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.

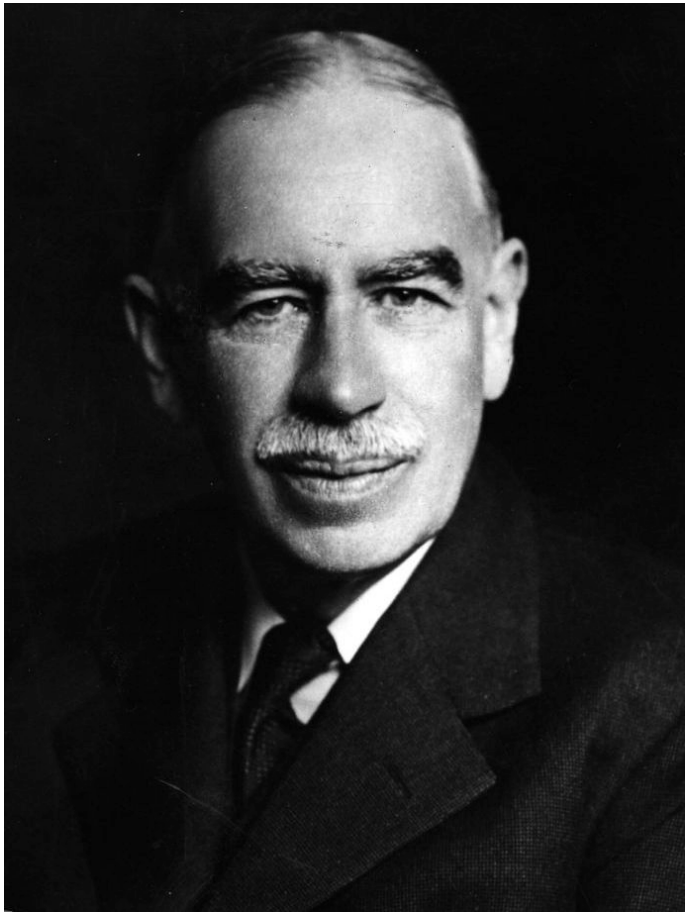
Why interpretation?

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

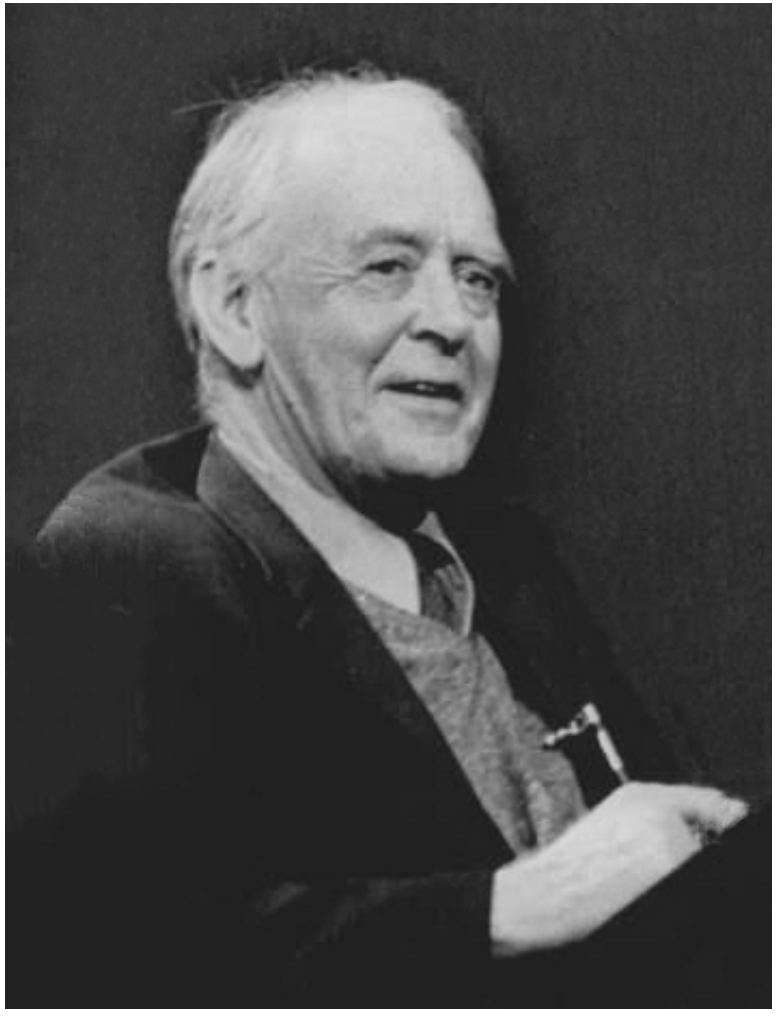
The IS-LM model the way we will learn here, analytically, is due to John Hicks in 1937.

- 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.

They 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:

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

As before, we will assume that:

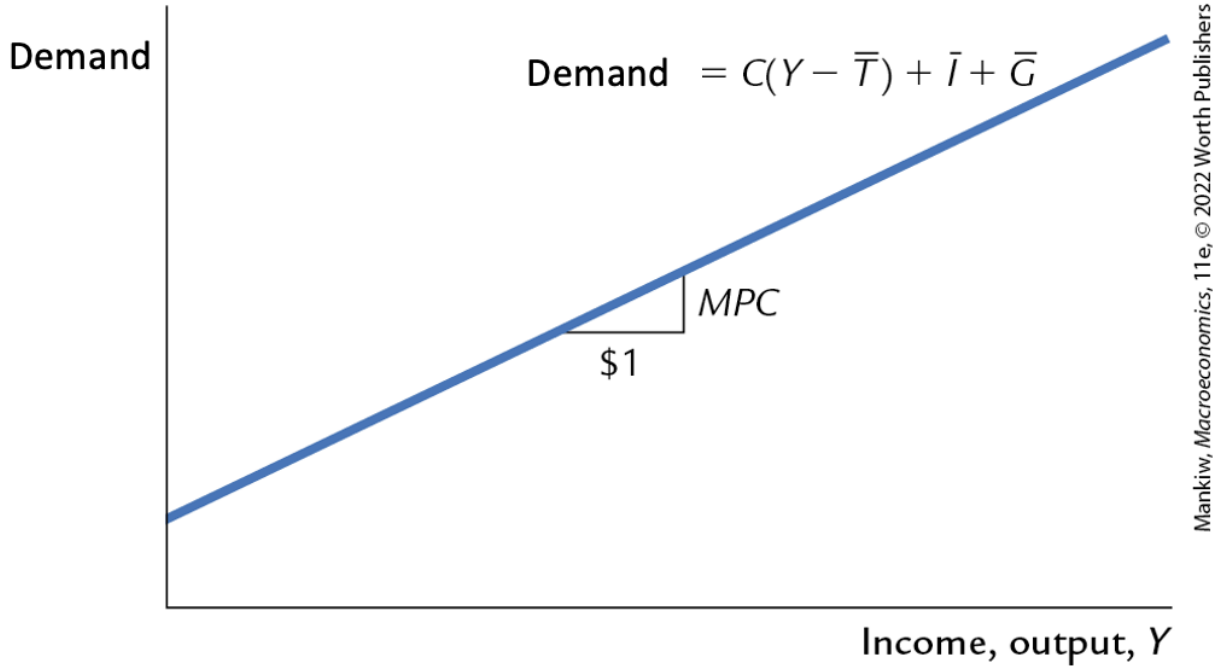
- C is a function of disposable income: $C = C(Y - T)$.
- G and T are exogenous.
  - We will denote the fixed values with a bar: $\bar{G}$ and $\bar{T}$.
- I is a decreasing function of the interest rate r.
  - For now, we will assume r is fixed.

Demand can be written as:

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

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.

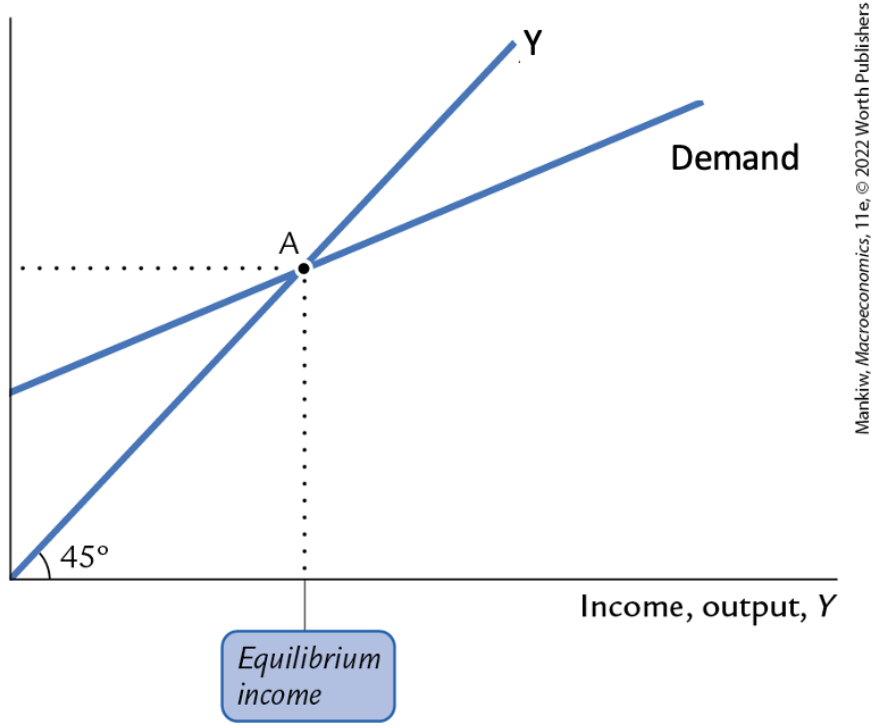
The IS curve

How do we find the equilibrium income Y?

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

$$Y = \text{Demand}$$

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



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

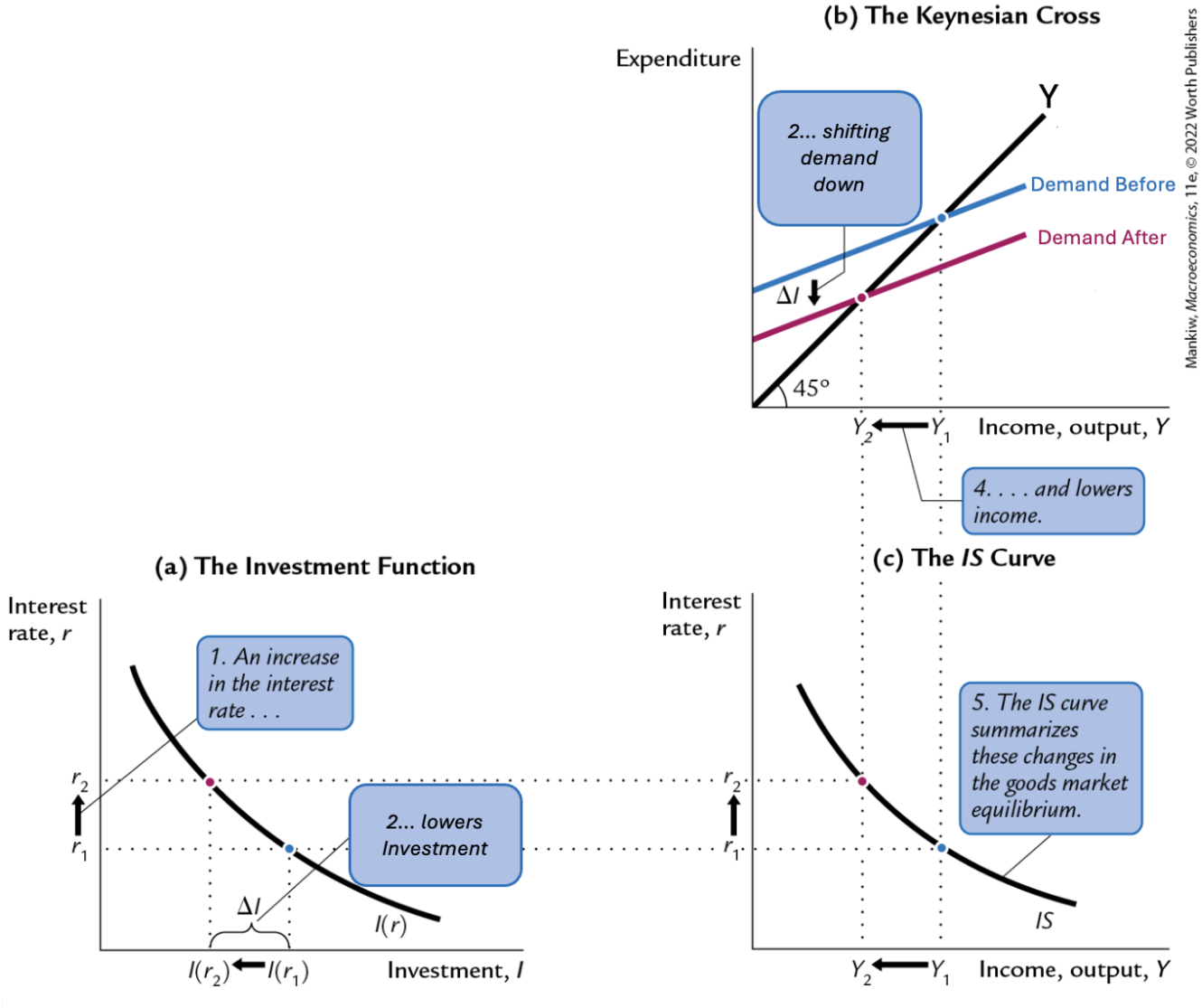
What happens to the equilibrium income if we increase the interest rate r?

- 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


(b) The Keynesian Cross
Expenditure
Y
2... shifting demand down
Demand Before
Demand After
ΔI
45°
Y2
Y1
Income, output, Y
4. . . . and lowers income.
Mankiw, Macroeconomics, 11e, © 2022 Worth Publishers
(a) The Investment Function
Interest rate, r
1. An increase in the interest rate . . .
r2
r1
2... lowers Investment
ΔI
I(r)
I(r2)
I(r1)
Investment, I
(c) The IS Curve
Interest rate, r
5. The IS curve summarizes these changes in the goods market equilibrium.
IS
Income, output, Y

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 theequilibrium 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.

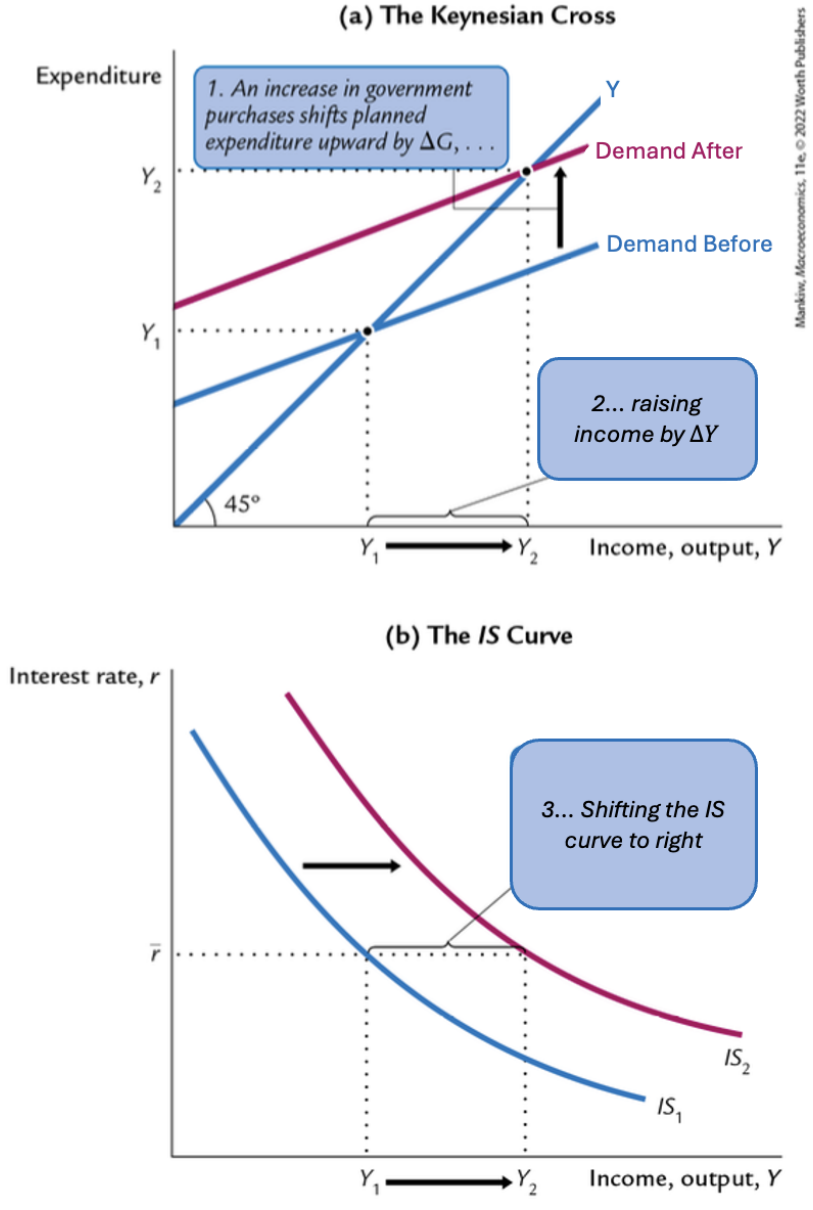
This means that the demand curve will shift up.

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



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!

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

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.

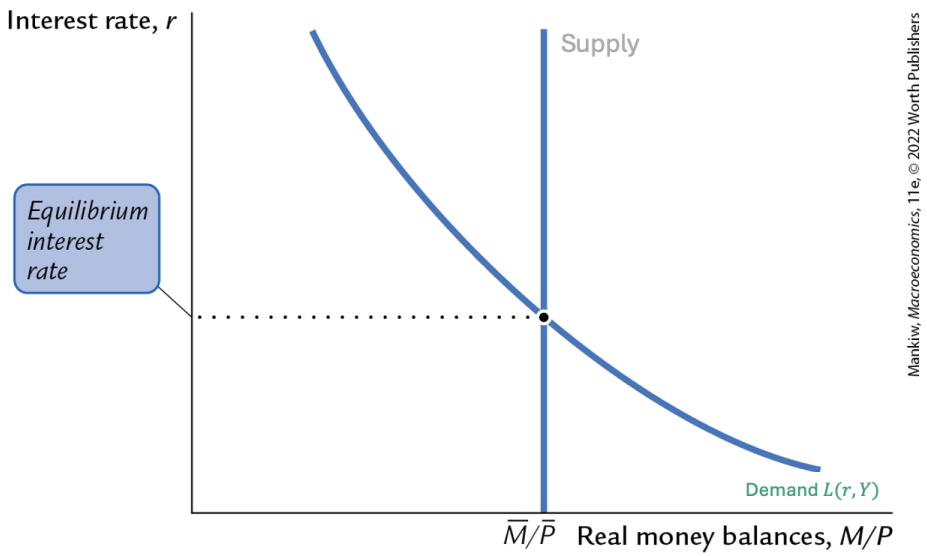
The LM Curve

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:

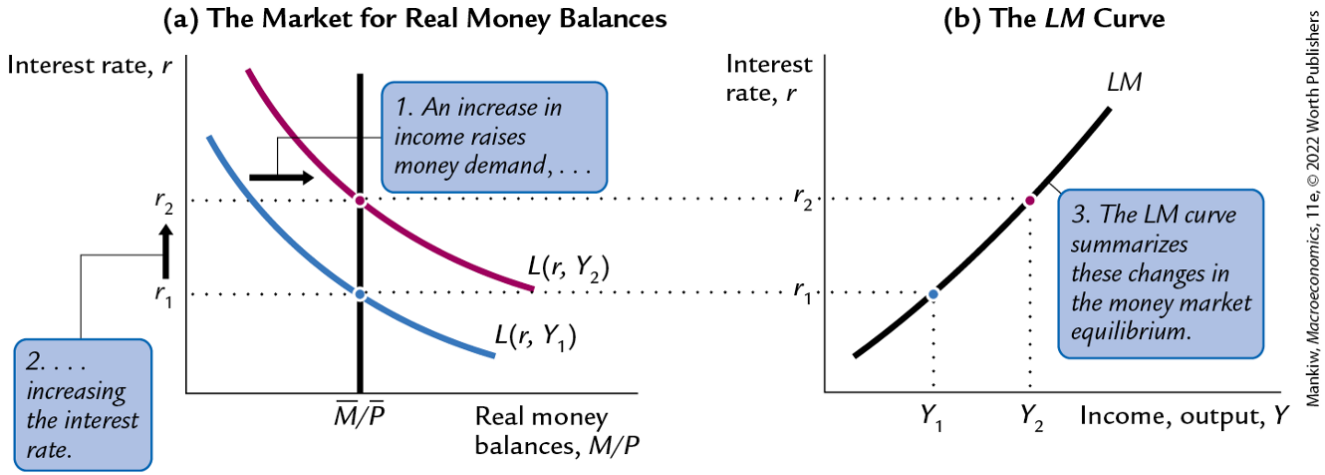


The LM Curve

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.

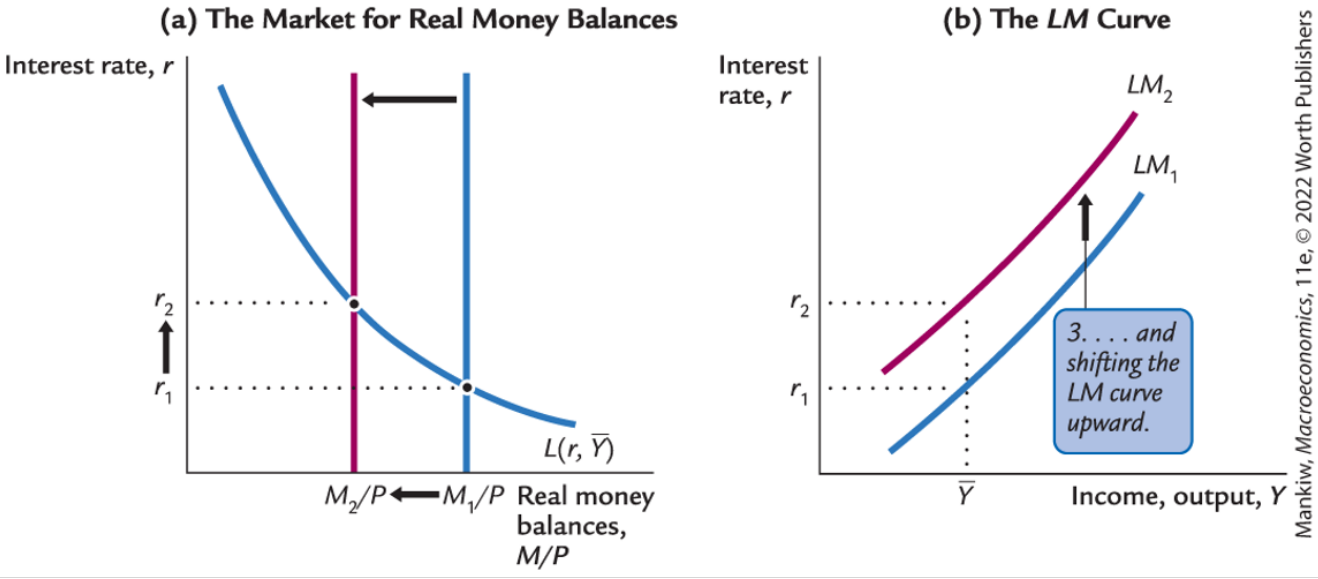
We will fix an income level $\bar{Y}$ and see what happens to the equilibrium interest rate r after we decrease the money supply.

- 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 $\bar{P}$.

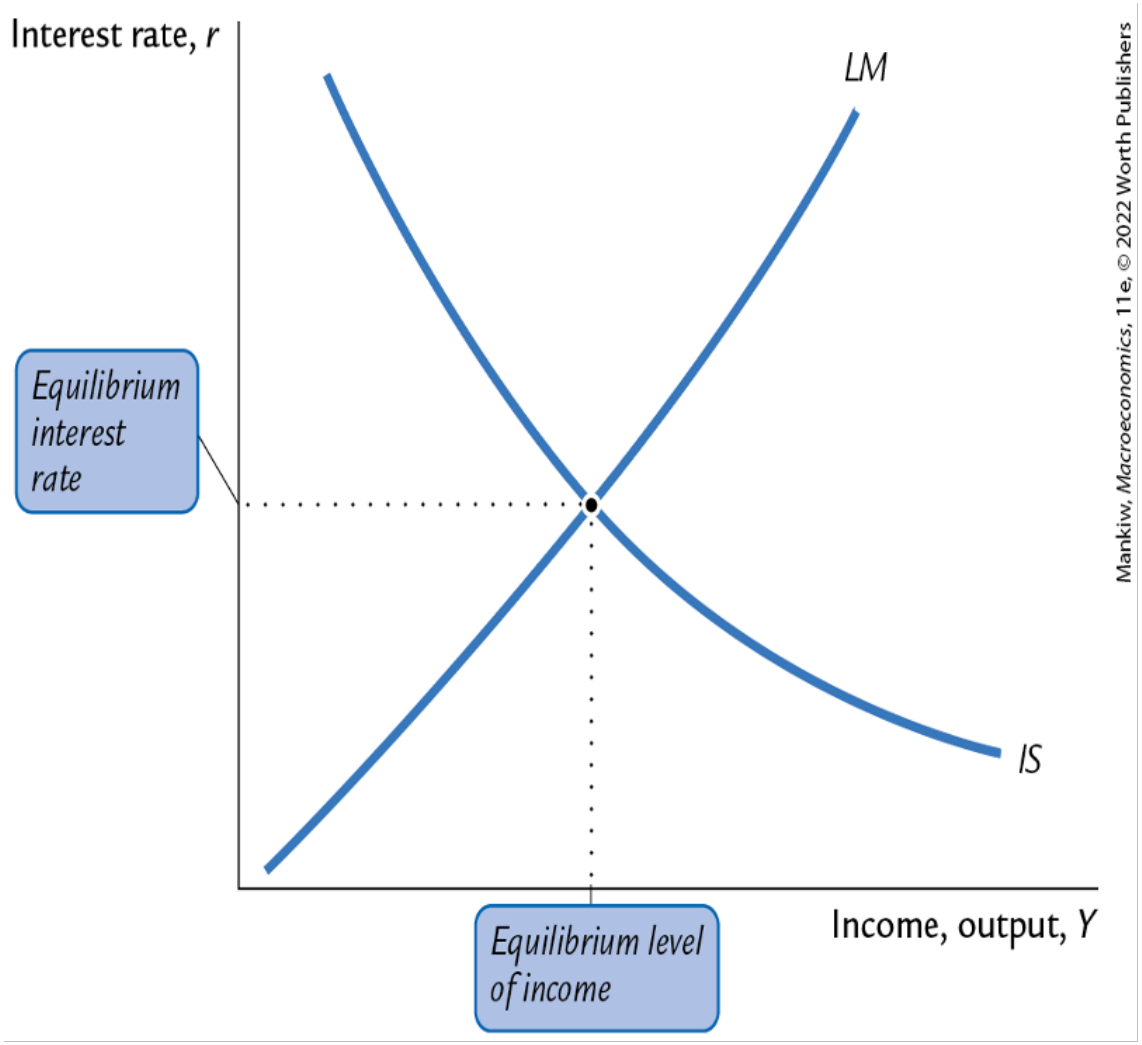
The endogenous variables are:

- 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: