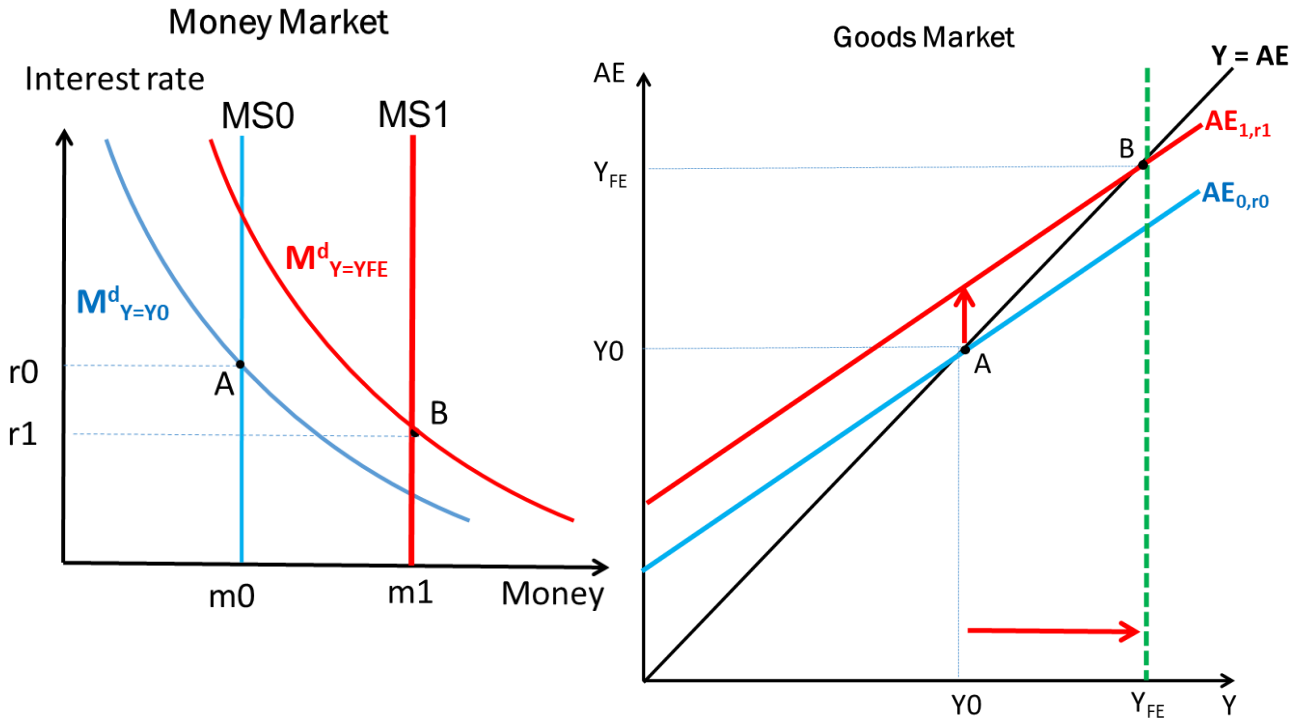
Solving these two equations simultaneously for Y^* and r^* allows us to find that Y^* = 12,000 billion (\$) and r^* = 0.15. These are the values for the two variables when both markets are initially in equilibrium.

When the government reduces purchases by \$600, simply replace 3,000 in the goods market equilibrium equation with 2,400 and solve for the new Y^* and r^* . One finds Y^* = 9,857 (\$) and r^* = 0.1071.

Thus, when all interactions are accounted for, the \$600 negative demand shock leads equilibrium output to fall by only \$2,143 instead of by \$3,000.

[1] This exercise is a numerical rendition of the "Investment-Saving-Liquidity-Money" or IS-LM model of aggregate demand that you will encounter in EC2102.

Q4



Refer to the paired diagrams above. The initial equilibria for both markets are given by the point A's, where output is Y0, the quantity of money is m0 and the interest rate is r0. Note that the level of money demand is consistent with output being Y0, and the level of aggregate expenditure is consistent with the interest rate being r0 (blue curves and lines).

Suppose the potential output is the higher level Y_{FE}. To push the economy to Y_{FE} (i.e. reach point B in the Goods Market), the central bank increases the money supply, aiming to push the interest rate down to r1. As it does so, the interest rate falls and aggregate expenditure rises.

However, the rise in equilibrium output will shift money demand to the right and raise the interest rate. The central bank must take this effect into account, and push money supply further to the right to compensate.

In the new equilibria for both markets, given by the point B's, the quantity of money rises to m1, output rises to Y_{FE}, and the interest rate falls to r1. Note that the level of money demand is consistent with output being Y_{FE}, and the level of aggregate expenditure is consistent with the interest rate being r1 (red curves and lines).

Q5

A.

Long term Interest rates had not fallen by much even as the central banks' benchmark interest rates hit the zero lower bound. The chief function of **quantitative easing** is to reduce the long-term interest rate directly by buying long term financial assets. Note that this is a generalization (to other financial assets) of the idea that bond prices vary inversely with interest rates.

Another function of quantitative easing (not mentioned in the reading) is to boost household wealth, so that autonomous consumption is stimulated.

With **forward guidance**, a central bank is communicating its future monetary policy to influence spending decisions today. For instance, suppose the European Central Bank communicates that it intends to keep its target rate at zero "for an extended period". Banks are thus willing to offer low rates for longer term loans, encouraging borrowing and the associated expenditure. Businesses and households may also be more willing to spend as the policy is perceived to be long term rather than temporary.

B.

The two central banks had difficulty pushing their target rates below 0%. They have also seen long term interest rates fall by less than expected with spreads widening. Given that conventional monetary policy has been exhausted, they have therefore resorted to unconventional monetary policies.

C.

With interest rates at the 'zero lower bound' expansionary fiscal policy is not affected by crowding out. Expenditure multipliers are therefore larger, making fiscal policy highly effective. The government can and should act as the "spender of last resort!"

D.

The BOE started a gradual **'passive' quantitative tightening** (i.e., reversal of quantitative easing) in February 2022. This is described as 'passive' because the BOE is not selling its stash of government bonds outright but is just letting some of the bonds mature without replacing them. 'Active' quantitative tightening, where it will sell government bonds outright, is scheduled to begin in November 2022. Incidentally, the BOE has been raising its target interest rate to combat inflation. The Bank of England rate has risen from 0.1% in December 2021 to 2.25% in September 2022.

The ECB has been gradually slowing quantitative easing, finally ending its asset purchase programme in July 2022. It has stopped short initiating quantitative tightening for now, likely because of worries over the Russian invasion of Ukraine. But discussions are ongoing and a decision will be made before the end of 2022. It has also started raising its target interest rate.

Both central banks have signaled that they will continue to raise interest rates, but neither has committed to a set path of interest rate increases. In a macroeconomic environment with high uncertainty, it is unwise to make strong commitments to future monetary policy that could be interpreted as forward guidance.