1. The “liquidity effect” refers to the negative response of interest rates to exogenous money supply shocks. Answer the two questions below in words, without the math.
   a. Does the ‘Classical model’ discussed in class imply a liquidity effect? Why or why not?
   b. Does the ‘sticky-wage model’ discussed in class imply a liquidity effect? Why or why not?

2. Assume that the following three equations describe a small open economy with flexible exchange rates and perfect capital mobility:
   \[ y = y(P), \quad y' > 0 \]
   \[ y = h(r^*, \frac{E}{P}) + g, \quad h_1 < 0, h_2 > 0 \]
   \[ \frac{M}{P} = m(r^*, y), \quad m_r < 0, m_y > 0 \]
   where the first equation is aggregate supply, the second is desired aggregate spending (in which \( h(\cdot) \) is desired private spending), and the third is the money market equilibrium condition. The three endogenous variables are output (\( y \)), the price level (\( P \)), and the nominal exchange rate (\( E \)). The exogenous variables are \( M \) (nominal money), \( g \) (government spending), and \( r^* \) (the foreign interest rate).
   a. Compute the multiplier showing the equilibrium effect of a change in the foreign interest rate on domestic output. Describe the economics underlying this effect.
   b. How does fiscal policy (an exogenous change \( g \)) affect output in equilibrium? Explain.

3. The ‘sluggish nominal wage’ model discussed in class implies that equilibrium real output depends on past values of the money stock according to
   \[ y_t = \alpha \sum_{i=0}^{\infty} \beta^i (M_{t-i} - M_{t-1-i}) \]
   (where I have set the constant term to zero for convenience). Suppose that an econometrician obtains the following estimates of the parameters of this model: \( \alpha = 1 \) and \( \beta = 0.5 \).
   a. Using these estimates, compute the dynamic multiplier \( \frac{\partial y_{t+3}}{\partial M_t} \), assuming that the money stock in all other periods remains constant.
   b. Compute the same multiplier, but now assume that the money stock changes permanently; i.e., \( \frac{\partial M_{t+3}}{\partial M_t} = \frac{\partial M_{t+2}}{\partial M_t} = \frac{\partial M_{t+1}}{\partial M_t} = \frac{\partial M_t}{\partial M_t} = 1 \). Briefly compare your answers to (a) and (b) and provide some economic intuition.

4. In many macroeconomic models, it is important to make assumptions about how economic agents form expectations about relevant variables, such as the future rate of inflation.
   a. For the case of forecasting inflation, distinguish between the assumption of ‘adaptive expectations’ and ‘rational expectations’.
   b. In a simple model in which aggregate supply depends on the deviation of the price level (or the inflation rate) from its expected value, how do the model’s predictions about the effect of the money stock on real output differ based on the alternative assumptions on expectation formation?
   c. What sort of evidence did Sargent use to test rational expectations against adaptive expectations? What were his general findings and conclusions?
Answers

1. The liquidity effect
   a. The Classical Model does not imply a liquidity effect. The model assumes flexibility in nominal prices and wages. When the nominal stock of money changes exogenously, the price level will adjust proportionately so that real money balances don’t change. The change in nominal price is matched by a change in nominal wages, so real wages don’t change and therefore there is no effect on the supply of total output. Because output remains the same, so must aggregate spending and there is no pressure for the interest rate to change.
   b. The sticky-wage model implies a liquidity effect. As nominal money, say, increases, the excess supply of money will lead to an increase in the price level. Since nominal wages are exogenous, real wages will fall, and output supply will rise. The excess supply of output will drive interest rates down to encourage additional spending. The lower interest rate will also increase the demand to hold real money balances.

2. Small open economy. For convenience, assume initial values of $M$, $P$, and $E$ equal 1.

\[
\begin{pmatrix}
1 & -y' & 0 \\
1 & h_2 & -h_2 \\
m_y & 1 & 0
\end{pmatrix}
\begin{pmatrix}
dy \\
dP \\
dE
\end{pmatrix}
= 
\begin{pmatrix}
0 \\
h_1 dr^* + dg \\
dM - m_r dr^*
\end{pmatrix}
\]

\[J = h_2 + y'm_y h_2 > 0\]

a. change in $r^*$

\[
\frac{\partial y}{\partial r^*} = -\frac{h_2 m_r y'}{J} > 0
\]

An increase in the foreign interest rate increases domestic output by reducing the domestic demand for real money balances, causing $P$ to rise and output supply to rise in turn by the first equation. Because $P$ and $r^*$ rise (both of which cause $h(\cdot)$ to fall), it must be the case that $E$ rises by more than $P$ so that aggregate demand will accommodate the increase in supply.

b. Fiscal policy

\[
\frac{\partial y}{\partial g} = 0
\]

\[
\frac{\partial P}{\partial g} = 0
\]

\[
\frac{\partial E}{\partial g} = -\frac{(1 + y'm_y)}{J} < 0
\]

(Note that the first two multiplier are evident if the order of the second and third equation are switched to reveal a block recursive system.) Because $r^*$ is exogenous and $r = r^*$ by the assumption of perfect capital mobility, the exchange rate changes to just offset the effect of government spending on output. In a closed economy model, an increase in government spending will increase the interest rate, causing money demand to fall, the price level to rise, and the supply of output to rise because of the upward sloping supply curve.
3. The easiest way to approach this problem is to rewrite the equation as:

\[ y_{t+k} = \alpha \sum_{i=0}^{\infty} \beta^i (M_{t+k-i} - M_{t+k-1-i}) \]

\[ y_{t+3} = M_{t+3} - M_{t+2} + \beta(M_{t+2} - M_{t+1}) + \beta^2(M_{t+1} - M_t) + \beta^3(M_t - M_{t-1}) + \ldots \]

a. Temporary change in money

\[ \frac{\partial y_{t+3}}{\partial M_t} = \beta^3 - \beta^2 = -0.125 \]

b. Permanent change in money

\[ \frac{\partial y_{t+3}}{\partial M} = \beta^3 = 0.125 \]

In the first case, aggregate demand increases for one period only; thus, as the nominal wage rises, output will fall from its initial value. When the money stock changes permanently, then aggregate demand remains higher than initially, and output will rise above its full employment level in the short-run.

4. Expectations

a. Under adaptive expectations, agents are assumed to forecast future inflation based only on the realized or observed values of past inflation. Under rational expectations, agents predict future inflation using the prediction of the economic model, so that they do not make systematic forecast errors.

b. Under adaptive expectations, anticipated changes in money can affect real output; under rational expectations, only unanticipated money can affect real output.

c. Sargent looked at a group of hyperinflations that ended abruptly and after credible and systematic changes in monetary policy. Because inflation fell quickly without out much output cost, and because the policy changes were anticipated and credible, Sargent inferred that expectations were rational. If expectations were adaptive, under which inflation would have momentum not easily reversed because agents were not forward looking, output would have fallen drastically with the anti-inflationary policies.