

The IS-LM Model

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Roadmap

- When did we realize we needed a different theory for the short run?
 - The Great Depression
 - Keynes

- The IS curve

- The LM curve

- The IS-LM model

Introduction

It all started in the **Great Depression**.

In 1933, the **unemployment** rate in the US was **25%** and real **GDP** was **30%** below its 1929 level.

The Great Depression was the most **painful** and **intellectually significant** economic event.

Many economists started to question the classical model.

- The **classical theory** posits that **GDP** is determined by the **factor supplies and technology**.
- Problem is: **neither of these changed significantly** during the Great Depression.

We needed a new model to explain what was happening during that time.

In 1936, **John Maynard Keynes** published *The General Theory of Employment, Interest, and Money* and revolutionized the way we think about the economy.

Introduction

According to Keynes, low GDP and high unemployment was a consequence of **insufficient aggregate demand**.

He **criticized** the classical model for assuming that **aggregate supply alone determines GDP!**

The model of **aggregate demand and aggregate supply reconciles** these **two opposing views**.

Our goal is to understand this model!

Introduction

The model of aggregate demand is called the **IS-LM**, and it is the leading **interpretation** of Keynes' ideas.

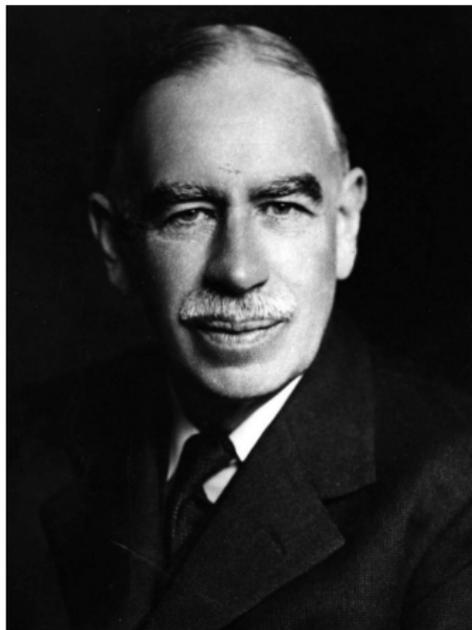
Why interpretation?

Keynes was not very clear in his writing and developed his ideas **with no math or graphs**.

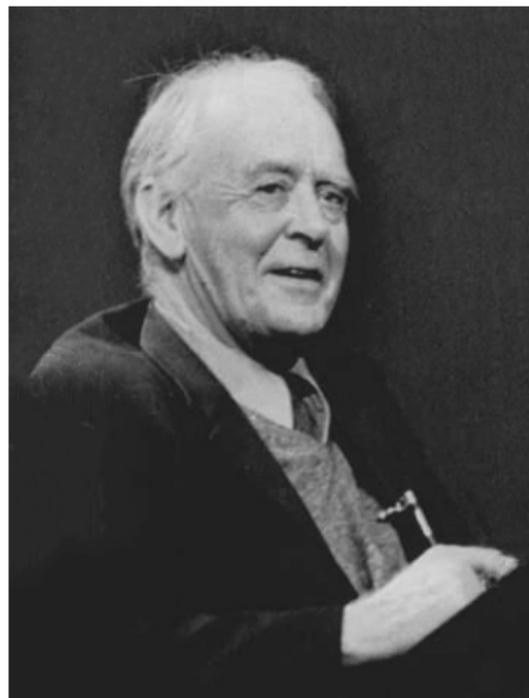
The IS-LM model the way we will learn here, analytically, is due to **John Hicks** in 1937.

- Hicks received the Nobel Prize for this work in 1972.
- The model was later refined by Alvin Hansen!

Introduction



John Keynes, 1883-1946



John Hicks, 1904-1989

Introduction

Since we are talking about great human beings, here is the Greatest of All Time: Roger Federer.



Sorry, I couldn't resist. Let's go back to Economics.

The IS Curve

We will now derive the IS curve.

IS stands for **Investment-Savings**.

The IS curve describes the **relationship** between the **interest rate** and the **income** that arises in the **market** for **goods** and **services**.

The building block of the IS curve is the **Keynesian Cross**.

The key idea is that, in the short run, **GDP** is **determined** by how much is **demanded!**

The IS Curve

What is demand? It is the **right side** of the **national income identity**!

We will still assume a **closed economy**. Then:

$$\text{Demand} = C + I + G$$

As before, we will assume that:

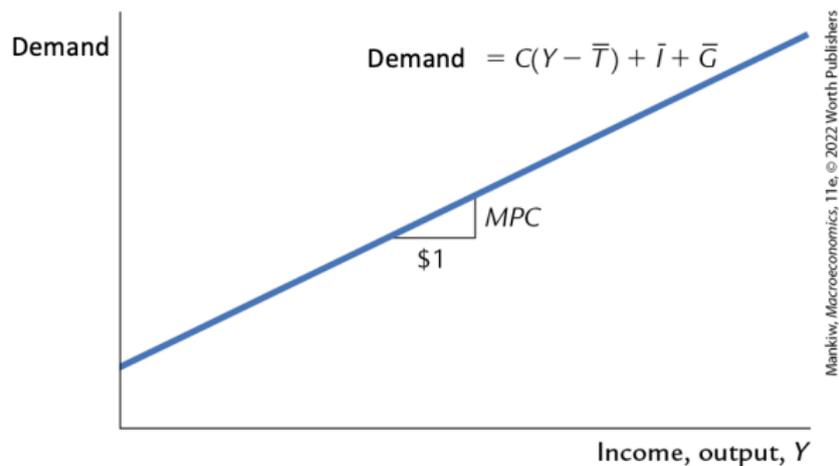
- C is a function of **disposable income**: $C = C(Y - T)$.
- G and T are **exogenous**.
 - We will denote the fixed values with a bar: \bar{G} and \bar{T} .
- I is a **decreasing** function of the interest rate r .
 - For now, we will assume r is fixed.

Then, demand can be written as:

$$\text{Demand} = C(Y - \bar{T}) + I(r) + \bar{G}$$

The IS Curve

Note that demand is a function of income Y . Let's plot this!



The **slope** of the **demand function** is your old friend: the **marginal propensity to consume**.

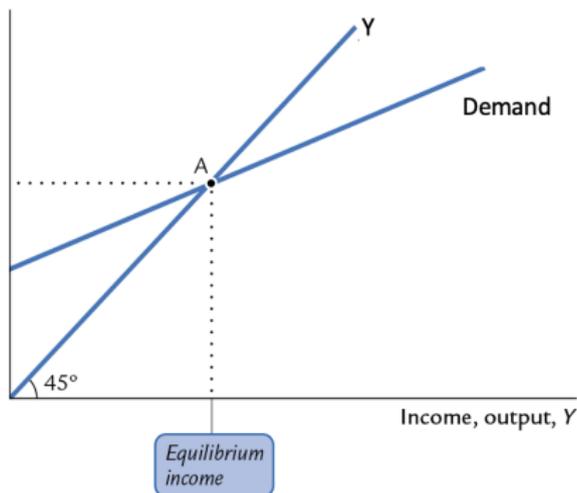
The IS curve

How do we find the equilibrium income Y ?

In **equilibrium**, **demand** must be equal to **(income) Y** :

$$Y = \text{Demand}$$

$$Y = C(Y - \bar{T}) + I(r) + \bar{G}$$



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The IS curve

You already saw something like this when we talked about the **closed economy model**.

It's the same idea, but with a different interpretation.

The equilibrium income is where the **demand function intersects** the **45-degree line**.

This is called the **Keynesian Cross**.

Recall that we draw the demand function for a **given** interest rate r , \bar{G} and \bar{T} .

But, remember: our goal is to **derive** a **relationship between Y and r** .

The IS curve

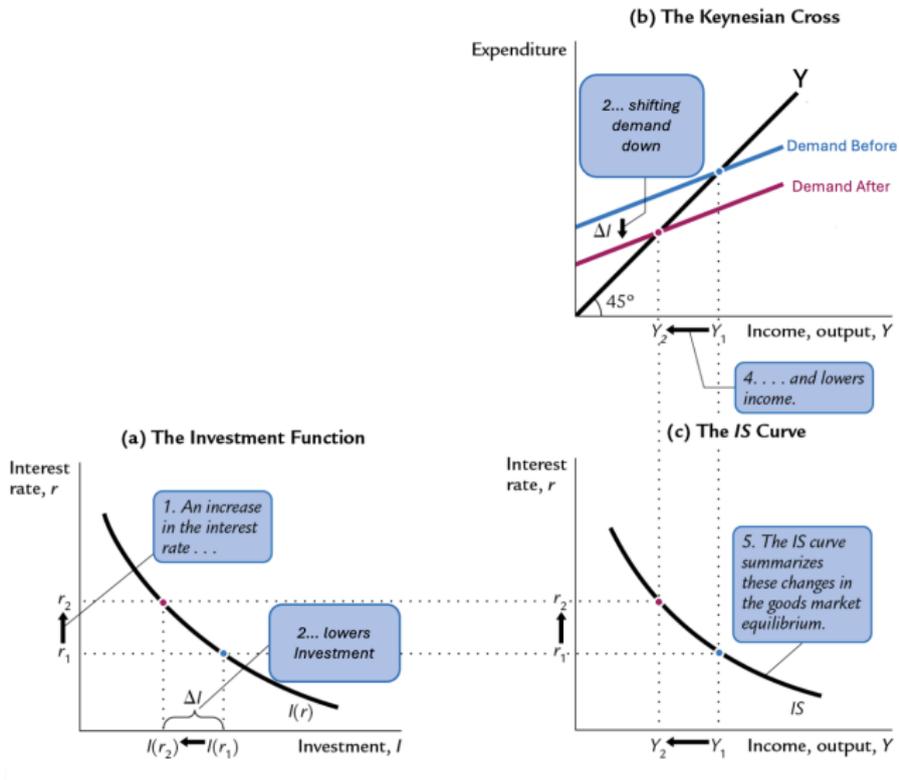
What happens to the equilibrium income if we increase the interest rate r ?

- Recall that we assumed investment is a decreasing function of the interest rate.
- Then, an increase in the interest rate will reduce investment.
- For the same level of income, demand will be lower.
- This means that the demand curve shifts down!
- The intersection with the 45-degree line will be at a lower level of income.

That's it! We found the IS curve!

The IS curve describes the inverse relationship between Y and r .

The IS Curve



Shifts in the IS Curve

⚠ The IS curve is drawn for a given level of \bar{G} and \bar{T} .

If we change \bar{G} or \bar{T} , the IS curve will shift!

- It will be a different curve!

Let's see how the IS curve shifts when we increase \bar{G} by ΔG .

We will fix an interest rate \bar{r} and see what happens to the equilibrium income Y after we increase \bar{G} .

- If the equilibrium income increases, the IS curve shifts to the right.
- If the equilibrium income decreases, the IS curve shifts to the left.

Shifts in the IS Curve

For a given level of income Y and interest rate \bar{r} , an increase in \bar{G} will **increase** the **demand** for goods.

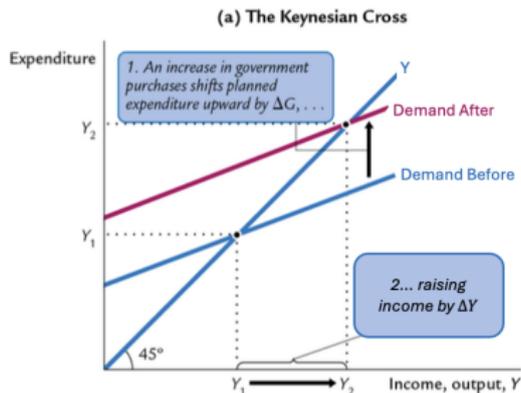
This means that the **demand curve** will **shift up**.

The **new intersection** with the 45-degree line will be at a **higher level of income**.

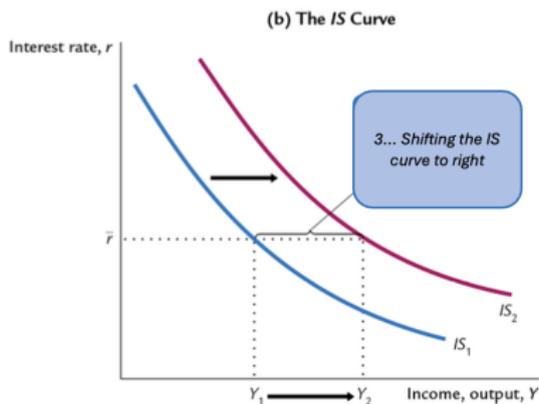
Therefore, the **equilibrium income** will **increase**!

- For a fixed interest rate \bar{r} , income is higher by ΔY .
- The **IS curve shifts** to the **right** by ΔY .

Shifts in the IS Curve



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Shifts in the IS Curve

The size of the shift depends on the slope of the demand function, i.e. the **marginal propensity to consume!**

Let's see this with an example.

Example: Suppose the consumption function is given by:

$C(Y - T) = a + MPC \cdot (Y - T)$. If we increase government expenditures by ΔG , how much is the shift in the IS curve? *Answer:* $\Delta Y = \frac{\Delta G}{1 - MPC}$.

The ratio $\frac{\Delta Y}{\Delta G} = \frac{1}{1 - MPC}$ is called the **government-purchases multiplier**.

- It tells how much **income increases** for a one **dollar increase** in **government expenditures**.

Similarly, we can define the **tax multiplier** as $\frac{\Delta Y}{\Delta T}$.

- The amount **income changes in response** to a **\$1 change in taxes!**
- You will derive this in the homework!

The LM Curve

We will now move to the second piece of this puzzle: the **LM curve**.

The LM curve stands for **liquidity-money**.

It **describes** the **relationship** between the **interest rate** and **income** that arises in the **market for money balances**.

It is based on the theory of **liquidity preference**.

The LM Curve

We will assume the money supply M^S is **exogenous** and **fixed**.

- It is a policy variable chosen by a Central Bank.
- **It will not change** in the **short run**.

In the **very short run**, we will assume that the **price level is fixed!**

- In other words, prices are **sticky**.

Therefore, the **supply of real money balances is fixed!**

- We will denote their fixed values with a **bar**!

$$\text{Supply Real Money Balances} = \left(\frac{M}{P}\right)^S = \frac{\bar{M}}{\bar{P}}$$

The LM Curve

We will now deal with the **demand** for **real money balances**.

We will assume that the **demand** for real money balances is a **function** of the **interest rate** r and the level of **income** Y .

$$\text{Demand Real Money Balances} = \left(\frac{M}{P}\right)^D = L(r, Y)$$

The function L is **decreasing** in the **interest rate** r and **increasing** in **income** Y .

- The intuition is that **people want to hold more money when they have more income**.
- They also want to hold less money when the **opportunity cost of holding money**, the interest rate, is high.
 - Recall our discussion in Lecture 5: when the interest rate is high, **people prefer to hold less money and more bonds**, for example.

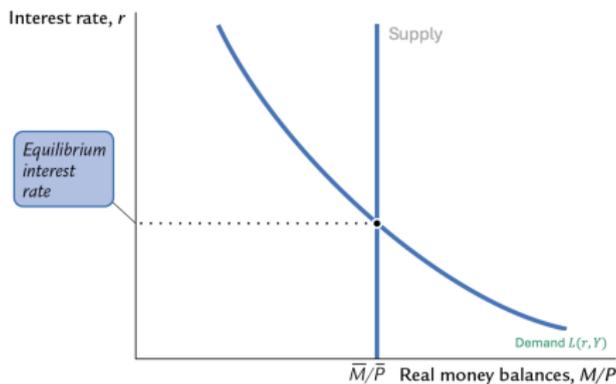
The LM Curve

How do we find the equilibrium interest rate r , for a given level of income Y ?

In equilibrium: the supply of real money balances must be equal to the demand for real money balances.

$$\frac{\bar{M}}{\bar{P}} = L(r, Y)$$

Graphically:



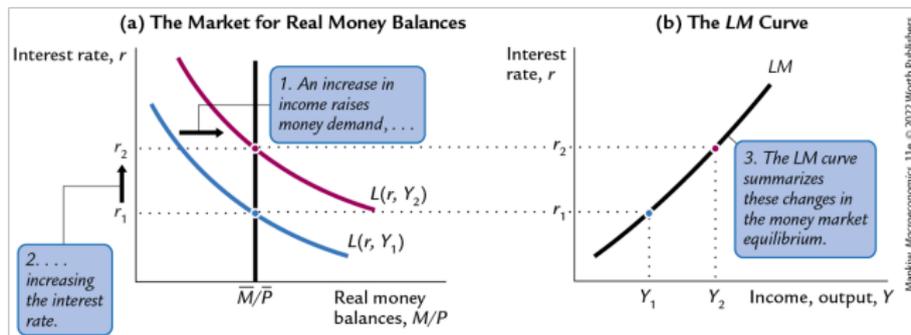
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The LM Curve

Our goal is to derive a **relationship between Y and r** for the money market.

How does an increase in Y affect the demand for real money balances?

- The demand for real money balances is **increasing in Y** !
- Then, for any given level of the interest rate r , the demand for real money balances **will be higher**.



The LM curve is **upward** sloping!

Shifts in the LM Curve

⚠ The LM curve is drawn for a given level of Money Supply \bar{M} and price level \bar{P} .

If we change \bar{M} or \bar{P} , the LM curve will shift!

- It will be a different curve!

Let's see how the LM curve shifts when we decrease the money supply from M_1 to M_2 .

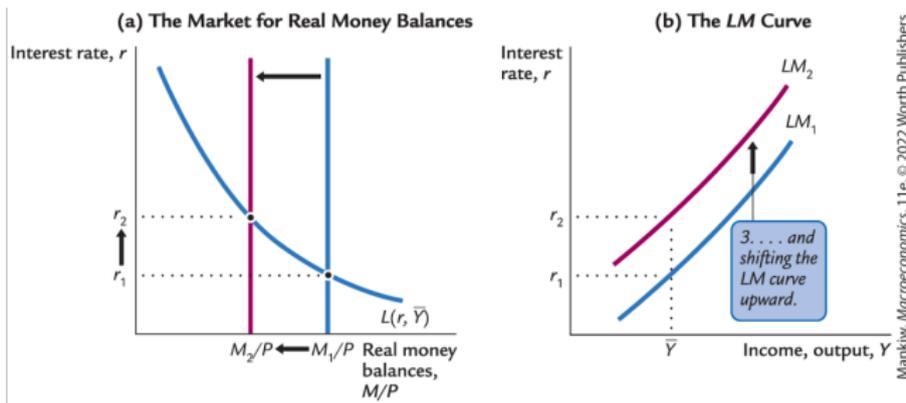
We will fix an income level \bar{Y} and see what happens to the equilibrium interest rate r after we decrease the money supply.

- Reducing the money supply \implies the vertical line representing the supply of real money balances will shift to the left.
- The function L doesn't shift!

Shifts in the LM Curve

The intersection will be at a higher interest rate!

Then, the LM curve shift upwards!



You should convince yourself that the effect of a decrease in M is qualitatively the same as an increase in P !

Short Run Equilibrium

The IS-LM can be described by a system of two equations:

$$Y = C(Y - \bar{T}) + I(r) + \bar{G} \quad (\text{IS})$$

$$\frac{\bar{M}}{\bar{P}} = L(r, Y) \quad (\text{LM})$$

The **exogenous variables** are:

- Fiscal Policy: \bar{G} and \bar{T} .
- Monetary Policy: \bar{M} .
- The price level \bar{P} .

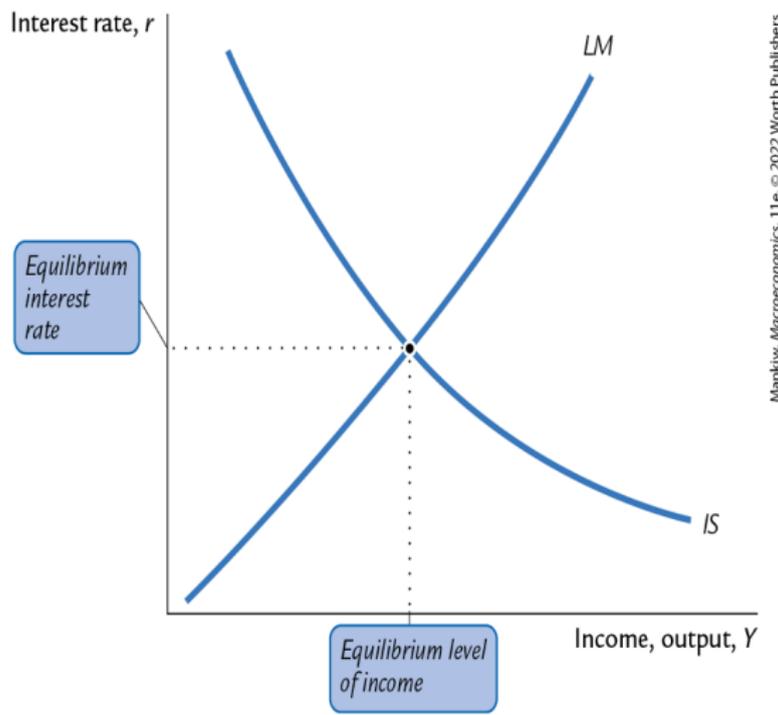
The **endogenous variables** are:

- The interest rate r .
- The income Y .

The short-run equilibrium is the combination of Y and r that satisfies **both equations**.

Short Run Equilibrium

Graphically, it is the **intersection** of the **IS** and **LM** curves:



Taking Stock

Our goal in this part of the course is to develop a **model** that explains the **short-run fluctuations in the economy**.

How far are we from this goal? Not very far!

Here is the **big picture** of what we have done so far and what we will do next:

