Monetary System

Rodrigo Pacheco

Columbia University

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Today's plan:

- What is Money?

- What is the role of the banking system in determining the amount of Money in the economy?

- How does a nation's central bank influence the banking system and the money supply?

What is money?

When we say that a person has a lot of Money, we usually mean that he is wealthy.

Economists, however, use the term "Money" in a more specialized way.

Money is the stock of assets that can be readily used to make transactions.

Roughly speaking, the dollars (or, in other places, euros, pesos...) in the hands of the public make up the economy's stock of Money.

Money has three purposes: It is a store of value, a unit of account, and a medium of exchange.

- ⚠ When determining if something can be called money, it needs to satisfy these three purposes above!

Money provides a smart way of circumventing the double coincidence of wants:

- The unlikely happenstance of two people each having a good that the other wants at the right time and place to make an exchange.

What is money?

Store of value:

- Money is a way to transfer purchasing power from the present to the future.
- If you work today and earn $100, you can hold the Money and spend it later.
- Money is not a perfect store of value, though: inflation!

Unit of account:

- Money provides the metric people use to quote prices of every good and record debts.
- A car dealer says that a car costs $40,000, not 800 shirts.

Medium of Exchange:

- Money is what people use to buy goods and services.
- When you walk into stores, you are confident that shopkeepers will accept your Money in exchange for the items they sell.
- Money is the economy's most liquid asset!
  - Liquidity: The ease with which an asset can be converted into the medium of exchange and used to buy other things.

The Types of Money

There are two types of Money: Fiat money and Commodity money.

Fiat Money:

- These pieces of green paper with small portraits of famous Americans you have in your wallet!
- Has no intrinsic value.
- It is established as money by government decree, or fiat.

Commodity money:

- It is a type of money that has intrinsic value.
- The most widespread example is gold, in the past.
- Gold standard:
  - When people use gold as Money (or use paper money redeemable for gold).
  - Was common throughout the world during the late nineteenth century!

From Commodity money to Fiat money

What would make people start valuing these pieces of green paper that are intrinsically useless?

It all started in an attempt to reduce the transaction costs when buying/selling something!

It is not surprising that some form of commodity money arises to facilitate exchange: gold, for example.

Now, imagine an economy in which people carry around bags of gold.

- When making a purchase, the buyer measures out the appropriate amount of gold.
- If the seller is convinced that the gold's weight and purity are correct, the exchange is made.
- Such a painful experience: it takes time to verify the purity of the gold and to measure the correct quantity.

From commodity money to Fiat money

The government tries to make our lives easier by minting gold coins of known purity and weight.

People are happier with this new improvement.

Next step: Government now accepts gold from the public in exchange for pieces of paper that can be redeemed for a specific quantity of gold.

If people believe the government's promise, the bills are just as valuable as the gold itself.

In addition, because the bills are lighter than gold (and gold coins), they are easier to use in transactions.

Eventually, no one carries gold anymore, and these gold-backed government bills become the monetary standard.

From commodity to Fiat money

At some point, the gold backing becomes irrelevant!

- If no one ever bothers to redeem the bills for gold, no one cares if the option is abandoned.
- As long as everyone accepts the paper bills in exchange, the bills will have value and serve as money.

Thus, the system of commodity money evolves into a system of fiat money.

In the end, the use of Money becomes a social convention:

- Everyone values fiat money because they expect everyone else to value it.

Bitcoin - Is it Money?

In 2009, the world was introduced to a strange asset called Bitcoin.

It is a form of "Money" that exists only in electronic form, conceived by Satoshi Nakamoto, an anonymous computer expert (or group of experts).

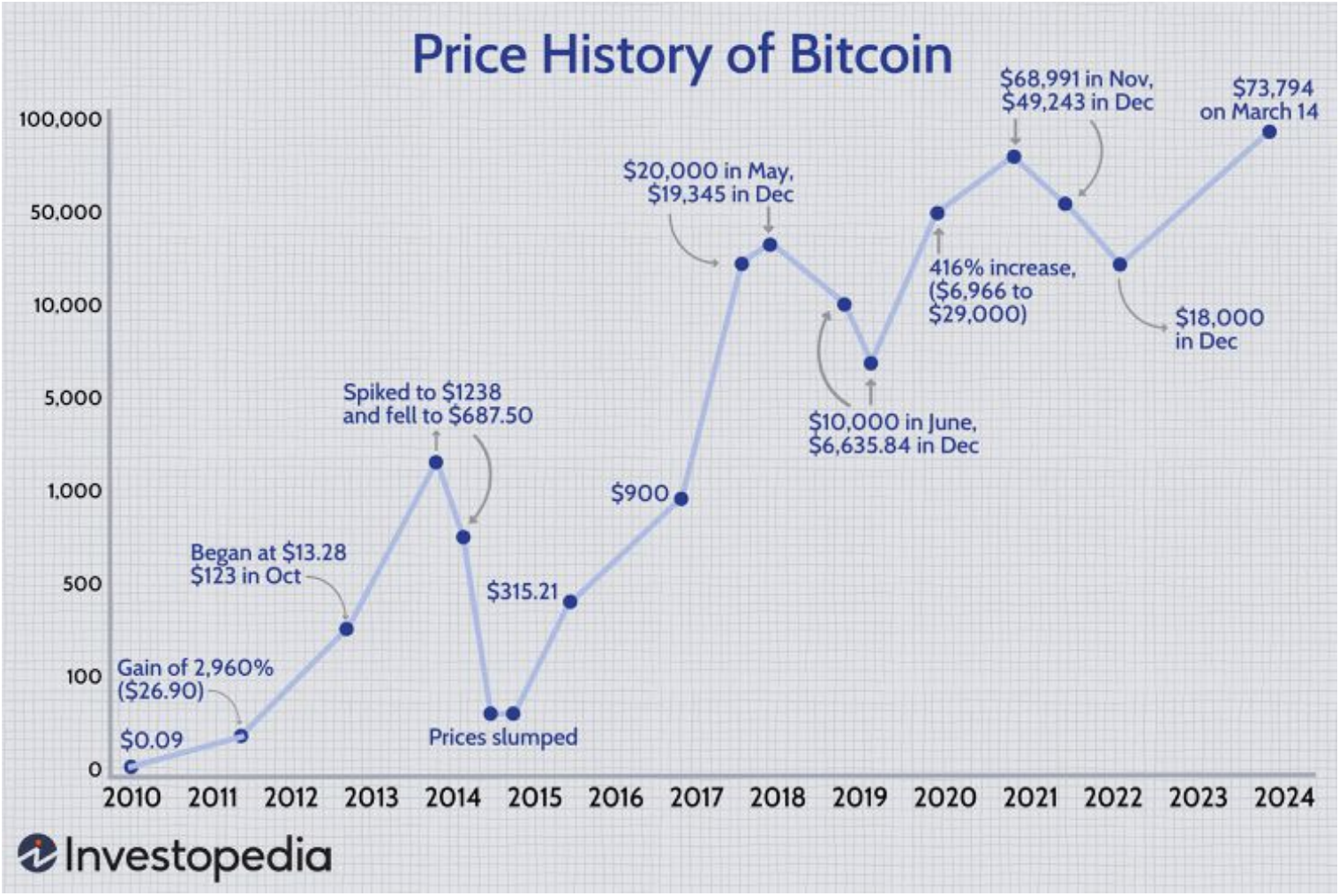
Bitcoins were initially obtained through a mining process: using computers to solve complex mathematical problems.

Now, they can be bought and sold for U.S. dollars and other currencies. The exchange rate is set by supply and demand.

The value of a bitcoin, as measured by its price in U.S. dollars, has fluctuated wildly.

A statue in Budapest dedicated to Satoshi Nakamoto - Wikipedia

Bitcoins - Is it money?



Bitcoins

Neither commodity money nor fiat money!

- They have no intrinsic value.
- They are not created by government decree.

What about the three properties we saw any type of Money must have?
Is it a:

- Store of value? Not really.
  - Large price fluctuations make it a risky way of transferring purchasing power from present to future.
- Unit of account? Not really.
  - Products and services are not generally quoted in Bitcoin.
- Medium of exchange? Not really.
  - You usually don't walk into a store expecting they will accept bitcoins in exchange for the items they are selling.

The long-term success of Bitcoin depends on whether it succeeds in performing these three functions of Money!

Measuring money in a broader sense

Money supply: the quantity of money available in the economy.

How can we measure it? Is it only cash/currency?

Not really!

Because it is hard to judge which assets should be included in the money stock, more than one measure is available.

In the U.S., the FED reports three different measures: C, M1 and M2:

- C: Currency (cash): paper bills and coins in the hands of the public.
- M1: C+ Demand deposits – balances in bank checking accounts that depositors can access on demand by writing a check or paying online.
- M2: M1+ Funds in other forms of bank accounts that can easily be transferred into checking accounts.

Measuring money in a broader sense

Symbol	Assets Included	Amount in January 2021 (bn of dollars)
C	Currency	$2,094.3
M1	Currency + Demand Deposits	18,105.4
M2	M1 + Funds in other forms of bank accounts that can easily be transferred into checking accounts	19,394.6

Each successive measure of the money supply is bigger and less liquid than the one it follows!

Who decides on the quantity of Money?

Money supply includes both currency and (different forms of) deposits.

Therefore, there are two channels for creating money:

- The central bank: through Monetary Policy.
  - Monetary policy: The government's control over the money supply.
  - In the U.S the central bank is the Federal Reserve (the Fed).
- Private banks: by offering liquid deposits.

We will start by understanding the role of banks in the monetary system and then look at the Fed.

The role of banks in the monetary system

Let's simplify things a bit and think Money Supply as consisting of two perfectly substitutable means of exchange:

$$\text{Money Supply } (M) = \text{Currency } (C) + \text{Deposits } (D)$$

C is cash, created by the Fed.

D is deposits at private banks.

To understand the money supply, we must understand the interaction between currency and demand deposits.

To do that, we first need to understand how to read Bank's Balance sheets.

Banks' Balance Sheets

We express the financial position of a bank with a balance sheet or T-account.

Three components: Assets, Liabilities and Capital.

Liabilities: What the bank owes (source of funds)

- Deposits.
- Debts.
- It is in the right side of the balance sheet.

Assets: what the bank owns (use of funds)

- Reserves:
  - The deposits that banks have received but have not lent out.
  - Some reserves are held in the vaults of local banks throughout the country, but most are held at a central bank.
- Loans
- Investments (government/corporate bonds...)
- It is in the left side of the balance sheet.

Banks' Balance Sheets

Capital or Equity:

- Opening a bank requires some money. That is, the bank owners must start with some financial resources to get the business going.
- Those resources are called: bank capital or equity.
- It's the value of the bank's assets minus the value of its liabilities.

$$\boxed{\text{Capital} = \sum \text{Assets} - \sum \text{Liabilities}}$$

How we represent it:

Assets	Liabilities
Reserves	Deposits
Loans	Debts
Investments	
	Capital/ Equity

Bank's Balance Sheet - Example

Example: Suppose a bank called RF has the following:

- Reserves = \$200
- Deposits = \$750
- Loans = \$500
- Debt = \$200
- Bonds = \$300

Let's find out how much the capital of RF is and draw its balance sheet.

Now, we are ready to understand the interaction between currency and demand deposits.

To do that, we will study two types of reserve banking system:

- 100-Percent-Reserve Banking
- Fractional-Reserve Banking

⚠ Before that, let's drink some water first. Water is good for you.

100-Percent-Reserve Banking

Suppose that there is \$1,000 of currency in the economy.

First, imagine a world without banks:

- There is no such thing called deposits.
- All money takes the form of currency.
- Then, money supply is just the amount of currency people hold: $M = C = 1000$.

Now we will introduce banks to this economy and compare with the situation with no banks.

To make things simple, let's assume that there are no investments, debts, or capital/equity!

100-percent-reserve banking

First, consider the case where a bank called FirstBank accepts deposits but does not make loans:

- The only purpose of the bank is to provide a safe place for depositors.
- Households like the safety provided and deposit the economy's entire \$1,000.
- Then, all deposits are held as reserves! $R = D = 1000$.
- This system is called 100-percent-reserve banking.

FirstBank balance sheet:

Assets	Liabilities
Reserves: \$1000	Deposits: \$1000

What is the money supply here?

$$M = C + D = D = 1000$$

The same result we got in a world without banks!

Conclusion: If banks hold 100% of deposits in reserves, the banking system does not affect the supply of money.

Fractional-Reserve Banking

A more realistic world is one where FirstBank lends out some of their deposits. Let's assume that!

FirstBank, must keep some reserves to be able to fulfill withdrawal obligations.

But, not everybody withdraws Money at the same time! The bank needs to keep only a fraction of its deposits as reserves.

Thus, FirstBank adopts a system called fractional-reserve banking.

The fraction of total deposits that a bank holds as reserves is called the reserve-deposit ratio: rr

$$\boxed{rr = \frac{R}{D}}$$

Fractional-Reserve Banking

Let's assume $rr = 0.20$ for FirstBank.

Its balance sheet after it makes a loan is:

Assets	Liabilities
Reserves: $200	Deposits: $1000
Loans: $800	

Rodrigo is the recipient of the beautiful loan from FirstBank. My balance sheet is:

Assets	Liabilities
Cash: $800 (will be spent soon on Amazon)	Loan: $800

What is the money supply here? $M = 1800$!!!

- The depositor still has a demand deposit of $1000
- Rodrigo holds $800 in currency.

Conclusion: In a system of fractional-reserve banking, banks create money.

Fractional-Reserve Banking

The creation of Money does not stop with FirstBank, though!

Let's assume the following:

- Nobody wants to keep any cash: $C = 0$!
- Those who borrow money spend it and the receivers of the money in turn deposit it at a bank.
- All banks choose a reserve-deposit-ratio of 20%.

The person who receives the Money I spent deposits it in SecondBank:

- SecondBank receives the \$800 in deposits.
- Keeps \$ 160 ($20\% \cdot 800$) in reserve.
- Lends \$640 to someone else.

SecondBank created \$640 of money!

Fractional-Reserve Banking

SecondBank's balance sheet:

Assets	Liabilities
Reserves: $160	Deposits: $800
Loans: $640	

Let's move forward! Imagine if this $640 is eventually deposited in ThirdBank:

- ThirdBank receives the $640 in deposits.
- Keeps $128 ($20\% \cdot 800$) in reserve.
- Lends $512 to someone else.

ThirdBank created $512 of money!

ThirdBank's balance sheet:

Assets	Liabilities
Reserves: $128	Deposits: $640
Loans: $512	

Fractional-Reserve Banking

This process of money creation can continue forever!

Let's check the amount of Money that the initial \$1,000 creates if this goes on forever, with an arbitrary reserve-deposit ratio rr.

$$
\begin{aligned}
\text{Initial Deposit} &= \$1000 \\
\text{FirstBank Lending} &= (1-rr) \times \$1000 \\
\text{SecondBank Lending} &= (1-rr)^2 \times \$1000 \\
\text{ThirdBank Lending} &= (1-rr)^3 \times \$1000 \\
&\vdots \\
\hline
\text{Total Money Supply} &= 1000 \cdot \left[1 + (1-rr) + (1-rr)^2 + (1-rr)^3 + \ldots\right] \\
&= (1/rr) \times \$1,000.
\end{aligned}
$$

In our example, $rr = 0.2$: The initial \$1,000 generates \$5,000 of money.

Fractional-Reserve Banking

Since consumers do not gold any cash, all the Money takes the form of deposits at banks:

$$M = C + D = 0 + 5000 = 5000$$

What about reserves?

$$rr = \frac{R}{D} \Rightarrow$$
$$R = rr \cdot D = 0.2 \cdot \$5000 = \$1000$$

⚠ The fractional-reserve banking does not create wealth, though!

- When a bank lends Money, the borrowers are undertaking debt obligations to the bank.
- So the loans do not make them wealthier!
- It just increases the money supply and the economy's liquidity!

Bank Capital, Leverage, and Capital Requirements

Banks increase liquidity, as we just saw. This is good!

But the model we considered is very simple: we are neglecting bank capital.

Let's go back to a more realistic balance sheet of a bank which we saw before:

Assets	Liabilities
Reserves: $200	Deposits: $750
Loans: $500	Debt: $200
Securities: $300	
	Capital: $50

This beautiful bank obtains resources from:

- Its owners who provide capital.
- Customers by taking in deposits.
- Investors by issuing debt.

Bank Capital, Leverage, and Capital Requirements

These resources are used:

- As reserves.
- To make loans.
- To buy financial securities, such as government or corporate bonds.

Leverage: a fundamental phenomenon in the banking system.

- The use of borrowed money to supplement existing funds for purposes of investment.
- A bit dangerous.

A key indicator of Leverage is the Leverage Ratio:

$$\text{Leverage ratio} = \frac{\text{Total Assets}}{\text{Capital}}$$

Bank Capital, Leverage, and Capital Requirements

In our example:

$$\text{Leverage ratio} = \frac{1000}{50} = 20$$

What does this mean?

- Of the \$20 of assets, \$19 are financed with borrowed money

That seems dangerous. Let's see why:

- Suppose that some of the securities the bank owns lose value.
- Say the bank assets decreases by 5% and is now worth \$950.
- The bank owes \$950 to depositors and debt holders, and they have the right to be paid first!

How much is the bank capital now?

$$\text{Capital} = \sum \text{Assets} - \sum \text{Liabilities} = 0$$

Bank Capital, Leverage, and Capital Requirements

If assets decline by more than 5%, bank capital will be below zero.

When a bank's equity is negative, it is insolvent!

To avoid this, regulators impose minimum capital requirements on banks.

- Its goal is to ensure that banks will be able to pay off their depositors and other creditors.
- The amount of capital required depends on how safe the bank's assets are.

Let's see the importance of the leverage ratio as an amplifier of gains/losses in equity.

Example: A bank has initial leverage ratio of L. If the assets then change by x%, how much is the percentage change in the equity E of the bank?

$$\boxed{\frac{\Delta E}{E} = L \cdot \frac{\Delta A}{A}}$$

2008-2009 Financial crisis

Leverage played a key role in the financial crisis of 2008–2009.

During this period, declining house prices caused many financial institutions to incur losses on mortgage-backed securities.

Because of Leverage, the losses to bank capital were proportionately much larger than the losses to bank assets.

Some institutions became insolvent, e.g. Lehman Brothers.

In the aftermath, legislative and regulatory changes imposed higher and increasingly complex capital requirements for many banks.

A Model of the Money Supply

We will now consider how the central bank influences the banking system and the money supply.

To do that, we will develop a model that take into account the interactions among:

- The Fed's decision about how many dollars to create.
- Banks' decisions about whether to hold deposits as reserves or to lend them out.
- Households' decisions about whether to hold their money in the form of currency or demand deposits.

The model will have 3 exogenous variables: cr, rr and B.

A Model of the Money Supply

Monetary base B:

- It is the total number of dollars held by the public as currency C and by the banks as reserves R.
- It is directly controlled by the Federal Reserve.

$$\boxed{B = C + R}$$

Reserve–deposit ratio *rr*:

- The fraction of deposits that banks hold in reserve
- It is determined by the business policies of banks and the laws regulating banks.

$$\boxed{rr = \frac{R}{D}}$$

A Model of the Money Supply

Currency–deposit ratio cr:

- The amount of currency people hold as a fraction of their holdings of demand deposits.
- It reflects the preferences of households.

$$\boxed{cr = \frac{C}{D}}$$

The endogenous variable in our model is the money supply M:

$$M = C + D$$

We want to solve for the money supply as a function of the three exogenous variables.

A Model of the Money Supply

Start by diving the expression of M by the expression of B:

$$\frac{M}{B} = \frac{C + D}{C + R}$$

We then divide both the top and bottom of the expression on the right by D:

$$\frac{M}{B} = \frac{C/D + 1}{C/D + R/D} = \frac{cr + 1}{cr + rr}$$

Then, given the monetary base B, we can find M:

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

A Model of the Money Supply

The last equation shows how the money supply is proportional to the monetary base.

The factor of proportionality is $\frac{cr+1}{cr+rr}$:

- We denote it by m.
- It receives the beautiful name of money multiplier.

$$\boxed{M = \frac{cr+1}{cr+rr} \cdot B = m \cdot B}$$

Each dollar of the monetary base produces m dollars of money.

For this reason, central bank money, B, is called high-powered money.

A Model of the Money Supply

Example: Suppose $B = 1,000$, $cr = .4$, and $rr = 0.6$. Find M, C, D, and R.

Answer: $M = 1400$, $D = 1000$, $C = 400$ and $R = 600$.

We will now see how the three exogenous variables affect the money supply:

Monetary Base: an increase in the monetary base increases the money supply by the same percentage.

Reserve-deposit ratio:

- The lower the rr, the more loans banks make and the more money banks create.
- A decrease in $rr \Rightarrow$ increase in m, thus increasing M.

Currency-deposit ratio:

- The lower the cr:
  - The fewer dollars of the monetary base the public holds as currency.
  - The more base dollars banks hold as reserves.
  - The more money banks can create.
- A decrease in $cr \Rightarrow$ increase in m, thus increasing M.

The Instruments of Monetary Policy

Although convenient, the assumption that the Federal Reserve controls the money supply directly is not quite right.

The Fed controls the money supply indirectly through various instruments.

These instruments can be classified into two broad groups:

- Instruments that affect the monetary base:
  - Open Market Operations (OMO).
  - Lending reserves to banks.

- Instruments that affect the reserve-deposit ratio:
  - The interest rate on reserves banks keep at the Fed.
  - Reserve requirements regulations.

Open Market Operations

Open-market operations (OMO) are the purchases and sales of government bonds by the Fed.

OMO changes the monetary base in the economy.

- Fed buys bonds $\Rightarrow$ Increase in B:
  - Whoever had these bonds before received money for it, thus increasing B.
  - These bonds are scarcer now, since demand increased.
  - Their price today must go up.
  - Yield (return) must go down, since the "price" of these bonds in the future is fixed.

- Fed sells bonds $\Rightarrow$ Decrease in B:
  - Whoever bought these bonds payed for it, thus decreasing B.
  - More bonds available in the market.
  - Their price today must go down.
  - Yield (return) must go up, since the "price" of these bonds in the future is fixed.

Open Market Operations

⚠ Let me emphasize this: OMO changes the monetary base in the economy.

- It changes both R and C, not just one of them!
- If I say that the Fed bought \$1000 worth of bonds, this means B increased by \$1000.
- The final effect in C and R will depend on the exogenous variables cr and rr!

Example: Let's go back to our previous example: $B = 1,000$, $cr = 0.4$, and $rr = 0.6$. Suppose now the Fed decides to sell \$200 worth of bonds. Assume that the other exogenous variables in the model don't change. Find the new B, C, R, D and M. *Answer*: $B = 800$, $D = 800$, $C = 320$. $R = 480$. $M = 1120$

Note that: The \$200 decrease in B can be decomposed as:

- $400 - 320 = 80$ currency/cash.
- $600 - 480 = 120$ bank reserves.

Banking lending

The Fed can also alter the monetary base by lending reserves to banks.

Banks can borrow from the Fed at the discount window.

The discount rate: the interest rate the Fed charges on those loans.

The lower the discount rate:

- the cheaper are borrowed reserves.
- the more banks borrow at the Fed's discount window.

A reduction in the discount rate $\Rightarrow$ raises the monetary base and the money supply.

When the Fed lends to a bank that is having trouble obtaining funds from elsewhere, it is said to act as the lender of last resort.

Interest on reserves at the Fed

We will now see how the Fed can change the reserve-deposit ratio:

- Reserve Requirements.
- Interest on reserves.

Reserve requirements: Fed regulations that impose a minimum reserve–deposit ratio on banks.

An increase in reserve requirements tends to:

- raise the reserve–deposit ratio $\Rightarrow$
- lower the money multiplier $\Rightarrow$
- lower the money supply.

However, banks may hold excess reserves, i.e. above the minimum required.

This is the least frequently used of the Fed's policy instruments.

In March 2020, the Fed eliminated reserve requirements entirely.

Interest on reserves

In October 2008, the Fed started paying interest on reserves.

When a bank holds reserves on deposit at the Fed, the Fed now pays the bank interest on those deposits.

This gives the Fed another tool with which to influence the economy.

The higher the interest rate on reserves:

- the more reserves banks will choose to hold $\Rightarrow$
- the higher the reserve deposit ratio $\Rightarrow$
- the lower the money multiplier $\Rightarrow$
- the lower the money supply.

Arguably the most important instrument of monetary policy in recent years.

The federal funds market

Funds kept in reserve are called federal funds.

The market for bank reserves is called the federal funds market.

Banks that have excess reserves at the end of the day lend them to banks that have insufficient reserves.

The federal funds rate is the rate at which commercial banks borrow and lend their excess reserves to each other overnight.

The target for this interest rate is set by the Federal Open Market Committee (FOMC).

- Before December 2008, the Fed targeted a specific rate, e.g. 3%.
- After that, the Fed started targeting a range for this rate, e.g. today the target is 5.25%-5.50%.

The federal funds market - How does it work?

The Fed sets a target for the fed funds rate after reviewing current economic data.

The FOMC meets about every six weeks and it votes on a target for this interest rate that will apply until the next meeting.

After the meeting is over, the Fed's bond traders (who are in New York) are told to conduct the open-market operations necessary to hit that target.

To increase the federal funds rate, the Fed decreases the supply of reserves (sells bonds) and vice versa.

The change in the fed funds rate always makes front page news.

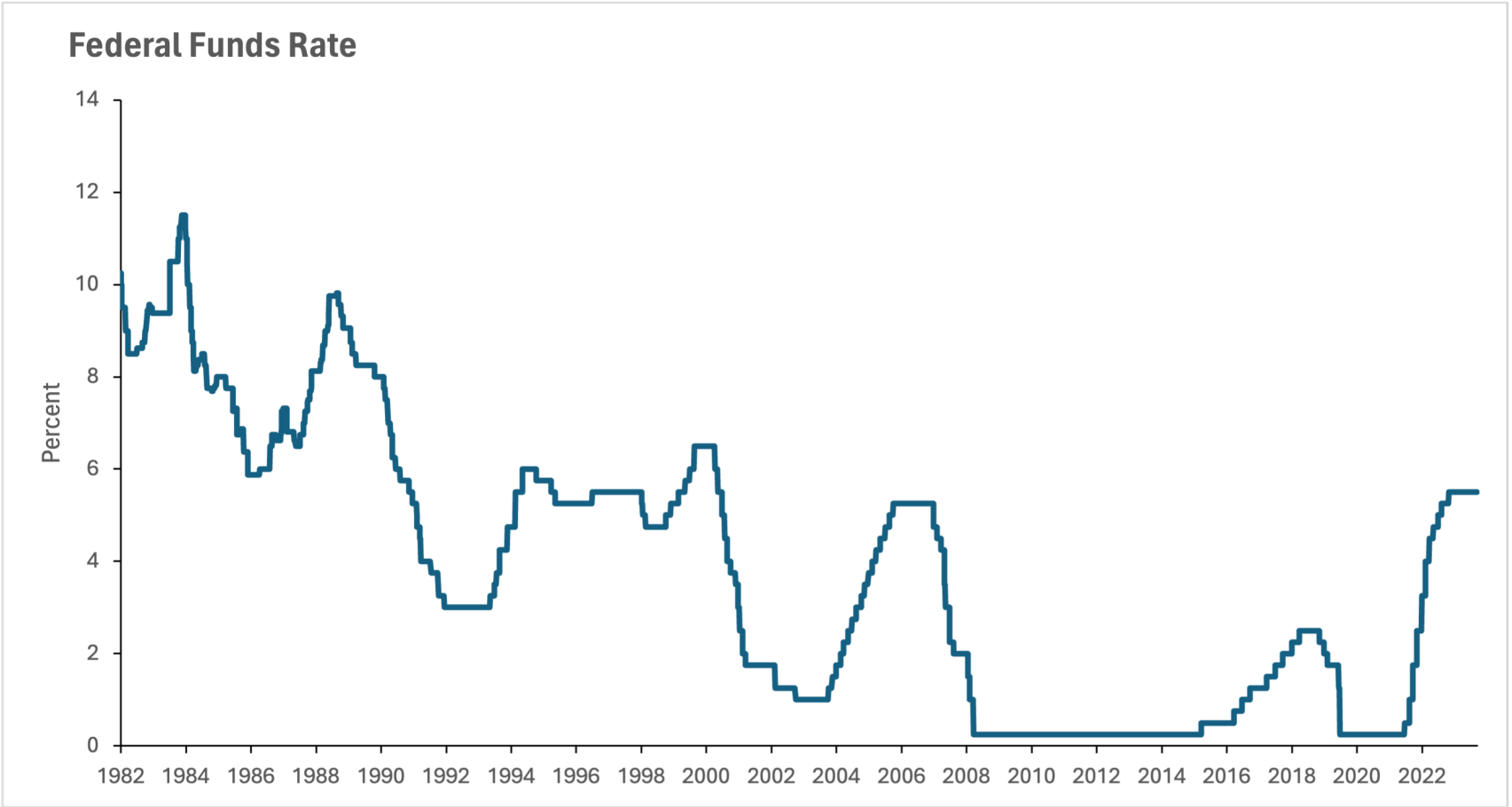
From the NYT, May 1st, 2024:

Live Updates: Fed Holds Rates, Noting 'Lack of Further Progress' on Inflation

The Federal Reserve left interest rates unchanged and Jerome H. Powell, the central bank's chair, said that gaining greater confidence in bringing down inflation would "take longer than previously expected."

May 1, 2024

Federal Funds Rate - History



Since December 2008, this plot is displaying the upper limit of the range targeted by the Fed!

Federal Funds Rate - Why so important?

We saw that the federal funds rate is the rate at which commercial banks borrow and lend their excess reserves to each other.

Why should we care about this?

If the costs of borrowing reserves are rising, then banks will decide to pass it along to consumers in the form of higher interest rates.

- It will likely increase the rates of loans and mortgages.
- It will likely increase the saving yields too, to attract more deposits.

We will see later in this course that an increase in interest rates tends to cool the economy, lowering inflation.

Problems in monetary control

The Fed has substantial power to influence the money supply.

However, it cannot control the money supply perfectly. Why?

Changes in the behavior of banks:

- Banks may choose to hold more excess reserves, lowering the money supply.

Changes in household behavior:

- If households decide to hold more of their money in the form of currency, the currency–deposit ratio increases and the money supply falls.

Hence, the money supply sometimes moves in ways the Fed does not intend!