International Macroeconomics
Supervision 1

Samuel Lee

Section A

A.1

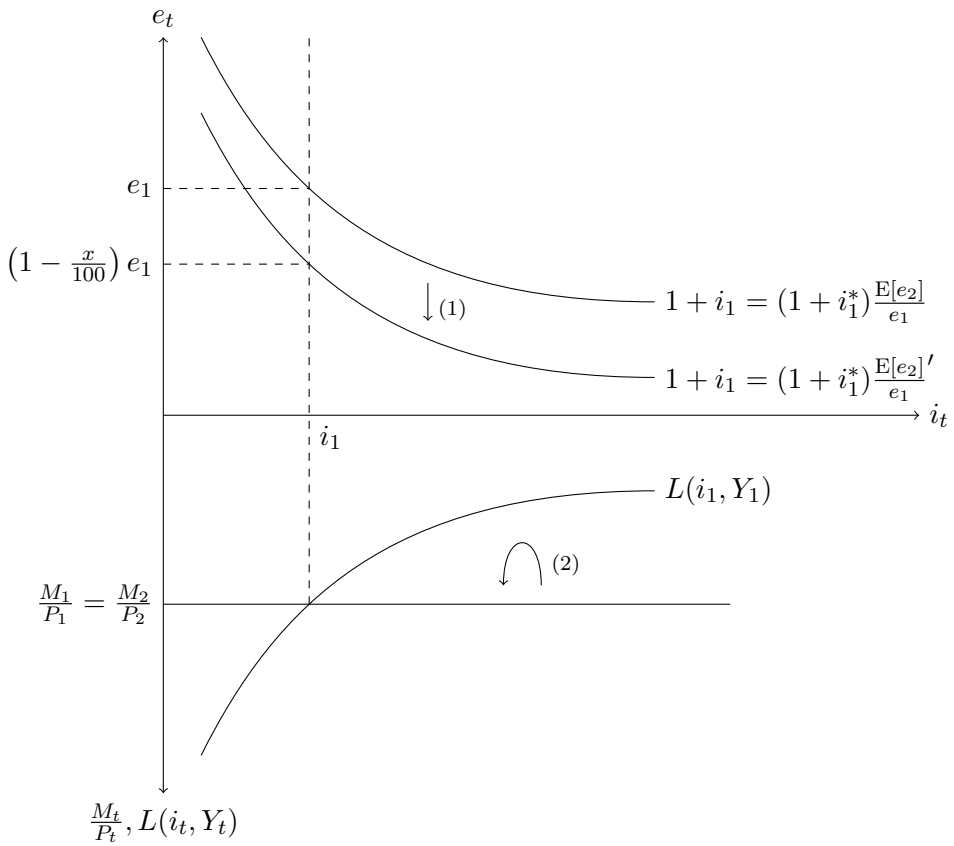
We have an uncovered interest rate parity condition:

$$1 + i_t = (1 + i_t^*)\frac{\mathrm{E}[e_{t+1}]}{e_t}$$

and a money market equilibrium condition:

$$\frac{M_t}{P_t} = L(\underset{(-)}{i_t}, \underset{(+)}{Y_t})$$

and plotting the two on one diagram, we get



We assume that the exchange rate is expected to remain constant at the start. At the beginning of period 1, the central bank announces that it will decrease M by $x\%$. With rational expectations, the public knows that this will lead to an appreciation of e_2 by exactly $(100 - x)\%$ of e_1 in the long-run, and so expectations of e_2 are updated to $\mathrm{E}[e_2]'$. This is depicted by movement (1) above. We know what this will do to the equilibrium exchange rate assuming interest rates remain at i_1: an interest rate of i_1 is now consistent with an exchange rate that is $x\%$ lower than before. Hence the exchange rate appreciates to $\left(1 - \frac{x}{100}\right) e_1$ in period 1 after the announcement.

In period 2, the central bank carries out the policy of reducing M by $x\%$, but because the public already knew of this policy beforehand and prices are set one period before, P will decrease by exactly as much as M with rational expectations, and there is no change in the real money supply. This is depicted by 'movement' (2) above. The UIP curve does not change since there is no further expected movement in e_t from period 2 onwards. Therefore, in period 1, e_t decreases by $x\%$, and in period 2, e_t does not change.

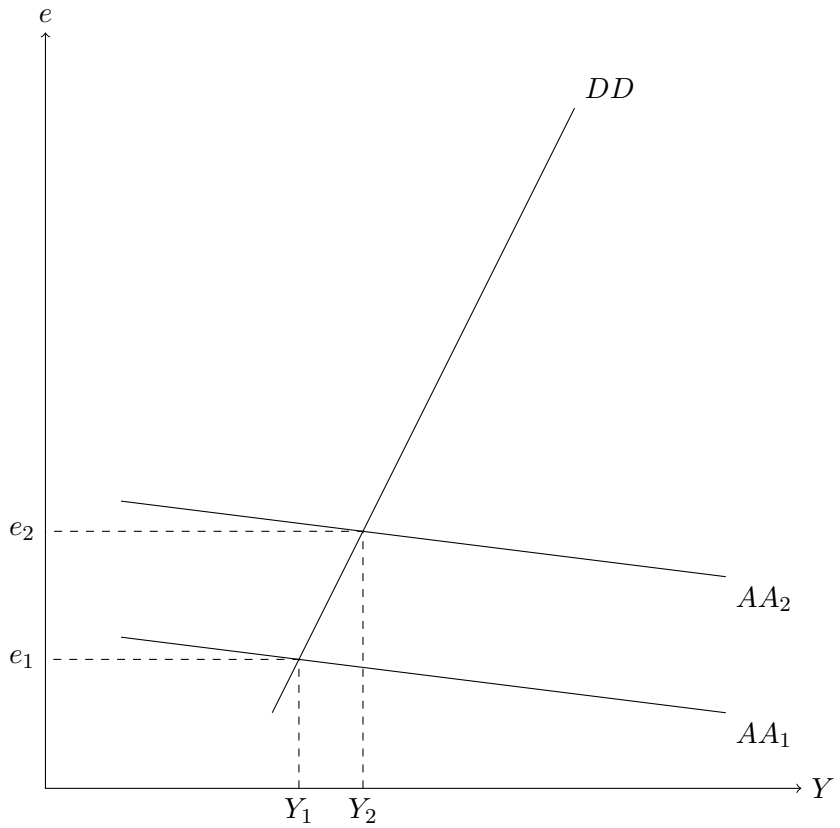
Section B

B.1

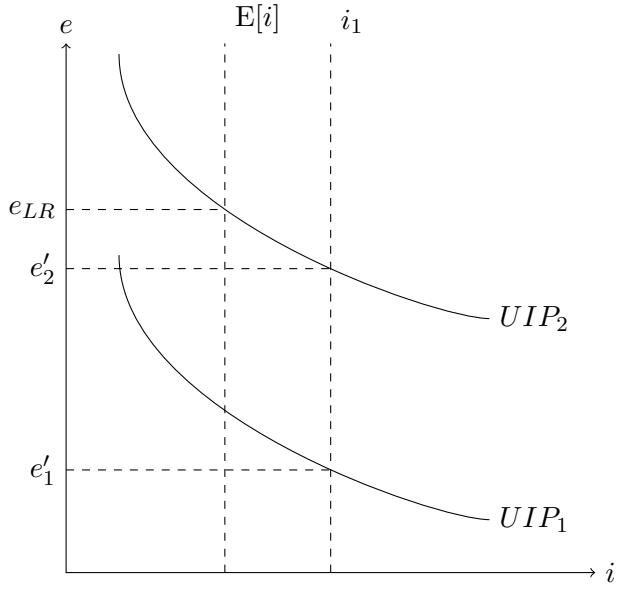
(a)

We skip the steps of deriving the DD and AA curves; it suffices to say that the DD curve represents the combinations of Y and e which allows for equilibrium in the goods market, and the AA curve represents the combinations of Y and e that arises from equilibrium in the money and foreign exchange market for a given money demand function and level of money supply, prices, foreign interest rates, and exchange rate expectations.

When people expect a 100 increase in the money supply next year, they will expect prices and the exchange rate to also increase by 100 in the long run. In the short-run we assume prices are fixed, but the expectation of the future exchange rate can change. Therefore $\mathrm{E}[e]$ will double from its initial value. The doubling of $\mathrm{E}[e]$ results in an upward shift of the AA curve from AA_1 to AA_2, and the short-run equilibrium output increases from Y_1 to Y_1 while the exchange rate depreciates from e_1 to e_2, as below:

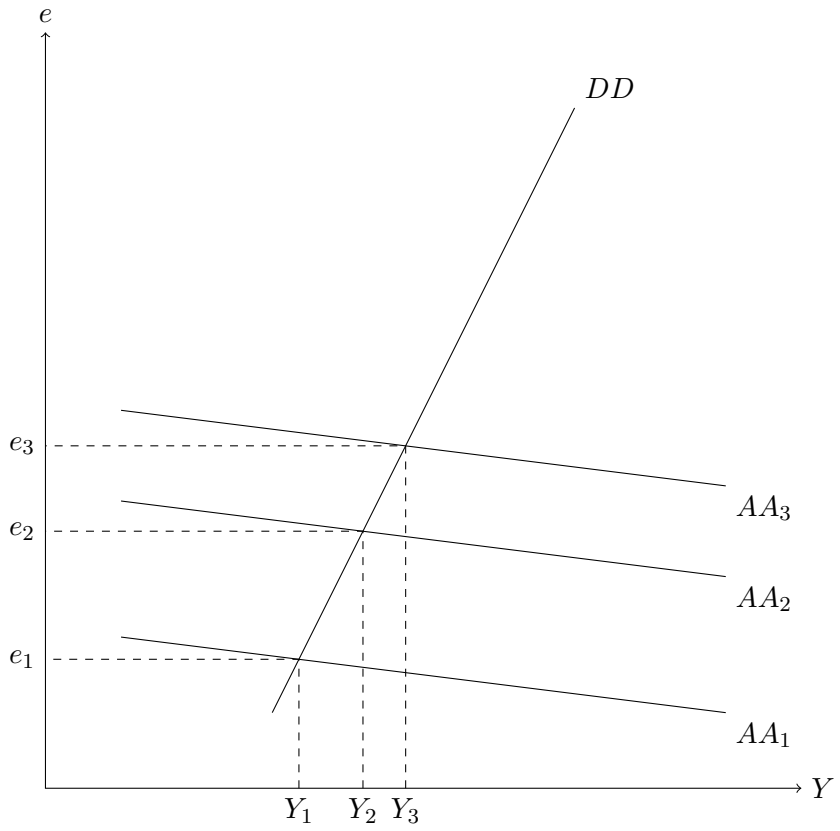


The money supply has not increased yet; it is only expected to increase next year. Therefore, equilibrium in the money market is still achieved by the same domestic interest rate as before for each level of output. However, with a higher expected future exchange rate E[e], investors require a more depreciated currency now (or less depreciation/more appreciation in the future) for every given interest rate, before they are willing to hold domestic assets. This is shown in the shift from UIP_1 to UIP_2, and is why the AA curve shifts upwards and the exchange rate depreciates.



(b)

In (a), the AA curve shifted upwards from AA_1 to AA_2 due to the expectations effect, where a more depreciated currency was required to satisfy uncovered interest parity for every given level of output due to an expected depreciation in the future. With an unanticipated permanent increase in the level of the money supply, the expectations effect is further augmented by a liquidity effect whereby a equilibrium in the money market is achieved with a lower domestic interest rate for every given level of output. For a given level of output, the exchange rate must depreciate even more compared to (a) before the rate of return on domestic and foreign assets can be equalized. Thus the AA curve must shift by more than in (a):

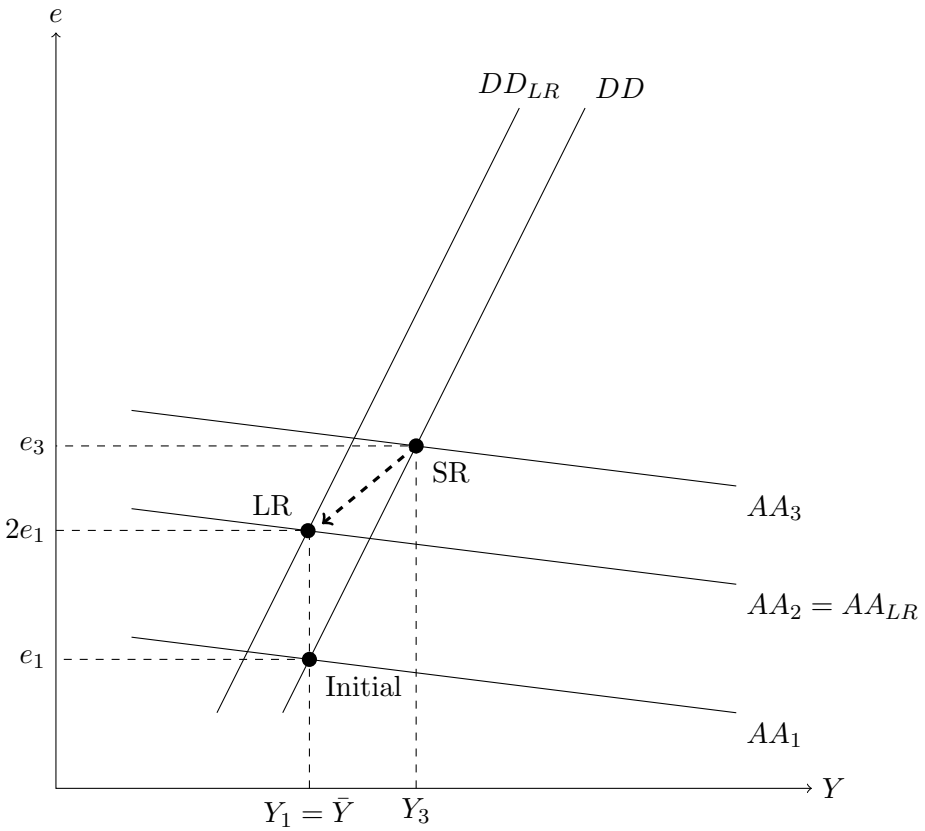


Therefore the exchange rate will depreciate even further to e_3 and output will increase even further to Y_3 in the short run.

We assumed that the economy was initially in long-run equilibrium, so $Y_1 = \bar{Y}$. And we should know that in the long run, $Y = \bar{Y}$, and $\hat{M} = \hat{P} = \hat{e}$ where $\hat{}$ denotes the percentage change of a variable. Therefore the new long-run equilibrium must be at $Y = Y_1$ and $e = 2e_1$; it is the only equilibrium that is consistent with rational expectations in the long-run.

(c)

As mentioned, the economy should adjust to a long-run equilibrium with $Y = \bar{Y} = Y_1$ and $e = 2e_1$. How this takes place is as such:

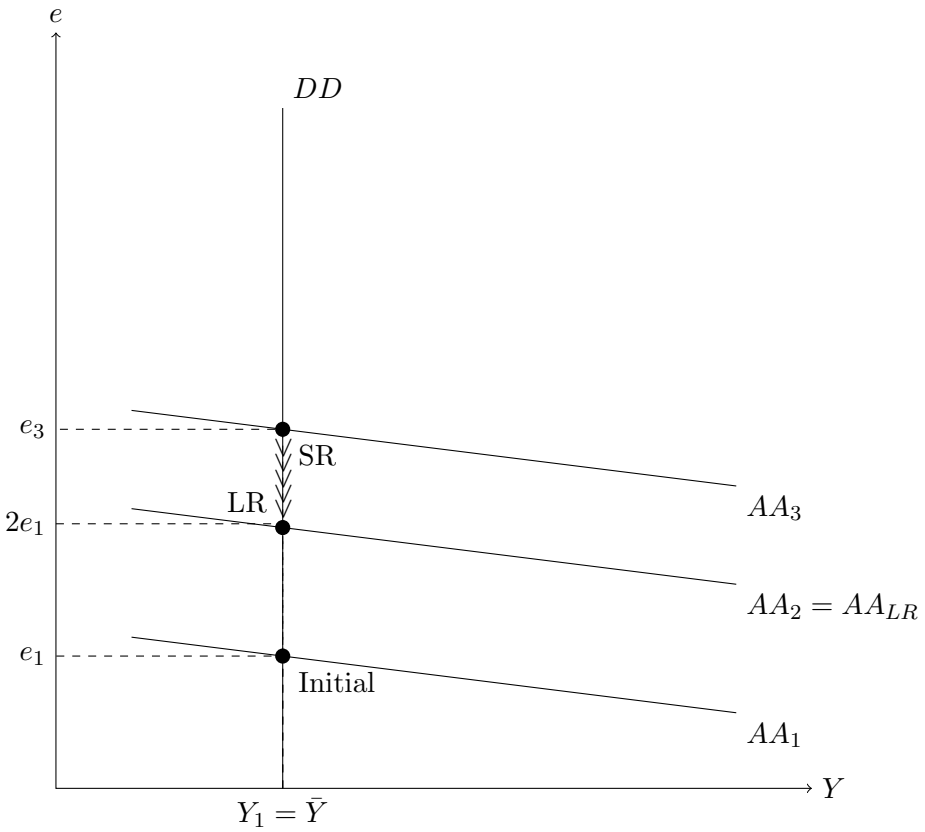


With the short-run equilibrium being at $Y_3 > \bar{Y}$, factors of production are working beyond capacity and there are upward pressures on wages. Prices adjust upwards in response, and this has two effects. The first is that an increasing domestic price level leads to an appreciation of the real exchange rate. For every nominal exchange rate e, net exports are now lower due to higher domestic prices. Therefore the DD curve shifts left from DD to DD_{LR}. At the same time, the increase in prices slowly undoes the initial expansion of the real money supply, and the liquidity effect on the AA curve is fully reversed. Therefore the AA curve shifts down from AA_3 to AA_{LR}. The expectations effect is still intact, so the AA curve does not return to its original position; this also means that the long-run AA curve is exactly the AA curve that results from the anticipated permanent monetary expansion in (a), AA_2. By the end of this adjustment, prices are twice their original level and the neutrality of money is preserved in the long-run.

(d)

i.

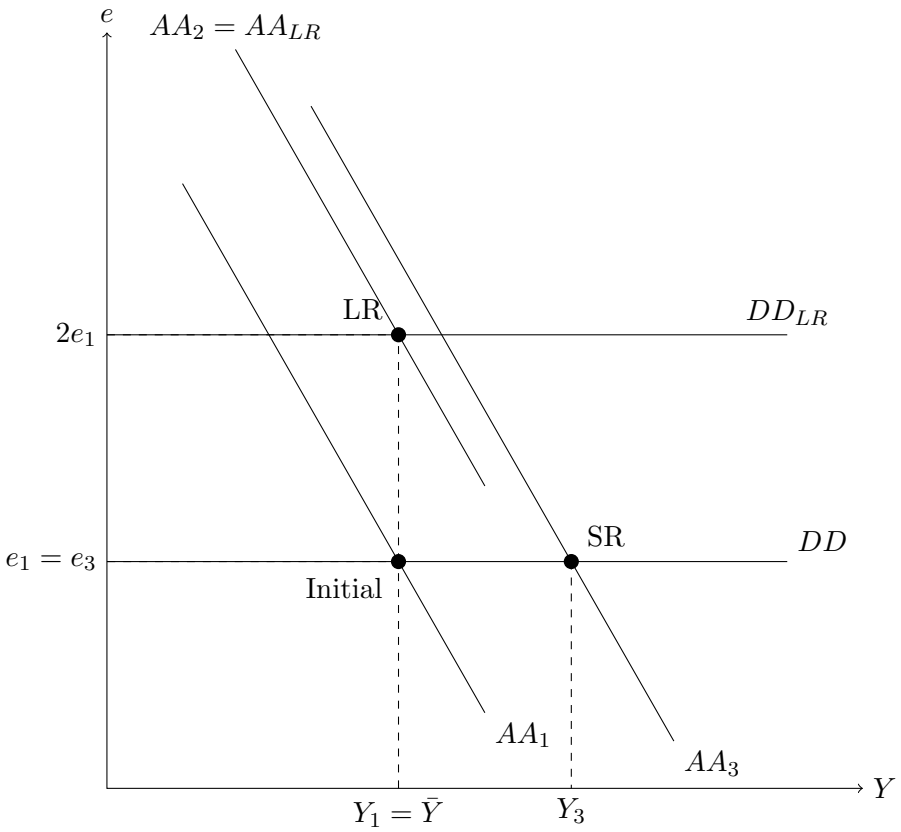
If the exchange rate sensitivity of the current account is 0, the DD curve will be vertical at $Y = \bar{Y}$. The shifts in the AA curve are unchanged:



Exchange rate overshooting is guaranteed to occur in this case. The goods market is completely unable to alleviate the monetary shock; adjustment takes place entirely through the exchange rate, which has to overshoot the long-run level under price stickiness to maintain uncovered interest parity.

ii.

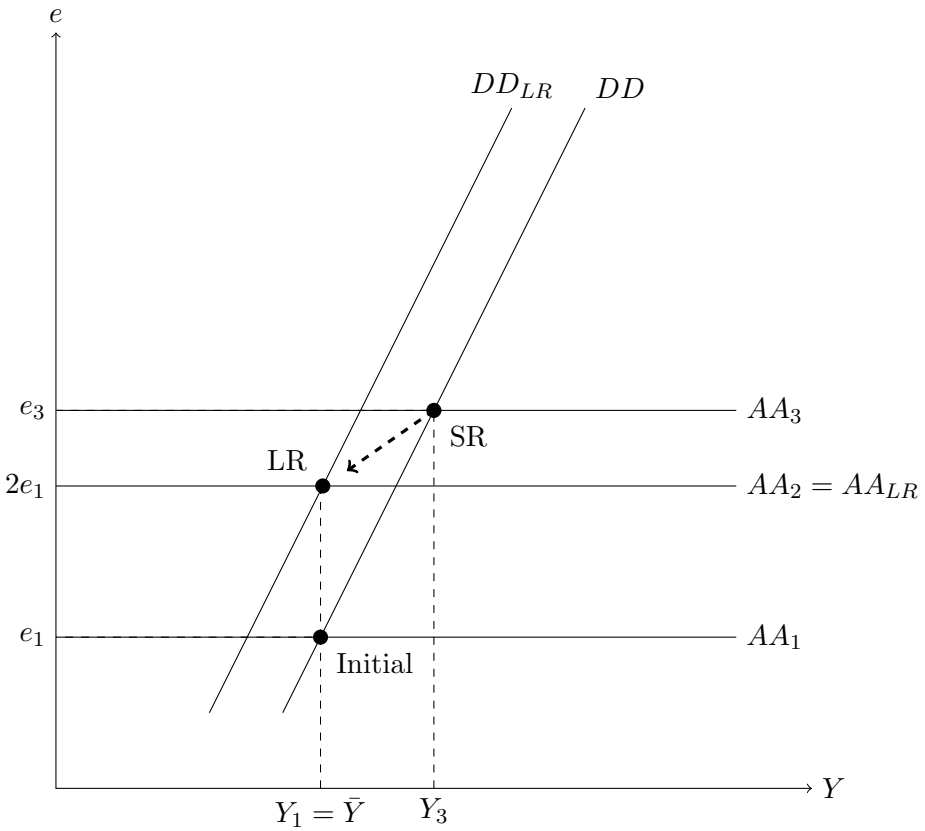
With the current account infinitely elastic to real exchange rates, the original DD curve is horizontal at $e = e_1$ where e_1 is the exchange rate that satisfies purchasing power parity at the initial price levels:



Now, the adjustment to the short-term equilibrium takes place entirely through output, and exchange rates do not move in the short run. The monetary expansion would put downward pressure on domestic interest rates, but uncovered interest parity is achieved purely by an increase in output from Y_1 to Y_3 which brings domestic interest rates back in line with foreign interest rates. Exchange rate overshooting never has to occur in this case.

iii.

When the output sensitivity of money demand is zero, transitory changes in output do not result in any change in the money market and equilibrium interest rates, and therefore the original AA curve is perfectly elastic at $e = e_1$.



The monetary expansion leads to a lower domestic interest rate and a higher expected exchange rate E[e]. When the output sensitivity of money demand is zero, none of the money injected into the economy can be absorbed by, say, an increased transactions demand for money. Therefore UIP can only be satisfied by letting the exchange rate depreciate to a unique level e_3. In the long-run, prices adjust and the real money supply goes back to the original state, but expectations of the exchange remain permanently higher. Again, there is a unique exchange rate $2e_1$ that satisfies UIP, and it will always be lower than the short-run exchange rate e_3 since the domestic interest rate is back to its original level.

iii.

When the output sensitivity of money demand is infinite, the AA curve is vertical at $Y = \bar{Y}$. Money demand is infinitely positive at $Y > \bar{Y}$ and infinitely negative at $Y < \bar{Y}$, and changes in the money supply or E[e] no longer shift the AA curve. So in the short run there is no effect on exchange rates, and in the long run the doubling in prices shifts the DD curve such that equilibrium is restored at $e = 2e_1$. There is no overshooting in this case; the intuition is that the money injected into the economy can be totally absorbed by the transactions demand for money with just an infinitesimal increase in output, and no short-run adjustment is required.

B.2

(a)

The first equation is an uncovered interest rate parity condition governing the no-arbitrage equilibrium in the foreign exchange market. The second equation represents money market equilibrium

whereby the real money supply finds its demand in the transactions demand and speculative demand for money. The third equation is an IS curve where goods market equilibrium is independent of the interest rate but dependent on the real exchange rate.

(b)

Substituting the variables with their long-run values, we have the three equations

$$i = \mathrm{E}[\mathbf{e}] - \mathbf{e} \tag{UIP}$$
$$\bar{\mathbf{M}} - \mathbf{P} = -\kappa i \tag{LM}$$
$$\alpha(\mathbf{e} - \mathbf{P}) = 0 \tag{IS}$$

Substituting (UIP) into (LM) yields $\bar{\mathbf{M}} - \mathbf{P} = -\kappa\{\mathrm{E}[\mathbf{e}] - \mathbf{e}\}$. (IS) implies $\mathbf{e} = \mathbf{P}$, and rearranging the relation derived before yields $\bar{\mathbf{M}} + \kappa\mathrm{E}[\mathbf{e}] = (1+\kappa)\mathbf{e}$. Taking expectations yields $\mathrm{E}[e] = \bar{\mathbf{M}}$, and we find that $\mathbf{e} = \mathbf{P} = \bar{\mathbf{M}}$, and (LM) gives us $i = 0$.

(c)

Solving for the equilibrium $\mathbf{Y}$ and $\mathbf{e}$,

$$\mathbf{M} - \mathbf{P} = \lambda\mathbf{Y} - \kappa\{i^* + \mathrm{E}[\mathbf{e}] - \mathbf{e}\} \tag{AA}$$
$$\mathbf{Y} = \alpha(\mathbf{e} + \mathbf{P}^* - \mathbf{P}) \tag{DD}$$

The two relations yield the equilibrium values

$$\mathbf{e} = \frac{1}{\lambda\alpha + \kappa}\{\mathbf{M} + (\lambda\alpha - 1)\mathbf{P} - \lambda\alpha\mathbf{P}^* + \kappa\{i^* + \mathrm{E}[\mathbf{e}]\}\}$$
$$\mathbf{Y} = \frac{\alpha}{\lambda\alpha + \kappa}\{\mathbf{M} - (1+\kappa)\mathbf{P} + \kappa\{i^* + \mathrm{E}[\mathbf{e}] + \mathbf{P}^*\}\}$$

We assume the economy starts off from the long-run equilibrium ($\mathbf{e} = \mathbf{P} = \bar{\mathbf{M}} = \mathbf{Y} = \bar{\mathbf{Y}} = 0$). With a permanent decrease in the money supply from $\mathbf{M} = 0$ to $\mathbf{M} = -1$, $\mathrm{E}[\mathbf{e}]$ will also decrease to -1. Substituting $\mathbf{M} = \mathrm{E}[\mathbf{e}] = -1$ and $i^* = \mathbf{P}^* = 0$, $\lambda = \kappa = 1$, $\alpha = \frac{1}{2}$ yields

$$\mathbf{e} = \frac{1}{\lambda\alpha + \kappa}(-1 - \kappa) = -\frac{4}{3}$$
$$\mathbf{Y} = \frac{\alpha}{\lambda\alpha + \kappa}(-1 - \kappa) = -\frac{2}{3}$$

which means the exchange rate appreciates and output decreases relative to their initial levels of 0. In the short run, the decrease in the Home money supply leads to a higher domestic interest rate for a given level of output. For uncovered interest parity to hold at each level of output, the exchange rate must appreciate relative to its current level. Furthermore, people in Home expect this permanent decrease to lead to a more appreciated exchange rate forever, reinforcing the appreciation that must happen now so that there will be depreciation or less appreciation later, equating the returns on Home and Foreign assets. Some of this downward pressure on the exchange rate can be 'released' through a decrease in output, which will lower the transactions demand for money and lead to a lower domestic interest rate relative to the case where output is not allowed to change. The amount of adjustment that takes place through $\mathbf{e}$ and the amount of adjustment that takes place through $\mathbf{Y}$ depends on the parameters of the model.

(d)

We know the long-run exchange rate must be $\mathbf{e} = \mathbf{M} = -1$, which was also how we derived $\mathrm{E}[\mathbf{e}]$ under rational expectations. The exchange rate appreciates more than this in the short-run, which means there is exchange rate overshooting. The economy adjusts to the new long run equilibrium mostly through the same way as in B.1(c), except with prices facing pressure downwards rather than up. Exports slowly become more competitive, increasing output back to $\bar{\mathbf{Y}}$. The real money supply gradually returns to its initial level, and the expected appreciation of the exchange rate decreases to 0 as $\mathbf{e}$ approaches $\mathrm{E}[\mathbf{e}]$ and i approaches i^*.