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## The IS – LM Model, Part 2

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## Agenda

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- The Demand for Money
  - Asset Market Equilibrium
  - The LM Curve
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## The Demand for Money

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- The **demand for money** is the quantity of money people want to hold in their portfolios.
    - The demand for money depends on expected return, risk, and liquidity.
      - Money is the most liquid asset.
      - Money pays a low (or zero) return.
    - Money-holding decisions depend on how much people value liquidity versus the low return on money.
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## The Demand for Money

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- Macroeconomic variables that affect the aggregate demand for money:
    - The price level,
    - Real income, and
    - Interest rates.
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## The Demand for Money

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- **The price level:**

- The higher the price level, the more money needed for transactions.
- Nominal money demand rises proportionally as the price level rises.

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## The Demand for Money

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- **Real income:**

- The higher real income, the higher is spending.
- The higher is spending, the more money needed for transactions.
- Real money demand rises less than proportionally as real income rises.

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## The Demand for Money

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- **Interest rates:**

- The higher the interest rate, the higher the expected return on non-monetary assets.
  - And the higher the opportunity cost of holding money.
- Nominal money demand declines as the interest rate (or return on non-monetary assets) increases.
  - People trade off less liquidity for a higher return.

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## The Demand for Money

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- **The demand for money function:**

$$M^d = P * L(Y, i)$$

- $M^d$  is nominal (aggregate) demand for money,
- $P$  is the price level,
- $L$  is the demand for money function,
- $Y$  is real income or output, and
- $i$  is the nominal interest rate on non-money assets.

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## The Demand for Money

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- The demand for money function:
  - The nominal money demand is proportional to the price level.
  - The real demand for money is positively related, but less than proportionally, to real income.
  - The nominal demand for money is inversely related to nominal interest rates.

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## The Demand for Money

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- **The demand for money function:**

- An alternative expression is:

$$M^d = P * L(Y, r + \pi^e)$$

- A rise in  $r$  or  $\pi^e$  reduces money demand.

- Another alternative expression:

$$M^d / P = L(Y, r + \pi^e)$$

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## The Demand for Money

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- **Elasticities of money demand:**

- How strong are these effects on money demand?
  - **Elasticity:** The percent change in money demand caused by a one percent change in some factor.
  - Empirical research on the money demand function provide estimates of these elasticities.

13-11

## The Demand for Money

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- Elasticities of money demand:

- **Income elasticity of money demand:**

- **Positive:** Higher income increases money demand.
- **Less than one:** Higher income increases money demand less than proportionately; typically income elasticities are around 2/3.

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## The Demand for Money

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- Elasticities of money demand:
  - **Interest elasticity of money demand.**
    - **Negative and small:** Higher interest rate on non-monetary assets reduces money demand slightly.

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## The Demand for Money

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- Elasticities of money demand:
  - **Price elasticity of money demand.**
    - **Unitary:** The demand for money is proportional to the price level.

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## The Demand for Money

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- Other factors affecting the demand for money:
  - **Wealth:**
    - A rise in wealth increases money demand.
      - Although statistically this effect is very small.
  - **Payment technologies:**
    - Increases in the efficiency of payments technologies decrease the demand for money.
      - Credit cards, ATMs, and other financial innovations have increased the efficiency of payments technologies.

13-15

## The Demand for Money

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- Other factors affecting money demand:
  - **Liquidity of alternative assets:**
    - Increased liquidity of non-money financial assets decreases the demand for money.
      - Deregulation, greater competition, and innovation have given other assets more liquidity.
  - **Riskiness of alternative assets:**
    - Increased riskiness of non-money financial assets increases the demand for money.

13-16

## Determinants of the Demand for Money

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- The demand for money will:
  - Increase proportionally with an increase in the **price level, P**, because more money is needed to finance higher priced transactions.
  - Increase less than proportionally with an increase in **real income, Y**, because more money is needed to finance additional transactions.

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## Determinants of the Demand for Money

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- The demand for money will:
  - Decrease with an increase in the **nominal (i) or real (r) interest rate** on non-money assets because of the higher opportunity cost of holding money.
  - Decrease with an increase in **expected inflation,  $\pi^e$** , because of the higher opportunity cost of holding money.

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## Determinants of the Demand for Money

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- The demand for money will:
  - Increase with an increase in **wealth, W**, because higher wealth implies more transactions.
  - Decrease with an increase in the **efficiency of payments technology** because less money is needed for transactions.

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## Determinants of the Demand for Money

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- The demand for money will:
  - Increase with an increase in the **riskiness of non-money assets**.
  - Decrease with an increase in the **liquidity of non-money assets**.

13-20

## Asset Market Equilibrium

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- **Asset market equilibrium:**
  - Assume that all assets can be grouped into two categories, money and non-monetary assets.
    - Money ( $M$ ) includes currency and checking accounts
      - Pays interest rate  $i^m$  (which we will assume is zero).
      - Supply is fixed at  $M$ .
    - Non-monetary assets ( $NM$ ) include stocks, bonds, etc.
      - Pays interest rate  $i = r + \pi$
      - Supply is fixed at  $NM$ .

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## Asset Market Equilibrium

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- **Asset market equilibrium:**
  - The nominal demand for assets:
    - Let  $m^d + nm^d$  be an individual's nominal demand for assets, and
    - Let  $M^d + NM^d$  is the aggregate nominal demand for assets.
      - Which is also aggregate nominal wealth.

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## Asset Market Equilibrium

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- **Asset market equilibrium:**
  - The nominal supply of assets:
    - Let  $M + NM$  be the aggregate nominal supply of assets.
      - Which is also aggregate nominal wealth.
  - Equilibrium in the asset market requires:

$$(M^d - M) + (NM^d - NM) = 0$$

13-23

## Asset Market Equilibrium

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- **Asset market equilibrium:**
  - Equilibrium in the asset market requires:
$$(M^d - M) + (NM^d - NM) = 0$$
    - The excess demand for money ( $M^d - M$ ) plus the excess demand for non-monetary assets ( $NM^d - NM$ ) must equal 0.

13-24

## Asset Market Equilibrium

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- **Asset market equilibrium:**
  - If money supply equals money demand, ( $M^d = M$ ), then non-monetary asset supply **MUST** equal non-monetary asset demand, ( $NM^d = NM$ ).
  - Consequently, when the money market is in equilibrium, the entire asset market is in equilibrium.

13-25

## Asset Market Equilibrium

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- **Asset market equilibrium:**

$$M/P = L(Y, r + \pi^e)$$

- Real money supply = Real money demand
  - $M$  is determined by the central bank,
  - $\pi^e$  is fixed (for now),
  - The labor market determines  $N$ ; given  $N$  the production function determines  $Y$ , and
  - Given  $Y$ , goods market equilibrium determines  $r$ .

13-26

## Asset Market Equilibrium

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- **Asset market equilibrium:**
  - Because all of the other variables are pre-determined, the asset market equilibrium condition determines the price level.

$$P = M / L(Y, r + \pi^e)$$

- The price level is the ratio of nominal money supply to real money demand.

13-27

## The LM Curve

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- The  $LM$  curve is the combinations of output ( $Y$ ) and the real interest rate ( $r$ ) that establish equilibrium in the asset market.
  - That is where  $L = M^s$ .

13-28

## Deriving the *LM* Curve

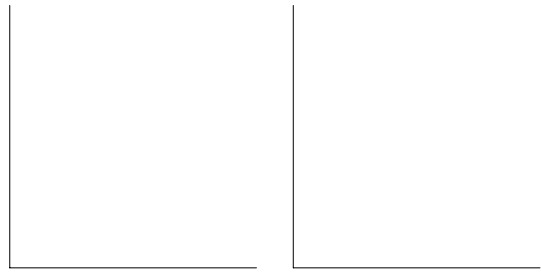
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- To derive the *LM* curve:
  - Start with the  $M^d/P$ ,  $M^s/P$  diagram and find the equilibrium level of output ( $Y_0$ ) and the real interest rate ( $r_0$ ) where  $M^d/P = M^s/P$ .
  - Then change the level of output (to  $Y_1$ ) and find the new real interest rate ( $r_1$ ) that re-establishes equilibrium so that  $M^d/P = M^s/P$  at  $Y_1$ .
  - Repeat.

13-29

## Deriving the *LM* Curve

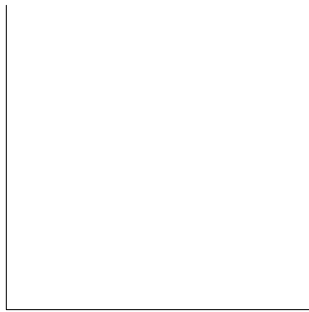
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## The *LM* Curve

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## The *LM* Curve

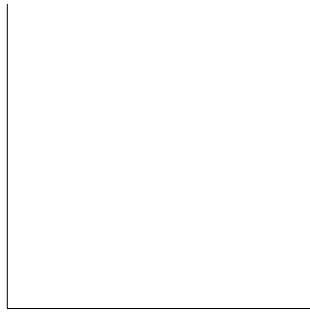
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- The **slope** of the *LM* curve reflects the both real interest rate sensitivity and the real income sensitivity of the demand for money ( $M^d/P$ ).

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## The *LM* Curve

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## The *LM* Curve: The adjustment mechanism

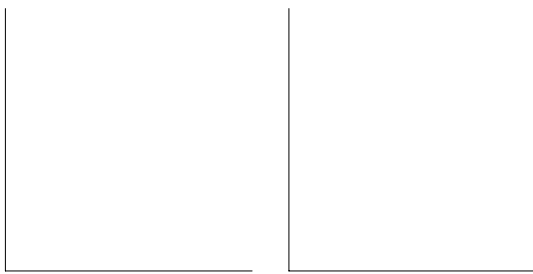
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- Suppose we are to the right of the *LM* curve.
  - At any given real interest rate ( $r$ ), the real demand for money is greater than the real supply of money.
    - $r$  must increase to reduce  $M^d/P$ , and/or
    - $Y$  must decrease to reduce  $M^d/P$ .
  - The adjustment mechanism in the asset market is primarily through changes in the real interest rate.

13-34

## The *LM* Curve: The adjustment mechanism

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13-35

## The *LM* Curve

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- Factors that shift the *LM* curve:
  - The *LM* curve shifts to the right because of:
    - an increase in the nominal money supply,
    - a decrease in the price level,
    - an increase in expected inflation,
    - a decrease in the nominal interest rate on money,

13-36

## The *LM* Curve

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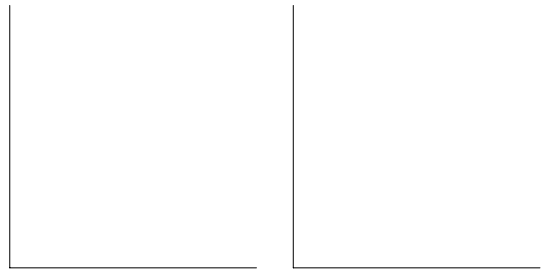
- Factors that shift the *LM* curve:
  - The *LM* curve shifts to the right because of:
    - a decrease in wealth,
    - a decrease in the risk of non-money assets,
    - an increase in the liquidity of non-money assets, and/or
    - an increase in the efficiency of payment technologies.

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## An increase in the real money supply

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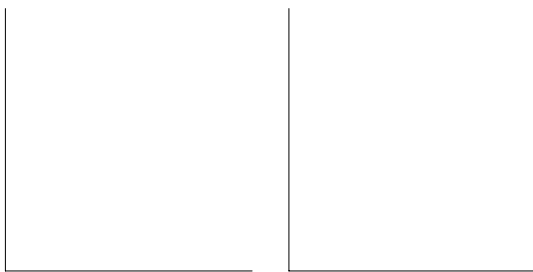


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## An increase in the real money demand

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13-39