Equilibrium in the IS-LM Model

The IS curve represents equilibrium in the goods market.
\[ Y = C(Y - T) + I(r) + G \]

The LM curve represents money market equilibrium.
\[ \frac{M}{P} = L(r, Y) \]

The intersection determines the unique combination of \( Y \) and \( r \) that satisfies equilibrium in both markets.

Policy analysis with the IS-LM Model

Policymakers can affect macroeconomic variables with
- fiscal policy: \( G \) and/or \( T \)
- monetary policy: \( M \)

We can use the IS-LM model to analyze the effects of these policies.
**An increase in government purchases**

1. IS curve shifts right by __________ causing output & income to rise.

2. This raises money demand, causing the interest rate to rise…

3. …which reduces investment, so the final increase in Y is ________ than \( \frac{1}{1-MPC} \) ΔG

**A tax cut**

Because consumers save (1–MPC) of the tax cut, the initial boost in spending is smaller for ΔT than for an equal ΔG… and the IS curve shifts by __________

...so the effects on r and Y are ________________

**Monetary Policy: an increase in M**

1. \( \Delta M > 0 \) shifts the LM curve down (or to the right)

2. …causing the interest rate to fall

3. …which increases investment, causing output & income to rise.
Shocks in the IS-LM Model

**IS shocks:** exogenous changes in the __________________________.

Examples:
- stock market boom or crash
  ⇒ change in households’ wealth
  ⇒ ΔC
- change in business or consumer confidence or expectations
  ⇒ ΔI and/or ΔC

---

**LM shocks:** exogenous changes in the __________________________.

Examples:
- a wave of credit card fraud increases demand for money
- more ATMs or the Internet reduce money demand

---

**CASE STUDY**

The U.S. economic slowdown of 2001

~What happened~

1. Real GDP growth rate
   1994-2000: 3.9% (average annual)
   2001: 1.2%
2. Unemployment rate
   Dec 2000: 4.0%
   Dec 2001: 5.8%
CASE STUDY
The U.S. economic slowdown of 2001

~Shocks that contributed to the slowdown~
1. ____________
   From Aug 2000 to Aug 2001: -25%
   Week after 9/11: -12%
2. The terrorist attacks on 9/11
   • increased uncertainty
   • ____________
   Both shocks reduced spending and
   ____________.

~The policy response~
1. Fiscal policy
   • large long-term ____________
     immediate $300 rebate checks
   • ____________:
     aid to New York City & the airline industry,
     war on terrorism
2. ____________
   • Fed lowered its Fed Funds rate target
     11 times during 2001, from 6.5% to 1.75%
   • Money growth increased, interest rates fell

What is the Fed’s policy instrument?

What the newspaper says:
"the Fed lowered interest rates by one-half point today"
What actually happened:
The Fed conducted expansionary monetary policy to
shift the LM curve to the right until the interest rate fell
0.5 points.
What is the Fed’s policy instrument?

Why does the Fed target interest rates instead of the money supply?
1) They are easier to measure than the money supply
2) The Fed might believe that LM shocks are more prevalent than IS shocks. If so, then targeting the interest rate stabilizes income better than targeting the money supply.

IS-LM and Aggregate Demand

- So far, we’ve been using the IS-LM model to analyze the short run, when the price level is assumed fixed.
- However, a change in $P$ would shift the LM curve and therefore affect $Y$.
- The __________________ (introduced in chap. 9) captures this relationship between $P$ and $Y$

Deriving the AD curve

Intuition for slope of AD curve:
1) $P$ ⇒ $(M/P)$
   ⇒ LM shifts left
   ⇒ ↑
   ⇒ ↓
   ⇒ ↓
Monetary policy and the AD curve

The Fed can increase aggregate demand:
↑M ⇒ LM shifts right
⇒ ↓
⇒ ↑
⇒ ↑

Fiscal policy and the AD curve

Expansionary fiscal policy (↑G and/or ↓T) increases agg. demand:
↑T ⇒ ↑
⇒
⇒ ↑Y at each value of P

Deriving AD curve with algebra

Suppose the expenditure side of the economy is characterized by:
\[ C = \bar{C} + b(Y - T) \quad 0 < b < 1 \]
\[ I = \bar{I} - dY - d > 0 \]
\[ G = \bar{G}, \quad T = \bar{T} \]
where: \( b \) & \( d \) are some numbers,
\( \bar{C} \) is the 'autonomous part of consumption' and \( \bar{I} \) is 'autonomous investment'
Deriving AD curve with algebra

Use the goods market equilibrium condition
\[ Y = C + I + G \]
\[ Y = C + b(Y - T) + I - dr + G \]
Solve for Y:
\[ Y - bY = C - bT + I - dr + G \]
\[ (1 - b)Y = C + I + G - bT + I - dr \]
\[ IS: Y = \left( \frac{C + I}{1-b} \right) + \left( \frac{1}{1-b} \right) G - \left( \frac{b}{1-b} \right) T - \left( \frac{d}{1-b} \right) r \]

A line relating \( Y \) to \( r \) with slope _________

Can see multipliers here: rise in \( Y \) taking \( r \) as given.
But \( r \) is an endogenous variable and it will change...

---

Deriving AD curve with algebra

Use the money market to find a value for \( r \):

As done for the LM curve previously, suppose the money market is characterized by:
\[ \left( \frac{M}{P} \right)^e = eY - fr \quad e > 0, f > 0 \]
\[ \left( \frac{M}{P} \right)^s = \frac{M}{P} \]
Equilibrium in money market requires:
\[ \left( \frac{M}{P} \right)^e = \left( \frac{M}{P} \right)^s \]
So LM:
\[ \frac{M}{P} = eY - fr \]
or write as: \[ r = \frac{eY - f}{f} \]
Line with slope _________

---

Deriving AD curve with algebra

Now combine the two, substituting in for \( r \):
IS: \[ Y = \left( \frac{C + I}{1-b} \right) + \left( \frac{1}{1-b} \right) G - \left( \frac{b}{1-b} \right) T - \left( \frac{d}{1-b} \right) \]
LM: \[ r = \frac{eY - f}{f} \]
\[ Y = \left( \frac{C + I}{1-b} \right) + \left( \frac{G}{1-b} \right) - \left( \frac{bT}{1-b} \right) + \left( \frac{e}{f} \right) \]
Solve for \( Y \). For convenience, define a term:
\[ z = \frac{e}{f} \quad so \quad 0 < z < 1 \]
\[ Y = z \left( \frac{C + I}{1-b} \right) + \frac{zG}{1-b} - \frac{zbT}{1-b} + \left( \frac{d}{f(1-b) - de} \right) \]

---
Deriving AD curve with algebra

\[ Y = z \left( \frac{C + I}{1 - b} \right) - \frac{z b}{1 - b} \frac{M}{P} \]

where \( z = \frac{d}{f \frac{L}{1 - b} + D} \), \( 0 < z < 1 \)

This implies a negative relationship between output (\( Y \)) and price level (\( P \)): an Aggregate Demand curve.

This math can help reveal under what conditions monetary and fiscal policies will be most effective...

Policy Effectiveness

Fiscal policy is effective (\( Y \) will rise much) when:

1) _________ (___ large or ___ small, so \( z \) near 1)

As the rise in \( G \) raises \( Y \), the increase in money demand does not raise \( r \) much:

- small \( e: M^d \) not responsive to \( Y \)
- large \( f: M^d \) is responsive to \( r \)

so investment is not crowded out as much.

\[ IS \]

\[ LM \]

\[ Y \]

\[ P \]

Policy Effectiveness

Fiscal policy is effective (\( Y \) will rise much) when:

2) _________ (___ small, ___ large, \( z \) near 1)

As the rise in \( G \) raises \( Y \):

investment does not respond much to the rising \( r \) coming from the money market, so investment is not crowded out as much.

\[ IS \]

\[ LM \]

\[ Y \]

\[ P \]
Policy Effectiveness

Monetary policy is effective (Y will rise much) when:

1) _______ (large: Investment _______)

As a rise in M lowers the interest rate (r), investment rises more in response to the fall in r, so output rises more.

\[ Y = \frac{C + I}{1 - b} + \frac{z}{1 - b} G + \frac{zb}{1 - b} G^* + \frac{d}{f(1 - b) + de} M \]

where \( z = \frac{f}{f + de/(1 - b)} \), \( 0 < z < 1 \)

Policy Effectiveness

Monetary policy is effective (Y will rise much) when:

2) ___________________

A rise in M requires a large fall in the interest rate (r) to make people willing to hold the extra cash. The large fall in r raises investment expenditure much, and this raises output much.

(This is hard to show graphically, because f affects shift as well as slope.)

\[ Y = \frac{C + I}{1 - b} + \frac{z}{1 - b} G + \frac{zb}{1 - b} G^* + \frac{d}{f(1 - b) + de} M \]

where \( z = \frac{f}{f + de/(1 - b)} \), \( 0 < z < 1 \)

IS-LM and AD-AS in the short run & long run

Recall from Chapter 9: The force that moves the economy from the short run to the long run is the gradual adjustment of prices.

<table>
<thead>
<tr>
<th>In the short-run equilibrium, if</th>
<th>then over time, the price level will</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y &gt; \bar{Y} )</td>
<td>rise</td>
</tr>
<tr>
<td>( Y &lt; \bar{Y} )</td>
<td>fall</td>
</tr>
<tr>
<td>( Y = \bar{Y} )</td>
<td>remain constant</td>
</tr>
</tbody>
</table>
The SR and LR effects of an IS shock

A negative IS shock shifts IS and AD left, causing Y to fall.

In the new short-run equilibrium, $Y = Y^*$

Over time, $P$ falls, which causes $M/P$ to increase, causing LM to move down.

Economy eventually reaches a long-run equilibrium with $Y = Y^*$

EXERCISE:

Analyze SR & LR effects of $\Delta M$

a. Drawing the IS-LM and AD-AS diagrams as shown here,

b. Show the short run effect of a Fed increase in $M$. Label points and show curve shifts with arrows.

c. Show what happens in the transition from the short run to the long run. Label points.

d. How do the new long-run equilibrium values compare to their initial values?

What Happened During the Great Depression?

<table>
<thead>
<tr>
<th>Year</th>
<th>Unemployment Rate (%)</th>
<th>Real GNP (2)</th>
<th>Consumption (3)</th>
<th>Investment (3)</th>
<th>Government Purchases (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1939</td>
<td>5.2</td>
<td>203.6</td>
<td>131.6</td>
<td>40.4</td>
<td>22.0</td>
</tr>
<tr>
<td>1940</td>
<td>8.9</td>
<td>183.5</td>
<td>130.4</td>
<td>27.4</td>
<td>24.3</td>
</tr>
<tr>
<td>1941</td>
<td>9.3</td>
<td>169.5</td>
<td>133.1</td>
<td>16.8</td>
<td>25.4</td>
</tr>
<tr>
<td>1942</td>
<td>11.2</td>
<td>144.2</td>
<td>118.6</td>
<td>4.7</td>
<td>24.2</td>
</tr>
<tr>
<td>1943</td>
<td>11.5</td>
<td>141.5</td>
<td>112.8</td>
<td>5.3</td>
<td>23.3</td>
</tr>
<tr>
<td>1944</td>
<td>12.0</td>
<td>154.3</td>
<td>115.1</td>
<td>9.4</td>
<td>26.4</td>
</tr>
<tr>
<td>1945</td>
<td>10.3</td>
<td>169.3</td>
<td>120.5</td>
<td>18.0</td>
<td>27.0</td>
</tr>
<tr>
<td>1946</td>
<td>11.0</td>
<td>193.2</td>
<td>136.4</td>
<td>24.6</td>
<td>31.8</td>
</tr>
<tr>
<td>1947</td>
<td>14.3</td>
<td>203.2</td>
<td>140.1</td>
<td>29.9</td>
<td>30.8</td>
</tr>
<tr>
<td>1948</td>
<td>18.1</td>
<td>192.9</td>
<td>140.2</td>
<td>17.8</td>
<td>33.9</td>
</tr>
<tr>
<td>1949</td>
<td>17.2</td>
<td>209.4</td>
<td>146.2</td>
<td>24.7</td>
<td>35.2</td>
</tr>
<tr>
<td>1950</td>
<td>14.6</td>
<td>227.2</td>
<td>151.7</td>
<td>33.6</td>
<td>36.4</td>
</tr>
</tbody>
</table>


Note: (1) The unemployment rate is series O9. (2) Real GNP, consumption, investment, and government purchases are series F11, F8B, F2C, and F6A, and are measured in Billions of 1958 dollars. (3) The interest rate is the prime Commercial.
Great Depression: Observations

- **Real side of economy:**
  - Output:
  - Consumption:
  - Investment:
  - Gov. purchases:

- **Nominal side:**
  - Nominal interest rate:
  - Money supply (nominal):
  - Price level:

The Spending Hypothesis: 
**Shocks to the IS Curve**

- asserts that the Depression was largely due to an exogenous fall in the demand for goods & services -- a leftward shift of the IS curve
- evidence:

<table>
<thead>
<tr>
<th>Year</th>
<th>Nominal Interest Rate (%)</th>
<th>Money Supply (billion US$)</th>
<th>Price Level</th>
<th>Inflation (%)</th>
<th>Real Money Balances (billion US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1929</td>
<td>0.9</td>
<td>266</td>
<td>30.6</td>
<td>-</td>
<td>32.6</td>
</tr>
<tr>
<td>1930</td>
<td>3.6</td>
<td>258</td>
<td>49.3</td>
<td>-2.6</td>
<td>32.3</td>
</tr>
<tr>
<td>1931</td>
<td>2.6</td>
<td>241</td>
<td>44.8</td>
<td>-10.1</td>
<td>34.5</td>
</tr>
<tr>
<td>1932</td>
<td>2.7</td>
<td>241</td>
<td>46.0</td>
<td>-8.3</td>
<td>32.5</td>
</tr>
<tr>
<td>1933</td>
<td>1.7</td>
<td>199</td>
<td>39.3</td>
<td>-2.2</td>
<td>30.7</td>
</tr>
<tr>
<td>1934</td>
<td>1.0</td>
<td>210</td>
<td>42.2</td>
<td>-7.4</td>
<td>31.8</td>
</tr>
<tr>
<td>1935</td>
<td>0.8</td>
<td>259</td>
<td>42.6</td>
<td>-0.9</td>
<td>60.8</td>
</tr>
<tr>
<td>1936</td>
<td>0.8</td>
<td>256</td>
<td>42.7</td>
<td>0.2</td>
<td>62.9</td>
</tr>
<tr>
<td>1937</td>
<td>0.9</td>
<td>309</td>
<td>44.5</td>
<td>4.2</td>
<td>69.5</td>
</tr>
<tr>
<td>1938</td>
<td>0.8</td>
<td>304</td>
<td>45.9</td>
<td>-1.3</td>
<td>69.5</td>
</tr>
<tr>
<td>1939</td>
<td>0.6</td>
<td>342</td>
<td>43.2</td>
<td>-1.6</td>
<td>79.1</td>
</tr>
<tr>
<td>1940</td>
<td>0.6</td>
<td>397</td>
<td>43.9</td>
<td>1.6</td>
<td>90.3</td>
</tr>
</tbody>
</table>
The Spending Hypothesis: Reasons for the IS shift

1. Oct-Dec 1929: S&P 500 fell 17%
   Oct 1929-Dec 1933: S&P 500 fell 71%
2. “correction” after overbuilding in the 1920s
   widespread bank failures made it harder to obtain financing for investment
3. in the face of falling tax revenues and increasing deficits, politicians raised tax rates and cut spending

The Money Hypothesis: A Shock to the LM Curve

- asserts that the Depression was largely due to huge fall in the money supply
- evidence:

- Argument:

A revision to the Money Hypothesis

- There was a big deflation: $P$ fell 25% 1929-33.
- A sudden fall in expected inflation means the ex-ante real interest rate rises for any given nominal rate ($i$)
  \[
  \text{ex ante real interest rate} = i - \pi^e
  \]
- This could have discouraged the investment expenditure and helped cause the depression.
- Since the deflation likely was caused by fall in $M$, monetary policy may have played a role here.
Why another Depression is unlikely

- Policymakers (or their advisors) now know much more about macroeconomics:
  - The Fed knows better than to ______,
  - Fiscal policymakers know better than to ______.
- Federal deposit insurance makes widespread bank failures very unlikely.
- Make fiscal policy expansionary during an economic downturn.

Chapter summary

1. IS-LM model
   - A theory of aggregate demand
   - Exogenous: \( M, G, T \)
     - \( P \) exogenous in short run, \( Y \) in long run
   - Endogenous: \( r \),
     - \( Y \) endogenous in short run, \( P \) in long run
   - IS curve: goods market equilibrium
   - LM curve: money market equilibrium

2. AD curve
   - Shows relation between \( P \) and the IS-LM model's equilibrium \( Y \).
   - Negative slope because
     - \( \uparrow P \Rightarrow \downarrow (M/P) \Rightarrow \uparrow r \Rightarrow \downarrow I \Rightarrow \downarrow Y \)
   - Expansionary fiscal policy shifts IS curve right, raises income, and shifts AD curve right
   - Expansionary monetary policy shifts LM curve right, raises income, and shifts AD curve right
   - IS or LM shocks shift the AD curve