JOHNSON
Cornell University

NBA 5420: Investment and Portfolio Management

Class 9: Fixed Income II

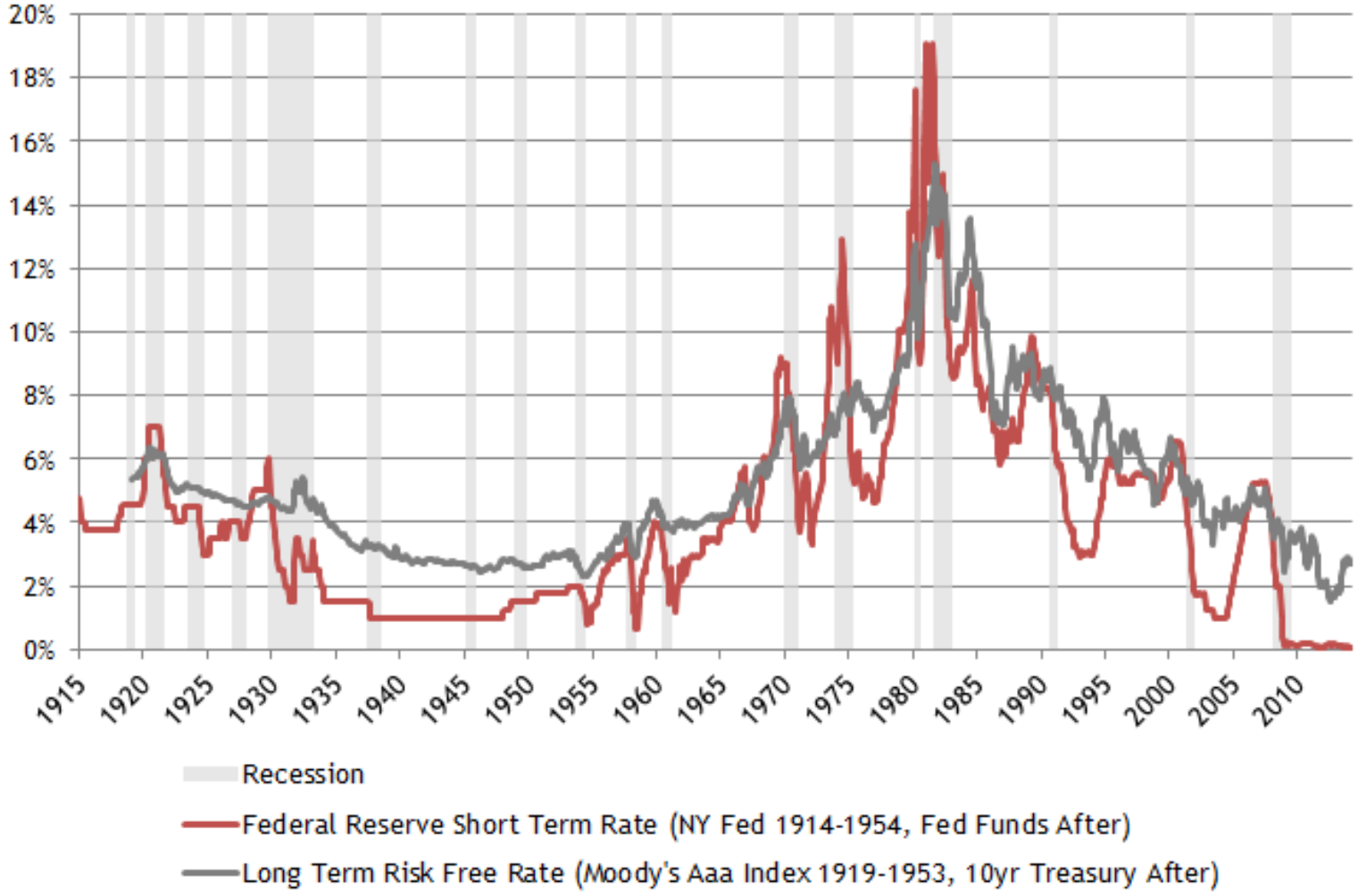
Professor Matt Baron

April 4, 2016

Interest rates

- In the previous class on fixed income, we assumed the short-rate was given
  - And used the expectations hypothesis to price long-term bonds
- If you take a class on fixed-income derivatives
  - You also assume that the random process governing the evolution of short-term rates is given.
- But where do short-term rates come from?
  - To answer this, we need to know about macro and monetary policy

Short and Long Term Interest Rates Since 1915



The Fisher Equation

$$i = r + \pi$$

- i = the nominal interest rate
  - the actual reported rate
- r = the real interest rate
  - adjusting for the loss of purchasing power of your future returns
- π = the inflation rate

The Fisher Equation

Can be interpreted 2 ways:

1) As a way to measure the (past) *realized* real rate:

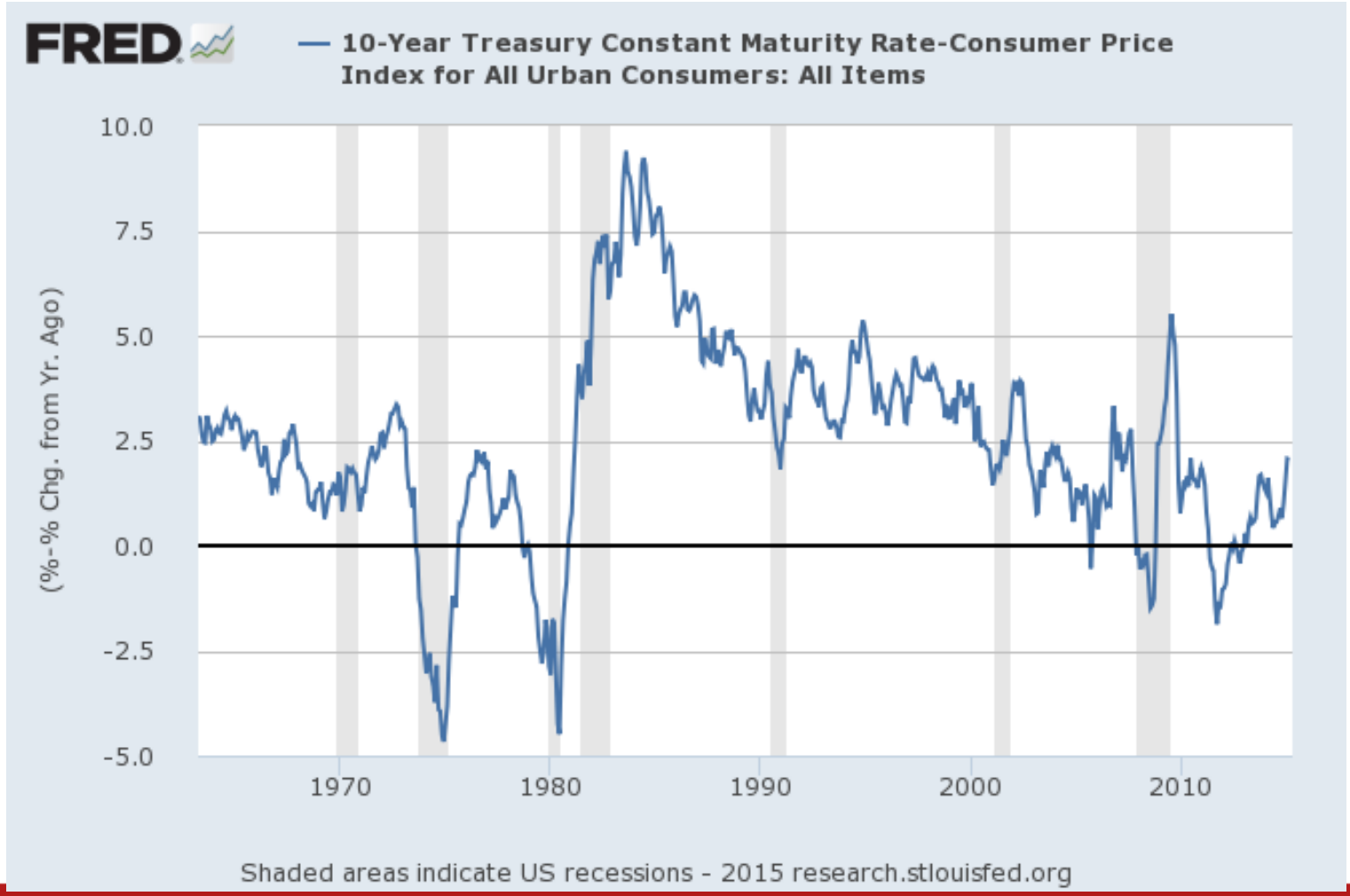
$$r_{realized} = i - \pi_{realized}$$

2) As a way to measure market *expectations for future inflation* (by comparing nominal yields to those from inflation-protected bonds):

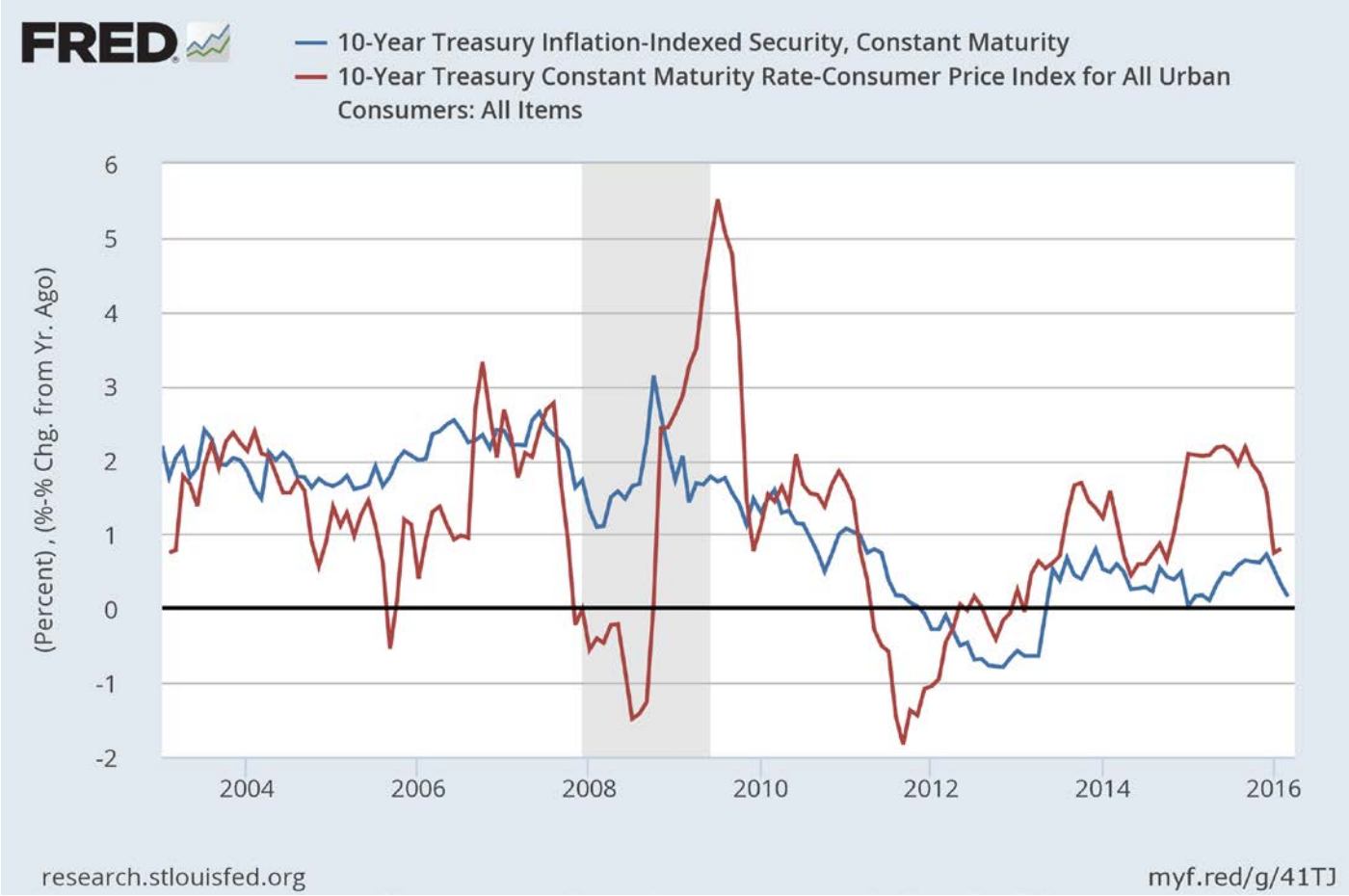
$$\pi_{predicted} = i - r_{\text{from inflation-protected bonds}}$$

Real interest rates

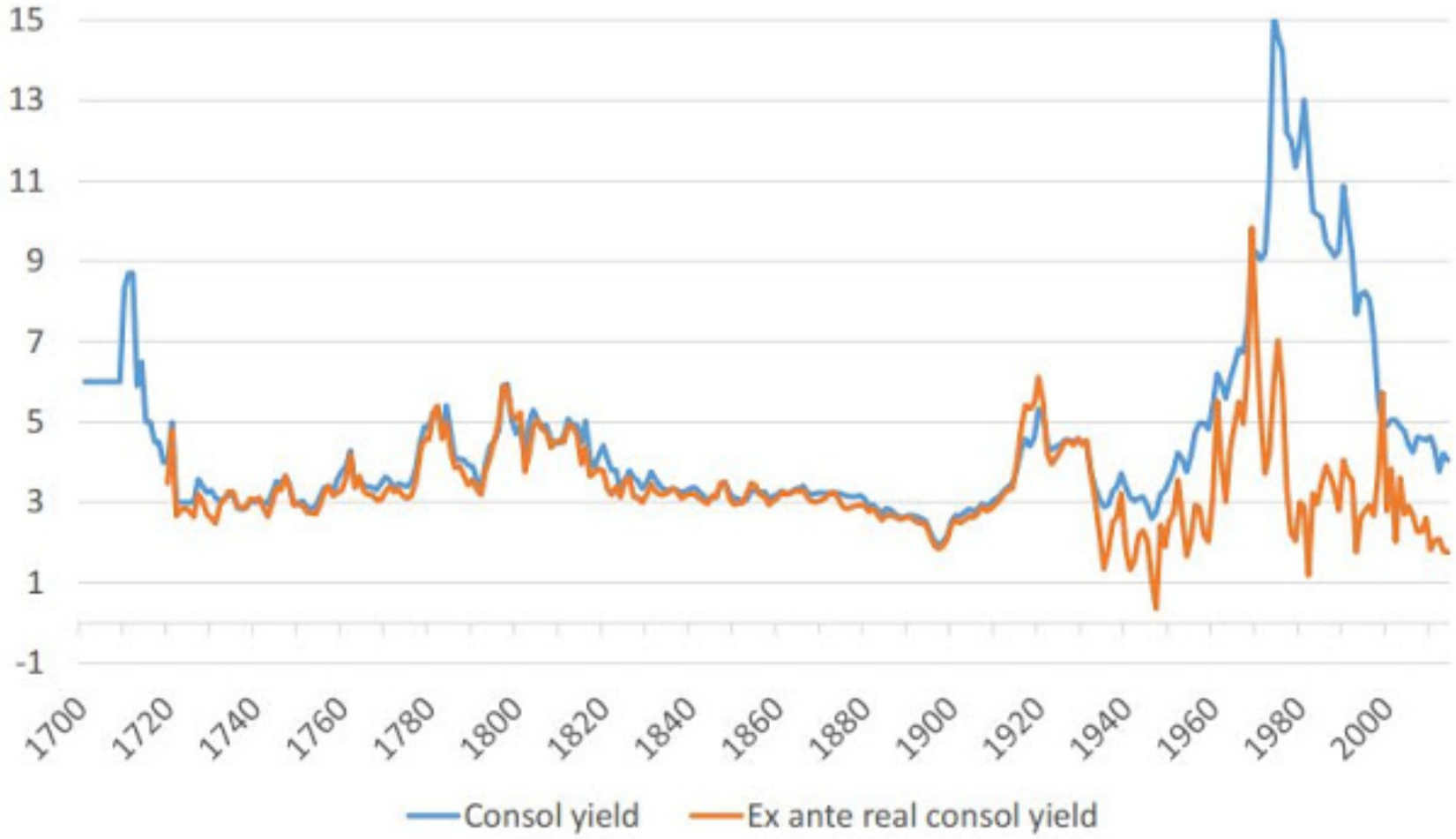
(as calculated by subtracting realized inflation)



Real interest rates
(realized vs. forward looking)



300 years of UK nominal and real long-term yields



The New York Times | http://nyti.ms/1R3ugSw

ECONOMY

Fed Slows Down on Plans to Pursue Interest Rate Increases

By BINYAMIN APPELBAUM MARCH 16, 2016

WASHINGTON — The Federal Reserve has once again pared its plans for raising interest rates, citing the weakness of the global economy as a reason for greater caution about the prospects for domestic growth.

The Fed's policy-making committee voted not to raise its benchmark rate at a meeting that ended on Wednesday, although general expectations at the beginning of the year were for an increase this month. And it pulled back sharply from a December prediction that the rate would rise by one percentage point this year. Fed officials now expect to raise rates by just half a percentage point this year.

The Fed's Statement

"The committee expects that economic conditions will evolve in a manner that will warrant only gradual increases in the federal funds rate; the federal funds rate is likely to remain, for some time, below levels that are expected to prevail in the longer run."

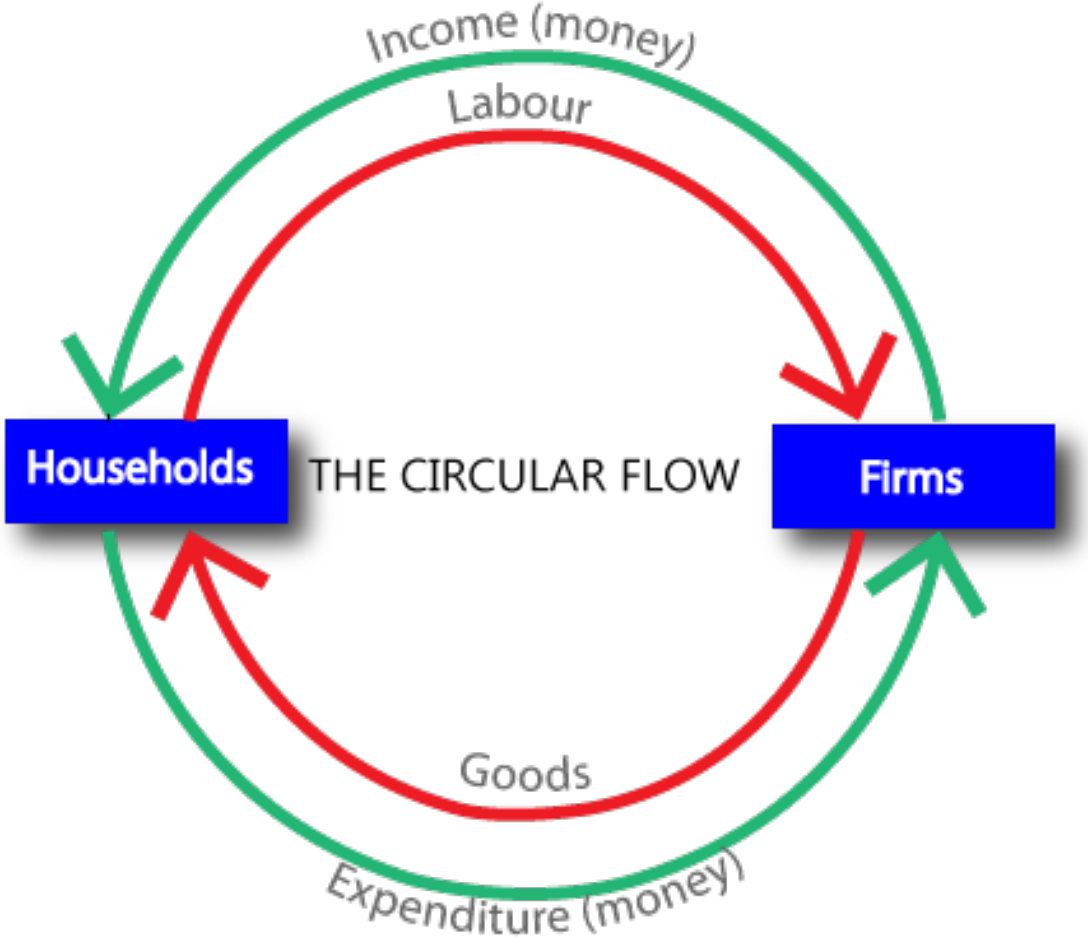
THE NEO-CLASSICAL THEORY OF MONETARY POLICY

(OF MILTON FRIEDMAN, PAUL SAMUELSON, ETC.)

Potential Output

- Suppose initially that every worker is employed
  - GDP is $100 billion
  - Workers take home $100 billion in wages, spend $100 billion on consumption or investment goods/services
  - Thus creating the demand to employ themselves.
- Potential Output is $100
  - Because it's the maximum supply of goods and services given the current technology, education levels, natural resources, etc. of the country
  - It's GDP at full-employment & with stable inflation

An economy at full-employment



Actual vs. Potential Output

- Now a “shock” (like tighter monetary policy or a financial crisis) throws 10% of people out of work
  - Now, 10% of people don’t have an income, don’t consume.
  - So workers only spend $90 billion on consumption or investment goods/services.
  - Thus only creating the demand to employ 90% of workers.
  - GDP is now $90 billion

- 10% of workers are stuck on the sidelines (unemployed)
  - Even though they have the capacity to produce useful goods/services and would create demand for their own labor if they were employed in the first place.
  - A “chicken-and-egg” problem

“This is a nightmare, which will pass away with the morning. For the resources of nature and men’s devices are just as fertile and productive as they were.

“The rate of our progress towards solving the material problems of life is not less rapid. *We are as capable as before* of affording for every one a high standard of life—high, I mean, compared with, say, twenty years ago—and will soon learn to afford a standard higher still. We were not previously deceived.

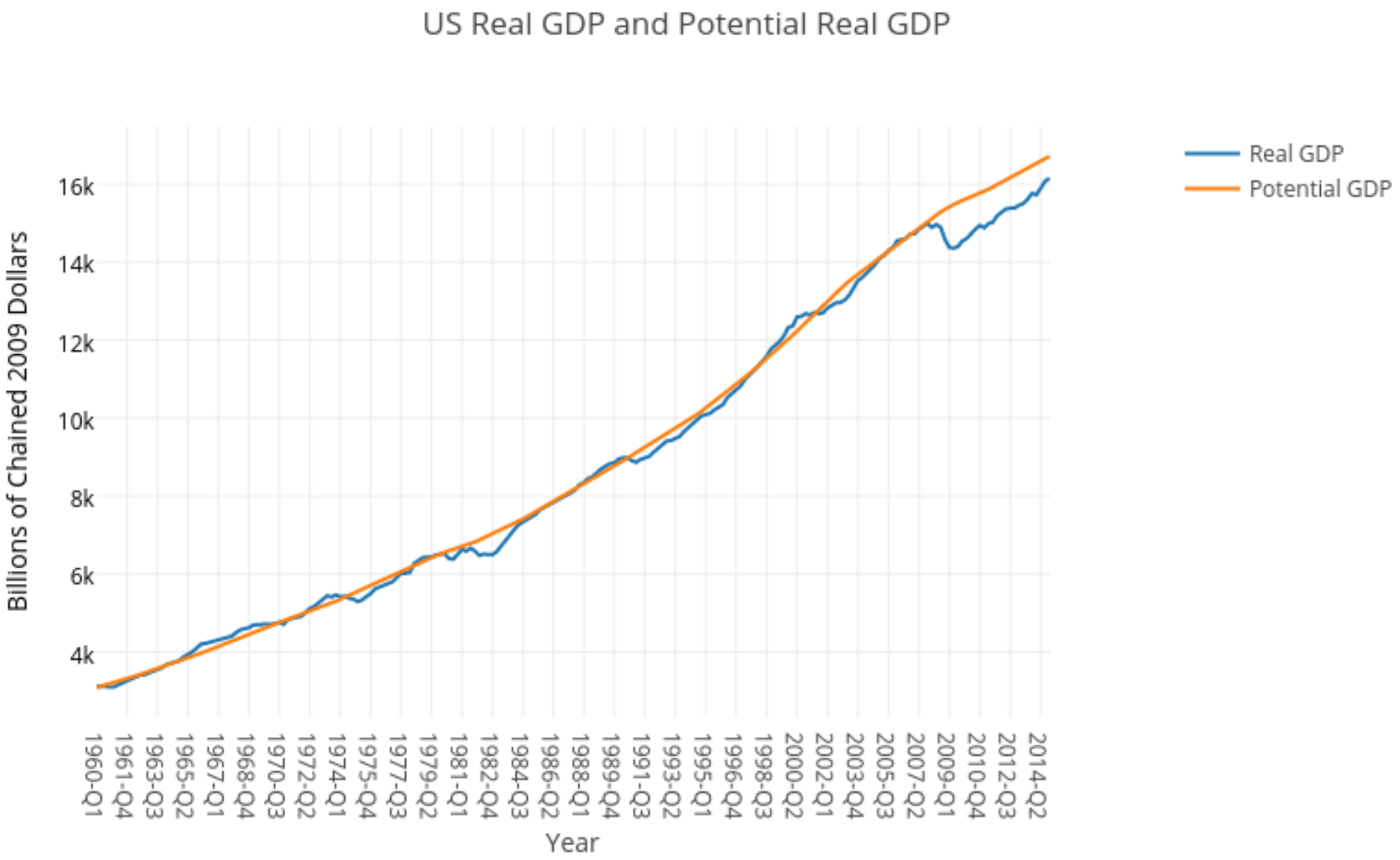
-- John Maynard Keynes
ESSAYS IN PERSUASION: THE GREAT SLUMP OF 1930

"But to-day we have involved ourselves in a colossal muddle, having blundered in the control of a delicate machine, the working of which we do not understand. The result is that our possibilities of wealth may run to waste for a time—perhaps for a long time…

"The machine would merely have been jammed as the result of a muddle. But because we have magneto [car engine] trouble, we need not assume that we shall soon be back in a rumbling waggon and that motoring is over."

-- John Maynard Keynes

ESSAYS IN PERSUASION: THE GREAT SLUMP OF 1930


US Real GDP and Potential Real GDP
Billions of Chained 2009 Dollars
16k
14k
12k
10k
8k
6k
4k
1960-Q1
1961-Q4
1963-Q3
1965-Q2
1967-Q1
1968-Q4
1970-Q3
1972-Q2
1974-Q1
1975-Q4
1977-Q3
1979-Q2
1981-Q1
1982-Q4
1984-Q3
1986-Q2
1988-Q1
1989-Q4
1991-Q3
1993-Q2
1995-Q1
1996-Q4
1998-Q3
2000-Q2
2002-Q1
2003-Q4
2005-Q3
2007-Q2
2009-Q1
2010-Q4
2012-Q3
2014-Q2
Year
Real GDP
Potential GDP

Cyclical vs. structural

- Cyclical Unemployment is short-term unemployment due to recessions
  - Usually due to Keynesian factors
  - As discussed on the previous slides
- Structural Unemployment is long-term unemployment
  - Due to “real” labor market rigidities

“Cyclical” Unemployment

- Unemployed workers are temporarily stuck on sidelines
  - Though they have the capacity to produce useful goods/services
  - Would create demand for own labor if they were employed in the first place.
  - A “chicken-and-egg” problem
- Initial shocks
  - tighter monetary policy (to fight inflation)
  - financial crises
- Solutions:
  - Monetary policy and fiscal policy
  - You can get “something for nothing” simply but putting workers on the sideline back into productive capacity

"Structural" Unemployment

Due to long-term "real" labor market rigidities, such as:

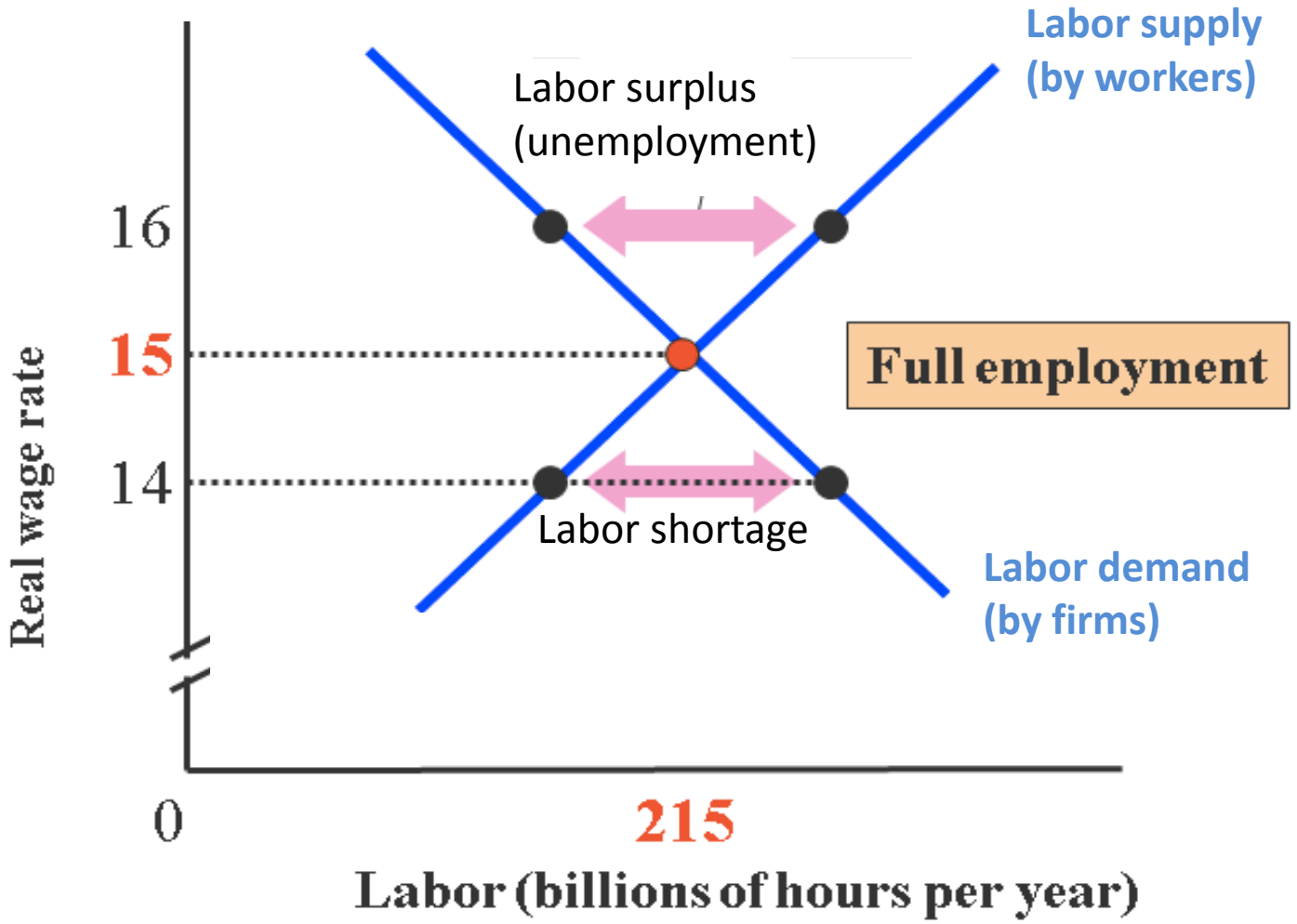
1. Higher costs of inputs (e.g. oil shocks)
2. Increased regulations, taxes, unions, & other labor market "rigidities"
3. Skill mismatch (factory workers unable to transition to high-tech)
4. Geographical mismatch (workers in Detroit don't to move to Texas)
5. Demographic changes (retirement of the workforce)
6. Overhang of poor past investment choices (e.g., housing bubble)

- Solutions:
  - Monetary and fiscal policy won't work (will just create inflation without increasing output)
  - Need to implement structural reforms

"Cyclical" theories of unemployment require "sticky price" frictions

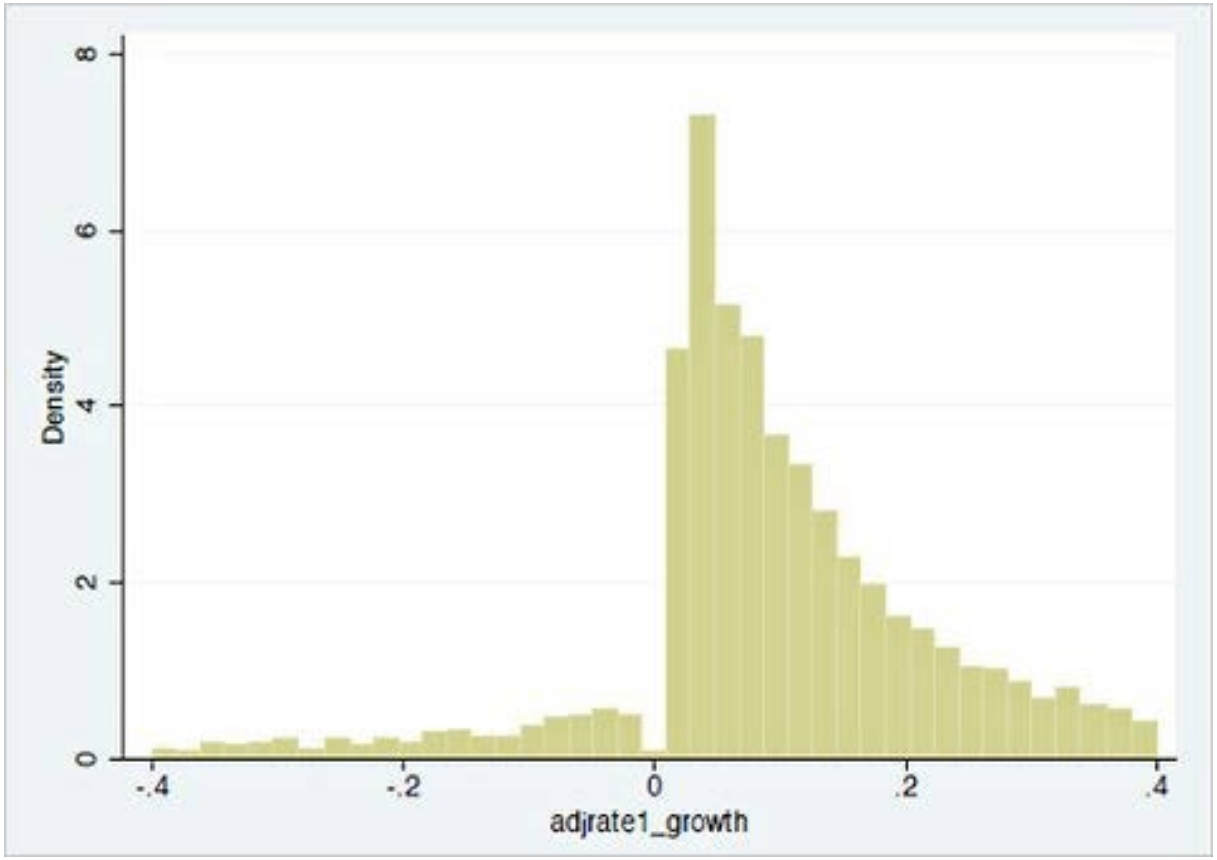
- When there's unemployment:
  - Supply of labor (by workers) is too high
  - Demand for labor (by firms) too low
  - Supply ≠ Demand
- However, if wages can fall
  - Then Supply = Demand, and economies can restore full-employment
  - So why doesn't this happen?
- Cyclical theories need wages to be inflexible in the short-run
  - Consistent with empirical evidence
    - Nominal wages rarely fall, even in recessions, so the price mechanism can't work to restore full employment
  - Suggests that slightly higher inflation can lead to a fall in real wages (if nominal wages are flat), helping to restore full employment

Supply and Demand for Wages



Downward Nominal Wage Rigidities

Distribution of non-zero wage changes, hourly workers in the U.S., 1996
(from Barattieri, Basu, and Gottschalk, 2010)

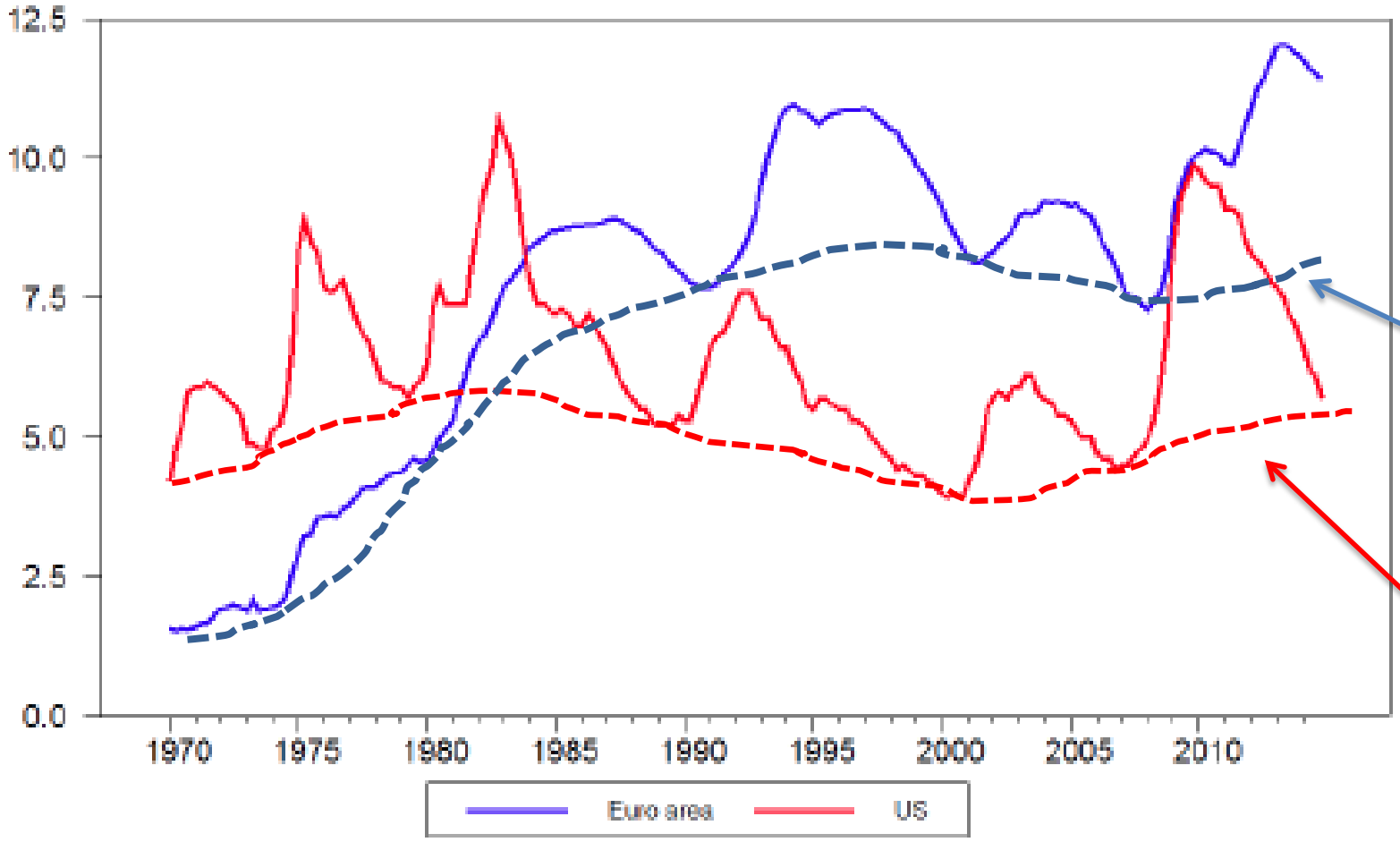


Maximum employment

- The lowest unemployment you can get without creating inflation ("full employment") is called the NAIRU
  - Non-Accelerating-Inflation-Rate of Unemployment
  - Thought to be currently ~4-5% for the U.S.
  - Potential Output is the GDP measured at the NAIRU

- Economies with less "rigid" labor markets will have lower NAIRUs (and hence higher potential output)

Figure 1. Unemployment Rate: United States vs. Euro Area



Euro NAIRU

US NAIRU

Different theories for different situations

- *"Cyclical" (Keynesian) explanations* help explain:
  - The Great Depression
  - The recent global Financial Crisis
  - The Volcker Recessions of the early 1980s
    - Fed sharply tightened monetary policy to fight inflation

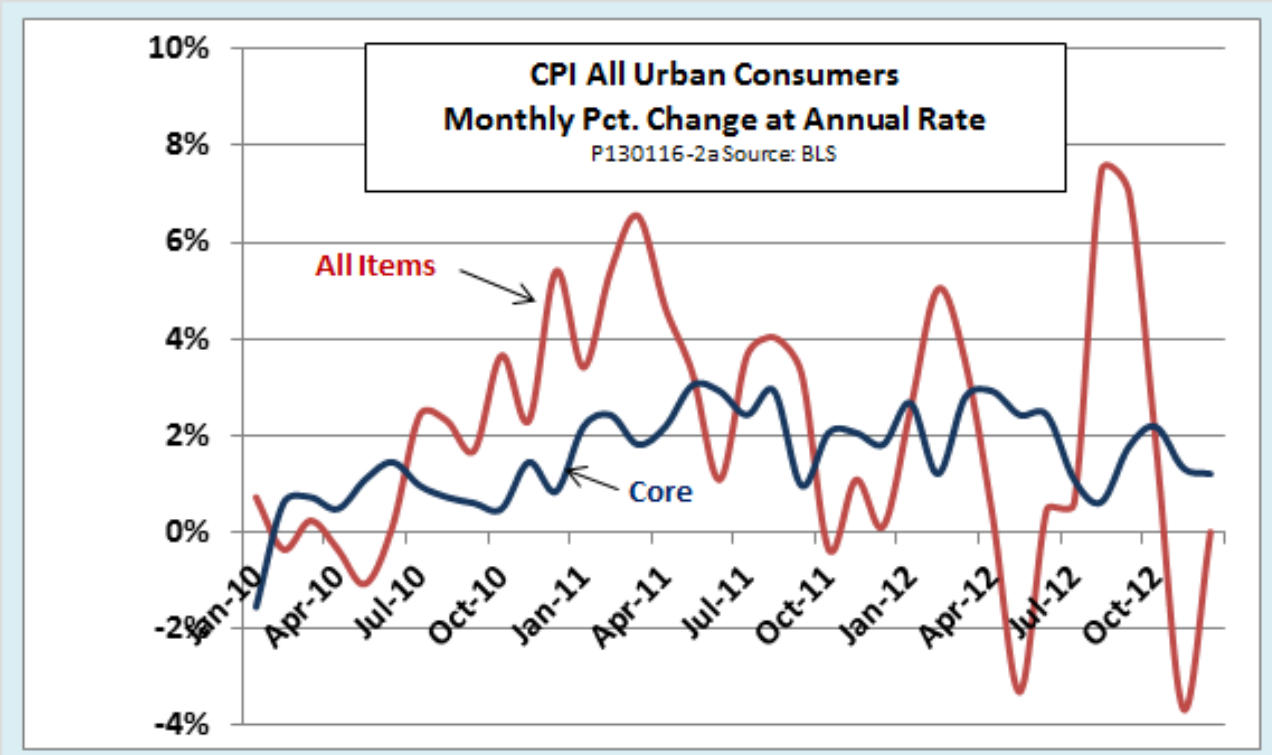
- *"Structural" explanations* help explain:
  - "Stagflation" and oil-shock recessions of the 1970s in the U.S.
  - High long-term unemployment in Europe in the 1980s-90s

Inflation

- A general rise in the price level
  - Both wages and prices increase simultaneously
  - It's a rise in the units in which value is measured
  - Fed's preferred measure is the price inflation measure for:
    - "Core" Personal Consumption Expenditures (PCE)
- If prices go up but wages are stagnant
  - That's not really inflation
  - That's the real cost of goods increasing
    - i.e. living standard declining

The Fed looks at Core Inflation

- "Core" measures *exclude energy and food* because they are highly volatile in the short-term, mean-reverting and don't predict long-term inflation

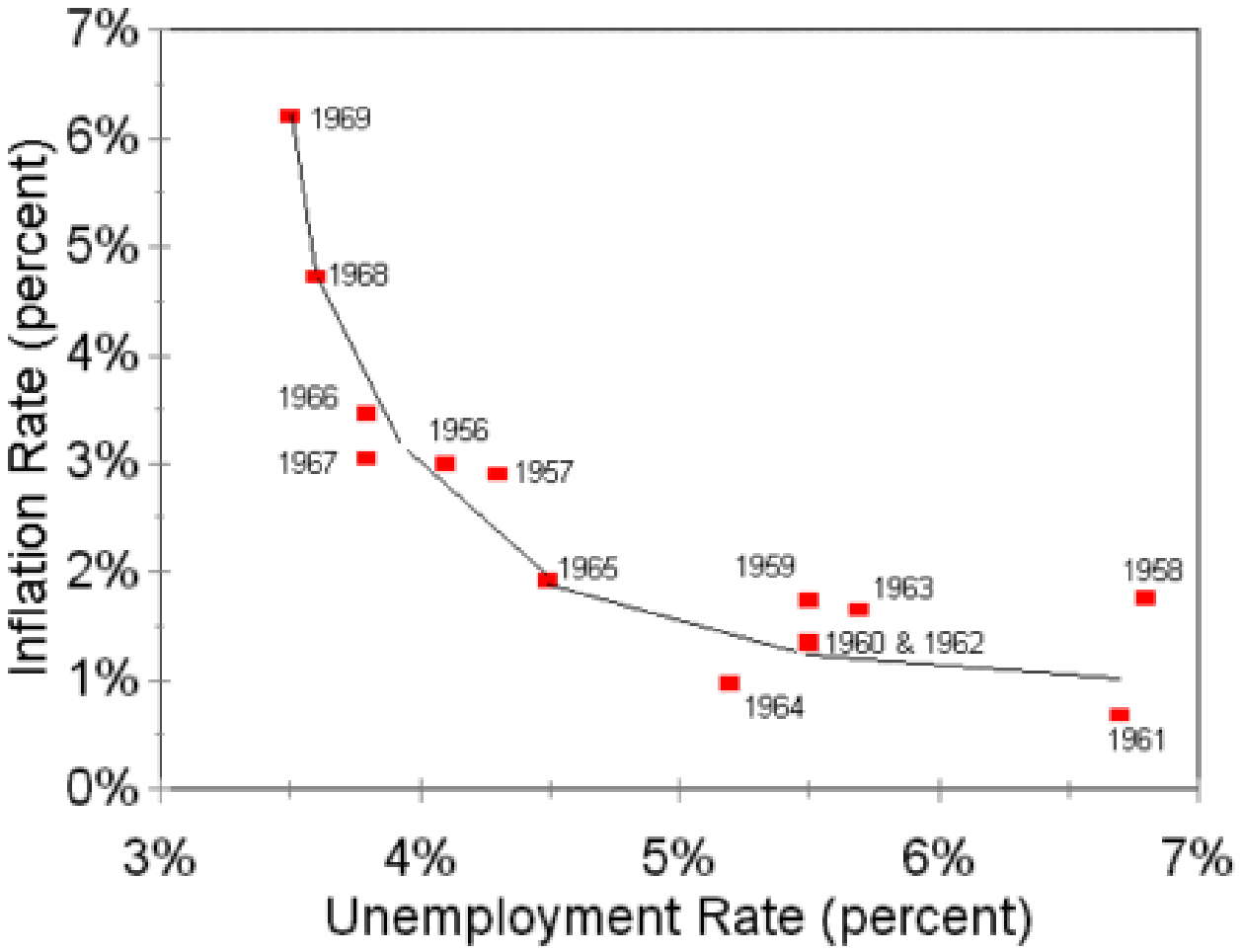


WHAT HAPPENS WHEN THE FED RAISES OR LOWERS INTEREST RATES?

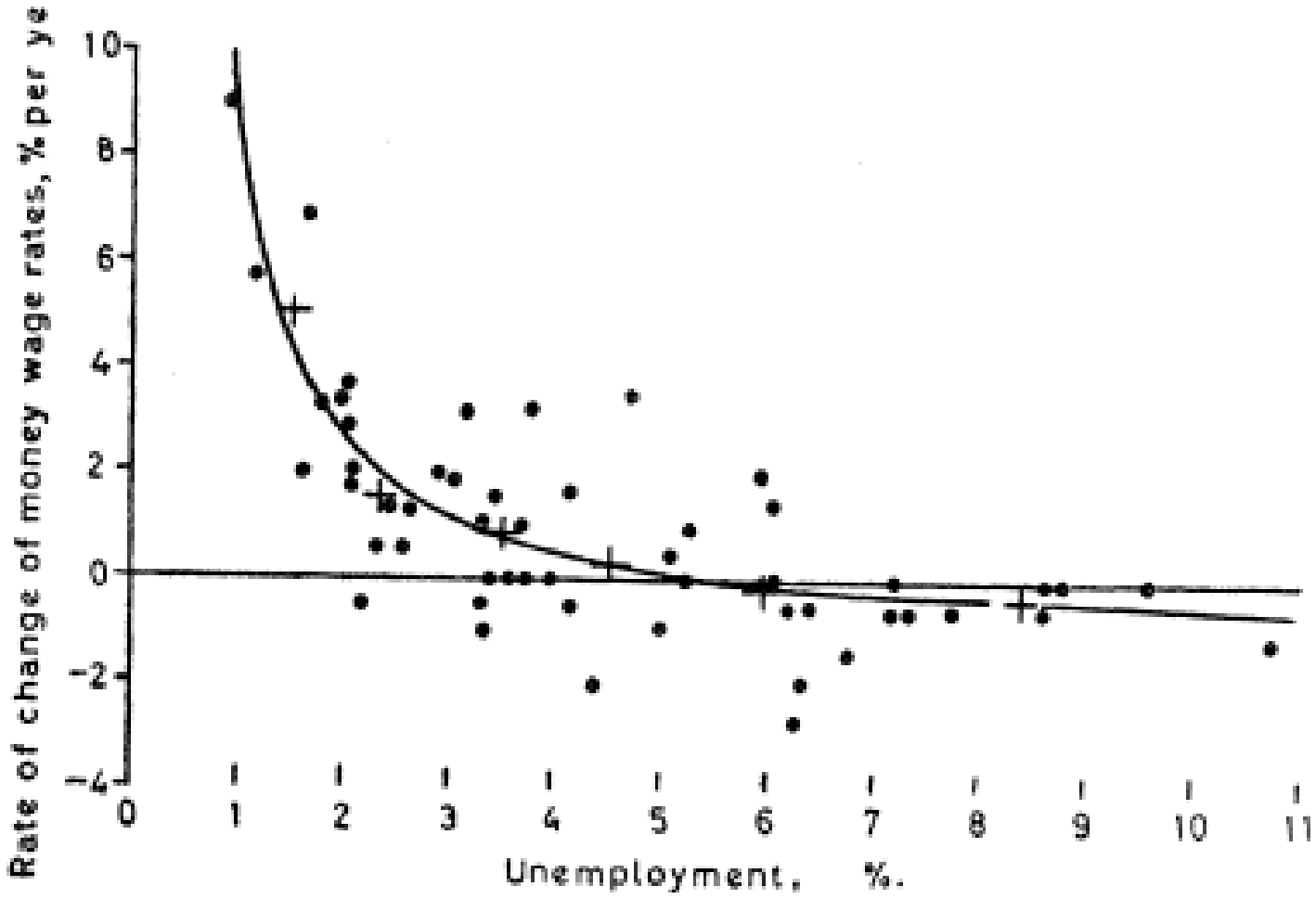
Policy interest rates

- When the Fed raises rates (tightens monetary policy):
  - GDP falls & unemployment increases
  - Inflation decreases
- When the Fed lowers rates (loosens monetary policy):
  - GDP increases & unemployment decreases
    - At least until Potential Output & Full-employment are reached
  - Inflation increases
- The Fed's job is to get the interest rate right
  - To keep inflation stable, while promoting full-employment

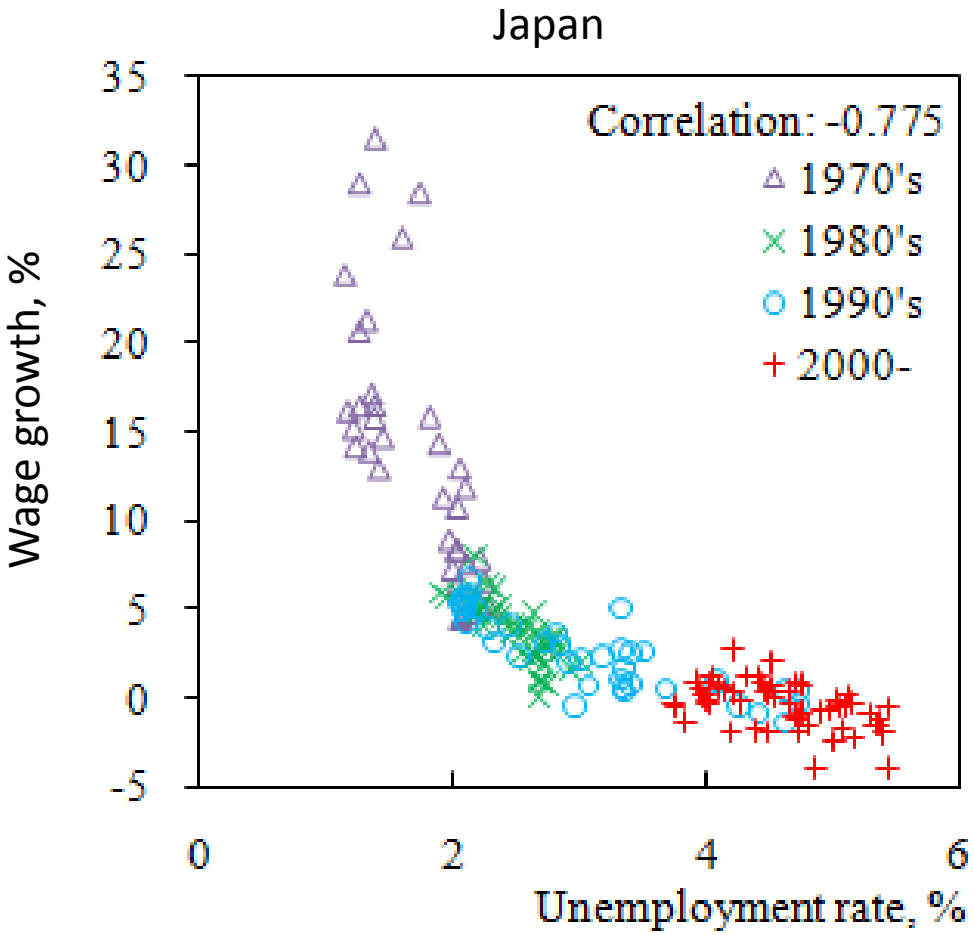
The U.S. Phillips Curve (inflation-unemployment trade-off)



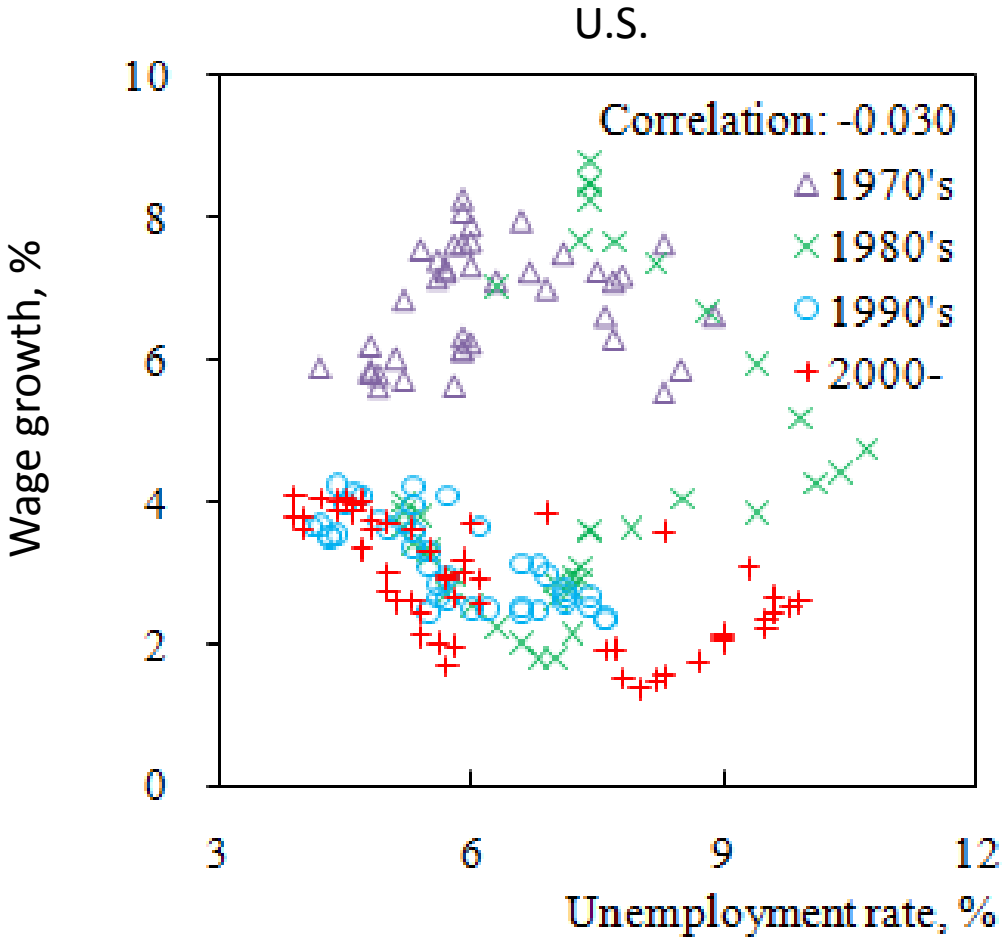
Phillips' original Phillips Curve UK, 1861-1913



Japan's Phillips Curve



Not stable over time in the U.S.

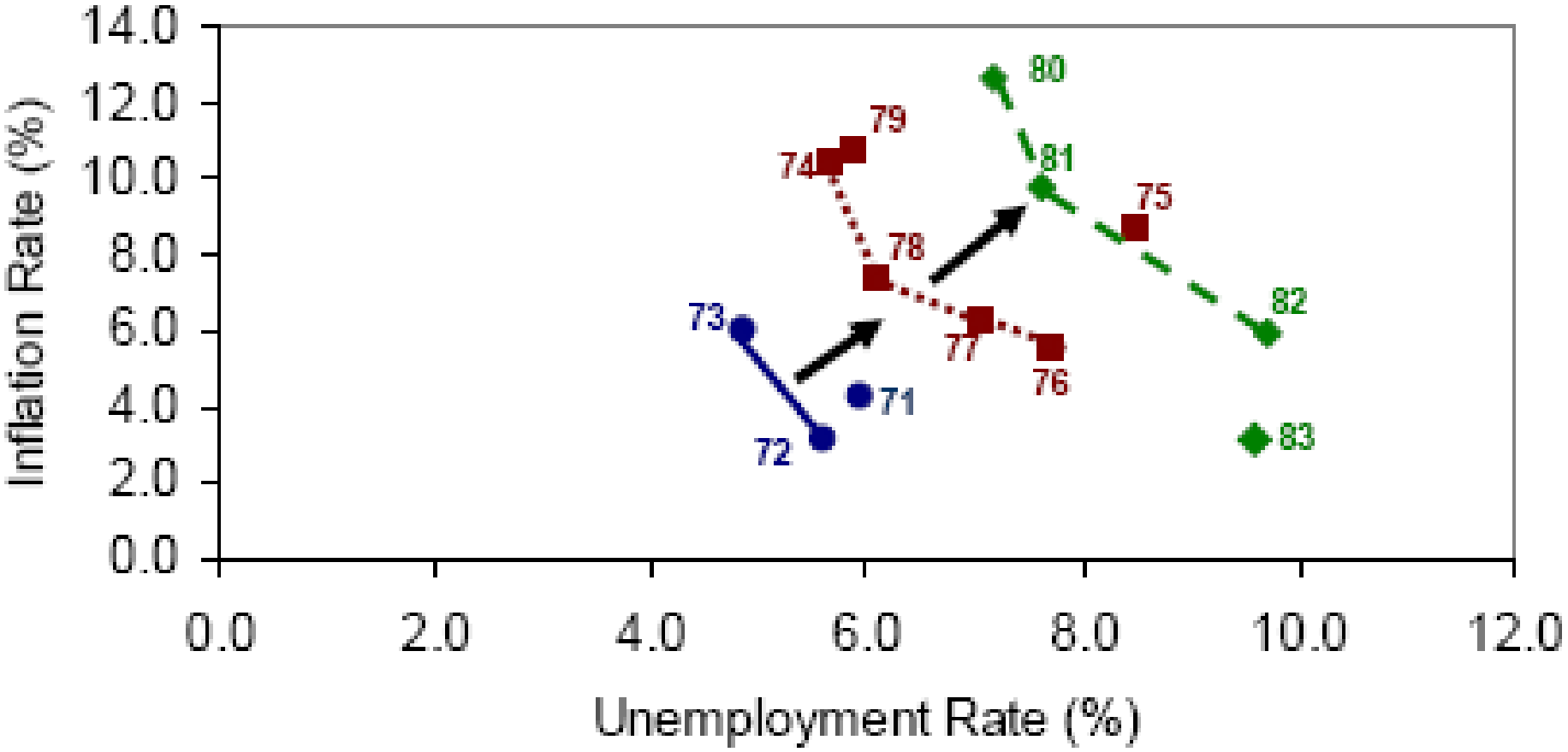


Why isn't the Phillips Curve stable?

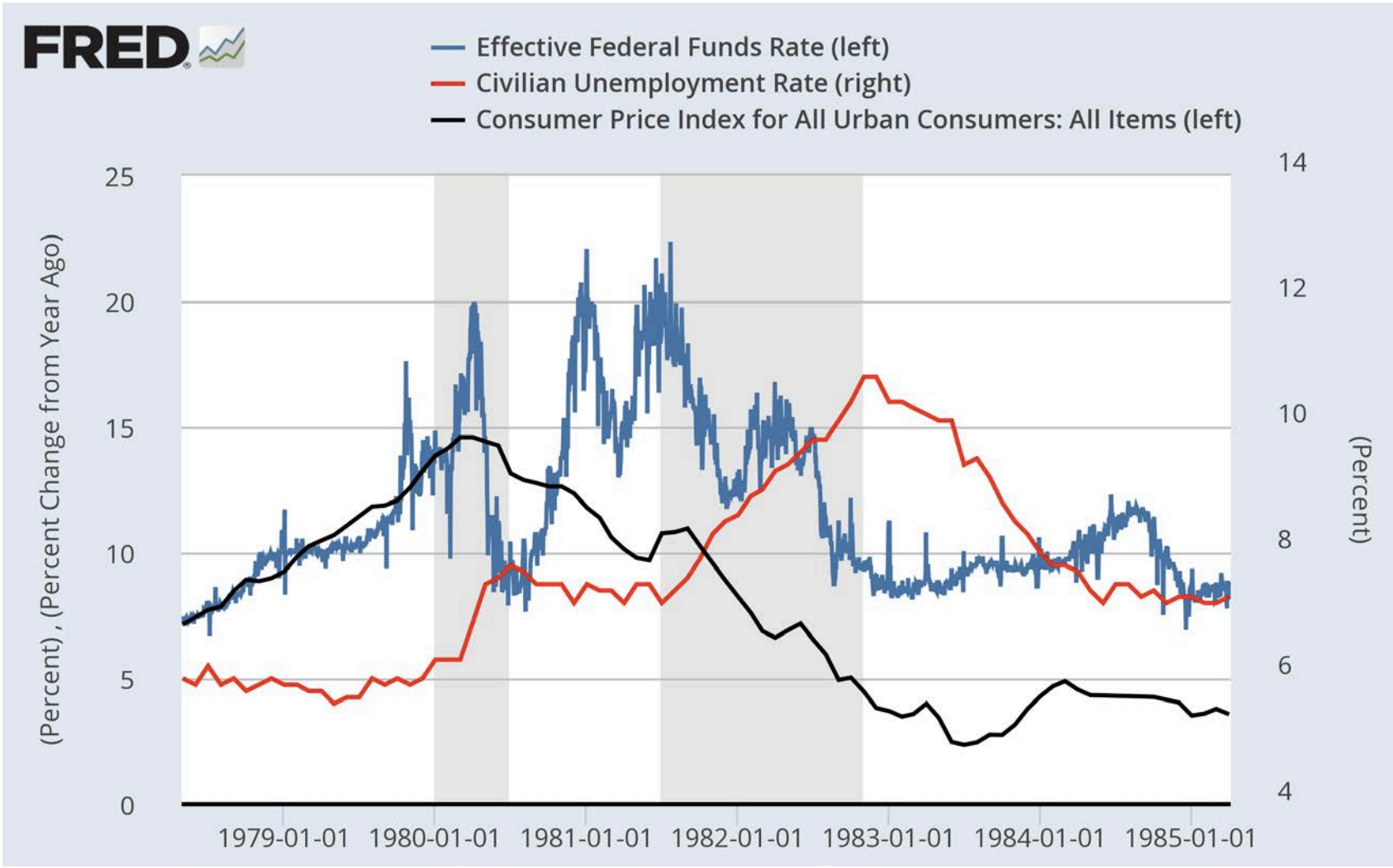
1. Temporarily higher inflation can stimulate the economy temporarily
   - But then this new higher level of inflation becomes the new normal, and you need even higher temporary inflation to continue stimulating the economy
   - Leads to an upward spiral in inflation

2. Also, stimulating the economy can never increase output past "potential output" (or, equivalently, lower unemployment below the NAIRU)
   - Can only work with unemployed workers sitting on the sidelines by putting them back to work
   - After they're put back to work and the economy gets back to potential, more stimulus will just create higher inflation, because there's nobody left to put to work

Because the “normal” inflation level is spiraling upward



The Volcker disinflation



The “Natural” Interest Rate

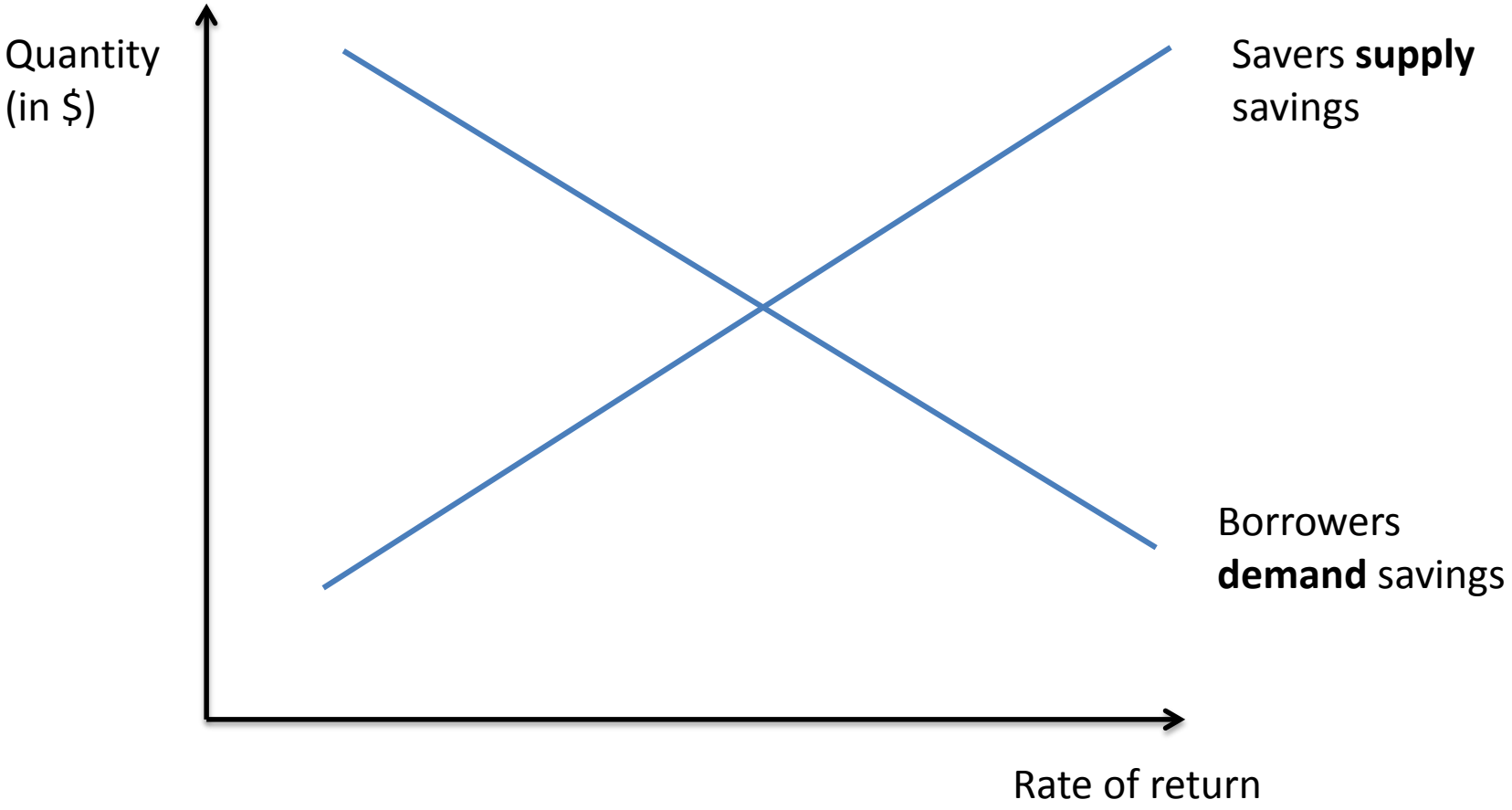
- The interest rate (at each point in time) set by the Fed which would ensure:
  - stable inflation rate (e.g., 2%)
  - and full-employment

The “Natural” Interest Rate

- If the Fed sets the policy rate too high:
  - People will save too much money in cash
  - There will be insufficient demand for goods & services
    - And thus unemployment & disinflation
- If the Fed sets the policy rate too low:
  - People will withdraw and spend too much cash
  - Will results in too much money chasing goods & services
    - And thus inflation
- So the “natural” rate is just right…
- How does the Fed know the “natural” rate?
  - It doesn’t, but it seeks the rate which is consistent with stable inflation and full employment

Financial equilibrium (without money)

Supply and demand of savings

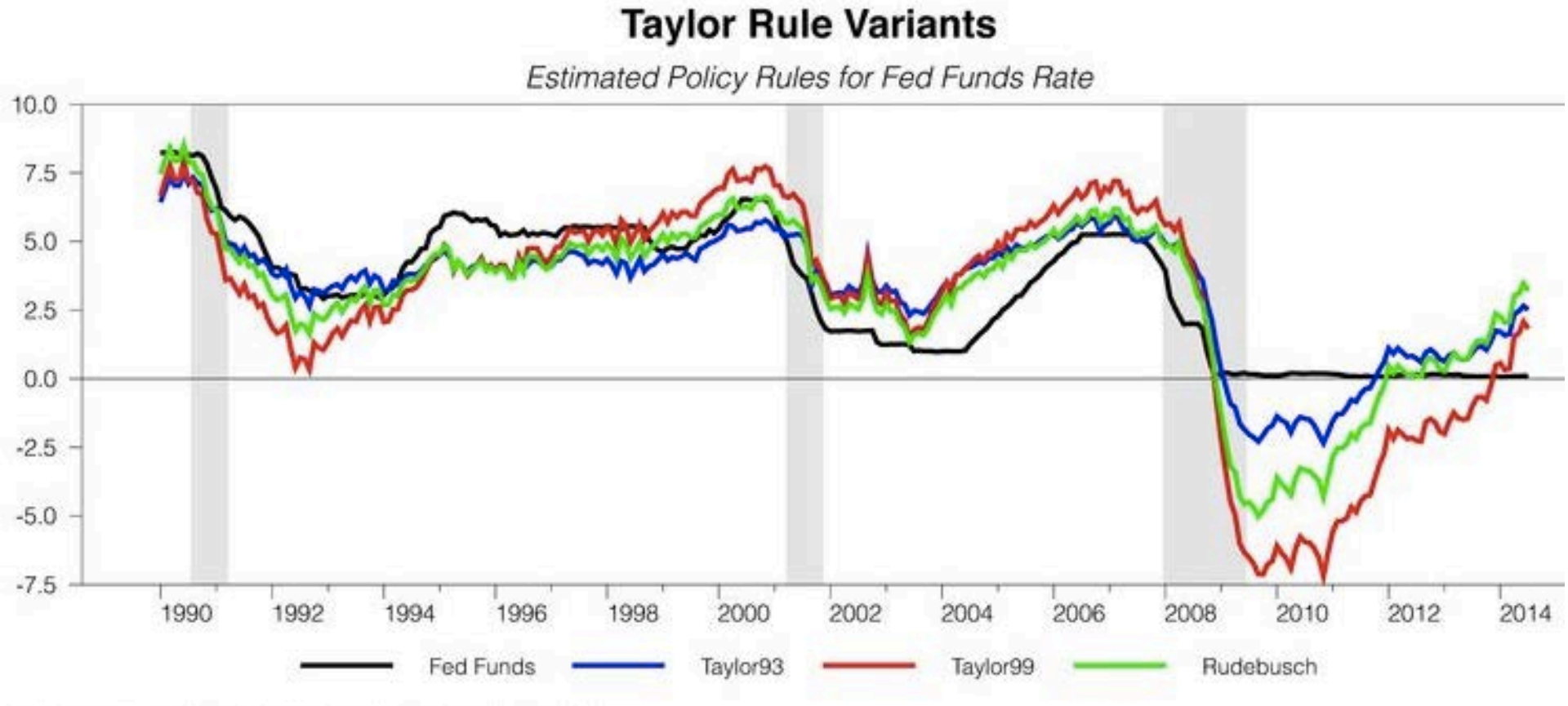


Taylor Rules

- A monetary-policy rule that stipulates how much the central bank should change the nominal interest rate in response to changes in inflation, output, or other economic conditions

$$i = r^* + \pi + a(\pi - \pi^*) + b(y - y^*)$$

  - i = the *policy interest rate*
  - r* = the economy's *long-run real interest rate*
  - $\pi - \pi^*$ = the *deviation of the actual inflation rate π from its target π**
  - $y - y^*$ = the *"output gap,"* the deviation of actual real output y from potential output y*



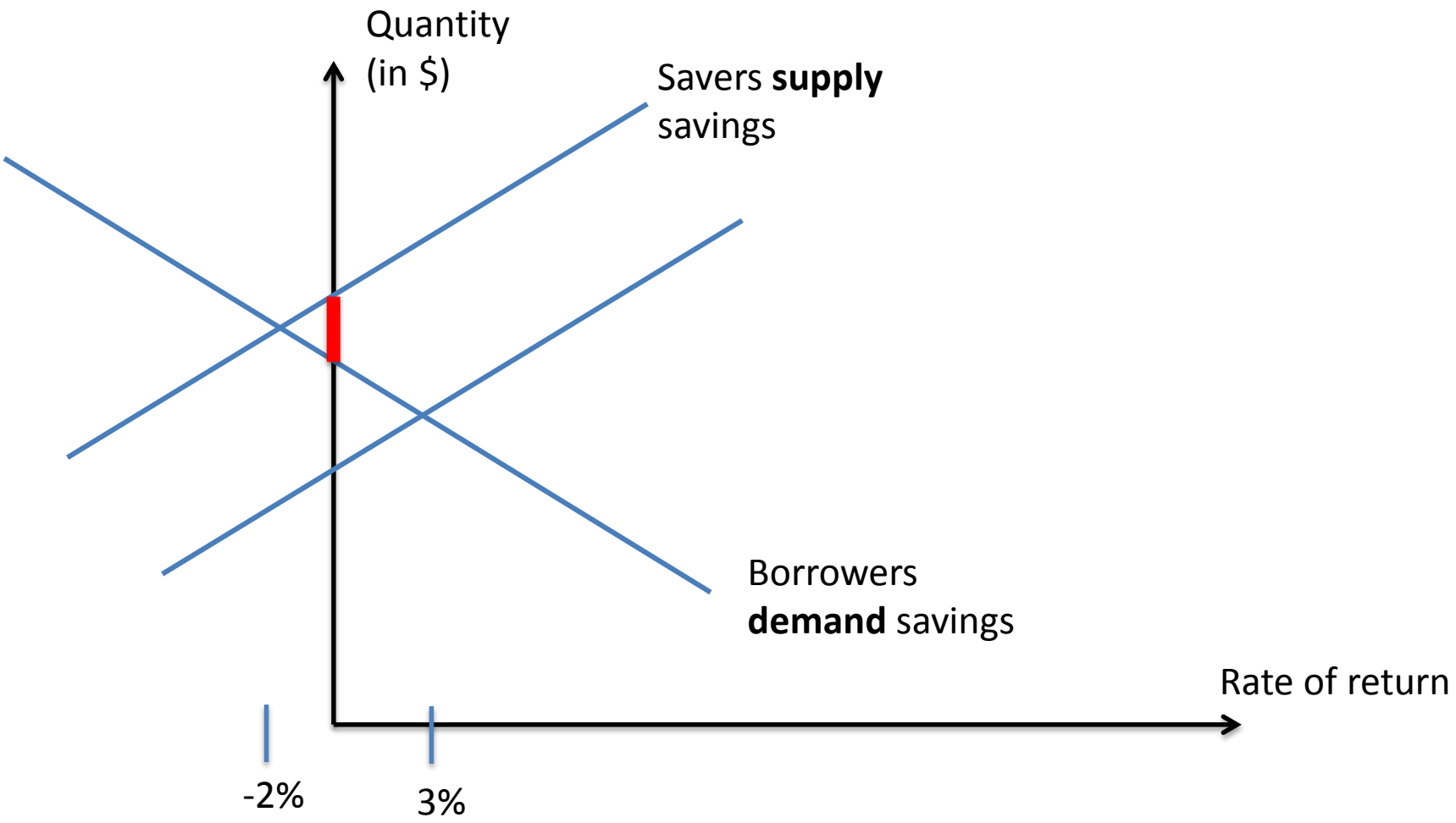
from a Janet Yellen speech, April 11, 2011

The liquidity trap

- Special problem when a recession is so bad that the "natural" nominal rate of interest falls below zero

- The Fed can only lower policy rates to zero, so the Fed's policy rate (at zero) will be greater than the "natural" rate (which is negative)
  - This induces tight monetary policy
  - Will lead to even higher unemployment and lower inflation
    - And this lower inflation will effectively raise the Fed's "real" rate
    - Which will be even more contractionary

Negative natural rate



The liquidity trap

- So there's no way to use monetary policy to stimulate an economy in such a situation
  - And the economy can be stuck in a permanent recession
  - Japan has been stuck in a 25 year recession after hitting the zero-lower bound
  - Europe might now be in a permanent recession too.

- You can try non-traditional tools to get out of a liquidity trap, but there's no guarantee this will work:
  1. Fiscal stimulus
  2. Quantitative easing
     - Asset purchases of the central bank
  3. Convincing people that there will be higher inflation in the future
     - Which will lower the central banks "real" interest rate, and therefore will be stimulatory

Practical questions

- Does lowering interest rates increase or decrease the price of…
  - Stocks?
  - Bonds?
  - The country's currency?

- What will (should) Janet Yellen and the FOMC do next?

THE “IS-LM” MODEL OF MONETARY POLICY

The IS-LM set-up

- A monetary model with three things:
  1. Goods and services (for immediate consumption)
  2. Real investments (e.g., factories)
  3. Money (or a safe asset)

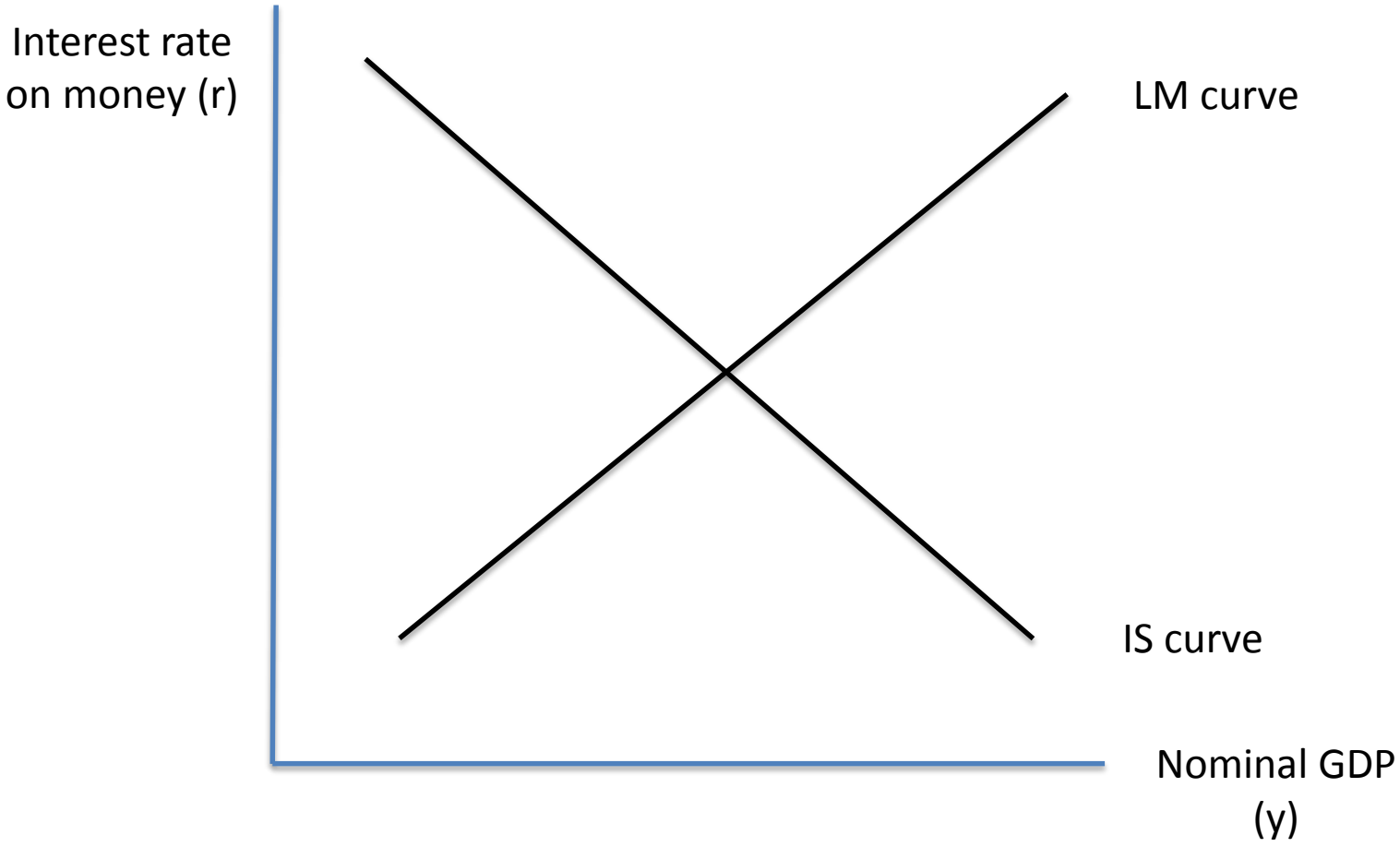
- Money is used both for storing value and for transactions
  - People need money to buy goods & services and real investments
  - We will assume “sticky price” frictions (in the short-run), so the price of goods & services and real investments is fixed
    - That is, you need $1 of money to buy 1 unit of stuff (and this is fixed)

- If too many people store money “under the mattress”, then there won’t be enough money for transactional purposes

Interest rates

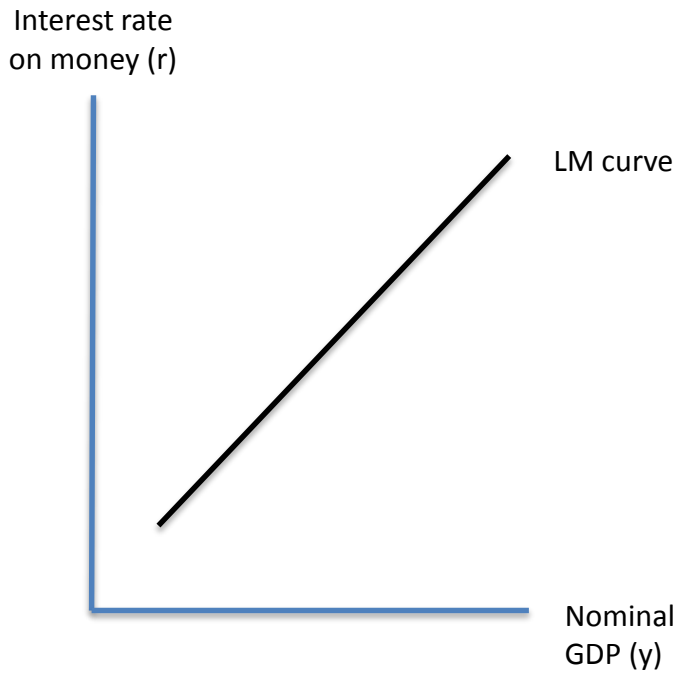
- Suppose you got interest on your cash by storing it at the central bank (CB)
  - That is, if you deposit $1 into the central bank's vault, you get $(1+r) tomorrow
- If the interest rate was high, would you be more or less likely to save paper money?
- Therefore, the CB raising interest rates leads to a contraction of the money supply
  - Since people deposit more paper money in the CB's vaults
  - Reduction in the circulation of money
    - Thus, less economic activity& lower inflation

Back to the IS-LM Model



The LM (liquidity-money) curve

- LM curve is upward-sloping
  - If there's increased economic activity
  - Then, there's more demand for money needed for transactional purposes
  - Then, there's a higher interest rate on cash
    - Since people who need to borrow cash to facilitate payments will bid up the rate
- L(r,y) = M
  - L = liquidity demand function
    - increasing in Y, and decreasing in r
  - M = fixed money-supply

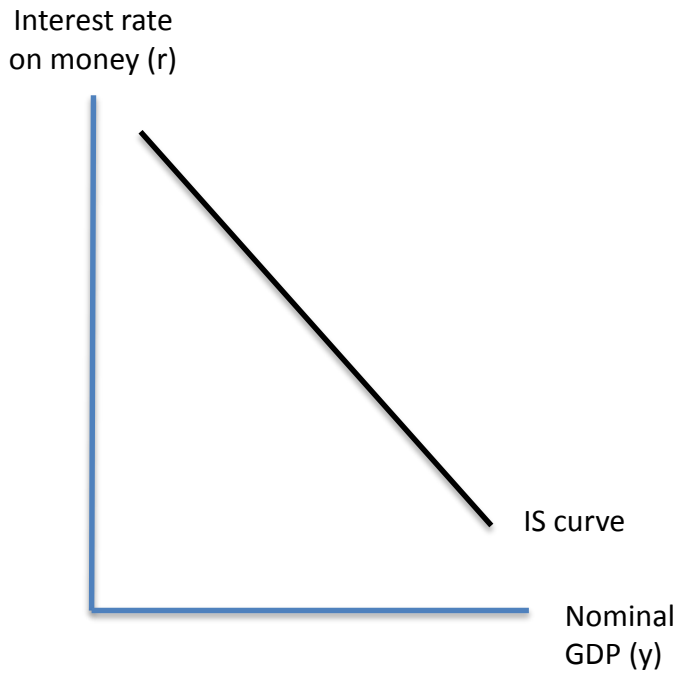


Money vs. real investments

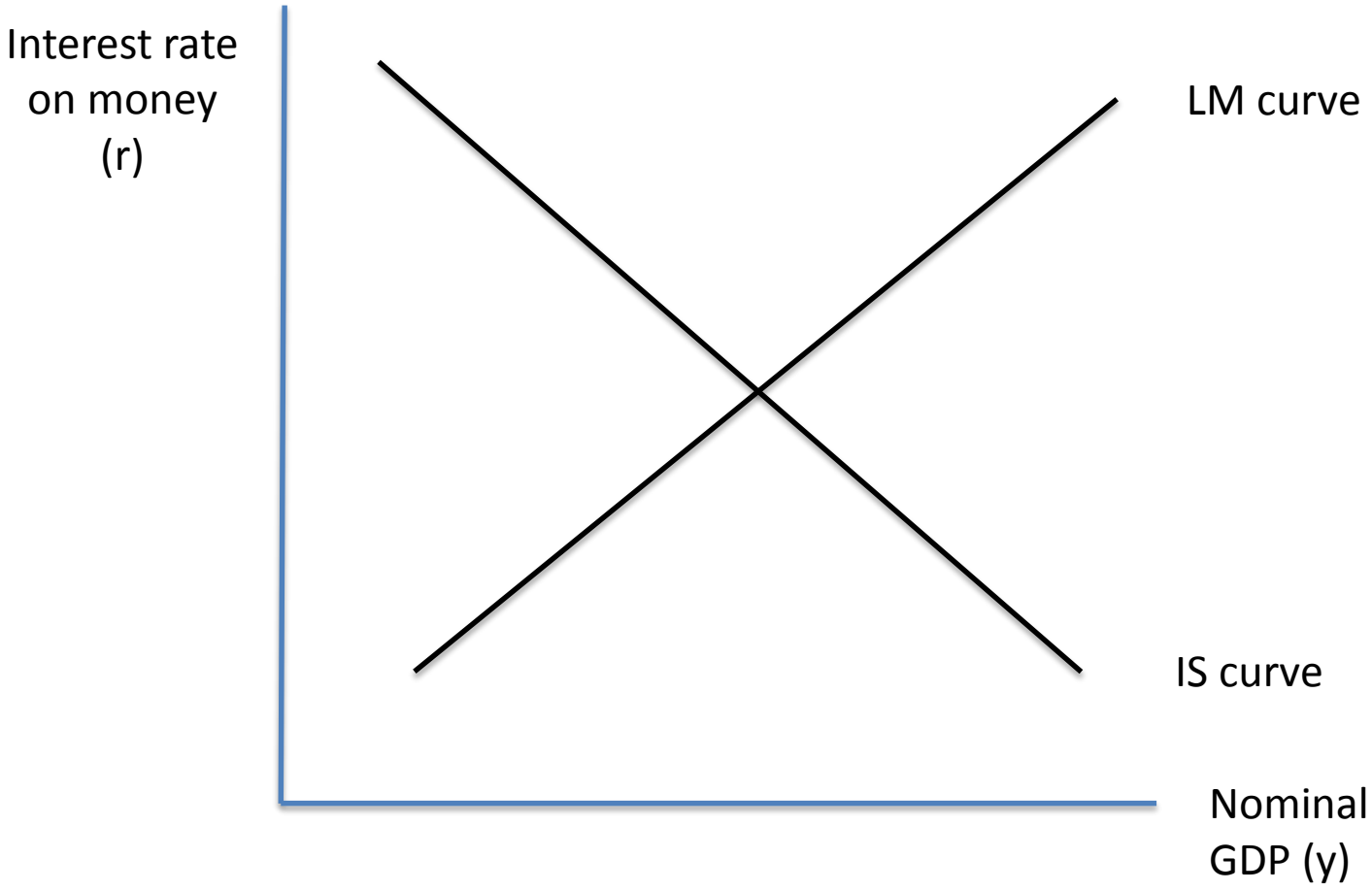
- Assume that real investments earn a fixed interest rate (say 5%)
  - Which is independent from the interest rate on money
- Assume that cash parked at the central bank earns r
- If r increases,
  - Would you want to increase your cash holdings or your holdings of real investments?

The IS (investment-savings) curve

- IS curve is downward-sloping
  - Cash (earning r) and real investments (earning a fixed 5%) are substitutes
- If there's a higher interest rate on cash
  - Then, investors hold more cash and make real investments
  - Which lowers aggregate demand and economic activity
- y = C + I(r) + G + NX
  - GDP can be decomposed into
  - Real Investments I
    - decreasing function of the interest rate on cash (r)
  - Consumption (C), Gov't purchases (G), and Net Exports (NX)
    - Assumed to be constants here



Putting this all together



Why is this useful?

- Used to explain the impact of policy changes
  - Monetary policy (increases or decreases of the money supply)
  - Fiscal policy (increased or decreased government purchases or taxes)
- Helps understand why monetary policy is ineffective at the zero lower bound

Policy experiments

- What happens if private consumption (C) decreases?
- What if government spending G increases?
- What happens if the exchange rate falls so that net exports (NX) increases?
- What is the money supply (M) increases?

Policy experiments

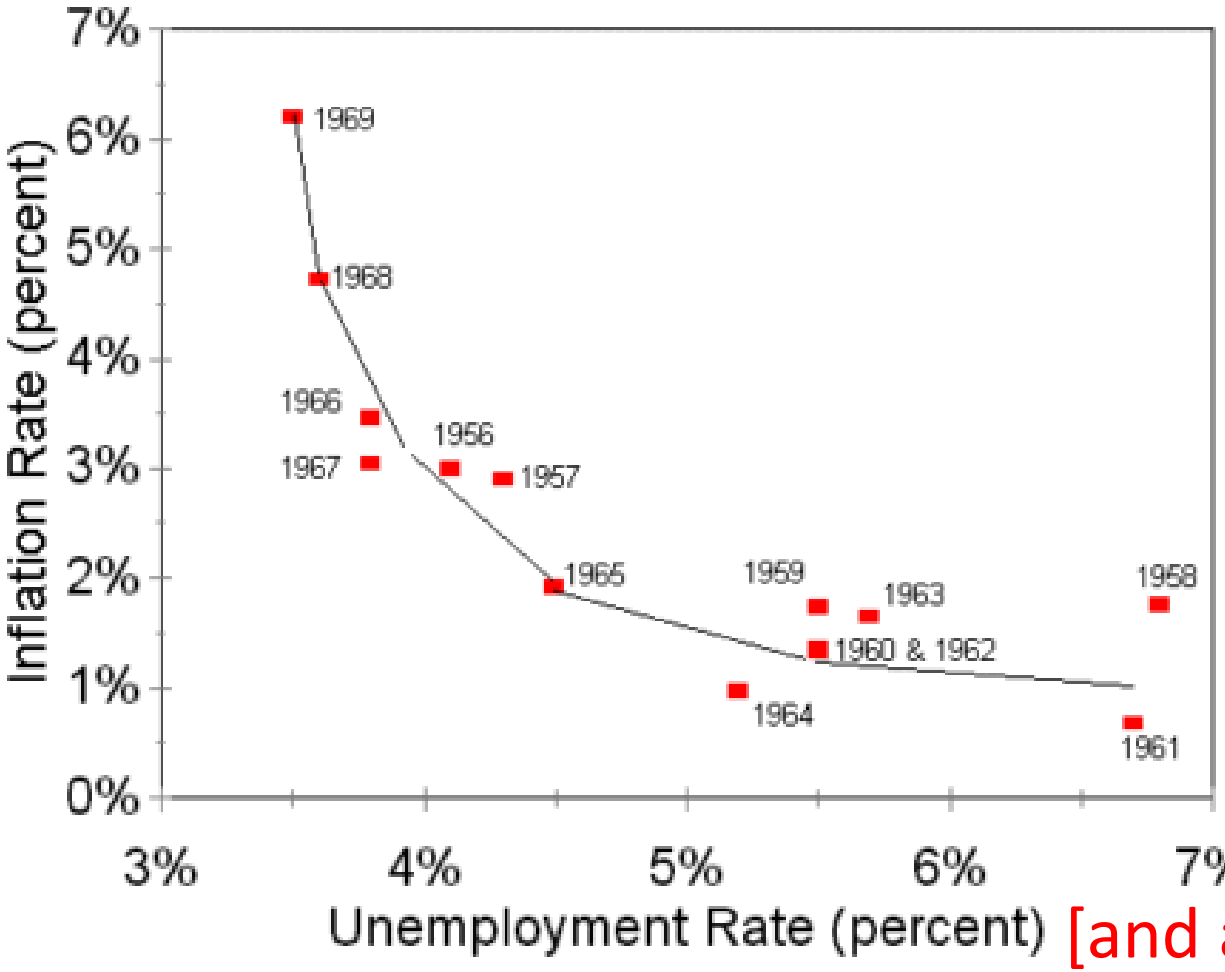
- What if real investments becomes more sensitive to the central bank's interest rate?
  - How does the new equilibrium compare to before if the money supply (M) increases?
- What if there's a zero lower bound?
  - What happens if the money supply (M) increases?
  - If government spending increases (G)?

Things to note about IS-LM

1. In the model, the CB chooses the money supply M and the economy generates the resulting interest rate on cash r
   - In the U.S. today, it's the reverse

2. The model shows how fiscal or monetary stimulus can raise *Nominal* GDP
   - Nominal GDP can be raised either by:
     - Increased real GDP
     - Increased inflation
   - The IS-LM model doesn't tell you which
   - But we can think of this being determined by a Phillips curve
     - Initially the effect is mostly to raise GDP (by putting people back to work)
     - After we reach full-employment (and potential output), it just causes inflation

The U.S. Phillips Curve (inflation-unemployment trade-off)



[and also GDP]

THE BANK BALANCE-SHEET VIEW OF MONETARY POLICY

The neo-classical theory does a pretty good job of describing the macroeconomy, but certain issues remain:

1. The neo-classical theory says that interest rates are the main relevant tool for influencing inflation & employment
   - So why did the Fed embark on Quantitative Easing (i.e. policies to expand the CB balance sheet)?

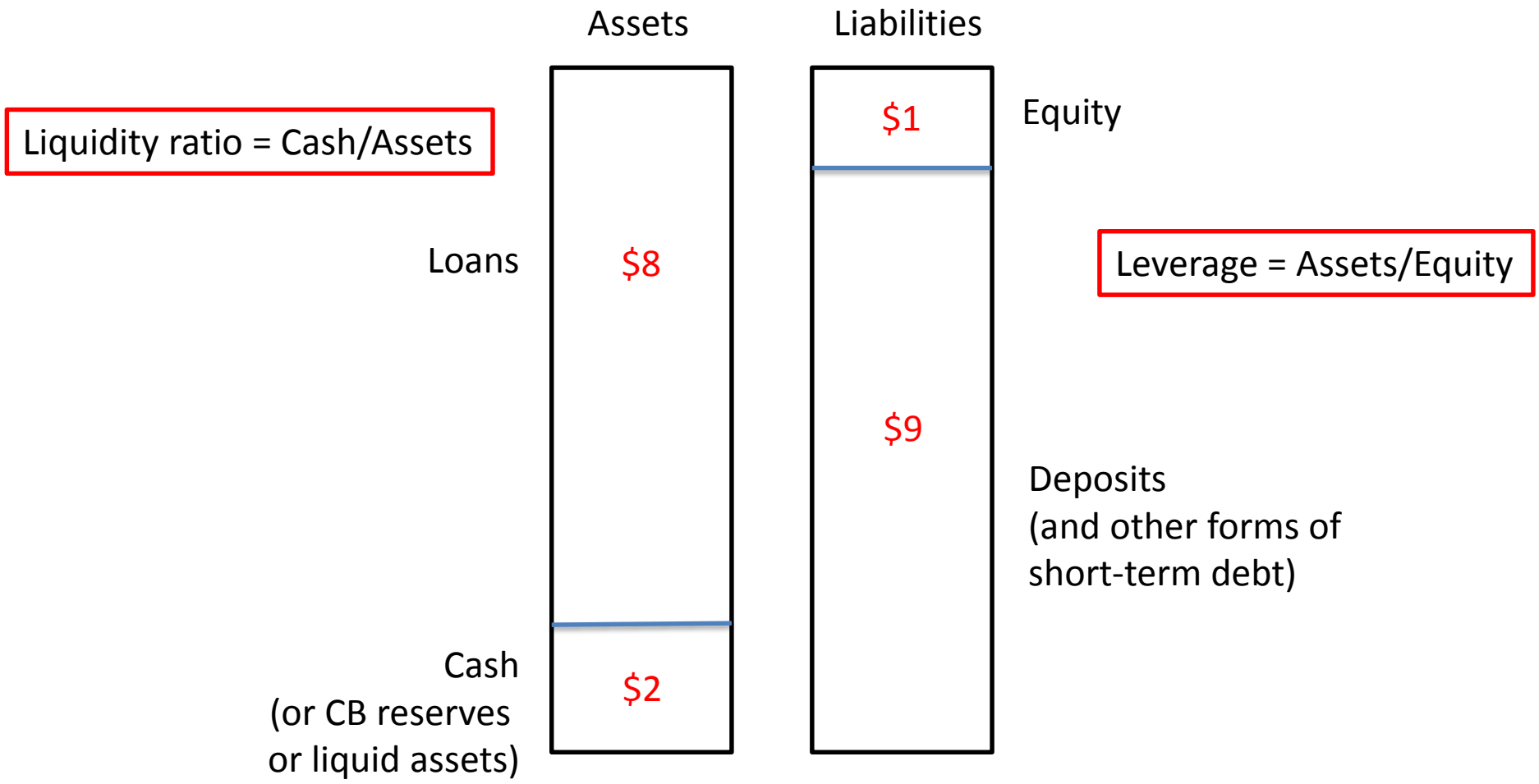
2. The neo-classical theory doesn't say anything about financial crises and the banking sector
   - Why they might affect GDP and inflation?
   - How can monetary policy be used to fight financial crises and mitigate the effects of a bank lending contraction?

The neo-classical theory does a pretty good job of describing the macroeconomy, but certain issues remain:

3. The neo-classical theory doesn't say anything about an overhang of bad household and corporate debt
   - Why can that create a drag on the economy?

4. The neo-classical theory says that CBs should lower interest rates in the face of a weakening economy.
   - So why do emerging markets have to raise interest rates in crises to stem capital outflows?
   - Wouldn't that just lead to a bigger recession?

A bank balance sheet



How do banks make money?

- If banks assets return 2% and depositors must be paid 1%
  - Then the bank's shareholders make the spread: 2% - 1% = 1% (the "net interest margin")
  - Banks like a bigger term spread

The need for banking regulation

- Suppose a bank is leveraged 20-to-1.
  - What's the return on equity (ROE) is the bank's assets return 1% (after paying interest to depositors)?
  - Suppose instead that 3% of its loans default (and become worthless). What is the shareholder loss?
  - What if instead 6% of its loans default?

- This suggests the importance of high regulatory capital requirements.

The need for banking regulation

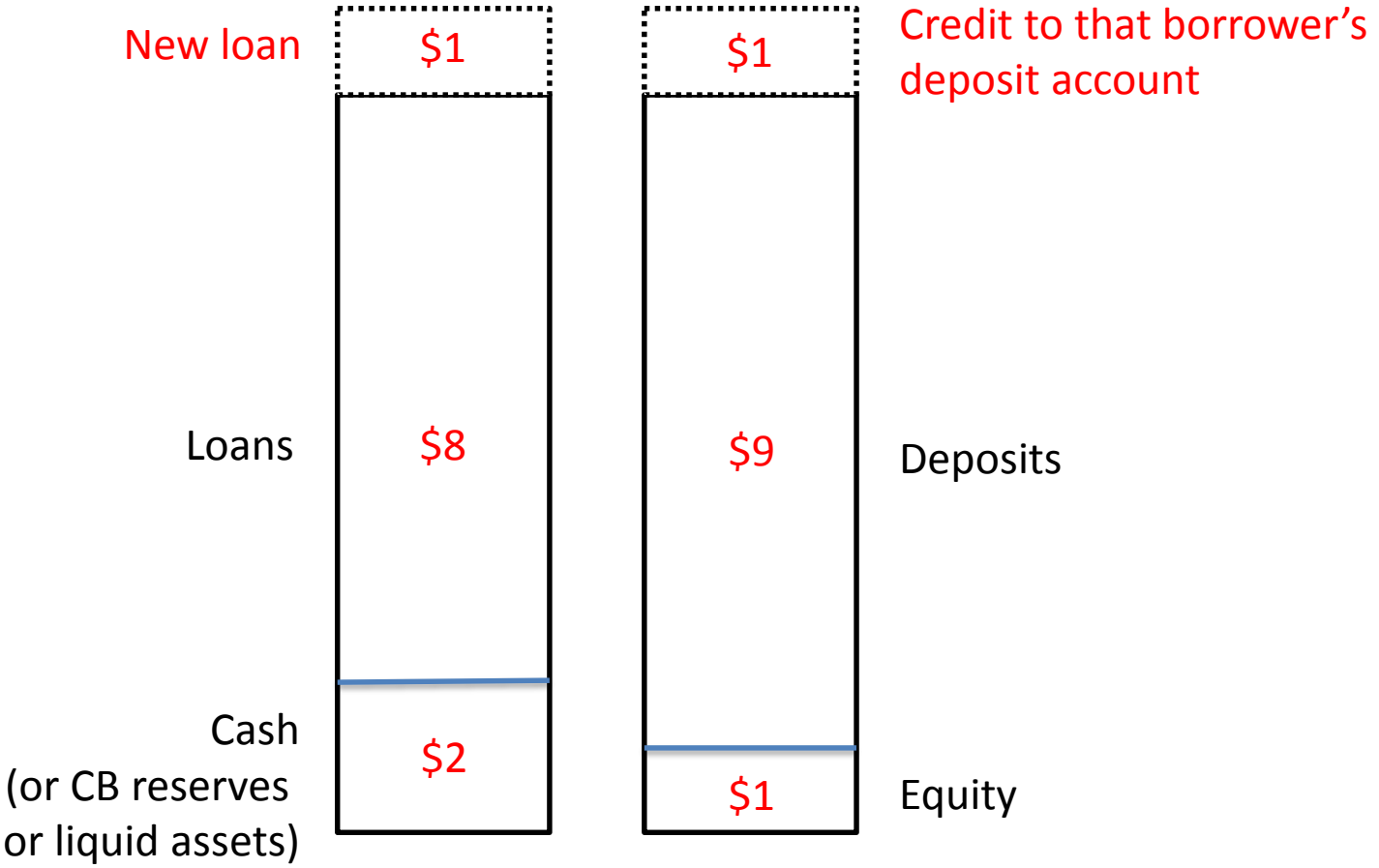
- Suppose a bank's liquidity ratio is 5%.
  - What if there's a run on the bank and 3% of its deposits try to withdraw their money?
  - What if instead 10% try to withdraw their money?

- This suggests the importance of high regulatory liquidity requirements.
  - And having a central bank that acts as a lender of last resort

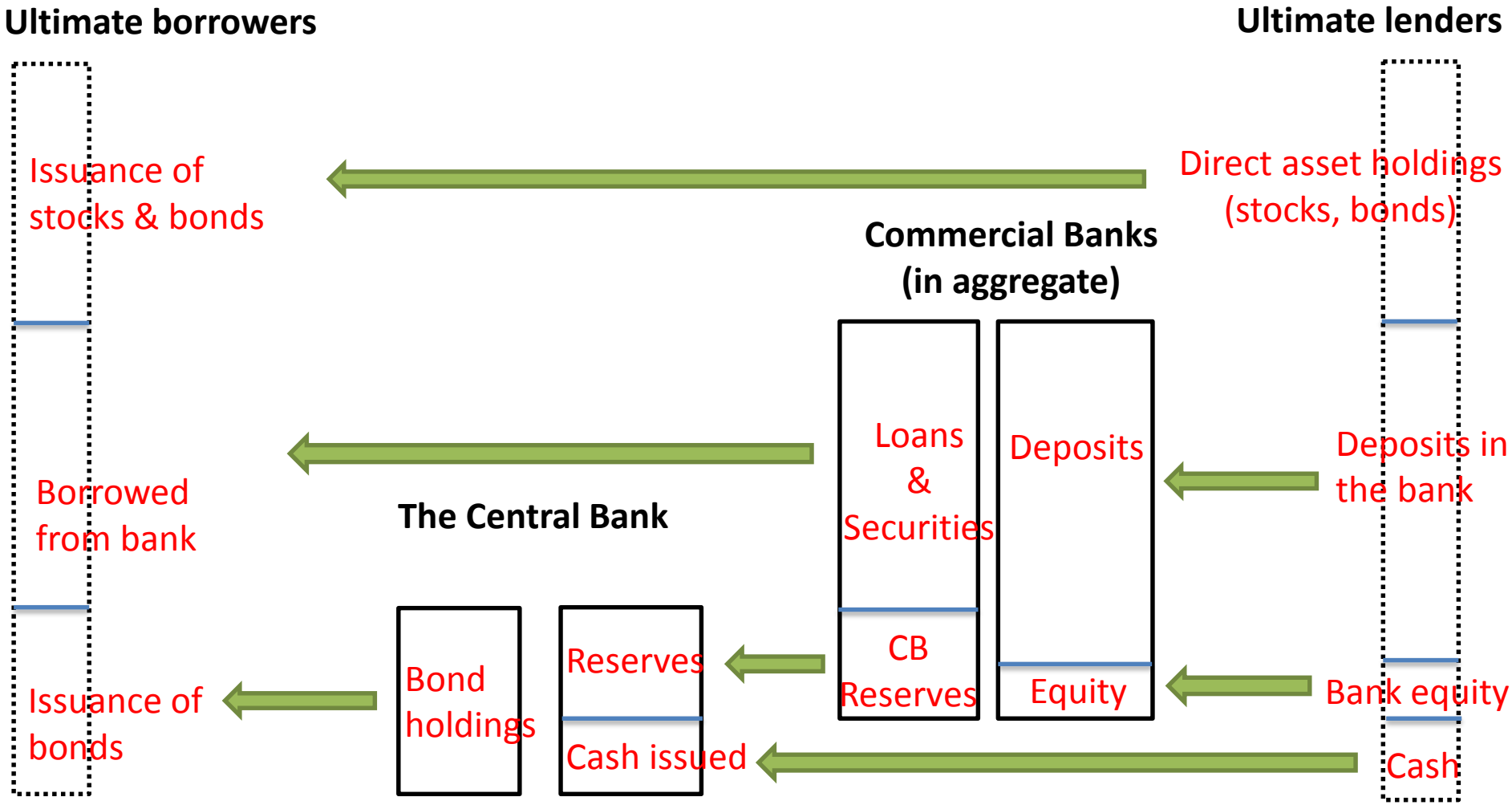
Confusions

- Many people say that capital requirements force banks to “hold capital”
  - Is this statement correct?
  - Would higher capital requirements impede bank lending?
  - Would higher liquidity requirements impede bank lending?
- Do banks need to have money to make a loan?

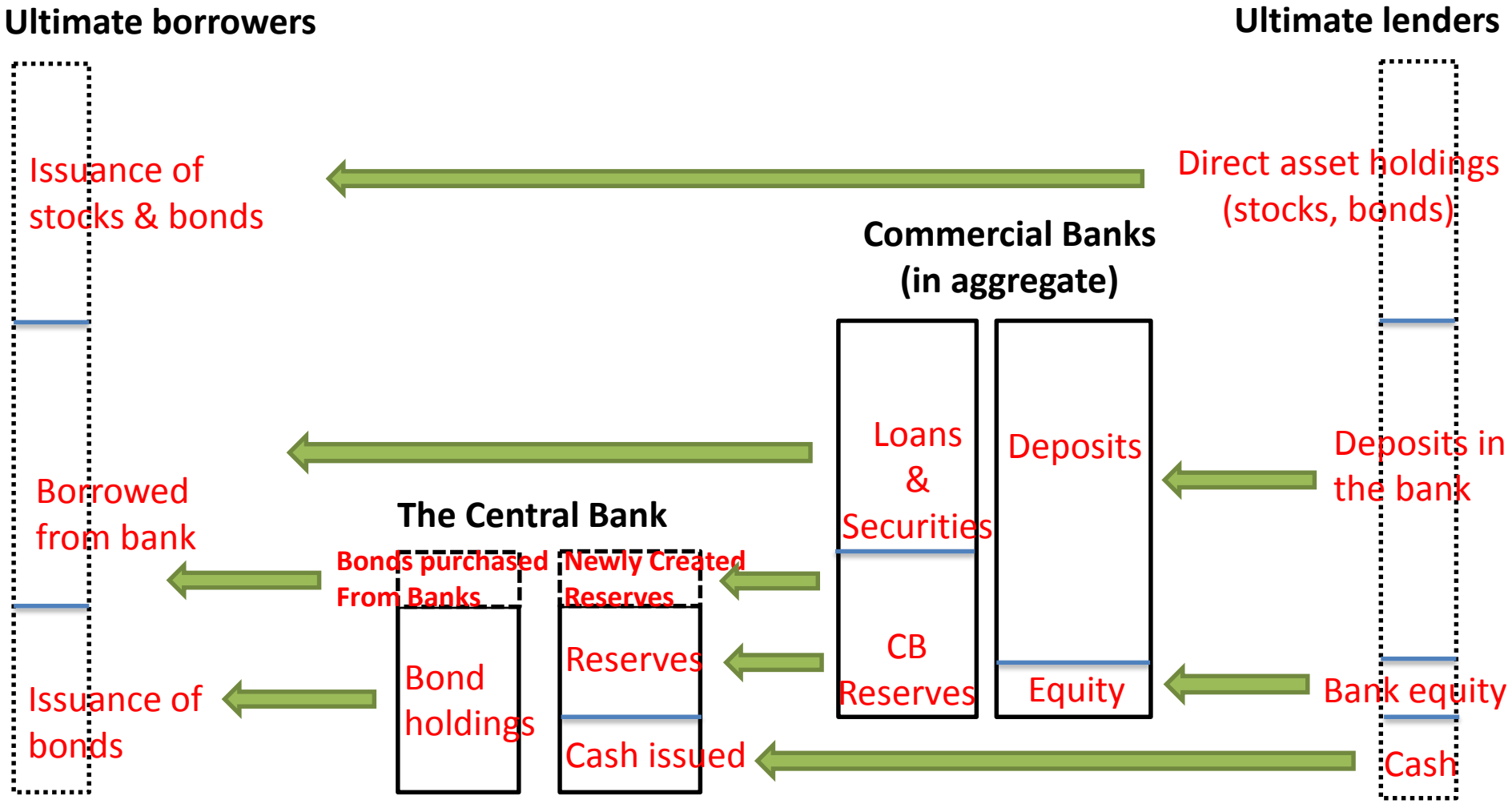
"Fountain pen money"



The banking system



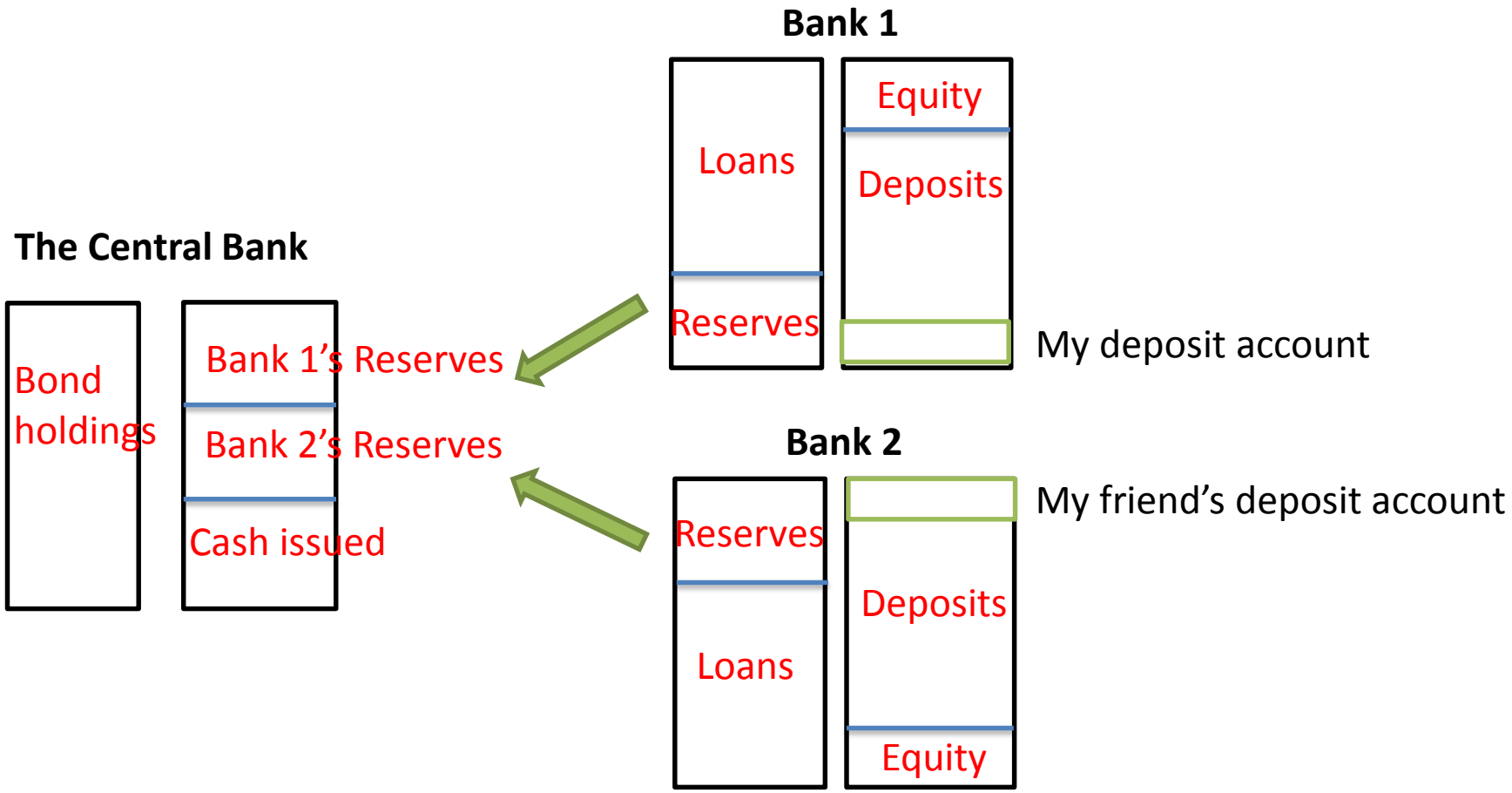
An open-market operation



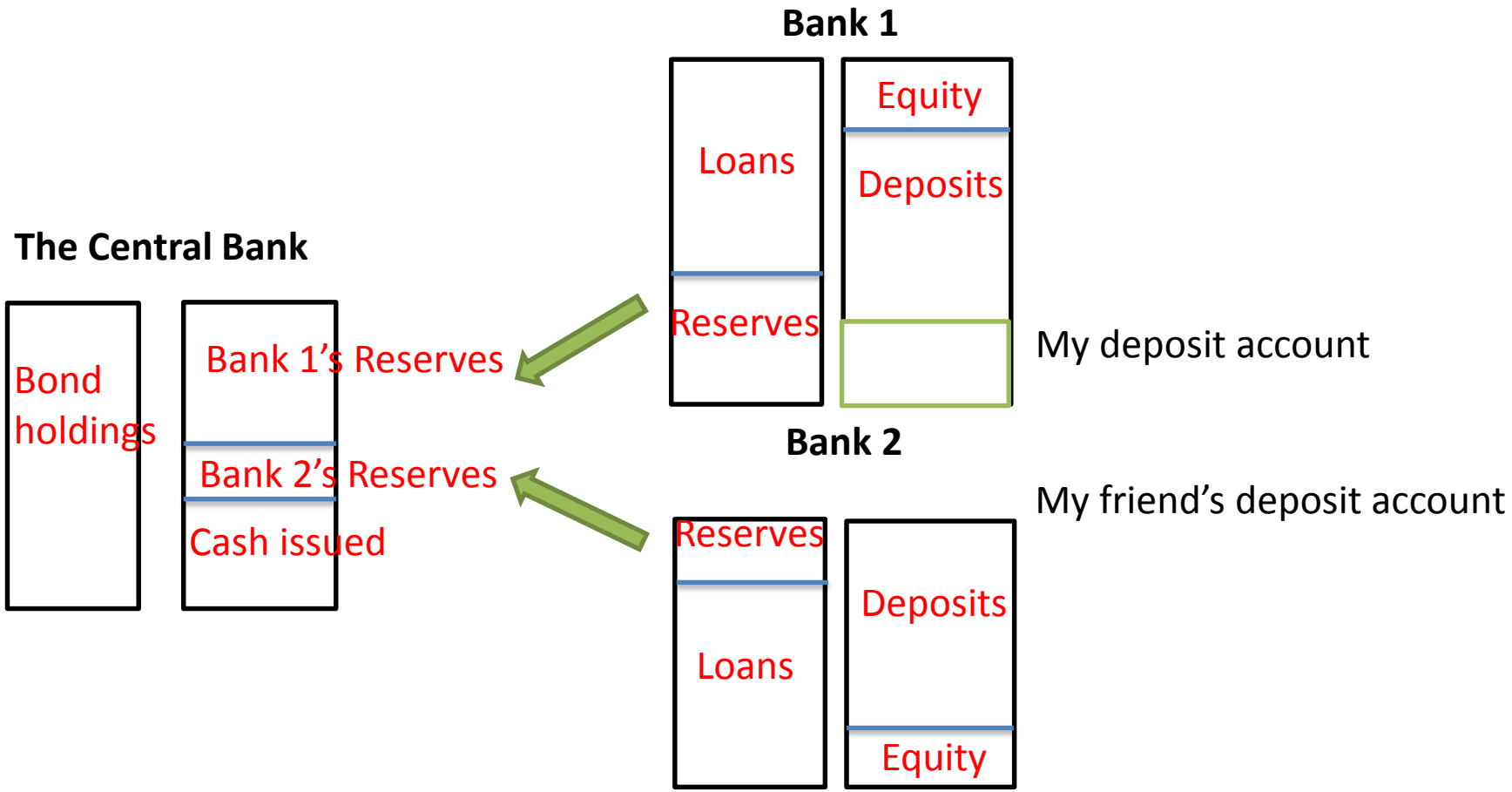
Confusions

- Many people think it's unfair that the Fed lends to the banks (but doesn't lend to "Main Street")
  - Does the Fed (on net) lend to the banks?
- When the Fed raises interest rates (and thus starts paying interest on reserves),
  - Who does it pay this interest to?

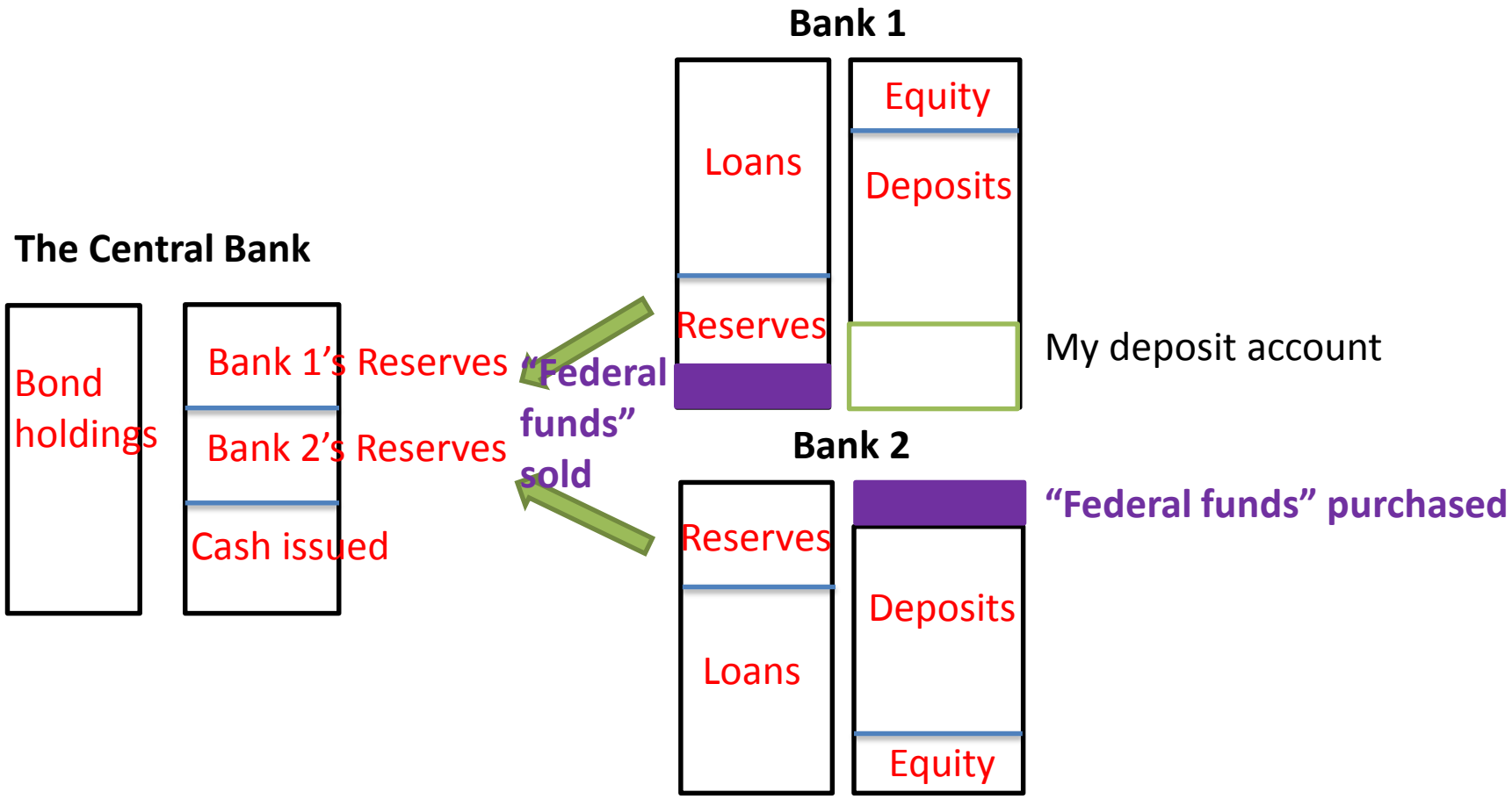
How is money transferred?



Method 1:
Bank 2 gives reserves to Bank 1



Method 2:
Bank 2 owes money to Bank 1



Some additional points

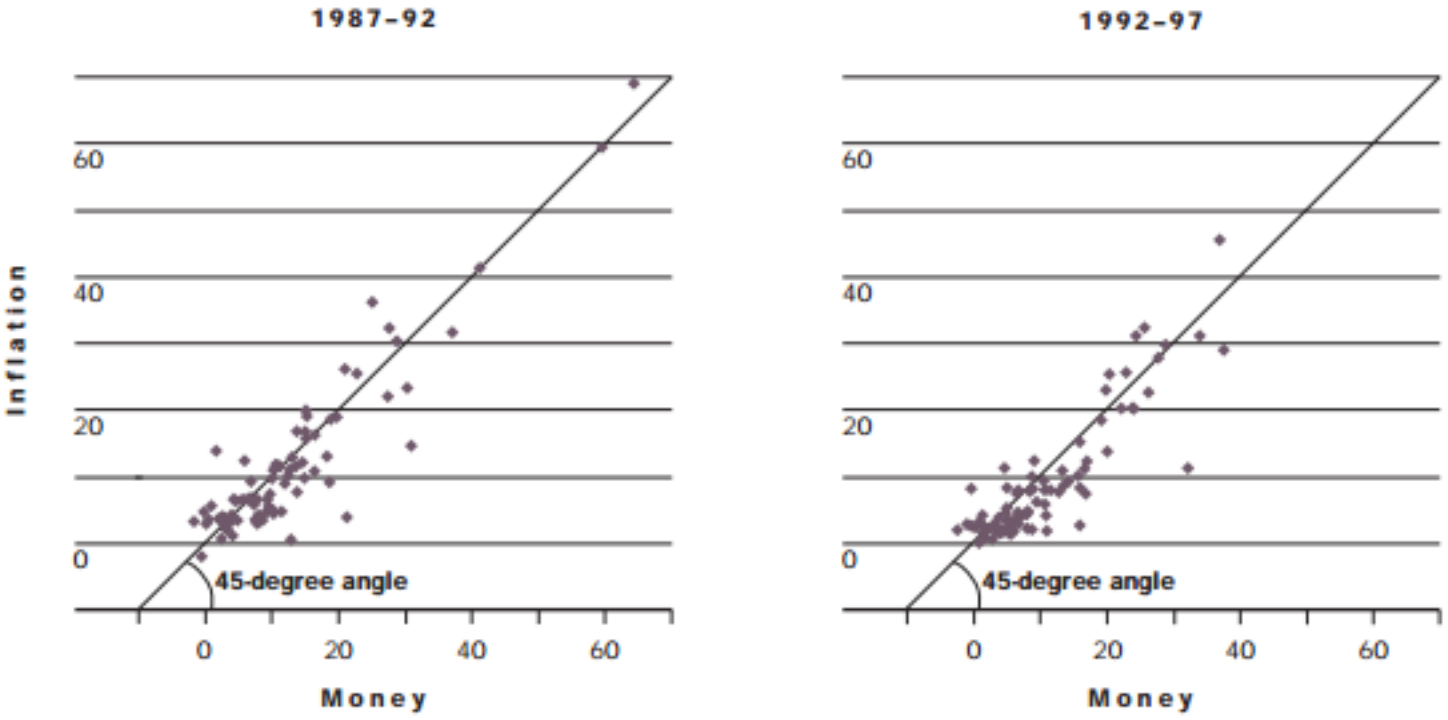
- What is the “money supply”?
  - M0 is central bank liabilities
    - Central bank money
  - M2 is all commercial bank deposit and savings accounts
    - Private money + central bank money

- Back in the day, it was assumed that:
  - M2 was a fixed multiple of M0
    - Determined by the reserve requirement
  - Inflation was determined by the growth of M2 (and thus the growth of M0)

- In the U.S. economy today, M0 (i.e. the quantity of CB money) is only loosely related to the inflation in the short-run. Two reasons:
  - Banks are not constrained by reserve requirements, so M2 is not a fixed multiple of M0
  - People actually have to spend the money, and that demand has to induce firms to raise prices. Money sitting dormant in a deposit account does not create inflation

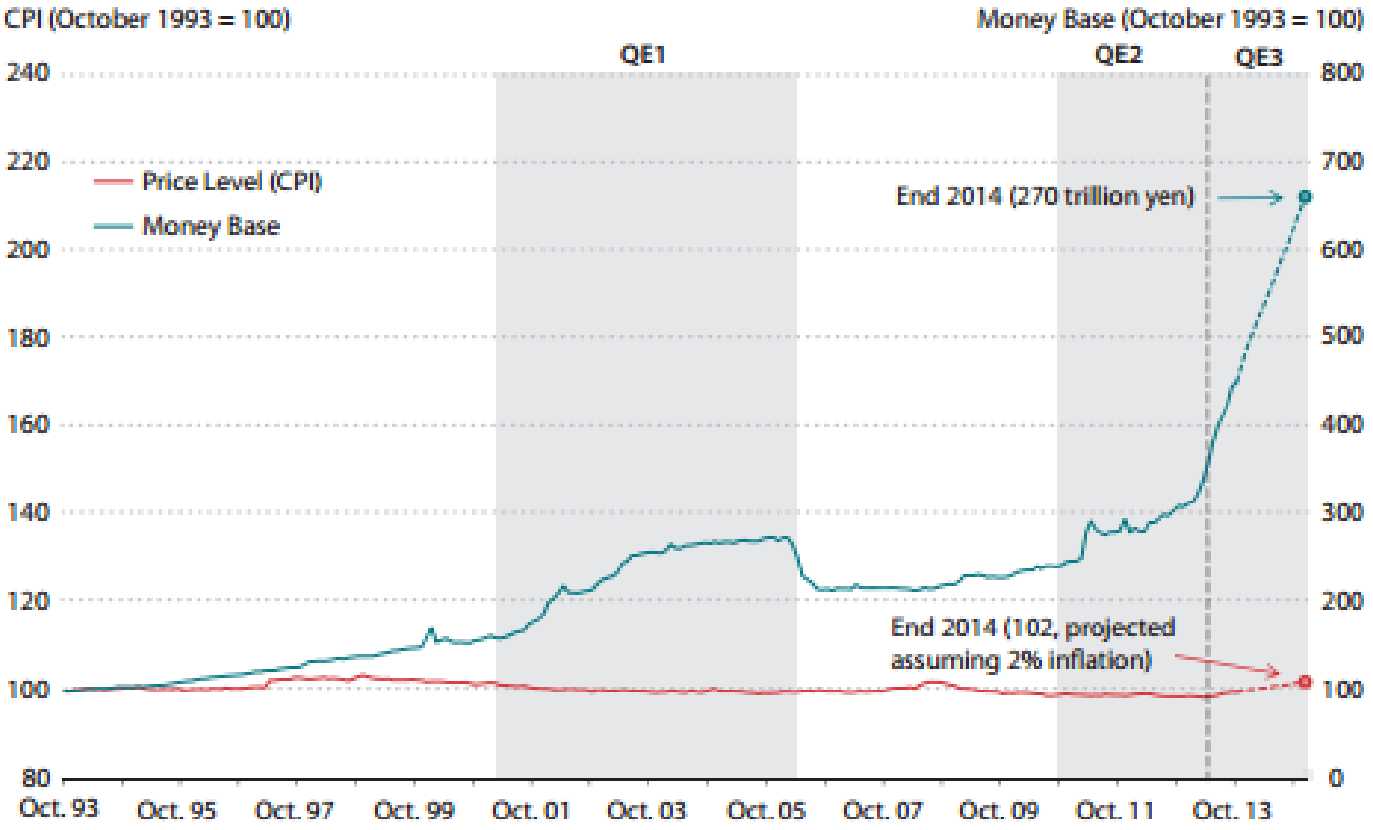
In the long-run (when we're not at the zero lower bound), changes in the money supply are reflected 1-for-1 in prices

CHART 5
Inflation and Growth Rate of Money Relative to Real Income across Countries



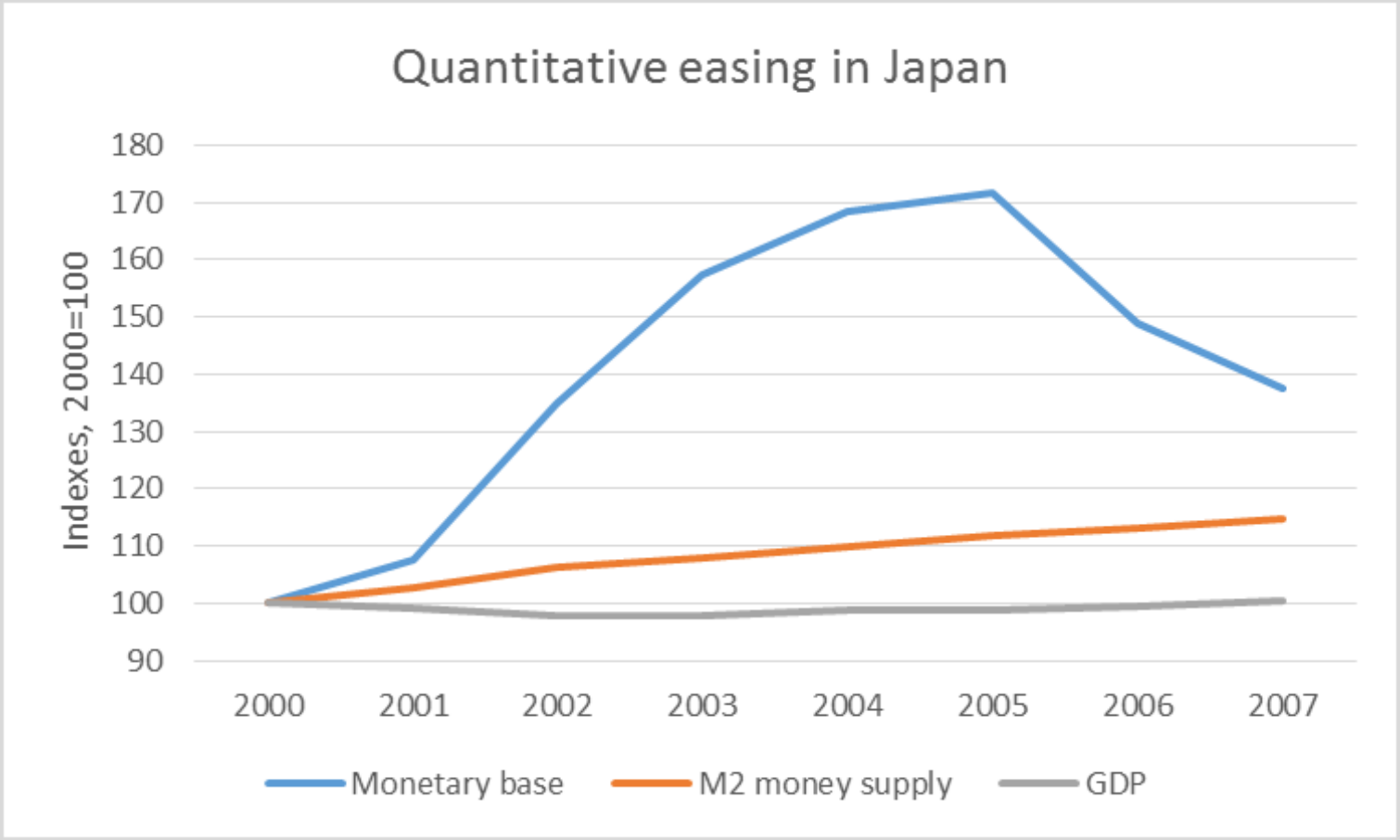
Liquidity trap economics

Japanese Monetary Base and Price Level (CPI)



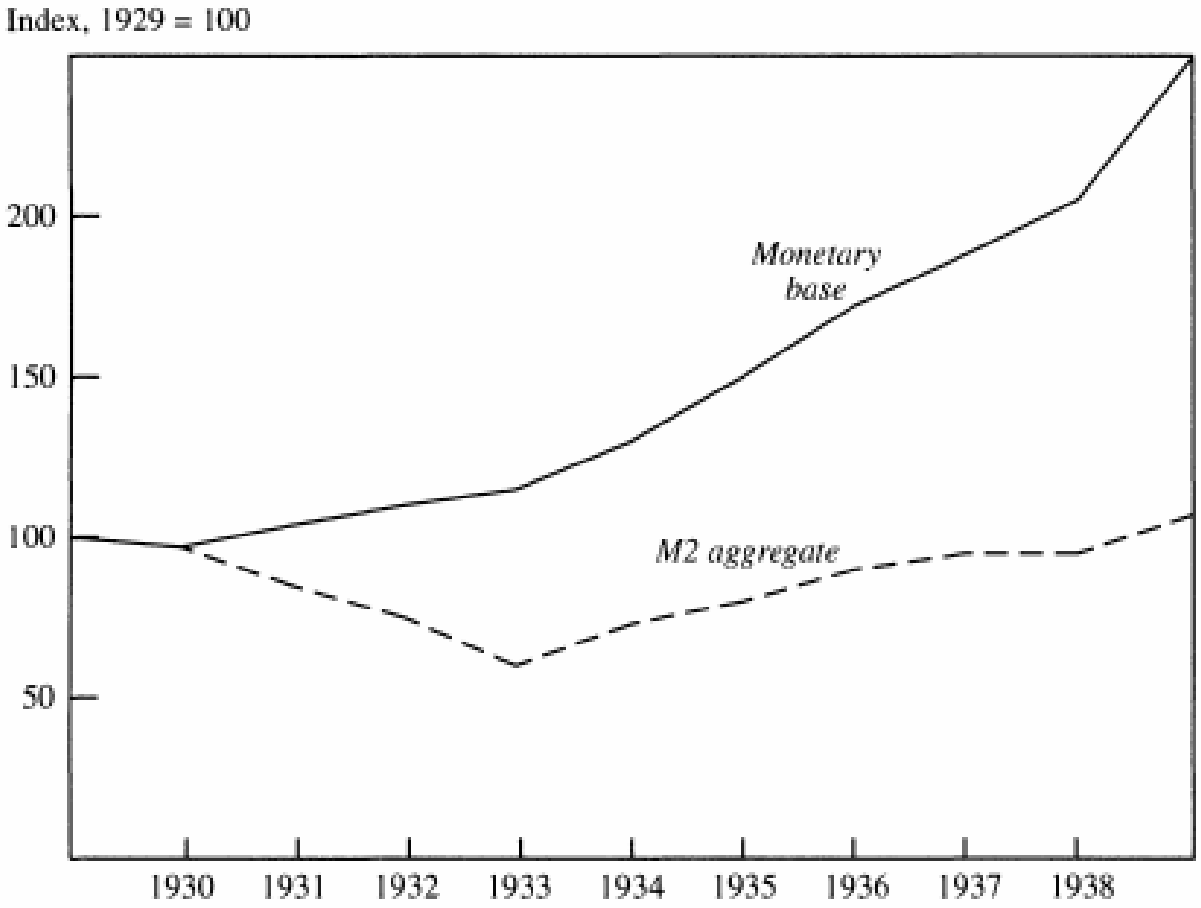
SOURCE: BOJ, Japanese Ministry of Internal Affairs and Communications, and Haver Analytics.

Liquidity trap economics



Liquidity trap economics

Figure 3. U.S. Monetary Trends, 1929–39



Liquidity trap economics