Macroeconomics in One Equation
Lecture 5: Money and Interest Rates

Biwei Chen
Lux Mentis Scientia

Colby College
Department of Economics

Questions for Discussion

1. What is money? What are the functions of money? And how do economists measure the quantity of money in the economy?
2. What is interest (rate)? Why does interest (rate) exist? What are the determinants of interest (rate) in theory? What determine the nominal interest rate in practice?
3. What is the difference between simple interest and compound interest? How does interest (rate) affect future value and present value of a loan?
4. What are financial assets and markets? What functions do they perform in the economy? What are the key indicators in various financial markets? What is the relationship between market interest rate and asset prices?
5. In the credit (debt) market, what are the demand and supply factors determining the equilibrium interest rate for borrowing and lending?
6. What is the relationship between money and interest rate? How are they determined in the money market? How do economists apply the money market equilibrium model to financial market conditions?

Overview

- In MV=PY, the quantity of money in circulation is, first of all, a medium of market exchange for the goods and services in the economy, and then it measures the nominal value of all exchanges. Therefore, the quantity theory of money is, first and foremost, considered as an exchange equation. In this sense, money was born out of exchange.
- Money serves other critical functions in the economy as well. Storing value and wealth created in the past, money is a medium of saving for future investment and consumption opportunities.
- The borrowing and lending of money (present income) at the cost of delayed gratification establishes the existence of interest (rate), the size of which is determined by consumption impatience, investment opportunities, and risks.
- Financial markets and instruments serve as intermediaries between borrowers (debtors) and lenders (creditors). Efficient functioning of the monetary and financial system is the key to economic development, growth, and prosperity.
- Money is the most liquid asset, easily convertible to any other items. As a function of income, price level, and interest rate, demand for money is derived from the demand for goods, services, and assets. Money market equilibrium is therefore determined by demand and supply of money.

Basic Concepts: Money and Asset

Money is a standardized medium of exchange.

Fundamental properties of money:

(1) Medium of exchange; (2) Store of value; (3) Unit of account

Money (cash or currency) is the most liquid asset.

A financial asset (financial instrument or security) entitles the owner to the future cashflow to be paid by the issuer.

Safe assets play four critical roles in a financial market:

(1) they are used as a pricing benchmark;
(2) they are used as collateral in financial transactions;
(3) they are used by certain financial entities to satisfy regulatory requirements;
(4) the development of asset pricing theory and derivatives pricing relies on the existence of a safe or riskless asset.

U.S. Money Stock Measures (w) (w)

Base Money (M0)

Monetary base, or M0, equals currency in circulation plus reserve balances.

Narrow Money (M1)

M1 consists of (1) currency in circulation; (2) demand deposits at commercial banks less cash items in the process of collection and Federal Reserve float; and (3) other liquid deposits, consisting of other checkable deposits (OCDs) and savings deposits (including money market deposit accounts).

Broad Money (M2)

M2 consists of M1 plus (1) small-denomination time deposits (in amounts of less than $100,000) less IRA and Keogh balances at depository institutions; and (2) balances in retail MMFs less IRA and Keogh balances.

Note: An adjustment is made in the definitions of M1 and M2 after May 2020.

Basic Concepts: Interest and Capital

Income is a series of event, the alpha and omega of economic life.

Capital (asset) generates income. Income is determined by capital.

The value of capital (asset) is determined by the value of future incomes and the market rate of interest.

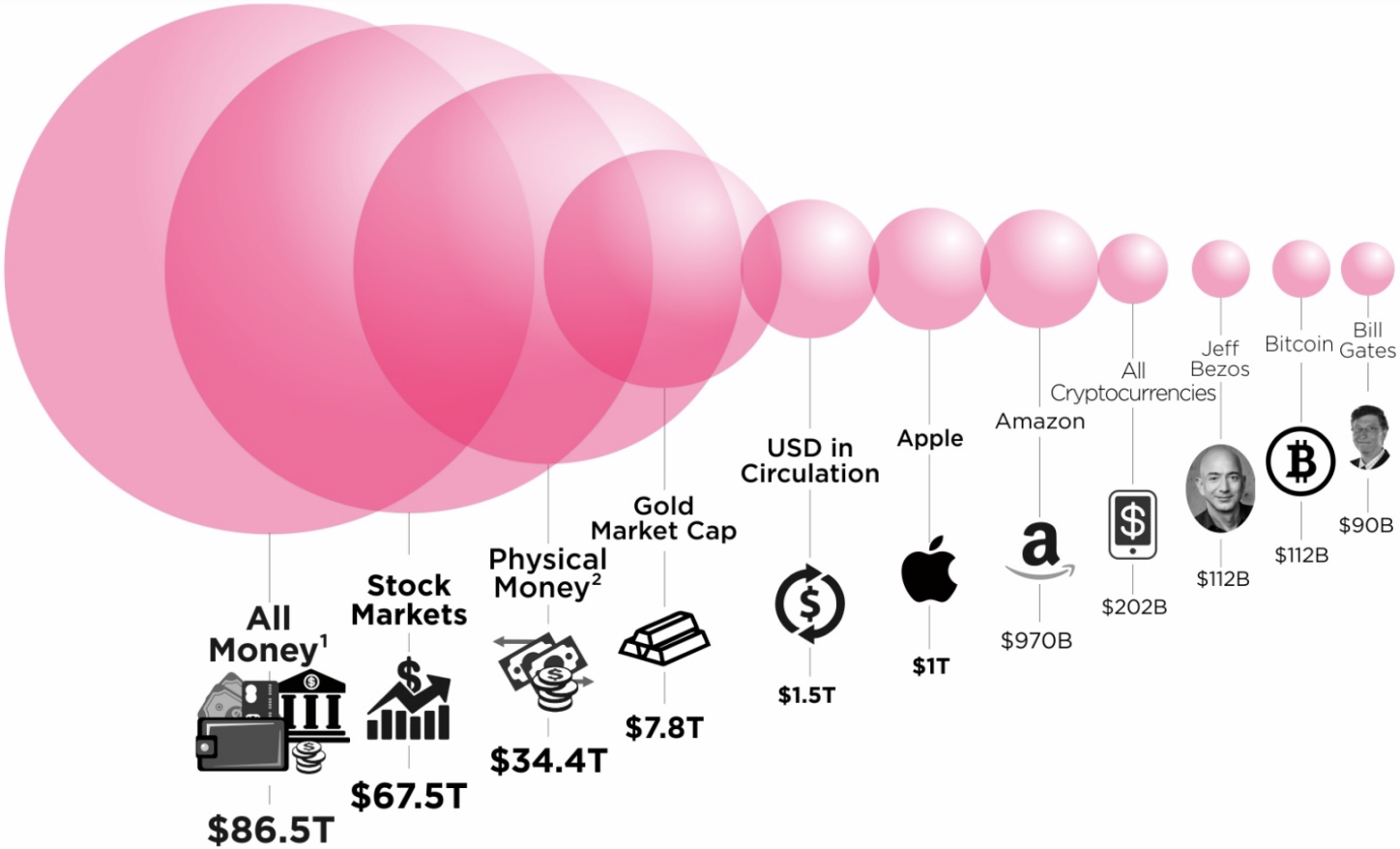
Interest is the cost of borrowing and return to lending (incomes).

Interest is the price paid to have incomes now rather than later.

Nominal interest rate is equal to real interest rate plus risk premia.

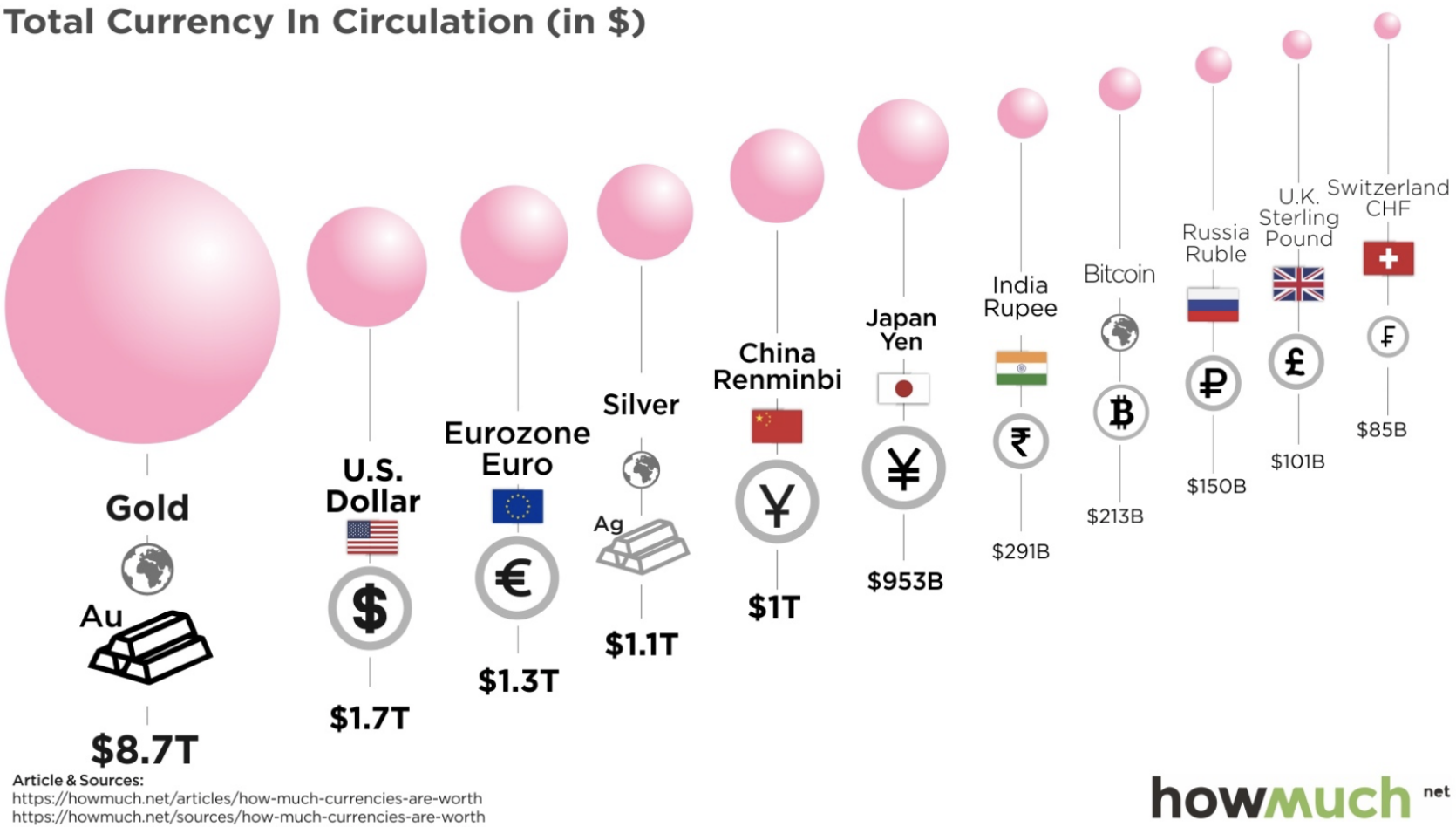
OUTLINE

Global Money in Perspective, 2018 (w)



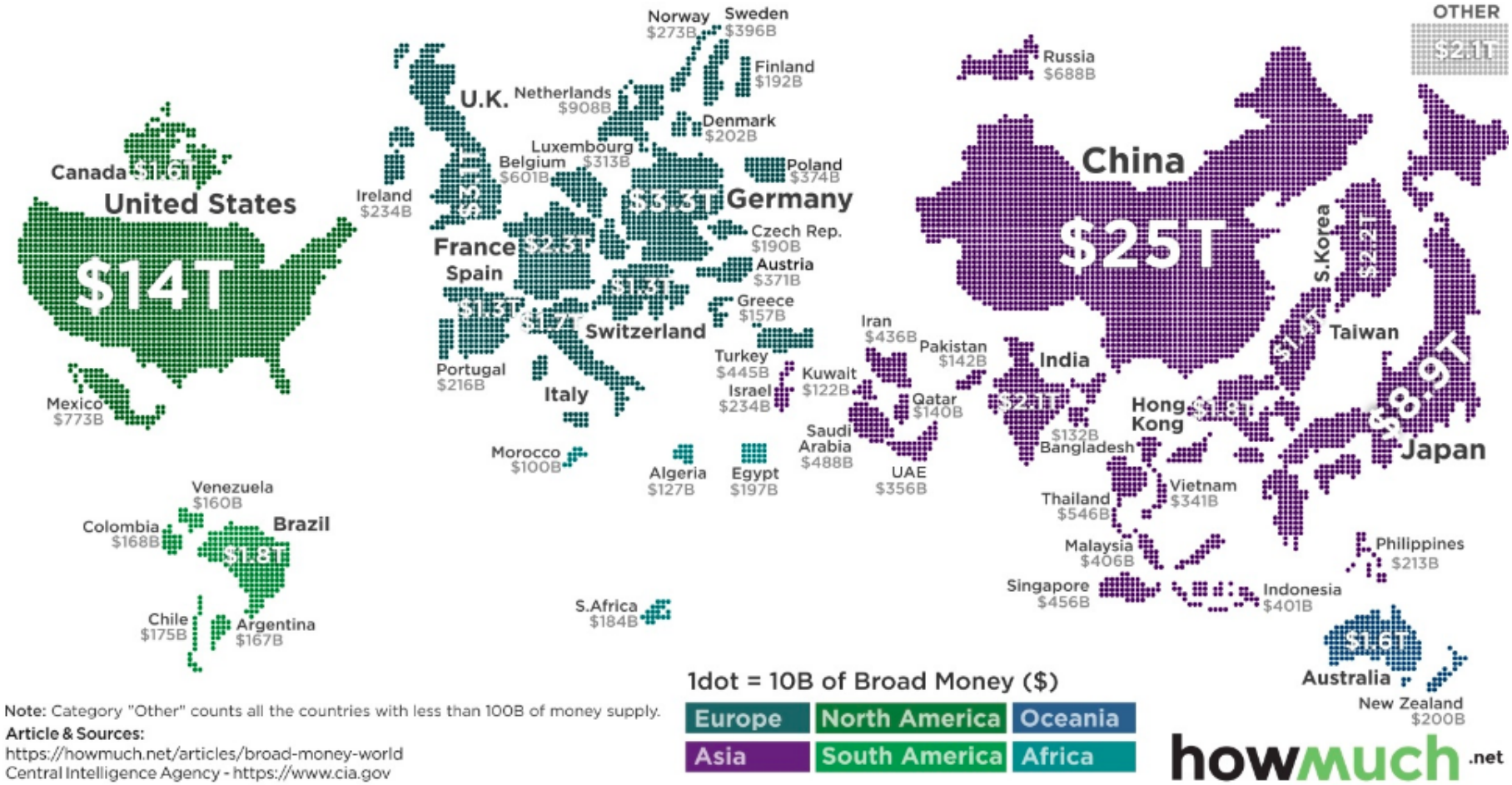
https://howmuch.net/articles/worlds-money-in-perspective-2018

Global Currencies, 2019 (w)



https://howmuch.net/articles/how-much-currencies-are-worth

Global Money Stock in Circulation, 2019 (w)



https://howmuch.net/articles/broad-money-world-2019

Global Reserve Currencies, 2019 (w)

Central banks hold foreign exchange reserves are for international payments and to support a national currency.

1. U.S. Dollar: $6.74 trillion (61.82%)
2. Euro: $2.21 trillion (20.24%)
3. Japanese Yen: $572 billion (5.25%)
4. Pound Sterling: $495 billion (4.54%)
5. Chinese Renminbi: $213 billion (1.95%)

Article & Sources:
https://howmuch.net/articles/worlds-top-reserve-currencies-2019
International Monetary Fund - http://data.imf.org

howmuch.net

Money: Definition and Functions

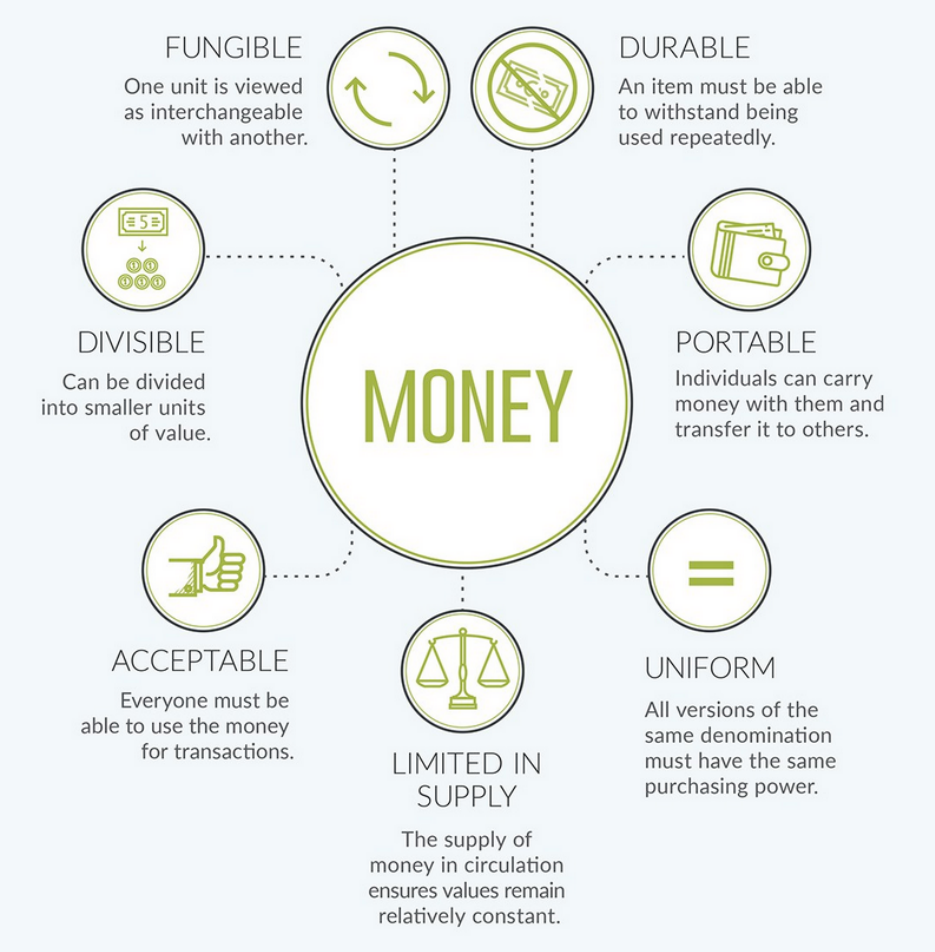
- Definition: Money is a standardized medium of exchange.
- Money, as a medium of exchange, evolves from society's persistent endeavor to reduce transaction cost.
- Money, as a unit of account, measures the value of the goods and services being exchanged. Prices are expressed in monetary units.
- Money, as a store of value, enables its owner to finance inter-temporal exchange, balancing consumption over time.
- In history, any good being chosen and developed as a universal medium of exchange can be defined as money. Other functions of money are derived henceforth. In a modern economy, however, money carries a more vital role —- credit and debt instrument.
- Money stores joint memories of income and wealth in human society.

All money is a matter of belief. –Adam Smith

Properties of Money (w)

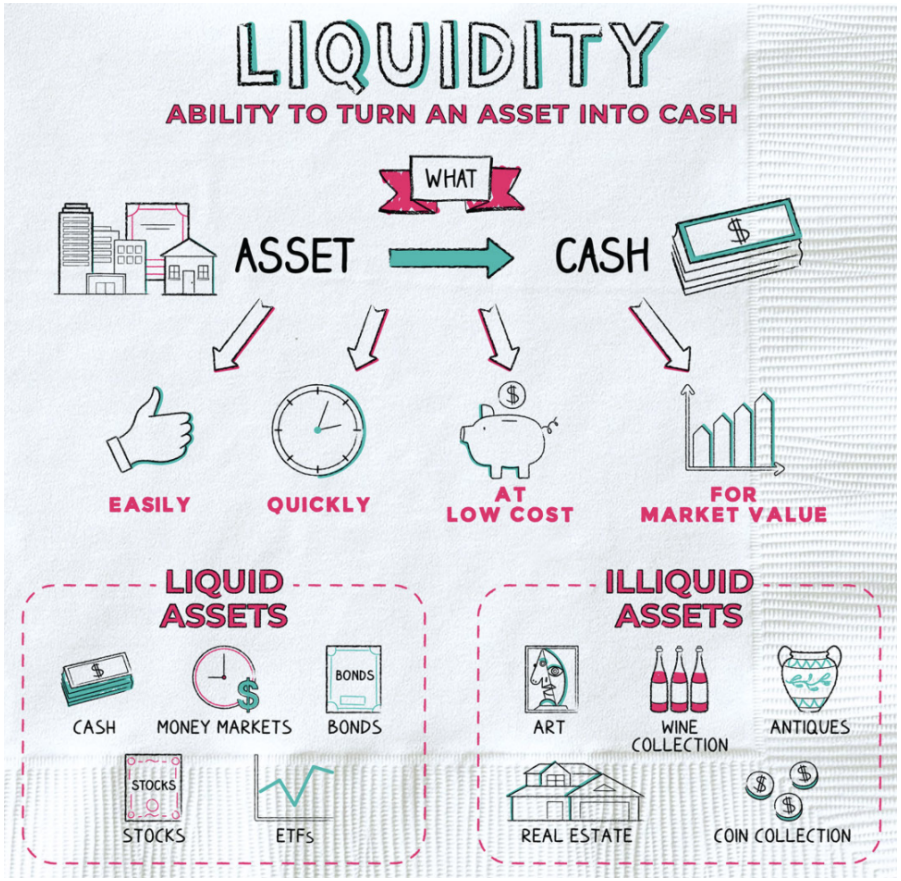
Are these money?

- Checks
- Pensions
- Gold and silver
- Checking accounts
- Savings accounts
- Credit card
- Debit card
- Diamond
- Bitcoin



https://sunnyclo.ipower.com/pearlsofliberty/

Money, Asset, and Liquidity (w)



https://napkinfinance.com/napkin/liquidity/

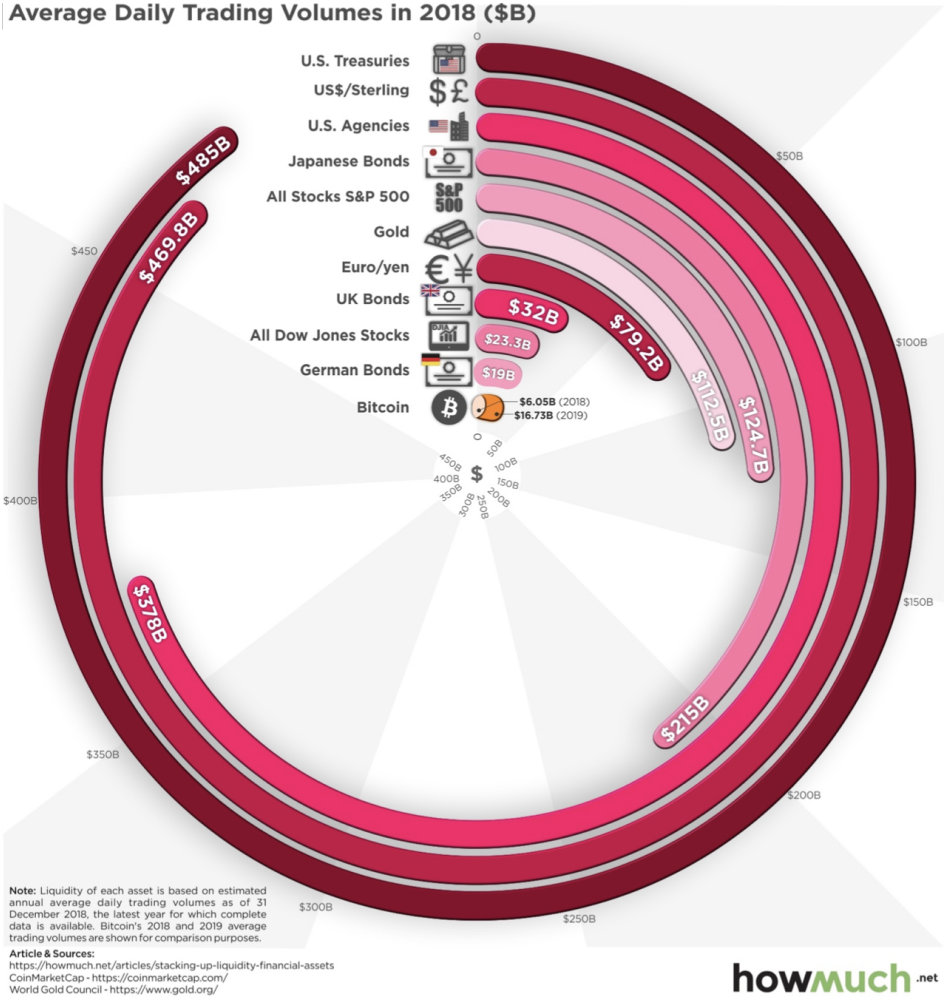
Assets are liquid if they can be exchanged for cash:

- Easily and quickly
- At little or no transaction cost
- At their fair market values, i.e., without having to entice a buyer with a big discount

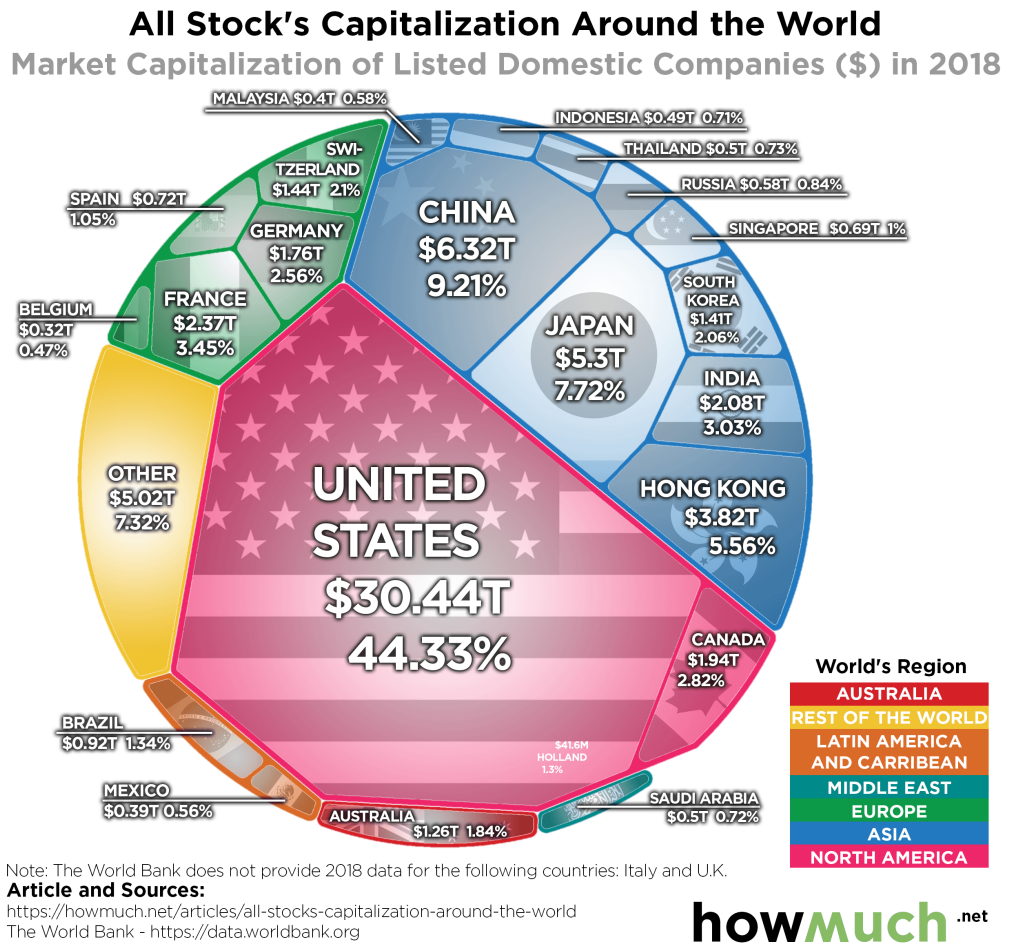
Liquidity refers to the ease with which an asset, or security, can be converted into ready cash without affecting its market price. Cash (money) is the most liquid asset because you can easily turn it into other assets.

Source: Investopedia.

Global Financial Assets Trading Liquidity (w)



1. U.S. treasuries are by far the most liquid class of assets, averaging some $485B per day in 2018.
2. Gold remains a highly liquid asset even in the age of fiat and crypto, topping $112.5B in 2018.
3. Bitcoin's average daily liquidity surged from 2018 to 2019, rising from $6.05B to $16.73B.
4. Despite its volatility, bitcoin sees almost as much daily liquidity as German bonds ($16.7B vs $19B).



Source: Howmuch.net (w). Note: World Bank data does not include the U.K. (LSE: $4.7T) and Italy ($0.65T).

1. The U.S. stock market is 5 times the size of the closest competitor.
2. In fact, the U.S. is so large it accounts for just under half of global equity value.
3. China makes up the largest emerging stock market with $6.32 trillion.
4. Hong Kong ($3.82T) matches half the equity value of China.
5. Small established economies as Switzerland have enormous markets relative to their population.

The Evolution of Money (w)

Medium of Exchange (Commodities)

During the period of early human civilization, any commodity that was demanded and chosen by common consent was used as a form of currency.

Goods like furs, salt, rice, wheat, weapons, animals, and much more were used as an exchange which was known as 'Barter Exchange.'

Metallic

With the progress of human civilization, commodity exchange transitioned into metallic money. Metals like gold, silver, copper, nickel, and much more were used as they could be easily handled and their quantity can be readily ascertained.

Paper

The inconveniences of carrying metallic currency seemed too dangerous and difficult because of thefts and the weight of the money. The invention of banknotes marked a very important stage in the development of money.

Paper money is regulated and controlled by a Central Bank of the country. Today, the vast majority of money consists mainly of currency notes or paper money issued by the Central Bank.

Plastic

The next type of money was the plastic payment money such as credit cards and debit cards. The aim was to remove the need for carrying cash when making transactions. With the debit card, the money comes directly from your bank account unlike the credit cards, which is a loan from the bank institution with a promise to pay back the amount used with interest each month.

Crypto

Cryptocurrency is a new revolutionary type of currency. Like any other currency or unit of account, they only have value because people give it value. Cryptocurrencies were designed as a unit of exchange and as a place to store assets without relying on a Central Bank, thus cutting out the middle person with lower fees and faster transactions time.

A move towards a more direct money transaction without having other people take a cut of your hard-earned cash.

In Mesopotamia, around the third millennium B.C., there were two types of money circulating: barley and silver. The interest rate on a barley loan was usually 33%, whereas, on silver, it was 20%. (w)

https://blog.coinpayments.net/news-features/the-evolution-of-money

https://www.huffpost.com/entry/what-is-money-explained-video_n_6511972

A Brief History of Money (w)

Source: Publish0X.

- In the beginning: Barter
- 9000 - 6000 B.C.: Cattle
- 1200 B.C.: Cowrie shells
- 1000 B.C.: First metal money and coins
- 500 B.C.: Modern coinage
- 118 B.C.: Leather money
- 806: Paper currency
- 1816: The gold standard
- 1930: End of the gold standard
- The present: Fiat money
- The future: Digital money

What Does the Bible say about Money? (w)

- 1 out of 10 verses in the Gospels deal with money
- 16 out of 38 of Jesus' parables deal with money and possessions
- Nearly 25% of Jesus' words in the NT deal with biblical stewardship
- There are more than 2,000 scriptures on tithing in the Bible, money, and possessions in the Bible, which is twice as many as faith and prayer combined.
- When it comes to breaking down what the Bible has to say about money, there are nine principles about money students can learn:
  1) God owns everything; 2) Money is a tool; 3) Worship with your money; 4) Get that money; 5) Fight for contentment; 6) Kill greed in your heart; 7) Be mindful of debt; 8) Manage your finances;
  9) Mo' money, mo' problems.

Source: Bible Verses about Money (w) (w)

OUTLINE

U.S. Money Stock Measures: Background

- The Central Bank of the United States, Federal Reserve System, has constructed and published monetary statistics since 1914.
- Timely and accurate data on the monetary aggregates are needed by the Board of Governors and the Federal Open Market Committee for use in monetary policy deliberations and by the public in assessing financial flows and conditions and their implications for the economy.
- Concepts and definitions of the money stock have evolved over time, reflecting changes in the regulatory and institutional environment.
- H.6 (money stocks) statistical release:

  `http://www.federalreserve.gov/releases/h6/current/`
- H.3 (aggregate reserves and monetary base):

  `https://www.federalreserve.gov/releases/h3/current/`
- H.4.1 (factors affecting reserve balances):

  `https://www.federalreserve.gov/releases/h41/current/default.htm`

U.S. Money Stock Measures: H.6 Release (w)

- The H.6 release, published monthly, provides measures of the monetary aggregates (M1 and M2) and their components.
- M1, the more narrowly defined measure, consists of the most liquid forms of money, namely currency and checkable deposits. Beginning May 2020, M1 also includes other liquid deposits.
- Beginning May 2020, M2 consists of M1 plus small-denomination time deposits (with the amount less than $100,000) and retail money market funds (MMFs), less IRA and Keogh balances.
- Currency in circulation consists of Federal Reserve notes and coin outside the U.S. Treasury and Federal Reserve Banks. Reserve balances are balances held by depository institutions in master accounts and excess balance accounts at Federal Reserve Banks.
- Monetary base equals currency in circulation plus reserve balances. Total reserves equal reserve balances plus, before April 2020, vault cash used to satisfy reserve requirements.

U.S. Money Stock Measures: H.6 Release

- Demand deposits at domestically chartered commercial banks, U.S. branches and agencies of foreign banks, and Edge Act corporations (excluding those amounts held by depository institutions, the U.S. government, and foreign banks and official institutions) less cash items in the process of collection and Federal Reserve float.
- Other liquid deposits consist of negotiable order of withdrawal (NOW) and automatic transfer service (ATS) balances at depository institutions, share draft accounts at credit unions, demand deposits at thrift institutions, and savings deposits, including money market deposit accounts.
- Small-denomination time deposits are those issued in amounts of less than $100,000. Individual retirement account (IRA) and Keogh account balances at depository institutions are subtracted from small-denomination time deposits.
- Total borrowings in millions of dollars from the Federal Reserve are borrowings from the discount window's primary, secondary, and seasonal credit programs and other borrowings from emergency lending facilities. Nonborrowed reserves equal total reserves less total borrowings from the Federal Reserve.

`https://www.federalreserve.gov/releases/h6/current/default.htm`

U.S. Money Stock Measures (w) (w)

Base Money (M0)

Monetary base, or M0, equals currency in circulation plus reserve balances.

Narrow Money (M1)

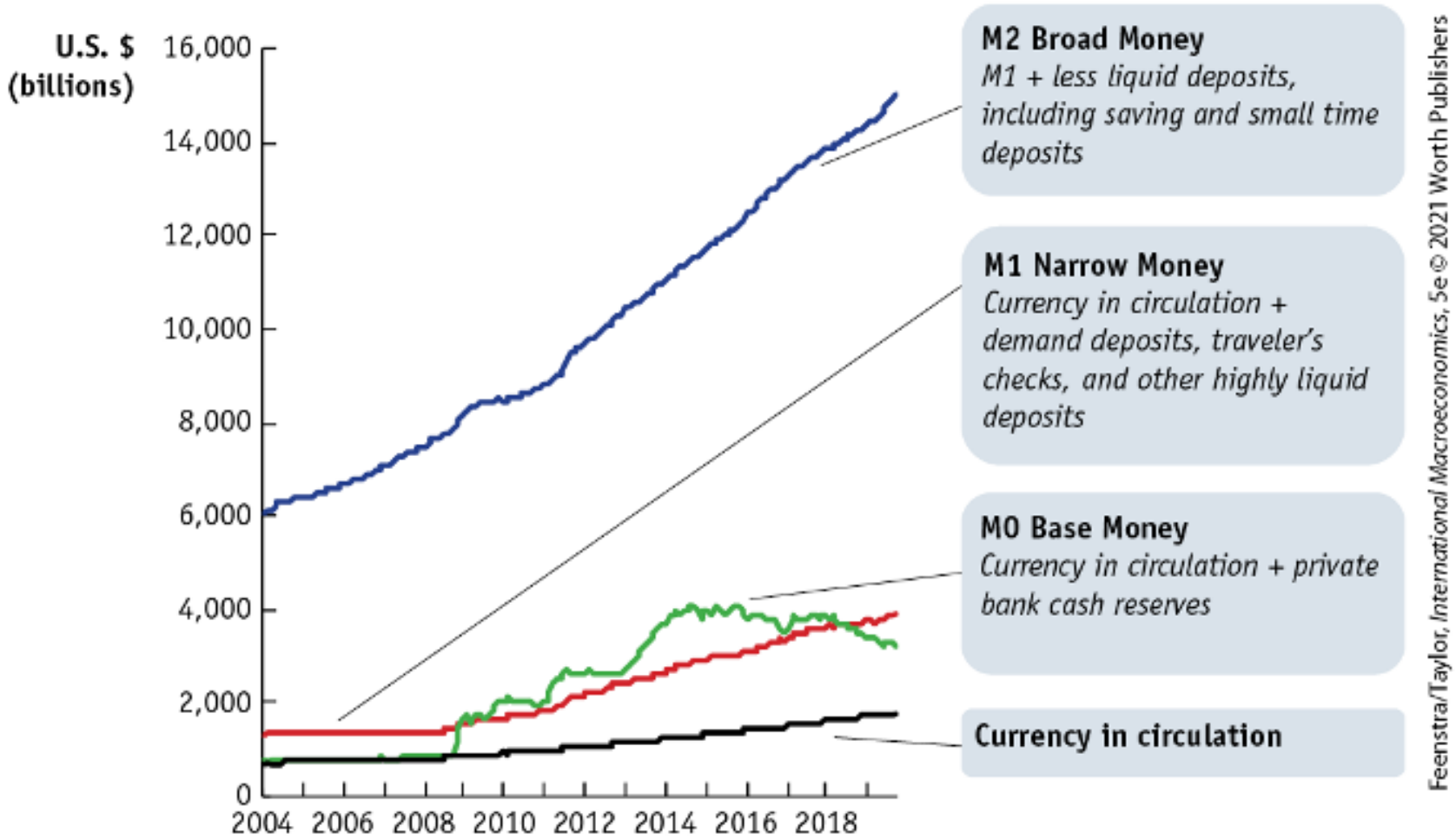
M1 consists of (1) currency in circulation; (2) demand deposits at commercial banks less cash items in the process of collection and Federal Reserve float; and (3) other liquid deposits, consisting of other checkable deposits (OCDs) and savings deposits (including money market deposit accounts).

Broad Money (M2)

M2 consists of M1 plus (1) small-denomination time deposits (in amounts of less than $100,000) less IRA and Keogh balances at depository institutions; and (2) balances in retail MMFs less IRA and Keogh balances.

Note: An adjustment is made in the definitions of M1 and M2 after May 2020.

U.S. Money Stock Measures, 2000 to 2020



U.S. Money Stock H.6 Statistics (w)

Table 1: Money Stock Measures (10)

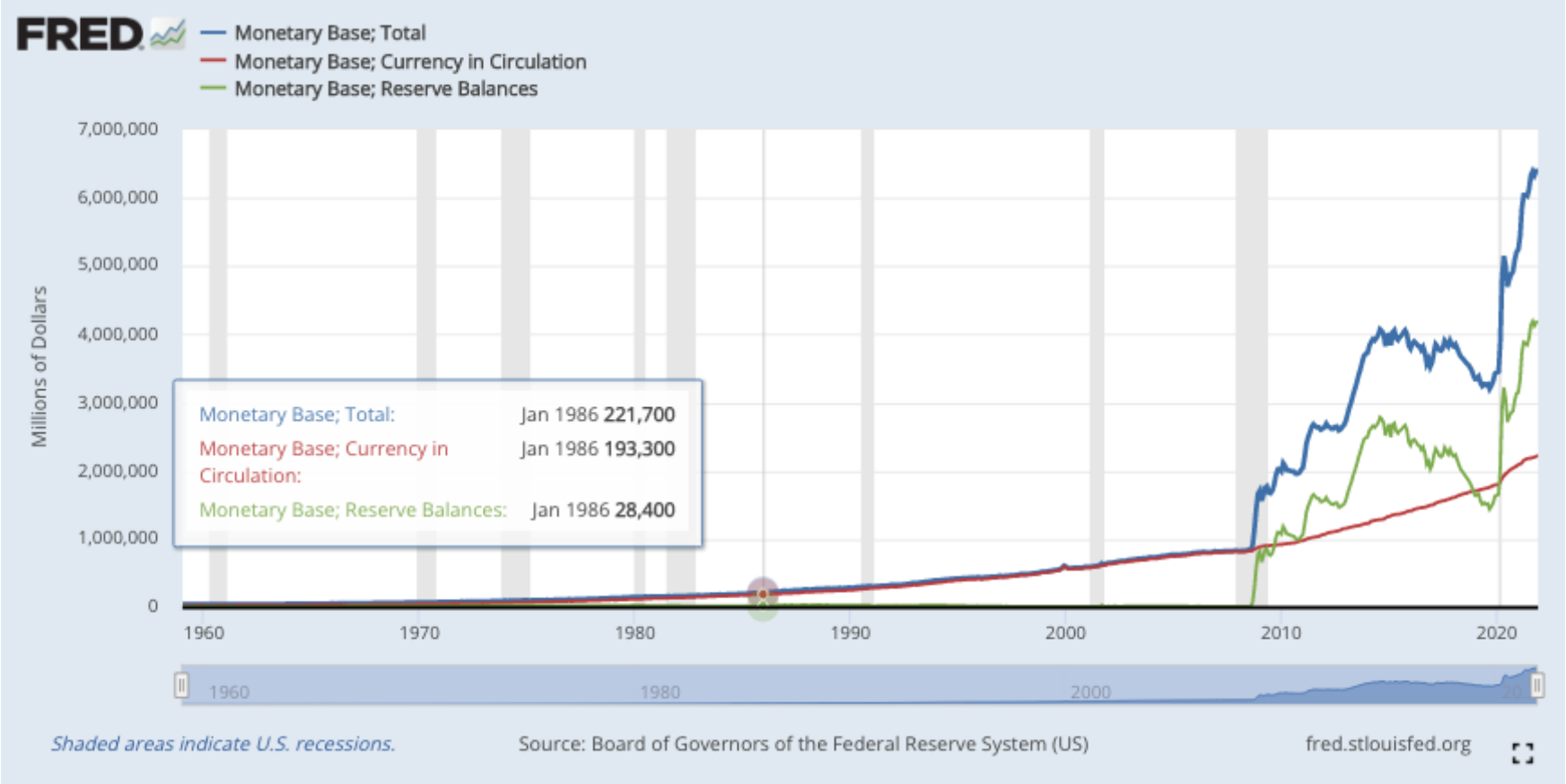
Table 2: Seasonally Adjusted Components of M1 and Non-M1 M2 (6)

Table 3: Not Seasonally Adjusted Components of M1 and Non-M1 M2 (16)

Name	Dec 2021	Nov 2021	Dec 2020	Units
▼ Seasonally Adjusted				
M1	20,553.1	20,345.4	17,812.4	Bil. of $
M2	21,638.1	21,437.0	19,129.5	Bil. of $
▼ Not Seasonally Adjusted				
▼ Monetary base	6,413,300	6,394,800	5,206,500	Mil. of $
Currency in circulation	2,225,300	2,214,300	2,071,600	Mil. of $
Reserve Balances	4,188,000	4,180,600	3,135,000	Mil. of $
M1	20,669.2	20,333.4	17,949.8	Bil. of $
M2	21,767.3	21,426.1	19,278.7	Bil. of $
▼ Memorandum: Reserves				
Total reserves	4,188.0	4,180.6	3,135.0	Bil. of $
Total borrowings from the Federal Reserve	38.0831	45.3176	58.6846	Bil. of $
Nonborrowed Reserves	4,149,900	4,135,300	3,076,300	Mil. of $

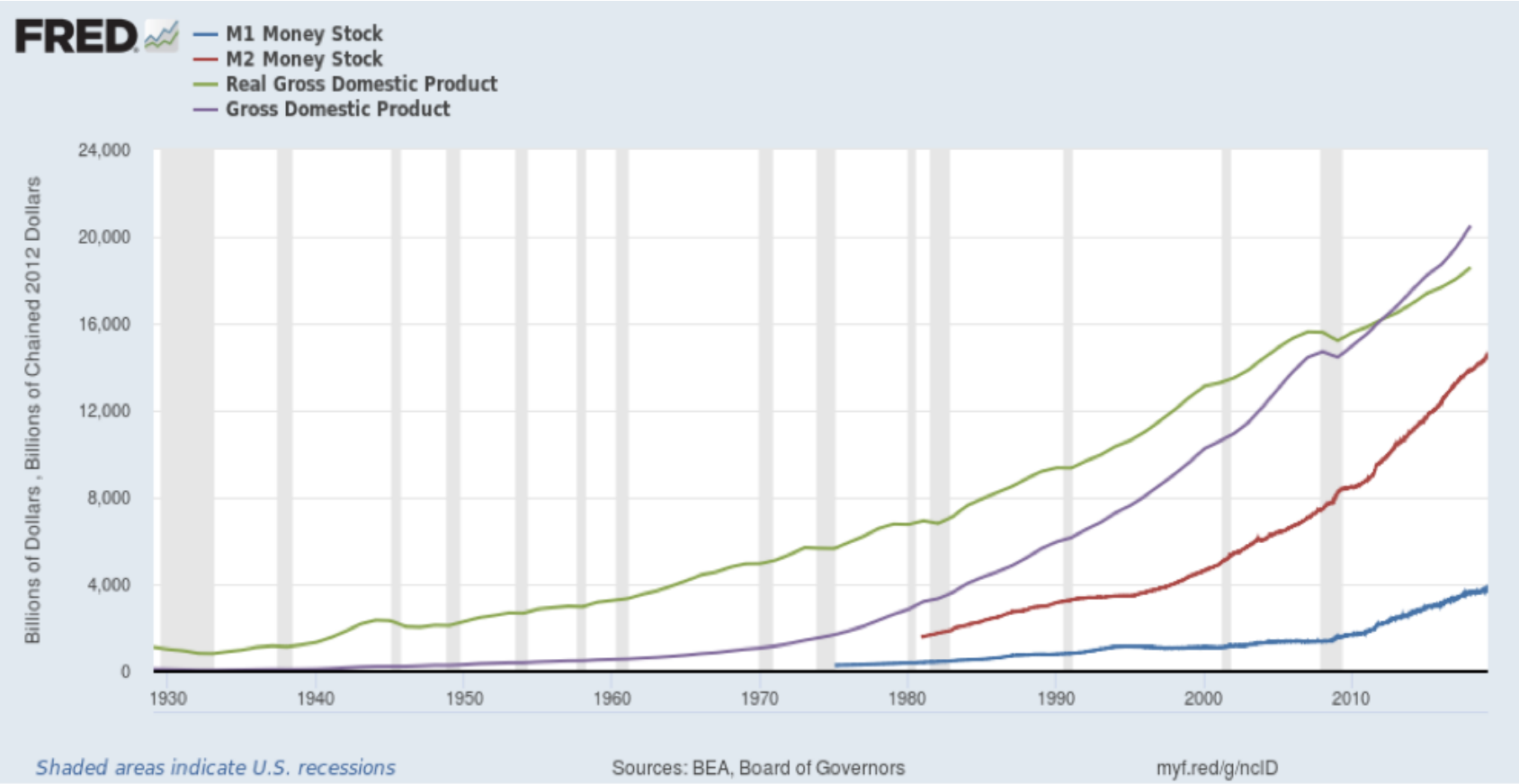
Source: FRED - H.6 Money Stock Measures, Release Tables.
https://fred.stlouisfed.org/release/tables?rid=21

U.S. Monetary Base, 1959-2021

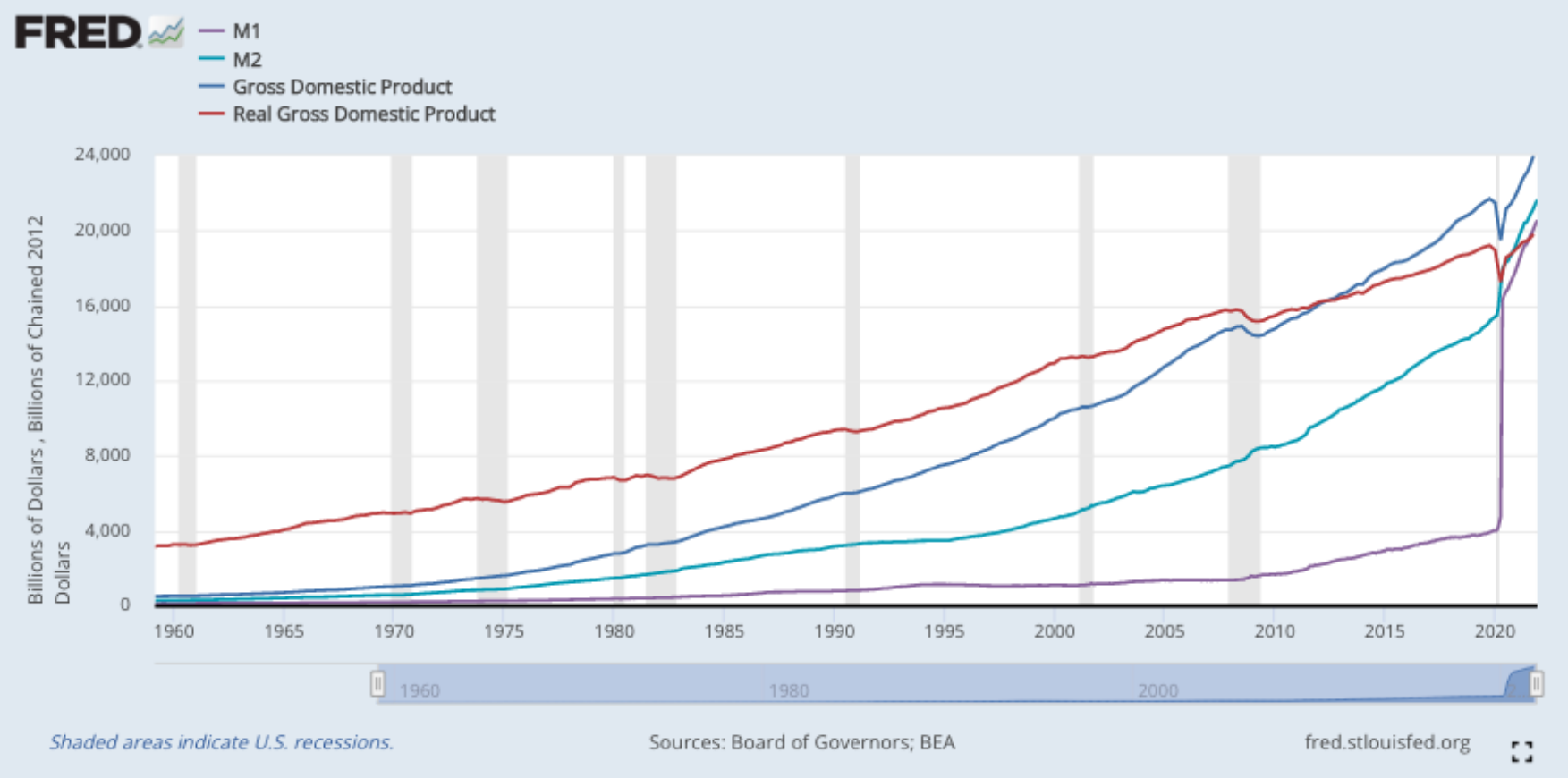


https://fred.stlouisfed.org/series/BOGMBASE

U.S. Money Stocks and National Income, 1930-2018



U.S. Money Stocks and National Income, 1960-2021



U.S. Money Stock Measures (in $B), 2020-2021

Date	Seasonally adjusted		Not seasonally adjusted							
			Monetary base					Memorandum: Reserves		
	M1 [1]	M2 [2]	Currency in circulation [3]	Reserve balances [4]	Monetary base [5]	M1 [1]	M2 [2]	Total reserves [6]	Total ($M) borrowings [7]	Nonborrowed reserves [8]
Aug. 2020	16,887.0	18,378.5	2,007.6	2,799.7	4,807.4	16,869.1	18,346.5	2,799.7	83,125.6	2,716.6
Sept. 2020	17,156.8	18,601.6	2,027.5	2,852.8	4,880.3	17,136.8	18,569.7	2,852.8	78,387.1	2,774.4
Oct. 2020	17,346.8	18,747.9	2,040.5	2,876.6	4,917.1	17,321.1	18,717.1	2,876.6	74,058.7	2,802.6
Nov. 2020	17,589.1	18,958.7	2,058.3	3,034.7	5,093.0	17,642.1	19,009.4	3,034.7	66,597.5	2,968.1
Dec. 2020	17,812.4	19,129.5	2,071.6	3,135.0	5,206.5	17,949.8	19,278.7	3,135.0	58,684.6	3,076.3
Jan. 2021	18,100.9	19,393.4	2,094.2	3,153.8	5,248.0	18,092.5	19,409.6	3,153.8	52,590.8	3,101.2
Feb. 2021	18,389.5	19,665.5	2,100.9	3,345.9	5,446.8	18,276.9	19,567.1	3,345.9	53,475.8	3,292.5
Mar. 2021	18,669.4	19,913.4	2,117.8	3,721.3	5,839.0	18,740.1	19,996.1	3,721.3	57,950.3	3,663.3
Apr. 2021	18,927.5	20,138.8	2,154.8	3,887.3	6,042.1	19,078.2	20,294.4	3,887.3	66,805.2	3,820.5
May 2021	19,209.0	20,402.7	2,169.5	3,872.4	6,041.9	19,159.8	20,342.1	3,872.4	80,781.7	3,791.6
June 2021	19,255.7	20,429.4	2,179.0	3,848.1	6,027.0	19,310.3	20,471.9	3,848.1	87,746.0	3,760.3
July 2021	19,420.0	20,578.8	2,186.3	3,943.9	6,130.2	19,464.0	20,609.0	3,943.9	87,621.1	3,856.3
Aug. 2021	19,696.7	20,834.1	2,188.6	4,140.1	6,328.7	19,689.5	20,812.3	4,140.1	80,766.7	4,059.3
Sept. 2021	19,876.9	20,996.9	2,195.7	4,193.2	6,388.9	19,889.9	20,997.6	4,193.2	68,567.7	4,124.6
Oct. 2021	20,082.9	21,186.8	2,202.9	4,128.1	6,331.0	20,077.7	21,177.9	4,128.1	54,558.8	4,073.5
Nov. 2021	20,345.4	21,437.0	2,214.3	4,180.6	6,394.8	20,333.4	21,426.1	4,180.6	45,317.6	4,135.3
Dec. 2021	20,553.1	21,638.1	2,225.3	4,188.0	6,413.3	20,669.2	21,767.3	4,188.0	38,083.1	4,149.9

https://www.federalreserve.gov/releases/h6/current/default.htm

M1 and M2 (Non-M1) Components, SA

Date	M1			Non-M1 M2	
	Currency [1]	Demand deposits [2]	Other liquid deposits [3]	Small-denomination time deposits [4]	Retail money market funds [5]
Aug. 2020	1,911.1	2,261.9	12,714.0	378.8	1,112.7
Sept. 2020	1,927.9	2,386.1	12,842.8	348.6	1,096.3
Oct. 2020	1,944.1	2,418.5	12,984.2	316.4	1,084.7
Nov. 2020	1,956.8	2,788.0	12,844.2	280.9	1,088.8
Dec. 2020	1,969.3	3,318.2	12,524.8	251.5	1,065.6
Jan. 2021	1,992.6	3,461.3	12,647.0	229.7	1,062.8
Feb. 2021	2,006.9	3,678.5	12,704.1	206.3	1,069.7
Mar. 2021	2,018.0	3,798.3	12,853.1	185.7	1,058.3
Apr. 2021	2,050.7	3,765.6	13,111.2	164.5	1,046.9
May 2021	2,065.0	3,999.8	13,144.2	152.0	1,041.8
June 2021	2,079.4	4,213.9	12,962.5	141.0	1,032.7
July 2021	2,089.4	4,343.7	12,986.8	130.1	1,028.8
Aug. 2021	2,093.5	4,487.8	13,115.4	118.9	1,018.5
Sept. 2021	2,099.5	4,516.5	13,260.9	108.6	1,011.4
Oct. 2021	2,105.4	4,641.7	13,335.8	100.5	1,003.4
Nov. 2021	2,114.6	4,766.1	13,464.7	93.7	997.9
Dec. 2021	2,124.5	4,827.1	13,601.5	84.9	1,000.1

Note: Seasonally Adjusted Components of M1 and Non-M1 M2. Billions of dollars.
`https://www.federalreserve.gov/releases/h6/current/default.htm`

M1 and M2 (Non-M1) Components, NSA

Date	M1			Non-M1 M2		Memorandum: IRA and Keogh accounts		
	Currency [1]	Demand deposits [2]	Other liquid deposits [3]	Small-denomination time deposits [4]	Retail money market funds [5]	At depository institutions	At money market funds	Total
Aug. 2020	1,908.8	2,274.1	12,686.2	381.7	1,095.6	577.9	375.8	953.7
Sept. 2020	1,929.2	2,387.4	12,820.1	350.4	1,082.6	585.9	380.5	966.4
Oct. 2020	1,944.1	2,427.4	12,949.7	315.2	1,080.7	592.9	382.8	975.7
Nov. 2020	1,957.9	2,753.0	12,931.2	277.0	1,090.2	598.7	382.5	981.2
Dec. 2020	1,973.8	3,356.3	12,619.7	248.3	1,080.6	604.7	382.1	986.8
Jan. 2021	1,988.3	3,368.1	12,736.1	228.0	1,089.1	606.6	380.2	986.9
Feb. 2021	1,999.3	3,527.8	12,749.7	205.2	1,085.1	604.4	376.9	981.4
Mar. 2021	2,019.9	3,762.7	12,957.5	184.7	1,071.3	602.3	373.6	975.9
Apr. 2021	2,053.6	3,849.5	13,175.1	165.1	1,051.1	599.5	369.9	969.4
May 2021	2,068.7	4,037.8	13,053.3	152.6	1,029.7	596.0	365.9	962.0
June 2021	2,080.7	4,296.7	12,932.9	142.6	1,019.1	592.5	361.9	954.4
July 2021	2,087.1	4,429.3	12,947.6	131.6	1,013.4	590.6 e	363.3 e	953.9 e
Aug. 2021	2,091.3	4,503.5	13,094.8	120.0	1,002.8	590.6 e	371.2 e	961.9 e
Sept. 2021	2,098.9	4,524.8	13,266.2	109.2	998.5	590.6 e	379.1 e	969.7 e
Oct. 2021	2,106.5	4,651.3	13,319.8	100.3	1,000.0	590.6 e	383.0 e	973.6 e
Nov. 2021	2,116.4	4,709.2	13,507.8	92.6	1,000.1	590.6 e	383.0 e	973.6 e
Dec. 2021	2,129.6	4,878.2	13,661.4	84.0	1,014.1	590.6 e	383.0 e	973.6 e

Note: Not Seasonally Adjusted Components of M1 and Non-M1 M2. Billions of dollars.
`https://www.federalreserve.gov/releases/h6/current/default.htm`

OUTLINE

What is an Interest Rate?

- An interest rate is the percentage of the amount loaned that the borrower agrees to pay the lender in a loan agreement each year.
- For instance, credit cards, student loans, auto loans, and mortgages each specifies a corresponding interest rate applicable between commercial banks and household borrowers.
- Basically, an interest rate is the cost of borrowing money from a lender and the compensation to the lender for loaning money.
- In the financial markets, there is no single interest rate for all loan arrangements in an economy.
- The interest rate offered on a particular loan depends on a myriad of factors related to the type of borrower (the issuer in the case of a bond), the characteristics of the loan arrangement, and the state of the economy.

Source: Fabozzi, Jones, Fabozzi, and Mann (2019) Foundations of Global Financial Markets and Institutions, pp. 346-347, 5e, MIT.

U.S. Interest Rate Statistics H.15

- The Board of Federal Reserve System publishes the H.15 statistics on daily interest rates for selected U.S. Treasury and private money market and capital market instruments.
- Money Market Rates (less than 1 year): Federal Funds, Commercial Paper, Certificates of Deposit, Eurodollar Deposits, Bank Prime Loans, U.S. Government Treasury Bills.
- Capital Market Rates (equal or over 1 year): Interest Rate Swaps, U.S. Government Treasury Notes and Bonds, Corporate Bonds, Municipal Bonds, Residential Mortgage Loans.
- Current and historical H.15 data, along with weekly, monthly, and annual averages, are available on the Board's Data Download Program (DDP). Weekly, monthly and annual rates are averages of business days unless otherwise noted. `https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15)`
- The H.15 statistics contains pivotal information on the U.S. interest rate structures. `https://www.federalreserve.gov/releases/h15/`

U.S. Interest Rates H.15 Statistics (w)

Instruments	2021 Feb 25	2021 Feb 26	2021 Mar 1	2021 Mar 2	2021 Mar 3
Federal funds (effective) 1 2 3	0.07	0.07	0.07	0.07	0.07
Commercial Paper 3 4 5 6					
Nonfinancial					
1-month	0.06	0.06	0.06	0.06	0.06
2-month	0.07	0.07	0.06	0.06	0.06
3-month	0.08	0.08	0.07	0.06	0.07
Financial					
1-month	n.a.	0.09	0.07	0.08	n.a.
2-month	n.a.	n.a.	n.a.	n.a.	n.a.
3-month	0.12	0.15	0.10	0.11	0.17
Bank prime loan 2 3 7	3.25	3.25	3.25	3.25	3.25
Discount window primary credit 2 8	0.25	0.25	0.25	0.25	0.25
U.S. government securities					
Treasury bills (secondary market) 3 4					
4-week	0.04	0.04	0.03	0.04	0.04
3-month	0.04	0.04	0.05	0.04	0.05
6-month	0.06	0.05	0.07	0.06	0.07
1-year	0.09	0.08	0.08	0.08	0.08

https://www.federalreserve.gov/releases/h15/

U.S. Interest Rates H.15 Statistics (w)

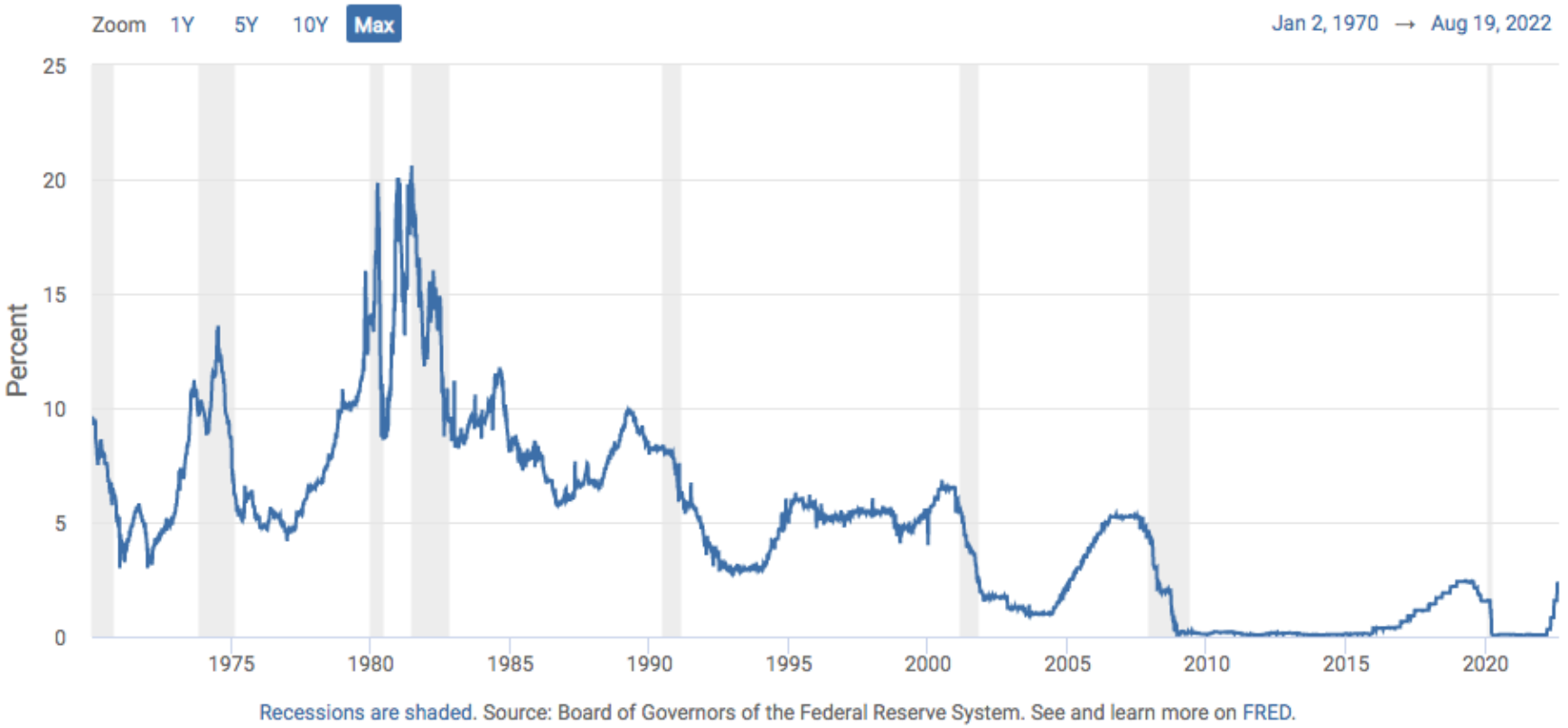
Instruments	2021 Feb 25	2021 Feb 26	2021 Mar 1	2021 Mar 2	2021 Mar 3
Treasury constant maturities					
Nominal 9					
1-month	0.04	0.04	0.03	0.04	0.04
3-month	0.04	0.04	0.05	0.04	0.05
6-month	0.06	0.05	0.07	0.06	0.07
1-year	0.09	0.08	0.08	0.08	0.08
2-year	0.17	0.14	0.13	0.13	0.14
3-year	0.34	0.30	0.27	0.26	0.29
5-year	0.81	0.75	0.71	0.67	0.73
7-year	1.23	1.15	1.12	1.08	1.14
10-year	1.54	1.44	1.45	1.42	1.47
20-year	2.25	2.08	2.11	2.09	2.12
30-year	2.33	2.17	2.23	2.21	2.25
Inflation indexed 10					
5-year	-1.53	-1.64	-1.69	-1.76	-1.72
7-year	-1.06	-1.16	-1.19	-1.26	-1.21
10-year	-0.60	-0.71	-0.71	-0.78	-0.74
20-year	-0.03	-0.18	-0.14	-0.18	-0.17
30-year	0.22	0.06	0.12	0.08	0.10
Inflation-indexed long-term average 11	0.05	-0.09	-0.03	-0.07	-0.05

https://www.federalreserve.gov/releases/h15/

U.S. Effective Federal Funds Rate, 2015-2025

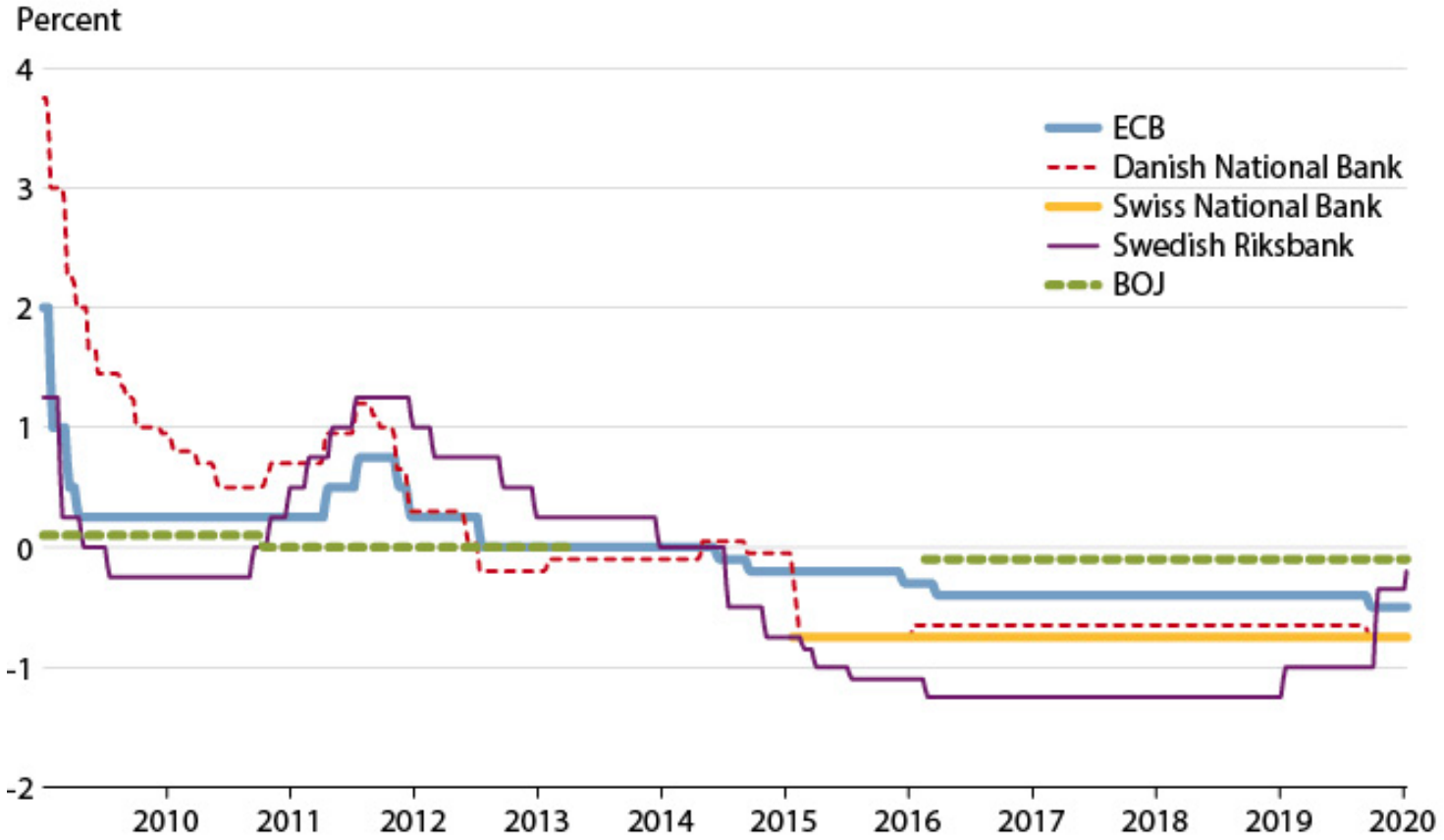
https://stlouisfed.shinyapps.io/macro-snapshot

U.S. Effective Federal Funds Rate, 1970-2022



https://stlouisfed.shinyapps.io/macro-snapshot

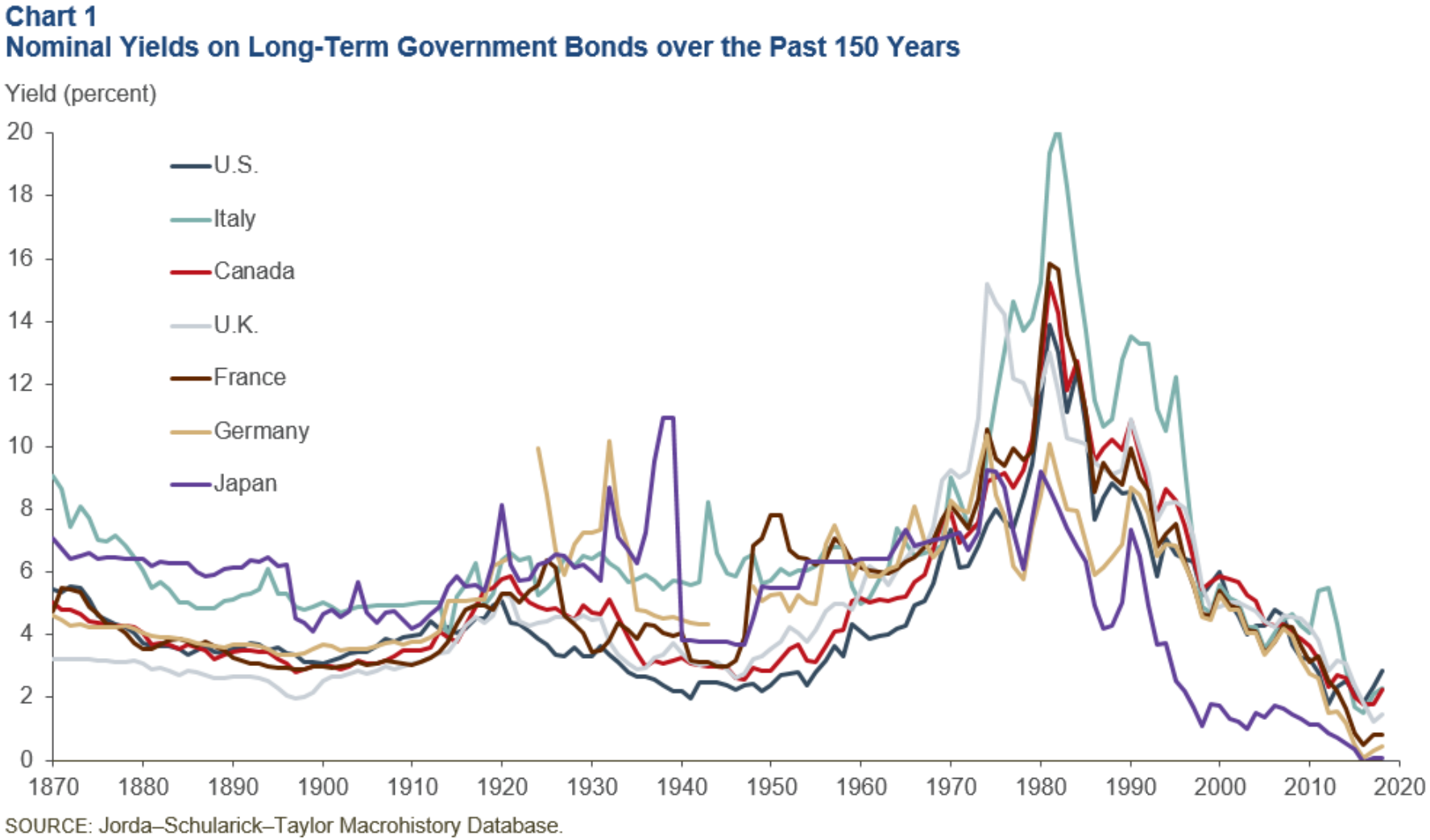
Negative Interest Rates, 2009-2020



NOTE: The BOJ line plots the uncollateralized overnight call rate lower limit (January 2009-April 2013) and the deposit facility policy rate (February 2016-present). Between April 2013 and February 2016, the BOJ did not set a target deposit rate. The ECB line plots the deposit facility rate. The Danish National Bank line plots the rate of interest on certificates of deposit. The Swiss National Bank line plots the rate of interest on sight deposits. The Swedish Riksbank line plots the deposit rate.
SOURCE: The BOJ, ECB, Danish National Bank, Swiss National Bank, and Swedish Riksbank.

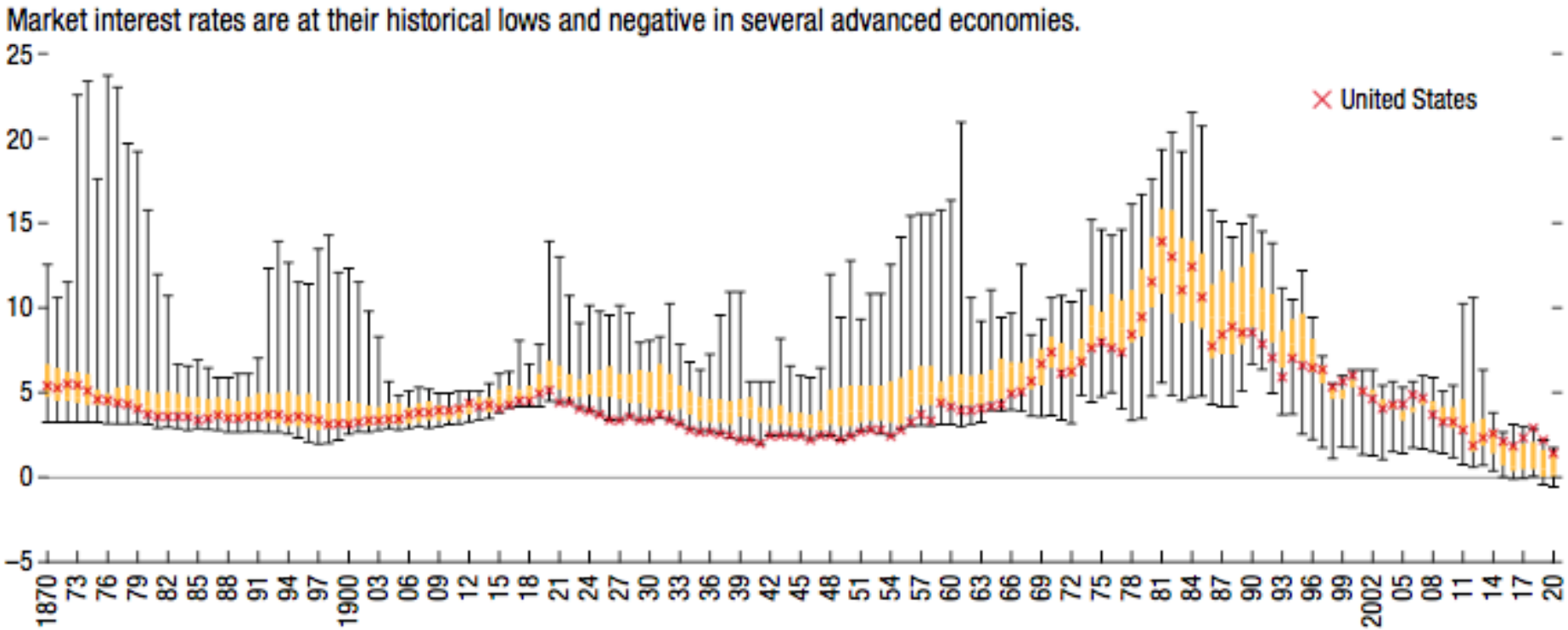
https://research.stlouisfed.org/publications/economic-synopses/2020/02/28/negative-u-s-interest-rates

Historical Long-Term Interest Rates 1870-2018



https://www.dallasfed.org/news/speeches/kaplan/2018/rsk181024.aspx

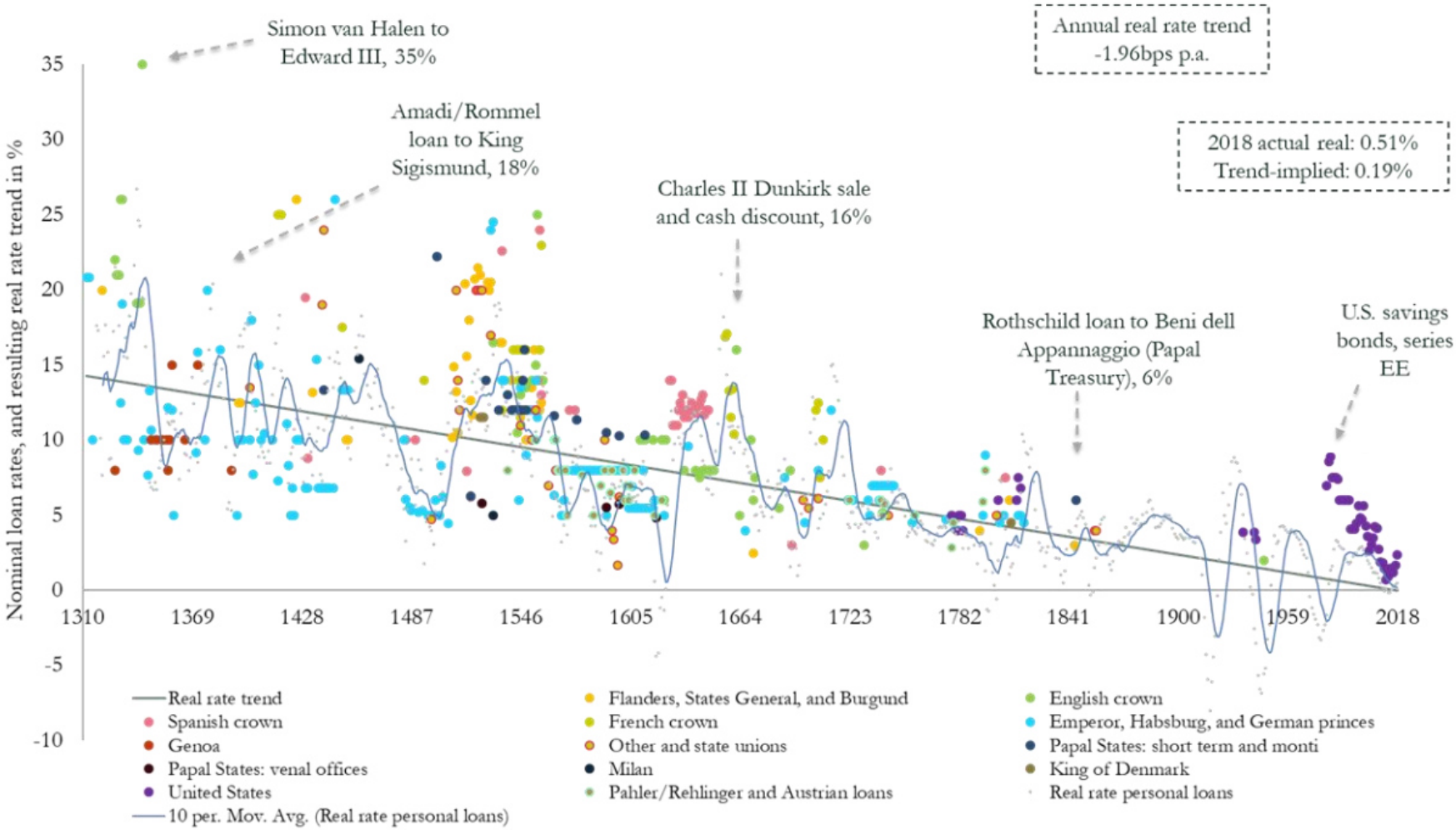
Historical Trends in Global Interest Rates 1870-2020



Sources: Jordà-Schularick-Taylor Macrohistory database (Jordà and others 2019); and IMF staff calculations.
Note: The sample includes Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The figure shows the interquartile range (yellow bars) and the 10th and 90th percentiles (whiskers). Red markers signify the United States. Data for 2020 are through the end of March.

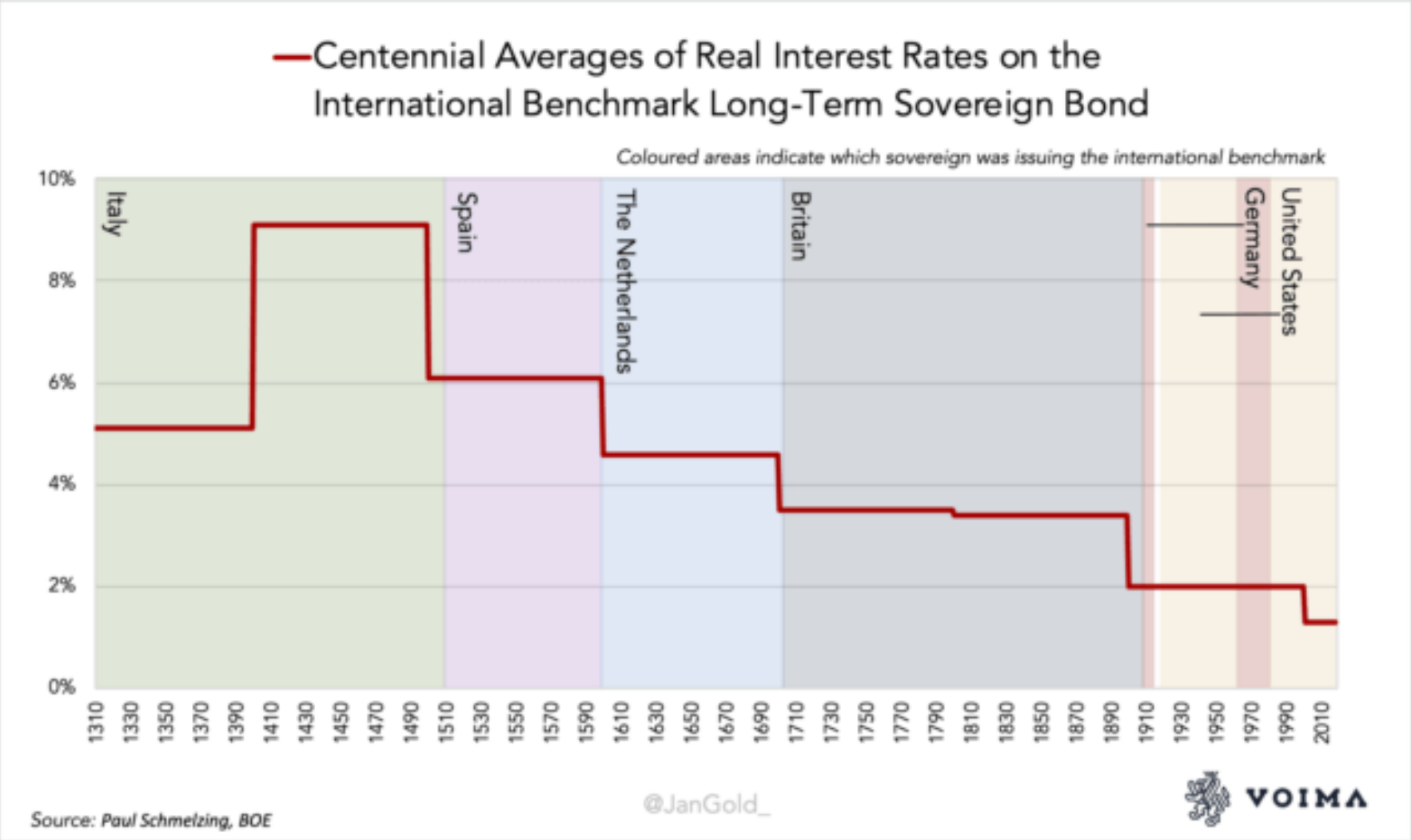
Note: 10-Year Government Bond Yields

Historical Long-Term Real Interest Rates 1310-2020 (w)

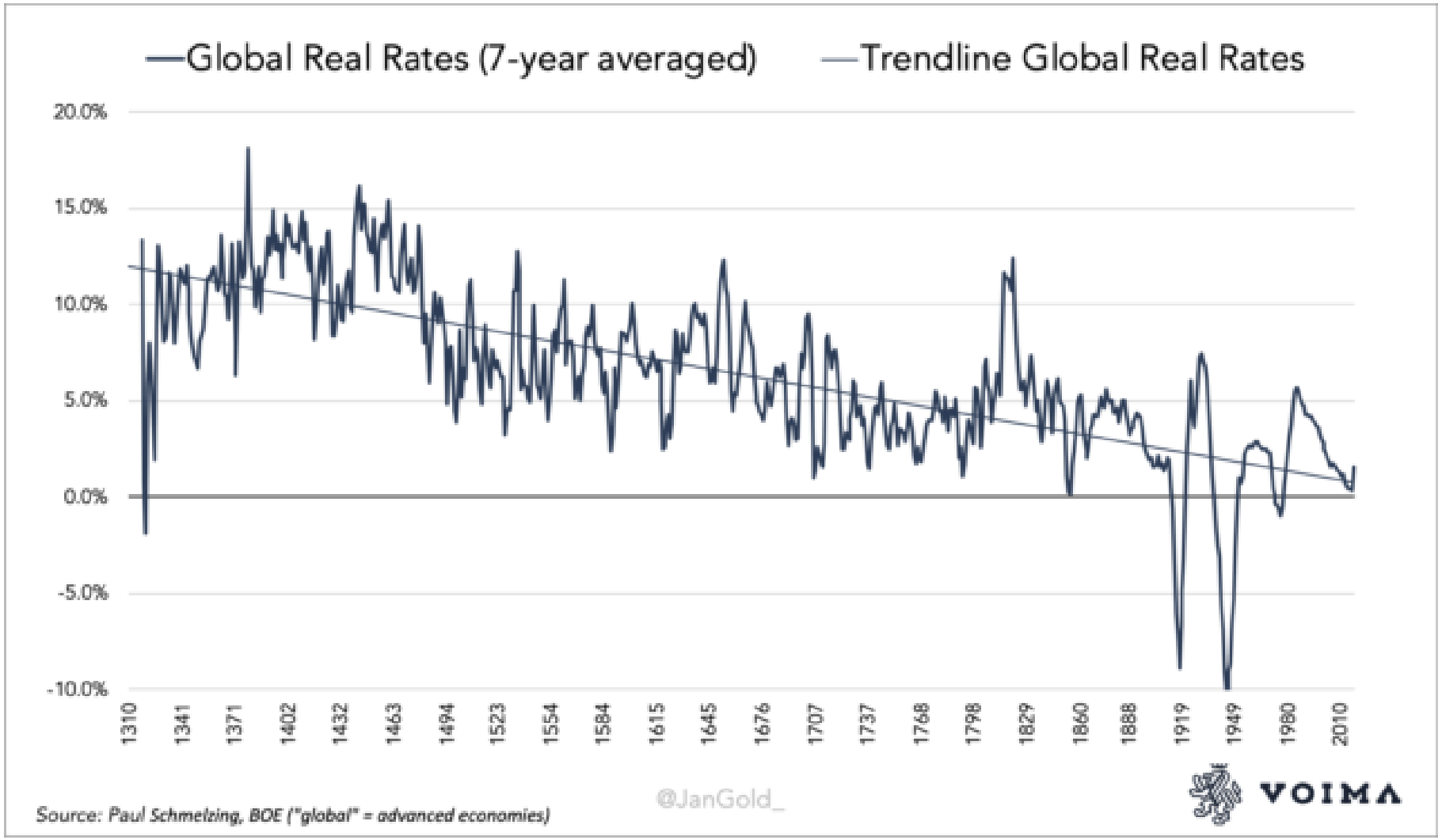


https://www.visualcapitalist.com/700-year-decline-of-interest-rates/

Historical Long-Term Real Interest Rates 1310-2010 (w)



Historical Long-Term Real Interest Rates 1310-2010 (w)



OUTLINE

What Determine Interest (Rate)?

The nature of interest had been mysterious and contentious in history. According to Wikipedia, in many historical societies including ancient Christian, Jewish, and many modern Islamic societies, usury meant the charging of interest of any kind and was considered wrong, or was made illegal.Religious and legal practices aside, why does interest exist ever on earth? Consider the following questions:

1. Which money do you prefer, \$100 today or \$100 one year after?
2. Which do you prefer, an apple today or the same apple next month?
3. Are the answers fundamentally different across space over time?
4. Why does interest exist? What determine its size?

Usury `https://en.wikipedia.org/wiki/Usury`
Charging interest `https://www.openbible.info/topics/charging_interest`

Böhm-Bawerk's Positive Theory of Capital

Forty years before Irving Fisher formulated his theory of interest rates as described in this chapter, the Austrian economist Eugen Böhm von Bawerk set forth his theory of interest rates and why interest rates must be positive. Böhm-Bawerk offered three reasons.

- His first two reasons have to do with what economists refer to as positive time preference.
- The first reason Böhm-Bawerk offers is that over time, an individual's marginal utility declines because an individual expects higher income in the future.
- Appealing to psychology, his second reason is that the marginal utility of a product/good declines over time.
- Taken together, positive time preference, according to Böhm-Bawerk, results in individuals who want to borrow to pay a positive interest rate and for those who are willing to lend to require compensation in the form of a positive interest rate.

Source: Fabozzi et al (2019) CH15, p.365.

Böhm-Bawerk's Positive Theory of Capital

- In addition to time preference, Böhm-Bawerk recognized the importance of technology and argued that it is the third reason for positive interest rates.
- The production process begins with the production of capital goods, and then once those capital goods are produced, they are used to help produce goods of lower order desired by the economy.
- As a result, for the same amount of input, a roundabout production process will generate a greater amount of output. In other words, productivity can be increased if some production is allocated to create goods of higher order that can be used to more efficiently create goods of lower order.
- If capital goods generate higher levels of output for a given level of inputs, there must be a reward for doing so. This increase in output takes the form of a rate of return, which is referred to as "net productivity," and it can be measured terms of a percentage per year.
- Producers of capital goods will create them only if doing so is expected to result in a positive net productivity (and therefore will lead to a positive interest rate) and will do so even if the two positive-time preference theories do not hold.

Source: Fabozzi et al (2019) CH15, p.365.

Irving Fisher (1930) The Theory of Interest

1. Income is the alpha and omega of economic life.
2. Investment is the balancing of consumption over time.
3. Capital generates income. Income is derived from capital.
4. The value of capital is derived from the value of income.
5. Interest is paid for immediate consumption at the cost of future consumption, the size of which is determined by consumption impatience and investment opportunity.
6. Interest (rate) is the (percentage) cost of borrowing and return to lending.
7. Nominal interest rate equals real interest rate plus a risk premium.
8. The price, or the present value, of an asset is the discounted sum of all its expected future cash flows, adjusting for risks.
9. Market interest rates and asset prices are ex-ante risk signals.

Fisher Equation: Nominal and Real Interest Rates

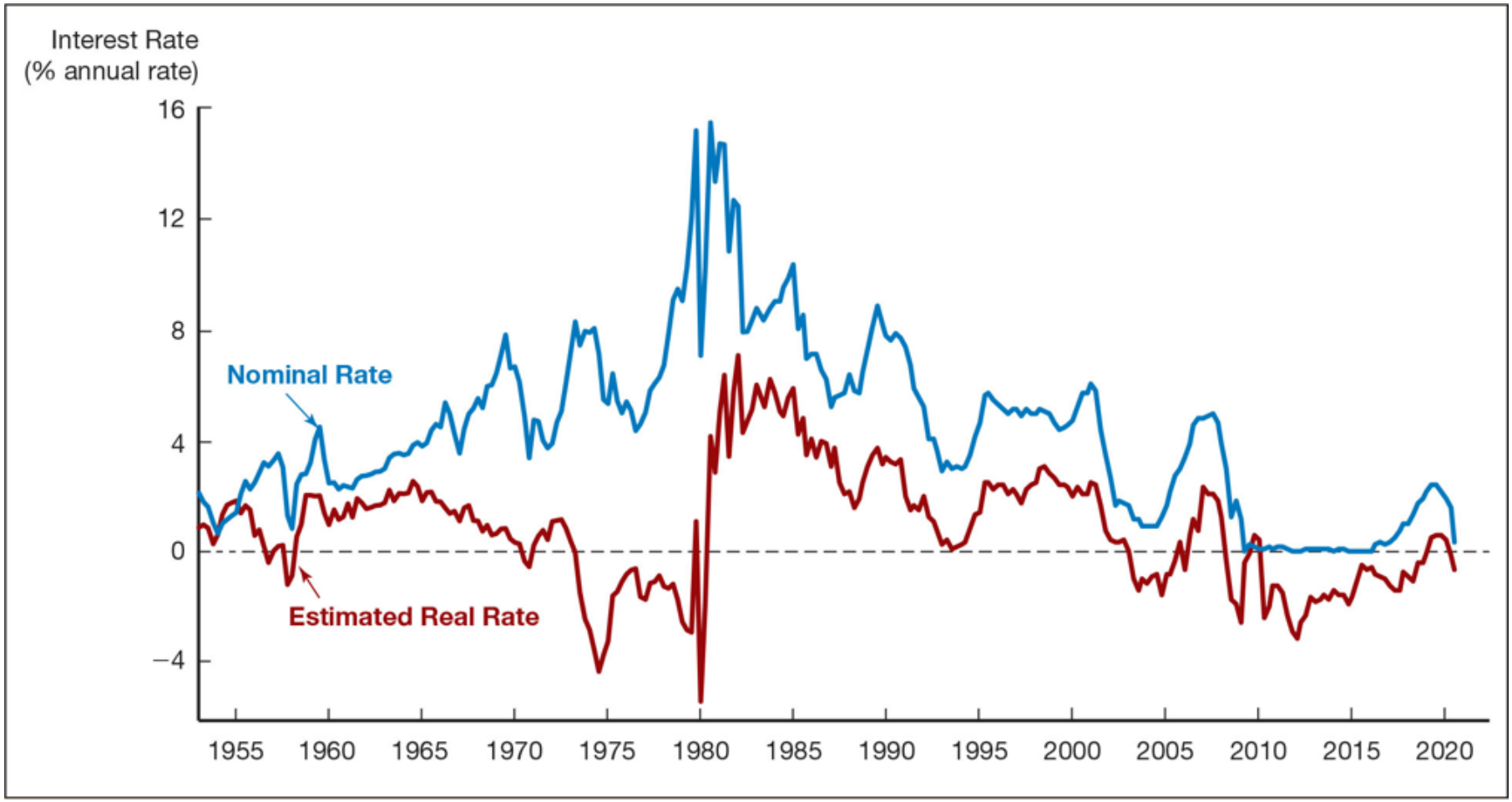
$$\boxed{i \approx r + \pi^e}$$

- Nominal and real interest rates differ because of monetary effects.
- The real interest rate is the rate of interest an investor expects to receive after allowing for the change in monetary value. It equals nominal rate minus expected future inflation rate.
- In other words, since inflation impairs the value of money, the nominal interest rate the bank offered should compensate for expected future inflation that prevails in the contracting period.
- Notice that Fisher's theory of interest is pure in the sense that no other risk is involved and expected inflation rate π^e is an ex-ante estimate.
- To recap, in a world without money and risk, the real rate of interest is determined by consumption impatience and investment opportunity.

Fisher Equation: Derivation and Application

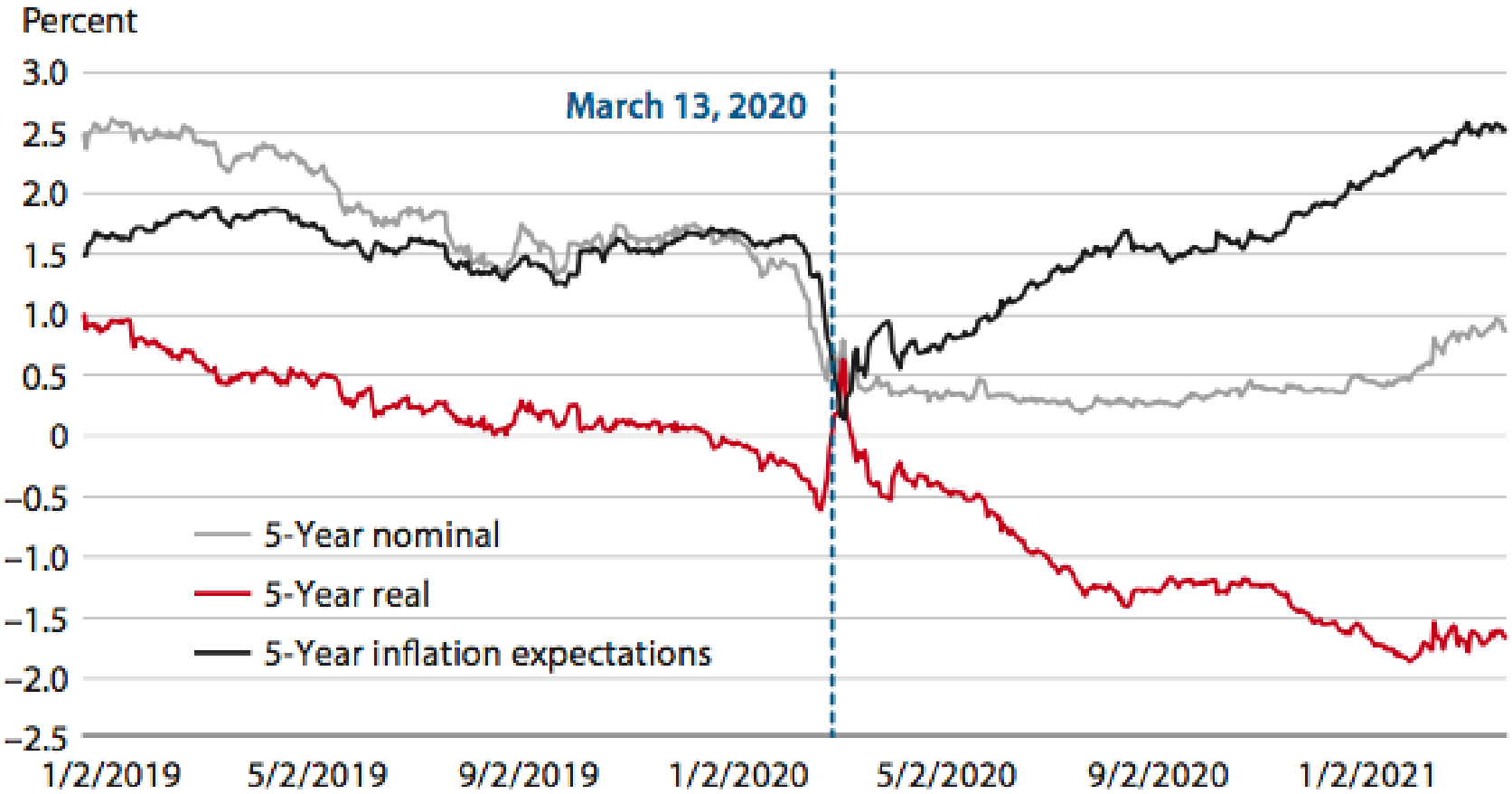
- But, why is Fisher equation an approximation?
- Assuming no transaction cost, deposit 1 dollar in a bank for one year shall earn enough interest to maintain market real return and offset the adverse impact of future inflation.
- No arbitrage equilibrium condition: $(1+i) = (1+r)(1+\pi^e)$.
- Fisher equation: $i = r + \pi^e + r\pi^e \approx r + \pi^e$ if $r \approx \pi^e \approx 0.00$.
- Application: Impute inflation rate from the GDP data
  - N_t: Nominal GDP in year t, so is N_{t-1} defined
  - R_t: Real GDP in year t, so is R_{t-1} defined
  - $D_t = N_t/R_t$: GDP deflator in year t
  - Real GDP growth equation: $R_t = R_{t-1}(1+g)$
  - Nominal GDP growth rate: $N_t = N_{t-1}(1+g)(1+\pi)$
  - Solve for $\pi_t = \frac{N_t/R_t}{N_{t-1}/R_{t-1}} - 1 = \frac{D_t}{D_{t-1}} - 1 = \frac{D_t - D_{t-1}}{D_{t-1}}$

Nominal and Real Interest Rates, 1953-2020



Note: The nominal interest rate is measured by the bond yield of the three-month Treasury bill.
Source: Mishkin (2022) CH4.

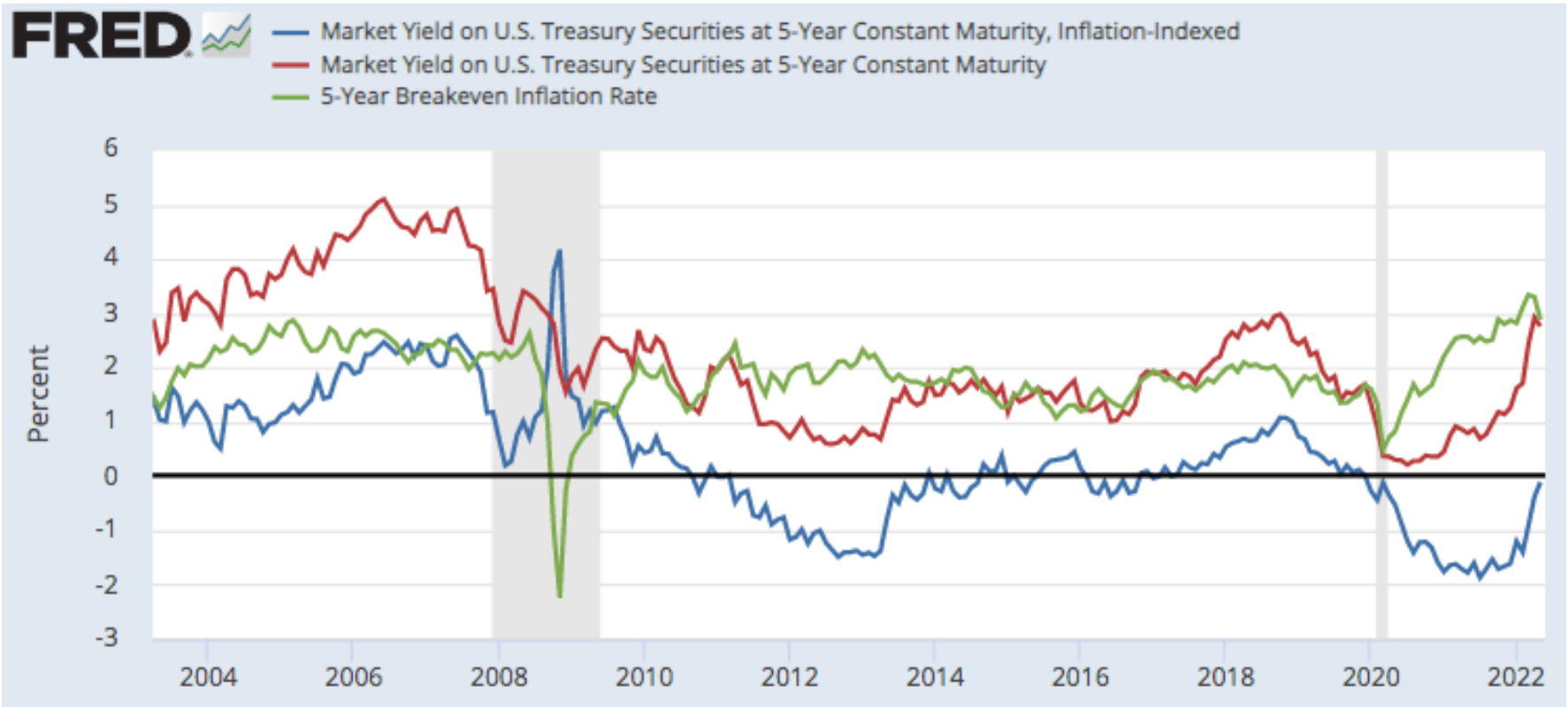
Five-Year Nominal and Real (TIPS) Treasury Yields and Inflation Expectations



SOURCE: U.S. Treasury and Haver Analytics.

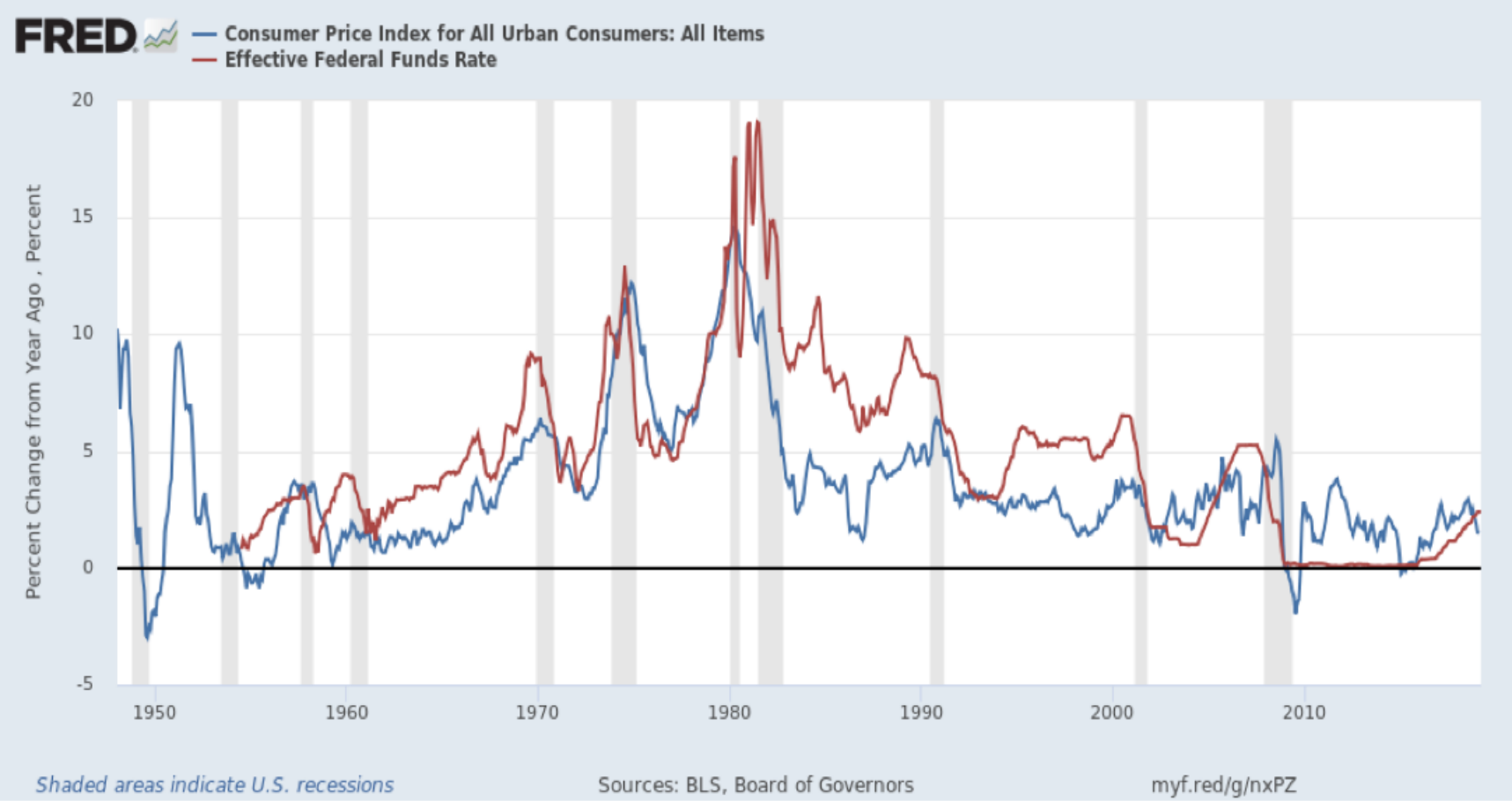
Last observation: April 5, 2021

Market-Based Breakeven Inflation Rate



https://fred.stlouisfed.org/series/T5YIE

U.S. Interest Rate and Inflation Rate



Interest Rates and Inflation in 2022

Jurisdiction	Jan 2022 Inflation	May 2022 Inflation	Jan 2022 Policy Rate	Jun 2022 Policy Rate
UK	5.50%	9.10%	0.25%	1.25%
U.S.	7.50%	8.60%	0.00%-0.25%	1.50%-1.75%
Euro Area	5.10%	8.10%	0.00%	0.00%
Canada	5.10%	7.70%	0.25%	1.50%
Sweden	3.90%	7.20%	0.00%	0.25%
New Zealand	5.90%	6.90%	0.75%	2.00%
Norway	3.20%	5.70%	0.50%	1.25%
Australia	3.50%	5.10%	0.10%	0.85%
Switzerland	1.60%	2.90%	-0.75%	-0.25%
Japan	0.50%	2.50%	-0.10%	-0.10%

The Euro area has 3 policy rates; the data above represents the main refinancing operations rate. Inflation data is as of May 2022 except for New Zealand and Australia, where the latest quarterly data is as of March 2022.

`https://www.visualcapitalist.com/interest-rate-hikes-vs-inflation-rate-by-country/`

How Do Interest Rate Hikes Combat Inflation?

- To understand how interest rates influence inflation, we need to understand how inflation works. Inflation is the result of too much money chasing too few goods.
- Over the last several months, this has occurred amid a surge in demand and supply chain disruptions worsened by Russia?s invasion of Ukraine.
- In an effort to combat inflation, central banks will raise their policy rate. This is the rate they charge commercial banks for loans or pay commercial banks for deposits. Commercial banks pass on a portion of these higher rates to their customers, which reduces the purchasing power of businesses and consumers. For example, it becomes more expensive to borrow money for a house or car.
- Ultimately, interest rate hikes act to slow spending and encourage saving. This motivates companies to increase prices at a slower rate, or lower prices, to stimulate demand.

https://www.visualcapitalist.com/interest-rate-hikes-vs-inflation-rate-by-country/

OUTLINE

Overview

- The financial system is composed of three parts: financial markets, financial institutions, and market infrastructure.
- A financial asset (instrument or security) entitles the owner to the future cash flow or income to be paid by the issuer.
- The value of any financial asset equals the present value of the expected cash flow. The holder of a financial asset's claim can be either an equity or a debt claim.
- Financial assets are grouped together into asset classes. The traditional asset classes include stocks, bonds, and cash equivalents. Nontraditional asset classes or alternative asset classes include real estate, commodities, private equities, hedge funds, venture capital, real assets, and currencies.
- Financial markets are linked to the real economy based on agents' inter-temporal consumption and investment decisions.

Source: Fabozzi et al. (2019) CH1.

Functions of Financial Assets and Markets

The two principal economic functions of a financial asset are

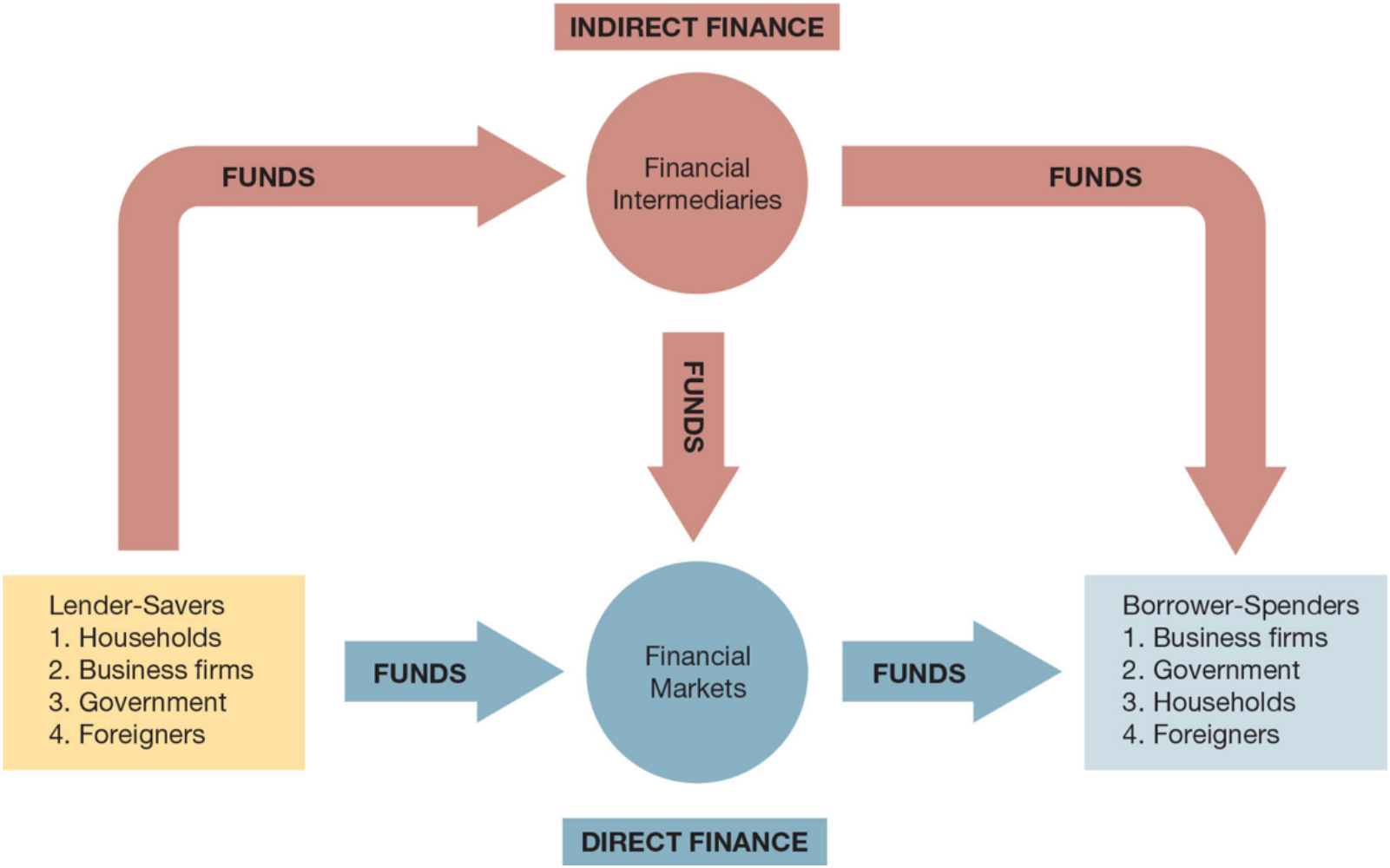
1. to transfer funds from those who have surplus funds to invest to those who need funds to invest in tangible assets.
2. to transfer funds in a way that redistributes the unavoidable risk associated with the cash flow generated by tangible assets among those seeking and those providing the funds.

Financial markets provide the following three additional functions beyond that of financial assets themselves

1. they provide a mechanism for determining the price (or, equivalently, the required return) of financial assets.
2. they make assets more liquid
3. they reduce the costs of exchanging assets.

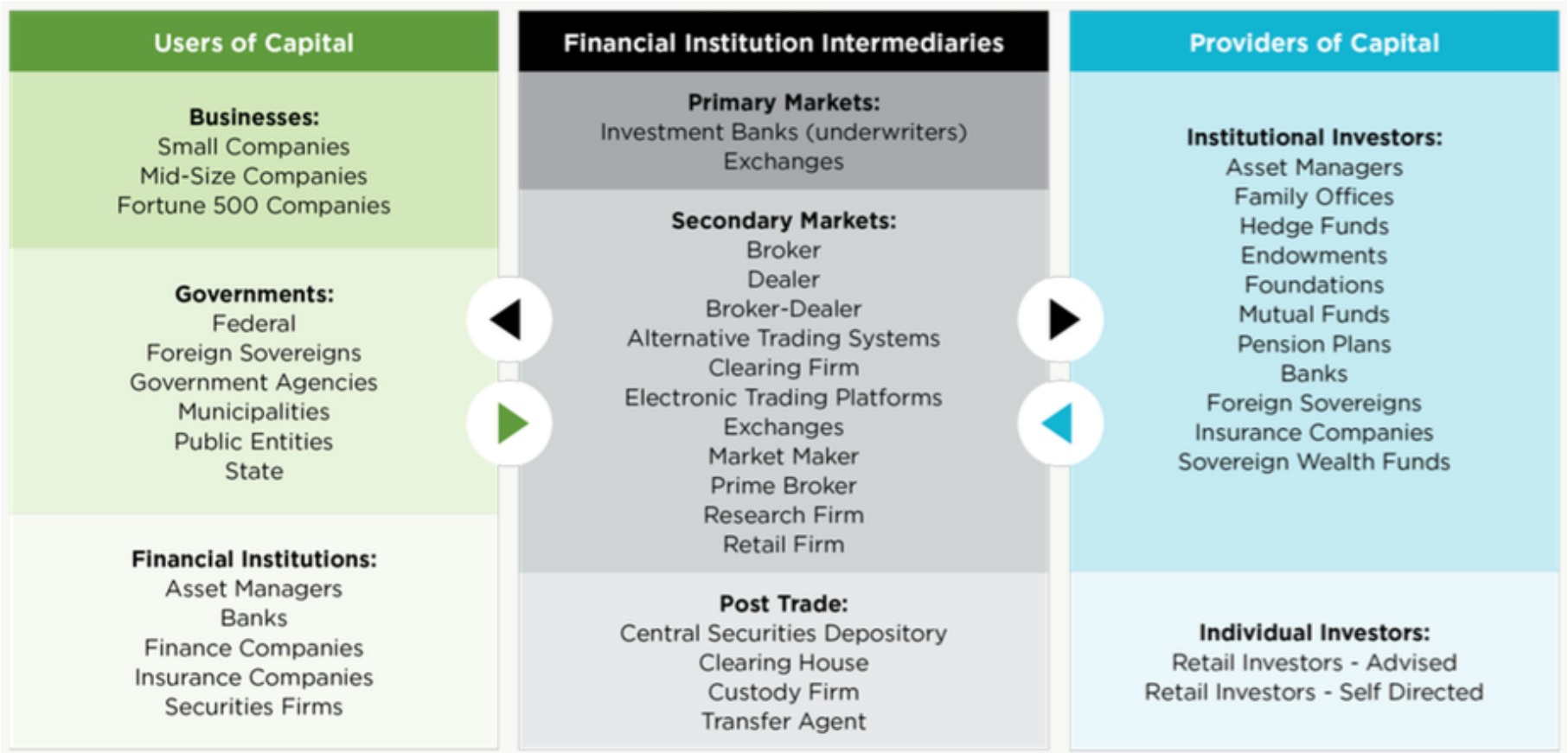
Source: Fabozzi et al. (2019) CH1.

Financial Markets Functions



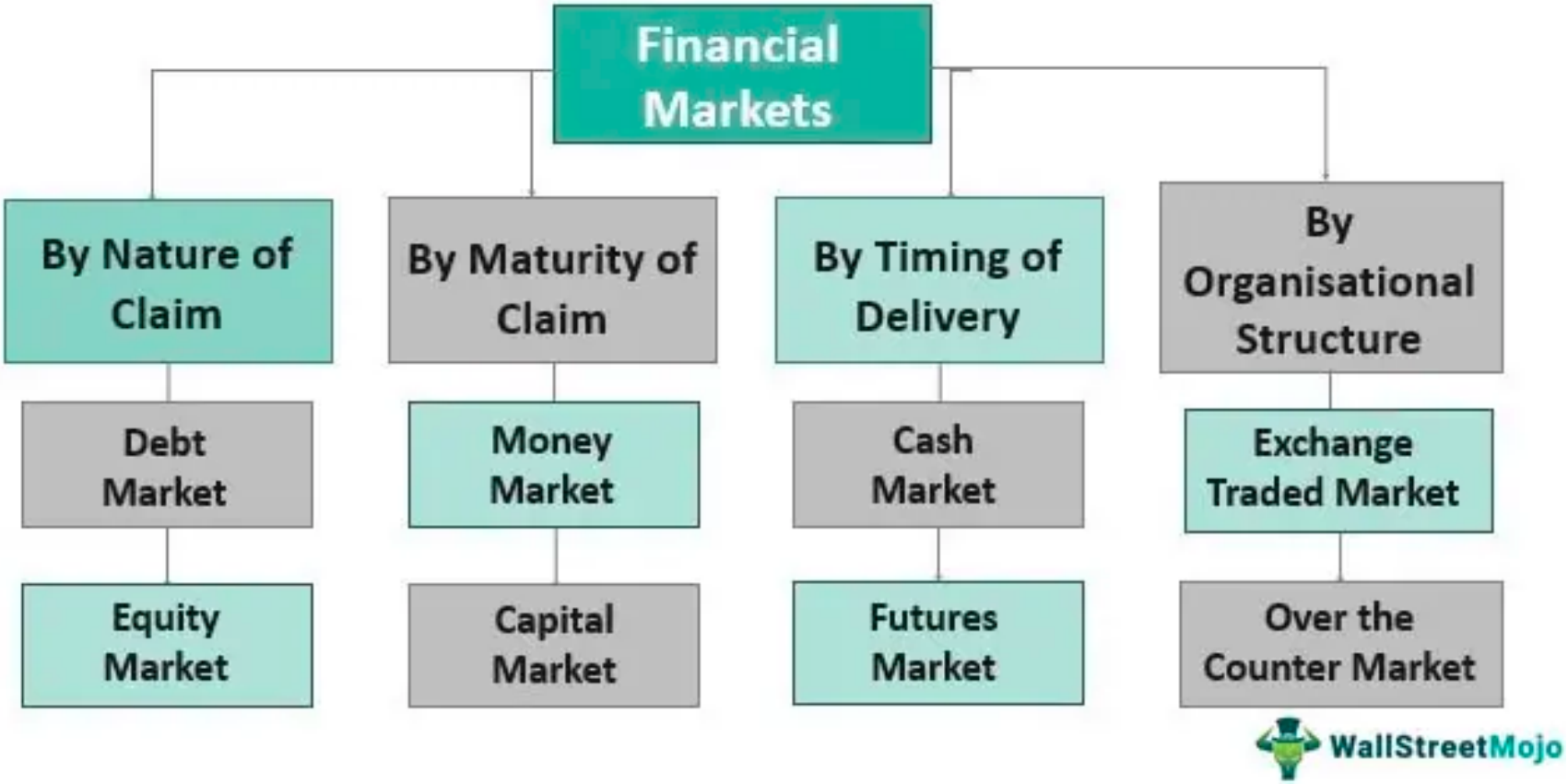
Source: Mishkin (2022) CH2.

Financial Markets Participants



Source: Sifma (2018) Capital Market Primer.
https://www.sifma.org/resources/news/primers-by-sifma-insights/

Classification of Financial Markets



The financial market is a marketplace where the creation and trading of financial assets, including shares, bonds, debentures, commodities, etc., is held. Financial markets are intermediaries between fund seekers (generally businesses, government, etc.) and fund providers (typically investors, households, etc.). It mobilizes funds between them, helping allocate the country?s limited resources.

https://www.wallstreetmojo.com/classification-of-financial-markets/

Financial Markets and Assets: Classification

Financial market is an institution where financial assets are exchanged.

1. By Nature
   - Debt market
   - Equity market
2. By Maturity
   - Money market
   - Capital market
3. By Seasoning
   - Primary market
   - Secondary market

1. By Delivery
   - Cash (spot) market
   - Derivatives market
2. By Organization
   - Auction market
   - Over-the-counter market
3. By Trading System
   - Order-driven market
   - Ouote-driven market

Money Markets and Capital Markets

TABLE 2.1 Financial markets and indexes

The money market
- Treasury bills
- Certificates of deposit
- Commercial paper
- Bankers' acceptances
- Eurodollars
- Repos and reverses
- Federal funds
- Brokers' calls

Indexes
- Dow Jones averages
- Standard & Poor's indexes
- Bond market indicators
- International indexes

The bond market
- Treasury bonds and notes
- Federal agency debt
- Municipal bonds
- Corporate bonds
- Mortgage-backed securities

Equity markets
- Common stocks
- Preferred stocks

Derivative markets
- Options
- Futures and forwards
- Swaps

- Money markets are the markets for securities with an original issue maturity of one year or less. These securities are typically marketable, liquid, low-risk debt securities. These instruments are sometimes called cash instruments or cash equivalents, because they earn little, and have little principal risk.
- Capital markets are for long maturity (>1 year) financial assets. Capital markets instruments include long-term debt, equity, and derivatives.

Source: Bodie et al. (2022) CH2, p.29.

Money Markets vs Capital Markets

Basis for Comparison	Money Market	Capital Market
Definition	It is the part of financial market where lending and borrowing takes place for short-term up to one year	Capital market is part of the financial market where lending and borrowing takes place for the medium-term and long-term
Types of instruments involved	Money markets generally deal in promissory notes, bills of exchange, commercial paper, T bills, call money, etc.	Capital market deals in equity shares, debentures, bonds, preference shares, etc.
Institutions involved/types of investors	The money market contains financial banks, the central bank, commercial banks, financial companies, chit funds, etc.	It involves stockbrokers, mutual funds, underwriters, individual investors, commercial banks, stock exchanges, Insurance Companies
Nature of Market	Money markets are informal	Capital markets are more formal
Liquidity of the market	Money markets are liquid	Capital Markets are comparatively less liquid
Maturity period	The maturity of financial instruments is generally up to 1 year	The maturity of capital markets instruments is longer and they do not have stipulated time frame
Risk factor	Since the market is liquid and the maturity is less than one year, Risk involved is low	Due to less liquid nature and long maturity, the risk is comparatively high
Purpose	The market fulfills the short-term credit needs of the business	The capital market fulfills the long-term credit needs of the business
Functional merit	The money markets increase the liquidity of funds in the economy	The capital market stabilizes the economy due to long-term savings
Return on investment	The return in money markets are usually low	The returns in capital markets are high because of higher duration

Trading in the money market is done mostly through over-the-counter (OTC), i.e., no or little use of exchanges. However, they provide businesses with short-term credit and play a major role in providing liquidity in the economy over the short term. In addition, it helps the business and industries with working capital requirements.
The capital market is a dealer and an auction market and consists of two categories: 1) Primary market, where the fresh issue of securities is offered to the public; 2) Secondary market, where securities are traded between the investors.

https://www.wallstreetmojo.com/money-market-vs-capital-market/

Primary Market vs Secondary Market

Primary Market

- Issuers create new securities and sell them to investors
- Issuers get the capital raised net of expenses, investors get the securities
- Sales of new issuances carried out through discrete transactions
- Securities issued at a single price

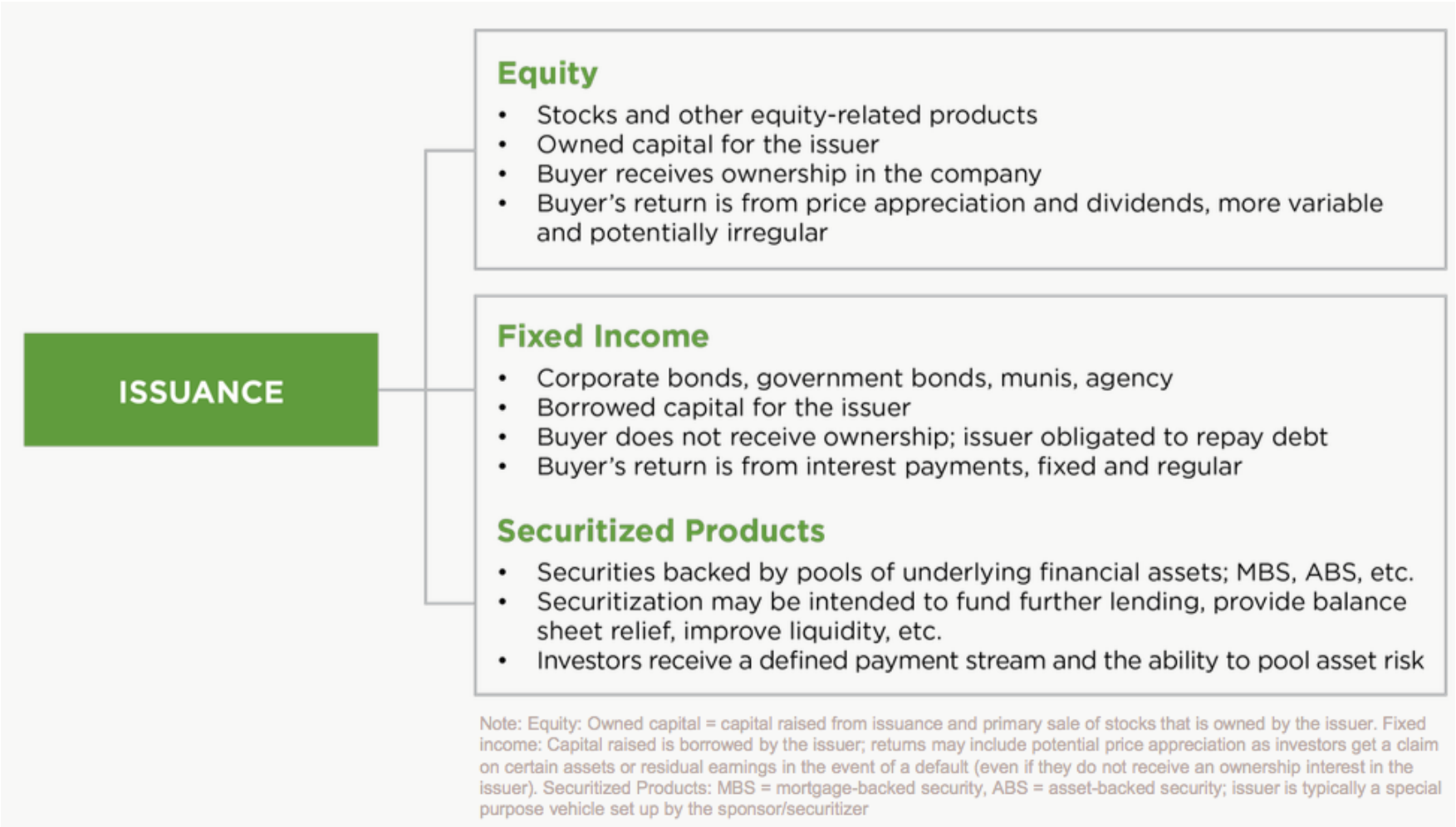
Secondary Market

- Investors trade securities, no issuer involvement
- Trading of securities can occur continuously
- Securities traded at market prices, fluctuating

Note: For primary markets, while the final offering price is fixed a day prior to the effective date, it will fluctuate during the opening auction of the IPO as the exchange balances bids (offers to buy) and asks (offers to sell). Additionally, an issuer may have follow-on offerings, or the subsequent issuance and sale of new shares of the same security.

Source: Sifma (2018) Capital Market Primer.
https://www.sifma.org/resources/news/primers-by-sifma-insights/

Primary Market: Issuance of Securitites



Source: Sifma (2018) Capital Market Primer.
https://www.sifma.org/resources/news/primers-by-sifma-insights/

Secondary Market: Assets and Products

Securities
- Equities, ETFs
- Multi-listed options, single-stock or index
- Bonds
- Exchange traded or OTC

Derivatives
- Security whose price is directly dependent upon (derived) from the value of an underlying asset(s) or pricing index
- Frequently used for hedging and as a risk management tool
- Exchange traded or OTC

Structured Products
- Replace payment features and returns of a traditional security with payments derived from the performance of an underlying security(ies)
- Facilitates customized risk-return objectives
- OTC traded

Securitization
- The process of designing a new financial instrument by packaging underlying assets with similar characteristics, supported by cashflows from those assets (residential or commercial mortgages, auto loans, etc.)
- Transforms illiquid assets into tradable securities
- OTC traded

Futures

Agreement to purchase or sell an asset at an agreed upon price at the end of the set contract date (contract may be satisfied by delivery of the specified asset or offset in cash)

Options

Contract granting the right (not the obligation) to buy or sell an asset at a set strike price (price the contract may be exercised, or acted on) by an expiration date (date the option no longer has value/exists)

Forwards

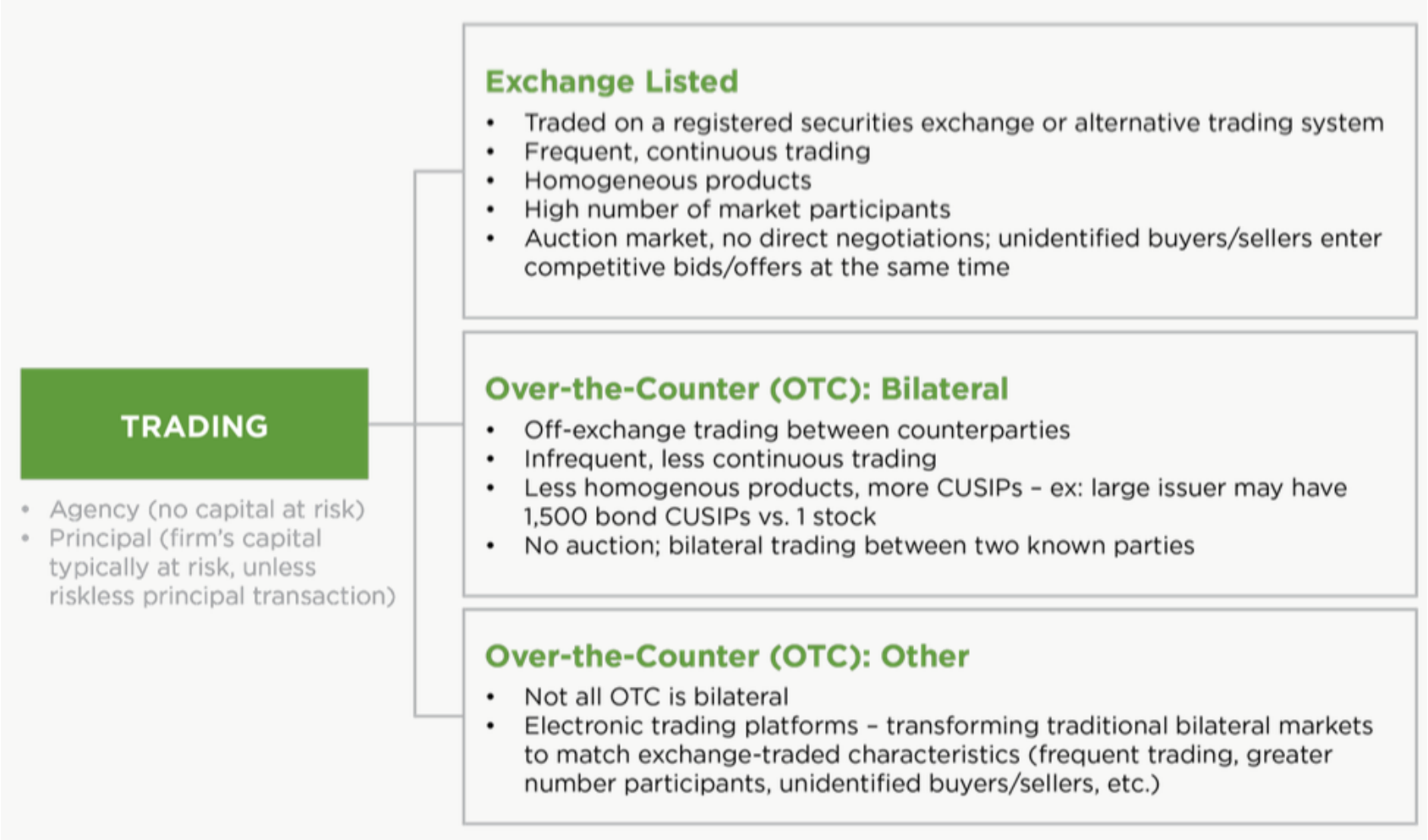
Agreement to deliver an asset at a specified future date & set price (agreed upon in advance or agreed upon at time of delivery)

Swaps

Exchange of one asset or liability for a similar asset or liability for the purpose of lengthening or shortening maturities, or otherwise shifting risks (ex: different currencies, exchanging income flows, etc.)

Source: Sifma (2018) Capital Market Primer.
`https://www.sifma.org/resources/news/primers-by-sifma-insights/`

Secondary Market: Trading



Source: Sifma (2018) Capital Market Primer.
https://www.sifma.org/resources/news/primers-by-sifma-insights/

Global Stock Exchanges by Market Cap 2020 (w)

Stock Market Indices

Stock indexes are used to track average returns, compare investment managers' performance to an index, and as a base for derivative instruments. Key factors to consider in constructing an index include:

1. what the index is supposed to measure
2. whether a representative sample of firms can be used or whether all firms must be included
3. how the index should be constructed

The examples of domestic indexes illustrate the diversity of indexes in practice.

- The Wilshire 5000 captures the overall domestic market.
- The DJIA (price weighted) captures the returns from the "bluest of blue chips" or a sample of very large well-known firms.
- The Standard & Poor's 500 Index (market-value weighted).
- NYSE Composite and NASDAQ Composite.

Source: Bodie et al. (2022) CH2, pp.43-48.

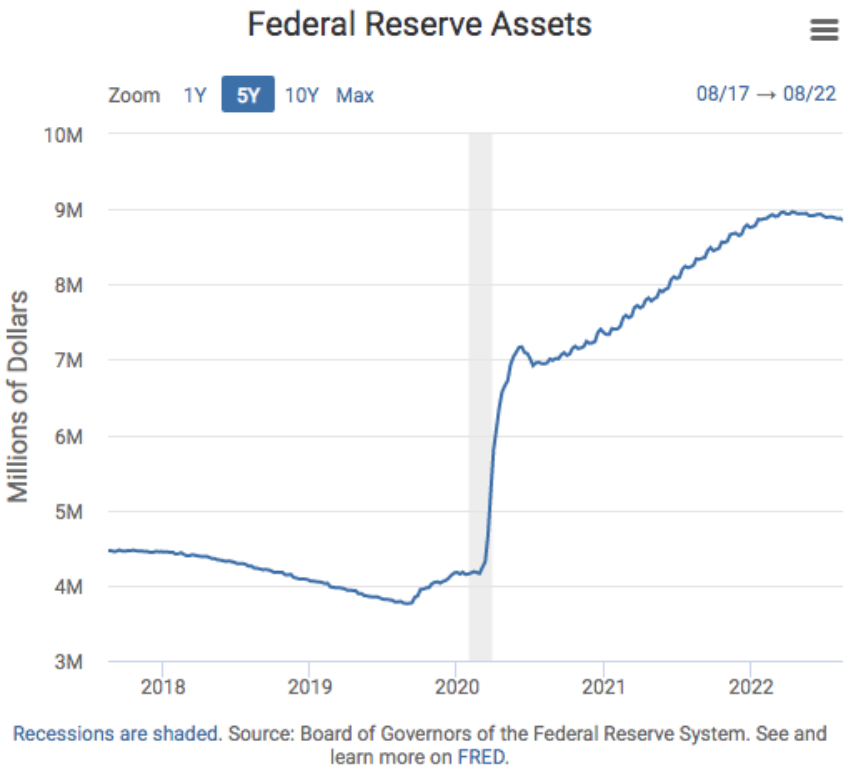
Asset Class Investment Options

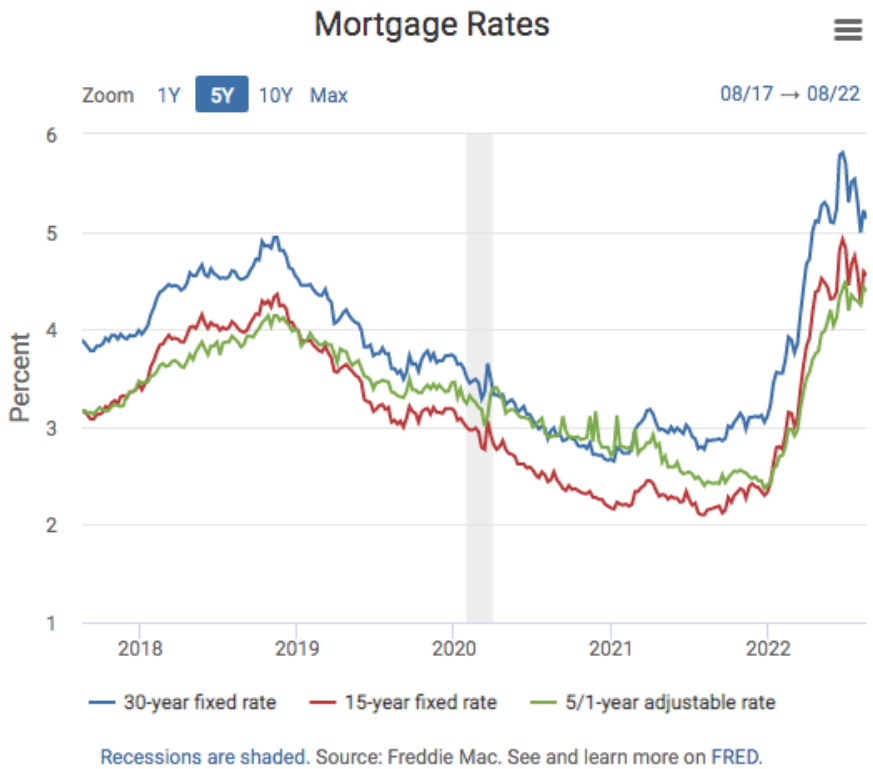
Asset Class	Ticker	Description	# of Holdings	Risk Potential (out of 5)
US Large Cap Stocks	VFIAX	The S&P 500 index. 500 of the largest U.S. companies, which span many different industries and account for ~75% of the U.S. stock market's value	500 stocks	4
US Small Cap Stocks	VSMAX	Broad exposure to small-sized U.S. companies	~1,400 stocks	5
International Developed Stocks	VTMGX	Exposure to large-, mid-, and small-capitalization companies in developed markets outside of the United States	~4,000 stocks	5
Emerging Market Stocks	VEMAX	Stocks of companies located in emerging markets around the world, such as Brazil, Russia, India, Taiwan, and China	~5,000 stocks	5
Canadian Stocks	XIC	Covers ~95% of the Canadian stock market. Canada's version of the S&P 500.	~200 stocks	4
All US Bonds	VBTLX	Exposure to U.S. investment-grade bonds. The fund invests in U.S. Treasuries and mortgage-backed securities of all maturities	~10,000 bonds	2
Hi-Yield US Bonds	VWEAX	Diversified portfolio of medium- and lower-quality U.S. corporate bonds, often referred to as "junk bonds".	~600 bonds	3
International Bonds	VTABX	Exposure to non-U.S. investment-grade bonds. Track the performance of an index that includes international government, agency, and corporate bonds, mostly from developed countries, but also some emerging markets countries	~6,000 bonds	2
Canadian Bonds	ZAG	Exposure to Canadian investment-grade bonds — consisting of Federal, Provincial and Corporate bonds.	~1,200 bonds	2
Cash (T-Bill)	VUSXX	Invests in short-term U.S. Treasury bills, and other debts that are sponsored, guaranteed, or owned by the federal government	~40	1
REIT	VGSLX	Invests in real estate investment trusts — companies that purchase office buildings, hotels, and other property	~200 REITS	4
Gold	IAU	Seeks to reflect the performance of the price of gold (in $USD)	1	n/a

https://themeasureofaplan.com/investment-returns-by-asset-class/

OUTLINE

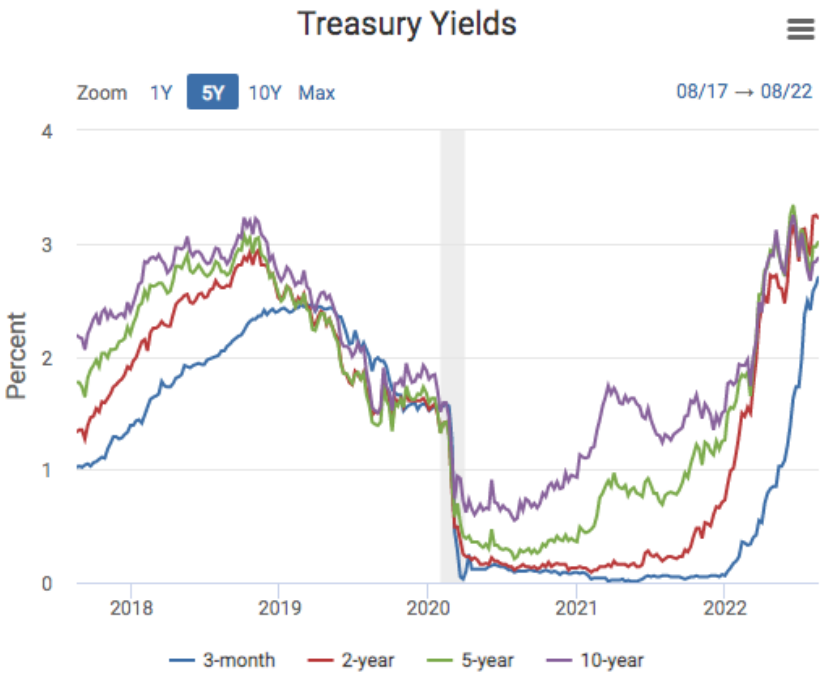
St. Louis Fed Macro Snapshot: Financial Markets





https://stlouisfed.shinyapps.io/macro-snapshot

St. Louis Fed Macro Snapshot: Financial Markets



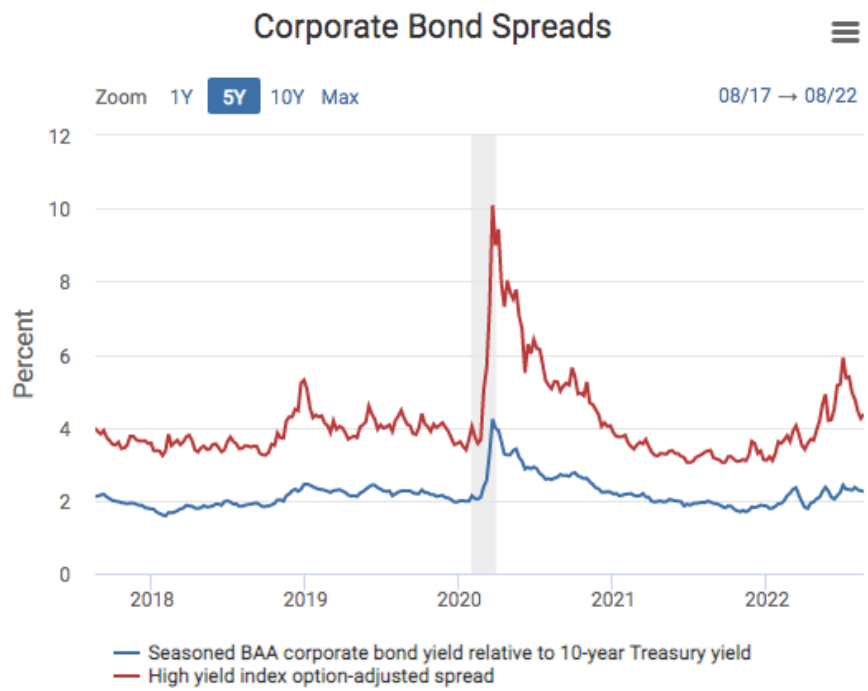
Recessions are shaded. Source: Board of Governors of the Federal Reserve System. See and learn more on FRED.

Recessions are shaded. Source: Federal Reserve Bank of St. Louis. See and learn more on FRED.

https://stlouisfed.shinyapps.io/macro-snapshot

St. Louis Fed Macro Snapshot: Financial Markets

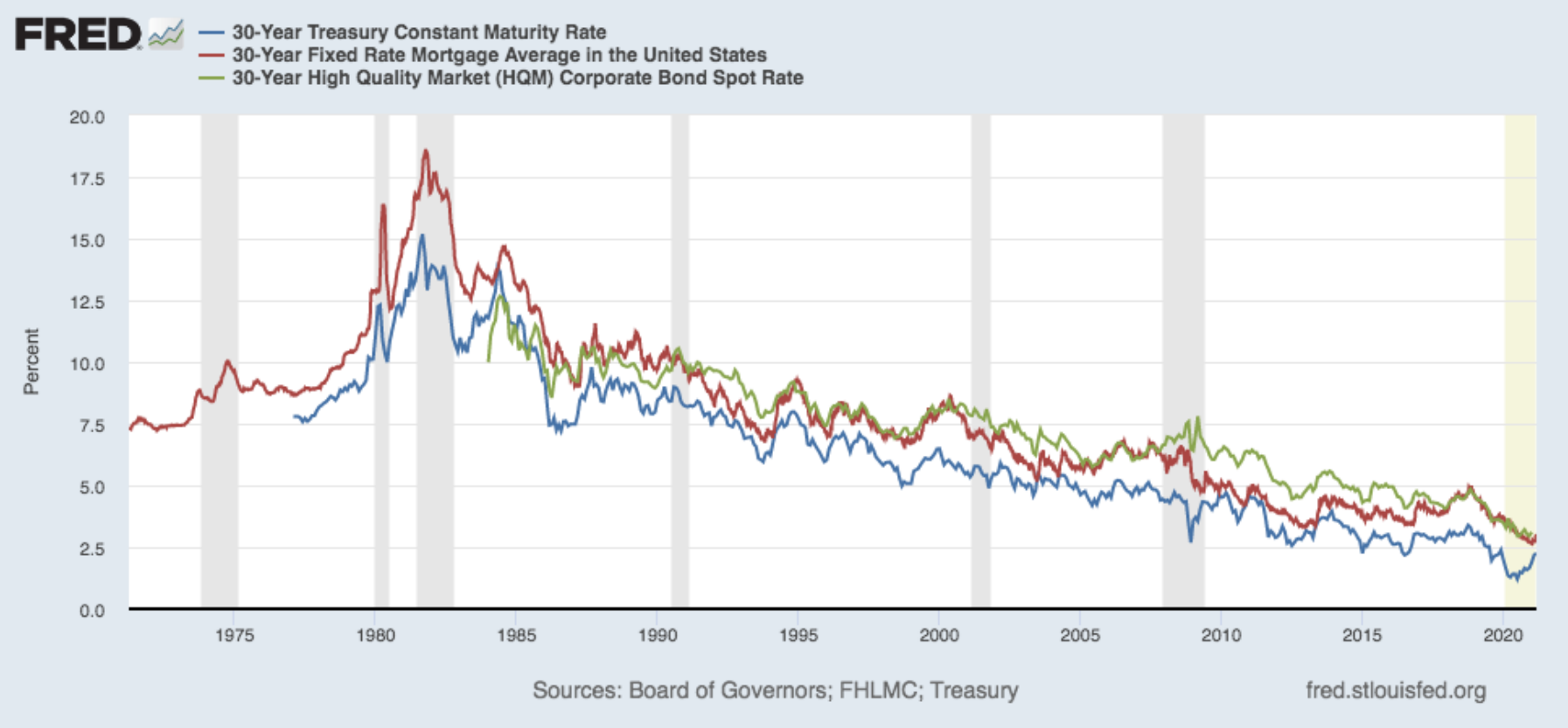
Recessions are shaded. Source: S&P Dow Jones Indices, LLC. See and learn more on FRED.



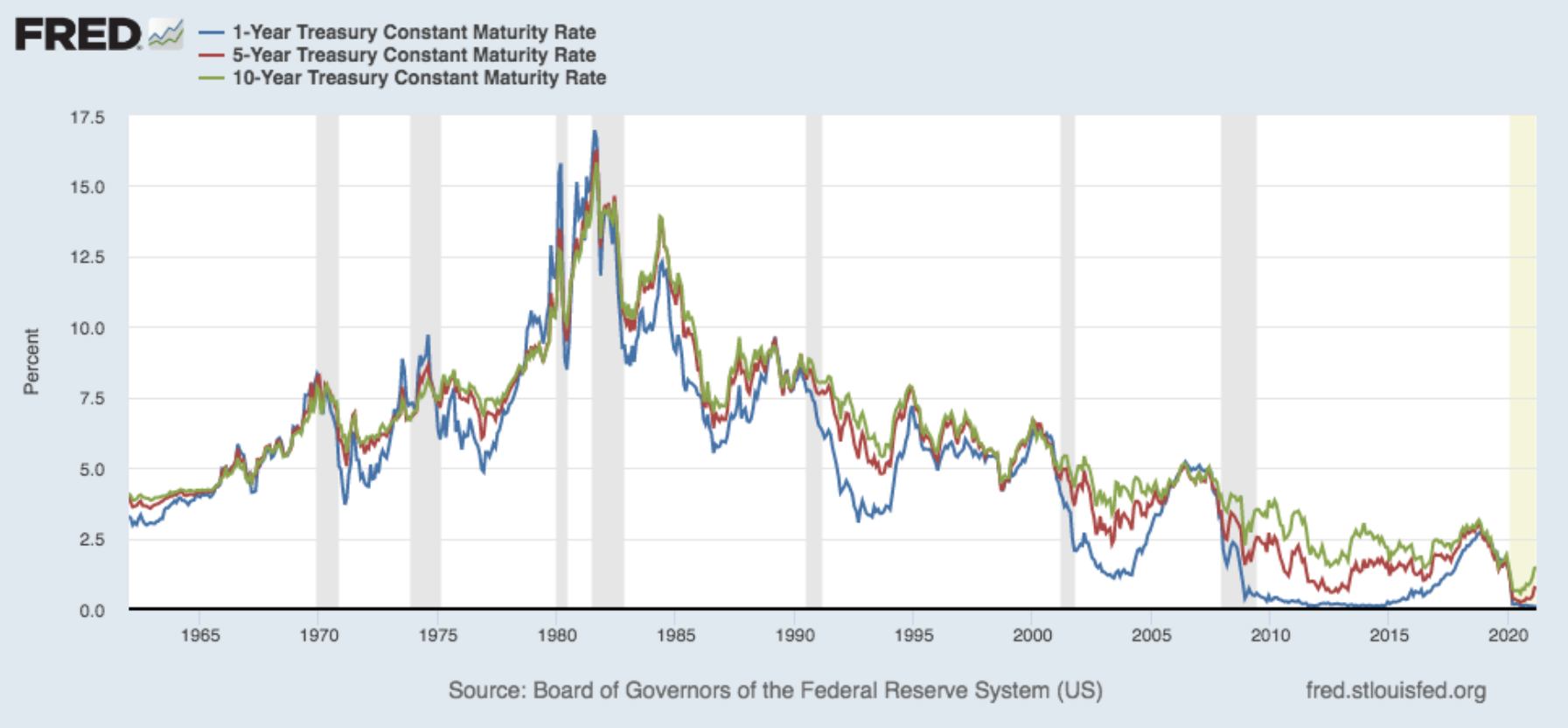
Recessions are shaded. Sources: Federal Reserve Bank of St. Louis and Ice Data Indices, LLC. See and learn more on FRED.

`https://stlouisfed.shinyapps.io/macro-snapshot`

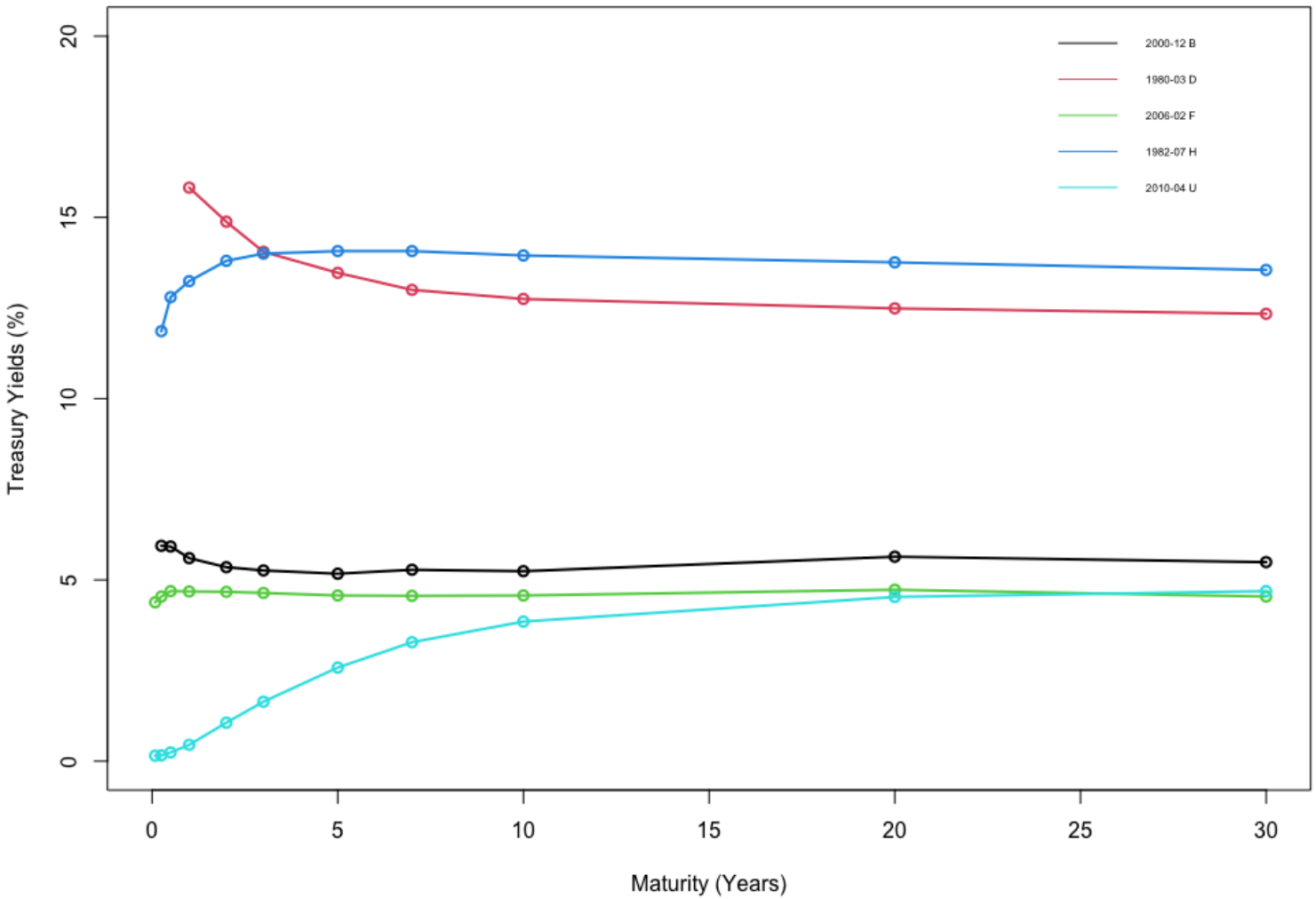
U.S. Interest Rate Risk Structure



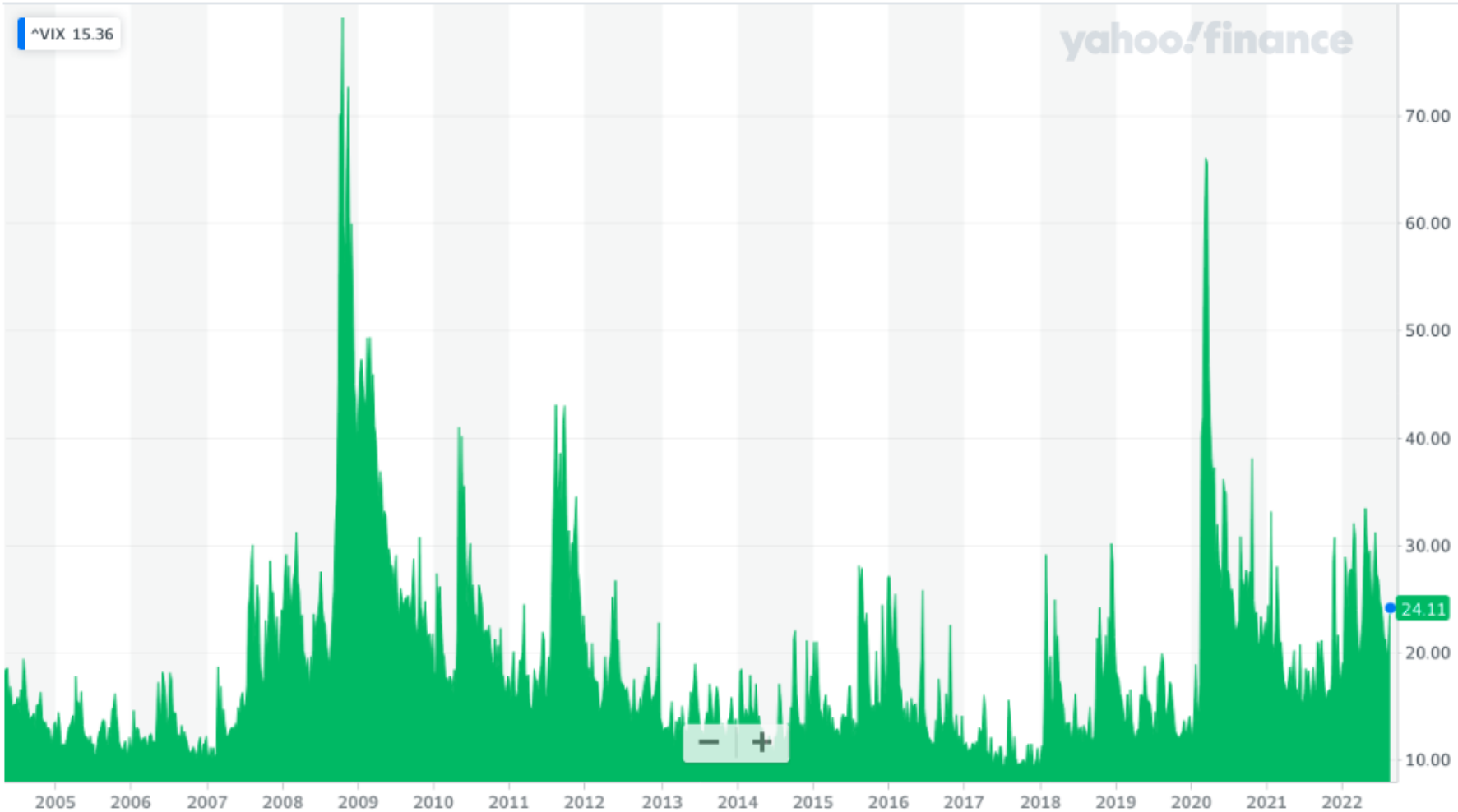
U.S. Interest Rate Term Structure



U.S. Treasury Yield Curves



CBOE Volatility Index (VIX)



Note: VIX is a forward-looking measure of option-implied volatility of the stock market index.
`https://finance.yahoo.com`

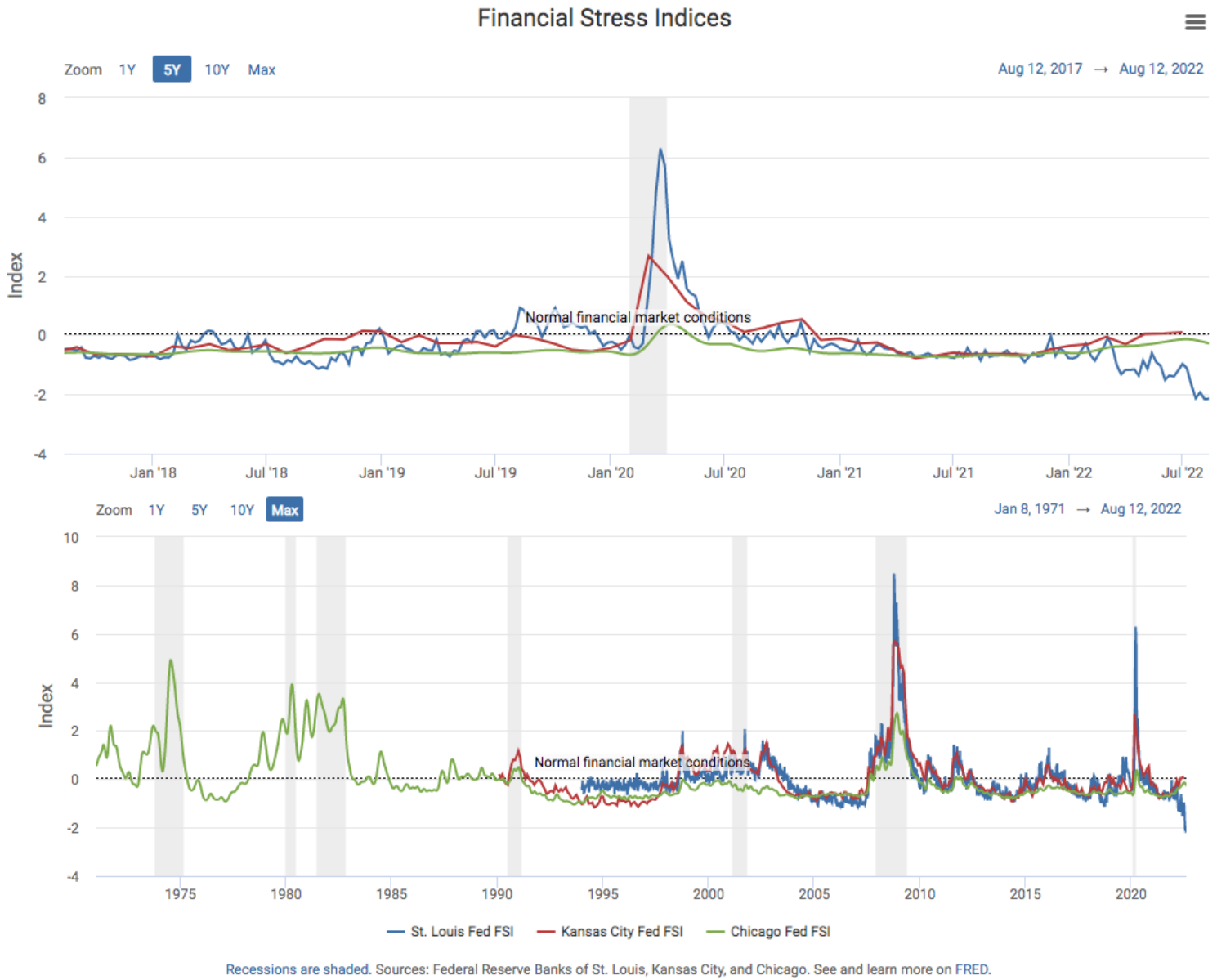
U.S. Financial Stress Indices

A positive value indicates that financial stress is above the long-run average, while a negative value signifies that financial stress is below the long-run average. Another useful way to assess the current level of financial stress is to compare the index to its value during past, widely recognized episodes of financial stress.

- St. Louis Fed Financial Stress Index (STLFSI3) measures the degree of financial stress in the markets and is constructed from 18 weekly data series: seven interest rate series, six yield spreads and five other indicators. Each of these variables captures some aspect of financial stress. Accordingly, as the level of financial stress in the economy changes, the data series are likely to move together.
- The Chicago Fed's National Financial Conditions Index (NFCI) provides a comprehensive weekly update on U.S. financial conditions in money markets, debt and equity markets and the traditional and "shadow" banking systems. Positive values of the NFCI indicate financial conditions that are tighter than average, while negative values indicate financial conditions that are looser than average. (w)
- Kansas City Financial Stress Index (KCFSI): The KCFSI is a monthly measure of stress in the U.S. financial system based on 11 financial market variables. (w)

https://fred.stlouisfed.org/series/STLFSI3
https://fred.stlouisfed.org/series/KCFSI
https://fred.stlouisfed.org/series/NFCI

Key Indicators



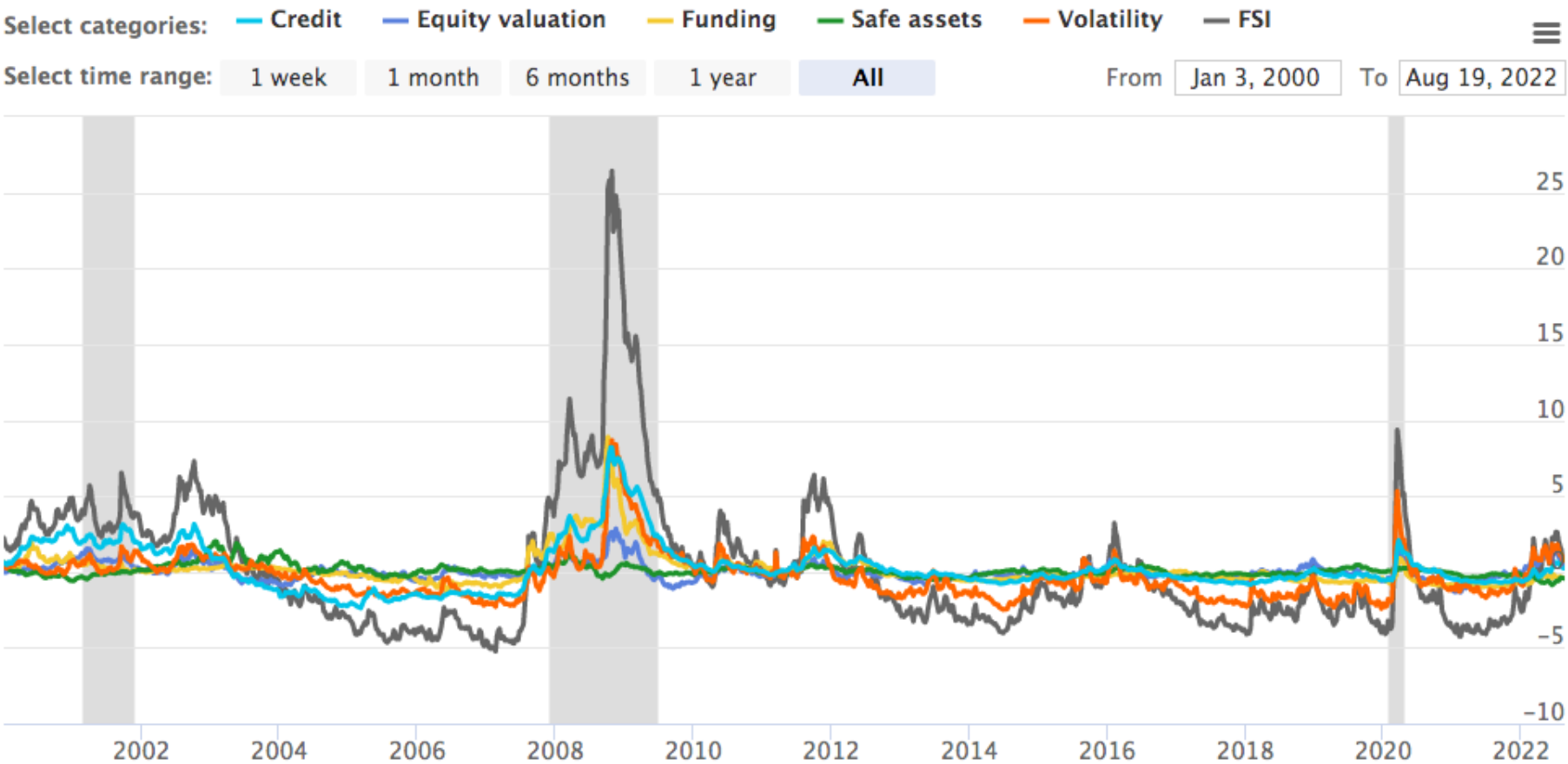
https://stlouisfed.shinyapps.io/macro-snapshot

OFR Financial Stress Index

- The OFR Financial Stress Index (OFR FSI) is a daily market-based snapshot of stress in global financial markets. It is constructed from 33 financial market variables, such as yield spreads, valuation measures, and interest rates.
- The OFR FSI incorporates five categories of indicators: credit, equity valuation, funding, safe assets and volatility. The FSI shows stress contributions by three regions: United States, other advanced economies, and emerging markets.
- The OFR FSI measures systemic financial stress—disruptions in the normal functioning of financial markets. Each variable in the index measures a feature of financial stress. Financial stress can be captured by how the variables move together through time. A statistical algorithm captures this co-movement and produces a set of weights for the variables.
- The value of the OFR FSI on a given day is the weighted average level of each variable observed in the market on that day, relative to its history. The index is zero when this average is zero, suggesting that stress is at normal levels. The index is calculated after each U.S. trading day.
- Monitoring financial stability requires tracking both vulnerabilities and stress.

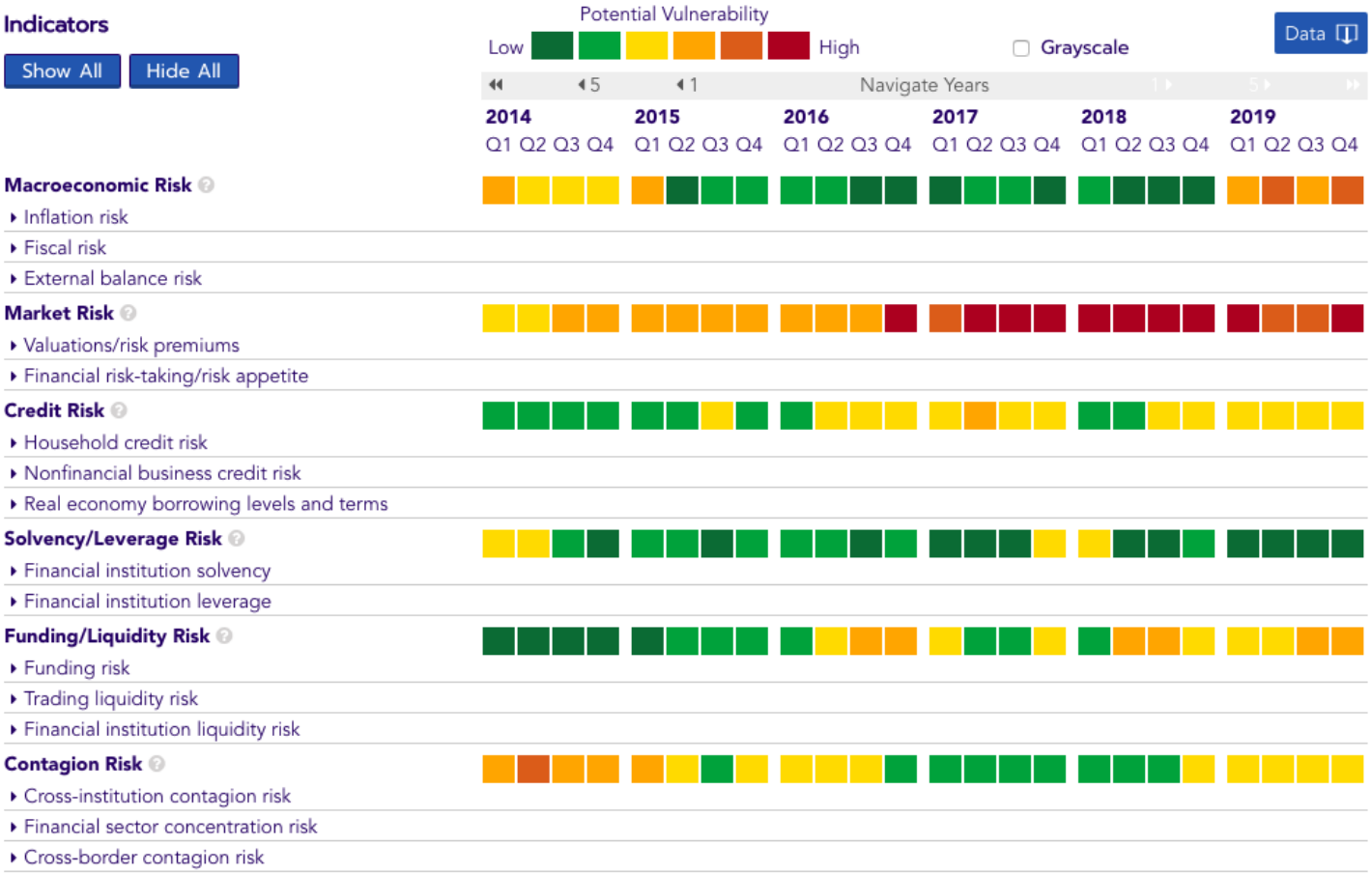
Source: Office of Financial Research. "OFR Financial Stress Index." updated daily. (accessed Aug. 20, 2022). https://www.financialresearch.gov/financial-stress-index/

U.S. OFR Financial Stress Index



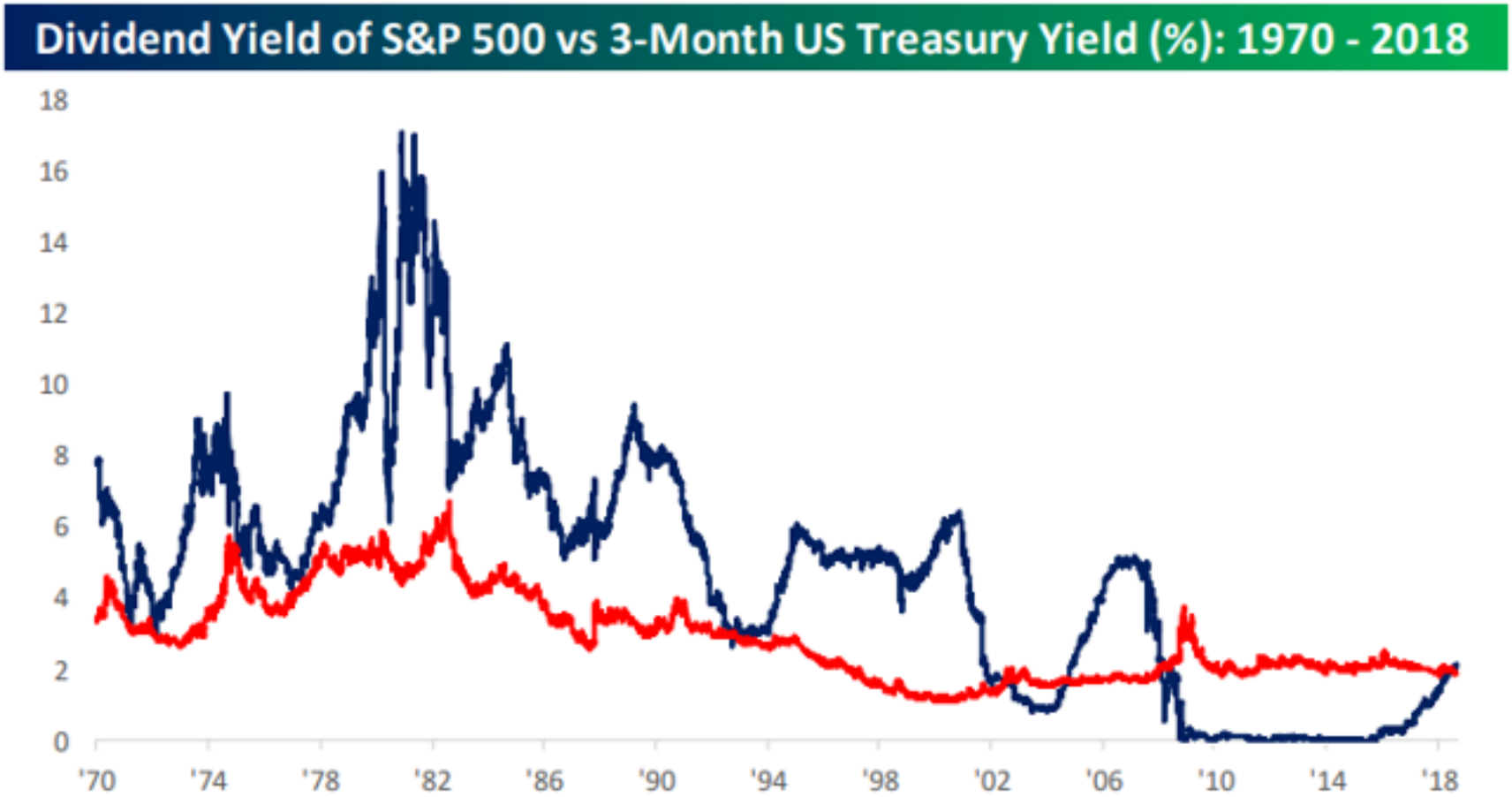
Note: The OFR FSI is positive when stress levels are above average, and negative when stress levels are below average. https://www.financialresearch.gov/financial-stress-index/

U.S. Financial System Vulnerabilities Monitor



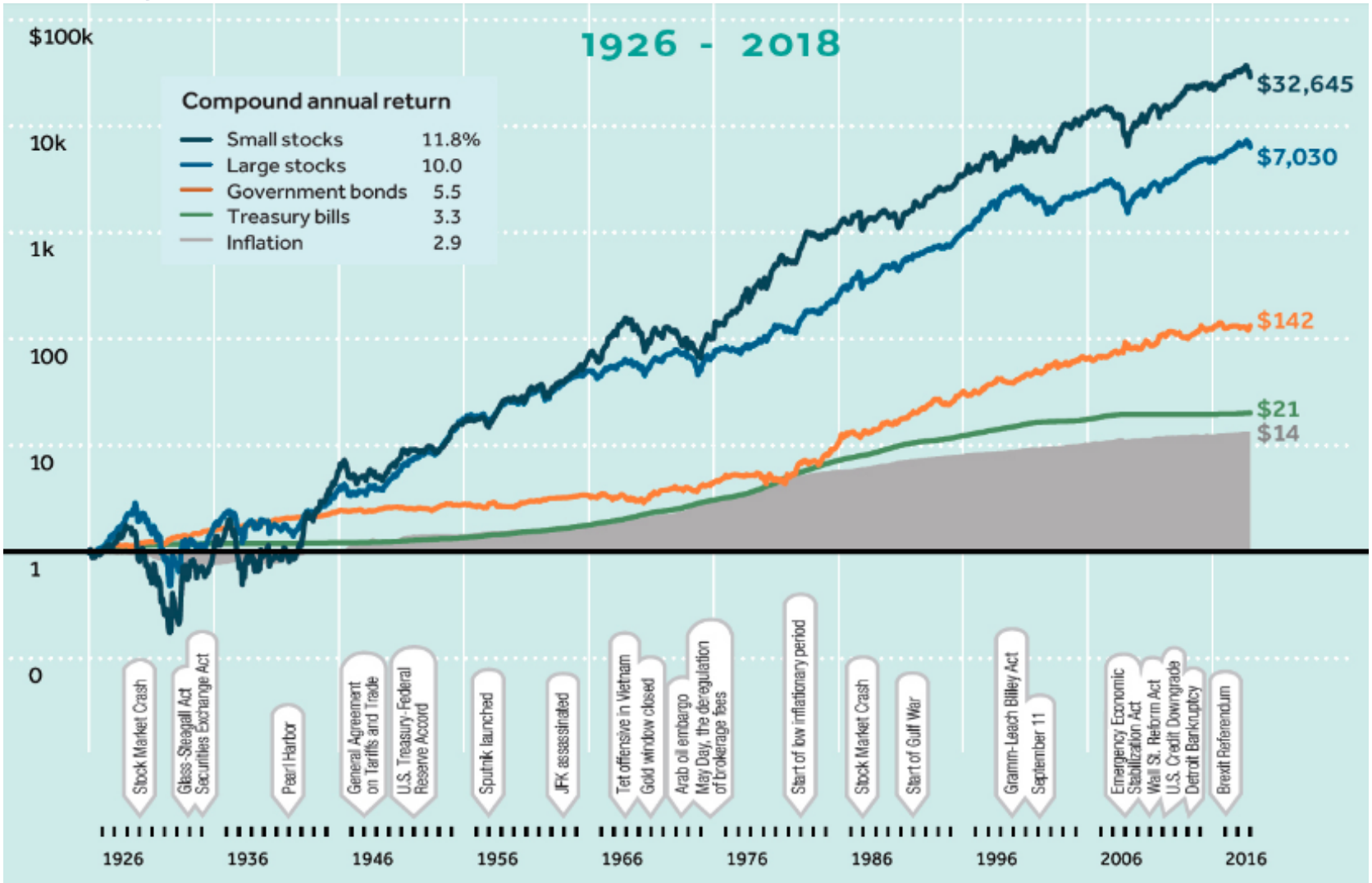
The OFR Financial System Vulnerabilities Monitor is a starting point for monitoring U.S. financial stability. It is a heat map of 58 indicators of potential vulnerabilities in the financial system, organized in six categories: macroeconomic, market, credit, solvency and leverage, funding and liquidity, and contagion. The monitor is designed to provide early warning signals of potential vulnerabilities that merit investigation, not conclusions about financial stability. `https://www.financialresearch.gov/financial-vulnerabilities`

Dividend Yield vs Treasury Yield



Note: Dividend yield – red line. Treasury yield – blue line.
https://seekingalpha.com/article/4208067-ust-yields-vs-s-and-p-500-dividend-yields

U.S. Long-Term Asset Returns (w)



https://graycelladvisors.com/smallcap/

Fisher Equation: Extensions on Risk Premia

The nominal rate of interest is the real rate of interest plus a risk premium(s) that the market or the consensus of investors requires on the financial asset.

$$\boxed{NR = RR + IP + DP + MP + LP + CP + ... + PP}$$

- NR is the nominal interest rate
- RR the real rate of interest
- IP the inflation premium
- DP the default premium
- MP the maturity premium
- LP the liquidity premium
- CP the currency premium
- PP the political risk premium

OUTLINE

Fisher's Theory of Interest

- Interest is the price paid for the temporary use of resources, and the amount of a loan is its principal.
- Irving Fisher's theory of interest analyzes the equilibrium level of the interest rate as the result of the interaction of savers' willingness to save and borrowers' demand for investment funds.
- In Fisher's terms, the interest rate reflects the interaction of savers' marginal rate of time preference (impatience to consume) and borrowers? marginal productivity of capital (investment opportunities).
- Fisher's theory is a general one and obviously neglects certain practical matters, such as the power of the government (in concert with depository institutions) to create money and the government's often large demand for borrowed funds, which is frequently immune to the level of the interest rate. Also, Fisher's theory does not consider the possibility that individuals and firms might invest in cash balances.

Source: Fabozzi et al. (2019) CH15, p. 362.

Interest Rate Determination: Macroeconomic Factors

Interest rates are determined in a free market where supply and demand interact. The supply of funds is influenced by the willingness of consumers, businesses, and governments to save. The demand for funds reflects the desires of businesses, households, and governments to spend more than they take in as revenues.

1. The strength of the economy (business cycles) and the willingness to save. Usually, in very strong economic expansions, businesses' desire to invest in plants and equipment and individuals' desire to invest in housing tend to drive interest rates up. During periods of weak economic conditions, business and housing investment falls and interest rates tend to decline.
2. Monetary policy. Interest rate declines are often reinforced by the policies of the country's central bank (the Federal Reserve in the United States), which attempts to reduce interest rates in order to stimulate housing and other interest-sensitive investments.
3. The rate of inflation. People's willingness to lend money depends partly on the inflation rate. Stable price levels encourage overall borrowing and lending activities, while unstable price levels discourage them.

https://www.econlib.org/library/Enc/InterestRates.html

Interest Rate Determination: Risk, Tax, and Term Factors

1. The riskiness of the borrower. I am willing to lend money to my government or to my local bank (whose deposits are generally guaranteed by the government) at a lower rate than I would lend to my wastrel nephew or to my cousin?s risky new venture. The greater the risk that my loan will not be paid back in full, the larger is the interest rate I will demand to compensate me for that risk. Thus, there is a risk structure to interest rates. The greater the risk that the borrower will not repay in full, the greater is the rate of interest.
2. The tax treatment of the interest. In most cases, the interest I receive from lending money is fully taxable. In certain cases, however, the interest is tax free. If I lend to my local or state government, the interest on my loan is free of both federal and state taxes. Hence, I am willing to accept a lower rate of interest on loans that have favorable tax treatment.
3. The time period of the loan. In general, lenders demand a higher rate of interest for loans of longer maturity. The interest rate on a ten-year loan is usually higher than that on a one-year loan, and the rate I can get on a three-year bank certificate of deposit is generally higher than the rate on a six-month certificate of deposit. But this relationship does not always hold.

`https://www.econlib.org/library/Enc/InterestRates.html`

Loanable Funds Theory: Determination

The loanable funds theory is an extension of Fisher's theory and proposes that the equilibrium rate of interest reflects the demand and supply of funds, which depend on savers' willingness to save, borrowers' expectations regarding the profitability of investing, and the government's action regarding money supply.

1. The total demand for funds by firms, governments, and households (or individuals) is negatively related to the interest rate. If income and other variables do not change, then an increase in the interest rate will reduce the demand (Q_D) for borrowing on the part of many firms and individuals, as projects become less profitable, and consumption and holding cash grow more costly.
2. The total supply of funds by firms, governments, banks, and individuals is positively related to the level of interest rates, if all other economic factors remain the same.
3. In an equilibrium, the intersection of the supply and demand functions sets the interest rate level and the level of loans.

Source: Fabozzi et al. (2019) CH15, p. 362.

Loanable Funds Theory: Equilibrium

- In loanable funds market equilibrium, the demand for funds equals the supply of funds. In this case, all agents are borrowing what they want, investing to the desired extent, and holding all the money they wish to hold. In other words, equilibrium extends through the money market, the bond market, and the market for investment assets.
- As in Fisher's theory of interest rates, shifts in the demand and supply curves may occur for many reasons: changes in the money supply, government deficits, changed preferences by individuals, new investment opportunities, and so on. These shifts affect the equilibrium level of the interest rate and of investment in predictable ways.
- Finally, the expectation of inflation can affect the equilibrium rate through the supply of funds curve, as savers demand higher rates (because of inflation) for any level of savings.
- Both theories have excluded the question of default on loans: the rate discussed is the risk-free rate, either in its nominal rate or real rate.

Source: Fabozzi et al. (2019) CH15, pp. 362-363.

Credit Market and Interest Rate

- Credit (loanable funds) is essential for the efficient allocation of incomes in the economy. The relevant price in he credit market is the interest rate (in real terms). In a world without inflation and other risks, the interest rate is the price of borrowing or lending, reflecting the economic trade-off between the present and future incomes that borrowers and savers face.
- Firms, households, and governments use the credit market for borrowing. The credit demand summarizes the relationship between the quantity of credit demanded by borrowers and the interest rate cost. The credit demand curve results from the optimizing behavior of the borrowers.
- Savors/lenders trade off consumption today for consumption in the future, taking into account of the reward (earned interest) for delaying consumption. The credit supply summarizes the relationship between the quantity of credit supplied and the interest rate.
- The intersection of the credit demand curve and the credit supply curve is the credit market equilibrium. At the equilibrium interest rate, the quantity of credit demanded is equal to the quantity of credit supplied.

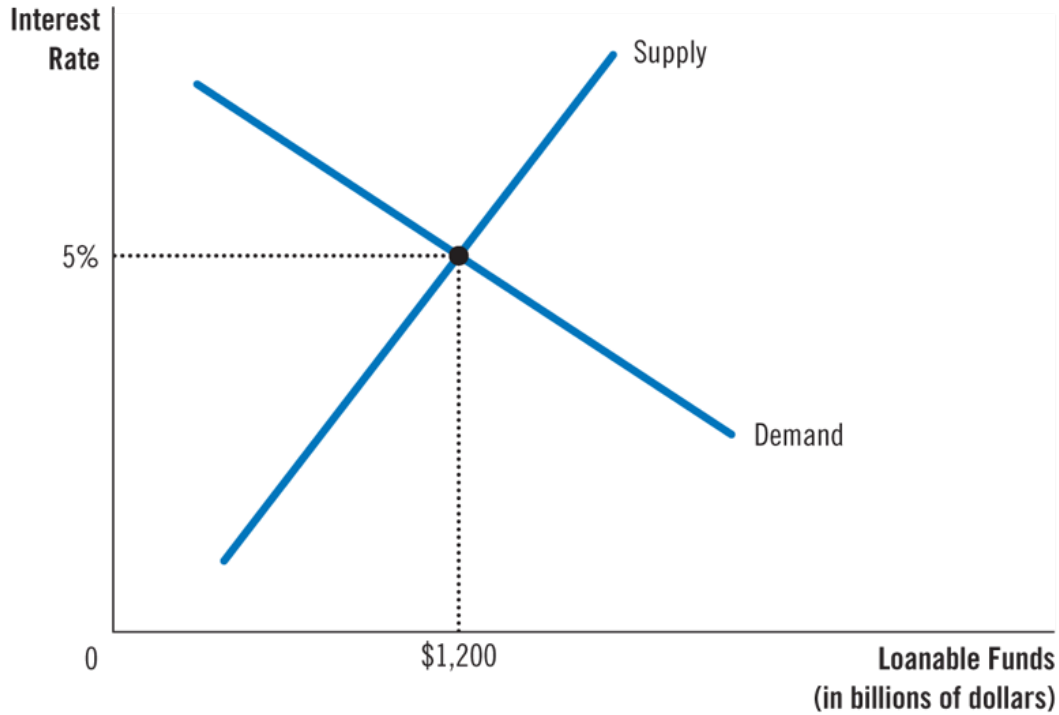
Source: Acemoglu, Laibso, and List (2022) CH10, Macroeconomics, 3e, Pearson. p. 256.

Credit (Loanable Funds) Market Equilibrium $S(i) = I(i)$

FIGURE 1

The Market for Loanable Funds

The interest rate in the economy adjusts to balance the supply and demand for loanable funds. The supply of loanable funds comes from national saving, including both private saving and public saving. The demand for loanable funds comes from firms and households that want to borrow for purposes of investment. Here the equilibrium interest rate is 5 percent, and $1,200 billion of loanable funds are supplied and demanded.



Source: N. G. Mankiw (2021) CH26, Principles of Economics, 9e, Cengage.

National Income Accounts: Saving and Investment

In a closed economy, national income identity implies that investment I must always be financed by saving S, and both are determined by the interest rate.

- $Y = C + I + G \Rightarrow I = Y - C - G$
- Add and subtract government tax T inside
- $Y - C - G = Y - C - T + T - G = (Y - C - T) + (T - G)$
- Private sector saving $= Y - C - T = S_{private}$
- Public sector saving $= T - G = S_{public}$
- $S = (Y - C - T) + (T - G) = S_{private} + S_{public}$
- National saving is equal to investment ($S = I$) in equilibrium.

In the loanable funds market for borrowing and lending activities, saving provides supply of fund whereas investment induces demand for fund. Market equilibrium is reached at the interest rate such that saving equals investment.

National Saving = Private Saving + Public Saving

$$\boxed{S = (Y - C - T) + (T - G) = S_{private} + S_{public}}$$

- National saving: the total income in the economy that remains after paying for consumption and government purchases.
- Private saving: the income that households and firms have left after paying for taxes and consumption.
- Public saving: the tax revenue that the government has left after paying for its spending.
- Budget surplus: an excess of tax revenue over government spending.
- Budget deficit: a shortfall of tax revenue from government spending.

Policy Analysis: Saving and Investment Incentives

Policy 1: Should the income tax laws be reformed to encourage savings?

- Many economists and policymakers have advocated increases in how much people save. Suppose that the government changes the tax code to encourage greater saving.
- This will cause an increase in saving, shifting the supply of loanable funds to the right. The equilibrium interest rate will fall and the equilibrium quantity of funds will rise.
- Thus, the result of the new tax laws would be a decrease in the equilibrium interest rate and greater saving and investment.

Policy 2: Should the corporate tax laws be reformed to encourage investment?

- Suppose instead that the government passed a new law lowering taxes for any firm building a new factory or buying a new piece of equipment (through the use of an investment tax credit).
- This will cause an increase in investment, causing the demand for loanable funds to shift to the right. The equilibrium interest rate will rise, and the equilibrium quantity of funds will increase as well.
- Thus, the result of the new tax laws would be an increase in the equilibrium interest rate and greater saving and investment.

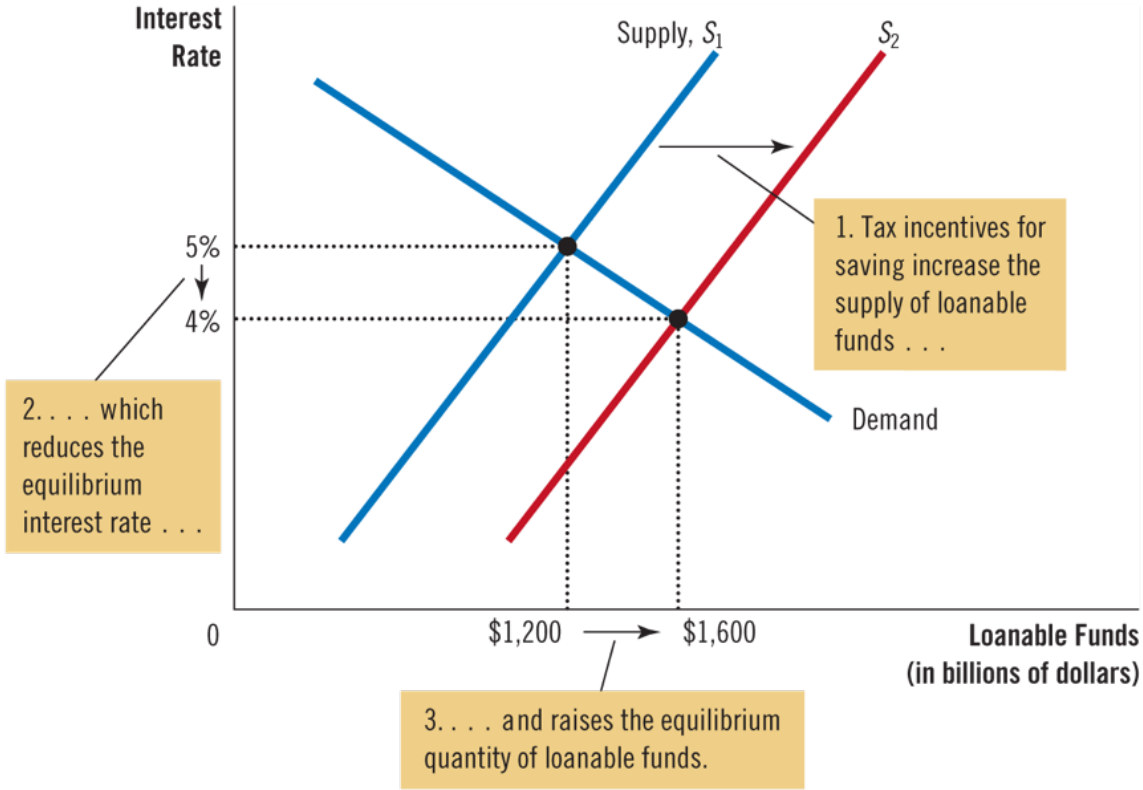
Source: N. G. Mankiw (2021) CH26, Principles of Economics, 9e, Cengage.

Saving Increases Supply of Credits (Funds)

FIGURE 2

Saving Incentives Increase the Supply of Loanable Funds

A change in the tax laws to encourage Americans to save more would shift the supply of loanable funds to the right from S_1 to S_2. As a result, the equilibrium interest rate would fall, and the lower interest rate would stimulate investment. Here the equilibrium interest rate falls from 5 percent to 4 percent, and the equilibrium quantity of loanable funds saved and invested rises from $1,200 billion to $1,600 billion.



Note: Policy 1 (a law to increase saving) leads to an increase in both saving and investment. Its effect on the interest rate is downside.
Source: N. G. Mankiw (2021) CH26, Principles of Economics, 9e, Cengage.

Investment Increases Demand for Credits (Funds)

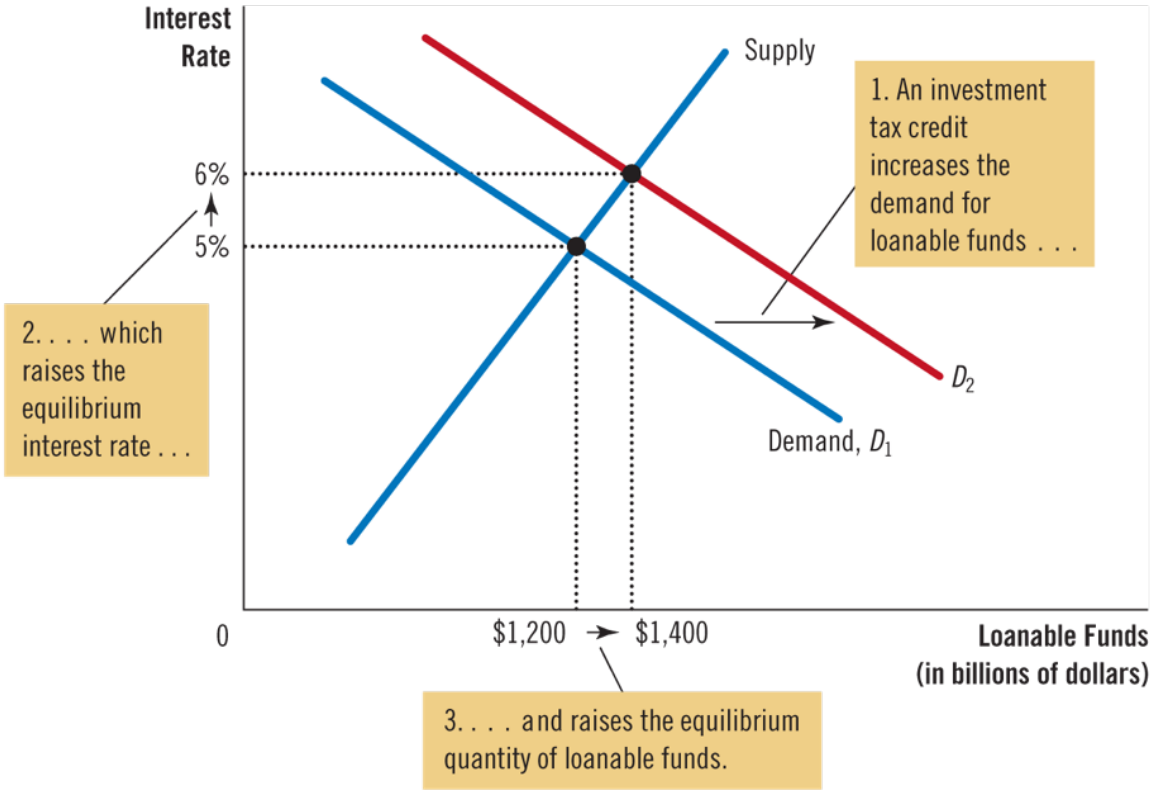


FIGURE 3

Investment Incentives Increase the Demand for Loanable Funds

If the passage of an investment tax credit encouraged firms to invest more, the demand for loanable funds would increase. As a result, the equilibrium interest rate would rise, and the higher interest rate would stimulate saving. Here, when the demand curve shifts from D_1 to D_2, the equilibrium interest rate rises from 5 percent to 6 percent, and the equilibrium quantity of loanable funds saved and invested rises from $1,200 billion to $1,400 billion.

Policy 2 (a law to increase investment) leads to an increase in both saving and investment. Its effect on the interest rate is upside. Source: N. G. Mankiw (2021) CH26, Principles of Economics, 9e, Cengage.

Policy Analysis: Government Budget Deficits

- A budget deficit occurs if the government spends more than it receives in tax revenue. This implies that public saving $(T - G)$ falls, which will lower national saving.
- In the model, the supply of loanable funds will shift to the left. The equilibrium interest rate will rise, and the equilibrium quantity of funds will decrease.
- When the public spending reduces national saving by running a budget deficit, the interest rate rises and investment falls.
- **Crowding out**: a decrease in investment that results from government borrowing.
- A budget deficit resulting from a tax cut has similar effects. A tax cut reduces public saving. Private saving rises by less than public saving declines. Once again, the budget deficit reduces the supply of loanable funds.
- Government budget surpluses work in the opposite way. The supply of loanable funds increases, the equilibrium interest rate falls, and investment rises.

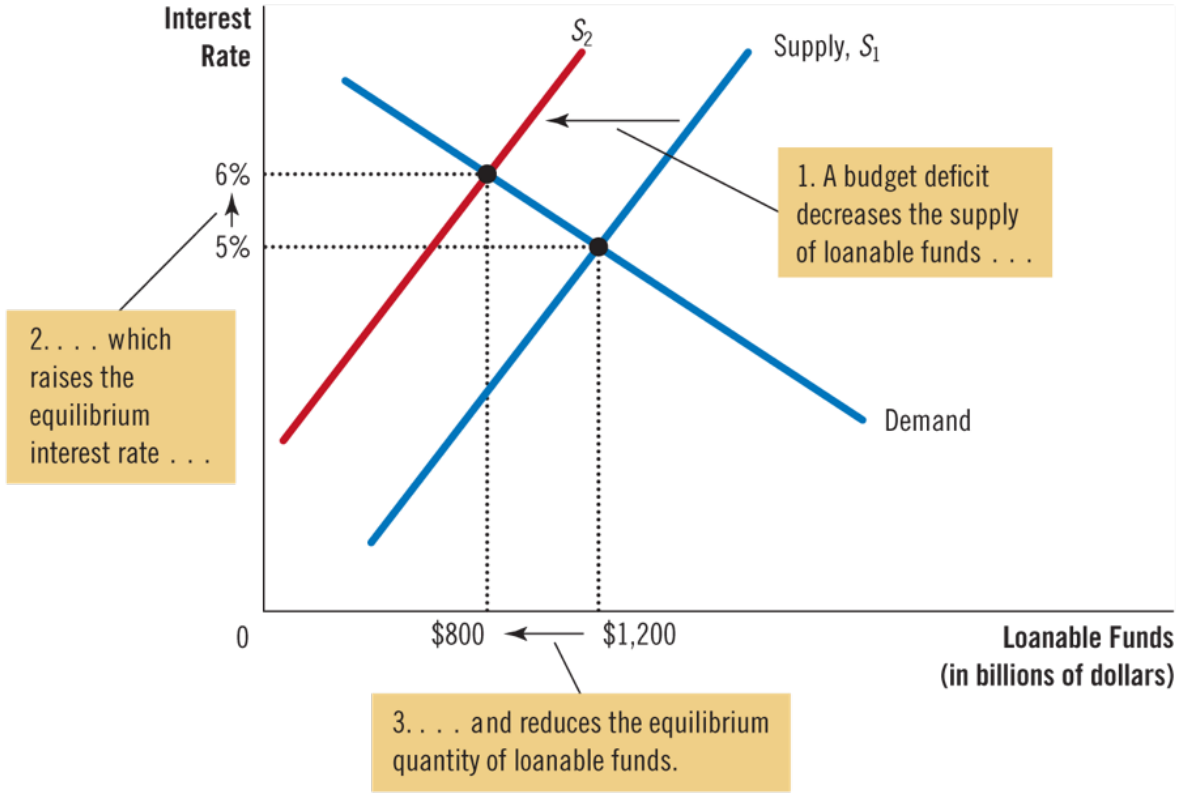
Source: N. G. Mankiw (2021) CH26, Principles of Economics, 9e, Cengage.

Government Deficit Decreases National Savings

FIGURE 4

The Effect of a Government Budget Deficit

When the government spends more than it receives in tax revenue, the resulting budget deficit lowers national saving. The supply of loanable funds decreases, and the equilibrium interest rate rises. Thus, when the government borrows to finance its budget deficit, it crowds out households and firms that otherwise would borrow to finance investment. Here, when the supply curve shifts from S_1 to S_2, the equilibrium interest rate rises from 5 percent to 6 percent, and the equilibrium quantity of loanable funds saved and invested falls from $1,200 billion to $800 billion.



All else equal, mounting government budget deficit (and debt) will lower national saving, drives up interest rate, and crowds out investment. Source: N. G. Mankiw (2021) CH26, Principles of Economics, 9e, Cengage.

OUTLINE

Monetary World v.s. Real World

- Money is a standardized medium of exchange and a metric of exchange value. Interest is most commonly expressed in monetary units.
- Fisher's theory of interest applies more generally even to a world without money. In a world where there is no money, interest still exists because of time preference and investment opportunity.
- Interest rate, in real terms, measures the percentage rate an individual would like to pay to obtain immediate income at the cost of future income. Or, the willingness to invest considering opportunities available.
- Introducing money into our society, all goods and services (or real income) are measured in terms of currency unit.
- Therefore, as a standardized metric of exchange value, the money itself becomes vital for the inter-termporal exchange of income or trade.

Nominal v.s. Real Variables

In economics, nominal value is expressed in monetary terms (in units of a currency). By contrast, real value adjusts nominal value to remove the effects of price level change in the economy. More fundamentally, a real variable is measured in terms of the quantity of goods and services. The five most pivotal real variables in macroeconomics and finance are:

1. Real income (NI/P): goods and services produced in a period.
2. Real wage (W/P): the amount of goods and services that the monetary or nominal wage can afford.
3. Real money balance (M/P): the purchasing power of money in terms of the amount of goods and services.
4. Real exchange rate ($RE = E * P_F / P_H$): the amount of domestic goods and services that a foreign currency can purchase.
5. Real interest rate ($r \approx i - \pi^e$): the rate of return for goods and services, which equals nominal interest rate minus inflation rate.

Classical Views of Money

- According to the classical theory, all markets fro goods continuously clear and relative prices flexibly adjust to ensure the equilibrium is attained. The economy is always in full resource allocation and employment except for the transitory deviations as a result of real disturbances.
- In such an economy, the role of money is simple: it serves as the numeraire, that is a commodity whose unit is used in order to express prices and values, but whose own value remains unaffected by this role. It also facilitates the exchange of goods as Jevons (1875) pointed out that the use of money satisfied double coincidence of wants.
- However, it does not influence the determination of relative prices, real interest rates, the equilibrium quantities of commodities, and thus aggregate real income. Money is a veil, so to speak
- Money is "neutral" with no consequences for real economic magnitudes. Its role as a store of value is perceived as limited under the classical assumption of perfect information and negligible transaction costs.

Source: Sriram (1999).

Money is Not Neutral: Evidence

1. Friedman and Schwartz (1963) analyzed the role of monetary policy in the severity of the Great Depression. They argue that the Fed failed to act from early 1930 and March 1933, and instead allowed the money supply to fall and a substantial fraction of the banking system to fail.
2. The Volcker disinflation and accompanying twin recessions of the late 1970s and early 1980s. The behavior of output during this period is consistent with the view that monetary nonneutrality is large. What makes the Volcker episode potentially compelling is that output fell and rose largely in sync with the actions of the Fed. If not for this, it would have been much harder to attribute the movements in output to changes in policy.
3. Mussa (1986) argued the abrupt change in monetary policy associated with the breakdown of the Bretton Woods system of fixed exchange rates in February 1973 caused a large increase in the volatility of the US real exchange rate.
4. Nakamura and Steinsson (2018) presented strong discontinuity-based evidence that monetary policy affects real interest rates. A large amount of monetary news is revealed discretely at the time of the eight regularly scheduled meetings of the Federal Open Market Committee of the Federal Reserve.

Source: Nakamura and Steinsson (2018)

Quantity Theory of Money: MV=PY

The quantity theory brings forth a direct and proportional relationship between the quantity of money and the price level. This relationship was developed in the classical equilibrium framework by two alternative but equivalent expressions. Money demand theories have evolved over time.
In general, it is demand for real money balances (Sriram, 1999).

1. M – money in circulation
2. V – transaction velocity
3. P – aggregate price level
4. Y – real output or income

Transaction equation is derived from the role of money as a means or medium of exchange. Irving Fisher (1911) concentrated on institutional details of the payment mechanism behind money demand in his analysis, Cambridge economists focused on motives for holding money by individuals.

Quantity Theory of Money: Earlier Formulations

Fisher's "equation of exchange" (1911): $M_S V_T = P_T T$

- The quantity of money in circulation M_S is related to the volume of transactions T and the price level of articles trade P_T in a given period through a proportionality factor V_T called "transaction velocity."
- This equation is not an identity rather an equilibrium condition. Money is held simply to facilitate transactions and has no intrinsic utility.

Pigou (1971) and Marshall (1923): the cash balance approach $M_D = kPY$

- The quantity of money is related to nominal income and money demand determines the effect of money supply on the price level.
- Cambridge economists pointed out the role of wealth and the interest rate in determining the demand for money.
- The emphasis the Cambridge formulation places on the demand for money influences both the Keynesian and the Monetarist theories.

Source: Sriram (1999).

Keynesian Theory of Money Demand

When classical and neoclassical analyzed the money demand primarily in terms of money in exchange, Keynes focused on the motives that lead people to hold money. His significant contribution to the money demand theory hinges on the role the speculative motive plays.

1. Transactions motive. Keynes accepted the quantity theory view that, money as a medium of exchange, the transactions component is proportional to the level of income.
2. Precautionary motive. Keynes recognized that people hold money as a cushion against unexpected wants. He argued that the precautionary money balances people want to hold would be proportional to income.
3. Speculative motive. Keynes believed people choose to hold money as a store of wealth, which he called the speculative motive. The speculative demand for money is the liquidity preference Keynes referred to.

Recall that the opportunity cost of holding money is the interest forgone.

Source: Mishkin (2022) The Economics of Money, Banking, and Financial Markets, 13e, Pearson.

Keynesian Theory of Liquidity Preference

- The store-of-value function is emphasized in the speculative motive of the demand for money. Individuals can hold their wealth either in money or in bonds. The price they are willing to pay for bonds depends on the interest rate (bond yields) as the prospective buyers would wish to earn.
- The rate of interest was formally introduced in the money demand function where the demand for real money balances is a function of real income and interest rate. $M_D = L(P, Y, i)$ or $M_D/P = L(Y, i)$
- The major implication of the Keynesian analysis is that when the interest rate is very low, everyone will expect it to rise in the future, and hence, prefers to hold money whatever is supplied.
- At this stage, the aggregate demand for money become perfectly elastic with respect to the interest rate. The economy falls into a situation called "liquidity trap" in which the interest elasticity of money demand can be infinitely at low levels of interest rate.

Source: Sriram (1999).

Money Supply in the U.S.

- The U.S. money supply comprises currency—dollar bills and coins issued by the Federal Reserve System and the U.S. Treasury—and various kinds of deposits held by the public at commercial banks and other depository institutions such as thrifts and credit unions.
- Because money is used in virtually all economic transactions, it has a powerful effect on economic activity. An increase in the supply of money works both through lowering interest rates, which spurs investment, and through putting more money in the hands of consumers, making them feel wealthier, and thus stimulating spending.
- Federal Reserve policy is the most important determinant of the money supply. The Federal Reserve affects the money supply by affecting its most important component, bank deposits.
- In a simplified equilibrium model, money supply is assumed perfectly inelastic to the interest rate, fully determined by the monetary policy. Hence, it is exogenous (independent of the market interest rate).

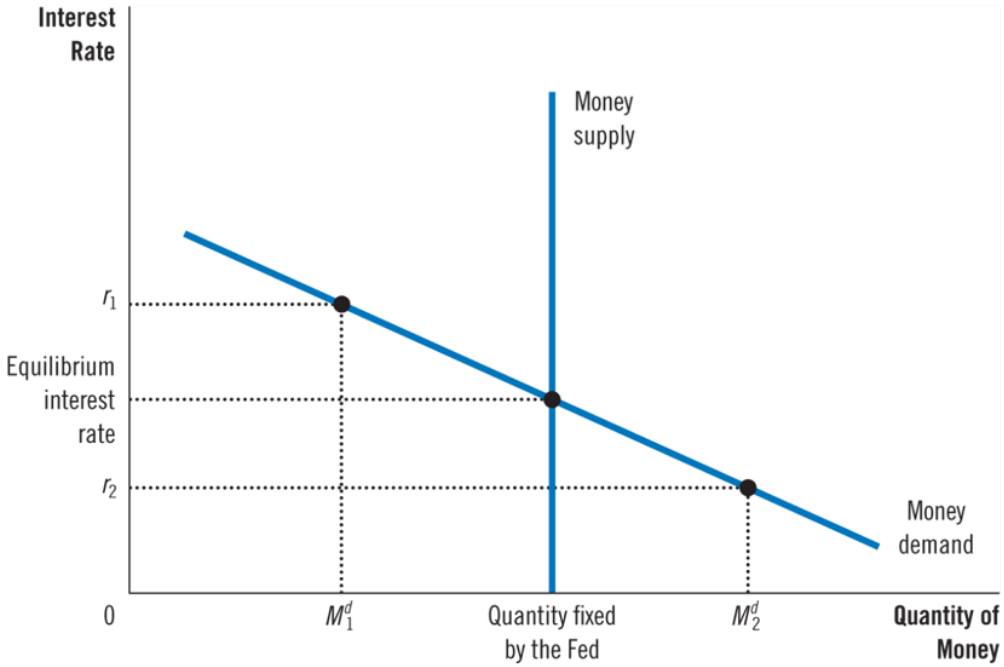
Source: Anna J. Schwartz, Money Supply. https://www.econlib.org/library/Enc/MoneySupply.html

Money Market Equilibrium $M_D = L(P, Y, i) = M_S$

FIGURE 1

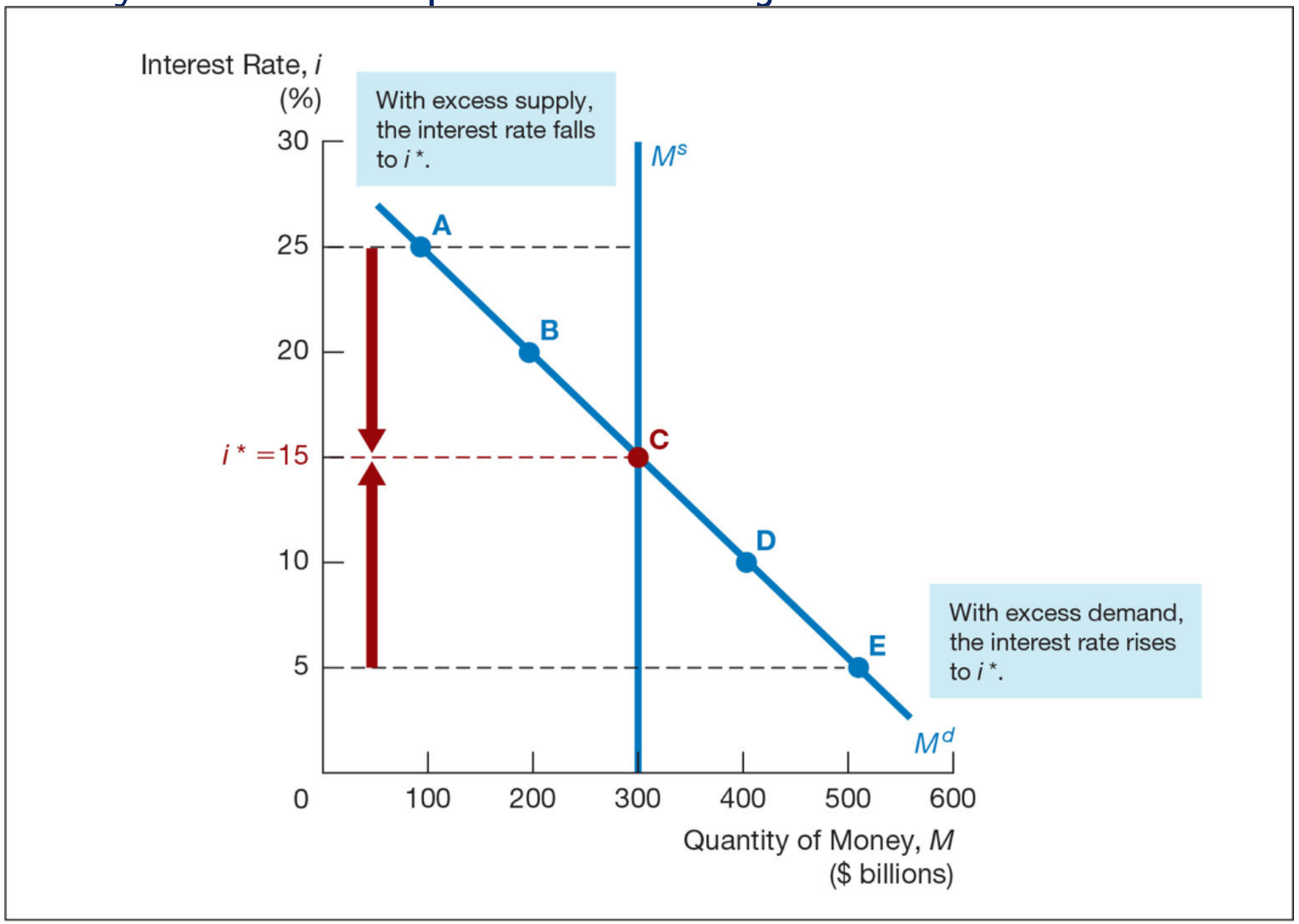
Equilibrium in the Money Market

According to the theory of liquidity preference, the interest rate adjusts to bring the quantity of money supplied and the quantity of money demanded into balance. If the interest rate is above the equilibrium level (such as at r_1), the quantity of money people want to hold (M_1^d) is less than the quantity the Fed has created, and this surplus of money puts downward pressure on the interest rate. Conversely, if the interest rate is below the equilibrium level (such as at r_2), the quantity of money people want to hold (M_2^d) exceeds the quantity the Fed has created, and this shortage of money puts upward pressure on the interest rate. Thus, the forces of supply and demand in the market for money push the interest rate toward the equilibrium interest rate, at which people are content holding the quantity of money the Fed has created.



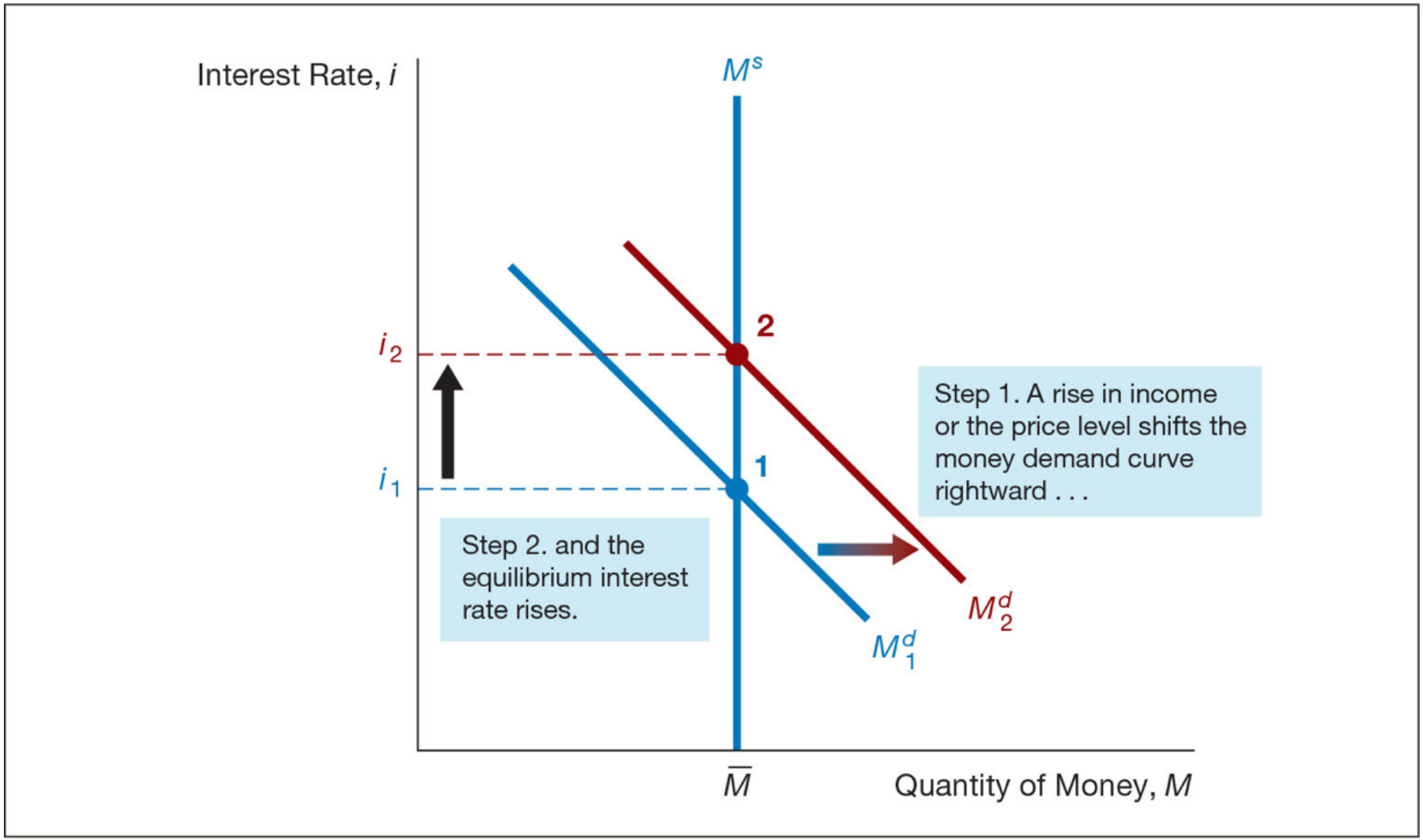
Source: Mankiw (2021) CH34, p.722.

Money Market Equilibrium Adjustment



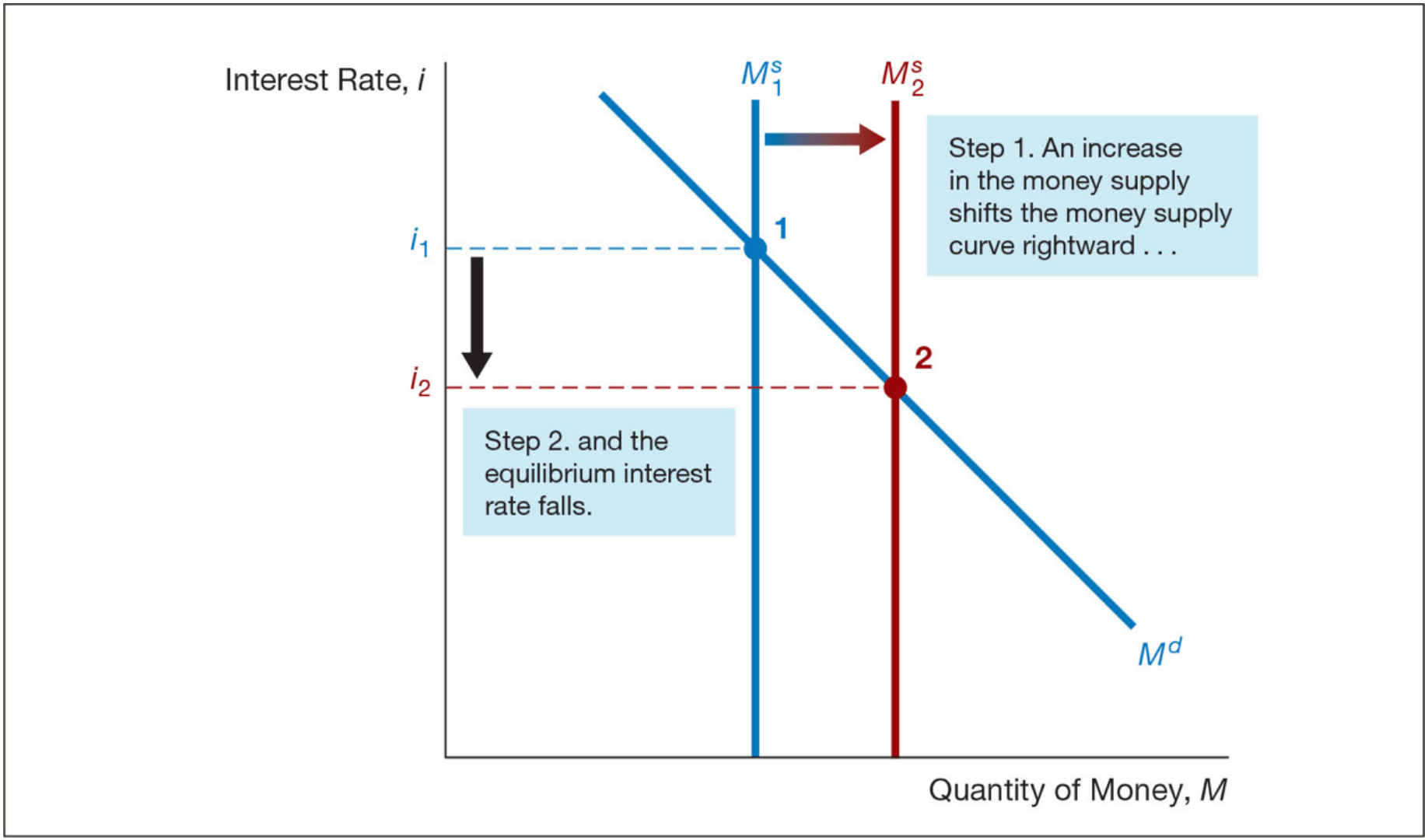
Source: Mishkin (2022) The Economics of Money, Banking, and Financial Markets, 13e, Pearson.

Change in Money Demand

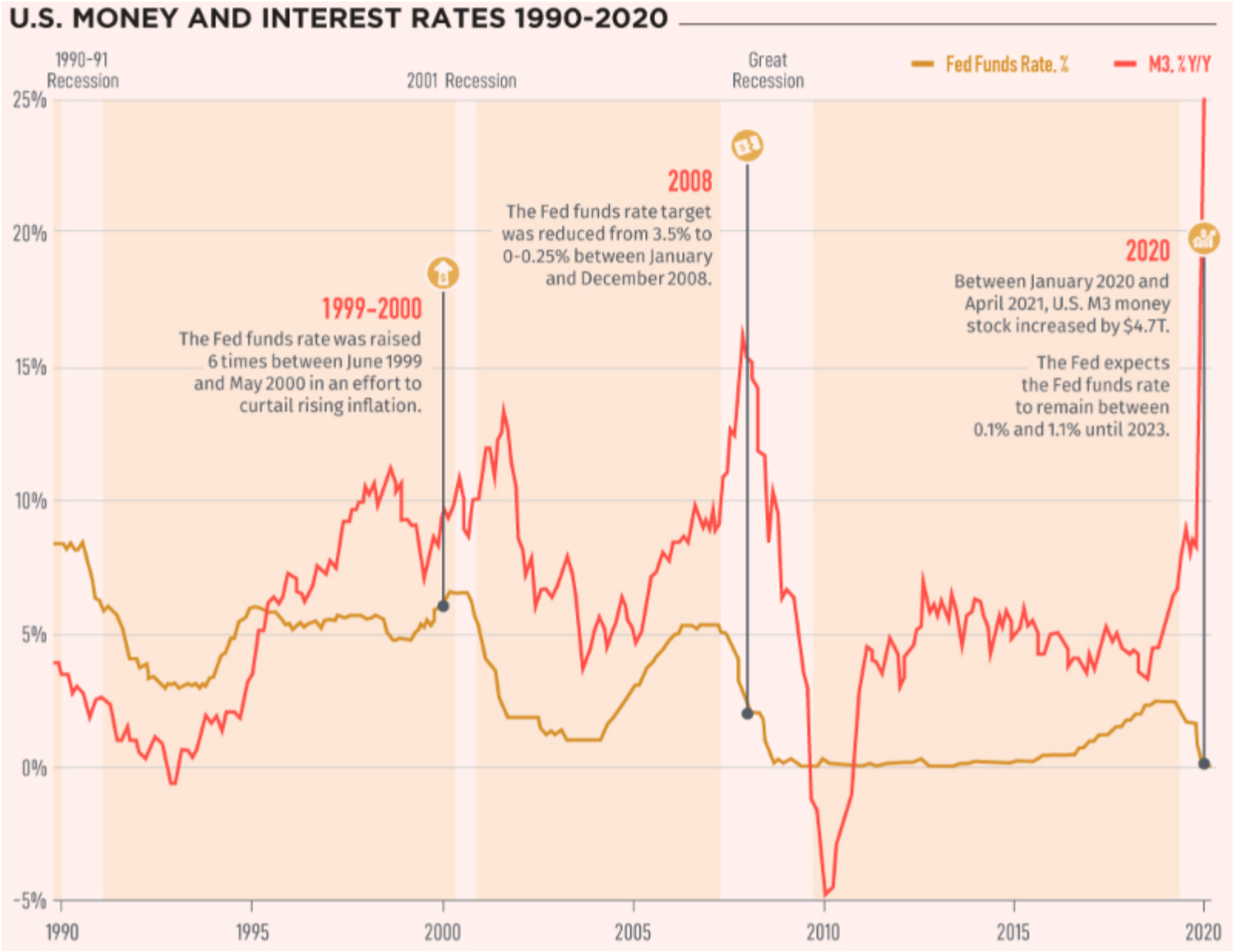


Source: Mishkin (2022) The Economics of Money, Banking, and Financial Markets, 13e, Pearson.

Change in Money Supply



Source: Mishkin (2022) The Economics of Money, Banking, and Financial Markets, 13e, Pearson.



https://elements.visualcapitalist.com/30-years-of-u-s-money-supply-and-interest-rates/

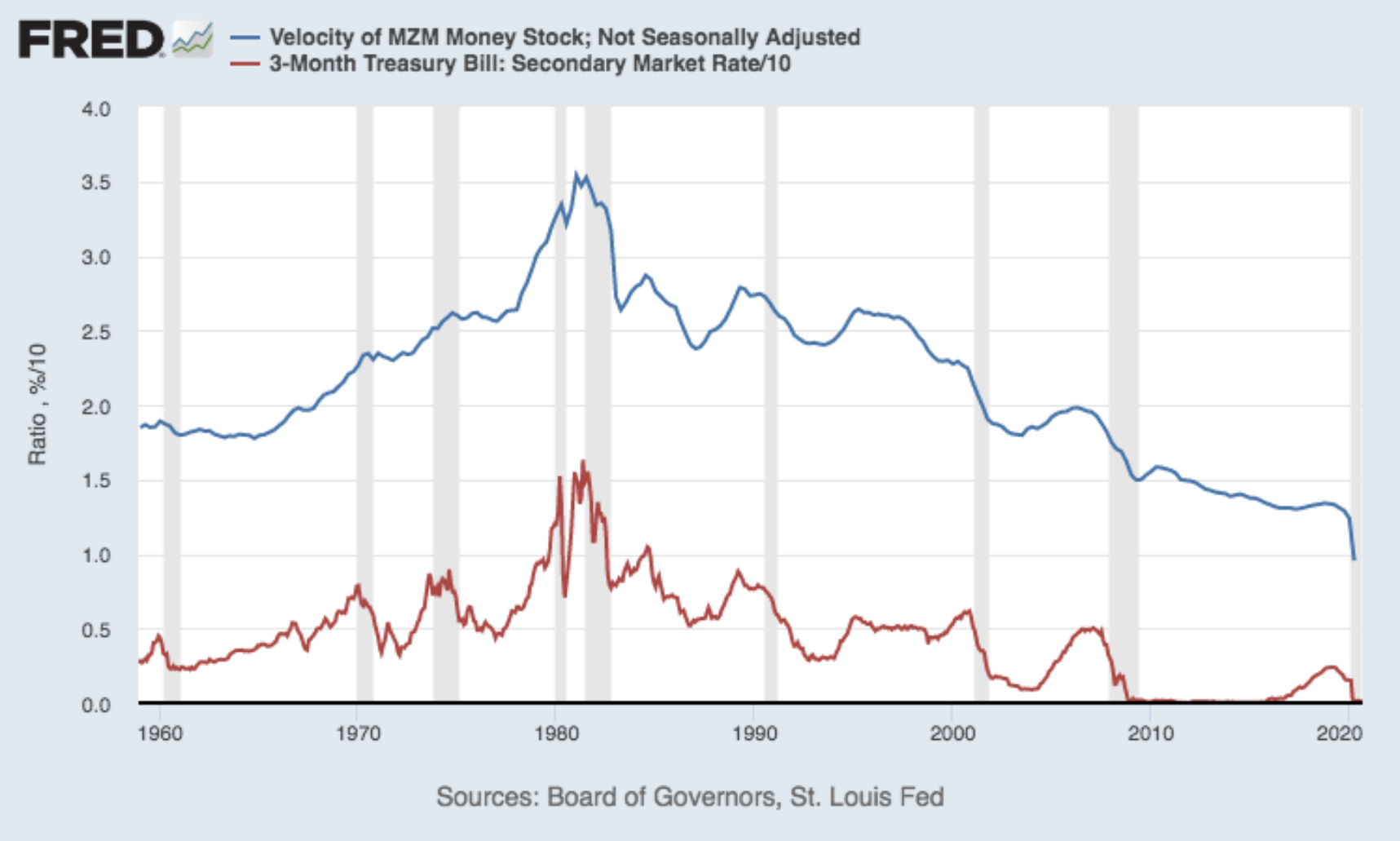
Money Velocity and Interest Rate

$$\boxed{M_D = L(P, Y, i) \quad \& \quad V = PY/M = Y/L(Y, i)}$$

- According to Keynes, the demand for real money balance is negatively related to the nominal interest rate and positively to real income.
- Later, Keynesian economists expanded the analysis and showed that interest rates play a more important role in money demand than even Keynes supposed. They demonstrated that even the transactions and precautionary demands would be negatively related to the interest rate.
- When interest rate $i$goes up, real money balance $M_D/P = L(i, Y)$ declines, and therefore velocity rises. Because interest rates undergo substantial fluctuations, Keynesian theories of money demand indicate that velocity undergoes substantial fluctuations as well.
- Thus, Keynesian theories cast doubt on the classical view that nominal income is determined primarily by movements in the quantity of money.

Source: Mishkin (2022) The Economics of Money, Banking, and Financial Markets, 13e, Pearson

Money Velocity and Interest Rate (w)



OUTLINE

Time Value and Interest Rate

$$\boxed{FV = PV \times (1 + i)}$$

- What is the value of \$100 next year, if the market interest rate is 1%?
- PV is the present value of a financial asset, i stands for interest rate.
- FV is the future value of the financial asset bearing interest over time.

$$\boxed{PV = FV \div (1 + i)}$$

- What is the value today for next year's \$100, if $i = 1\%$?
- How much shall we deposit today in order to withdraw \$100 next year?
- How much we can borrow today if we have to pay back \$100 next year?

Future Value and Simple Interest

$$\boxed{FV = PV + i \times T}$$

- Suppose the market interest rate is 1% and remains the same.
- Simple interest pays a fixed amount of interest year over year.
- The value of \$100 in one year: $FV_1 = 100 + 100 \times 1\% = \$101$
- The value of \$100 in two years: $FV_2 = 100 + 1 + 1 = \$102$
- .....
- The value of \$100 in T years: $FV_T = 100 + 1 + ... + 1 = \$100 + 1 \times T$
- Conclusion: A financial asset with simple interest grows in linear value.

Future Value and Compound Interest

$$\boxed{FV = PV \times (1+i)^T}$$

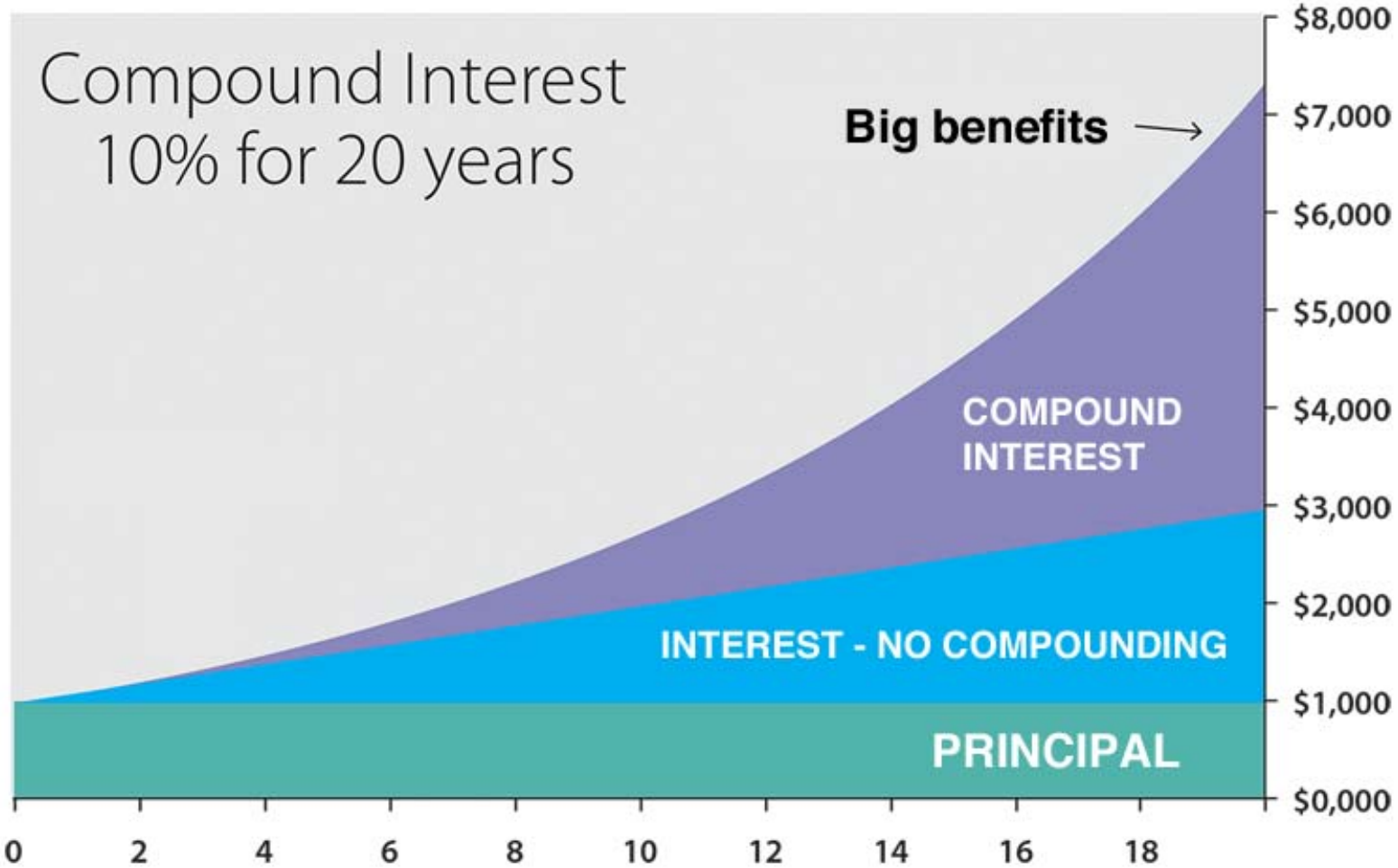
- Suppose the market interest rate is 1% and remains the same.
- Compound interest pays interest year over year on earlier interest paid.
- The value of \$100 in one year: $FV_1 = 100 + 100 \times 1\% = PV \times (1+i)$
- The value of \$100 in two years: $FV_2 = FV_1 + FV_1 \times 1\% = FV_1 \times (1+i)$
- The value of \$100 in three year: $FV_3 = FV_2 + FV_2 \times 1\% = FV_2 \times (1+i)$
- .....
- The value of \$100 in T years: $FV_T = FV_{T-1} \times (1+i) = PV \times (1+i)^T$
- Conclusion: A financial asset with compound interest grows exponentially.

The Rule of 72 and Compounding

- A simple rule, the rule of 72, tells how long it takes your money to double if it is invested at compound interest. The number 72 divided by the interest rate gives the approximate number of years it will take to double your money. For example, at a 5 percent interest rate, it takes about fourteen years to double your money ($72 \div 5 = 14.4$), while at an interest rate of 10 percent, it takes about seven years.
- There is a wonderful actual example of the power of compound interest. Upon his death in 1791, Benjamin Franklin left $5,000 to each of his favorite cities, Boston and Philadelphia. He stipulated that the money should be invested and not paid out for one hundred to two hundred years. At one hundred years, each city could withdraw $500,000; after two hundred years, they could withdraw the remainder. They did withdraw $500,000 in 1891; they invested the remainder and, in 1991, each city received approximately $20,000,000.

Source: Burton G. Malkiel, Interest Rates. ECONLIB CEE (w)

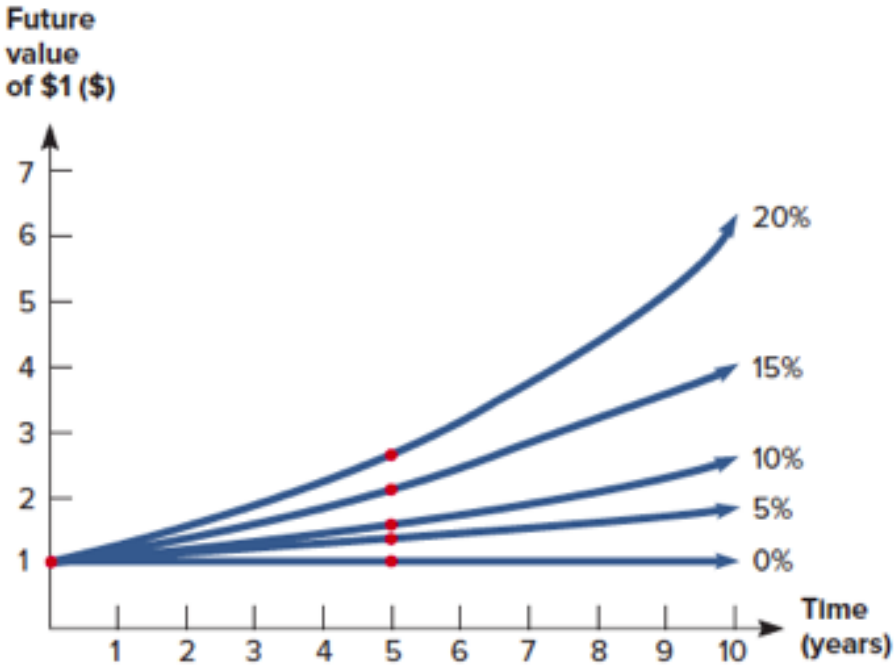
The Effect of Compound Interest (w)



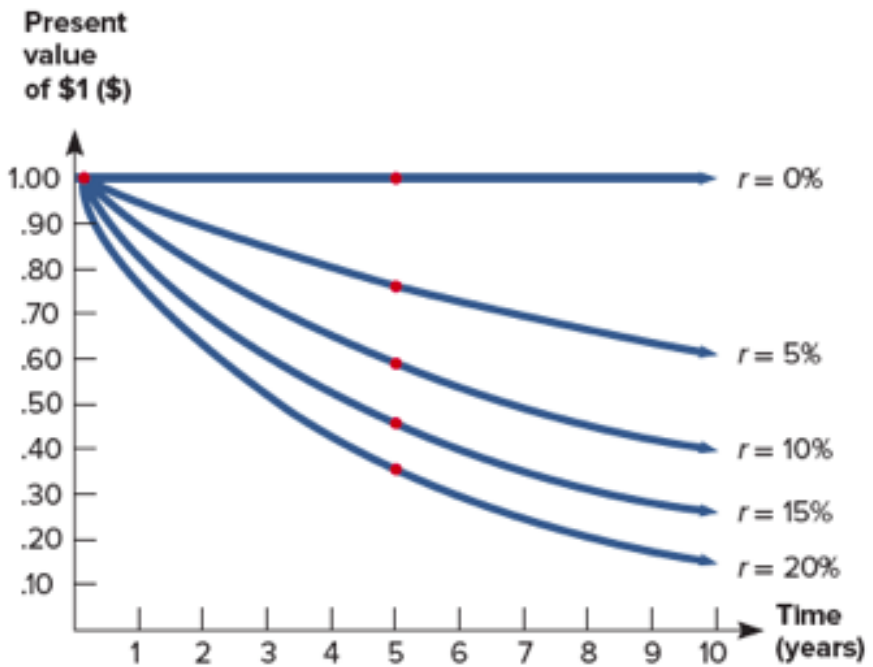
https://www.thecalculatorsite.com/articles/finance/compound-interest-formula.php

Future Value v.s. Present Value

$FV = (1+i)^T$ (Compounding)



$PV = (1+i)^{-T}$ (Discounting)



Source: Ross (2021). FV rises with the compound rate i and the time horizon. For the same future value, PV falls with the discount rate i and time horizon. Higher interest rate (discount rate) lowers the present value of the loan.

Quotes on Compound Investment

Compounding is the magic of investing. —Jim Rogers

My life has been a product of compound interest. —Warren Buffett

The nature of compound interest is it behaves like a snowball of sticky snow. And the trick is to have a very long hill, which means either starting very young or living very—to be very old. —Warren Buffett

Charlie always describes compound interest as being like, you know, being at the top of a very large hill with wet snow and starting with a snowball and getting it rolling downhill. —Warren Buffett

The elementary mathematics of compound interest is one of the most important models there is on earth. —Charlie Munger

Even apparently modest return differentials, operating over long periods of time, translate into staggering wealth differentials. During the 78 years of the Ibbotson series (1926-2003), one dollar invested in large company stocks expanded 2,285 times, while bonds produced a 61 multiple, and cash, an 18 multiple. —David Swenson

Einstein called compounding the eighth wonder of the world and our mission is to harness this dynamic for our investors benefit. —Christopher Begg

`http://mastersinvest.com/compounding`

OUTLINE

Interest Rate and Liquidity Trap

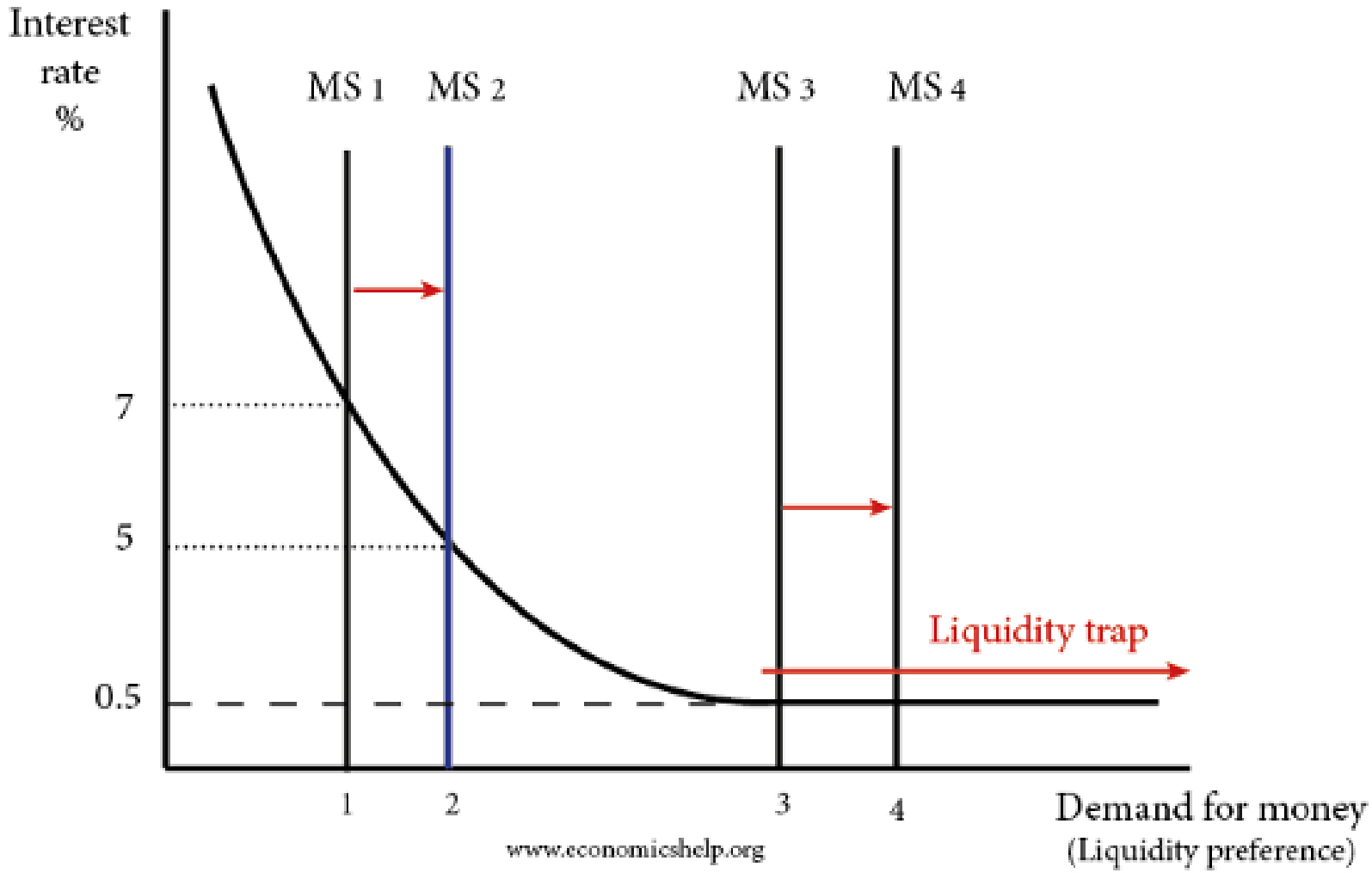
Liquidity traps occur when low interest rates and high cash balance fail to increase Aggregate Demand in an economy which is in a downturn. This can occur due to several factors:

1. Troubled banks were risk averse due to their lack of liquidity making them reluctant to grant loans and loans may come with a risk premium attributed to it. On the policy side, a bank may also be required to hold onto more capital which further reduces the number of loans granted.
2. Worsening household confidence implied little incentive to consume any goods in the economy. If all households were to save, then all of goods and services in the economy would become impoverished. Keynes advocates that households saved as little as possible and instead increased spending.
3. Firms and households may be pre-occupied trying to cutting existing debt instead of planning on creating any more debt.

Keynes warned against these ideas and suggested these were contributing factors to the Great Depression, since there were little reaction to the reductions in interest rates.

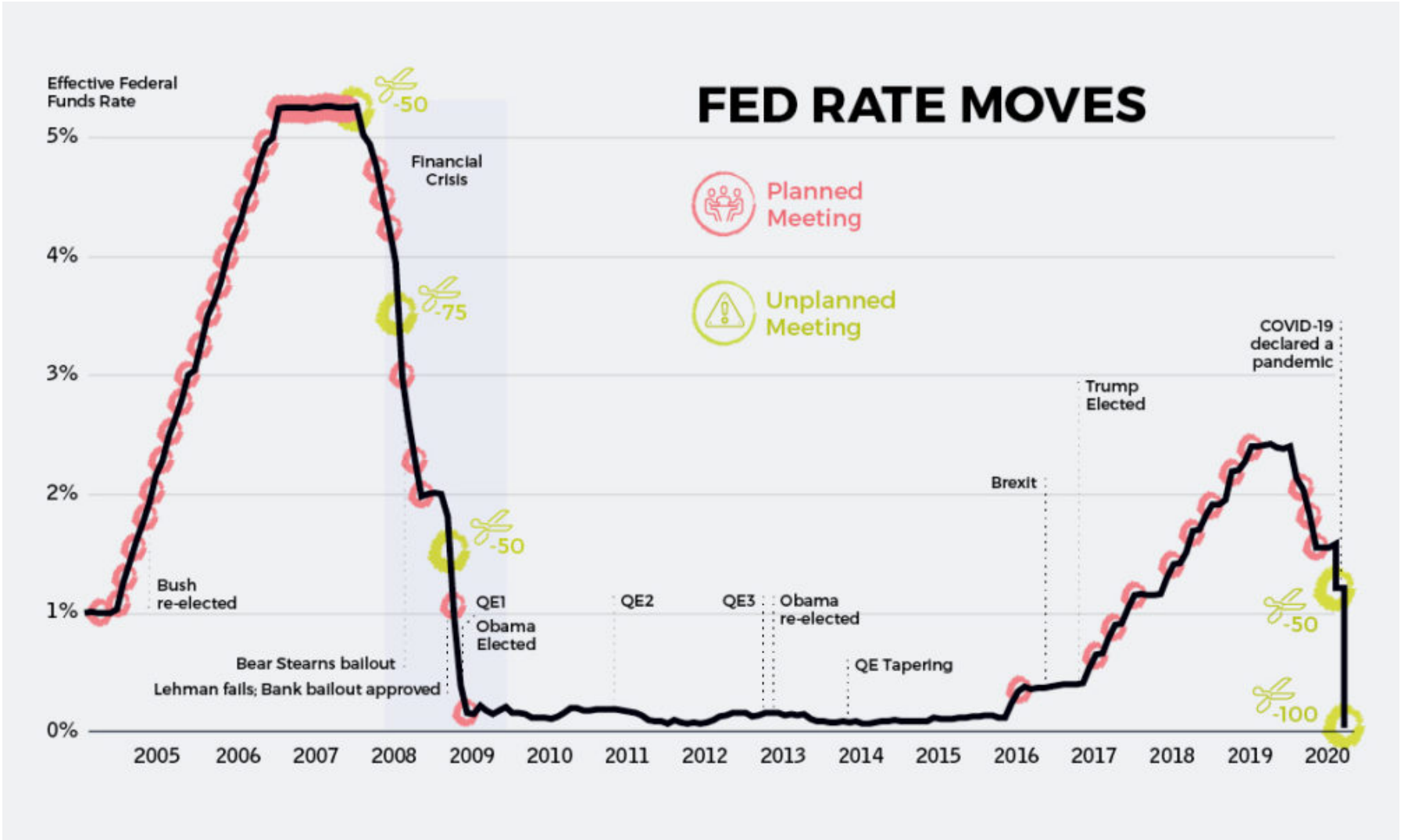
https://medium.com/geekculture/keynesian-economcics-8cdc614e33c

Interest Rate and Liquidity Trap



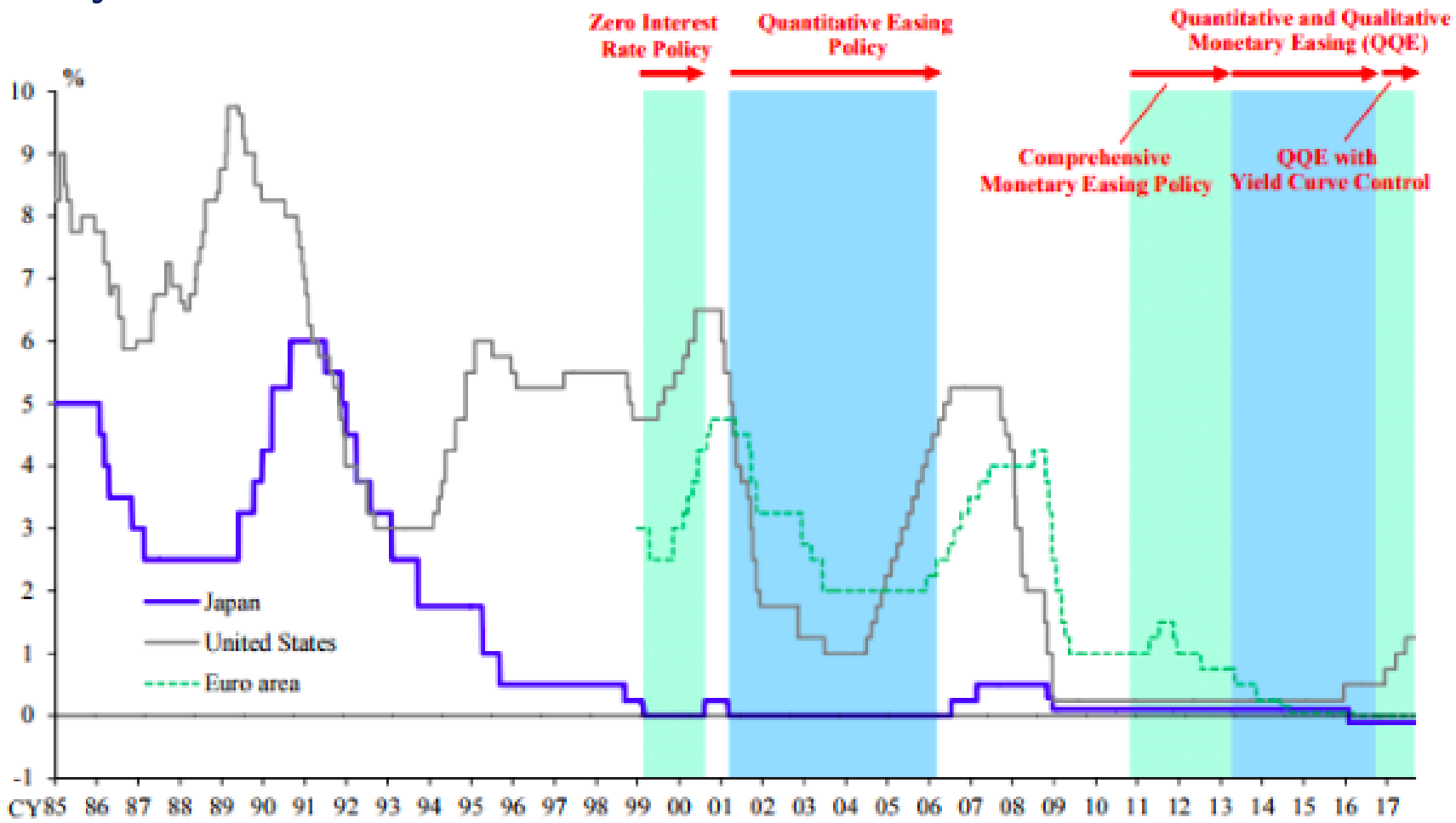
https://medium.com/geekculture/keynesian-economics-8cdc614e33c

Federal Funds Rate, 2005-2020



https://www.visualcapitalist.com/chart-the-downward-spiral-in-interest-rates/

Policy Interest Rates in JP, US, EU

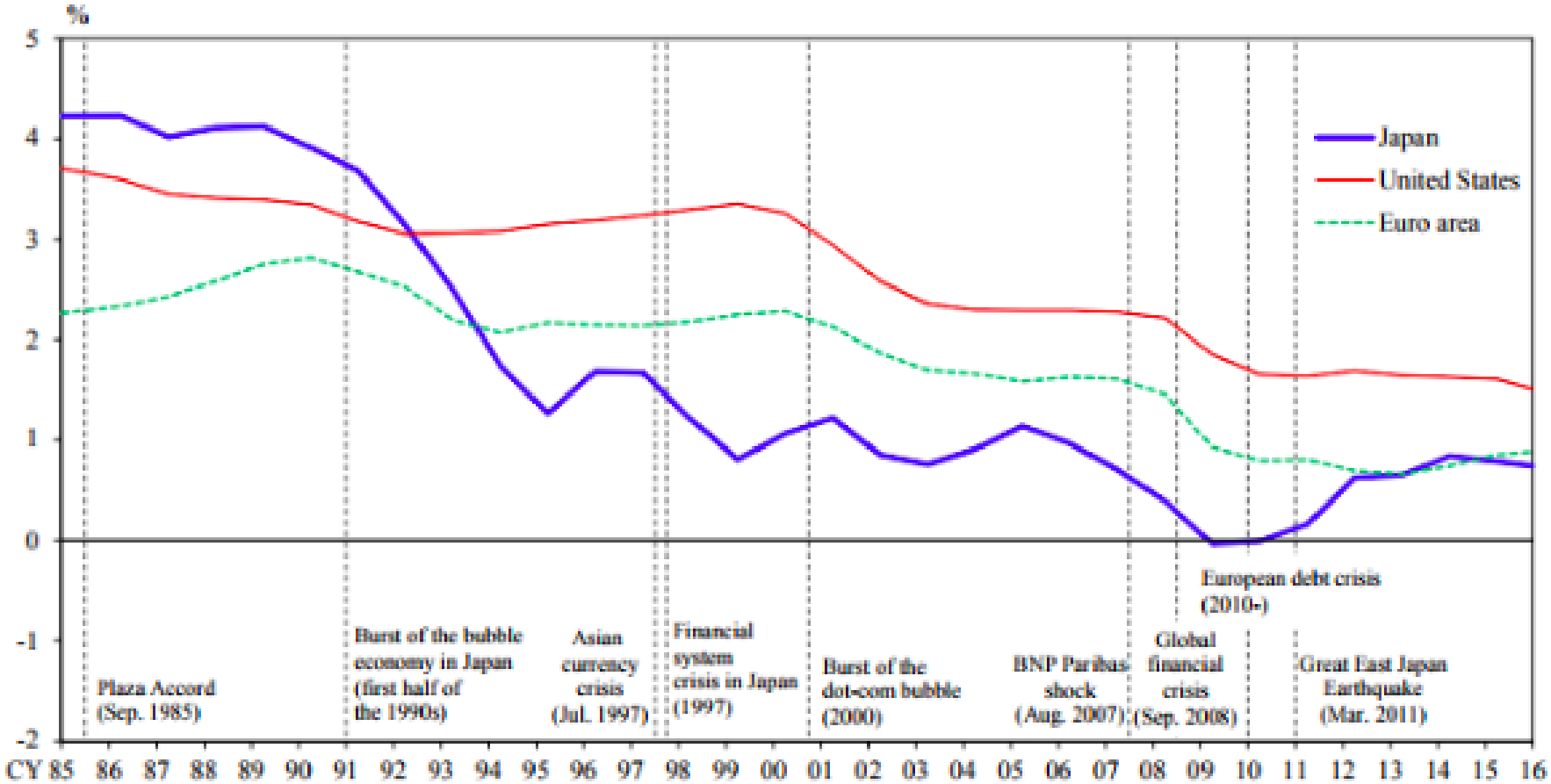


Note: For Japan, for the period when no target interest rate was adopted, figures for the policy rate are the interest rate applied on excess reserves.
Sources: Bank of Japan; Federal Reserve; European Central Bank; Haver; Bloomberg.

2

Source: Nakaso (2017) `https://www.bis.org/review/r171020d.htm`

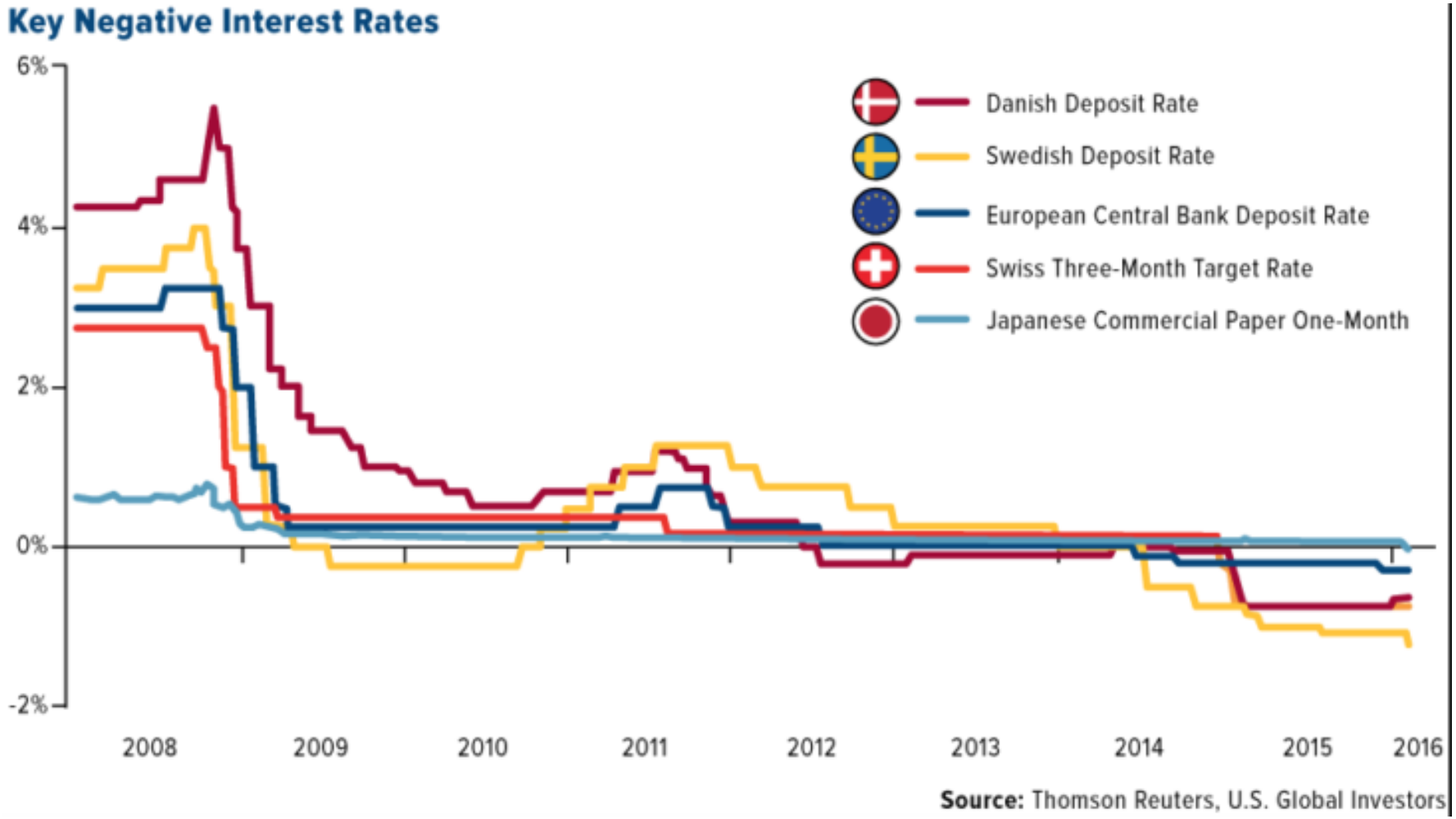
Potential Economic Growth in JP, US, EU



Note: The figure for Japan is based on BOJ staff estimations (fiscal year based). Figures for the United States and the euro area are based on the OECD estimations.
Sources: Bank of Japan; OECD.

Source: Nakaso (2017) `https://www.bis.org/review/r171020d.htm`

Negative Interest Rates, 2008-2016



https://www.econlib.org/negative-interest-rates-and-negative-ioer/

Money Videos

The Surprising Evolution Of Money, In Just Five Minutes (w)

BIS (Bank for International Settlement): Money Videos

Money through cooperation (4:46) Jan 2022 (w)

The future of finance (4:42) Jan 2022 (w)

Risk and stability (4:48) Jan 2022 (w)

Changing finance today (4:51) Jan 2022 (w)

Project Helvetia Phase II: Overview (7:23) Jan 2022 (w)

How to make cross-border payments faster and cheaper (2:58) Jul 2021 (w)

Project mCBDC Bridge - Cross-border transactions with CBDC (3:12) Apr 2021(w)

TechChallenge winners (5:40) Nov 2020 Trade Finance (w)

Textbook References

N. G. Mankiw (2021) Principles of Economics, 9e, Cengage

Olivier Blanchard (2021) Macroeconomics, 8e, Pearson

Acemoglu, Laibso, and List (2022) Macroeconomics, 3e, Pearson

Bade and Parkin (2021) Foundations of Macroeconomics, 9e, Pearson

Abel, Bernanke, and Croushore (2020) Macroeconomics, 10e, Pearson

Roger Leroy Miller (2021) Economics Today Macro View, 20e, Pearson

Goolsbee, Levitt, and Syverson (2020) Microeconomics, 3e, Worth

Kennedy and Pray (2017) Macroeconomic Essentials, 4e, MIT

Bodie, Kane, and Marcus (2022) Essentials of Investments, 12e, McGraw Hill.

Fredrick Mishkin (2022) The Economics of Money, Banking, and Financial Markets, 13e, Pearson.

Fabozzi, Jones, Fabozzi, and Mann (2019) Foundations of Global Financial Markets and Institutions, 5e, MIT.

Web References

Eugen von Böhm-Bawerk (1884) Capital and Interest: A Critical History of Economic Theory. Macmillan (w)

Fisher Irving (1930) The Theory of Interest: As Determined by Impatience to Spend Income and Opportunity to Invest It. Macmillan. (w)

Paul Samuelson (1994) Two Classics: Böhm-Bawerk's Positive Theory and Fisher's Rate of Interest through Modern Prisms. Journal of the History of Economic Thought, 16-2, 202-228.

Anna J. Schwartz, Money Supply. ECONLIB CEE (w)

Paul Heyne, Interest. ECONLIB CEE (w)

Burton G. Malkiel, Interest Rates. ECONLIB CEE (w)

Web References

Subramanian Sriram (1999) Survey of literature on demand for money: theoretical and empirical work with special reference to error-correction models. IMF WP. (w)

Hiroshi Nakaso: Evolving monetary policy - the Bank of Japan's experience. Central Bankers' Speeches. https://www.bis.org/review/r171020d.htm

Emi Nakamura and Jon Steinsson (2018) Identification in Macroeconomics. Journal of Economic Perspectives, 32-3, 59-86.

Emi Nakamura and Jon Steinsson (2018) High-frequency Identification of Monetary Non-neutrality: The Information Effect. The Quarterly Journal of Economics. 1283-1330.