Chapters 3-6 (7e) Review for IS-LM

Chapter 3 The Goods Market

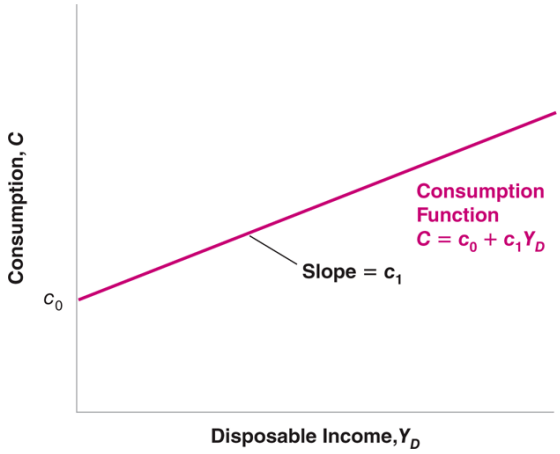
3.1 The Composition of GDP

On the expenditure side, GDP can be decomposed into consumption (C), government spending (G), fixed investment (I), net exports (X-IM), and inventory investment.

3.2 The Demand for Goods

- Assume there is only one good, and use the decomposition of GDP to think about demand for that good. Assume the *economy is closed*, so that *exports, imports and net exports are all zero*, and ignore inventory investment, which is typically a small part of GDP. Then, demand (Z) can be written as $Z=C+I+G$. (3.1)

- Write **consumption** as a linear function of disposable income (Y_D), which is income minus taxes (T): $C=c_0+c_1(Y_D)=c_0+c_1(Y-T)$. (3.2)
  - The parameter c_0, which represents how much consumption would occur even if disposable income were zero, is called *autonomous consumption or consumer confidence*.
  - The parameter c_1, which represents the increase in consumption for every extra unit of disposable income, is called the *(marginal) propensity to consume.* Assume that households do not consume every dollar of additional income, but save some, so that $0< c_1<1$. (Figure 3-1)



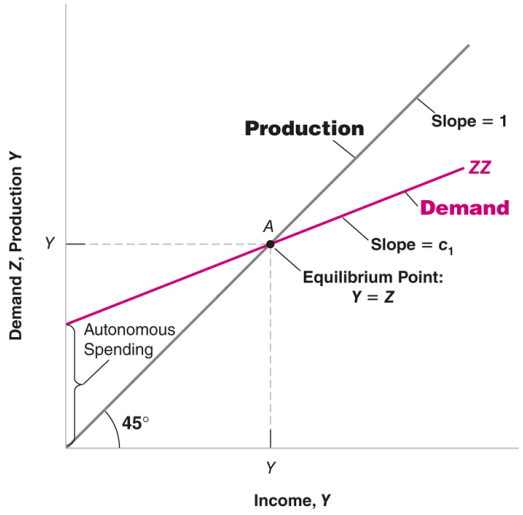
- Assume that **investment** is exogenous, and call it $\bar{I}$.
- Assume that **government spending** and **taxes** are exogenous, and under the control of the fiscal authorities.
  - Note that "taxes" (T) refers to *taxes minus government transfers*.
  - Government spending (G) does not include transfers.

- Substitute for consumption and investment, and rewrite demand:
  $Z = c_0 + c_1(Y-T) + \bar{I} + G$. (3.3)

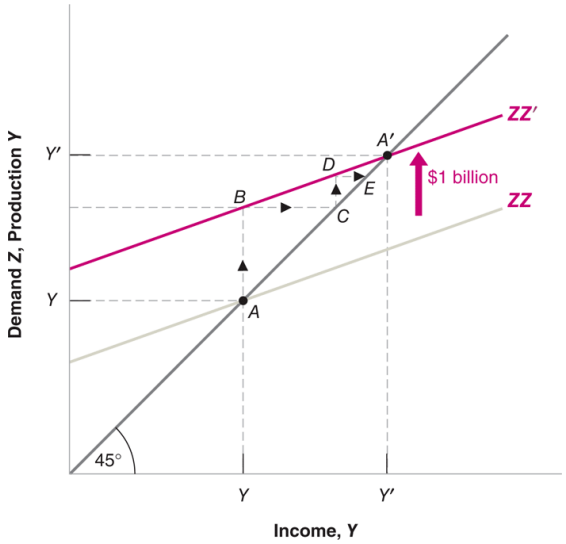
3.3 The Determination of Equilibrium Output

- Output is determined by equilibrium in the goods market.
- The *equilibrium condition* is that *production equals demand*.
- Assume for now that production simply increases or decreases with demand without any change in price.
- Thus, in the short run, output is fully determined by demand. Then, we can write the equilibrium condition, $Y=Z$, as $Y = c_0 + c_1(Y-T) + \bar{I} + G$. (3.4)
- To solve the model, it is necessary to write Y as a function of the exogenous variables, i.e., those determined outside the model. i.e. $Y = [1/(1-c_1)][c_0 - c_1 T + \bar{I} + G]$. (3.5)

- In the graph, equilibrium occurs where demand (the ZZ curve) crosses the 45° line (i.e., the line along which $Y=Z$). (Figure 3-2)



- Equilibrium income is the product of two factors: **autonomous spending** (the second term in brackets in equation (3.5)) and a "**multiplier**" (the first term in brackets).
- Assume that autonomous spending is positive, which (given that c_1<1) will be true unless the budget surplus, T-G, is very large.
- The multiplier, which depends on the value of the propensity to consume, arises because consumption is affected by income.
- Suppose there is an increase in autonomous consumption — say, because of an increase in consumer confidence. (Figure 3-3)
    - The initial increase in consumption because of the rise in c_0 leads to an increase in income.
    - The increase in income leads to a further increase in consumption, which leads to a further increase in income, and so on.
    - Thus, the effect of the initial increase in consumer confidence is "multiplied." The multiplier captures this effect.



3.4 Investment Equals Saving: An Alternative Way of Thinking About Goods Market Equilibrium

- Private saving is defined as disposable income minus consumption, or

  $S=Y-T-C$. (3.6)

- Using this definition, the equilibrium output condition ($Y=C+I+G$) can be expressed as

  $I=S+(T-G)$. (3.7)

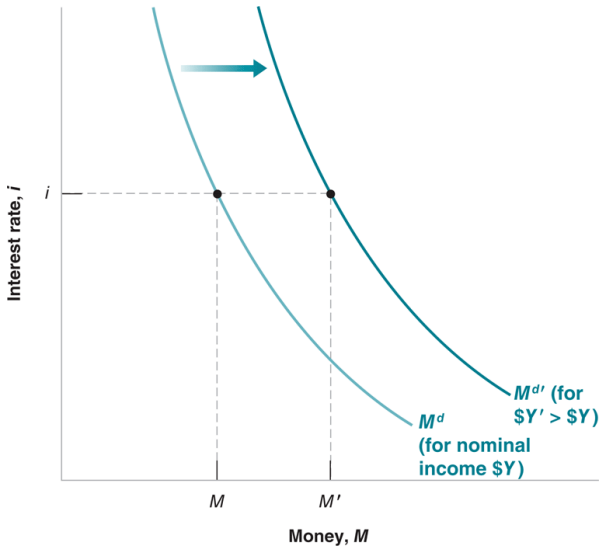
- In a closed economy, investment equals private (consumer) saving (S) plus government saving ($T-G$).
- The quantity $T-G$ is called the *budget surplus*.
- The quantity $G-T$ is called the *budget deficit*.

Chapter 4 Financial Markets

4.1 The Demand for Money

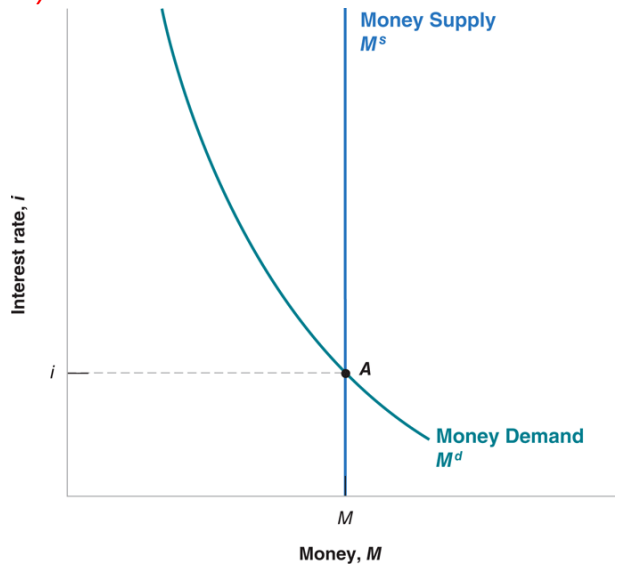
- Suppose the financial markets include only **two assets**:
  - **money**, which can be used to purchase goods and services and pays no interest; and
  - **bonds**, which cannot be used for transactions, but pay a positive interest rate *i*.
- **Financial wealth** equals the sum of money and bonds.

- By assumption, money is needed for transactions.
- Although it is hard to measure the overall level of transactions in the economy, it seems reasonable to assume that the level of transactions is proportional to nominal income, denoted $Y.
- So, money demand should be proportional to $Y.
- On the other hand, allocating wealth to money comes at the cost of forgone interest on bonds.
- So, money demand should decrease with the interest rate. Putting these observations together, the chapter specifies money demand as Md=$YL(i), where the function L decreases as the interest rate increases. *(Figure 4.1)*

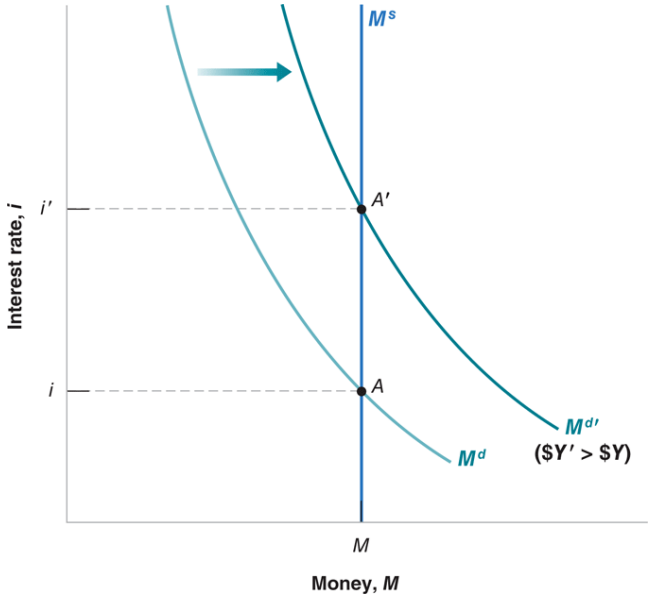


4.2 The Determination of the Interest Rate, I

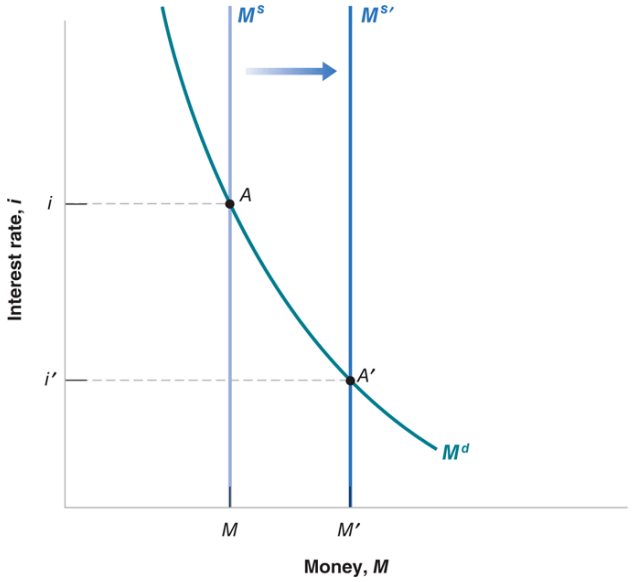
- Assume all money is currency, so there are no checking accounts or banks.
- Consider the supply of money to be fully in the control of the central bank, and take nominal income as given.
- Then, equilibrium in the money market occurs when the supply of money (M) equals the demand for money (M^d) given in equation (4.1). *(Figure 4.2)*



- An *increase in nominal income* (for a given money supply) shifts the money demand curve to the right and generates a new equilibrium with a higher interest rate.
- The increase in nominal income leads to an increase in the quantity of money demanded at the original interest rate.
- Since the supply of money has not changed, the interest rate must rise to reduce the quantity of money demanded and thereby offset the effect of the increase in income. (Figure 4-3)



- An *increase in the money supply* shifts the vertical line to the right, resulting in a new equilibrium with a lower interest rate.
- In order to induce the private sector to hold more money, bonds must become less attractive (the interest rate must fall). (Figure 4-4)



- How does the central bank control the money supply?
  - Consider the central bank's balance sheet.
  - Currency held by the public constitutes the central bank's liabilities.
  - The central bank's assets are any bonds that it owns.

- Expansionary Open Market Operation.
  - To **increase the money supply**, the central bank creates currency to **purchase bonds**, thus increasing assets (through the additional bonds) and liabilities (through the new currency created and exchanged for bonds).
- Contractionary Open Market Operation.
  - To **reduce the money supply**, the central bank **sells bonds** for existing currency, thus reducing assets (through the sale of bonds) and liabilities (through the reduction of currency held by the general public).
- Purchases and sales of bonds by the central bank are called **open market operations**.

- The text also considers open market operations in terms of their effect on bond prices.
- Suppose a bond promises a payment of *$F* one year in the future. Call the current price of the bond $\$P_B$.
- Then, the interest rate (or rate of return) on this bond is given by $i=(\$F-\$P_B)/\$P_B$. (4.2)
- Equation (4.2) can be solved for the bond price: $\$P_B=\$F/(1+i)$. (4.3)
- Given fixed nominal bond payments, equation (4.2) shows that the nominal interest rate and the bond price are inversely related.
- For example, when the central bank purchases bonds, it increases the demand for them and tends to increase their price, which reduces the interest rate.

4.3 The Determination of the Interest Rate, II

- Banks receive funds from depositors (individuals and firms) and allow their depositors to write checks against (or withdraw) their account balances.
- These checkable deposits are liabilities of banks.

- On the asset side, banks hold *bonds*, *loans* (which are claims against borrowers), and *reserves* of some of their deposits.
- Some bank reserves are held in cash and the rest in accounts at the central bank.
- Banks hold reserves (a) to protect against daily excesses of withdrawals (in currency or check form) over deposits and (b) they are required to do so by the central bank.

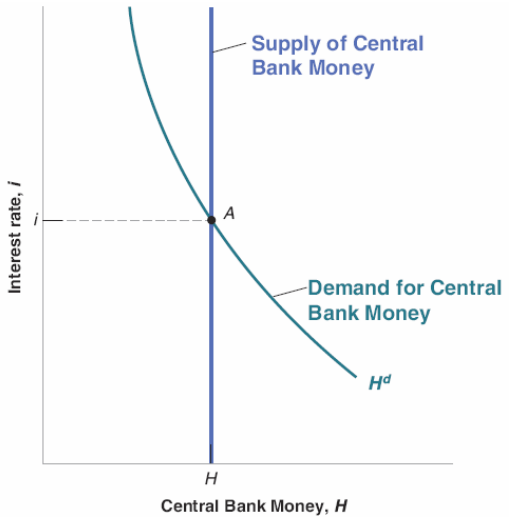
- Adding banks to the economy alters the central bank balance sheet only on the liabilities side.
- Central bank liabilities now consist of currency held by the public plus reserves held by banks.
- Central bank liabilities—the money the central bank has created—are called *central bank money*.

- Now reconsider money market equilibrium *in terms of central bank money* (H).
- The ***supply of central money*** (H) is under the control of the central bank.
- The **demand for central bank money** (Hd) arises from two sources: **currency held by the public** (*CUd*) and **reserves held by banks** (*Rd*).

  - On the *demand side*, assume that overall money demand is determined as before, i.e., Md=$YL(i), and that the demand for currency (as opposed to checkable deposits) is a fraction c (where 0<c<1) of overall money demand.
  - In addition, assume that banks keep a fixed fraction θ of checkable deposits as reserves.
- Putting these assumptions together with equation (4.4) gives

  $$H = Hd = CUd + Rd = cMd + \theta(1-c)Md = [c+\theta(1-c)]\$YL(i). \qquad (4.5)$$

- Equilibrium can be depicted just as in Figure 4.2, with H substituting for M on the horizontal axis. (Figure 4-7)



- An increase in H (through open market operations) leads to a decrease in the nominal interest rate.

4.4 Two Alternative Ways of Looking at the Equilibrium

- Equation (4.5), which equates supply and demand for central bank money, describes money market equilibrium in an economy with banks. There are two ways to think about this equation.

1. First, consider *equilibrium in the market for reserves*. The *supply of reserves* is central bank money minus currency. The *demand for reserves* is Rd.
    - Equating the supply and demand for reserves gives H-CUd=Rd, (4.6) which is clearly identical to the equilibrium condition in equation (4.4).
    - The advantage of thinking about equilibrium in this way is that it facilitates discussion of the *federal funds market*—the market for bank reserves—and the federal funds rate—the interest rate that adjusts to clear this market. In the federal funds market, banks that need reserves at the end of the day borrow them from banks that have excess reserves.

2. Second, consider *equilibrium in terms of the overall supply and the overall demand for money* (currency and checkable deposits). Reorganize equation (4.5) to read

$H/[c+\theta(1-c)]=\$YL(i)$. (4.7)

- The quantity $1/[c+\theta(1-c)]$ is called the **money multiplier**. .
- The money supply equals central bank money times the multiplier. Since c and θ are assumed to be fixed, the central bank can control the money supply by controlling H.
- For this reason, central bank money is often called *high powered money* or *the monetary base*.

- Note that $0<c<1$ and $0<\theta<1$ together imply that the money multiplier is greater than one.
- Thus, a given increase in central bank money leads to a larger increase in the overall money supply.

Chapter 5. Goods and Financial Markets: The IS-LM

5.1 The Goods Market and the IS Relation

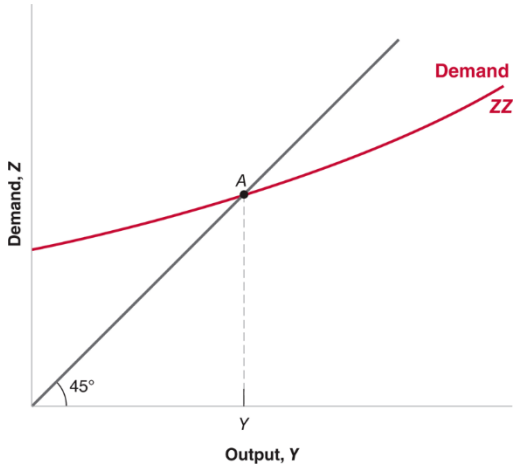
- First, relax the assumption that investment is **endogenous**.
- In terms of the framework developed thus far, investment should depend on two factors: **sales** and the **interest rate**.
- A firm facing an increase in sales will need to purchase new plant, equipment, or both to increase production.
- Thus, investment increases when sales increase.

- An increase in the interest rate will increase the cost of borrowing needed to purchase new plant and equipment.
- Thus, investment decreases when the interest rate increases.
- investment function: $I=I(Y, i)$.

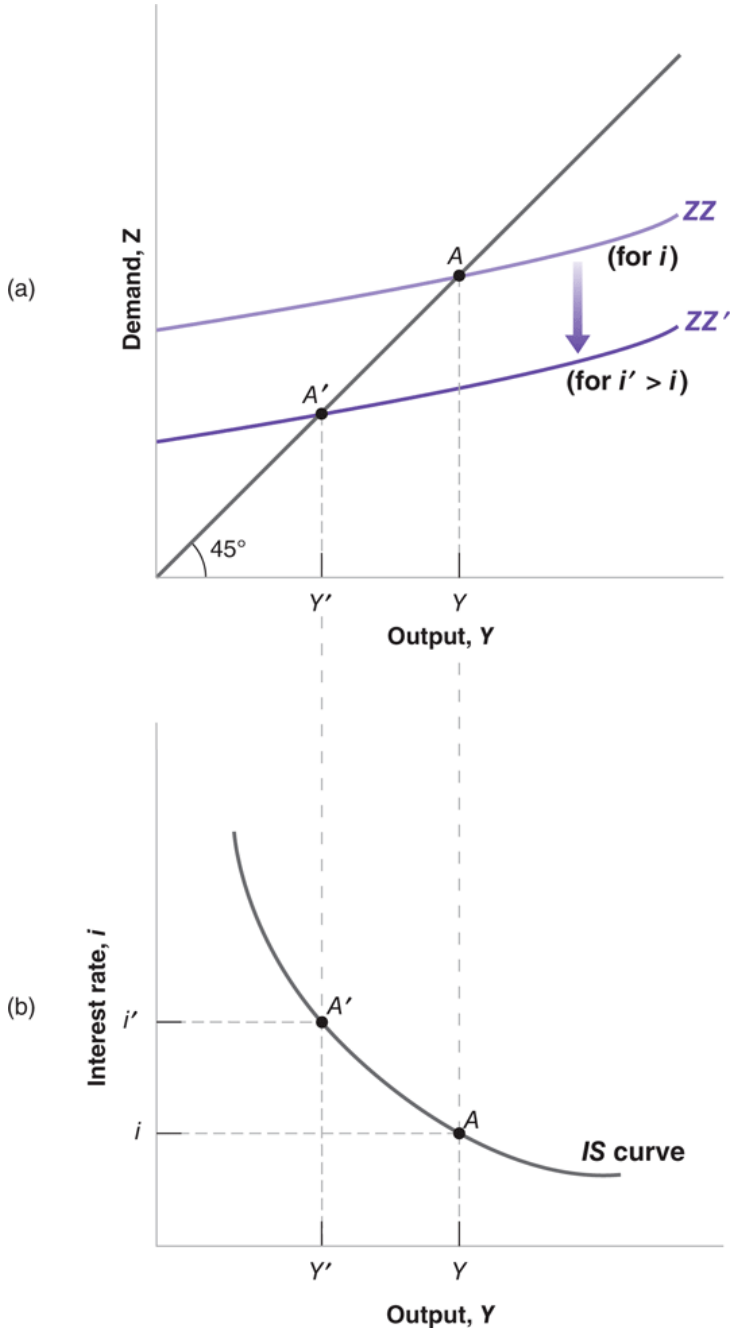
$+ -$

- Although the discussion suggests that investment should depend on sales, rather than income, the chapter continues to assume that inventory investment is zero, so **income equals sales**.
- With the revised investment function, the closed economy, goods market equilibrium condition becomes Y=C(Y-T)+I(Y,i)+G. [IS relation]
- In the new IS curve:
    - First, demand for goods and services (the RHS of equation (5.2)) is no longer assumed to be linear.
    - Second, an additional assumption is required to ensure that an equilibrium exists (i.e., that the ZZ curve intersects the 45 degree-line).
    - A sufficient assumption for this purpose is that the sum of the (marginal) propensity to consume out of income and the (marginal) propensity to invest out of income is less than one.

      (Figure 5-1)



- To trace out an IS curve, start with a Keynesian cross with a given interest rate, then vary the interest rate.
- A decrease in the interest rate increases the level of investment for any level of output, so the ZZ curve shifts up and output increases.
- Therefore, the IS curve has a *negative slope in Y-i space* (Figure 5-2).

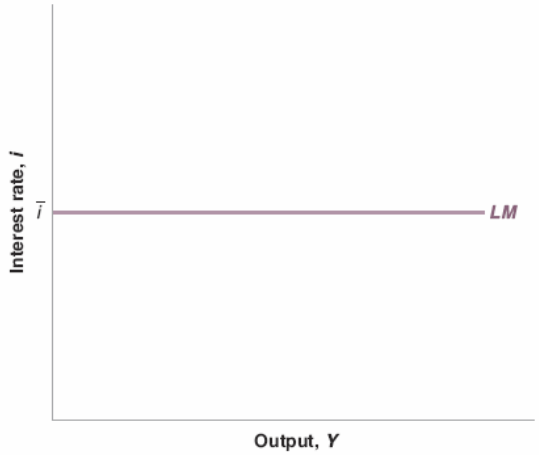


5.2 Financial Markets and the LM Relation

- Start with the money-market equilibrium condition from Chapter 4, rewrite nominal income as PY (where P is the price level), and divide by P to derive the real money market equilibrium condition:

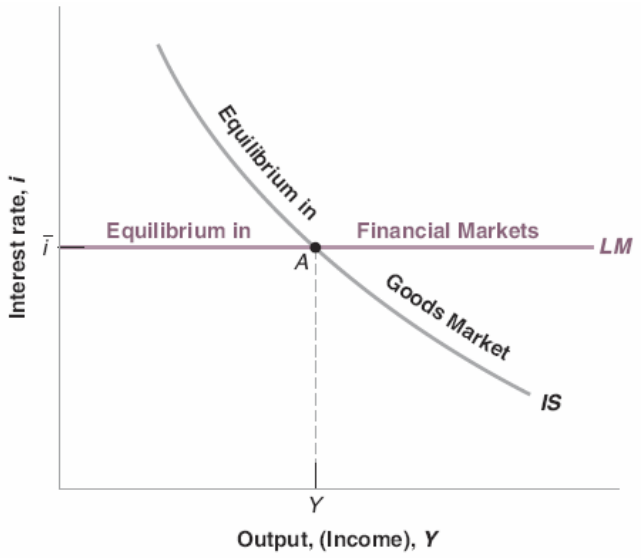
  M/P=YL(i). *[LM (Liquidity-Money) relation]*

- Real money market equilibrium is characterized by the same graph developed in Chapter 4, but the real money supply (M/P) is substituted for the nominal money supply (M).
- The chapter maintains the short-run assumption of a **fixed price** and, and assumes that M is under the control of the central bank.
- Since the **central bank chooses the money supply**, and **therefore the interest rate**, the LM curve is graphed as a horizontal line as shown in Figure 5-4.



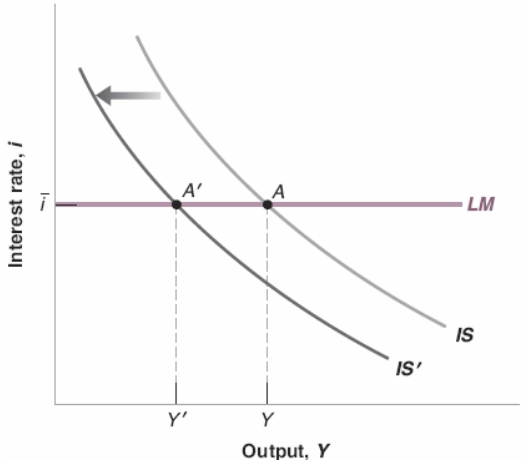
5.3 Putting the IS and the LM Relations Together

- The equilibrium values of i and Y are those that satisfy simultaneously the goods market equilibrium condition (equation (5.2)) and the money market equilibrium condition (equation (5.3)).
- Graphically, these values are determined by the point of intersection of the IS and LM curves (Figure 5-5).

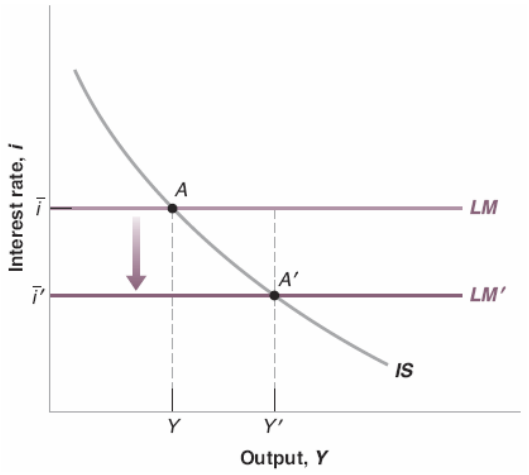


- Changes in the equilibrium values of output and the interest rate (Y* and i*) can be brought about only as the result of shifts in the IS curve, the LM curve, or both.

- An **increase in taxes** (or a reduction in government spending), which shifts the **IS curve to the left**, reduces equilibrium output. Investment reduces. (Figure 5-6)

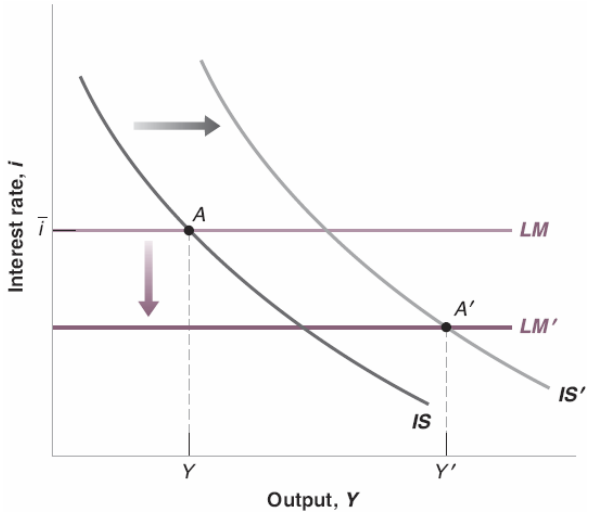


- A monetary expansion lowers the interest rate and shifts the horizontal LM curve down resulting in higher output. (Figure 5-7)



5.4 Using a Policy Mix

- Combination of monetary policy and fiscal policy.
  - Monetary policy: change in M shifts LM curve
  - Fiscal Policy: Change in G or T shifts IS curve
- For example: (figure 5-8)
  - The fiscal expansion shifts the *IS* curve to the right.
  - A monetary expansion shifts the *LM* curve down.
  - Equilibrium: higher output and lower interest rate



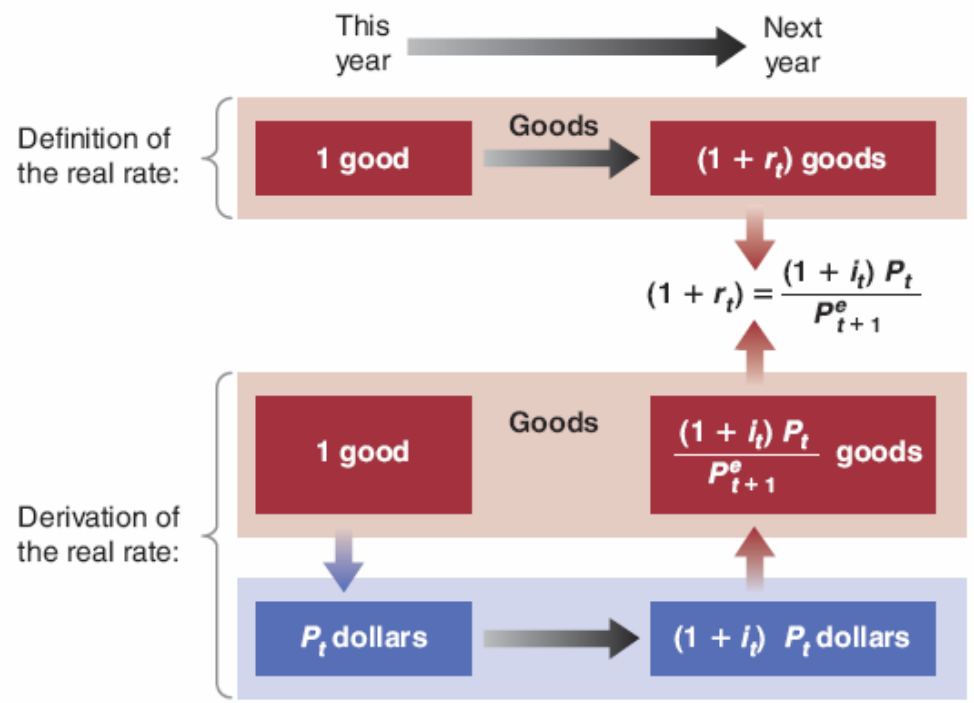
Chapter 6. Financial Markets II: The Extended IS-LM Model

6.1 Nominal Versus Real Interest Rates

- **Nominal interest rates**, often called quoted rates or stated rates, differ from real interest rates based on the rate of inflation.
- Nominal rates are the rates quoted by various lenders.
- In contrast the **real interest rate** is the interest rate expressed in terms of a basket of goods.

$$1 + r_t = (1 + i_t)\frac{P_t}{P^e_{t+1}} \qquad (6.1)$$

(Figure 6-1)



- In terms of inflation, $$(1 + r_t) = \frac{1 + i_t}{1 + \pi^e_{t+1}} \qquad (6.3)$$
  - Where $$\pi^e_{t+1} = \frac{(P^e_{t+1} - P_t)}{P_t} \qquad (6.2)$$
- A simple way to express the relationship between the two rates follows, $r_t \approx i_t - \pi^e_{t+1}$ (6.4)

where rt is equal to the real interest rate, it is equal to sum of the nominal interest rate, and π^{e}_{t+1} inflation expected next period or year.

- This equation has several implications:
  - When the expected inflation rate is zero the nominal rate and the real rate are equal.
  - Since inflation is typically positive the real rate is usually lower than the nominal rate.
  - For a given nominal interest rate higher inflation will lead to a lower real interest rate.

6.2 Risk and Return Premia

- Until now we have assumed only one type of bond exists.
- However bonds differ based on several factors including **maturity** and **default risk**.
- For example, **government bonds are almost risk-free** but can vary in maturity substantially and bond investors typically require an **interest-rate premium** to hold longer-term bonds.
- In addition bond investors will demand a risk premium to hold bonds with higher levels of default risk.

- Two factors determine the **risk premium**;

  1) Higher probabilities of default require higher interest rates to entice bond buyers.

  2) More risk averse bondholders demand higher premiums.

- The U.S. government bonds consistently pay lower interest rates due to the lack of default risk.

6.3 Extending the IS-LM

- Now we revisit the IS-LM model with the addition of inflation and risk premia embedded in market interest rates.

- The *LM* interest rate is the **policy rate** (nominal rate) while the IS interest rate is the **borrowing rate** (real rate) in terms of nominal rate.

  IS relation: $Y = C(Y - T) + I(Y, i - \pi e + x) + G$

  LM relation: $i = \bar{\imath}$

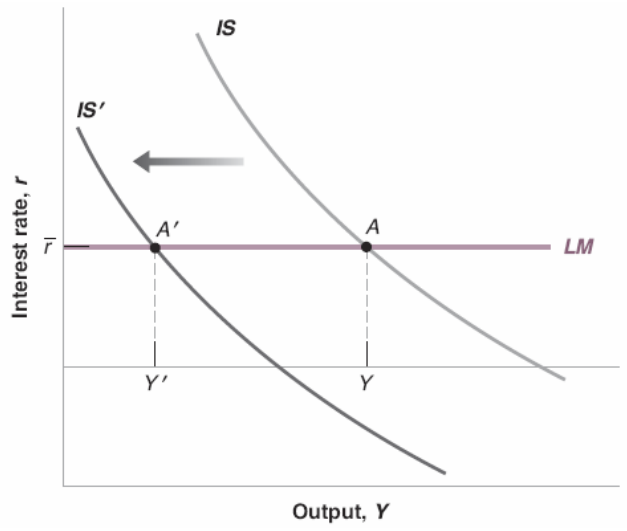
  Where π^e is equal to expected inflation and *x* is a risk premium.

- Note that the *LM* relation remains the same since interest rates are still set by the central bank.
- However, the *IS* relation changed in two ways;
  1) Spending depends on the real interest rate rather than the nominal interest rate.
  2) The risk premium captures higher perceived risk and/or risk aversion.

- You can now see that the interest in the *LM* and *IS* equations are now different rates.
- The central bank now sets the **real policy rate (*r*),** but spending decisions are determined by the borrowing rate ($r + x$) which factors in a risk premium.

  IS relation: $Y = C(Y - T) + I(Y, r + x) + G$
  LM relation: $r = \bar{r}$

- Now we can see what happens when there is a change in overall risk.
- If the risk premium increases, it will shift the IS curve to the left resulting in lower output (Figure 6-5).



- As the borrowing rate increases, spending will fall, which potentially leads to recession.
- However, this lower spending can be offset by higher government spending (i.e. fiscal policy) or the central bank lowering interest rates (i.e. monetary policy).
- However, monetary policy may not be possible if interest rates are zero lower bounded.
