

Money, Banks, and the Money Supply

Session 6 – Introduction to Macroeconomics

Francesco Chiocchio

ESCP Business School

Recap: Session 5

Answer the questions individually (10 minutes).

1. Compare the **Classical and Keynesian views**: assumptions about prices and wages, drivers of output and employment, and the role of policy.
2. Define the **Keynesian cross** and the **fiscal multiplier**.
3. Let $\bar{G} = 10$, $\bar{T} = 5$, $\bar{I} = 14$, and $C = 0.8(Y - \bar{T})$.
(i) Construct the Keynesian cross and solve for Y . (ii) Find the multiplier.
Now let $T = 0.2Y$ and $C = 12 + 0.8(Y - T)$.
(iii) Find Y . (iv) Find the multiplier. (v) Why is it different?
4. Define the **investment–saving (IS) curve**. How do we obtain IS?
5. What is an **inflationary gap**? What should policy do?

Recap: Classical and Keynesian Views

1. **How do prices, output, employment, and the role of policy differ?**

Recap: Classical and Keynesian Views

1. How do prices, output, employment, and the role of policy differ?

Classical long-run benchmark

- ▶ Flexible prices and wages allow markets to clear.
- ▶ Capital, labor, and technology determine sustainable output, $\bar{Y}$, and employment.
- ▶ Demand policy changes the price level or composition of spending; sustained output gains require greater productive capacity.

Keynesian short-run view

- ▶ Many prices and wages adjust slowly.
- ▶ Demand affects output and employment; equilibrium output can differ from $\bar{Y}$.
- ▶ Fiscal and monetary policy can stabilize demand and help close output gaps.

Recap: The Keynesian Cross and Fiscal Multipliers

2. Define the Keynesian cross and the fiscal multiplier.

Recap: The Keynesian Cross and Fiscal Multipliers

2. Define the Keynesian cross and the fiscal multiplier.

- ▶ The **Keynesian cross** finds goods-market equilibrium where output equals planned expenditure: $Y = PE = C + \bar{I} + \bar{G}$, with prices fixed.
- ▶ A **fiscal multiplier** measures the change in equilibrium output caused by a one-unit change in government purchases or net taxes.

With $C = c(Y - \bar{T})$, fixed investment, and $0 < c < 1$:

$$\frac{\Delta Y}{\Delta G} = \frac{1}{1 - c}, \quad \frac{\Delta Y}{\Delta T} = -\frac{c}{1 - c}.$$

Here c is the **marginal propensity to consume (MPC)** and T is taxes net of transfers.

Recap: Output and the Multiplier

3(i)–(ii). Construct the Keynesian cross, find Y and the multiplier.

$$\bar{G} = 10, \quad \bar{T} = 5, \quad \bar{I} = 14, \quad C = 0.8(Y - \bar{T}).$$

Recap: Output and the Multiplier

3(i)–(ii). Construct the Keynesian cross, find Y and the multiplier.

$$\bar{G} = 10, \quad \bar{T} = 5, \quad \bar{I} = 14, \quad C = 0.8(Y - \bar{T}).$$

$$\begin{aligned} PE &= 0.8(Y - 5) + 14 + 10 = 0.8Y + 20, \\ Y = PE &\Rightarrow 0.2Y = 20 \Rightarrow Y = 100. \end{aligned}$$

$$\frac{\Delta Y}{\Delta G} = \frac{1}{1 - 0.8} = 5.$$

Plot $PE = 20 + 0.8Y$ against the 45° line; they intersect at $Y = 100$.

Interactive Keynesian cross: Desmos

Recap: Autonomous Consumption and Income Taxes

3(iii)–(v). Find Y , the multiplier, and explain the difference.

Keep $\bar{G} = 10$ and $\bar{I} = 14$. Set $T = 0.2Y$ and autonomous consumption $\bar{C} = 12$.

$$C = 12 + 0.8(Y - T) = 12 + 0.64Y.$$

Recap: Autonomous Consumption and Income Taxes

3(iii)–(v). Find Y , the multiplier, and explain the difference.

Keep $\bar{G} = 10$ and $\bar{I} = 14$. Set $T = 0.2Y$ and autonomous consumption $\bar{C} = 12$.

$$C = 12 + 0.8(Y - T) = 12 + 0.64Y.$$

$$PE = 12 + 0.64Y + 14 + 10 = 36 + 0.64Y,$$

$$Y = \frac{36}{1 - 0.64} = 100, \quad \frac{\Delta Y}{\Delta G} = \frac{1}{1 - 0.8(1 - 0.2)} \simeq 2.78.$$

- ▶ Income taxes reduce the slope of PE : some extra income goes to taxes, weakening the spending feedback and reducing the multiplier.
- ▶ Autonomous consumption raises the intercept, leaving the slope unchanged. Here the two changes happen to leave $Y = 100$.

Recap: The IS Curve

4. Define IS. How do we obtain it?

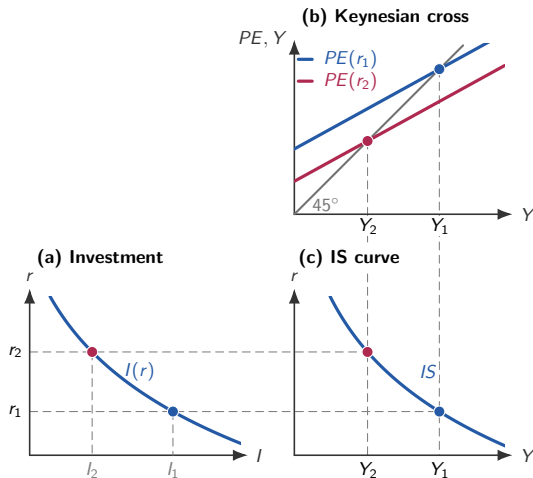
Recap: The IS Curve

4. Define IS. How do we obtain it?

- **IS:** all (Y, r) pairs satisfying goods-market equilibrium:

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

- A higher real interest rate reduces planned investment: $I = I(r)$.
- Lower I shifts PE down and reduces equilibrium Y in the Keynesian cross.



Recap: An Inflationary Gap

5. What is an inflationary gap, and what could policy do?

Recap: An Inflationary Gap

5. What is an inflationary gap, and what could policy do?

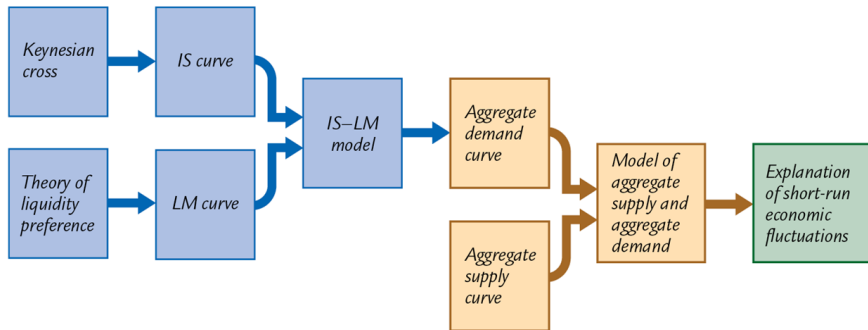
- ▶ Output is above its sustainable level: $Y > \bar{Y}$.
- ▶ This creates pressure on wages and prices as the economy adjusts.
- ▶ Lower government purchases, higher net taxes, or tighter monetary policy can reduce demand.
- ▶ The fixed-price Keynesian cross identifies the output gap; price adjustment requires the aggregate supply–demand framework.

Session 5 video: review demand- and supply-side policies, the roles of taxes and government spending, and countercyclical policy.

The 2026 Economics Prize: Stabilisation Policy

- ▶ **Robert E. Hall and Michael Woodford** received the prize for the **microeconomic foundations of macroeconomic stabilisation**: explaining the economy through households' and firms' decisions.
 - ▶ This is directly related to what we are studying now: **short-run business cycles and their stabilisation**.
- ▶ **Hall: consumption looks ahead.** He developed tests of how expected future income shapes spending today. Households with little cash or access to credit may spend a larger share of a temporary income gain.
- ▶ **Woodford: sticky prices and expectations.** He helped build the New Keynesian framework linking forward-looking spending, firms' pricing decisions, and interest-rate policy.
- ▶ **Why it matters:** central banks and governments use these models to evaluate how policies affect output and inflation. Credibility and expectations influence the results.

The Overall Plan



Mankiw, *Macroeconomics*, 11e, © 2022 Worth Publishers

- **So far:** spending and the goods market give us IS.
- **Today:** what money is and how its supply is determined.
- **Next:** the money-market curve (LM) completes the IS-LM model.

Source: Mankiw, *Macroeconomics*, 11th ed. (2022), Worth Publishers.

Session 6: Outline

1. **What Is Money?**

Functions, types, and measures of the money supply.

2. **Central Banks and Monetary Policy**

Main functions, independence, and policy tools.

3. **Banks and Money Creation**

Balance sheets, lending, and deposit expansion.

4. **Bank Capital and Financial Stability**

Leverage, losses, and bank runs.

5. **A Model of the Money Supply**

The monetary base, the money multiplier, and their assumptions.

Reading: Mankiw, *Macroeconomics*, Chapter 4, *The Monetary System* (9th and 11th editions).

1. What Is Money?

Which assets can we use to make payments?

Money Is a Stock

- ▶ **Money** consists of assets readily usable for transactions.
- ▶ **The money supply** is the quantity of these assets held at a particular date.
- ▶ Compare:
 - ▶ Money in your wallet and current account: a **stock**.
 - ▶ Your salary each month: an income **flow**.
 - ▶ Your net wealth: all assets minus debts, including less liquid assets.

Money Is a Stock

- ▶ **Money** consists of assets readily usable for transactions.
- ▶ **The money supply** is the quantity of these assets held at a particular date.
- ▶ Compare:
 - ▶ Money in your wallet and current account: a **stock**.
 - ▶ Your salary each month: an income **flow**.
 - ▶ Your net wealth: all assets minus debts, including less liquid assets.
- ▶ A house is valuable, but buying lunch with it would require selling or borrowing against it first.

The Three Functions of Money

Function	What it does	Example
Medium of exchange	Settles purchases	Paying for lunch
Unit of account	Expresses prices in a common unit	Comparing two prices in euros
Store of value	Carries purchasing power into the future	Keeping a balance for next week

The Three Functions of Money

Function	What it does	Example
Medium of exchange	Settles purchases	Paying for lunch
Unit of account	Expresses prices in a common unit	Comparing two prices in euros
Store of value	Carries purchasing power into the future	Keeping a balance for next week

- ▶ Inflation reduces money's purchasing power: a store of value need not preserve value perfectly.

Commodity Money and Fiat Money

Commodity money

- ▶ Has value in a non-monetary use.
- ▶ Examples: gold coins; cigarettes used in prisoner-of-war camps.

Fiat money

- ▶ Its material value is small relative to its monetary value.
- ▶ Acceptance rests on institutions, trust, and widespread use.
- ▶ Example: euro banknotes, which are not redeemable for a fixed quantity of gold.

Commodity Money and Fiat Money

Commodity money

- ▶ Has value in a non-monetary use.
- ▶ Examples: gold coins; cigarettes used in prisoner-of-war camps.

- ▶ Bank deposits are claims on commercial banks, payable in the currency in which they are denominated.
- ▶ **Watch the video** for more on the history of money.

Fiat money

- ▶ Its material value is small relative to its monetary value.
- ▶ Acceptance rests on institutions, trust, and widespread use.
- ▶ Example: euro banknotes, which are not redeemable for a fixed quantity of gold.

Which of These Count as Money?

Classify each item. What matters for your answer?

Item

Currency

Current-account deposit

Cheque or debit card

Credit card

Time deposit (money held
for an agreed period)

Bitcoin

Which of These Count as Money?

Classify each item. What matters for your answer?

Item	Answer
Currency	Yes: banknotes and coins used for payments.
Current-account deposit	
Cheque or debit card	
Credit card	
Time deposit (money held for an agreed period)	
Bitcoin	

Which of These Count as Money?

Classify each item. What matters for your answer?

Item	Answer
Currency	Yes: banknotes and coins used for payments.
Current-account deposit	Yes: a balance available on demand.
Cheque or debit card	
Credit card	
Time deposit (money held for an agreed period)	
Bitcoin	

Which of These Count as Money?

Classify each item. What matters for your answer?

Item	Answer
Currency	Yes: banknotes and coins used for payments.
Current-account deposit	Yes: a balance available on demand.
Cheque or debit card	A way to transfer a deposit; the underlying balance is money.
Credit card	
Time deposit (money held for an agreed period)	
Bitcoin	

Which of These Count as Money?

Classify each item. What matters for your answer?

Item	Answer
Currency	Yes: banknotes and coins used for payments.
Current-account deposit	Yes: a balance available on demand.
Cheque or debit card	A way to transfer a deposit; the underlying balance is money.
Credit card	No: access to credit; the purchase creates an obligation to repay.
Time deposit (money held for an agreed period)	
Bitcoin	

Which of These Count as Money?

Classify each item. What matters for your answer?

Item	Answer
Currency	Yes: banknotes and coins used for payments.
Current-account deposit	Yes: a balance available on demand.
Cheque or debit card	A way to transfer a deposit; the underlying balance is money.
Credit card	No: access to credit; the purchase creates an obligation to repay.
Time deposit (money held for an agreed period)	Less readily spendable; inclusion depends on the monetary aggregate and maturity.
Bitcoin	

Which of These Count as Money?

Classify each item. What matters for your answer?

Item	Answer
Currency	Yes: banknotes and coins used for payments.
Current-account deposit	Yes: a balance available on demand.
Cheque or debit card	A way to transfer a deposit; the underlying balance is money.
Credit card	No: access to credit; the purchase creates an obligation to repay.
Time deposit (money held for an agreed period)	Less readily spendable; inclusion depends on the monetary aggregate and maturity.
Bitcoin	A crypto-asset accepted for some payments. Limited acceptance and price volatility restrict its monetary functions; excluded from euro-area M1–M3.

Measuring Money in the Euro Area

The **European Central Bank (ECB)** uses increasingly broad monetary aggregates.

Measure	Assets included
---------	-----------------

M1	Currency in circulation and overnight deposits.
----	---

M2	M1 plus deposits with agreed maturity up to two years and deposits redeemable at notice up to three months.
----	---

M3	M2 plus repurchase agreements, money-market fund shares, and short-term debt securities issued by monetary financial institutions.
----	--

Broader measures include assets that can be converted into transaction balances.

Source: ECB, monetary aggregates. M3 debt securities have maturity up to two years. Aggregates cover holdings by the money-holding sector, excluding central government.

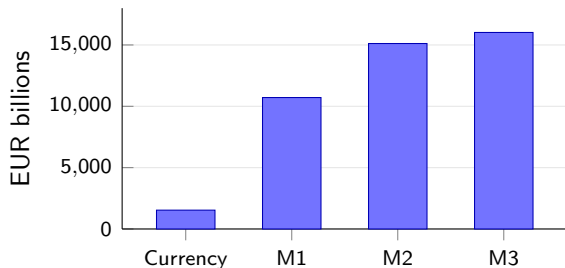
Euro-Area Money: A Historical Snapshot

June 2023, EUR billions

Currency	1,535
M1	10,714
M2	15,117
M3	16,018

Most transaction money is held as **deposits**, rather than cash.

Source: ECB, 26 July 2023 release, Table 1. End-June stocks, seasonally adjusted; rounded. Measures overlap: do not add the bars.



The Same Labels Can Have Different Definitions

United States, January 2021: monthly averages, USD billions

Measure	Coverage in this period	Amount
M1	Currency held outside banks, demand deposits, and other liquid deposits, including savings deposits.	18,105.4
M2	M1 plus small time deposits and retail money-market fund balances.	19,394.6

- ▶ The **Federal Reserve (Fed)**, the US central bank, included savings deposits in M1 from May 2020.
- ▶ Definitions, dates, and currencies must be aligned before comparing countries or changes over time.

Source: Federal Reserve, H.6, 23 February 2021, Table 1 and notes. Seasonally adjusted; published vintage. Some retirement-account balances are excluded from M2.

2. Central Banks and Monetary Policy

What do central banks do?

Central Banks and Monetary Policy

- ▶ A **central bank** is the public institution responsible for monetary policy and the supply of central-bank money.
- ▶ **Monetary policy** influences interest rates and financing conditions to pursue price stability and other objectives in its mandate.
- ▶ **United States:** the Federal Reserve (Fed).
- ▶ **Euro area:** the Eurosystem consists of the ECB and the national central banks of euro-area countries.

The Functions of a Central Bank

1. **Issue money:** supply banknotes and central-bank reserves, the balances banks hold at the central bank.
2. **Support banking-system stability:** oversee risks and payments, working with other supervisory authorities.
3. **Conduct monetary policy:** influence financing conditions and pursue its statutory objectives.
4. **Lender of last resort to commercial banks:** provide emergency liquidity to solvent banks (assets cover liabilities) facing funding difficulties, subject to conditions.
5. **Lender-of-last-resort support to governments:** depends on its legal mandate and financing powers.

Independence and Government Financing

- ▶ A **dependent central bank** follows government instructions. It may be required to finance deficits cheaply, even when inflation calls for tighter policy.
- ▶ **Example: United States, 1942–1951.** The Fed kept government borrowing rates low by buying bonds as needed. This constrained inflation control; the 1951 Treasury–Fed Accord restored policy autonomy.
- ▶ An **independent central bank** chooses policy within its legal mandate and remains accountable for its decisions.
 - ▶ Operational independence is the norm in advanced economies, including the US, the euro area, and the UK.
- ▶ **Euro area:** direct central-bank financing of governments is prohibited; purchases of existing bonds may be allowed for monetary-policy purposes.

Monetary Policy

- ▶ **For our model:** monetary policy aims to affect the money supply. Why money matters for demand and output is the focus of **Session 7**.
- ▶ Central banks can influence money through:
 - ▶ **Securities transactions:** buying or selling bonds.
 - ▶ **Lending to banks:** changing the availability and cost of funds.
 - ▶ **Reserve policy:** requirements and interest paid on reserves.
- ▶ We study these tools in detail in **Session 8**.

How these tools affect the money supply depends on the **banking system**. Why? We study this now.

3. Banks and Money Creation

How can lending increase the stock of money?

Money and a Bank's Balance Sheet

For the teaching model, define money narrowly:

$$M = C_u + D.$$

- ▶ C_u : currency held by the public outside banks. D : demand deposits.
- ▶ R : bank reserves, consisting of vault cash and balances at the central bank.

Assets: what the bank owns or is owed	Liabilities: what the bank owes
Reserves; loans to customers	Customers' deposits

A deposit is an asset for its holder and a liability for the bank.

We use C_u for currency to distinguish it from consumption C ; M now denotes money, rather than imports. Bank equity is introduced in Section 4.

Three Banking Scenarios

- ▶ Each scenario starts with **1,000 units of currency** held by the public.
- ▶ Compare:
 1. No banks.
 2. Banks keep all deposits as reserves.
 3. Banks keep a fraction of deposits as reserves.

Three Banking Scenarios

- ▶ Each scenario starts with **1,000 units of currency** held by the public.
- ▶ Compare:
 1. No banks.
 2. Banks keep all deposits as reserves.
 3. Banks keep a fraction of deposits as reserves.
- ▶ For deposit expansion, assume a fixed reserve–deposit ratio, willing borrowers, and eventual redeposit of all loan proceeds.
- ▶ We temporarily omit bank equity, defaults, and other assets.

Scenario 1: No Banks

- ▶ The public holds **1,000 units of currency**.
- ▶ There are no banks, so there are no bank deposits: $D = 0$.

What is the money supply?

Scenario 1: No Banks

- ▶ The public holds **1,000 units of currency**.
- ▶ There are no banks, so there are no bank deposits: $D = 0$.

What is the money supply?

$$C_u = 1,000, \quad D = 0, \quad M = C_u + D = 1,000.$$

Scenario 2: 100-Percent-Reserve Banking

- ▶ Banks keep **all deposits as reserves**.

Scenario 2: 100-Percent-Reserve Banking

- ▶ Banks keep **all deposits as reserves**.
- ▶ Now deposit all the currency in Firstbank.

Firstbank after the deposit

Assets		Liabilities	
Reserves	1,000	Deposits	1,000

Scenario 2: 100-Percent-Reserve Banking

- ▶ Banks keep **all deposits as reserves**.
- ▶ Now deposit all the currency in Firstbank.

Firstbank after the deposit

Assets		Liabilities	
Reserves	1,000	Deposits	1,000

$$C_u = 0, \quad D = 1,000, \quad M = C_u + D = 1,000.$$

- ▶ The deposit changes the **form** of money; the total is unchanged.
- ▶ The bank cannot lend these deposits to borrowers: it must keep them all as reserves.
- ▶ **Would banks still be useful if they worked like this?**

Scenario 3: Fractional-Reserve Banking

Firstbank keeps 20% of deposits as reserves and lends 800 in cash to someone else. The original depositor still holds a deposit of 1,000.

Firstbank after lending in cash

Assets		Liabilities	
Reserves	200	Deposits	1,000
Loans	800		

How much money does the public hold?

Scenario 3: Fractional-Reserve Banking

Firstbank keeps 20% of deposits as reserves and lends 800 in cash to someone else. The original depositor still holds a deposit of 1,000.

Firstbank after lending in cash

Assets		Liabilities	
Reserves	200	Deposits	1,000
Loans	800		

How much money does the public hold?

- ▶ Original depositor: 1,000 in deposits.
- ▶ Borrower: 800 in currency.

$$M = 800 + 1,000 = 1,800.$$

- ▶ **Money has been created!** M has risen by 800; the borrower also owes the bank 800.

The Next Rounds of Deposit Expansion

The 800 is deposited at Secondbank. All banks keep 20% of deposits as reserves.

Bank	Deposit received	Reserves retained	Loan paid out
Firstbank	1,000	200	800
Secondbank			
Thirdbank			

The Next Rounds of Deposit Expansion

The 800 is deposited at Secondbank. All banks keep 20% of deposits as reserves.

Bank	Deposit received	Reserves retained	Loan paid out
Firstbank	1,000	200	800
Secondbank	800	160	640
Thirdbank			

A transfer of existing money into a deposit changes its form. **The additional loan** expands money.

The Next Rounds of Deposit Expansion

The 800 is deposited at Secondbank. All banks keep 20% of deposits as reserves.

Bank	Deposit received	Reserves retained	Loan paid out
Firstbank	1,000	200	800
Secondbank	800	160	640
Thirdbank	640	128	512

A transfer of existing money into a deposit changes its form. **The additional loan** expands money.

Each round is smaller: part of each deposit is retained as reserves.

How Large Is the Total Expansion?

Assume all loan proceeds are eventually redeposited.

$$D = 1,000 + 800 + 640 + 512 + \cdots = 1,000 (1 + 0.8 + 0.8^2 + \cdots) .$$

How Large Is the Total Expansion?

Assume all loan proceeds are eventually redeposited.

$$D = 1,000 + 800 + 640 + 512 + \cdots = 1,000 (1 + 0.8 + 0.8^2 + \cdots).$$

Writing $rr = R/D$ for the reserve–deposit ratio:

$$D = \frac{1,000}{1 - (1 - rr)} = \frac{1,000}{rr} = \frac{1,000}{0.2} = 5,000.$$

- ▶ At the end, $C_u = 0$, so $M = D = 5,000$.
- ▶ Total reserves remain 1,000; total loans are 4,000.
- ▶ The original 1,000 has supported 4,000 of **additional** money.

What Limits Bank Lending?

- ▶ **Profitability and credit risk:** borrowers must be willing and expected to repay.
- ▶ **Capital:** banks need equity to absorb possible losses.
- ▶ **Liquidity and funding:** banks must meet withdrawals and settle payments to other banks.
- ▶ **Monetary policy and regulation:** interest rates and prudential requirements affect lending conditions.

The fixed reserve ratio is a useful teaching assumption. Actual lending responds to all of these constraints.

4. Bank Capital and Financial Stability

Why can relatively small losses threaten a bank?

Bank Capital Is Owners' Equity

Assets: what the bank owns or is owed. **Liabilities:** what it owes.

$$\text{Capital} = \text{assets} - \text{liabilities}.$$

Assets		Liabilities and equity	
Reserves	200	Deposits	750
Loans	500	Other debt	200
Securities	300	Capital (equity)	50
Total	1,000	Total	1,000

- ▶ Owners provide equity and bear losses before depositors and other creditors.
- ▶ Here, capital is $1,000 - 950 = 50$. It is an **equity cushion**, not a separate pile of reserves.

Leverage Magnifies Losses

Leverage means financing assets partly with borrowed funds.

Initial leverage: $\text{assets/capital} = 1,000/50 = 20$.

What happens if the bank suffers a loss of 50, with liabilities unchanged?

Before the loss	
Assets	1,000
Liabilities	950
Capital	50

Leverage Magnifies Losses

Leverage means financing assets partly with borrowed funds.

Initial leverage: $\text{assets/capital} = 1,000/50 = 20$.

What happens if the bank suffers a loss of 50, with liabilities unchanged?

	Before the loss	After the loss
Assets	1,000	950
Liabilities	950	950
Capital	50	0

$\text{Loss as \% of initial equity} = 5\% \times 20 = 100\%$.

- ▶ A **5% loss of total assets** wipes out all initial equity.

Leverage Magnifies Losses

Leverage means financing assets partly with borrowed funds.

Initial leverage: $\text{assets/capital} = 1,000/50 = 20$.

What happens if the bank suffers a loss of 50, with liabilities unchanged?

	Before the loss	After the loss
Assets	1,000	950
Liabilities	950	950
Capital	50	0

$$\text{Loss as \% of initial equity} = 5\% \times 20 = 100\%.$$

- ▶ A **5% loss of total assets** wipes out all initial equity.
- ▶ A loss **above 5%** makes the bank **insolvent**: assets fall below liabilities. A 6% loss leaves assets of 940 and equity of -10 .

Capital and Reserves Address Different Risks

	Capital	Reserves
What it is	Owners' equity	Vault cash and central-bank balances
Main role	Absorb losses	Meet withdrawals and settle payments
Balance sheet	Assets minus liabilities	An asset of the bank

- ▶ **Capital requirements** set minimum equity cushions; risk-based rules require more capital against riskier exposures.
- ▶ **2008–2009 crisis:** excessive mortgage-related risk and thin capital cushions left many banks vulnerable. Losses forced them to cut lending, weakening spending and deepening the downturn.
- ▶ Adequate capital relative to risk helps banks absorb losses and keep lending.

Bank Runs: Liquidity and Solvency

- ▶ A **bank run** occurs when many depositors try to withdraw funds at once, often because they fear others will withdraw first.
- ▶ Deposits are repayable on demand; loans are repaid over time.
- ▶ **Illiquid**: the bank cannot meet immediate payments.
Insolvent: the value of its assets is below its liabilities.



Bank Runs: Liquidity and Solvency

- ▶ A **bank run** occurs when many depositors try to withdraw funds at once, often because they fear others will withdraw first.
- ▶ Deposits are repayable on demand; loans are repaid over time.
- ▶ **Illiquid**: the bank cannot meet immediate payments.
Insolvent: the value of its assets is below its liabilities.



Credible **deposit insurance** reduces the incentive to run. **Lender-of-last-resort** liquidity can support a solvent bank that cannot obtain funding.

5. A Model of the Money Supply

How do the central bank, banks, and the public interact?

The Monetary Base and the Money Supply

Money held by the public

$$M = C_u + D.$$

- ▶ Currency outside banks.
- ▶ Demand deposits.
- ▶ A deposit is money owed by a **commercial bank** to its customer. A reserve balance is money owed by the **central bank** to a commercial bank.

Monetary base

$$B = C_u + R.$$

- ▶ Currency outside banks.
- ▶ Bank reserves.

The Monetary Base and the Money Supply

Money held by the public

$$M = C_u + D.$$

- ▶ Currency outside banks.
- ▶ Demand deposits.
- ▶ A deposit is money owed by a **commercial bank** to its customer. A reserve balance is money owed by the **central bank** to a commercial bank.
- ▶ In this model, the central bank **controls the monetary base**, B .

Monetary base

$$B = C_u + R.$$

- ▶ Currency outside banks.
- ▶ Bank reserves.

Three Inputs to the Model

Input	Definition	Who influences it?
Monetary base	$B = C_u + R$	Central bank
Reserve–deposit ratio	$rr = R/D$	Banks and regulation
Currency–deposit ratio	$cr = C_u/D$	Public's payment and saving choices

- ▶ Treat these three inputs as **exogenous** for this exercise, with $D > 0$, $cr \geq 0$, and $0 < rr < 1$.
- ▶ Solve for deposits, currency, reserves, and the total money supply.

Deriving the Money Multiplier

- ▶ The **money multiplier** is the ratio of the money supply to the monetary base:
 $m = M/B$.

Using $M = C_u + D$ and $B = C_u + R$:

$$m = \frac{M}{B} = \frac{C_u + D}{C_u + R}$$

Deriving the Money Multiplier

- ▶ The **money multiplier** is the ratio of the money supply to the monetary base:
 $m = M/B$.

Using $M = C_u + D$ and $B = C_u + R$:

$$\begin{aligned} m &= \frac{M}{B} = \frac{C_u + D}{C_u + R} \\ &= \frac{C_u/D + 1}{C_u/D + R/D} = \frac{cr + 1}{cr + rr}. \end{aligned}$$

Deriving the Money Multiplier

- ▶ The **money multiplier** is the ratio of the money supply to the monetary base:
 $m = M/B$.

Using $M = C_u + D$ and $B = C_u + R$:

$$\begin{aligned} m &= \frac{M}{B} = \frac{C_u + D}{C_u + R} \\ &= \frac{C_u/D + 1}{C_u/D + R/D} = \frac{cr + 1}{cr + rr}. \end{aligned}$$

$$M = mB, \quad m = \frac{1 + cr}{rr + cr}.$$

With rr and cr fixed, $\Delta M = m \Delta B$.

With $rr < 1$, we have $m > 1$: deposits allow the money supply to exceed the base.

A Numerical Example

Given $B = 1,200$, $rr = 0.1$, **and** $cr = 0.2$, **find** M .

A Numerical Example

Given $B = 1,200$, $rr = 0.1$, **and** $cr = 0.2$, **find** M .

$$m = \frac{1 + 0.2}{0.1 + 0.2} = 4, \quad M = 4 \times 1,200 = 4,800.$$

A Numerical Example

Given $B = 1,200$, $rr = 0.1$, **and** $cr = 0.2$, **find** M .

$$m = \frac{1 + 0.2}{0.1 + 0.2} = 4, \quad M = 4 \times 1,200 = 4,800.$$

Check where the money is held:

$$B = (cr + rr)D \Rightarrow D = \frac{1,200}{0.3} = 4,000,$$
$$C_u = crD = 800, \quad R = rrD = 400.$$

$$M = 800 + 4,000 = 4,800, \quad B = 800 + 400 = 1,200.$$

What Changes the Money Supply?

Each comparison changes one input from the same baseline.

$$M = \frac{1 + cr}{rr + cr} B.$$

Case	B	rr	cr	m	M
Baseline	1,200	0.1	0.2	4.0	4,800
Higher monetary base	1,320	0.1	0.2		
Higher reserve ratio	1,200	0.2	0.2		
Higher currency ratio	1,200	0.1	0.4		

What Changes the Money Supply?

Each comparison changes one input from the same baseline.

$$M = \frac{1 + cr}{rr + cr} B.$$

Case	B	rr	cr	m	M
Baseline	1,200	0.1	0.2	4.0	4,800
Higher monetary base	1,320	0.1	0.2	4.0	5,280
Higher reserve ratio	1,200	0.2	0.2		
Higher currency ratio	1,200	0.1	0.4		

Higher B : with both ratios fixed, more base money supports proportionally more currency and deposits. M rises by 10%.

What Changes the Money Supply?

Each comparison changes one input from the same baseline.

$$M = \frac{1 + cr}{rr + cr} B.$$

Case	B	rr	cr	m	M
Baseline	1,200	0.1	0.2	4.0	4,800
Higher monetary base	1,320	0.1	0.2	4.0	5,280
Higher reserve ratio	1,200	0.2	0.2	3.0	3,600
Higher currency ratio	1,200	0.1	0.4		

Higher rr : banks keep more reserves per unit of deposits. The same base supports fewer loans and deposits, reducing M .

What Changes the Money Supply?

Each comparison changes one input from the same baseline.

$$M = \frac{1 + cr}{rr + cr} B.$$

Case	B	rr	cr	m	M
Baseline	1,200	0.1	0.2	4.0	4,800
Higher monetary base	1,320	0.1	0.2	4.0	5,280
Higher reserve ratio	1,200	0.2	0.2	3.0	3,600
Higher currency ratio	1,200	0.1	0.4	2.8	3,360

Higher cr : the public holds more of the base as currency, leaving fewer reserves to support deposits. The fall in deposits exceeds the rise in currency.

What Changes the Money Supply?

Each comparison changes one input from the same baseline.

$$M = \frac{1 + cr}{rr + cr} B.$$

Case	B	rr	cr	m	M
Baseline	1,200	0.1	0.2	4.0	4,800
Higher monetary base	1,320	0.1	0.2	4.0	5,280
Higher reserve ratio	1,200	0.2	0.2	3.0	3,600
Higher currency ratio	1,200	0.1	0.4	2.8	3,360

A higher B increases M when the ratios stay fixed. A higher rr or cr reduces the deposits supported by a given base.

Special case: with no public currency ($cr = 0$), $m = 1/rr$.

Reserve and Currency Ratios in the Data

United States, January 2021: monthly averages, USD billions

Here D includes **all M1 deposits, including savings deposits**. All figures below are **not seasonally adjusted**.

Public currency, C_u	1,989.3
Deposits, D	16,114.9
Monetary base, B	5,248.0
Bank reserves, $R = B - C_u$	3,258.7

$$rr = \frac{R}{D} \simeq 20.2\%, \quad cr = \frac{C_u}{D} \simeq 12.3\%.$$

- ▶ rr measures **actual reserves relative to deposits**, rather than the legally required minimum (**0% in the US in January 2021**).
- ▶ These ratios vary over time and depend on the definition of deposits.

Source: Federal Reserve, H.6, 23 February 2021, Tables 1 and 3; Reserve Requirements; author's calculations. R includes vault cash and balances at the Fed. Published vintage; rounded.

Why the Central Bank Cannot Precisely Set Broad Money

$$M = mB, \quad m = \frac{1 + cr}{rr + cr}.$$

- ▶ The public can change its currency–deposit ratio, cr .
- ▶ Banks can change reserves relative to deposits, rr ; loan demand and credit conditions also change.

Why the Central Bank Cannot Precisely Set Broad Money

$$M = mB, \quad m = \frac{1 + cr}{rr + cr}.$$

- ▶ The public can change its currency–deposit ratio, cr .
- ▶ Banks can change reserves relative to deposits, rr ; loan demand and credit conditions also change.
- ▶ The formula follows from balance-sheet definitions. Predicting $\Delta M = m\Delta B$ additionally requires **stable ratios**.
- ▶ Modern monetary policy affects lending and spending mainly through financing conditions. Deposit creation is not a fixed mechanical response to additional reserves.

What to Remember

- ▶ **Money supports transactions.** Its measured quantity depends on which liquid assets are included.
- ▶ **Bank lending creates deposits and debt.** It increases liquidity; the loan itself does not create net wealth.
- ▶ **Capital absorbs losses; reserves provide liquidity.** Leverage and bank runs can threaten financial stability.
- ▶ **The money multiplier depends on behavior.** $M = mB$ gives a fixed policy multiplier only when its ratios stay fixed.
- ▶ **Central banks influence monetary conditions.** Their tools, mandates, and independence determine how they act.

Next session: money demand, money-market equilibrium, and the LM curve.