ANSWER 1.a

(1 point) This open market operation decreases the holding of the government bonds on the central bank’s balance sheet. Therefore, the monetary base and money supply decrease. However, this change in money supply is temporary because the open market operation is reversed in 2 months. We can display the time path of money supply in Mexico in Figure 1.

![Figure 1: Temporary money reduction in Mexico](image)

The temporary money expansion in Mexico affects Mexico’s money market by increasing the peso interest rate, as in Figure 2.A. The nominal money supply expansion increases the real money supply in Mexico because the price level is sticky in the short run. As a result, the real money supply schedule shifts to the left, and the equilibrium in money market shifts from Point 1 and Point 2. The peso interest rate rises from $i_p^1$ to $i_p^2$. 2 months later when the Bank of Mexico reverses its money expansion, the real money supply schedule shifts back to its original one. Consequently, 2 months later the peso interest rate also returns to its original level. Points 1, 2, and 3 in Figure 2 correspond to the initial equilibrium, the equilibrium after money supply is reduced, and the equilibrium after the open market operation is reversed.
Following the temporary money expansion in Mexico, the peso interest rate falls and causes the domestic return (DR) schedule in Figure 2.B to shift upward from DR₁ to DR₂. Therefore, the exchange rate moves from $E^1_{p/$ to $E^2_{p/$, indicating that the peso appreciates against the dollar. When the peso interest rate returns to $i^1_p$ 2 months later, the exchange rate also return to $E^1_{p/$.

We can display the time path of the dollar-peso exchange rates in Figure 3.

Note that we can also answer this question using the dollar-peso exchange rate and treating the peso interest rate as the foreign interest rate. In this case, the FR schedule in Figure 3.B will shift upward instead of the DR schedule. The resulting exchange rate will indicate depreciation of the dollar. The time path of exchange rate in this case will be a mirror image of Figure 3.

**ANSWER 1.b**

(1 point) The anticipation about the temporary money reduction was formed 1 month before the actual change in money supply. We can display time path of Mexico’s money supply in Figure 4.
In Figure 4, we denote the time in which the anticipation is formed as Period 0. From ANSWER 1.a, market participants understand that in Period 1 the peso interest rate will rise, and a rise in interest rate usually makes the peso appreciate. For this reason, market participants respond by reducing their expectations about future exchange rate or $E_{p/s}^{e}$. The reduction in the expected future spot rate then shift the FR schedule downward in Period 0, and the peso appreciates immediately in the foreign exchange market. We depict these changes in Figure 5 below.

In Figure 5, the initial equilibrium today is Point 1. Point 2 is the equilibrium after market participants change expectations. The appreciation of the peso happens purely because of a shift in expectations about future spot rate, despite the fact that nothing really changes in the money market. 1 month later Mexico’s money supply falls and as a result the peso interest rate rises. We display the equilibrium after the money supply in Mexico is reduced using Point 3. Consequently, the DR schedule in Figure 5.b shifts upward. The other shift following the money reduction is the shift of the FR scheduled back to its original position. The reason is that the change in expectations about future spot rate is not permanent and lasts for only 1 month. Market participants do not anticipate the change in money supply to be permanent, and they have validated their expectations after the money supply is actually reduced in Period 1. 2 months
later, in Period 3 the peso interest rate returns to its original level, and so does the DR schedule. The final equilibrium is displayed by Point 4. The time path of peso-dollar exchange rates is in Figure 6 below.

\[ E_{p/s} \]

![Figure 6: Peso-dollar exchange rates with anticipated money reduction](image)

**ANSWER 2.a**

The path of Mexico’s money supply is displayed in Figure 7.

\[ M \]

![Figure 7: Permanent money reduction in Mexico](image)

The effects of permanent money reduction on Mexico’s money market are illustrated in Figure 8.A. In the short run, the real money supply schedule shifts to the left, causing the peso interest rate to rise from \( i_p^1 \) to \( i_p^2 \). But in the long run, the price level falls to catch up with the money supply reduction, thus the real money supply schedule shifts back to its original level in the long run. For this reason, in the long run the peso interest rate returns to \( i_p^1 \).
In Figure 8.B, the immediate effect of a rise in the peso interest rate shifts the DR schedule upward. In addition, the foreign exchange market the FR schedule shifts down because of the expectations about future exchange rate. According to the monetary approach, the long-run fall in the price level of Mexico results in long-run appreciation of the peso or depreciation of the dollar. Thus, $E_{p/$ fall and shifts FR from FR\(_1\) to FR\(_2\). The short run exchange rate is $E_{3\ p/$. Note that $E_{2\ p/$ does not realize in the currency market, and it is only a point to illustrate the effect of the peso interest rate. The distance between $E_{1\ p/$ and $E_{2\ p/$ measures the interest rate effect or the liquidity effect.

From the short run to the long run, the peso interest rate gradually falls back to its original level as a result of falling price level in Mexico. Thus, DR gradually falls too. In the long run, FR remains at FR\(_2\), and this schedule reflects the permanent change in the expectations about future exchange rate. The long run exchange rate is $E_{p/$. We display the time path of exchange rate, price level and nominal interest rate in Figure 9.
B. Price level in Mexico

C. Peso interest rate

Figure 9: Time paths of peso-dollar exchange rate, price level and peso interest rate

In Figure 9.A, Period 0 represents the short run, and Period T represents the long run, in which the price level in Mexico is fully adjusted. The short run change of peso-dollar exchange rate is measured by the distance $|E^{i_{p} \text{$/\text{S}}}_{p} - E^{i_{p} \text{$/\text{S}}}_{p}|$. The short run change of peso-dollar exchange rate is the distance $|E^{i_{p} \text{$/\text{S}}}_{p} - E^{i_{p} \text{$/\text{S}}}_{p}|$. Clearly, the long run change is smaller than the short run change. Thus, there is exchange rate overshooting in the short run.

What exactly is the exchange rate overshooting?

Exchange rate overshooting characterizes the event that the short-run change in exchange rates is larger than their long-run change. Exchange rate overshooting occurs when (1) there are permanent changes in the money market; and (3) prices are sticky in goods markets but flexible in asset markets. In the short run, permanent changes in the money market create two effects that cause exchange rate to change. One is the interest rate effect or liquidity effect, coming from a change in interest rates. Two is the expectations effect, coming from a change in the expectations. But in the long run, prices of goods adjust to reflect the permanent changes in the money market and this adjustment will eliminate previous changes in the interest rates or the interest rate effect. In the long run, only the expectations effect remains.
ANSWER 2.b

(2 points) The permanent rise in output in Mexico increase money demand in Mexico permanently, as displayed in Figure 10. The money demand schedule shift from $M_1^{d}$ to $M_2^{d}$, causing the peso interest rate to rise from $i_p^1$ to $i_p^2$ in the short run.

![Figure 10: Effects of permanent increase in output in Mexico](image)

But in the long run, the price level will adjust. Recall that inflation is driven by the difference between money supply growth and output growth, according to the monetary approach. (We continue to assume that the elasticity of money demand to output is one.) For this reason, the price level falls gradually over time and gradually shifts the real money supply schedule to the right. In the long run, the peso interest rate will falls back to $i_p^1$. Point 1 is the initial equilibrium, and the short run equilibrium is Point 2. Point 2 is the same as Point 3 in a sense that expectations about future exchange rate and price level do not affect the short run equilibrium in money market. Finally, the long run equilibrium is Point 4.

Notice that the movements of the peso interest rate and the price level are exactly the same as in Answer 2.a. For this reason, the FX diagram and the time path of exchange rates and other key variables are the same as those in Figures 8.B and 9. There is also exchange rate overshooting.

ANSWER 2.c

(2 points) When permanent money reduction and permanent output expansion happen at the same time, their effects on peso-dollar exchange rate and other variables are qualitatively the same as those in ANSWER 2.a. However, quantitatively their effects on all variables will be doubled since we have two driving forces that drive all variables in the same direction. Suppose the scale of permanent money expansion is the same as the scale of the permanent output.
expansion. Then, the scale of exchange rate overshooting will be doubled of that in ANSWER 2.a and ANSWER 2.b.

**ANSWER 3**

(2 points) According to the Trilemma in international finance, a monetary authority can choose 2 out of 3 following goals. One is fixing exchange rate. Two is free capital mobility. Three is independent monetary policy. In this question, Hong Kong has chosen to fix exchange rate. The other choice will influence Hong Kong interest rate and inflation as follows.

**Case 1: Hong Kong chooses free capital mobility**

Free capital mobility implies that the uncovered interest parity (UIP) holds. With fixed exchange rate against the US dollar, expected depreciation of Hong Kong dollar against the US dollar is zero. Substituting zero rate of expected depreciation into the UIP gives:

\[ i_{HK} = i_{US} \] (1)

Also, free capital mobility implies that the real interest rate in Hong Kong is the same as the US real interest rate:

\[ r_{HK} = r_{US} \] (2)

According to Fisher Parity, real interest rate is the difference between nominal interest rate and inflation. We can apply this parity to both Hong Kong and the US.

\[ r_{US} = i_{US} - \pi_{US} \] (3)

\[ r_{HK} = i_{HK} - \pi_{HK} \] (4)

Substituting (2)-(4) into (1) yields equalization of Hong Kong inflation and US inflation.

\[ \pi_{HK} = \pi_{US} \]

In other words, fixing exchange rate and maintaining free capital mobility make Hong Kong lose monetary independence and import the inflation rate from the US.

**Case 2: Hong Kong chooses independent monetary policy**

We have illustrated in Case 1 that Hong Kong will lose monetary independence if Hong Kong fixes exchange rate and maintains free capital mobility at the same time. If Hong Kong prefers monetary independence, i.e. to have different interest rate and different inflation rate from the US, Hong Kong must impose capital control to prevent free capital mobility.