

# **EC106: Introduction to Economics**

## **– MACROECONOMICS –**

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 kansoy

Lecture - 7 -

\* University of Warwick

# This Week: Outline

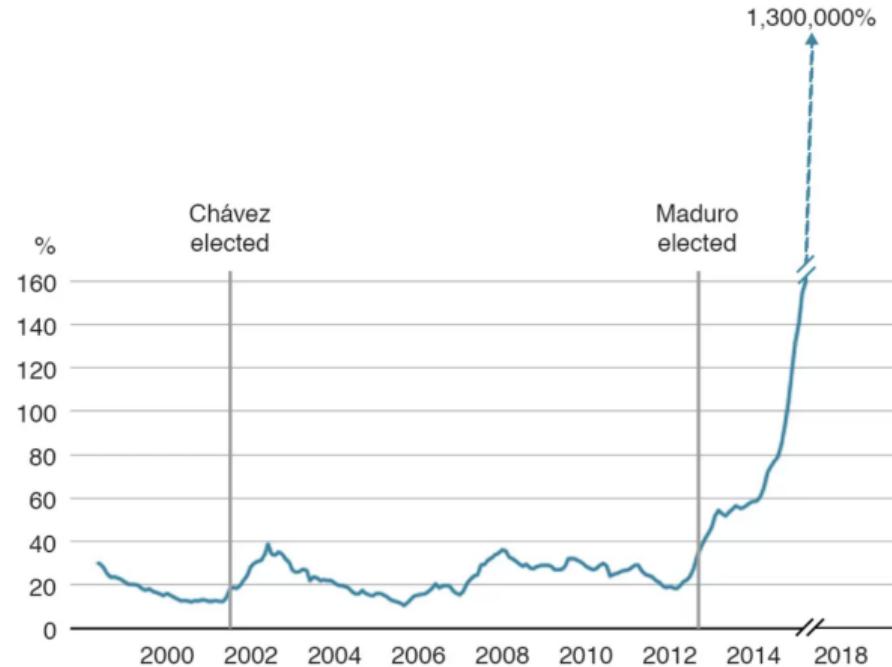
1. Inflation is everywhere!
2. Money
3. Measurements the Amount of Money in an Economy
4. The Quantity Theory of Money

# Inflation is ridiculous

- ▶ According to a study by the opposition-controlled National Assembly, the annual inflation rate reached 1,300,000% in the 12 months to November 2018.
- ▶ By the end of last year, prices were doubling every 19 days on average. This has left many Venezuelans struggling to afford basic items such as food and toiletries.
- ▶ The number of bolivars - the national currency - needed to buy US\$ 1 has also rocketed.

# Inflation: Mother of All Evils

Estimate for 2018 is off the scale



Source: Bloomberg/Reuters estimate for 2018

BBC

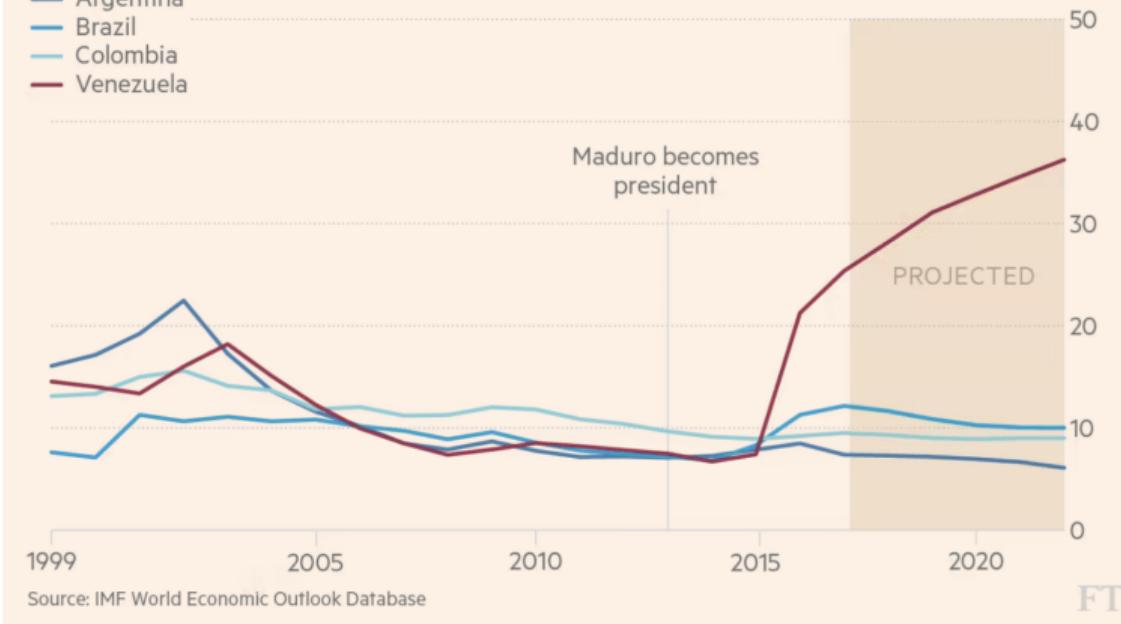
SOURCE. BBC:"Venezuela: All you need to know about the crisis in nine charts", 2023. .

# Inflation: Mother of All Evils

The IMF predicts unemployment in Venezuela will skyrocket

Unemployment rate (%)

- Argentina
- Brazil
- Colombia
- Venezuela



SOURCE. Financial Times:"Venezuela's economic and political crisis in charts", 2023. .

# Inflation: Mother of All Evils



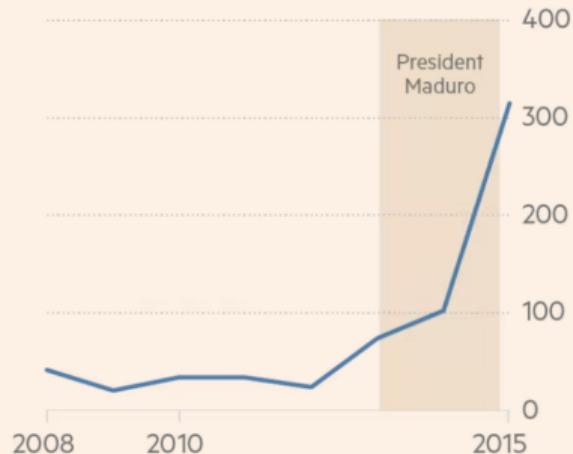
SOURCE. Financial Times:"Venezuela's economic and political crisis in charts", 2023. .

# Inflation: Mother of All Evils

## The changing Venezuelan diet

As food prices skyrocket...

Year-on-year price increase of food and non-alcoholic beverages (%)



Source: Encuesta Sobre Condiciones de Vida en Venezuela, Instituto Nacional de Estadística

...Venezuelans can no longer afford many staples

Share of families who said they buy each product (%)



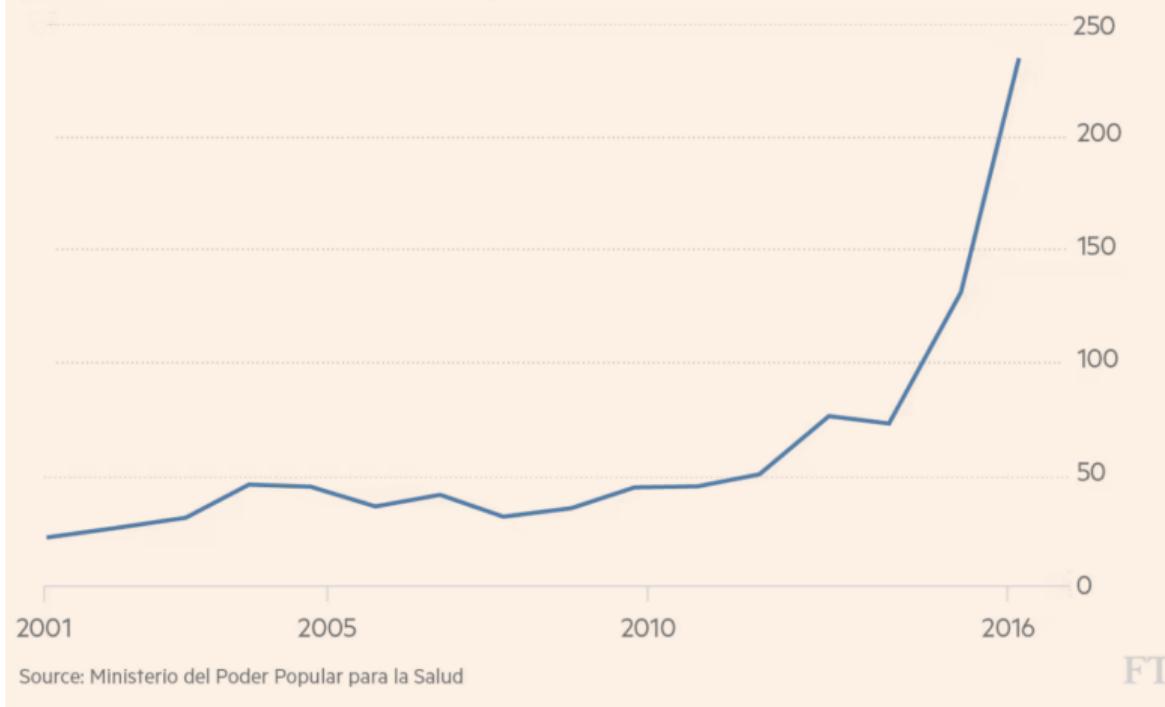
FT

SOURCE. Financial Times: "Venezuela's economic and political crisis in charts", 2023. .

# Inflation: Mother of All Evils

## A spike in malaria

Malaria cases in Venezuela (in thousands)



FT

SOURCE. Financial Times:"Venezuela's economic and political crisis in charts", 2023. .

# Inflation: Mother of All Evils

## Venezuela's homicide rate is one of the world's highest

Violent death estimates\*

- OVV total
- Official total



\*The OVV, a Venezuelan NGO, includes homicides, resistance to authority deaths and deaths under investigation in its count.  
Sources: Observatorio Venezolano de Violencia, Ministerio del Poder Popular para la Salud

FT

SOURCE. Financial Times:"Venezuela's economic and political crisis in charts", 2023. .

# Inflation: Mother of All Evils

## Decreasing flights to Caracas

Scheduled monthly flights to Caracas airport



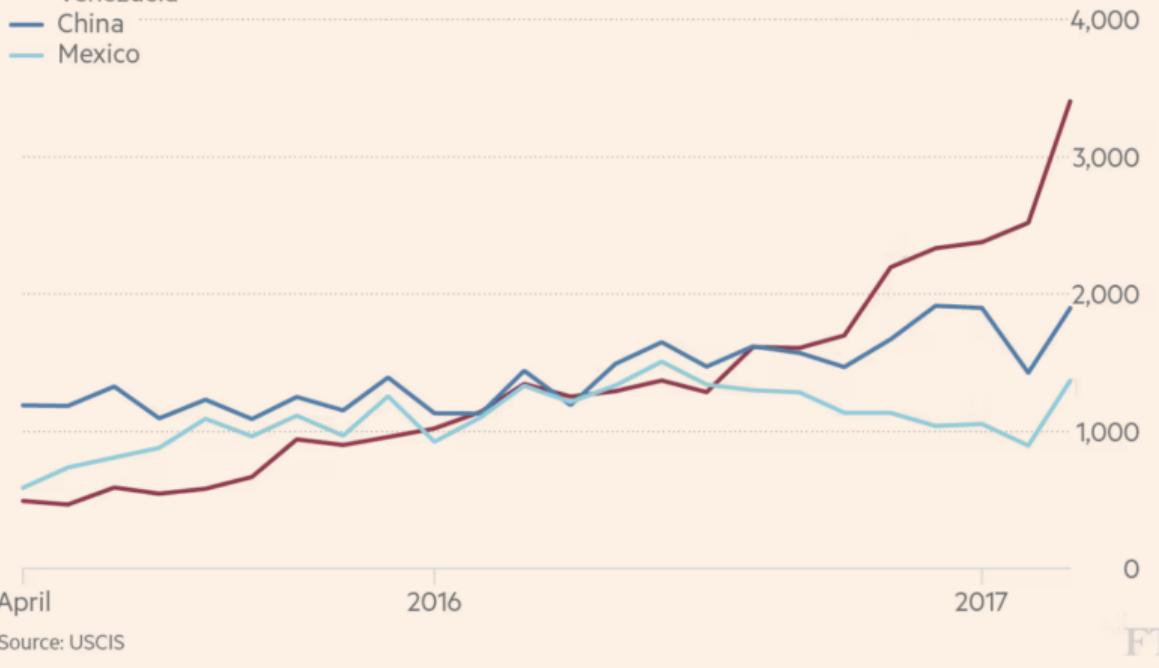
SOURCE. Financial Times:"Venezuela's economic and political crisis in charts", 2023. .

# Inflation: Mother of All Evils

**Venezuelans are now the biggest group of asylum seekers in the US**

Number of asylum applications filed with USCIS by month

- Venezuela
- China
- Mexico



SOURCE. Financial Times:"Venezuela's economic and political crisis in charts", 2023..

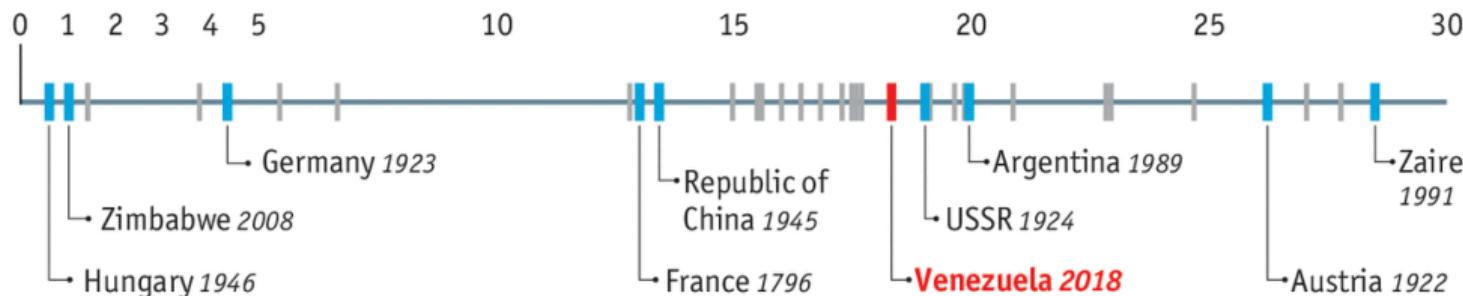
# Inflation is everywhere!

- ▶ In late 1919, a loaf of bread in Germany cost about 26 pfennig, or just over a fourth of a mark.
- ▶ By November 1923, the same loaf of bread cost 80 billion marks.
- ▶ More generally, the overall price level in Germany had risen by a factor of 1 trillion in 4 years.
- ▶ This massive inflation proved enormously costly to German society, and perhaps to the world as a whole.
- ▶ By late 1923, prices were rising 300-fold during the course of a month. The daily price increase was so large at the peak that every day was payday; wages were paid at 11 a.m., and workers immediately dashed with suitcases full of paper money to buy whatever goods they could find.
- ▶ Many people lost their lifetime savings, and many businesses failed.
- ▶ The economic turmoil and strife caused by the German inflation was one of the factors that led to the rise of the Nazi movement.

# Inflation is everywhere!

## Runaway reaction

Hyperinflation, number of days for prices to double at peak monthly rate



Sources: "World Hyperinflations" by Steve Hanke and Nicholas Krus; *The Economist*

The Economist

SOURCE. The Economist, 2023. .

# Inflation is everywhere!

≡ 🔎

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US inflation + Add to myFT

## US inflation stays at 40-year high, defying expectations of bigger drop

CPI increase of 8.3% in April includes rise in core inflation and prompts fall in equities

A photograph showing a person from behind, wearing a dark jacket and a face mask, pushing a shopping cart through a supermarket aisle. The shelves are filled with various types of apples, ranging in color from red to green. Below the apples, there are bottles of juice and other grocery items. The lighting is bright, typical of a supermarket interior.

Economists broadly expect the pace of consumer price growth to moderate further from these levels as the immediate effects of the war in Ukraine abate © George Frey/Bloomberg

Colby Smith in Washington MAY 11 2022

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SOURCE. Financial Times, 2023. .

# Inflation is everywhere!

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UK inflation + Add to myFT

## UK inflation rate rises to 40-year high of 10.1%

Consumer price index in July registered double-digit annual increase for first time since 1982

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Year-on-year change in CPI  
JULY 2022 10.1%

2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022

Source: ONS Photo: Shutterstock

Chris Giles in London AUGUST 17 2022

740

SOURCE. Financial Times, 2023. .

# Inflation is everywhere!

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## German inflation hits 40-year high as calls mount for bigger ECB rate rises

Consumer prices in Europe's largest economy driven by soaring costs of energy and food

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The European Central Bank headquarters in Frankfurt. The bank's policymakers will be under pressure when they meet next week to be more aggressive in their response to inflation © Michael Probst/AP

Martin Arnold in Frankfurt AUGUST 30 2022

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SOURCE. Financial Times, 2023. .

# Inflation is everywhere!

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Opinion Global Insight

## While the world fights inflation, China's problem is deflation

Zero-Covid policy has left the world's second-largest economy out of sync with its peers

THOMAS HALE + Add to myFT



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Residential buildings under construction in Shanghai. The property market has seen waves of defaults among developers and a fall in transactions © Aly Song/Reuters

Thomas Hale NOVEMBER 15 2022

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SOURCE. Financial Times, 2023. .

# What causes inflation?

“

Inflation is  
always and  
everywhere a  
**monetary**  
phenomenon.

Milton Friedman

the recipient of the 1976 Nobel  
Memorial Prize in Economic

@kansoy



# What causes inflation?

“

Inflation is  
always and  
everywhere a  
**fiscal**  
phenomenon.

Thomas Sargent

the recipient of the 2011 Nobel  
Memorial Prize in Economic

@kansoy



# What is Inflation?

- ▶ **Inflation** is a sustained rise in the general level of prices—the price level.
- ▶ **The inflation rate** is the rate at which the price level increases.
- ▶ Deflation is a sustained decline in the price level (negative inflation rate).
- ▶ Both can be good or bad.
- ▶ Macroeconomists typically look at two measures of the price level, **two price indexes: the GDP deflator and the Consumer Price Index**.

# The GDP Deflator

- The **GDP deflator** in year  $t$ ,  $P_t$ , is defined as the ratio of nominal GDP to real GDP in year  $t$ :

$$P_t = \frac{\text{NominalGDP}_t}{\text{RealGDP}_t} = \frac{\$Y_t}{Y_t}$$

- The GDP deflator is called an **index number** (1 in 2012), which has no economic interpretation.
- *The rate of change has a clear interpretation: the rate of inflation.*

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

- But this ( $\pi_t$ ) has a clear economic interpretation: It gives the rate at which the general level of prices increases over time – **the rate of inflation**.

# The GDP Deflator

- ▶ Defining the price level as **the GDP deflator** implies a simple relation between nominal GDP, real GDP, and the GDP deflator:

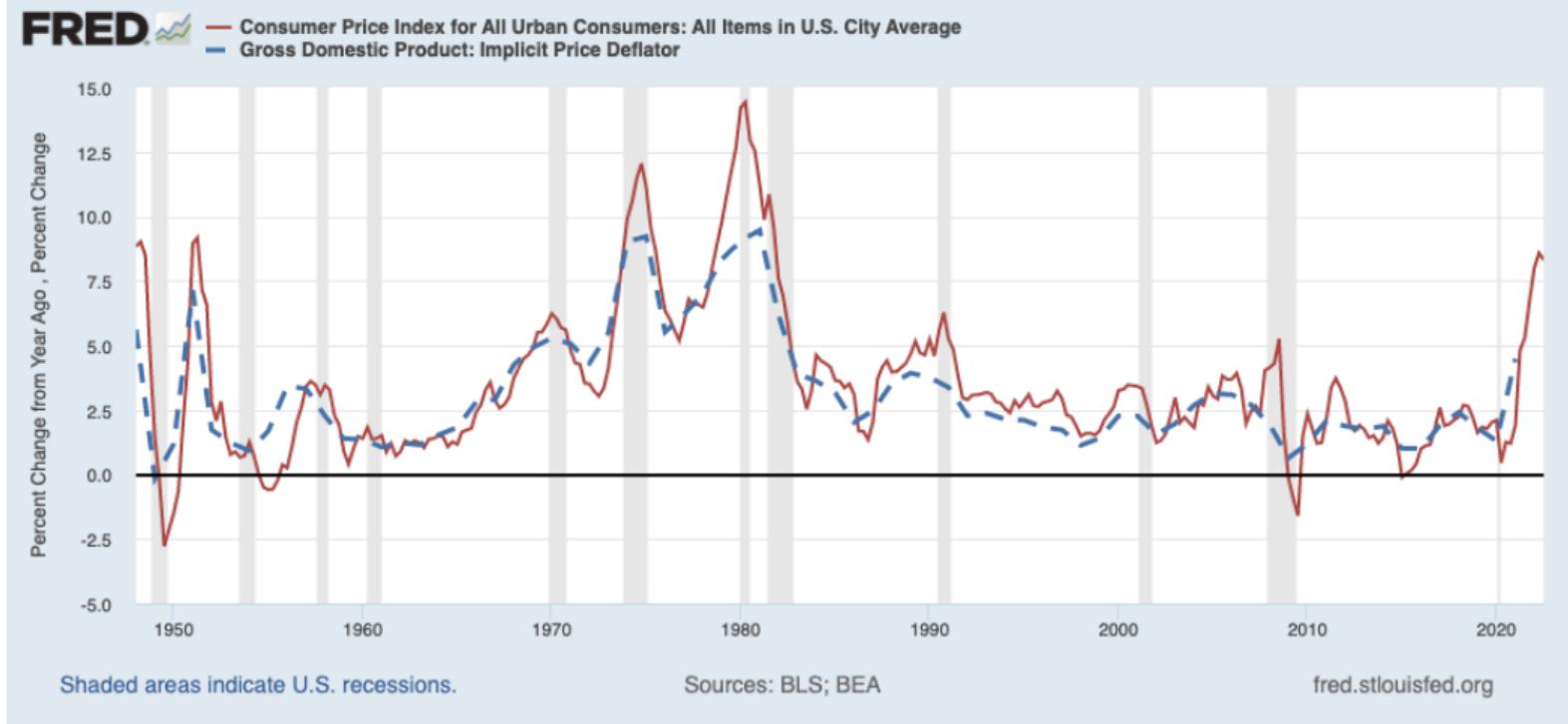
$$\$Y_t = P_t * Y_t$$

- ▶ *Nominal GDP is equal to the GDP deflator times real GDP.*
- ▶ The rate of growth of nominal GDP is equal to the rate of inflation plus the rate of growth of real GDP
- ▶ The GDP deflator gives the average price of output—the **final goods produced** in the economy.
- ▶ But consumers care about *the average price of consumption*—the goods they consume. The two prices may not be the same.

# The Consumer Price Index

- ▶ The set of goods produced in the economy is not the same as the set of goods purchased **by consumers** because:
- ▶ Some of the goods in GDP are sold not to consumers but to firms, to the government, or to foreigners.
- ▶ Some of the goods bought by consumers are not produced domestically but are imported from abroad.
- ▶ **The Consumer Price Index (CPI)** is a measure of the cost of living.
- ▶ The CPI is published monthly by the national static agency for the US this is the Bureau of Labor Statistics (BLS), which collects price data for 211 items in 38 cities.
- ▶ For the UK this is Office for National Statistics (ONS). The ONS uses around 700 items to calculate the rate of inflation.
- ▶ The CPI gives the cost in dollars of a specific list of goods and services over time.

# The GDP Deflator and the CPI. 195-2022



SOURCE. FRED, Series GDPDEF and CPIAUCSL. 2023. .

# Why Inflation Matters?

- ▶ **Pure inflation** is a proportional increase in **all prices and wages**.
- ▶ This type of inflation causes only a minor inconvenience as relative prices are unaffected.
- ▶ Real wage (wage measured by goods rather than dollars) would be unaffected.

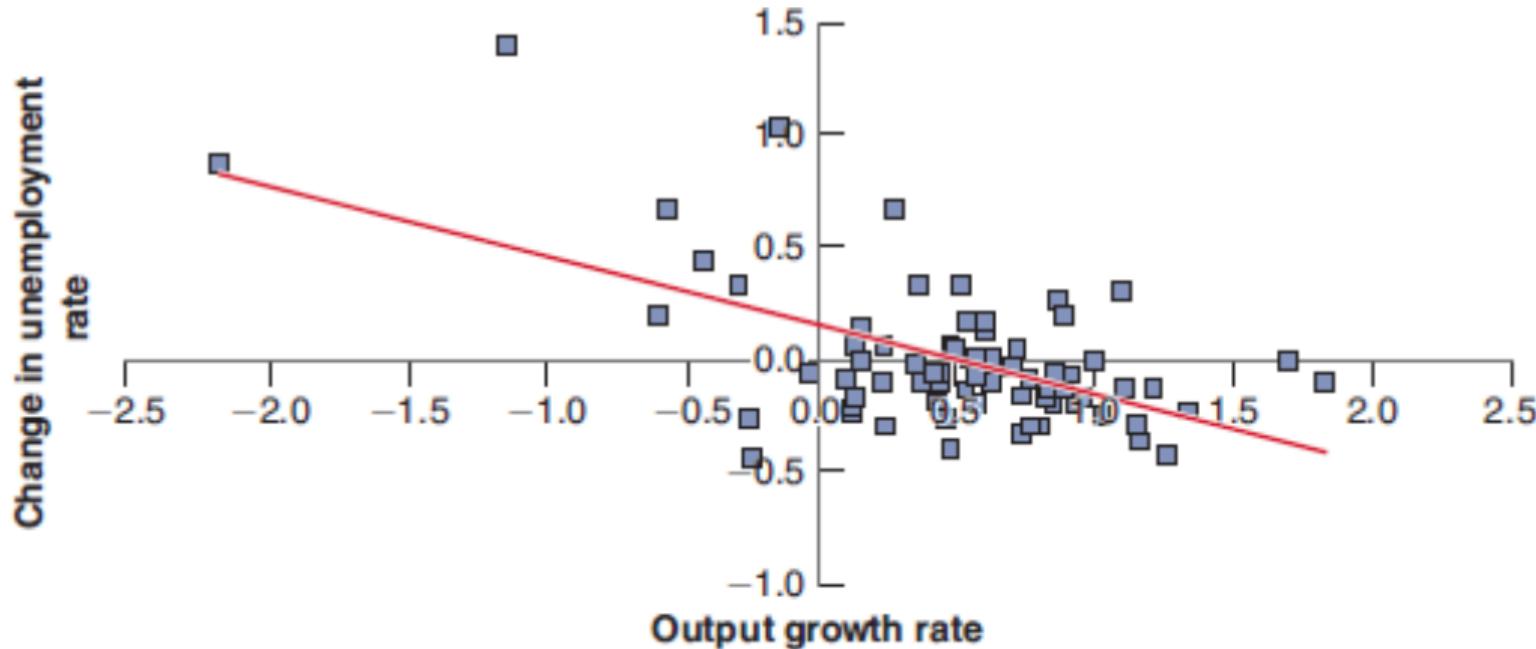
**However, there is no such thing as pure inflation.**

- ▶ Inflation affects income distribution when not all prices and wages rise proportionally.
- ▶ Inflation leads to distortions due to uncertainty, some prices that are fixed by law or by regulation, and its interaction with taxation (bracket creep in taxes).
- ▶ Most economists believe the “*best*” rate of inflation to be a low and stable rate of inflation between 1 and 4%.

**What about deflation?**

- ▶ If inflation is so bad, does this imply that deflation (negative inflation) is good? The answer is no.
- ▶ First, high deflation (a large negative rate of inflation) would create many of the same problems as high inflation, from distortions to increased uncertainty.
- ▶ Second, even a low rate of deflation limits the ability of monetary policy to affect output, look at the Japanese case after 2000.

## Put them together: Okun's Law

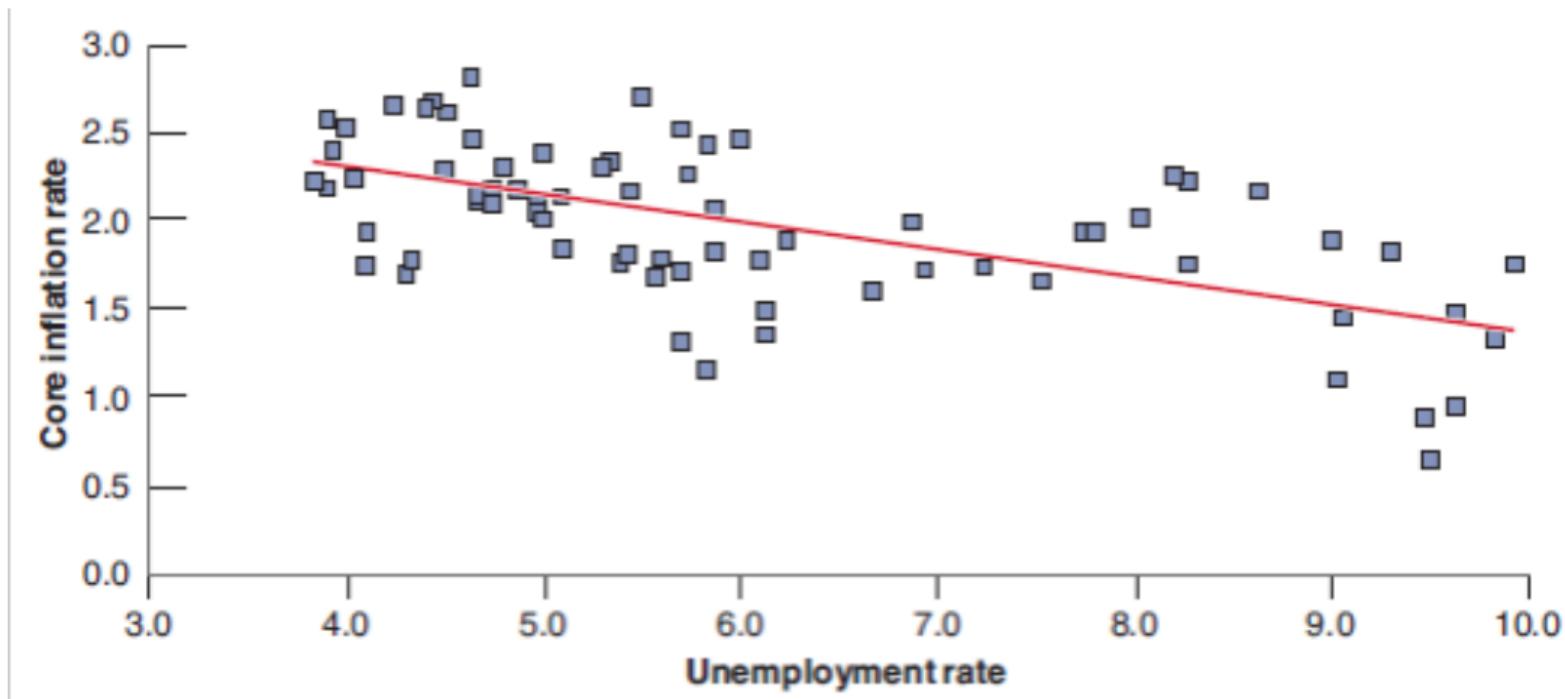


SOURCE. Blanchard Macroeconomics, 2023. .

## Put them together: Okun's Law

- ▶ **Okun's law** is a relation first examined by U.S. economist Arthur Okun.
- ▶ In figure above, the line that best fits the points is downward sloping.
- ▶ The slope of the line is  $-0.3$ , which implies that, on average, an increase in the growth rate of 1% decreases the unemployment rate by  $-0.3\%$ .
- ▶ The line crosses the horizontal axis where output growth is  $0.5\%$ , meaning that it takes a growth rate of  $2\%$  to keep unemployment constant
- ▶ Output growth that is higher than usual is associated with a reduction in the unemployment rate.
- ▶ Output growth that is lower than usual is associated with an increase in the unemployment rate.

# Put them together: The Phillips Curve



SOURCE. Blanchard Macroeconomics, 2023. .

# Put them together: The Phillips Curve

- ▶ **The Phillips curve** is a relation first explored in 1958 by New Zealand economist A.W. Phillips.
- ▶ Figure above plots the change in the inflation rate against the unemployment rate, along with the line that best fits the points.
- ▶ The line is downward-sloping, meaning that higher unemployment leads, on average, to a decrease in inflation, and vice versa.
- ▶ When unemployment has been above 5%, inflation has typically been above 2%.
- ▶ A low unemployment rate leads to an increase in the inflation rate.
- ▶ A high unemployment rate leads to a decrease in the inflation rate.

# Money

- Money (or the “money supply”): anything that is generally accepted as payment for goods or services or in the repayment of debts.
- **Money** (a stock concept) is different from:
- **Wealth**: the total collection of pieces of property that serve to store value
- **Income**: flow of earnings per unit of time (a flow concept)

# FUNCTIONS OF MONEY

## **Medium of Exchange:**

- Eliminates the trouble of finding a double coincidence of needs (reduces transaction costs)
- Promotes specialization

## **A medium of exchange must:**

- be easily standardized
- be widely accepted
- be divisible
- be easy to carry
- not deteriorate quickly

# FUNCTIONS OF MONEY

## **Unit of Account:**

- Used to measure value in the economy
- Reduces transaction costs

# FUNCTIONS OF MONEY

## Store of Value:

- Used to save purchasing power over time.
- Other assets also serve this function.
- Money is the most liquid of all assets but loses value during inflation.

# Is BITCOIN MONEY?

**Based on the answer of Frederic S. Mishkin**

- Medium of Exchange - Yes.
- Unit of Account - No.

*"The volatility of Bitcoin is eight times higher than the stock market (S&P500)"*

- Store of Value - No.

*"Almost no one quotes the prices of their products in terms of Bitcoin."*

# WHAT DO YOU THINK?

The image shows a poll interface from the Vevox platform. The poll title is "Is Bitcoin Money?". It features a photograph of several gold Bitcoin coins resting on US dollar bills. Two options are listed: "Yes, of course. How dare you!" and "No, no way. Oh come on!". Both options have a teal circular progress bar at 0% completion. The poll has 0/0 responses. The interface includes a sidebar with a QR code, a hand holding a smartphone displaying the poll, and a navigation bar with icons for search, filters, and other poll details.

Join at:  
[vevox.app](http://vevox.app)

ID:  
**134-993-169**

Is Bitcoin Money?

Yes, of course. How dare you!

No, no way. Oh come on!

0% 0%

0 / 0

X A  IS BITCOIN MONEY? 1/1

# WHAT DO YOU THINK?



BUT...



<https://www.vaneck.com/us/en/blogs/digital-assets/bitcoin-less-volatile-than-many-sp-500-stocks/>

# BUT... (2)

 MARKETS BUSINESS INVESTING TECH POLITICS CNBC TV INVESTING CLUB PRO

TECH

## Tesla buys \$1.5 billion in bitcoin, plans to accept it as payment

PUBLISHED MON, FEB 8 2021 7:48 AM EST | UPDATED MON, FEB 8 2021 1:43 PM EST

Steve Kovack @STEVEKOVACK

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**KEY POINTS**

- Tesla announced in an SEC filing Monday that it has bought \$1.5 billion worth of bitcoin.
- The company also said it would start accepting bitcoin as a payment method for its products.
- CEO Elon Musk has been credited for raising the prices of cryptocurrencies, including bitcoin, through his messages on Twitter.

In this article TSLA +\$1.67 (+2.0%)

  
VIDEO 03:12  
Tesla purchases \$1.5 billion in bitcoin — Here's what could happen next

Tesla announced Monday it has bought \$1.5 billion worth of bitcoin.

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<https://www.cnbc.com/2021/02/08/tesla-buys-1point5-billion-in-bitcoin.html>

# A HUMBLE ADVICE

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Finance & economics New instructions  
Mar 20th 2021 edition >

## Efforts to modernise economics teaching are gathering steam

The hope is that it will help diversify the profession



Getty Images

Mar 20th 2021  
WASHINGTON, DC

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**E**CONOMISTS ARE keen fans of dynamism, but there are too few signs of it in economics teaching. A survey of American lecturers last year found that their methods, which rely on lectures and assigned textbook reading, had barely changed in 25 years.\* Textbooks themselves can lag behind the practice of economics. A study by Jane Ihrig of the Federal Reserve Board and Scott Wolla of the Federal Reserve Bank of St Louis found that at least three of six leading texts published since the start of 2020 misrepresented monetary policy. They say the Fed sets short-term interest rates by buying and selling securities. But since 2008 the central bank has changed the rate it pays on banks' reserves instead.

[https:](https://www.economist.com/finance-and-economics/2021/03/20/efforts-to-modernise-economics-teaching-are-gathering-steam)

//www.economist.com/finance-and-economics/2021/03/20/efforts-to-modernise-economics-teaching-are-gathering-steam

### The Consumer Price Index, 1900-2015 (2015 = 100)

Year	CPI	Year	CPI
1900	3.43	1980	34.76
1930	7.05	1990	55.14
1950	10.16	2000	72.65
1960	12.50	2010	92.00
1970	16.39	2015	100.00

Source: Lawrence H. Officer and Samuel H. Williamson, "The Annual Consumer Price Index for the United States, 1774-2015," MeasuringWorth, [www.measuringworth.com](http://www.measuringworth.com).

# **Measurements the Amount of Money in an Economy**

# Amount of Money in an Economy

Different Measures of the Money Supply in February 2023 (billions of dollars)

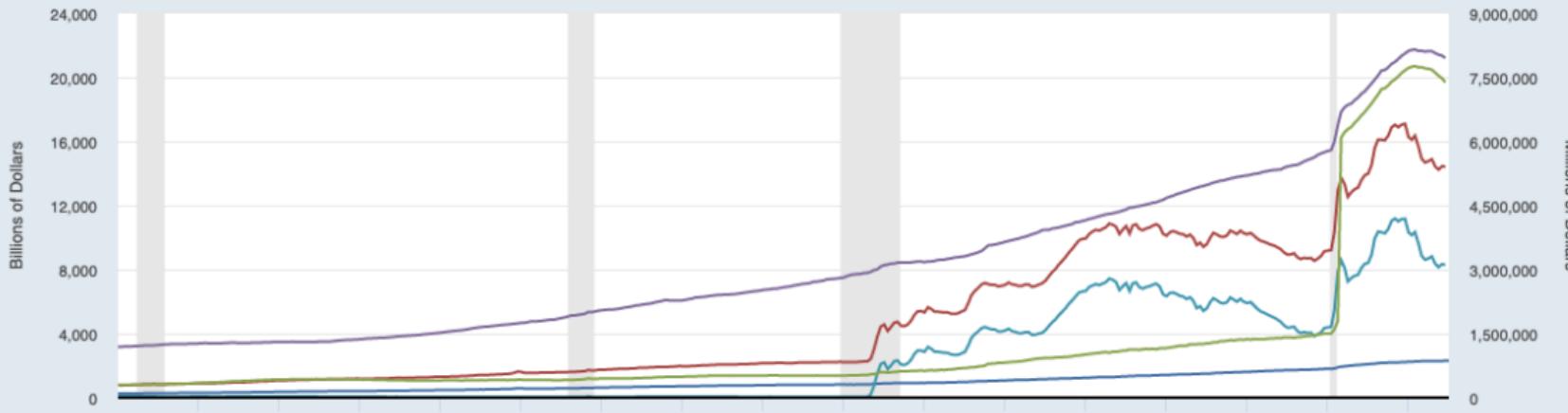
C	Currency	2,297,344
R	Researve = currency plus reserves	3,107,300
MB	Monetary base = currency plus reserves	5,405,400
M1	Currency plus demand deposits (e.g., checking accounts)	19,685,800
M2	M1 plus savings deposits and individual money market accounts	21,207,400

Source: Federal Reserve Board of Governors, H.3 and H.6.

# Amount of Money in an Economy

**FRED** 

- Currency in Circulation (left)
- Monetary Base; Reserve Balances (right)
- Monetary Base; Total (right)
- M1 (left)
- M2 (left)



Shaded areas indicate U.S. recessions.

Source: Board of Governors of the Federal Reserve System (US)

[fred.stlouisfed.org](http://fred.stlouisfed.org)

- ▶ **Currency:** Currency refers to the physical paper bills and coins that are in circulation in an economy. This includes both the currency held by the public and the currency held by banks.
- ▶ **Reserves:** Reserves are the funds that banks hold on deposit with the central bank. These funds are used to meet the bank's reserve requirements, which are typically set as a percentage of the bank's deposits.
- ▶ **Monetary Base:** The monetary base, also known as high-powered money, is the sum of currency in circulation and reserves held by banks.
- ▶ **M1:** M1 is a measure of the money supply that includes currency in circulation, demand deposits (checking accounts), and other checkable deposits held by the public.
- ▶ **M2:** M2 is a broader measure of the money supply that includes M1 plus savings deposits, time deposits, and other non-checkable deposits held by the public.

These measures are important for understanding the amount and types of money that are in circulation in an economy, and for guiding monetary policy decisions made by central banks.

# Total national money supply

## Monetary Base

Means of exchange  
Liquid assets

Circulation Currency

Coins and bank notes

M0

Bank deposits

Savings held by banks and financial institutions

M1

Commercial bank credit and loans

Money available to banks and financial institutions for lending

M2

Stores of wealth  
Money stock

Governement and national bank reserves

Large reserves of currency and assets such as precious metals

M3

# The Quantity Theory of Money

# The Quantity Equation

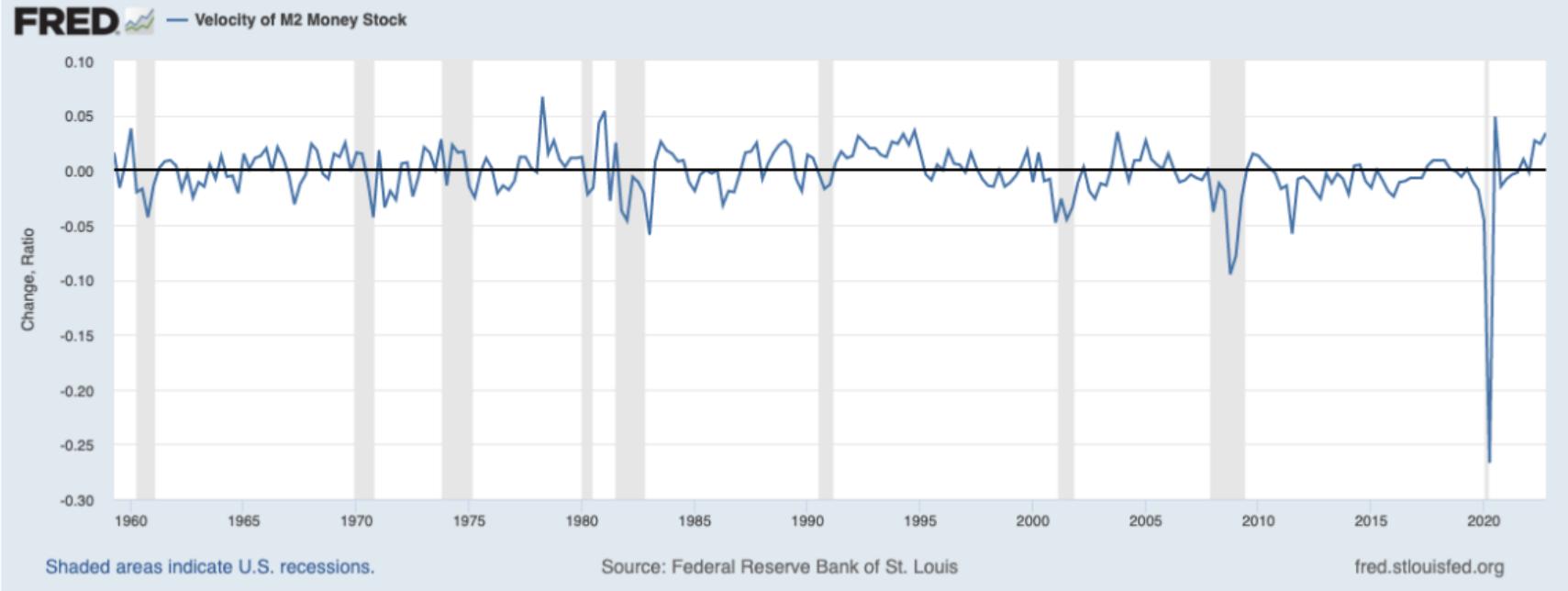
- ▶ The Quantity equation allows us to make the connection between money and inflation.
- ▶ Suppose  $M_t$  is quantity of money.
- ▶ Also, let  $P_t$  denote the price level,
- ▶ and  $Y_t$  denote real GDP.

The quantity theory then says that

$$M_t V_t = P_t Y_t$$

- ▶ where  $V_t$  is called the velocity of money.
- ▶ The velocity of money should be thought of as the average number of times per year that each piece of paper currency is used in a transaction. Mostly it is constant.

# Velocity of Money Supply



# The Quantity Theory of Money

$$M_t V_t = P_t Y_t$$

- ▶ The expression on the right-hand side,  $P_t Y_t$ , is nominal GDP—the amount of goods and services purchased in an economy, valued at current prices.
- ▶ According to the quantity theory, these goods and services are bought with money.
- ▶ The left-hand side is the amount of money in circulation  $M_t$  multiplied by the number of times each piece of paper changes hands  $V_t$ .
- ▶ The theory, then, says that nominal GDP is equal to the effective amount of money used in purchases,  $M_t V_t$ .
- ▶ At this point, we have a single quantity equation and four unknowns:  $M_t$ ,  $V_t$ ,  $P_t$ , and  $Y_t$ .
- ▶ To complete the quantity theory, we need to specify three additional equations, and the four together will provide us with a theory of inflation.

# The Classical Dichotomy

- ▶ The classical dichotomy, says that in the long run, the real and nominal sides of the economy are completely separate.
- ▶ In particular, real GDP in the long run is determined solely by real considerations.
- ▶ As we seen in growth lectures, real GDP depends on real variables like the investment rate, new ideas, and total factor productivity.
- ▶ With this dichotomy in mind, we assume  $\bar{Y}_t = \bar{Y}_t$ . That is, real GDP is taken to be an exogenous variable in the quantity theory of money, determined by the forces (investment rate, TFP, and so on) discussed in previous chapters.
- ▶ As usual, the overbar denotes an exogenous variable that's given from outside the model.

# Velocity and Exogenous Monetary Policy

- ▶ The third equation of the quantity theory specifies the velocity of money. Largely because it is extremely convenient, we will assume the velocity of money is an exogenous constant; that is,  $V_t = \bar{V}$ .
- ▶ There is no time subscript here, since velocity is assumed to be constant over time.
- ▶ In reality, the velocity of the M<sub>2</sub> definition of money is approximately constant, so this is not a bad assumption in the long run, at least as a starting point.
- ▶ The final equation of the quantity theory determines the money supply itself.
- ▶ This supply is a policy variable chosen by the central bank of an economy, one of whose main roles is to determine monetary policy.
- ▶ To keep things simple, we take monetary policy itself as exogenous, so that  $M_t = \bar{M}_t$ .

# The Quantity Theory for the Price Level

The quantity theory of money is summarized in Table.

The Quantity Theory of Money: 4 Equations and 4 Unknowns	
Endogenous variables:	$M_t, V_t, P_t, Y_t$
The quantity equation	$M_t V_t = P_t Y_t$
Real GDP from growth model (classical dichotomy)	$Y_t = \bar{Y}_t$
Exogenous and constant velocity	$V_t = \bar{V}$
Exogenous variables/parameters:	$\bar{M}_t, \bar{V}, \bar{Y}_t$

- We assume real GDP, velocity, and money are determined exogenously, so the quantity equation is left to pin down the price level.
- Solving the model is quite straightforward. Our last three equations give the solutions for  $Y_t$ ,  $V_t$ , and  $\bar{M}_t$ .
- Plugging these exogenous values into the quantity equation, we get the price level:

$$P_t^* = \frac{\bar{M}_t \bar{V}}{\bar{Y}_t}$$

# The Quantity Theory for the Price Level

$$P_t^* = \frac{\bar{M}_t \bar{V}}{\bar{Y}_t}$$

- ▶ This equation says that the price level is determined by the ratio of the effective quantity of money  $\bar{M}_t \bar{V}$  divided by the volume of goods  $\bar{Y}_t$ .
- ▶ An increase in the money supply causes the price level to rise, as does a decrease in real GDP.
- ▶ Since the velocity of money and the level of real GDP are taken as given in the model, any changes in the supply of money will show up in the long run as changes in prices.
- ▶ If the central bank decides to increase  $M$ , the only way the quantity equation can hold is if the aggregate price level  $P$  rises as well.
- ▶ This is the essence of the quantity theory of money: in the long run, **a key determinant of the price level is the level of the money supply.**

# The Quantity Theory for Inflation

- ▶ The inflation rate is defined as the percentage change in the overall price level.
- ▶ So to translate the quantity theory into a statement about inflation, we apply our basic trick for figuring growth rates: the growth rate of the product of two variables is the sum of the growth rates of those variables
- ▶ Applied to the quantity equation, we have

$$\bar{g}_M + \bar{g}_V = g_P + \bar{g}_Y.$$

- ▶ Now, since velocity is constant,  $\bar{g}_V = 0$ .
- ▶ Let denote the rate of inflation:  $\pi \equiv g_P$ .
- ▶ Rearranging equation above, we have our second key result from the quantity theory of money:

$$\pi^* = \bar{g}_M - \bar{g}_Y$$

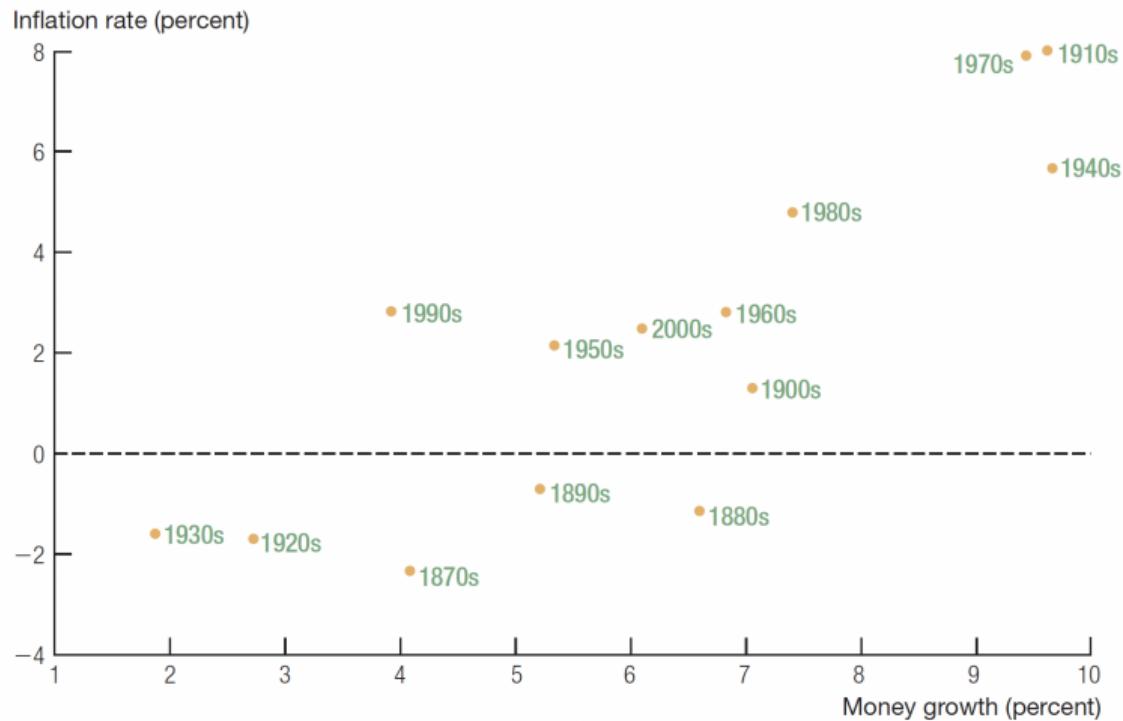
# The Quantity Theory for Inflation

$$\pi^* = \bar{g}_M - \bar{g}_Y$$

- ▶ The inflation rate is thus equal to the growth rate of money less the growth rate of real GDP.
- ▶ The growth rate of real GDP is some constant in the long run, which we can think of as being determined by the long-run growth theory we developed in early lectures.
- ▶ The growth rate of money, however, as mentioned earlier, is a policy variable controlled by the central bank.
- ▶ The quantity theory implies that in the long run, changes in **the growth rate of money lead one-for-one to changes in the inflation rate**.
- ▶ This general result serves as the main basis for the assertion by Milton Friedman that "**inflation is always and everywhere a monetary phenomenon**"; it's determined, in other words, by the rate of growth of the money supply.

# Empirical Test

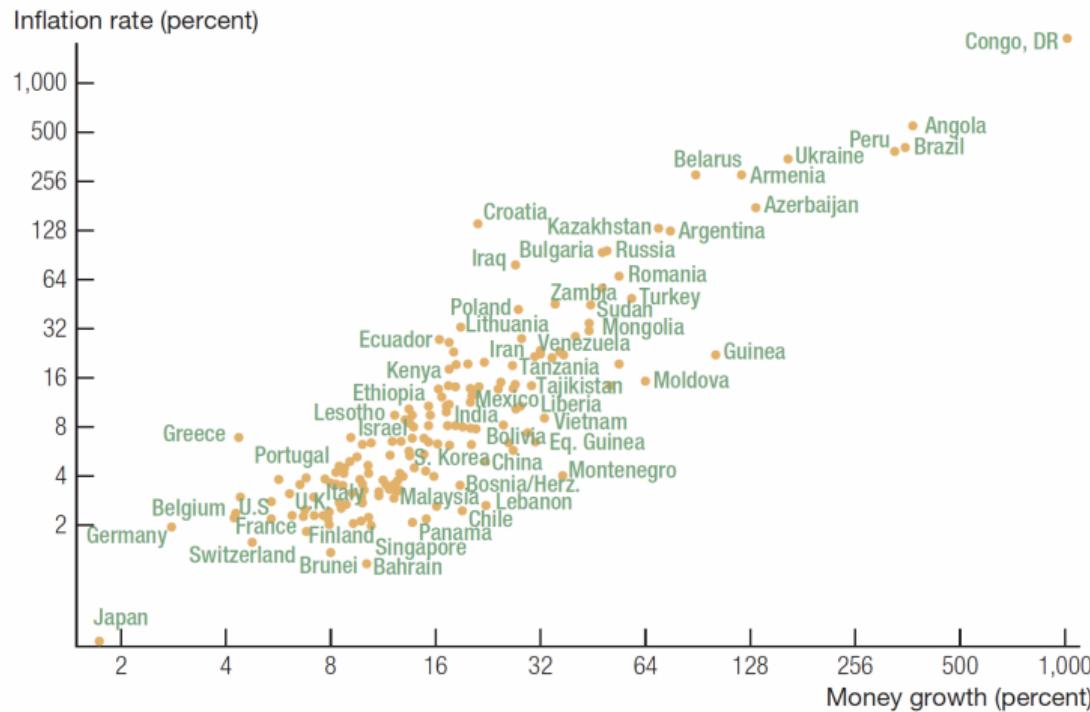
## Money Growth and Inflation in the United States, 1870–2012



CHARLES JONES : Macroeconomics, 5th Edition.

# Empirical Test

## Money Growth and Inflation around the World, 1990–2011



# The Neutrality of Money.

- ▶ We are now prepared to understand why the classical dichotomy (that the real and nominal sides of the economy are separate in the long run) holds.
- ▶ Now suppose the central bank simply doubles the money supply, in the economy. What happens?
- ▶ All prices can still double, relative prices will not have changed, and there's no reason for anyone to change any real behavior: the quantity of goods produced and the allocation of those goods is unaffected.
- ▶ The proposition that changes in the money supply have no real effects on the economy and only affect prices is called **the neutrality of money**.
- ▶ This kind of reasoning underlies the classical dichotomy, and as a statement about the long run, it seems entirely compelling.
- ▶ The general consensus among economists is that the classical dichotomy provides a good description of how the economy behaves in the long run but not in the short.

- ▶ The quantity equation can be interpreted as a theory of money demand by making assumptions about velocity
- ▶ Can write:

$$M_t = \frac{1}{V_t} P_t Y_t$$

- ▶ Monetarists: velocity is determined primarily by payments technology (e.g. credit cards, ATMs, etc) and is therefore close to constant (or at least changes are low frequency and therefore predictable)
- ▶ Let  $\kappa = V_t^{-1}$  and treat it as constant. Since money demand,  $M_t^d$ , equals money supply,  $M_t$ , our money demand function is:

$$M_t^d = \kappa P_t Y_t$$

- ▶ Money demand proportional to nominal income;  $\kappa$  does not depend on things like interest rates
- ▶ This is called the quantity theory of money

- ▶ The terms "velocity" and "money demand" are often used interchangeably
- ▶ Re-write in terms of real balances (purchasing power of money):

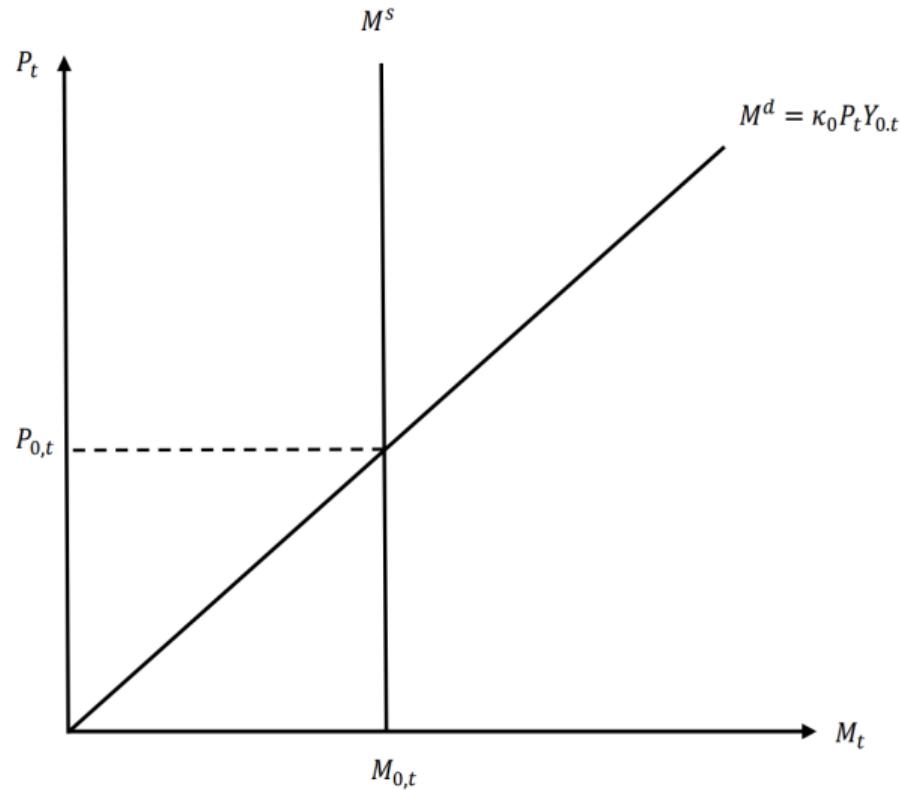
$$\frac{M_t}{P_t} = \frac{1}{V_t} Y_t$$

- ▶ The demand for real balance is proportional to the real quantity of exchange
- ▶  $\frac{1}{V_t}$  is the demand "shifter" - demand for money goes up, means velocity goes down
- ▶ Quantity theory of money: assumes velocity is roughly constant (equivalently, demand for money is stable)

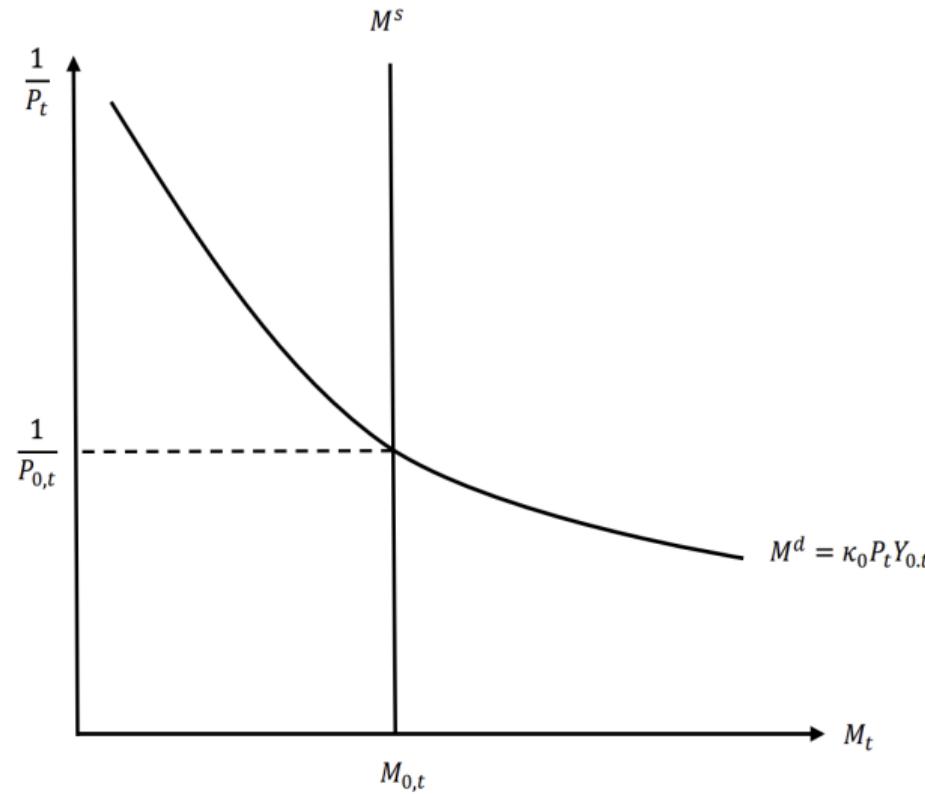
# Experiments on Money Supply and Demand

- ▶ Assume money supply is exogenously "set" by the central bank
- ▶ Graph demand for money as upward-sloping in  $P_t$  (taking  $Y_t$  and  $\kappa = \frac{1}{V_t}$  as given)
- ▶ Alternatively, downward-sloping in  $1/P_t$ 
  1. Increases in money supply:  $P_t$  rises
  2. Increase in money demand (decrease in velocity):  $P_t$  falls
  3. Increase in  $Y_t$ :  $P_t$  falls

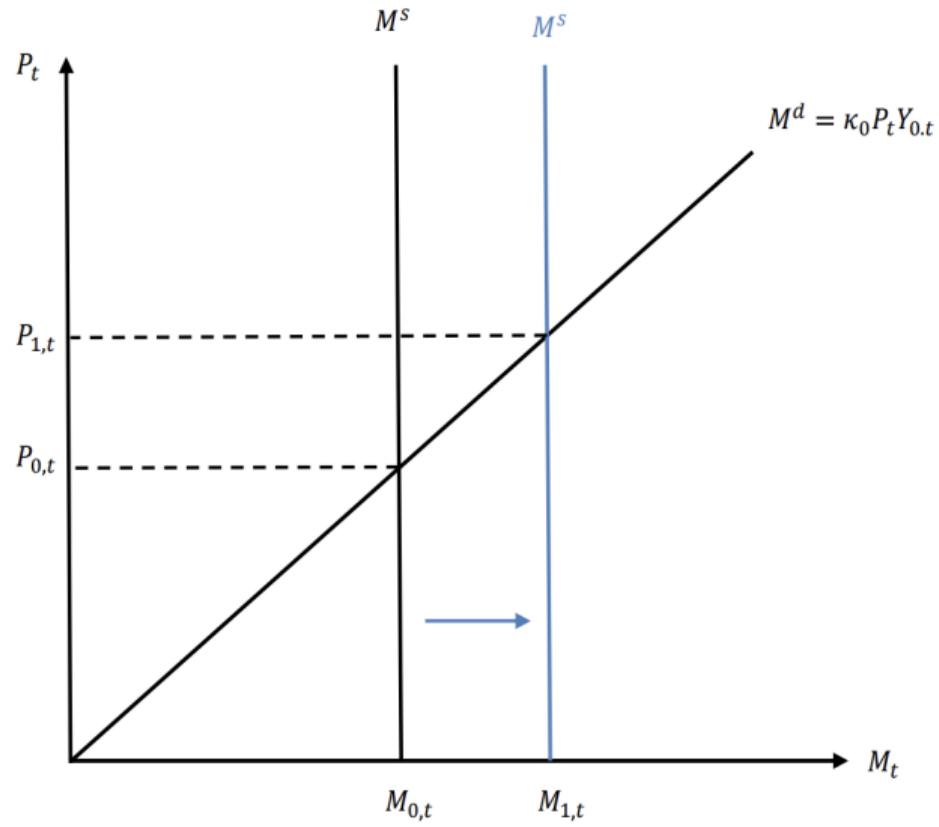
# Money Supply and Demand



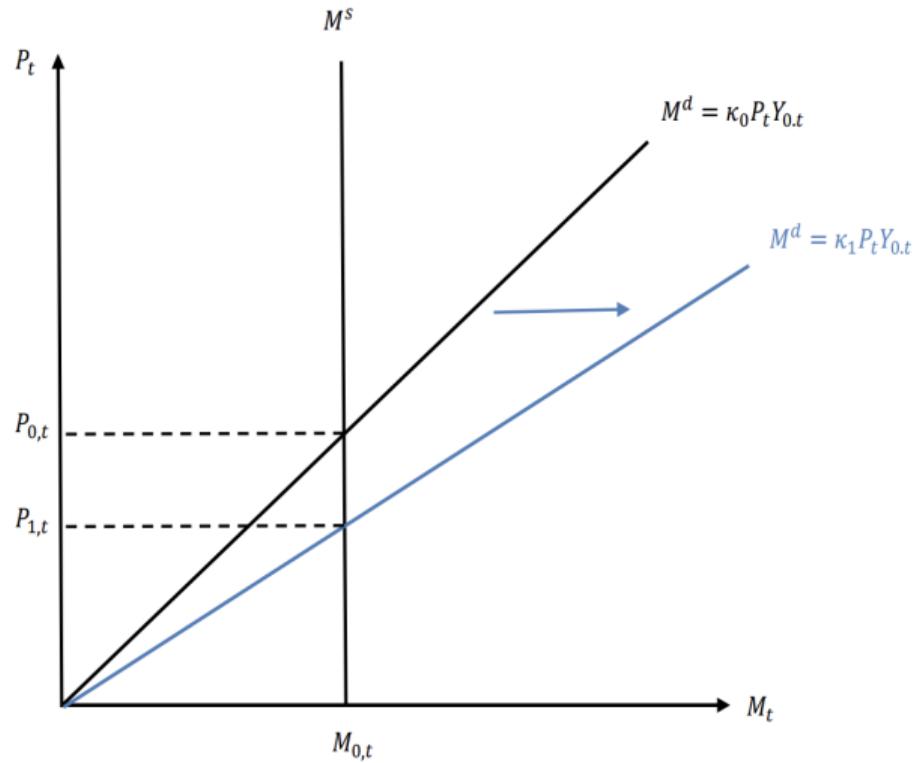
# Alternative Money Supply and Demand Graph



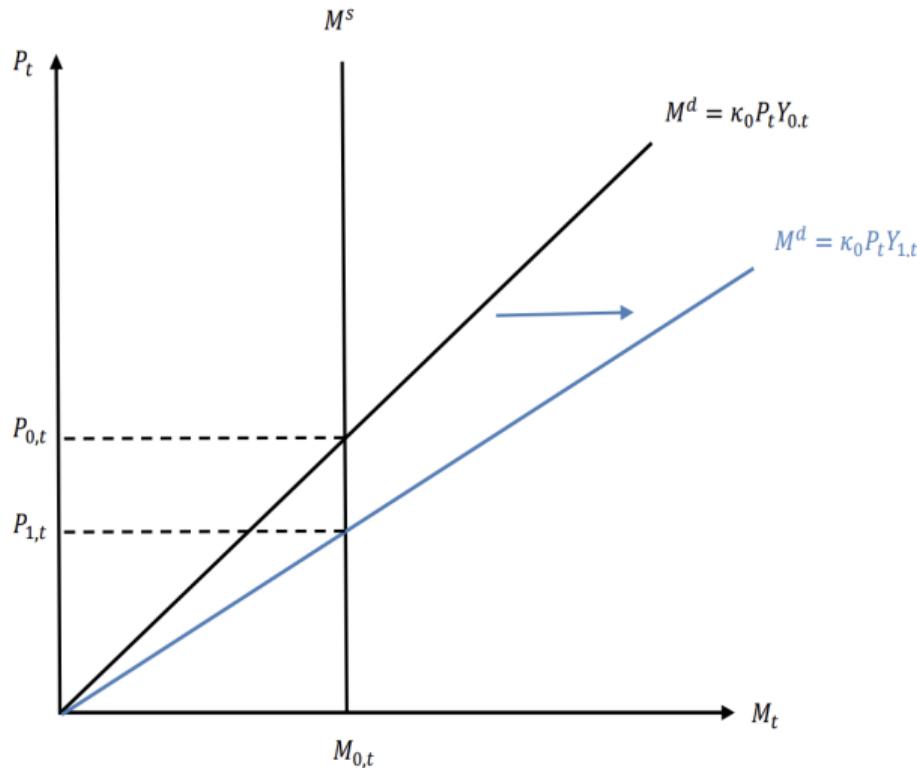
# Effects of Increasing Money Supply



# Increase in Money Demand (Decrease in Velocity)



# Increase in $y_t$ (Increase in Money Demand)



# Real and Nominal Interest Rates

- ▶ In the long run, the real interest rate is equal to the marginal product of capital.
- ▶ That is, the real interest rate is determined by the real return to purchasing a unit of capital, investing it, reaping the return to the investment, and then selling the capital: it is the total amount (in consumption goods) you earn by this process.
- ▶ However, this real interest rate is not the interest rate earned in a savings account or discussed in the newspaper.
- ▶ The interest rate on a savings account, for example, is the number of pounds/dollars/yuans you earn by taking £100 and putting it in a savings account for a year.
- ▶ This is a **nominal interest rate**,  $i$ . The real interest rate is paid in goods, while the nominal interest rate is paid in units of currency, like dollars.

## the Fisher equation

- ▶ We know that the price level  $P$  allows us to convert between real GDP and nominal GDP.
- ▶ Since interest rates are the return over the course of a year (maturity), then the difference between the nominal interest rate and the real interest rate is the change in the price level—the rate of inflation.
- ▶ Thus, if we let  $R$  denote the real interest rate and  $i$  denote the nominal interest rate, these two rates are related by

$$i = R + \pi.$$

- ▶ This formula is called **the Fisher equation** after Irving Fisher, an economist at Yale University in the first half of the twentieth century who first drew a clear distinction between real and nominal interest rates.
- ▶ It says that the nominal interest rate is equal to the sum of the real interest rate and the rate of inflation.

## A Simple Example

To understand this equation, suppose the real interest rate in the economy is equal to 5 percent and the rate of inflation, determined by the quantity theory, is equal to 3 percent. What is the nominal interest rate? The Fisher equation gives the answer: 8 percent.

- ▶ To see the economic reasoning behind this equation, consider the following example.
- ▶ Suppose for simplicity that a machine costs £100 today. The inflation rate is 3 percent, then the machine will be sold for £103 a year from now.
- ▶ Now suppose an investor buys a machine, uses it to produce output for a year, and then sells the output and the machine.
- ▶ How much will this investment earn?
- ▶ Since the real interest rate is 5 percent, the output produced by the machine must be worth £5.
- ▶ And since the machine sells for £103 at the end of the year, the investor earns an additional £3 on the value of the machine, for a total nominal return of £8.
- ▶ As a percentage of the original investment of £100, this is 8 percent, the nominal interest rate, exactly what the Fisher equation predicts.

## A Simple Example

- ▶ As mentioned earlier, the real interest rate is not a statistic we can look up in the newspaper.
- ▶ Instead, economists typically calculate it by applying the Fisher equation.
- ▶ Rewriting that equation, we see that

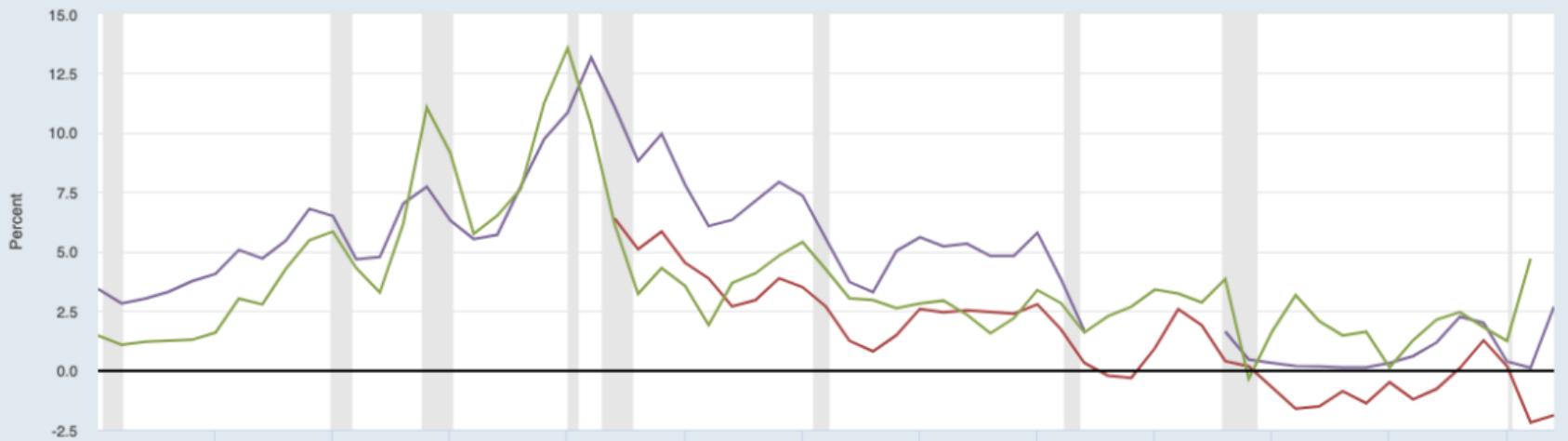
$$R = i - \pi$$

- ▶ That is, the real interest rate in the economy is computed by subtracting the inflation rate from the nominal interest rate.
- ▶ Figure below shows the nominal and real interest rates for the United States since 1960 for three months and 1 year data.
- ▶ As the Fisher equation suggests, the nominal rate is generally high when inflation is high—compare Figures.
- ▶ For example, the nominal rate reaches its peak in the graph in 1981 at just over 14 percent, close to the 1980 peak of inflation.

# 1 Year: Real and Nominal Interest Rates vs Inflation

FRED

— 1-Year Real Interest Rate  
— 1-Year Treasury Bill Secondary Market Rate, Discount Basis  
— Inflation, consumer prices for the United States



Shaded areas indicate U.S. recessions.

Sources: Cleveland Fed; Board of Governors; World Bank

fred.stlouisfed.org

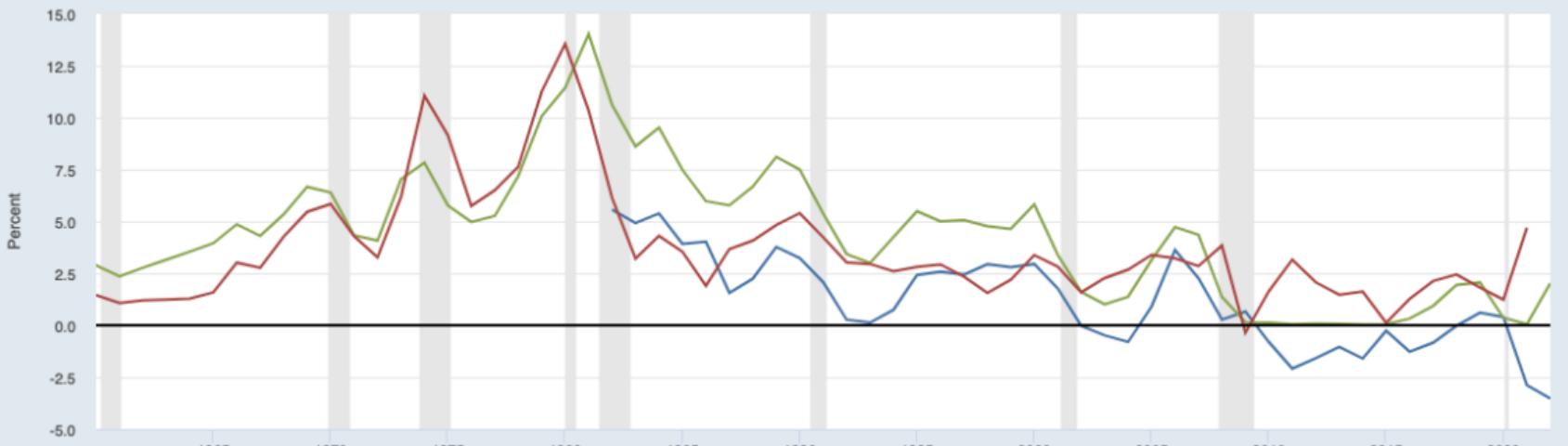
# Role of Expectation

- ▶ It's not a coincidence that the nominal interest rate peaks a year later (1981).
- ▶ Think about why that is the case; we will return to this topic next weeks: the role of expectation on inflation)
- ▶ In 2009, an interesting event occurred: the real interest rate actually became larger than the nominal interest rate.
- ▶ How could this happen? Consider equation  $R = i - \pi$ , and then look at the graph of inflation. What happened to inflation in 2009?

# 1 and 3 Month: Real and Nominal Interest Rates vs Inflation

FRED

— 1-Month Real Interest Rate  
— Inflation, consumer prices for the United States  
— 3-Month Treasury Bill Secondary Market Rate, Discount Basis



Shaded areas indicate U.S. recessions.

Sources: Cleveland Fed; Board of Governors; World Bank

[fred.stlouisfed.org](http://fred.stlouisfed.org)

# Real World Example of the Fisher Equation

$$i = R + \pi$$

Click  
Guardian  
Financial Times  
Wall Street Journal

# Costs of Inflation

The costs of inflation can be broadly classified into three categories:

- ▶ Shoe-leather costs: These refer to the costs associated with people having to hold less cash balances due to inflation, and the additional effort and time required to reduce cash holdings. The formula for shoe-leather costs is:  $\text{Cost of Shoe-leather} = (0.5) \times (\text{Rate of Inflation}) \times (\text{Value of Cash Holdings})$
- ▶ Menu costs: These are the costs associated with businesses having to frequently adjust prices due to inflation. The formula for menu costs is:  $\text{Cost of Menu} = (k) \times (\text{Rate of Inflation}) \times (\text{Total Revenue})$   
Where k represents the proportion of revenue spent on menu costs.
- ▶ Redistribution costs: These refer to the costs associated with the redistribution of wealth and income due to inflation. Inflation can have a redistributive effect on different sections of society, with some gaining and others losing out. The formula for redistribution costs is:  $\text{Cost of Redistribution} = (\text{Rate of Inflation}) \times (\text{Value of Cash Holdings} - \text{Real Interest Rate})$   
Where the real interest rate is the nominal interest rate minus the rate of inflation.

Overall, the costs of inflation can have a significant impact on the economy, and it is important for policymakers to carefully balance the benefits of inflation against these costs.

# The Fiscal Causes of High Inflation

- ▶ From the quantity theory of money we understood that the main cause of high inflation is that the central bank prints too much money.
- ▶ But why?
- ▶ For example, given the costs of inflation, would a central bank do this? The answer is that printing money is one way for the government to pay its bills.
- ▶ To see this, consider the following equation, called the government budget constraint:

$$\underbrace{G}_{\text{uses}} = \underbrace{T + \Delta B + \Delta M}_{\text{sources of funds}}$$

- ▶ That is, the government's uses of funds must equal its sources of funds.
- ▶ According to this equation, the government finances its spending, denoted by  $G$ , with three main sources of funds.
- ▶ The first is tax revenue  $T$ .
- ▶ The second is borrowing. Let  $B$  denote the government's outstanding stock of debt; then  $\Delta B$  is the change in the stock of debt, which is the amount of new borrowing.
- ▶ Finally, the third source of funds is printing money. Since  $M$  is the stock of money, the change in the stock of money  $\Delta M$  is the amount of new money issued by the government.

# The Inflation Tax

- ▶ To take a concrete example, suppose the government decides to spend an extra £100 million to provide additional health fund for the NHS.
- ▶ This spending must be paid for in some way, and the government has limited choices.
- ▶ It can cut some of its other spending or raise taxes.
- ▶ Or it can borrow the £100 million from the UK and foreign citizens and promise to pay it back as part of future spending (bond issuing).
- ▶ Or, and this is the intriguing possibility that concerns us here, the Bank of England (or a central bank) could issue an extra £100 million of currency that the government could use to pay for the higher spending.
- ▶ The revenue the government obtains by issuing new money ( $\Delta M$ ) is called seigniorage, or the inflation tax.
- ▶ Who pays the so-called inflation tax?

# Who pays the so-called inflation tax?

- ▶ By printing money, the government is taking resources from the rest of the economy, but from whom exactly?
- ▶ Suppose each person in the economy holds £200 in currency.
- ▶ Now suppose the government decides to double the money supply.
- ▶ It prints an extra £200 for each person but then spends that currency itself.
- ▶ From the quantity theory of money, we know that the long-run effect of this monetary expansion is to double the price level.
- ▶ Therefore, the £200 of currency held by the private sector is now worth only half as much in real terms.
- ▶ People must now pay prices that are twice as high.
- ▶ **The inflation tax, which shows up as a rise in the price level, is thus paid by people holding currency.**

# Sargent: Inflation is always and everywhere a fiscal phenomenon

- ▶ This basic story is at the heart of most episodes of hyperinflation.
- ▶ It has led Thomas Sargent, professor of economics at New York University and winner of the 2012 Nobel Prize in economics, to a variation on Milton Friedman's statement: "Persistent high inflation is always and everywhere a fiscal phenomenon" ("fiscal" means pertaining to government expenditures, revenues, or debt).
- ▶ Though Friedman is correct when he says that the root cause of inflation is the central bank's printing too much money,
- ▶ Sargent tells us why a government may allow this: there's no other way to satisfy its budget constraint.

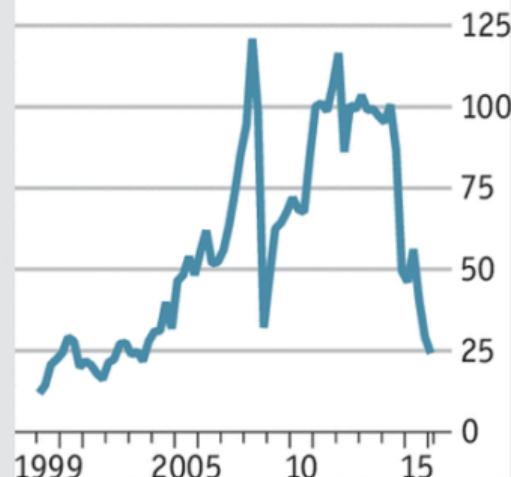
# Budget Balance

## Rocky horror show

Venezuela's:

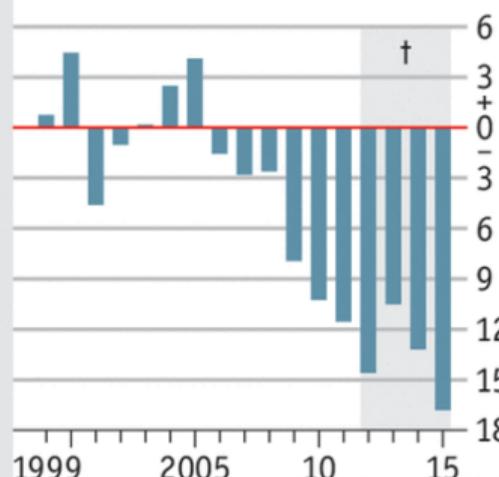
Crude oil\*

\$ per barrel



Budget balance

% of GDP



GDP

% change on a year earlier



Sources: Banco Central de Venezuela; Bloomberg; Economist Intelligence Unit

\*Venezuelan crude oil basket price †Estimate

Economist.com

# Central Bank Independence

- ▶ This basic story is also at the heart of an important institutional choice made by many countries: the independence of the central bank.
- ▶ The temptation to print money to pay for its spending is there for all governments.
- ▶ To avoid this temptation, many countries establish a kind of separation between the central bank and the branches of government responsible for spending and taxation.
- ▶ In the US, in the UK, for example, the government cannot order the Federal Reserve / Bank of England to issue more currency so that the government can pay its bills.
- ▶ Instead, decisions about monetary policy are conducted by the Federal Reserve / Bank of England, and decisions about government spending and taxation are conducted by the government.
- ▶ In much of Western Europe, these decisions are even more sharply separated: each country that uses the euro has its own government, which is responsible for spending and taxation, while monetary policy is conducted by a multinational European Central Bank.
- ▶ In general, then, central bank independence is an attempt to prevent fiscal considerations from leading to excessive inflation.
- ▶ However, at some level, though, the central bank is part of the government, and the head of the central bank is typically a political appointee.