Money and Inflation

Cheng Sun

Guanghua School of Management

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Today's Class

- The money system
  - What is money
  - The role of banks in monetary system
  - How central banks influence the money supply
- Inflation
  - The quantity theory of money
  - Inflation and interest rates
  - The nominal interest rate and the demand for money
  - The social cost of inflation
  - Hyperinflation

What is Money

- The functions of money
  - Store of value: transfer purchasing power from the present to the future.
  - Unit of account: the term in which prices are quoted and debt are recorded.
  - Medium of exchange: what we use to buy goods and services.
- The type of money
  - Fiat money: dollar bill.
  - Commodity money: gold standard.

What is Money

- The development of money
  - People are willing to accept a commodity currency such as gold because it has intrinsic value.
  - To reduce transaction costs, the government started to mint gold coin of know purity and weight.
  - The coin is easier to use, because their values are widely recognized.
  - The government accepted gold from the public in exchange for gold certificates.
  - The gold backing becomes irrelavant.
  - The system of commodity money evolves into a system of fiat money.

History of Chinese currency

- Unification:
  - Qin Shi Huang introduced a uniform copper coin based on the coins previously used by Qin.
- Song: China again reunited the currency system displacing coinages from ten or so independent states.
  - By 1000, unification was complete and China experienced a period of rapid economic growth.
  - The Northern Song is thought to have minted over two hundred million strings of coins which were often exported to Inner Asia, Japan, and South-East Asia, where they often formed the dominant form of coinage.
  - By the 12th century, various forms of paper money had become the dominant forms of currency in China.

History of Chinese currency

- Mongol: The Yuan dynasty attempted to use paper currency.
  - They created a unified, national system that was not backed by silver or gold.
  - They attempted to prohibit all transactions in or possession of silver or gold, which had to be turned over to the government.
  - Inflation that resulted from undisciplined printing remained a problem for the Yuan court until the end of the Dynasty.
- Ming: the early Ming dynasty attempted to use paper currency in the early re-unification period.
  - This currency experienced rapid inflation and issues were suspended in 1450.
  - For most of the Ming China had a purely private system of currency for all important transactions.
- Qing: late Imperial China maintained both a silver and a copper currency system.

The Quantity of Money

- How the quantity of money is controlled
  - Money supply: the quantity of money available in the economy.
  - Monetary policy: the government's control over the money supply.
  - Central bank: monetary policy is delegated to it.
  - Open market operation: the purchase and sale of government bond.
- How the quantity of money is measured
  - Currency: the sum of outstanding paper money and coins.
  - Demand deposit: the funds people hold in their checking account.
  - The measure of money: C, M1, M2.

The Quantity of Money

TABLE 4-1

The Measures of Money

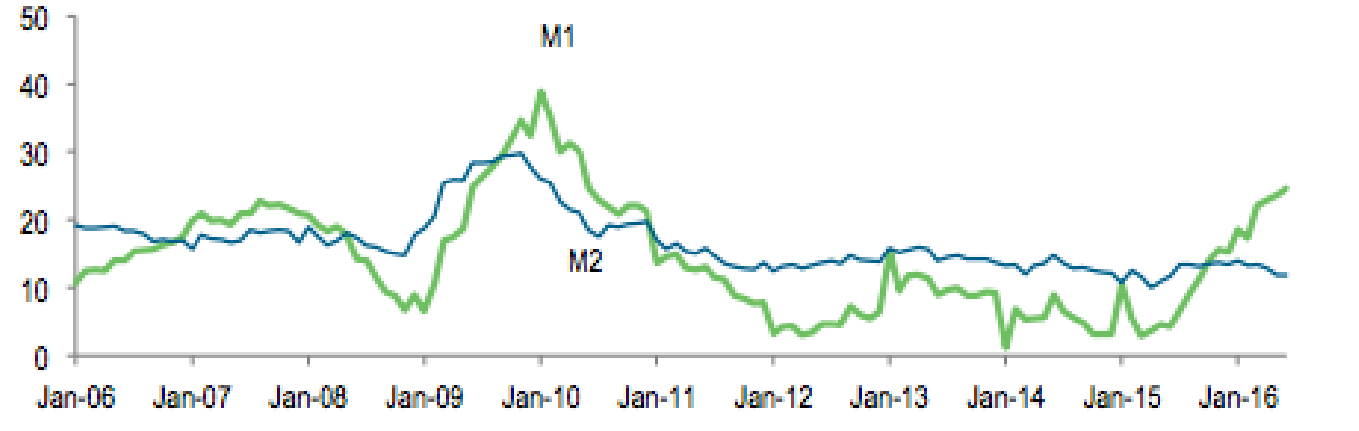
Symbol	Assets Included	Amount in July 2011 (billions of dollars)
C	Currency	972
*M*1	Currency plus demand deposits, traveler's checks, and other checkable deposits	2,006
*M*2	*M*1 plus retail money market mutual fund balances, saving deposits (including money market deposit accounts), and small time deposits	9,314

Source: Federal Reserve.

The Gap Between M1 and M2 in China

Figure 1: The gap between M1 and M2 growth has widened

M1 and M2 growth, y/y %

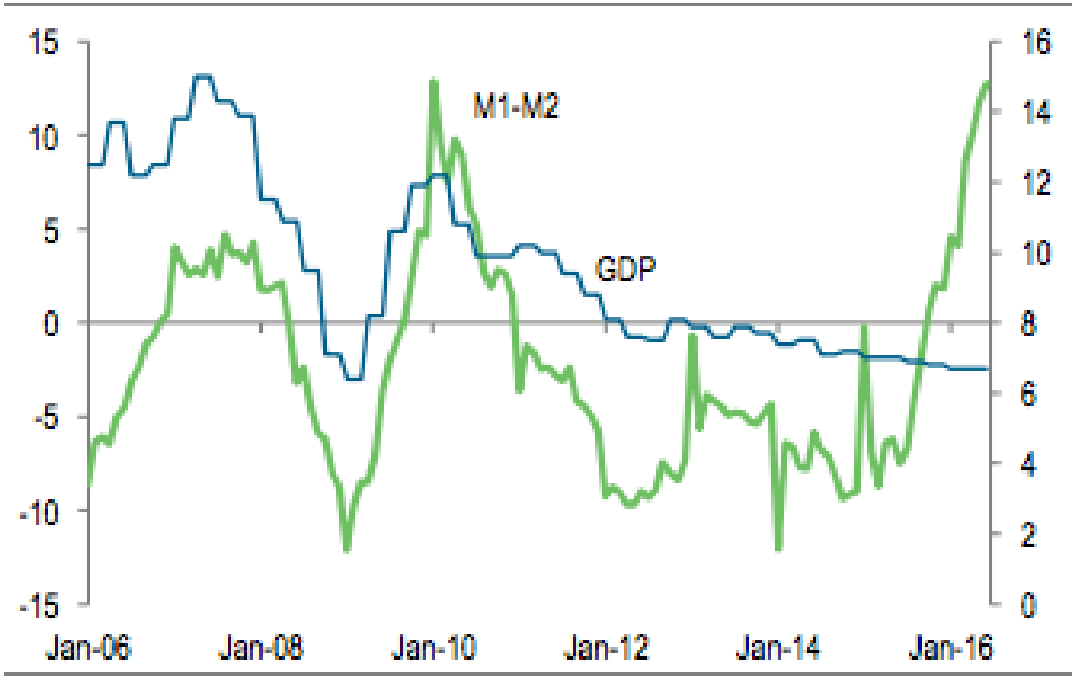


Sources: CEIC, Standard Chartered Research

The Gap Between M1 and M2 in China

Figure 2: M1-M2 gap has not yet revived growth this time

Real GDP growth, M1-M2 gap, y/y %

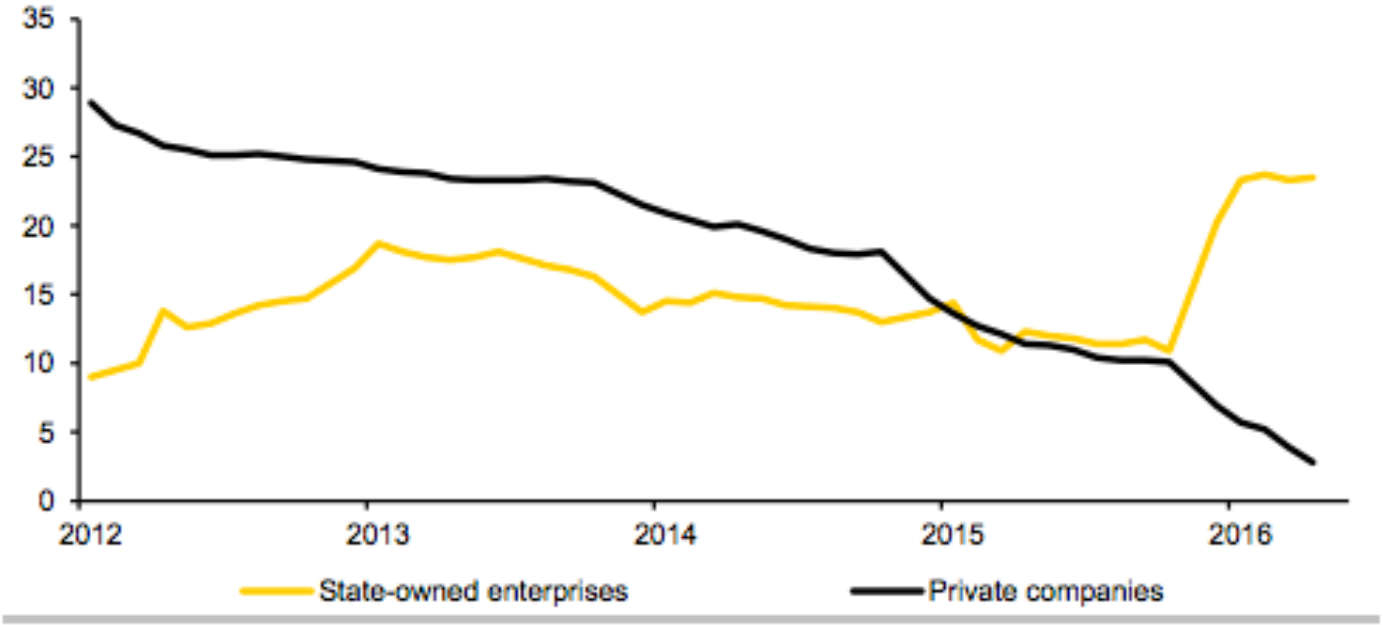


Sources: CEIC, Standard Chartered Research

Private Investment Dropped

CHART 2: **Private investment dropped while SOEs become more proactive**

Fixed asset investment, y/y, YTD, in % by state-owned companies and private companies



Source: Bloomberg, Commerzbank Research

Today's Class

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  - Hyperinflation

The Role of Banks

- Money supply
  - Money Supply = Currency + Demand Deposit, or $M = C + D$
- 100-Percent-Reserve Banking
  - Reserve: banks have received but not lent out.
  - 100-percent-reserve banking: all deposits are held as reserves.
  - If banks hold 100 percent of deposit in reserve, the banking system does not affect the supply of money.
- Fractional-Reserve Banking
  - Banks keep only a fract of their deposit in reserve.
  - Banks create money in this system.
  - The process of transferring funds from saver to borrowers is called financial intermediation.

The Role of Banks: Example

- 100-Percent-Reserve Banking

Firstbank's balance sheet

Assets	Liabilities
Reserves $ 1,000	Deposits $ 1,000

- Fractional-Reserve Banking

Firstbank's balance sheet

Assets	Liabilities
Reserves $ 200	Deposits $ 1,000
Loans $ 800	

The Role of Banks: Example

- Fractional-Reserve Banking

Secondbank's balance sheet

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

- Repeat the process of Fractional-Reserve Banking
  - rr denotes the reserve-deposit ratio.
  - The nth-bank lending is $(1 - rr)^n * 1000$
  - Total money supply is $(1 + (1 - rr) + (1 - rr^2) + ...) * 1000$, or $(1/rr) * 1000$.

Bank Capital and Leverage

- The bank owners must start business with their own equity: bank capital.

Realbank's balance sheet

Assets	Liabilities
Reserves $ 200	Deposits $ 750
Loans $ 500	Debt $ 200
Securities $ 300	Capital (owners' equity) $ 50

- Leverage
  - Leverage ratio: the ratio of the bank's total assets to bank capital.
  - Capital requirement: the banks must hold sufficient capital.
  - The amount of capital required depends on the kind of asset.

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How Central Banks Influence the Money Supply

- Define the variables
  - The money base B is the total held by the public as currency C and by the bank as reserves R and controlled by the central bank.
  - The reserve-deposit ratio rr is the fraction of deposits that banks hold in reserve. It is determined by the banks and the regulator.
  - The currency-deposit ratio cr is the ratio of people's currency holding C to their holding of demand deposits D.
- A model of the money supply
  - The money supply and the monetary base:

$$M = C + D$$

$$B = C + R$$

  - Devide the first one by the second $\frac{M}{B} = \frac{C/D+1}{C/D+R/D}$.
  - Rewrite with the ratios $M = \frac{cr+1}{cr+rr} * B$.

How Central Banks Influence the Money Supply

- The money multiplier
  - Money multiplier m: the ratio $\frac{cr+1}{cr+rr}$.
  - Money base B is called high-power money, since $M = m * B$.
- Remark
  - An increase in monetary base increases the money supply proportionally.
  - A decrease in the reserve-deposit ratio raises the money multiplier and the money supply.
  - A decrease in the currency-deposit ratio raises the money multiplier and the money supply.

How Central Banks Influence the Money Supply

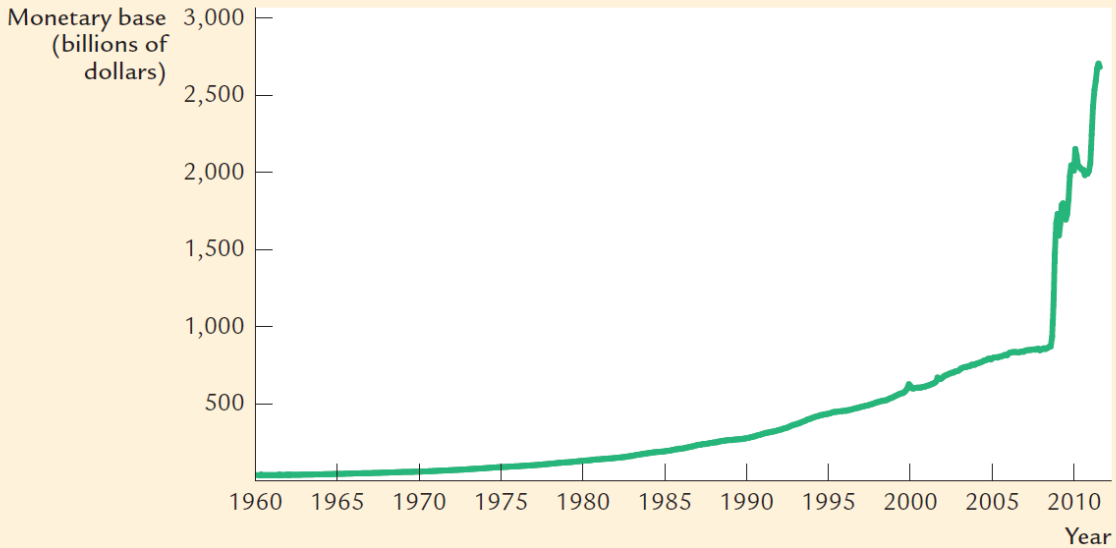
- A numerical example
  - The monetary base B is \$800 billion.
  - The reserve-deposit ratio rr is 0.1.
  - The currency-deposit ratio cr is 0.8.
  - The money multiplier is $m = \frac{0.8+1}{0.8+0.1} = 2$.
  - The money supply is $M = 2 * \$800 = \$1600$ billion.

The Instruments of Monetary Policy

- How the Fed changes the monetary base
  - Open market operation: the purchases/sales of government bonds, and the purchases increase the money supply.
  - The lender of last resort: lending reserves to banks and increasing money supply.
  - The discount window: the banks can borrow at such discount rate.
- How the Fed changes the reserve-deposit ratio
  - Reserve requirements: the minimum reserve deposit ratio required.
  - Excess reserves: reserves above the minimum required.
  - Interest on reserve: interest the bank recieved on their deposits.

Quantitative Easing

FIGURE 4-1



The Monetary Base The monetary base has historically grown relatively smoothly over time, but from 2007 to 2011 it increased approximately threefold. The huge expansion in the monetary base, however, was not accompanied by similar increases in *M*1 and *M*2.

Quantitative Easing

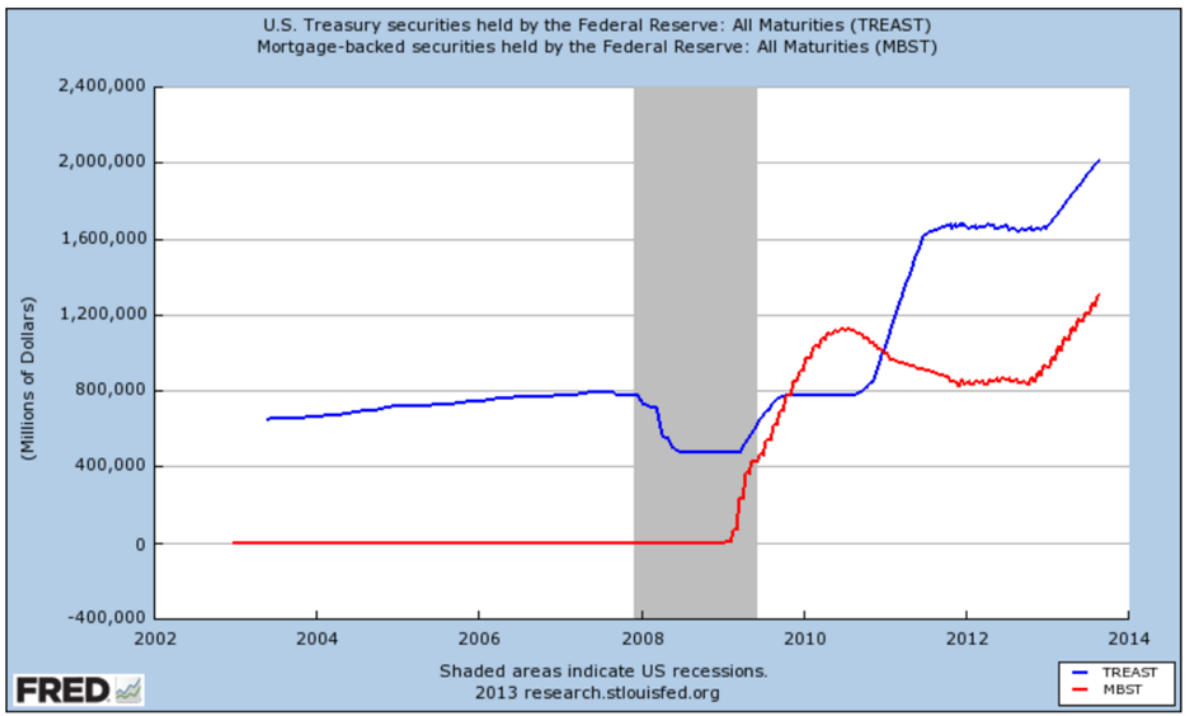
- Definition
  - The Fed pursued a policy of buying long-term government bonds to keep their prices up and long-term interest rates down.
  - It is an open-market operation.
  - It led to the substantial increase in the monetary base.
- Observation
  - It did not lead to a similar increase in broader measures of the money supply.
  - The monetary base increased about 200 percent from 2007 to 2011.
  - M1 increased by only 40 percent and M2 by only 25 percent.
  - The banks kept much of their available funds in reserve.

Quantitative Easing

- Timing
  - The U.S. Federal Reserve System held between $700 billion and $800 billion of Treasury notes on its balance sheet.
  - QE1: In November 2008, the Fed started buying $600 billion in mortgage-backed securities. By March 2009, it held $1.75 trillion of bank debt, mortgage-backed securities, and Treasury notes; this amount reached a peak of $2.1 trillion in June 2010.
  - QE2: In November 2010, the Fed announced a second round of quantitative easing, buying $600 billion of Treasury securities by the end of the second quarter of 2011.
  - QE3 or QE-infinity: the Federal Reserve decided to launch a new $40 billion per month, open-ended bond purchasing program of agency mortgage-backed securities.
  - The Federal Open Market Committee announced that it would likely maintain the federal funds rate near 0 "at least through 2015."

Quantitative Easing

U.S. Federal Reserve: Treasury and Mortgage-Backed Securities Held

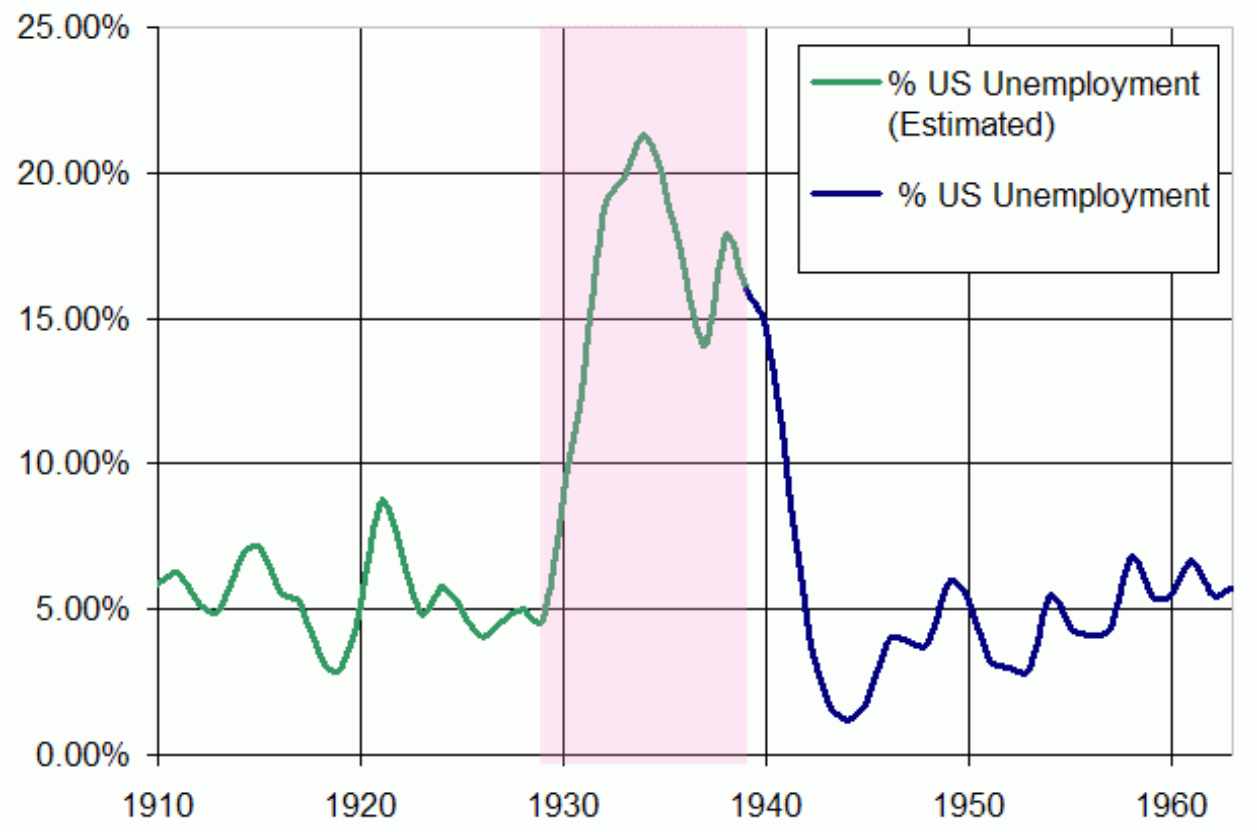


Great Depression

- Timing
  - Although the country spent two months with declining GDP, it was not until the Wall Street Crash in October 1929 that the effects of a declining economy were felt.
  - Banks began to fail in October 1930 (one year after the crash) when farmers defaulted on loans.
  - There was no federal deposit insurance during that time as bank failures were considered quite common.
  - People started to withdraw money and changed it into currency.
  - As deposits taken out from the bank increased, the money supply decreased because the money multiplier worked in reverse, forcing banks to liquidate assets.
  - This caused the money supply to shrink and the economy to contract and a significant decrease in aggregate investment.
  - Unemployment in rose to 25%, and crop prices fell by almost 60%.

Great Depression

Great Depression



Bank Failures and the Money Supply in the 1930s

- Observation
  - Between August 1929 and March 1933, the money supply fell 28 percent.
  - The monetary base rose 18 percent over this period.
  - The money supply fell because the money multiplier fell 38 percent.
- Explanation
  - More than 9,000 banks suspended operations, often defaulting on their depositors.
  - Bank failures raised the currency-deposit ratio by reducing public confidence in the banking system.
  - It raised the reserve-deposit ratio by making bankers more cautious.

Bank Failures and the Money Supply in the 1930s

TABLE 4-2

The Money Supply and Its Determinants: 1929 and 1933

	August 1929	March 1933
Money Supply	**26.5**	**19.0**
Currency	3.9	5.5
Demand deposits	22.6	13.5
Monetary Base	**7.1**	**8.4**
Currency	3.9	5.5
Reserves	3.2	2.9
Money Multiplier	**3.7**	**2.3**
Reserve–deposit ratio	0.14	0.21
Currency–deposit ratio	0.17	0.41

Source: Adapted from Milton Friedman and Anna Schwartz, *A Monetary History of the United States, 1867–1960* (Princeton, N.J.: Princeton University Press, 1963), Appendix A.

Today's Class: Part II

- Inflation
  - The quantity theory of money
  - Inflation and interest rates
  - The nominal interest rate and the demand for money
  - The social cost of inflation
  - Hyperinflation

The Quantity Theory of Money

- Transactions and the quantity equation
  - Money $*$ Velocity $=$ Price $*$ Transactions, or $M * V = P * T$
  - M is the quantity of money.
  - V transaction velocity of money
- Example
  - 60 loafs of bread are sold at \$ 0.50 per loaf.
  - The total number of dollar exchanged is $PT = \$0.5 * 60 = \$30$ per year.
  - Suppose that the quantity of money is $M = \$10$.
  - The velocity is $V = PT/M = 3$ times per year.

The Quantity Theory of Money

- From transaction to income
  - Money $*$ Velocity $=$ Price $*$ Output, or $M * V = P * Y$
  - Y is total income.
  - V is called the income velocity of money.
- Remark
  - The number of transactions is difficult to measure.
  - Transactions and output are related, but not the same.
  - When one person sells a used car to another person, it is a transaction using money not part of current output.
  - The dollar value of transactions is roughly proportional to the dollar value of output.

The Quantity Theory of Money

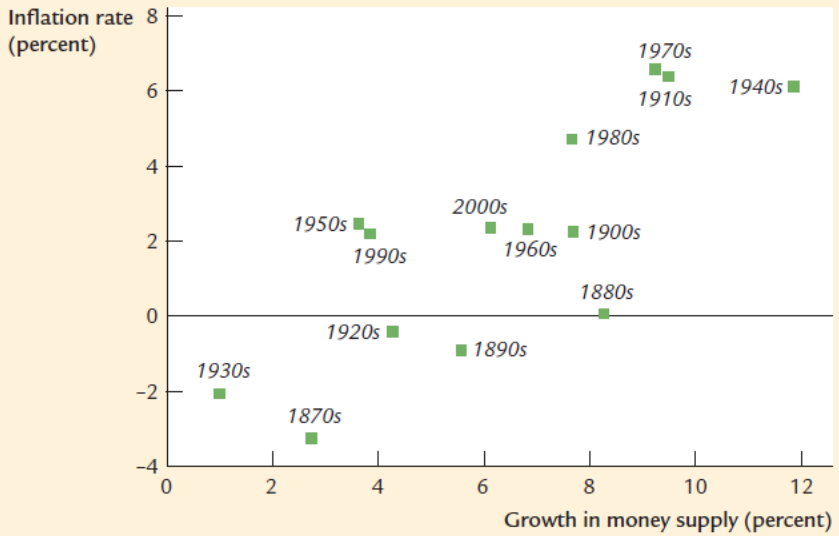
- The money demand function and the quantity equation
  - Real money balances M/P
  - Money demand function: $(M/P)^d = kY$.
  - Condition: the demand for real money balances $(M/P)^d$ equals the supply M/P.
  - Rearrangment: $M(1/k) = PY$, and $MV = PY$ or $V = 1/k$.
- The assumption of constant return.
  - The velocity is constant: $M\bar{V} = PY$.
  - A change in the quantity of money (M) must cause a proportionate change in nominal GDP (PY).

Money, Price and Inflation

- Main results from the theory
  - The factors of production and the production function determine the level of output Y.
  - The money supply M set by the central bank determines the nominal value of output PY.
  - The price level P is the ratio of the nominal value of output PY ot the level of the output,
- Percentage-change form
  - $\%$Change in $M+$ $\%$Change in $V =\%$Change in $P+$ $\%$Change in Y
  - The growth in the money supply determines the rate of inflation.

Money, Price and Inflation

FIGURE 5-1

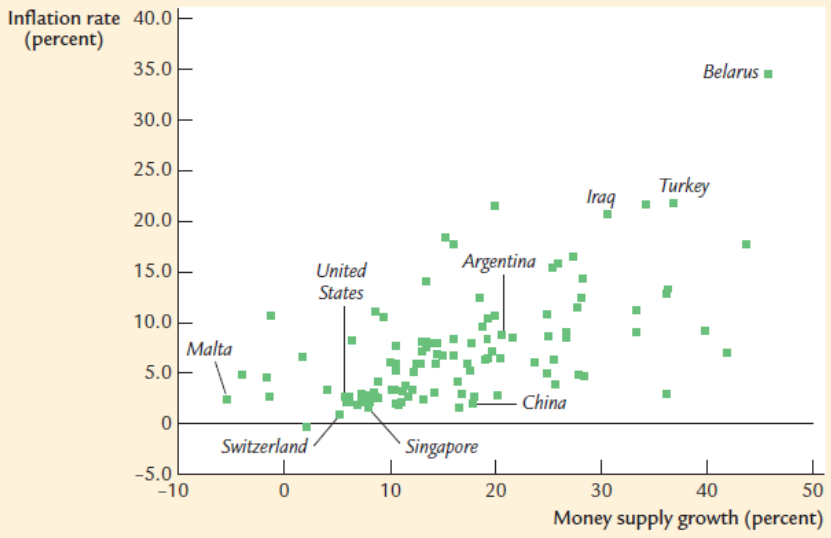


Historical Data on U.S. Inflation and Money Growth In this scatterplot of money growth and inflation, each point represents a decade. The horizontal axis shows the average growth in the money supply (as measured by *M2*) over the decade, and the vertical axis shows the average rate of inflation (as measured by the GDP deflator). The positive correlation between money growth and inflation is evidence for the quantity theory's prediction that high money growth leads to high inflation.

Source: For the data through the 1960s: Milton Friedman and Anna J. Schwartz, *Monetary Trends in the United States and the United Kingdom: Their Relation to Income, Prices, and Interest Rates 1867–1975* (Chicago: University of Chicago Press, 1982). For recent data: U.S. Department of Commerce and Federal Reserve Board.

Money, Price and Inflation

FIGURE 5-2



International Data on Inflation and Money Growth
In this scatterplot, each point represents a country. The horizontal axis shows the average growth in the money supply (as measured by currency plus demand deposits) during the period 2000 to 2010, and the vertical axis shows the average rate of inflation (as measured by the CPI). Once again, the positive correlation is evidence for the quantity theory's prediction that high money growth leads to high inflation.

Source: International Monetary Fund.

Seigniorage

- Definition
  - The revenue raised by printing money.
  - Printing money to raise revenue is like imposing an inflation tax.
- Example: Paying for the American Revolution
  - In 1775 new issues were $6 million. $19 million in 1776, $13 million in 1777, $63 million in 1778, and $125 million in 1779.
  - The price of gold measured in continental dollars was more than 100 times its level of only a few years earlier.
  - Congress passed the Mint Act of 1792, which established gold and silver as the basis for a new system of commodity money.

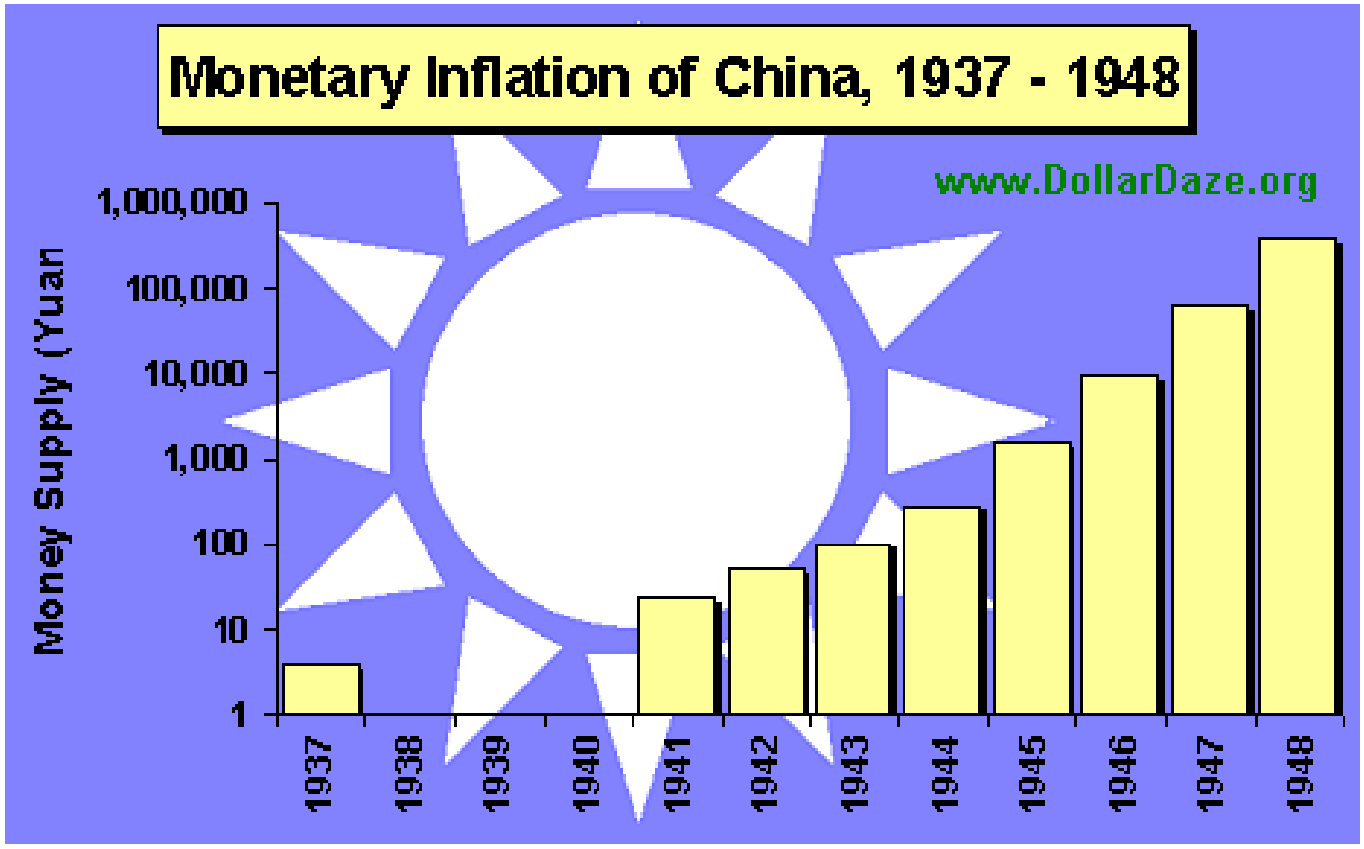
Seigniorage

- Example: Hyperinflation in China, 1937-1949, currency
  - The currency of China was initially silver-backed.
  - The nationalist government seized control of private banks in the notorious banking coup of 1935 and replaced the currency with the Fabi.
  - Particular effort was made by the ROC government to install this currency as the monopoly currency of China.
  - A total of 1.4 billion Chinese yuan was issued in 1936, but by the end of World War II 1.031 trillion in notes was issued.
  - By 1947, some 33.2 trillion of currency was issued as a result of massive budget deficits resulting from war.
  - Taxation revenue was just 0.25 billion, compared with 2500 billion in war expenses.
  - By 1949, the total currency in circulation was 120 billion times more than in 1936.

Seigniorage

- Example: Hyperinflation in China, 1937-1949, timing
  - Silver Leaves China for the U.S.: in 1934, the U.S. passed the Silver Purchase Act that enabled the U.S. Treasury to buy up silver.
  - Recession: massive amounts of silver flowed out of China to the U.S. sparking a deflationary recession. In 1934 the gross domestic product for China fell 26%.
  - Seizure of Private Banks: by July 1935, the Nationalist government had effectively ended private banking in China as it was the majority shareholder in each bank.
  - The war with Japan: 65 to 80 percent of the annual expenditures were covered by newly printed money.
  - Resumption of Civil War: money creation continued unabated, covering some 50 to 65 percent of the government's spending.

Inflation and Interest Rate



Today's Class: Part II

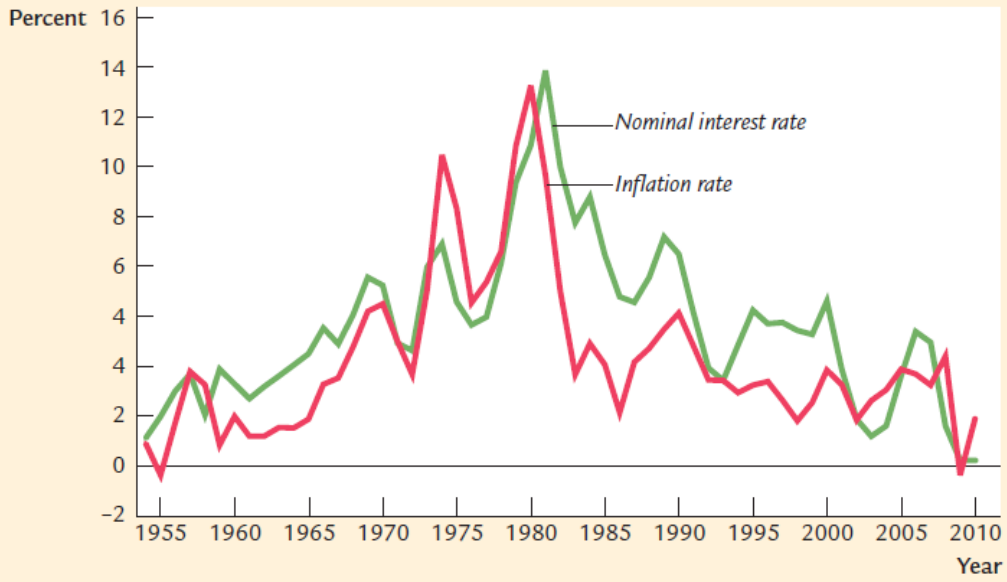
- Inflation
  - Inflation and interest rates
  - The nominal interest rate and the demand for money
  - The social cost of inflation
  - Hyperinflation

Inflation and Interest Rate

- Two interest rates: real and nominal
  - Nominal interest rate i: the interest rate that the bank pays.
  - Real interest rate r: the increase in the purchasing power.
  - The inflation rate π: $r = i - \pi$
- Fisher effect:
  - The nominal interest rate in the sum of the real interest rate and the inflation rate $i = r + \pi$.
  - 1% increase in the inflation causes 1% increase in the nominal interest rate.
- Two real interest rates: ex ante and ex post
  - Ex ante real interest rate: the expected rate.
  - Ex post real interest rate: the realized rate.
  - Fisher effect: $i = r + E\pi$

Inflation and Interest Rate

FIGURE 5-3

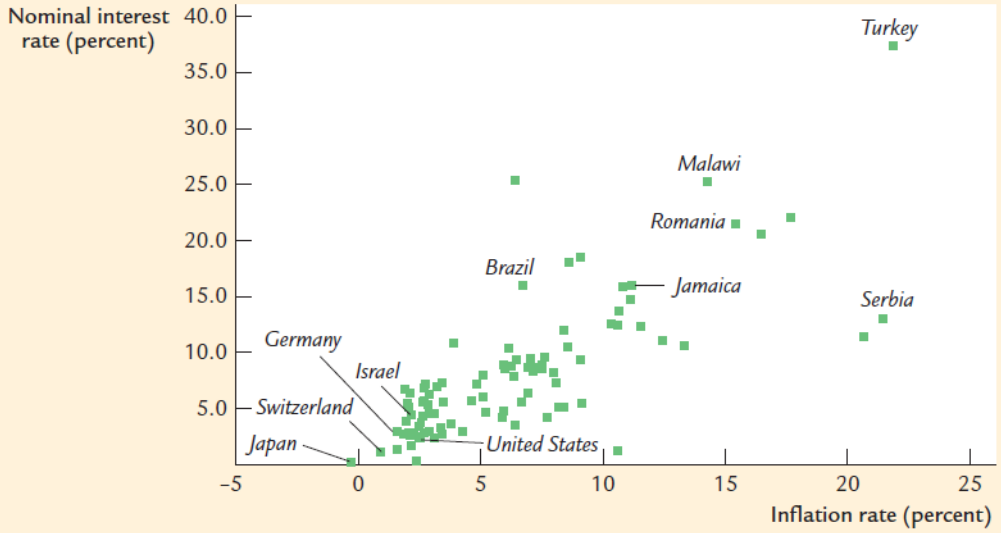


Inflation and Nominal Interest Rates Over Time This figure plots the nominal interest rate (on three-month Treasury bills) and the inflation rate (as measured by the CPI) in the United States since 1954. It shows the Fisher effect: higher inflation leads to a higher nominal interest rate.

Source: Federal Reserve and U.S. Department of Labor.

Inflation and Interest Rate

FIGURE 5-4



Inflation and Nominal Interest Rates Across Countries
This scatterplot shows the average nominal interest rate on short-term Treasury bills and the average inflation rate in almost 100 countries during the period 2000 to 2010. The positive correlation between the inflation rate and the nominal interest rate is evidence for the Fisher effect.

Source: International Monetary Fund.

Today's Class: Part II

- Inflation
  - The nominal interest rate and the demand for money
  - The social cost of inflation
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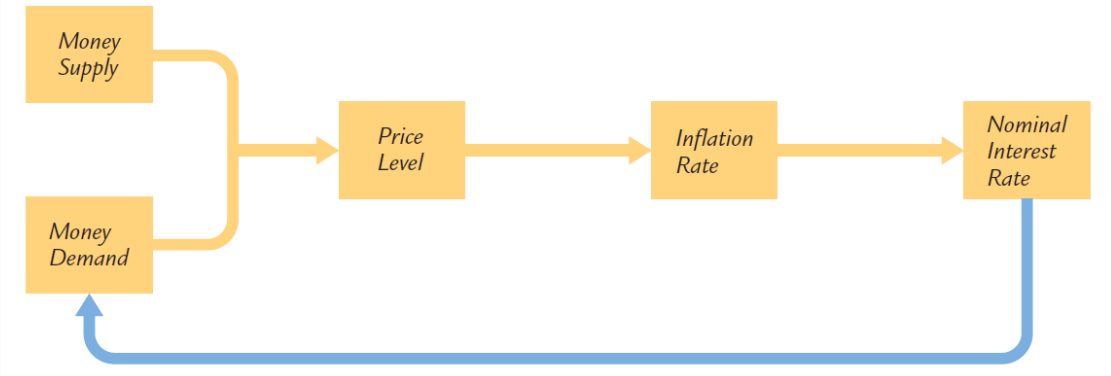
The Nominal Interest Rate and the Demand for Money

- The cost of holding money
  - The nominal interest rate is the opportunity cost, $r + E\pi$.
  - The quantity of money demanded depends on the price of holding money: $(M/P)^d = L(i, Y)$.
  - L denotes money demand, and money is the most liquid asset.
- Future money and current price
  - Equate the supply to demand: $M/P = L(i, Y)$
  - The real money balances depends on the expected rate of inflation $M/P = L(r + E\pi, Y)$.

The Nominal Interest Rate and the Demand for Money

FIGURE 5-5



The Linkages Among Money, Prices, and Interest Rates This figure illustrates the relationships among money, prices, and interest rates. Money supply and money demand determine the price level. Changes in the price level determine the inflation rate. The inflation rate influences the nominal interest rate. Because the nominal interest rate is the cost of holding money, it may affect money demand. This last link (shown as a blue line) is omitted from the basic quantity theory of money.

Today's Class: Part II

- Inflation
  - The social cost of inflation
  - Hyperinflation

The Social Cost of Inflation

- The costs of expected inflation
  - The distorting effect of the inflation tax on people's holding.
  - Firms need to change their prices more often.
  - Microeconomic inefficiencies in the allocation of money.
  - The tax code does not consider the inflation.
  - Inconvenience of living.
- The costs of unexpected inflation
  - It increases uncertainties for both creditors and debtors.
- One benefit of inflation
  - Observation: cuts in nominal wages are rare:
  - Some inflation may make the labor markets work better.

Today's Class: Part II

- Inflation
  - Hyperinflation

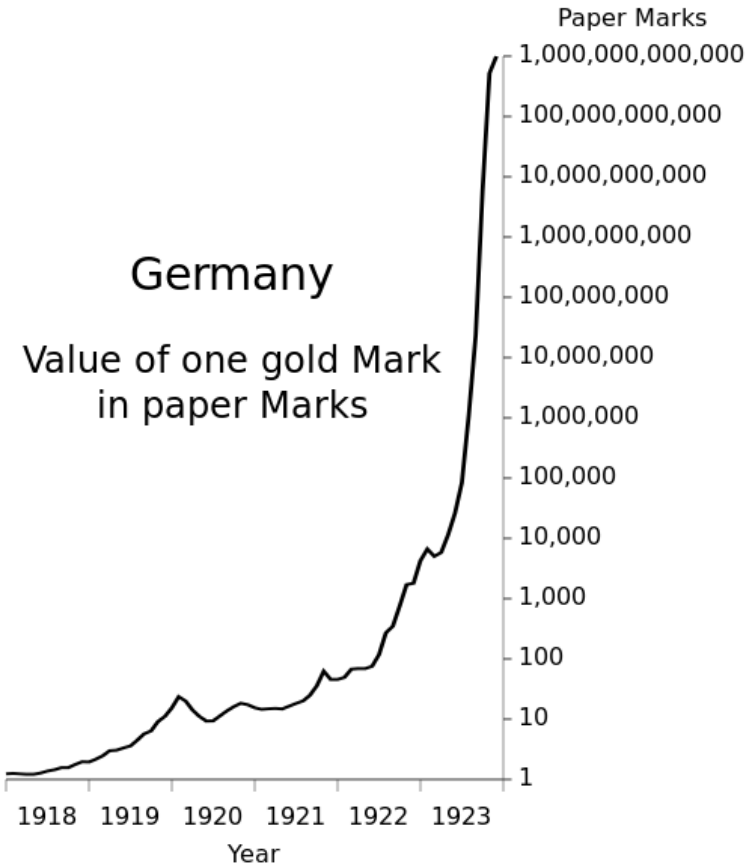
Hyperinflation

- Hyperinflation: inflation that exceeds 50% per month.
- The costs of inflation become intolerable with such rates.
- The causes of hyperinflation
  - Excessive growth in the supply of money.
  - Inadequate tax revenue to pay for government spending.
  - The ends of hyperinflation always coincide with fiscal inflation.
- Examples
  - Interwar Germany, between WWI and WWII.
  - Zimbabwe: 2008-2009
  - China's civil war: 1947-1948

Hyperinflation in the Weimar Republic

- A three-year hyperinflation between June 1921 and January 1924.
- Background
  - In order to pay for the large costs of the ongoing First World War, Germany suspended the gold standard.
  - The German Emperor Wilhelm II and the German parliament decided without opposition to fund the war entirely by borrowing.
  - The government believed that it would be able to pay off the debt by annexing resource-rich industrial territory to the west and east and imposing massive reparations on the defeated Allies.
  - The exchange rate of the mark against USD steadily devalued throughout the war from 4.2 to 7.9 marks per dollar.
  - It was at about 90 marks per USD during the first half of 1921.
  - The London Ultimatum of May 1921 demanded reparations in gold or foreign currency to be paid in annual installments of 2 billion gold marks plus 26% of the value of Germany's exports.

Hyperinflation in the Weimar Republic

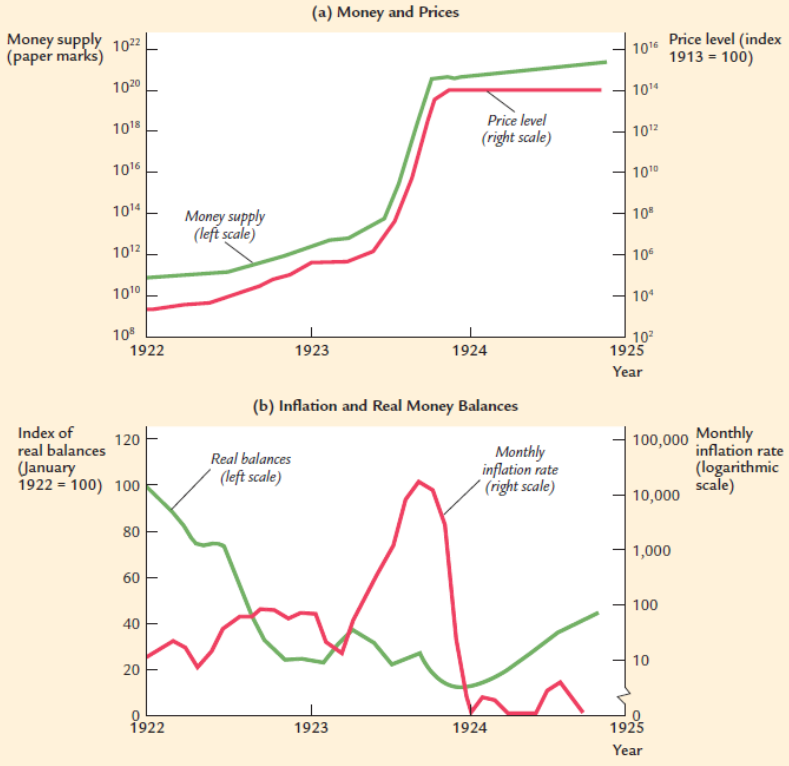


Hyperinflation in the Weimar Republic

- Hyperinflation
  - Beginning in Aug 1921, Germany began to buy foreign currency with marks at any price.
  - During the first half of 1922, the mark stabilized at about 320 Marks per dollar.
  - At this time international reparations conferences were held, including one in June 1922 that was organized by US investment banker J. P. Morgan, Jr.
  - The inflation changed to hyperinflation and the mark fell to 7,400 Marks per Dollar by Dec 1922.
  - By the fall of 1922, Germany cannot make reparations payments.
  - Reparations were to be paid in goods such as coal.
  - In Jan 1923 French and Belgian troops occupied the Ruhr, the industrial region of Germany in the Ruhr valley, to ensure this.
  - By Nov 1923, it was 4,210,500,000,000 German marks per USD.

Hyperinflation: Interwar Germany

FIGURE 5-6



Money and Prices in Interwar Germany Panel (a) shows the money supply and the price level in Germany from January 1922 to December 1924. The immense increases in the money supply and the price level provide a dramatic illustration of the effects of printing large amounts of money. Panel (b) shows inflation and real money balances. As inflation rose, real money balances fell. When the inflation ended at the end of 1923, real money balances rose.

Source: Adapted from Thomas J. Sargent, "The End of Four Big Inflations," in Robert Hall, ed., *Inflation* (Chicago: University of Chicago Press, 1983), 41–98.