Problem Set 4 Suggested Solutions

1. (a) New cigarettes mean an increase in the money supply. With higher nominal money supply and no change in real money demand, the equilibrium price level must rise.
   (b) If people anticipate prices rising when the new cigarettes arrive, they will hold less money so that they will not lose purchasing power when prices go up. But if their real money demand is reduced, with the same nominal money supply the equilibrium price level must rise. The result is that when prices are anticipated to rise in the future, people may take actions that cause prices to rise immediately.

2. (a) An increase in government purchases reduces national saving, causing the real interest rate to rise for a fixed level of income. If the real interest rate is higher, then real money demand will be lower. So prices must rise to make money supply equal money demand. The result is that output is unchanged, the real interest rate increases, and the price level increases.
   (b) When expected inflation falls, real money demand increases. With no effect on employment or saving and investment, output and the real interest rate remain unchanged. With higher real money demand and an unchanged nominal money supply, the equilibrium price level must decline. So output and the real interest rate are unchanged and prices decline.
   (c) When labor supply rises, full-employment output increases. Also, with higher output, saving will increase, so the real interest rate will decline. Both higher output and a lower real interest rate increase real money demand. The price level must decline to equate money supply with money demand. The result is an increase in output and a decrease in both the real interest rate and the price level.
   (d) When the interest rate paid on money increases, real money demand rises. With no effect on employment or saving and investment, output and the real interest rate remain unchanged. With higher real money demand and an unchanged nominal money supply, the equilibrium price level must decline. So output and the real interest rate are unchanged and prices decline.

3. (a) $100/.05 = $2,000
   (b) $1,000/(1.03)^2(1.04)^3 = $837.96
   (c) $100/(1.03) + $100/(1.03)^2 + $100/(1.03)^3 + $100/(1.03)^4 + $1000/(1.03)^5 = $1,234.32
   (d) zero – a stock which will never pay dividends has no fundamental value
   (e) For a stock, news can affect expected future dividends, and higher future dividends raise a stock’s price. For stocks and bonds, news can affect expected future interest rates and higher future interest rates reduce the prices of stocks and bonds.

4. Abel & Bernanke Ch. 9, Numerical Problem #2 (p. 345)
(a) \( \frac{M^d}{P} = 3000 + 0.1Y - 10,000i \)

\[ = 3000 + 0.1Y - 10,000(r + \pi_e) \]
\[ = 3000 + 0.1Y - 10,000(r + .02) \]
\[ = 2800 + 0.1Y - 10,000r. \]

Setting \( \frac{M}{P} = \frac{M^d}{P} \):
\[ \frac{6000}{2} = 2800 + 0.1Y - 10,000r \]
\[ 10,000r = -200 + 0.1Y \]
\[ r = -0.02 + \frac{Y}{100,000}. \]

When \( Y = 8000 \), \( r = 0.06 \).

When \( Y = 9000 \), \( r = 0.07 \).

These points are plotted as line \( LM^a \) in the figure below.

(b) \( M = 6600 \), so \( \frac{M}{P} = 3300 \). Setting money supply equal to money demand:
\[ 3300 = 2800 + 0.1Y - 10,000r \]
\[ 10,000r = -500 + 0.1Y \]
\[ r = -0.05 + \frac{Y}{100,000}. \]

When \( Y = 8000 \), \( r = 0.03 \).

When \( Y = 9000 \), \( r = 0.04 \).

The \( LM \) curve is shifted down and to the right from \( LM^a \) to \( LM^b \) in Figure 9.20, since the same level of \( Y \) gives a lower \( r \) at equilibrium.
(c) \[ \frac{M^d}{P} = 3000 + 0.1Y - 10,000(r + \pi^e) \]
\[ = 3000 + 0.1Y - 10,000r - (10,000 \times .03) \]
\[ = 2700 + 0.1Y - 10,000r. \]

Setting money supply equal to money demand:
\[ 3000 = 2700 + 0.1Y - 10,000r \]
\[ 10,000r = - 300 + 0.1Y \]
\[ r = - 0.03 + (Y/100,000). \]

When \( Y = 8000, \) \( r = 0.05. \)
When \( Y = 9000, \) \( r = 0.06. \)
The \( LM \) curve is shifted down and to the right from \( LM^a \) to \( LM^c \) in the figure above, since there is a higher real interest rate for every given level of output. The \( LM \) curve shifts down and to the right by one percentage point (the increase in \( \pi^e \)) because for any given \( Y, \) the same nominal interest rate clears the asset market. With an unchanged nominal interest rate, the increase in \( \pi^e \) is matched by an equal decrease in \( r. \)

5. Abel & Bernanke Ch. 9, Numerical Problem #4 (p. 346)
(a) First, look at labor market equilibrium. Labor supply is \( NS = 55 + 10(1 - t)w. \) Labor demand (\( ND \)) comes from the equation \( w = 5A - (0.005A \times ND). \) Substituting the latter equation into the former, and equating labor supply and labor demand gives \( N = 100. \) Using this in either the labor supply or labor demand equation then gives \( w = 9. \) Using \( N \) in the production function gives \( Y = 950. \)
(b) Next, look at goods market equilibrium and the IS curve.
\[ S^d = Y - C^d - G = Y - [300 + 0.8(Y - T) - 200r] - G = Y - [300 + (0.4Y - 16) - 200r] - G \]
\[ = -284 + 0.6Y + 200r - G. \]
Setting \( S^d = I^d \) gives \(-284 + 0.6Y + 200r - G = 258.5 - 250r.
Solving this for \( r \) in terms of \( Y \) gives \( r = (542.5 + G)/450 - 0.004/3 \).
When \( G = 50 \), this is \( r = 1.317 - 0.004/3 Y \).
With full-employment output of 950, using this in the IS curve and solving for \( r \) gives \( r = 0.05 \). Plugging these results into the consumption and investment equations gives \( C = 654 \) and \( I = 246 \).

(c) Next, look at asset market equilibrium and the LM curve.
Setting money demand equal to money supply gives \( 9150/P = 0.5Y - 250(r + 0.02) \), which can be solved for \( r = [0.5Y - (5 + 9150/P)]/250. \) With \( Y = 950 \) and \( r = 0.05 \), solving for \( P \) gives \( P = 20 \).

(d) With \( G = 72.5 \), the IS curve becomes \( r = 1.367 - 0.004/3 Y \). With \( Y = 950 \), the IS curve gives \( r = .10 \), the LM curve gives \( P = 20.56 \), the consumption equation gives \( C = 644 \), and the investment equation gives \( I = 233.5 \). The real wage, employment, and output are unaffected by the change.
6. Abel & Bernanke Ch. 9, Analytical Problem #2 (p. 346)

The increase in the price of oil reduces the marginal product of labor, causing the labor demand curve to shift to the left from $ND^1$ to $ND^2$ in Figure 1. Since households’ expected future incomes decline, labor supply increases, shifting the labor supply curve from $NS^1$ to $NS^2$ (but by assumption, the shift to the left in labor demand is larger than the shift to the right in labor supply). At equilibrium, there is a reduced real wage and lower employment. The productivity shock results in a shift to the left of the full-employment line from $FE^1$ to $FE^2$ in Figure 2, as both employment and productivity decline. Because the shock is permanent, it reduces future output and reduces the future marginal product of capital, both of which result in a downward shift of the $IS$ curve. The new equilibrium is located at the intersection of the new $IS$ curve and the new $FE$ line. If, as shown in the figure, this intersection lies above and to the left of the original $LM$ curve, the price level will increase and shift the $LM$ curve upward (from $LM^1$ to $LM^2$) to pass through the new equilibrium point. The result is an increase in the price level, but an ambiguous effect on the real interest rate. Since output is lower, consumption is lower. Since the effect on the real interest rate is ambiguous, the effect on saving and investment are ambiguous as well, though the fall in the future marginal product of capital would tend to reduce investment.
The result is different from that of a temporary supply shock; when the shock is temporary there is no impact on future output or the marginal product of capital, so the IS curve does not shift. In that case the price level increases to shift the LM curve up and to the left from $LM^1$ to $LM^2$ in Figure 3 to restore equilibrium. In that case, the real interest rate unambiguously increases. Under a permanent shock, the IS curve shifts down and to the left, so the rise in the real interest rate is less than in the case of a temporary shock, and the real interest rate can even decline.
7. Abel & Bernanke Ch. 9, Analytical Problem #3 (p. 347)

(a) The decrease in expected inflation increases real money demand, shifting the $LM$ curve up, as shown in Figure 1. The real interest rate rises and output declines.

Figure 1
(b) The increase in desired consumption shifts the IS curve up and to the right, as shown in Figure 2. This causes the real interest rate and output to rise.

![Figure 2](image)

(c) The increase in government purchases shifts the IS curve up and to the right, with the same result as in part (b).

(d) If Ricardian equivalence holds, the increase in taxes has no effect on either the IS or LM curves, so there is no change in either the real interest rate or output. If Ricardian equivalence doesn’t hold, so that the increase in taxes reduces consumption spending, the IS curve shifts down and to the left, as shown in Figure 3. Both the real interest rate and output decline.

![Figure 3](image)

(e) An increase in the expected future marginal productivity of capital shifts the IS curve up and to the right, with the same result as in part (b).

8. The Fed is considering two alternative monetary policies: holding the money supply constant and letting the interest rate adjust, or adjusting the money supply to hold the
interest rate constant. In the IS-LM-FE model, which policy will better stabilize output under the following conditions?

a. **All shocks to the economy arise from exogenous changes in the demand for goods and services.** Holding the money supply constant will be more stabilizing. Suppose, for example, that there is an increase in government spending that pushes up the IS curve. If the money supply remains constant, the short-run equilibrium occurs at the intersection of the initial LM curve and the new IS curve. If the money supply rises to offset the rise in interest rates, however, the short-run equilibrium will occur at the intersection of the new, lower, LM curve and the new IS curve. It is easy to see that a policy of targeting the interest rates amplifies demand-based fluctuations in output. With interest rate targeting, expansionary demand shocks are matched with expansionary monetary policy, and contractionary demand shocks are matched with contractionary monetary policy.

b. **All shocks to the economy arise from exogenous changes in the demand for money.** Interest rate targeting will be more stabilizing. Since the interest rate is not allowed to change, the Fed must offset any change in the LM curve. For example, if money demand rises, the LM curve will shift up, causing the interest rate to rise. The Fed will respond by increasing the money supply, which pushes the LM curve, and the interest rate, back down to its initial level. Output fluctuates only to the extent that the Fed does not respond immediately to the LM shocks.

9. **Suppose that the government wants to raise investment but keep output constant. In the IS-LM-FE model, what mix of monetary and fiscal policy will achieve this goal? In the early 1980s, the U.S. government cut taxes and ran a budget deficit while the Fed pursued a tight monetary policy. What effect should this policy mix have?**

A mix of contractionary fiscal policy (either an increase in taxes or a decrease in government spending) and expansionary monetary policy would lower interest rates, increase investment, and keep output stable (the expansionary monetary policy offsets the contractionary monetary policy). The policy in the 1980s had the opposite effect: interest rates increased, investment declined, but output remained constant due to the expansionary fiscal policy.

10. **Pretend that you are riding on a train and a curious passenger asks you to explain what the IS, LM, and FE curves represent. Without using graphs or equations, provide a clear explanation of the three curves. Also, explain how the IS-LM-FE can be used as a model of both short-run and long-run economic activity.**

The IS curve depicts all of the output and real interest rate pairs that correspond to equilibrium in the goods market. At any point along the IS curve, the demand for investment spending by firms is exactly met by the supply of saving by households and the government. The LM curve depicts the equilibrium output and real interest rate pairs
in the money market. At any point along the LM curve, the demand for money by households is exactly accommodated by the supply of money from the Fed. The FE curve represents the output the economy would produce if capital, labor, and technology were used efficiently. When the economy produces above the FE line, prices will begin to rise as workers become scarce and firms exhaust their inventories. Below the FE line, prices will fall as wage pressure decreases and inventories build up. The IS-LM-FE model is a model of the short-run economy when prices are “sticky.” When prices adjust, the economy returns to its long-run values given by the intersection of all three curves.
## SUMMARY 10

The Cyclical Behavior of Key Macroeconomic Variables
(The Business Cycle Facts)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Direction</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial production</td>
<td>Procyclical</td>
<td>Coincident</td>
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<tr>
<td>Durable goods industries are more volatile than nondurable goods and services</td>
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<tr>
<td><strong>Expenditure</strong></td>
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<tr>
<td>Consumption</td>
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<td>Coincident</td>
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<tr>
<td>Business fixed investment</td>
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<tr>
<td>Residential investment</td>
<td>Procyclical</td>
<td>Leading</td>
</tr>
<tr>
<td>Inventory investment</td>
<td>Procyclical</td>
<td>Leading</td>
</tr>
<tr>
<td>Government purchases</td>
<td>Procyclical</td>
<td>—^3</td>
</tr>
<tr>
<td>Investment is more volatile than consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Labor Market Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
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<td>Coincident</td>
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<tr>
<td>Unemployment</td>
<td>Countercyclical</td>
<td>Unclassified^4</td>
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<tr>
<td>Average labor productivity</td>
<td>Procyclical</td>
<td>Leading^4</td>
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<tr>
<td>Real wage</td>
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<td>—^3</td>
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<td><strong>Money Supply and Inflation</strong></td>
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<tr>
<td>Money supply</td>
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<td>Leading</td>
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<tr>
<td>Inflation</td>
<td>Procyclical</td>
<td>Lagging</td>
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<td><strong>Financial Variables</strong></td>
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<td>Nominal interest rates</td>
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</tr>
<tr>
<td>Real interest rates</td>
<td>Acyclical</td>
<td>—^3</td>
</tr>
</tbody>
</table>

^3Timing is not designated by The Conference Board.

^4Designated as "unclassified" by The Conference Board.

Source: Business Cycle Indicators, April 2003. Industrial production: series 47 (industrial production); consumption: series 57 (manufacturing and trade sales, constant dollars); business fixed investment: series 86 (gross private nonresidential fixed investment); residential investment: series 29 (new private housing units started); inventory investment: series 30 (change in business inventories, constant dollars); employment: series 41 (employees on nonagricultural payrolls); unemployment: series 43 (civilian unemployment rate); money supply: series 106 (money supply M2, constant dollars); inflation: series 120 (CPI for services, change over six-month span); stock prices: series 19 (index of stock prices, 500 common stocks); nominal interest rates: series 119 (Federal funds rate), series 114 (discount rate on new 91-day Treasury bills), series 109 (average prime rate charged by banks).