IS-LM
1) MARKET I: GOODS MARKET

- goods demand = \( C + I + G (+NX) = Y = \) goods supply (set by maximizing firms)
- IS curve

2) MARKET II: MONEY MARKET

- money demand = \( L_d(Y, r + \pi^e) = M_s/P = \) money supply (set by the Fed)
- LM curve

→ IS-LM EQUILIBRIUM = EQUILIBRIUM IN BOTH MARKETS I and II
**Goods Market**

- **IS curve** represents the equilibrium in the goods market:

\[ Y = C + I + G + NX \]  

- Recall the definition of private savings \( S (hh) = Y - T - C \)

- Recall the definition of national savings \( S = S (hh) + T - G \)

- Combining them

\[ S = Y - C - G \]  

- From (1) and (2) the demand side of the economy can be written as:

\[ S = I + NX \]

The IS curve is named as it is because it documents the **relationship between Investment and Saving** (holding NX constant).
Demand side: the IS curve

C is a function of PVLR (Y, Y^f, W), tax policy, expectations, etc.

I is a function of r, A^f, K, and investment tax policy.

G is a function of government policy (we will discuss this shortly)

NX we will model in the last lecture of the course (for the U.S., NX is small)

• The IS curve relates Y to r. How do interest rates affect Y?

• As r falls, Investment increases (due to firm profit maximization behavior).

• Also Consumption increases (substitution effect dominates)

IS curve is downward sloping in \{r, Y\} space.
IS Curve: Graphical Derivation

I curve  
S curve (Y=Y₁)
An increase in current $Y$ leads to more desired $S$, hence the equilibrium $r$ needs to be lower!
Suppose $r$ is set by the Fed at the level of $r^*$ (we will explore this in depth later in the course). For a given $r$, we can solve for the level of output desired by the demand side of the economy.

We represent the demand side of the economy, drawn in \{r,Y\} space as the I-S curve. Why IS? Because the demand side of the economy can be boiled down to $I = S$ (when NX is zero).
What shifts the IS curve to the right?

Anything that increases **C, I or G** (or NX when we model it):

- higher expected income or wealth $\rightarrow$ higher PVLR $\rightarrow$ higher C
- higher consumer confidence $\rightarrow$ higher PVLR $\rightarrow$ higher C
- higher Tr or lower T (if the Ricardian equivalence fails) $\rightarrow$ higher C
- higher expectations about $A^f$ $\rightarrow$ higher MPK$^f$ $\rightarrow$ higher I
- higher business confidence $\rightarrow$ higher MPK$^f$ $\rightarrow$ higher I
- lower $\delta$ or mm, or lower $t_K$ $\rightarrow$ lower adjusted user cost of $K$ $\rightarrow$ higher I
- higher G

**Changes in r WILL NOT cause IS curve to shift**

(causes movement along IS curve)
An increase in desired S requires r to decrease if Y is unchanged!
**Money Market**

**LM curve** represents the equilibrium in the money market

The Money Market is in Equilibrium when

\[ \frac{M_s}{P} = L_d(Y, r + \pi^e) \]

\( M_s/P \) = Real Money Supply

\( L_d(Y, r + \pi^e) \) = Real Money Demand

The money supply is decided by the Fed and does not change with interest rates

What shifts real money supply: \( M, P \)
What shifts real money demand: \( Y, \pi^e \)

LM curve is named as it is because it documents the relationship between Liquidity and Money
Money Market Equilibrium

\[ \frac{M_s}{P} = \frac{M_d}{P} = L_d(Y, \pi^e) \]
LM Curve: Graphical Derivation

Money Market

$M_0 / P$

$L_d(Y_0, \pi_c)$
An increase in the level of transaction will increase the interest rate (for given money supply)!
What shifts the LM Curve

LM Curve: represents the relationship of Y and r through the money market

As Y increases - $L_d$ shifts upwards - causing real interest rates to rise (increase in transactions demand increases the demand for money).

What shifts the LM curve to the right?

- Higher nominal money supply $\rightarrow$ higher $M_s/P$
- Lower prices $\rightarrow$ higher $M_s/P$
- higher $\pi^e$ $\rightarrow$ higher I and hence lower money demand
LM Shift: Increase in Ms

Thought experiment: Suppose M increases. What would happen to r if Y was held constant?

An increase in the nominal money supply will cause the LM curve to shift to the right.
1) MARKET I : GOODS MARKET

- goods demand = \( C + I + G (+NX) = Y \) = goods supply (set by maximizing firms)
- as the interest rate increases, I and C fall and the demand for goods falls
- IS curve is downward sloping

2) MARKET II : MONEY MARKET

- money demand = \( L_d(Y, r + \pi^e) = M_s/P \) = money supply (set by the Fed)
- as output increases, money demand increases and the interest rate has to increase to bring the demand back to the supply
- LM curve is upward sloping

→ IS-LM EQUILIBRIUM = EQUILIBRIUM IN BOTH MARKETS I and II
IS-LM Equilibrium

\[ LM = f(M, P, \pi^e) \]

\[ IS = f(G, PVL, taxes^{Af}) \]
• **SHORT RUN**: equilibrium given by intersection of IS and LM

• When aggregate demand for goods rises, assume that firms are willing to hire more workers in the short run to produce the extra output and meet the expanded demand

• **LONG RUN**: also labor market is in equilibrium and full employment:
  \[ Y^* = f(N^*,K,A) \]

• In the long run, if there is higher demand, firms will increase prices until they hire the optimal amount of workers and produce the potential level of output.
Labor Market

**FE Curve**: the equilibrium in the labor market (Full Employment)

- **Factors Affecting Labor Supply**
  - The Real Wage ($w/p$)
  - The Household’s Present Value of Lifetime Resources ($PVLR$)
  - The Marginal Tax Rate on Labor Income ($t_n$)
  - The Marginal Tax Rate on Consumption ($t_c$)
  - Value of Leisure (reservation wage) - non-’work’ status ($VL$)
  - The Working Age Population ($pop$)

- **Factors affecting Labor Demand**:
  - TFP ($A$)
  - Capital ($K$)

**Y* is not sensitive to r!**
What shifts Y*?

- Anything that affects the labor market will affect Y*!

- If N* increases, Y* will shift to the right.

- If N* decreases, Y* will shift to the left.

- For example, Y* will shift right if:
  
  - A increases
  - K increases
  - population increases
  - labor income taxes fall (and income effect is small relative to substitution effect)
  - labor income taxes rise (and income effect is large relative to substitution effect)
IS-LM-FE Equilibrium

\[ Y^* = f(N^*, K, A) \]

\[ r \]

\[ LM = f(M, P, \pi^e) \]

Money Market

Labor Market

Goods Market

\[ IS = f(G, PVLR, \text{taxes}, A^f) \]
Firms are not going to be willing to produce $Y^*$ anymore for long, hence $P$ will increase!
In the Money Market…

\[
\frac{M}{P} = \frac{M_s}{P} = \frac{M_d}{P} = L_d(Y, \pi^e)
\]

\[ r^* \]

\[ M/P \]
Temporary Decrease in A (Step 2)

In the new long run equilibrium, output is lower, interest rate higher and prices higher!
Short Run versus Long run!

- Conventional Definition:
  - **SHORT RUN**: Prices are sticky
  - **LONG RUN**: Prices adjust

- Traditional debate in Macroeconomics on the “length” of the Short Run!
  - **Classical economists**: prices adjust fast
  - **Keynesian economists**: prices adjust slowly

- Basic Distinction:
  - **Business Cycle**: focus on the short run
  - **Growth**: focus on the long run
Long Run

- The short run equilibrium is an equilibrium in the sense that the aggregate quantity of goods produced is equal to the quantity demanded.

- **It is not an equilibrium in the sense that to meet the aggregate demand of goods, firms have to produce more (or less) output than their potential level** $Y^*$.

- $Y^*$ is the level of output that maximizes firms’ profits. Hence, firms are producing more (or less) than what they would like.

- **This will induce at some point firms to change prices.** If $M$ increases, firms will start to increase prices up to the point that $M/P$ is the same as before, so that the demand is equal to $Y^*$.
As M increase, money holders have more money than what they need and increase the demand for bonds and decrease r. This increases I and C.
Monetary Policy in the Long Run

**LONG RUN:** prices adjust and back to the general equilibrium

In the long-run, monetary policy has no effect!
The effectiveness of Monetary Policy will depend on how sticky prices are.

\[ M_s^{0/P0} = M_s^{1/P1} \]

\[ M_1 > M_0 \]

\[ P_1 > P_0 \]

\[ M_d = L_d(Y_1) \]

\[ M_d = L_d(Y^*) \]
Monetary Neutrality

- **Consensus:** after some economic disturbance prices will eventually restore the economic general equilibrium

- Disagreement on the speed of this adjustment!

- Classical economists: prices adjust immediately
  - Money is Neutral!

- Keynesian economists: prices are sticky

- **Money is neutral only in the long run, it is non-neutral in the short run!**
Suppose G increases

\[ Y^* = f(N^*, K, A) \]

\[ LM = f(M, P, \pi^e) \]

As r increases, private I and C are somehow crowded out
Fiscal Policy in the Long Run

If fiscal policy doesn’t affect $Y^*$, then prices will rise and LM shifts in...

$Y^* = f(N^*, K, A)$

Inflationary pressures

LM = $f(M, P, \pi^e)$

IS = $f(G^0)$

Output is unchanged and $G$ has crowded out $C$ and $I$ (through higher $r$)
How can we represent the current recession in the IS-LM model?

As a negative shock to the IS Curve for different reasons:

1) Direct reduction in C and I due to credit crunch
2) Fall in consumer and business confidence
3) Fall in financial wealth (NPVLR)
Fall in private demand: a recession

\[ \text{LM} \quad \text{IS} \]

\( r \quad r^e \quad Y^* \quad Y \)
Expansionary Monetary Policy by the Fed: $M^s$ increases
Recall: prices are fixed for now.
When Monetary Policy does not work…

1) Vertical IS Curve

• firms don’t respond much to interest rate changes if they think that the banking system is frozen
• The effect of an expansionary monetary policy is dampened

1) Horizontal LM Curve  →  Liquidity Trap

• Nominal interests rates are bounded at zero
• Lower bound on \( r \) is equal to \(-\pi^e\) and the Fed cannot reduce it further!
• This is what is happening now in the US and what happened in Japan in the late 1990s
• Read Krugman’s Babysitting the Economy (From Week 1)
Vertical IS

What if Ms increases?
Liquidity Trap
Fighting the Recession: Fiscal Policy

If monetary policy does not work, fiscal stimulus: G increases