2014-2015 – Licence 3 – Macro

Lecture 9 : The Liquidity Trap

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Disclaimer

These are the slides I am using in class. They are not self-contained, do not always constitute original material and do contain some "cut and paste" pieces from various sources that I am not always explicitly referring to (not on purpose but because it takes time). Therefore, they are not intended to be used outside of the course nor to be distributed. Thank you for signaling me typos or mistakes at franck.portier@TSE-fr.eu.

0. Introduction

- What is the Liquidity Trap : a situation in which :
  - × the nominal interest rate i is zero,
  - × the economy is in a recession,
  - × monetary policy is inefficient because it cannot reduce i any further
- Why can't i be negative : it is possible on bonds (i is a contractual arrangement)
- But then people will hold money, not bonds, because the nominal interest rate on money is zero
- It is not *technically* possible to make it negative (unless one uses *melting money*)
- Therefore demand for bond would be zero if i was negative on bonds

0. Introduction

- We first briefly review the liquidity trap in IS-LM
- Then we look at facts to show that it is not a theoretical curiosity :
  - × the US in the 1930's (Great Depression),
  - × Japan in the 1990's (Lost Decade),
  - × the US and France after 2008 (Great Recession).
- Then we construct a micro-founded model that gives a rigorous treatment of the liquidity trap.
- We will see in particular that expectations are crucial to understand what is going on.

1. IS-LM

Assumptions

- Prices are fixed
- Output is determined by demand
- Economic agents make portfolio decisions and decide to hold money and bonds.

1. IS-LM

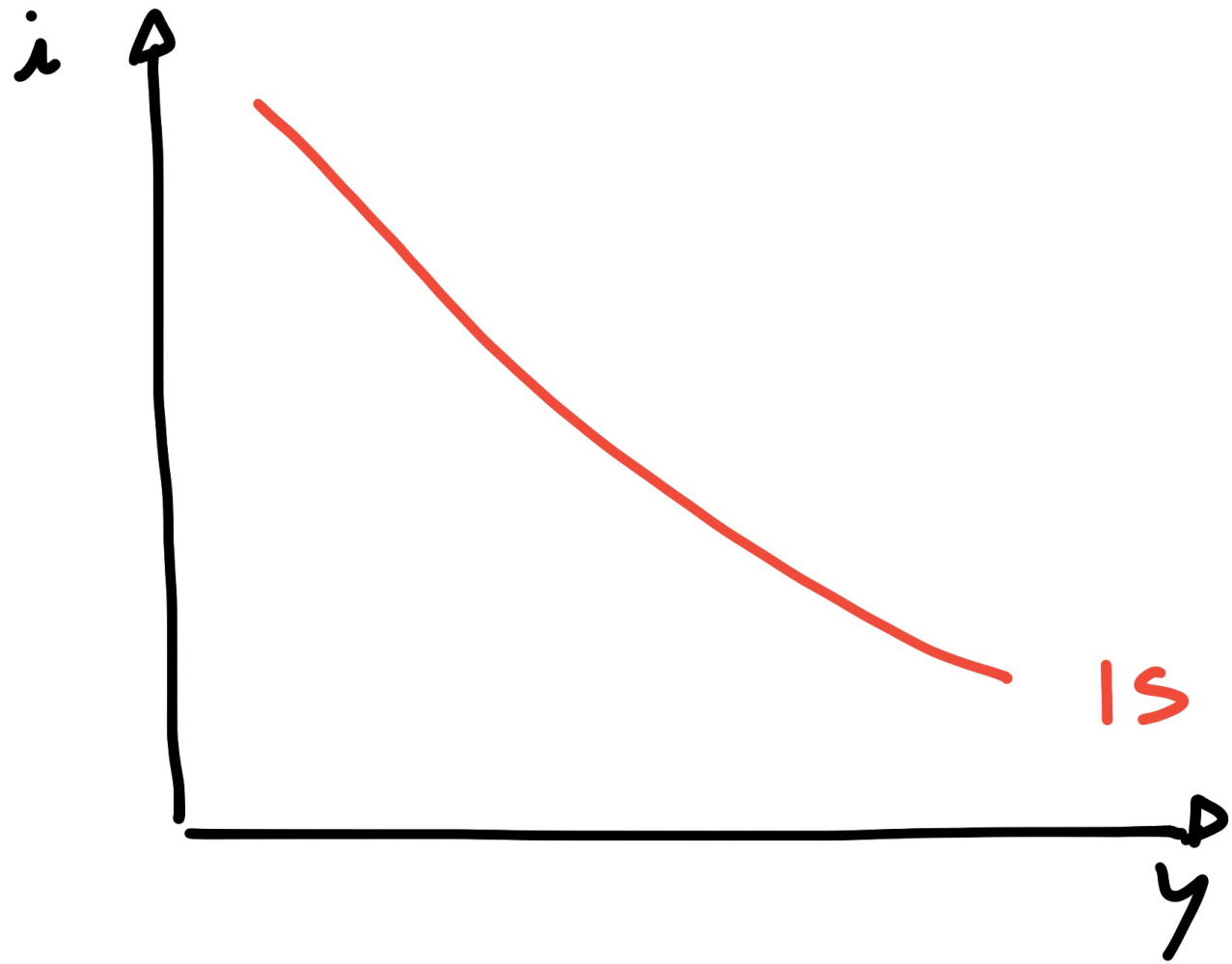
IS

- $C = C(Y - T)$, $C' > 0$
- $I = I(i)$, $I' < 0$
- $i = r + \pi$, where π is inflation
- G is given
- $G + B^G = T + M/P$, T, M and B^G given, but satisfies the Gvt budget constraint
- Equilibrium : Income Y creates demand that is equal to income :

$$C + I + G = Y \qquad (IS)$$

- IS is downward sloping in the plane (Y, i)

FIGURE 1 : The IS curve



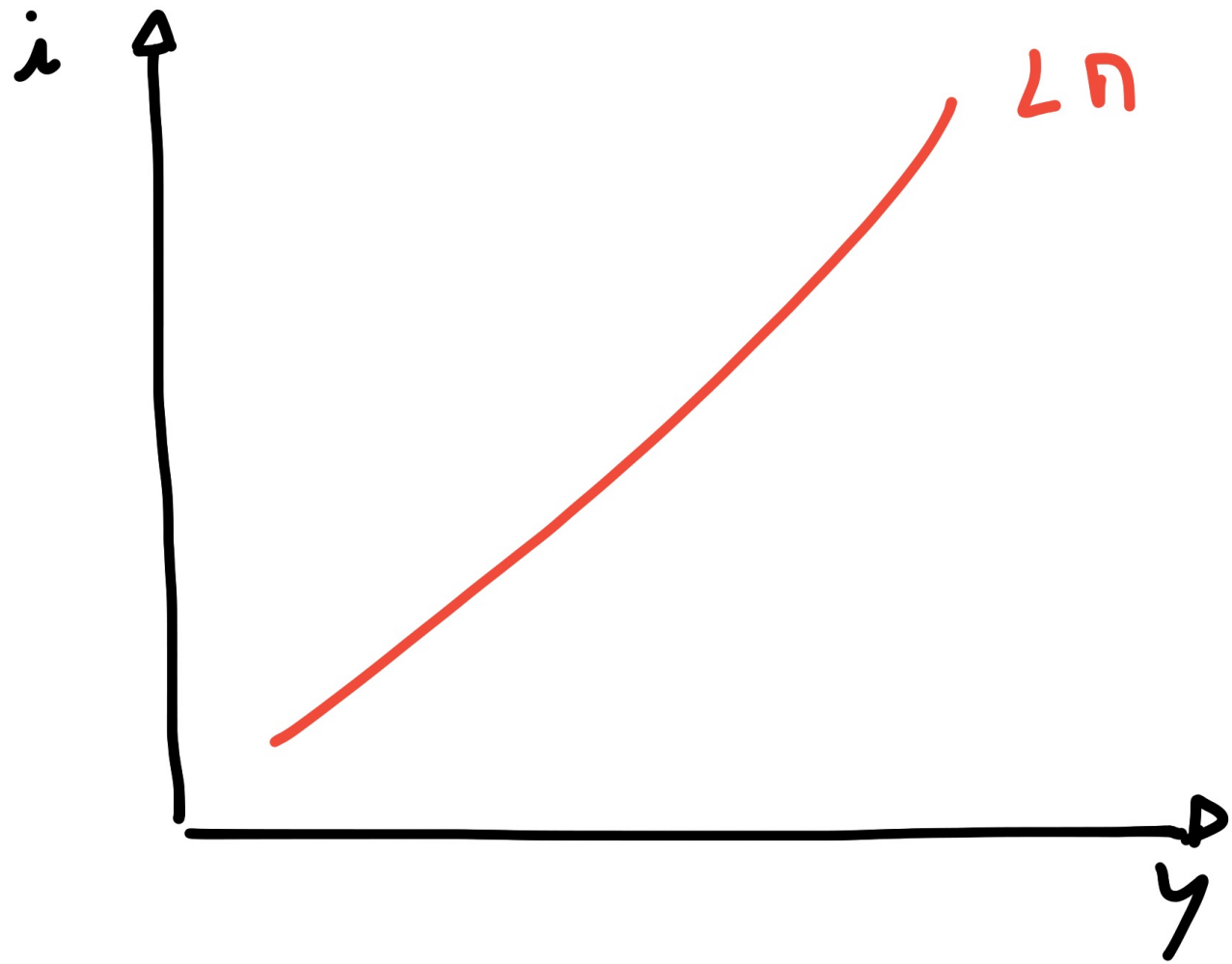
LM

- Money supply is given M/P
- Real money demand is $L = L(Y, i)$ with $L_Y > 0$ and $L_i < 0$
- $L(Y, i)$ is derived from an arbitrage between money and bonds :
  - × when income is high, money is needed for transaction, so that economic agents use more money (and less bonds) as a mean of savings,
  - × when i is high, the opportunity cost of holding money is high, so that agents hold less mopey (and more bonds)
  - × Equilibrium (on the money market) :

$$L(Y, i) = M/P \qquad (LM)$$

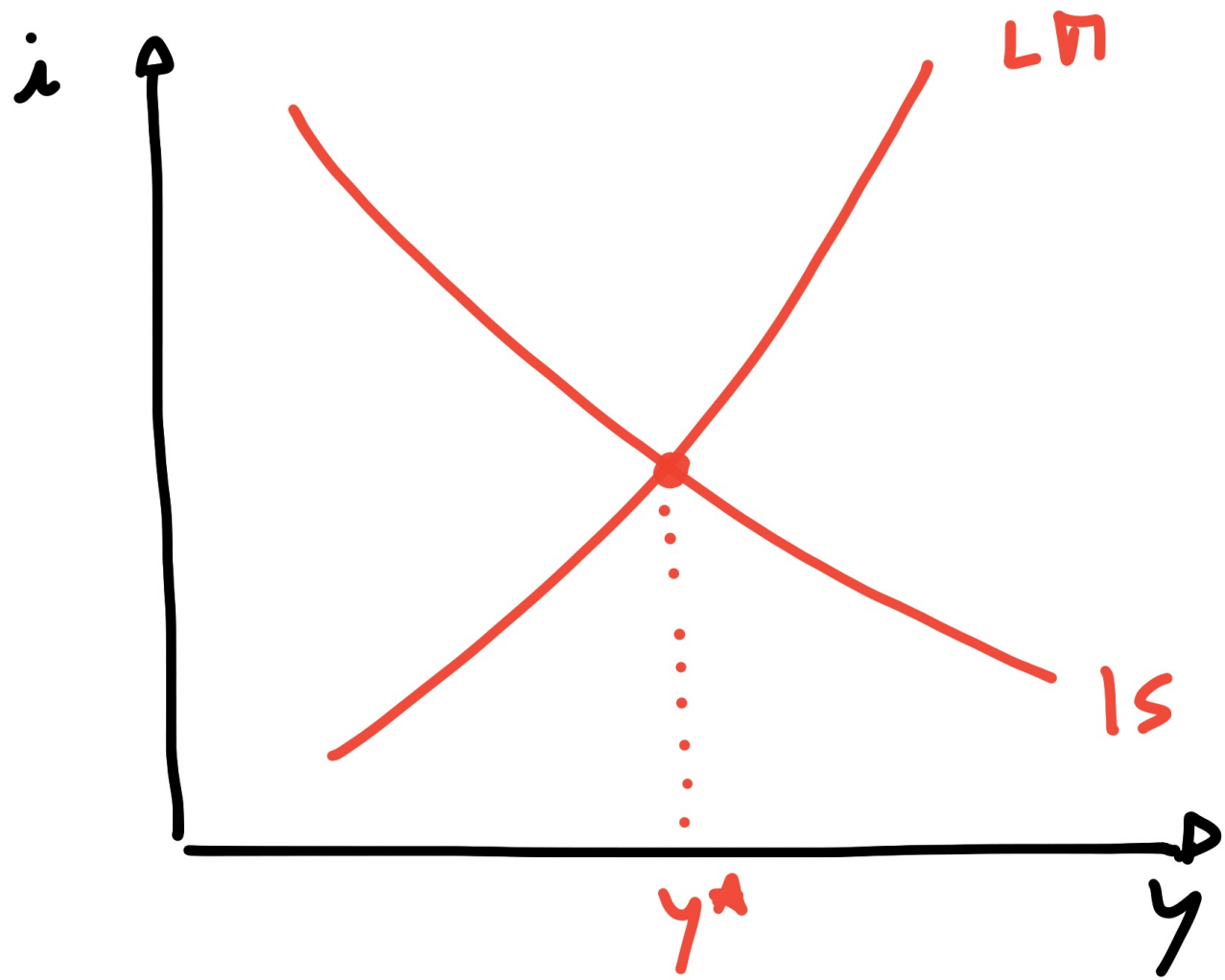
  - × LM is upward sloping in the plane (Y, i)

FIGURE 2 : The LM curve



- Equilibrium is $(Y^\star, i^\star)$ such that
  - Income generate a demand of good equal to income
  - Money market clears
  - By Walras law, the bond market also clears
- The equilibrium is at the intersection of IS and LM

FIGURE 3 : Equilibrium in IS-LM



IS-LM

Negative demand shock and the role of expansionary policy

- Suppose that aggregate demand goes down (for example autonomous investment goes down following a stock market crash)
- This is likely to create a recession
- Expansionary monetary policy can restore a high Y equilibrium :
  - × Expansionary monetary policy reduced i
  - × a drop in i increases I
  - × the increase in I has a multiplier effect

FIGURE 4 : A negative shock to aggregate demand

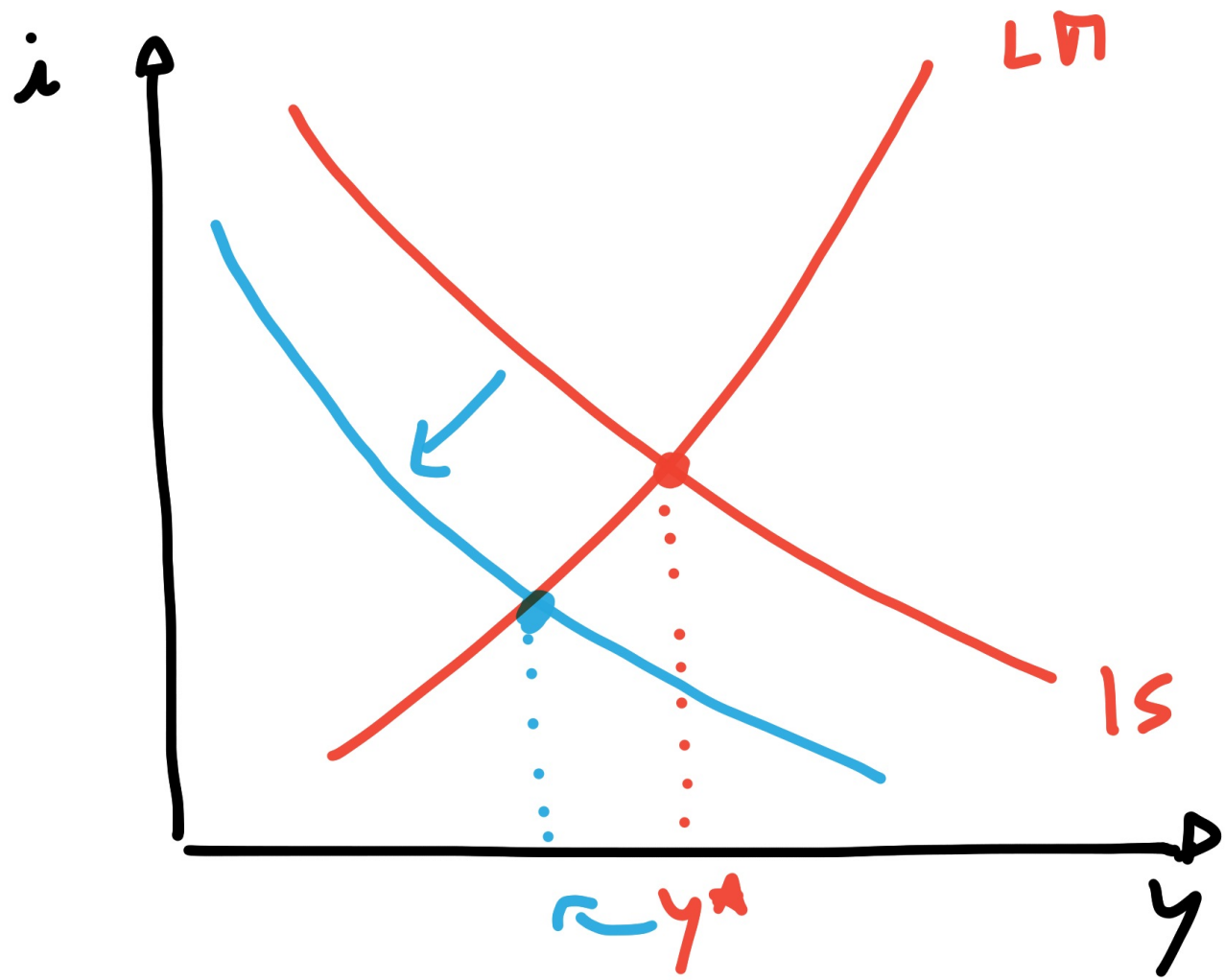
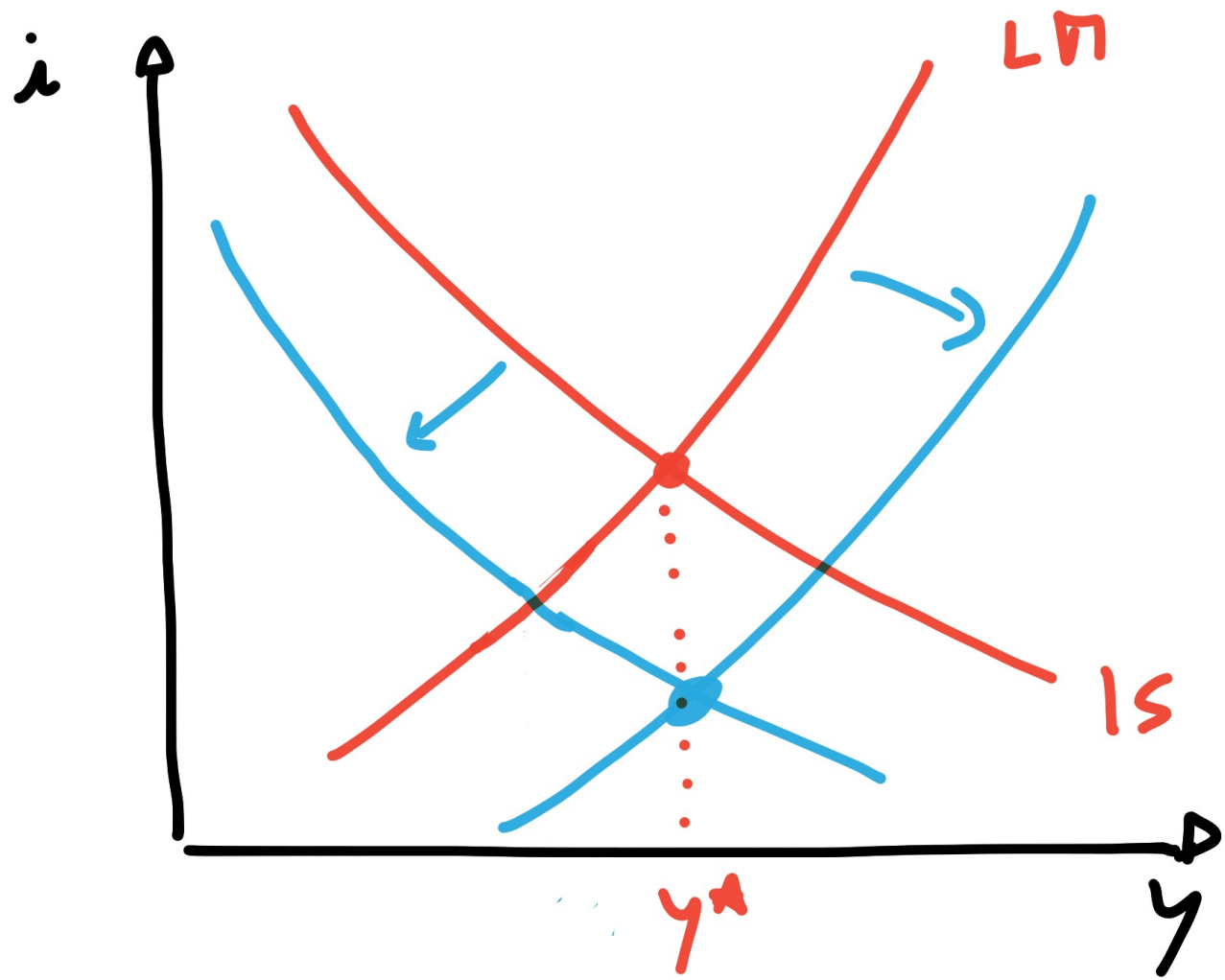


FIGURE 5 : Expansionary monetary policy



- Assume there is a level of i that is so low (say $i \approx 0$) such that
  - × the demand for bonds is vey low (because the return is almost zero)
  - × an increase in money supply cannot decrease any more i because all the money distributed is kept in cash and -is not used to buy bonds
- In that case, the elasticity of L with respect to i is zero when i is at the *Zero Lower Bound*.
- Monetary policy cannot reduce i, and is therefore inefficient.
- If the government cannot run a deficit (because public debt is already high), then there is no possibility to eliminate the recessionary effect of a negative demand shock.

FIGURE 6 : The liquidity trap

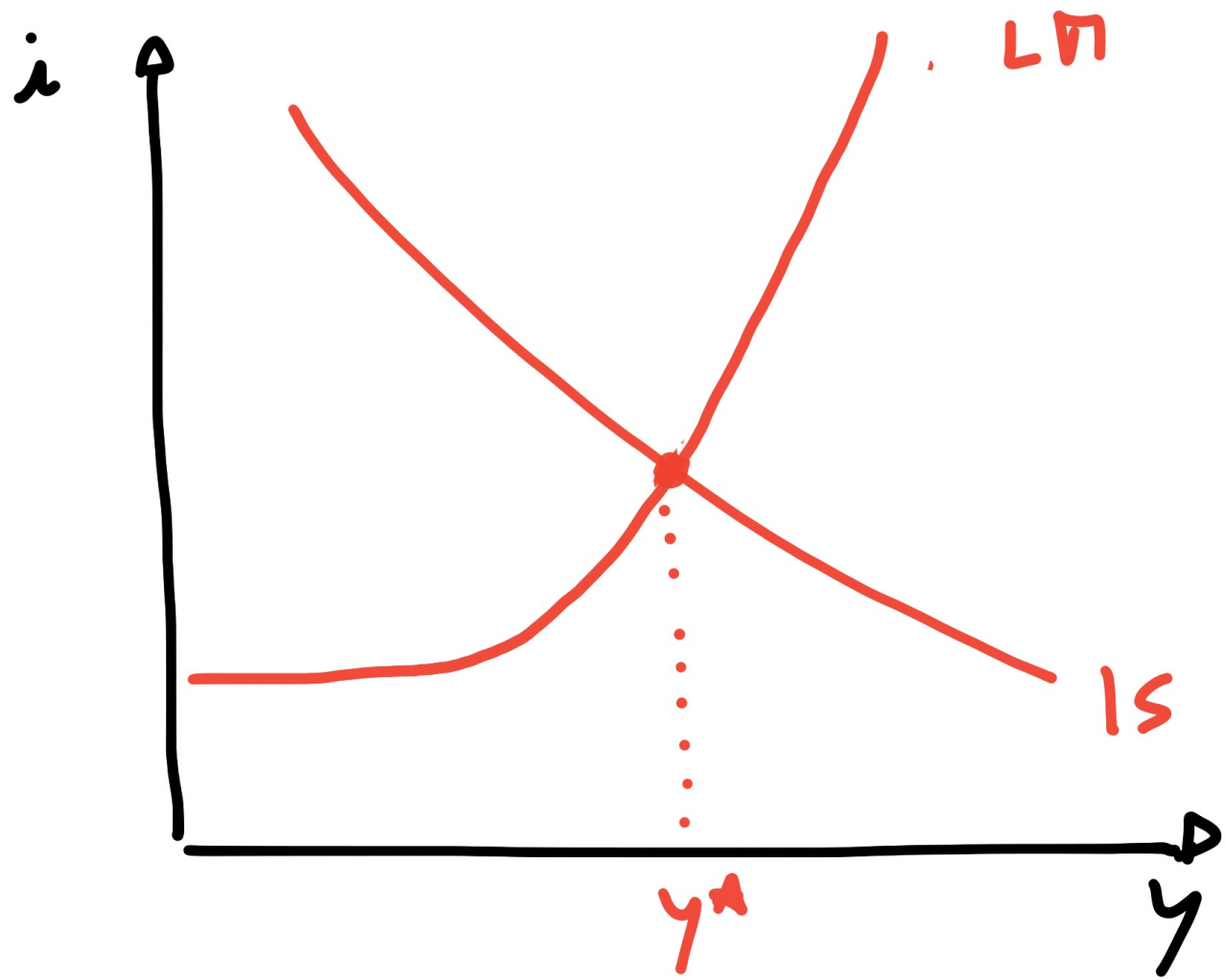


FIGURE 7 : The liquidity trap

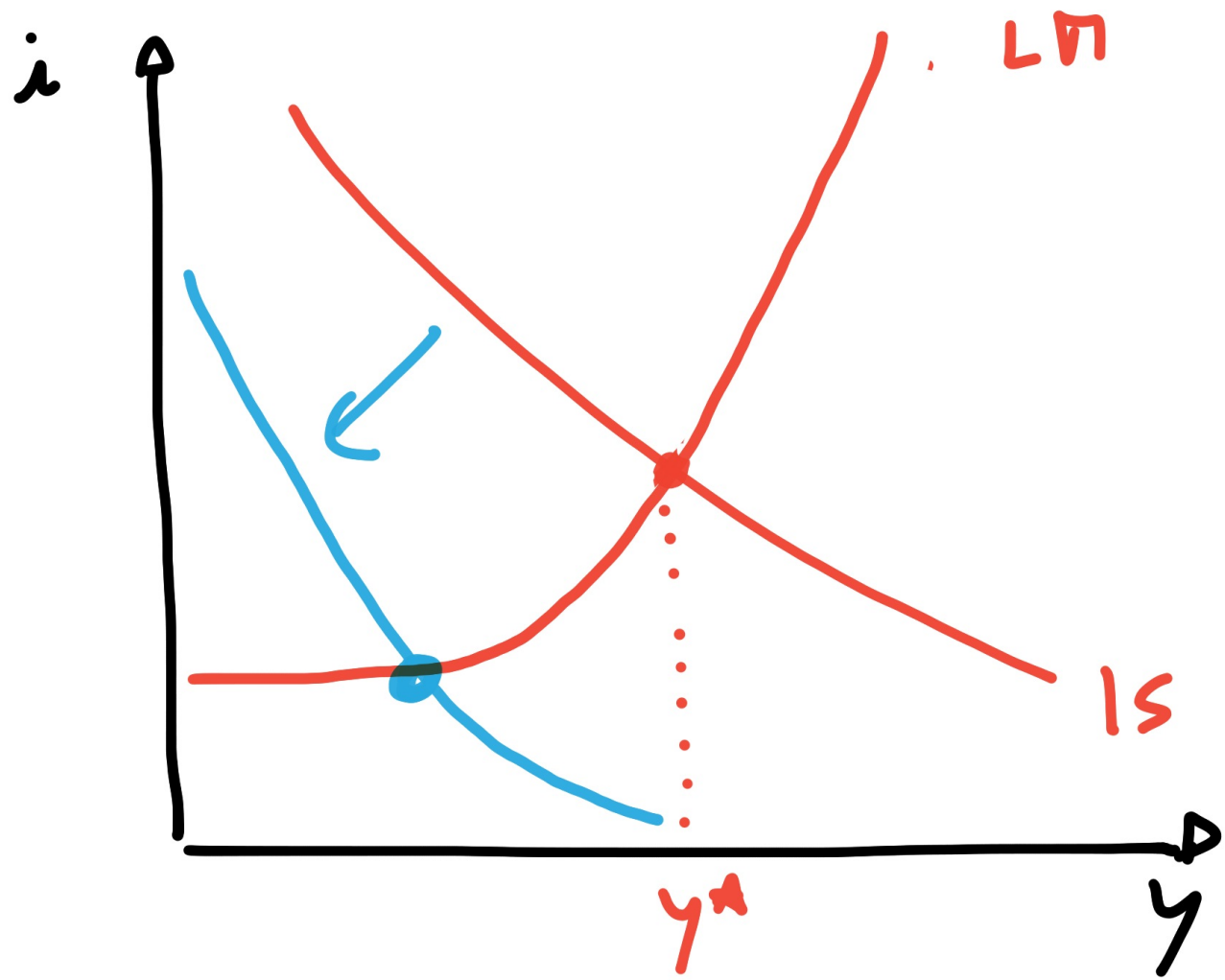
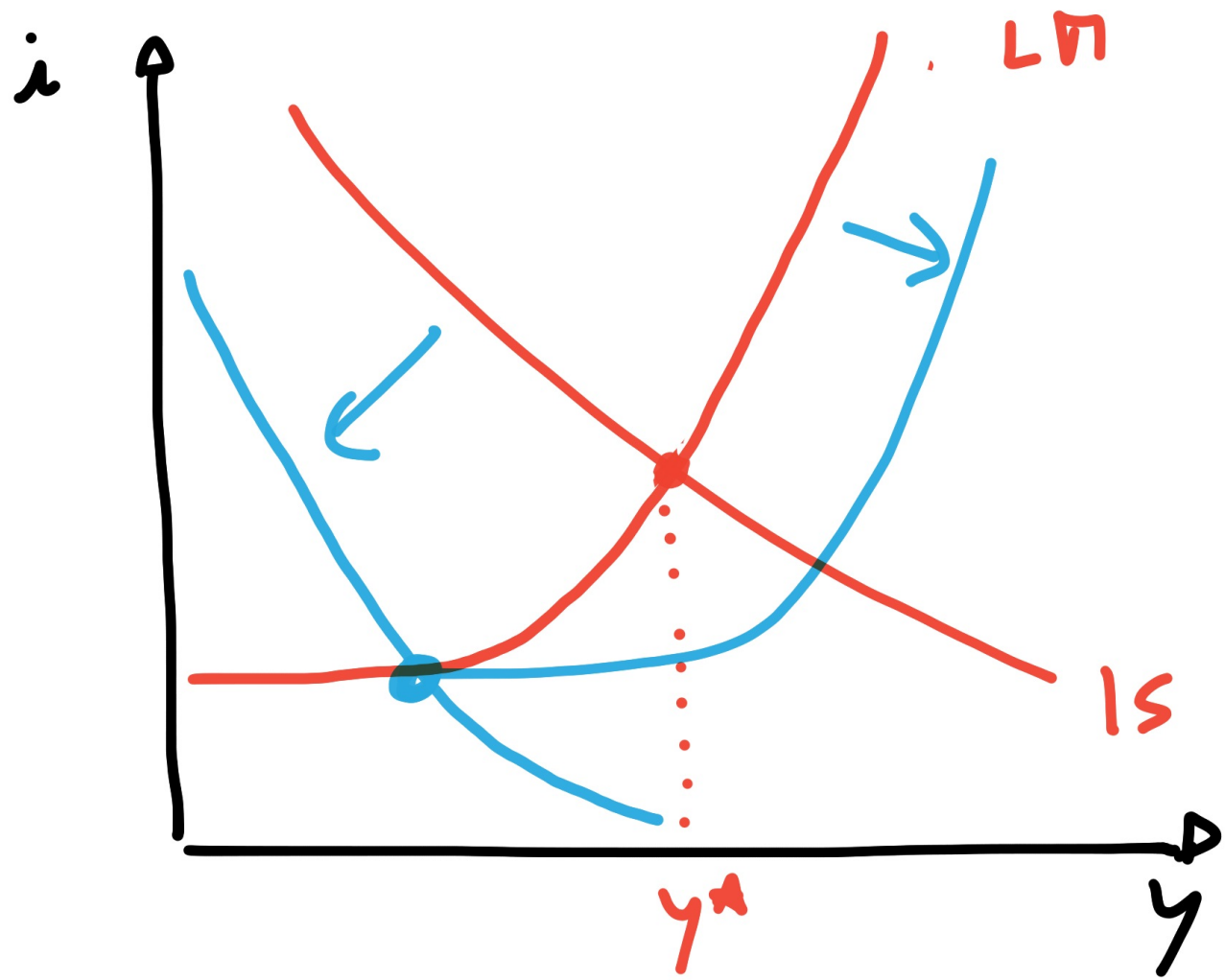


FIGURE 8 : The liquidity trap



2. Facts

- We look at facts to show that the liquidity trap is not a theoretical curiosity :
  - × the US in the 1930's (Great Depression),
  - × Japan in the 1990's (Lost Decade),
  - × the US and France after 2008 (Great Recession).

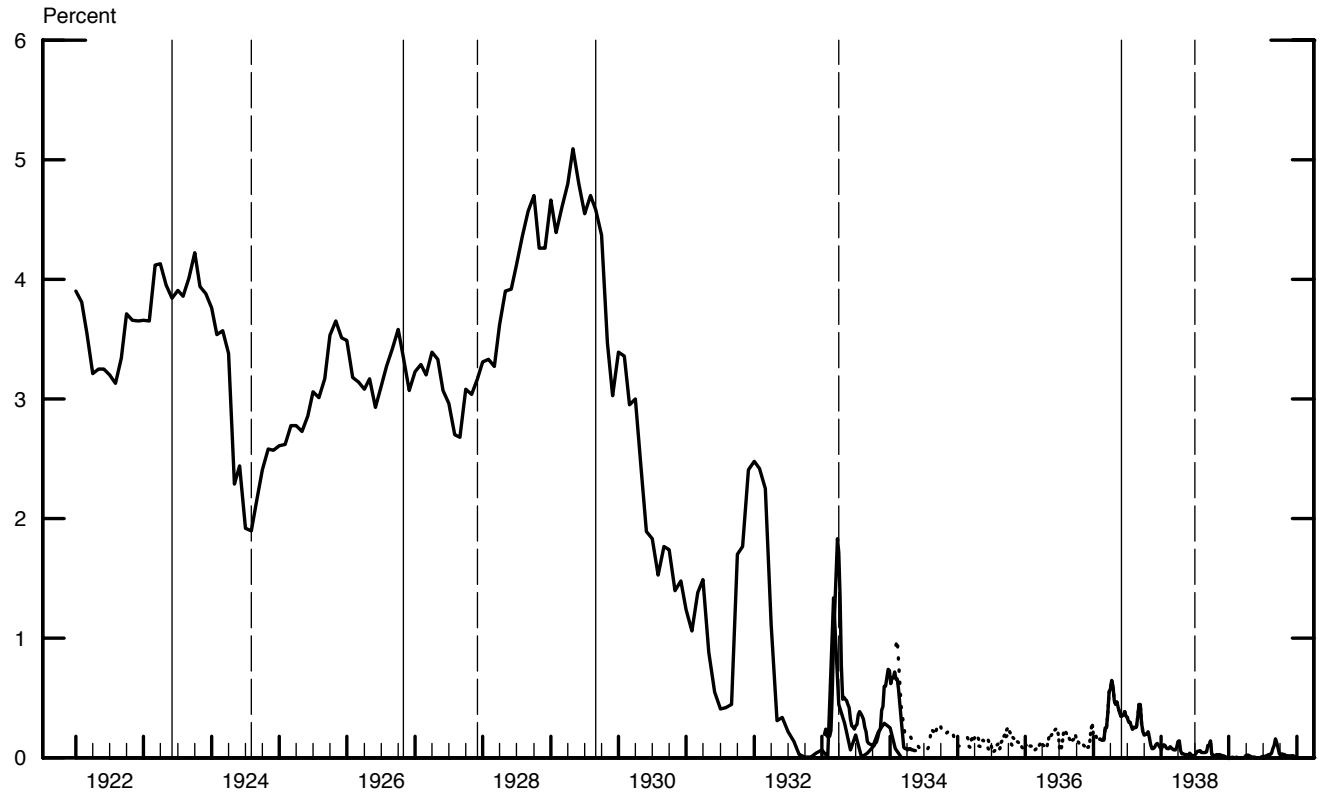
2. Facts

- In all cases, we observe a similar pattern :
  - Asset prices (stock market) crashes
  - nominal interest rate is almost zero
  - there is a recession in output
  - unemployment is high
  - there is a initial period of deflation (not prolonged for the 2008 recession)

2. Facts

The US Great Depression

FIGURE 9 : Short-term interest rates

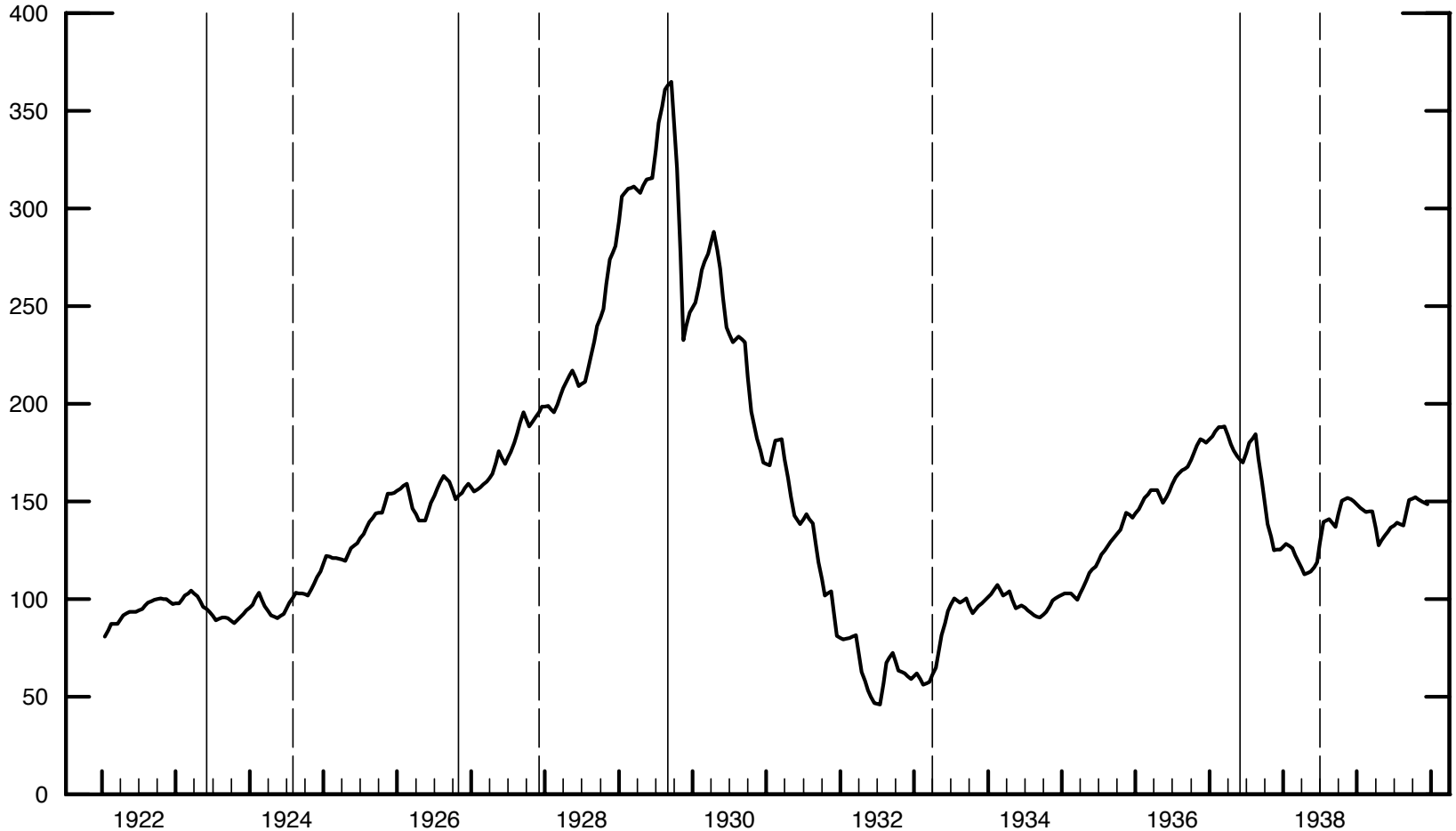


The solid line denotes the yield on new issues of 3-month Treasury bills or equivalents. The dotted lines (from 1934 to 1937) reflect yields on new issues of 6- and 9-month Treasury bills.

2. Facts

The US Great Depression

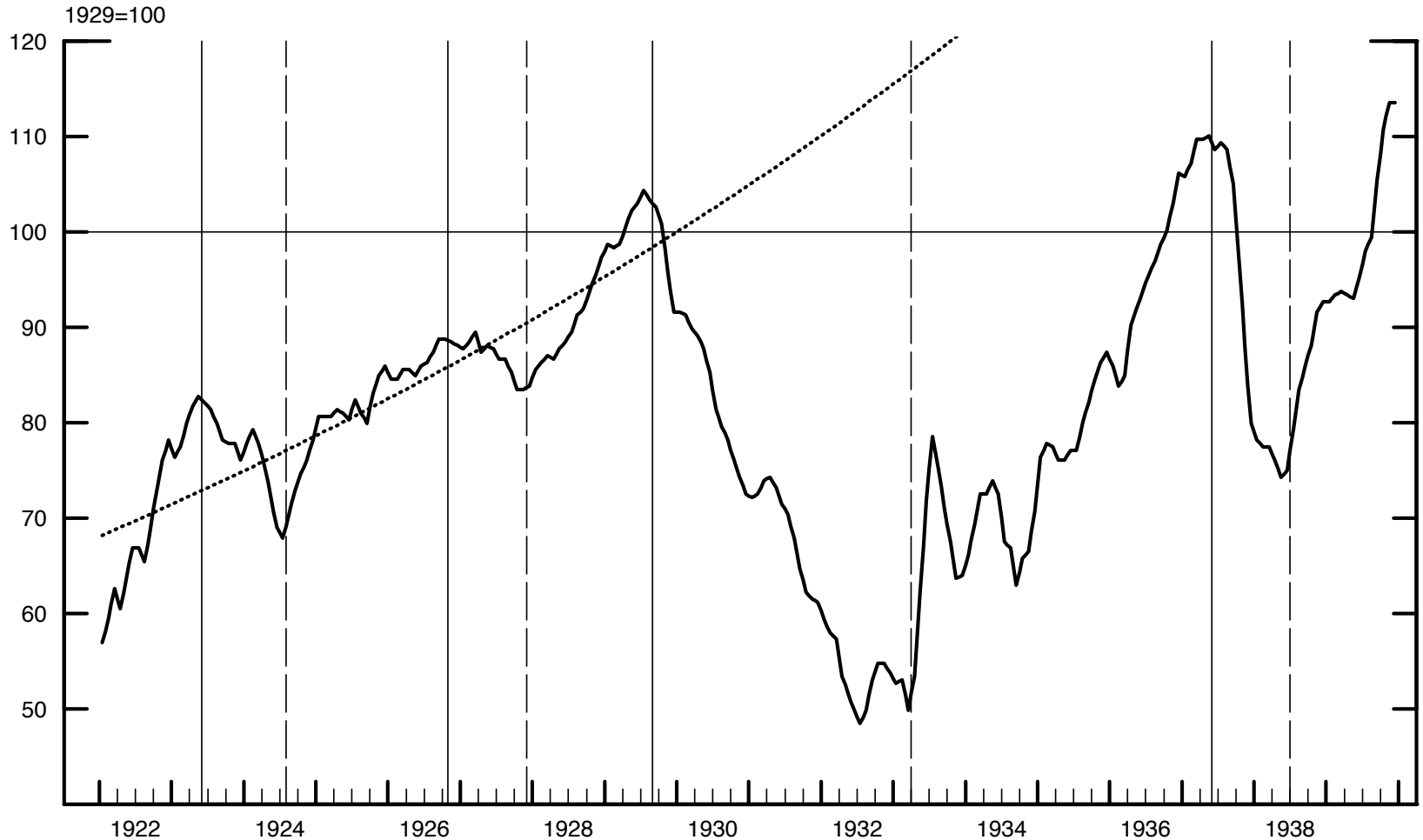
FIGURE 10 : Equity prices (Dow Jones Index)



2. Facts

The US Great Depression

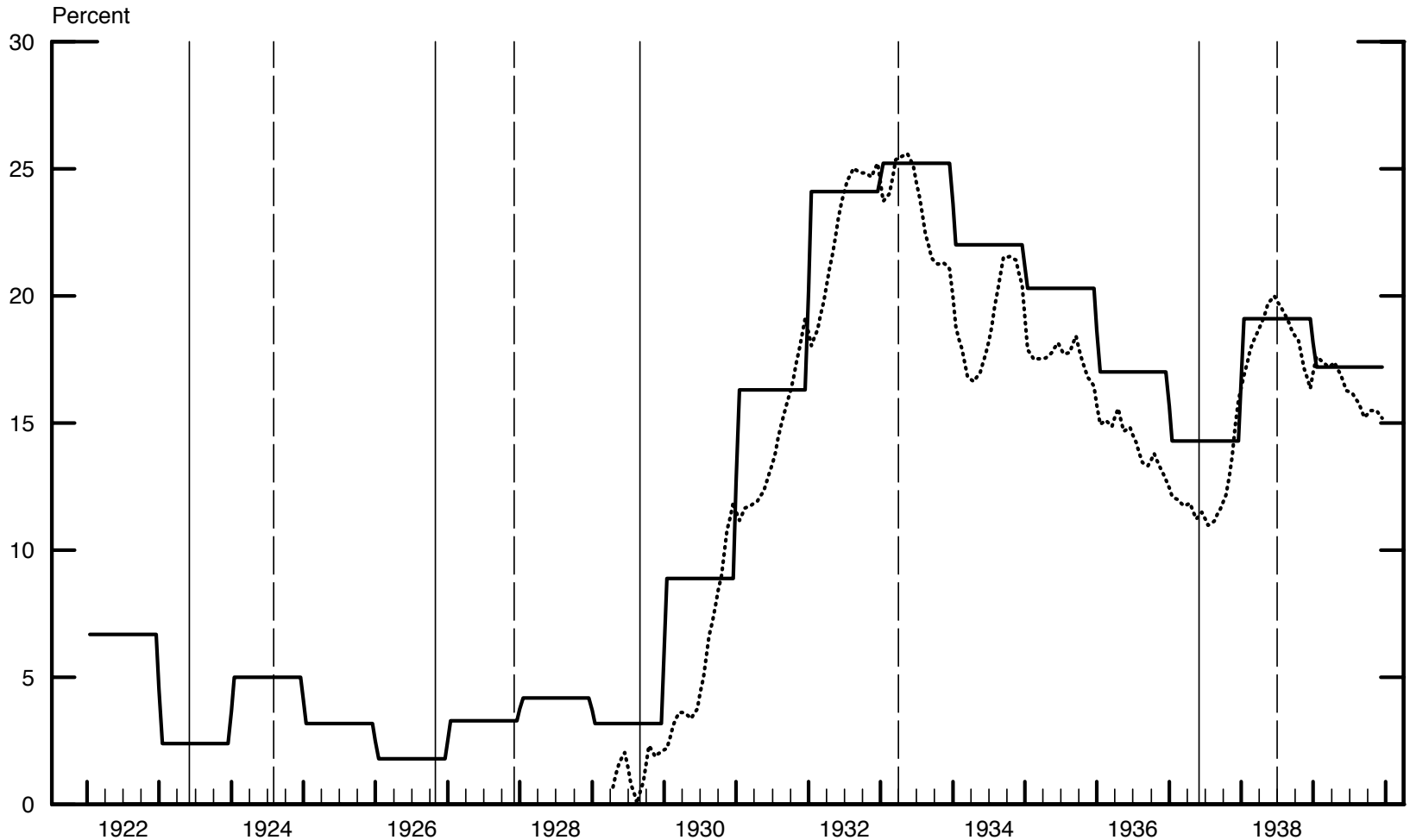
FIGURE 11 : Industrial production



2. Facts

The US Great Depression

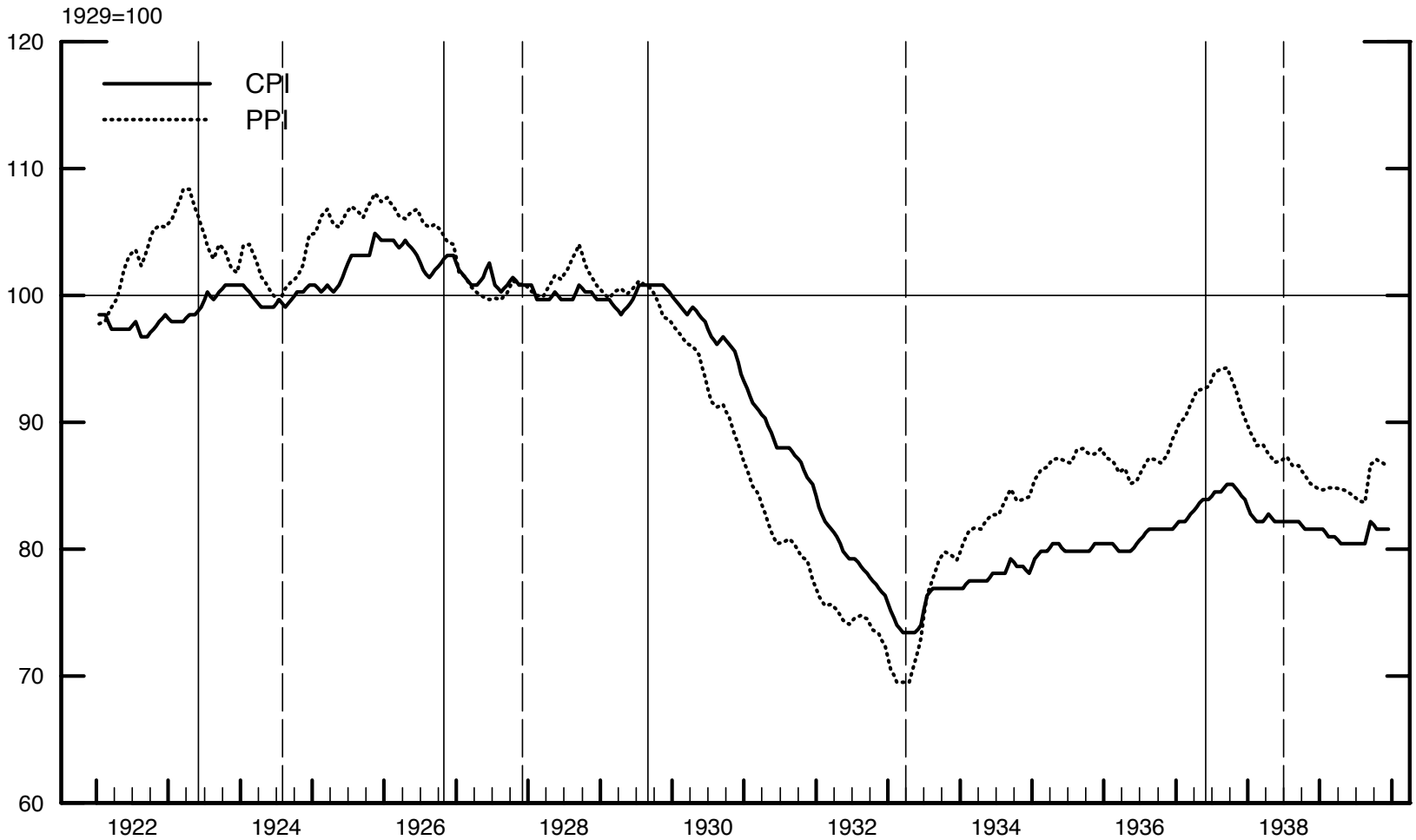
FIGURE 12 : Unemployment rate



2. Facts

The US Great Depression

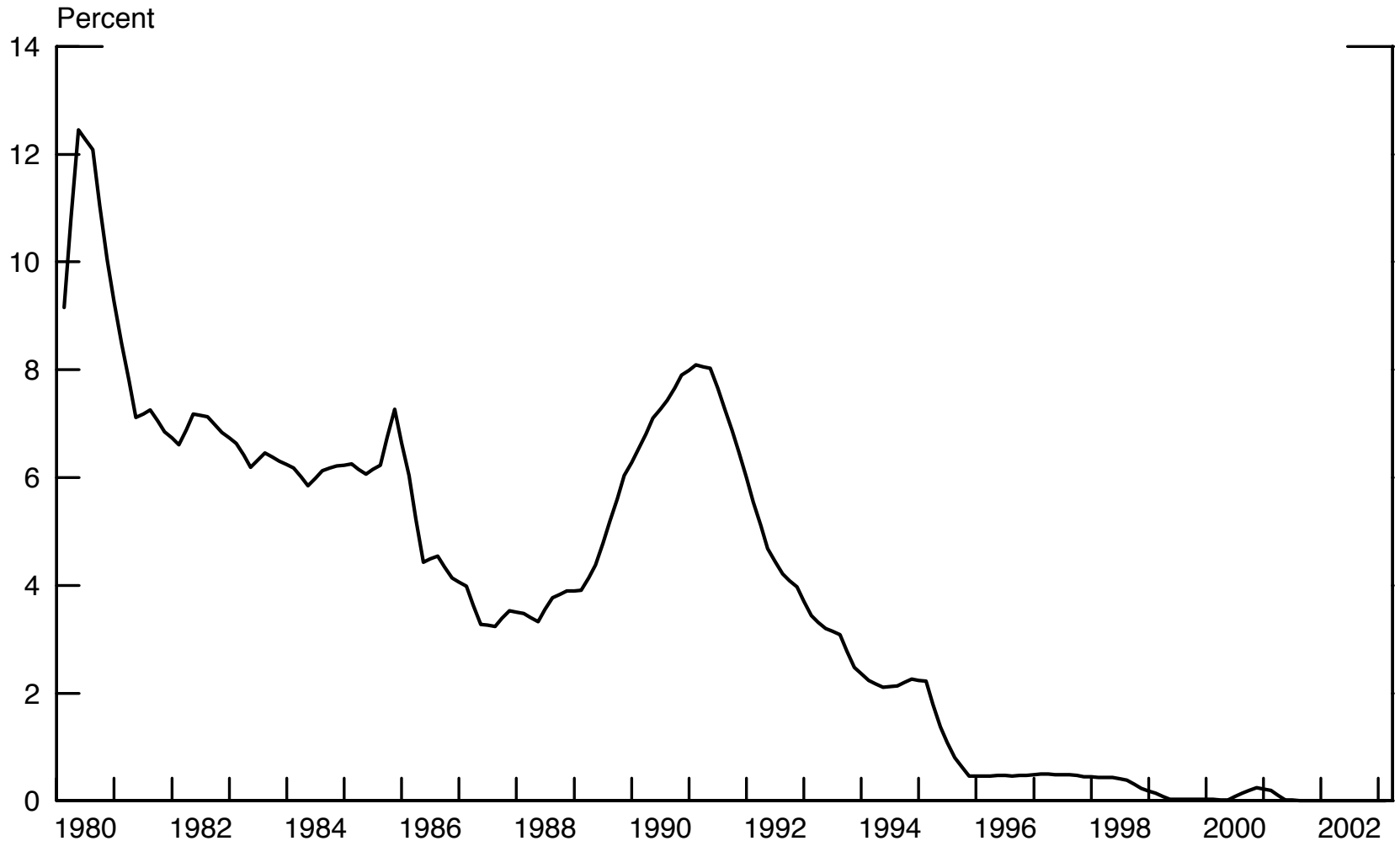
FIGURE 13 : Consumer and Producer Prices



2. Facts

The Japan's lost decade of the 1990s

FIGURE 14 : Overnight Interest rate



2. Facts

The Japan's lost decade of the 1990s

FIGURE 15 : Equity prices (Nikkei Index)



2. Facts

The Japan's lost decade of the 1990s

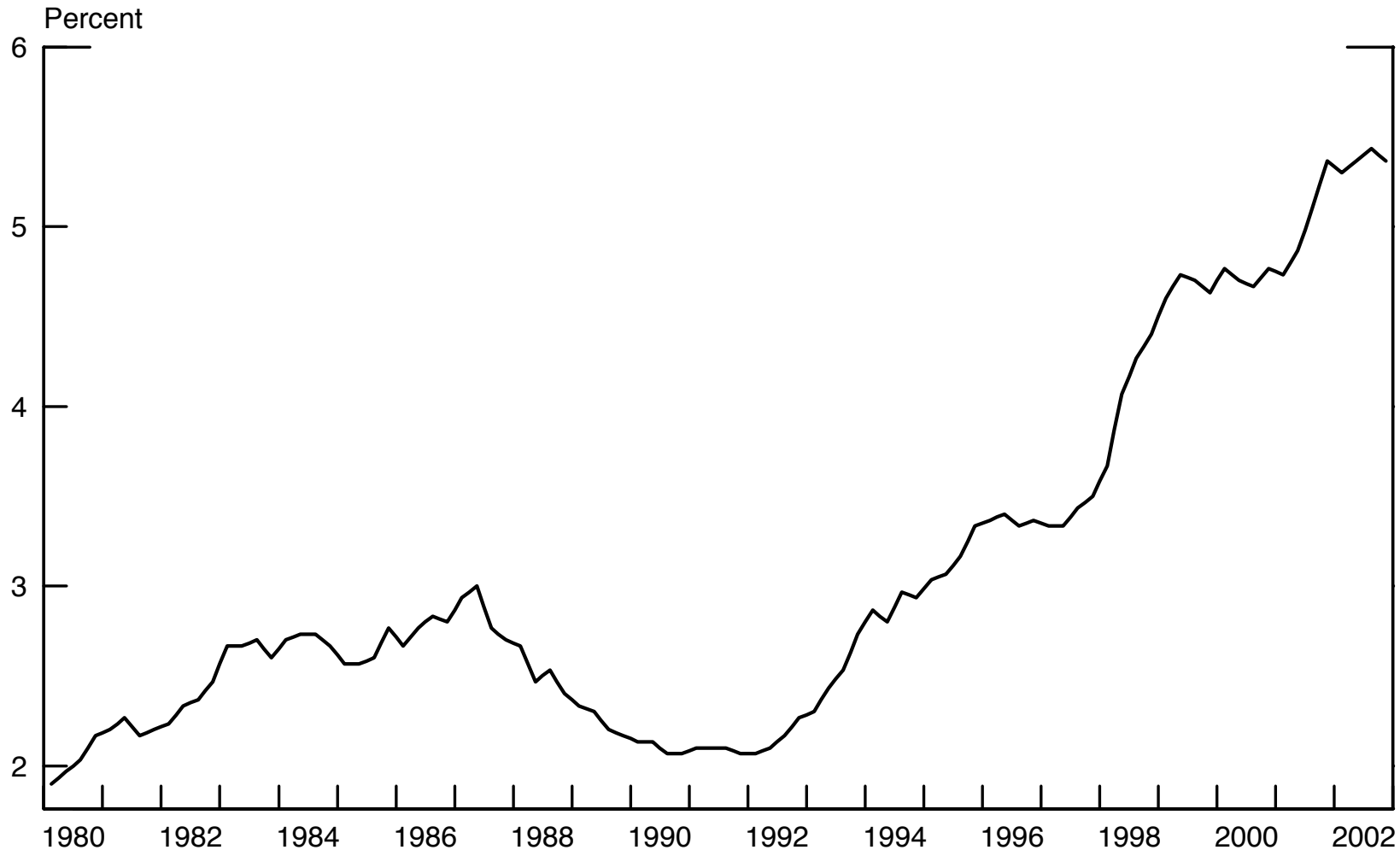
FIGURE 16 : Industrial production



2. Facts

The Japan's lost decade of the 1990s

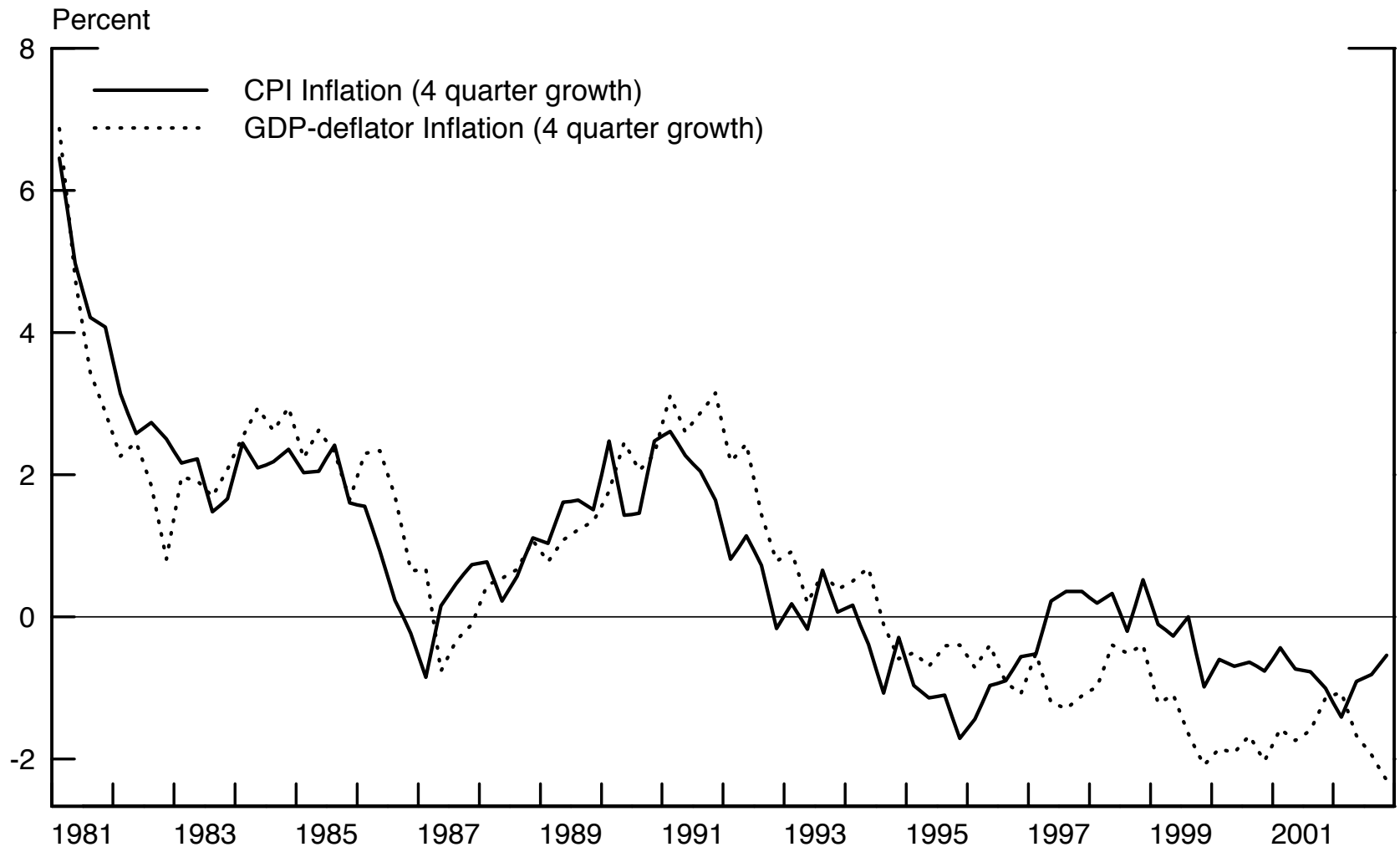
FIGURE 17 : Unemployment rate



2. Facts

The Japan's lost decade of the 1990s

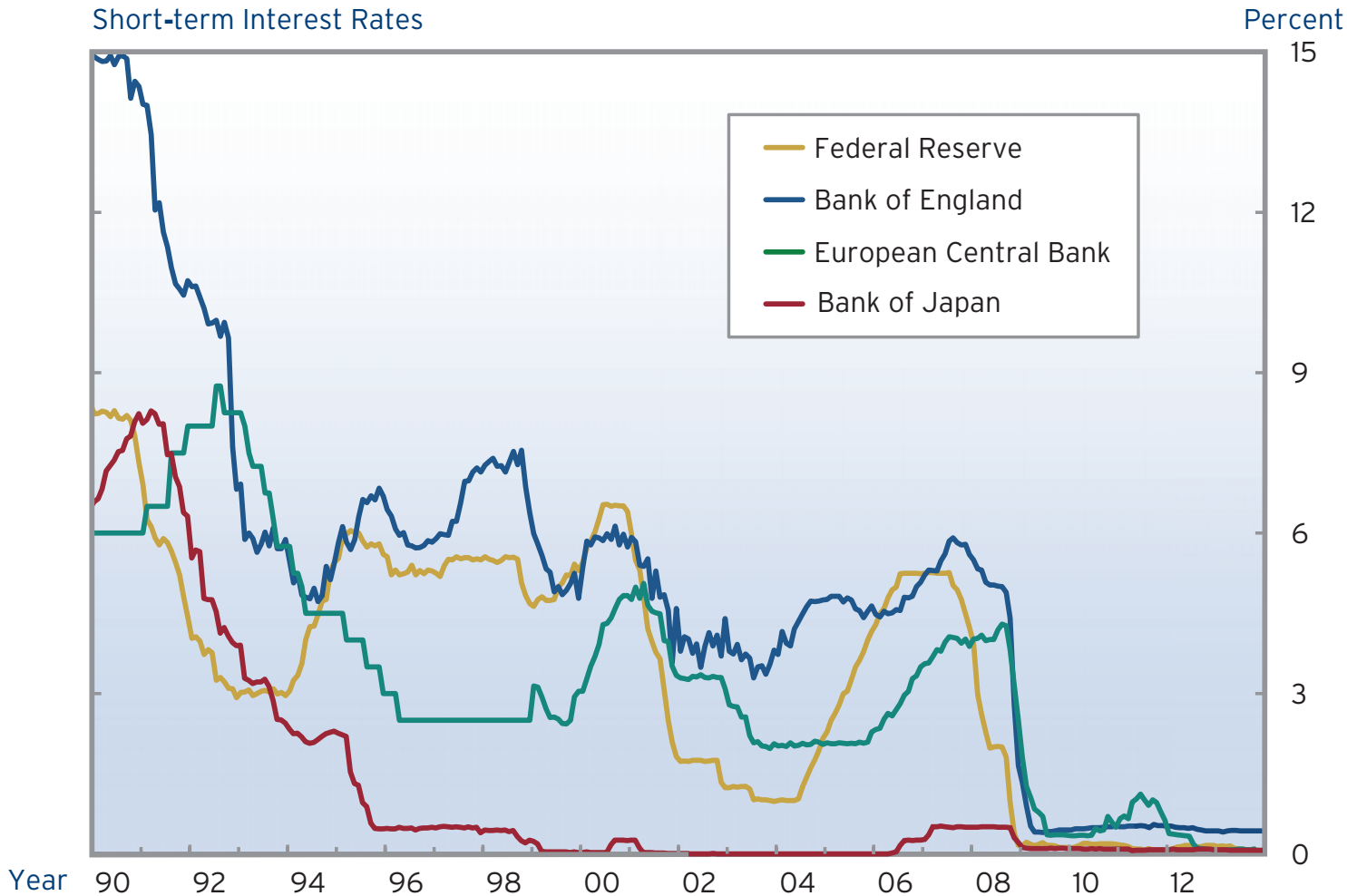
FIGURE 18 : Inflation (CPI and GDP deflator)



2. Facts

The Great Recession

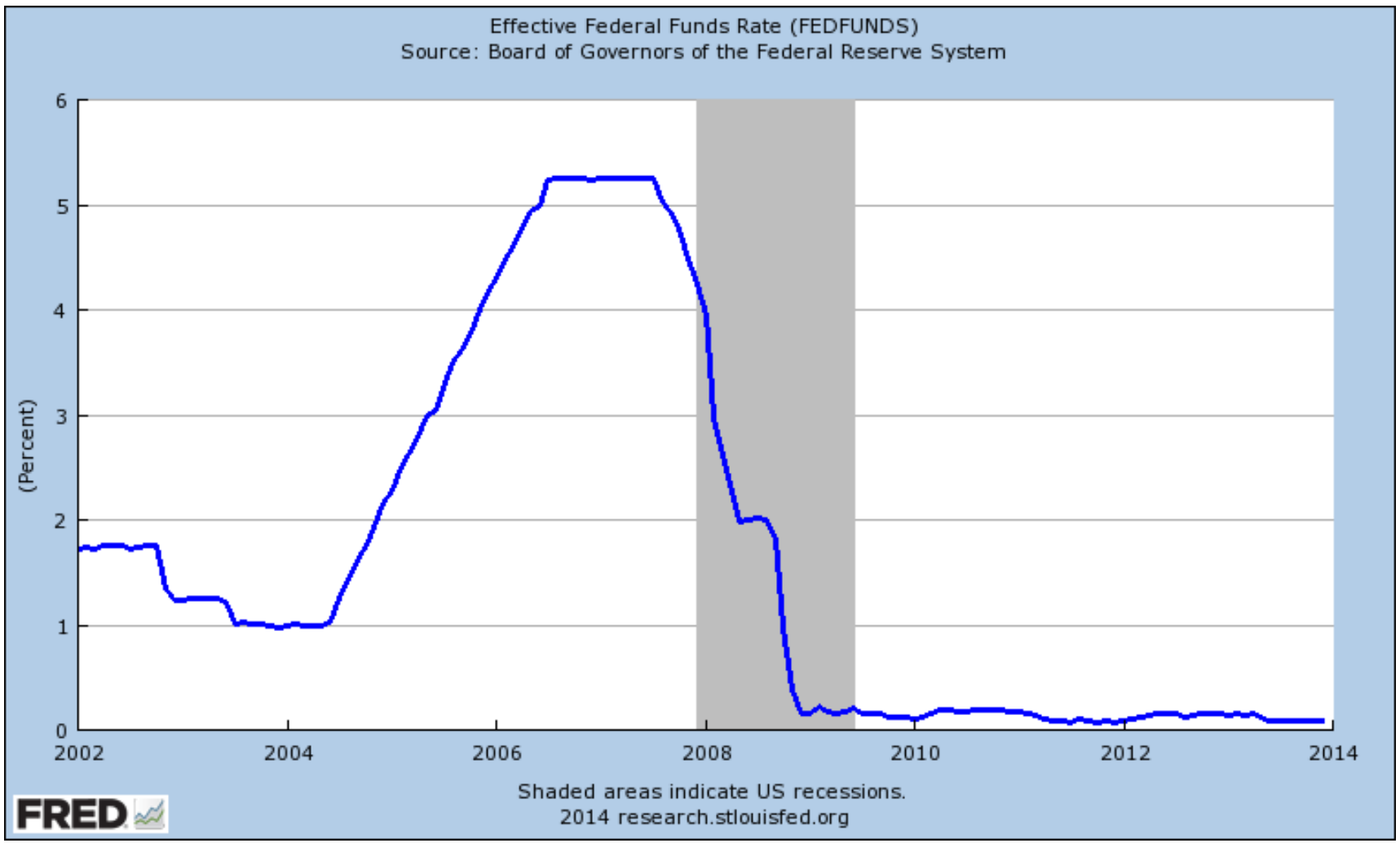
FIGURE 19 : Short term interest rates



2. Facts

The US Great Recession

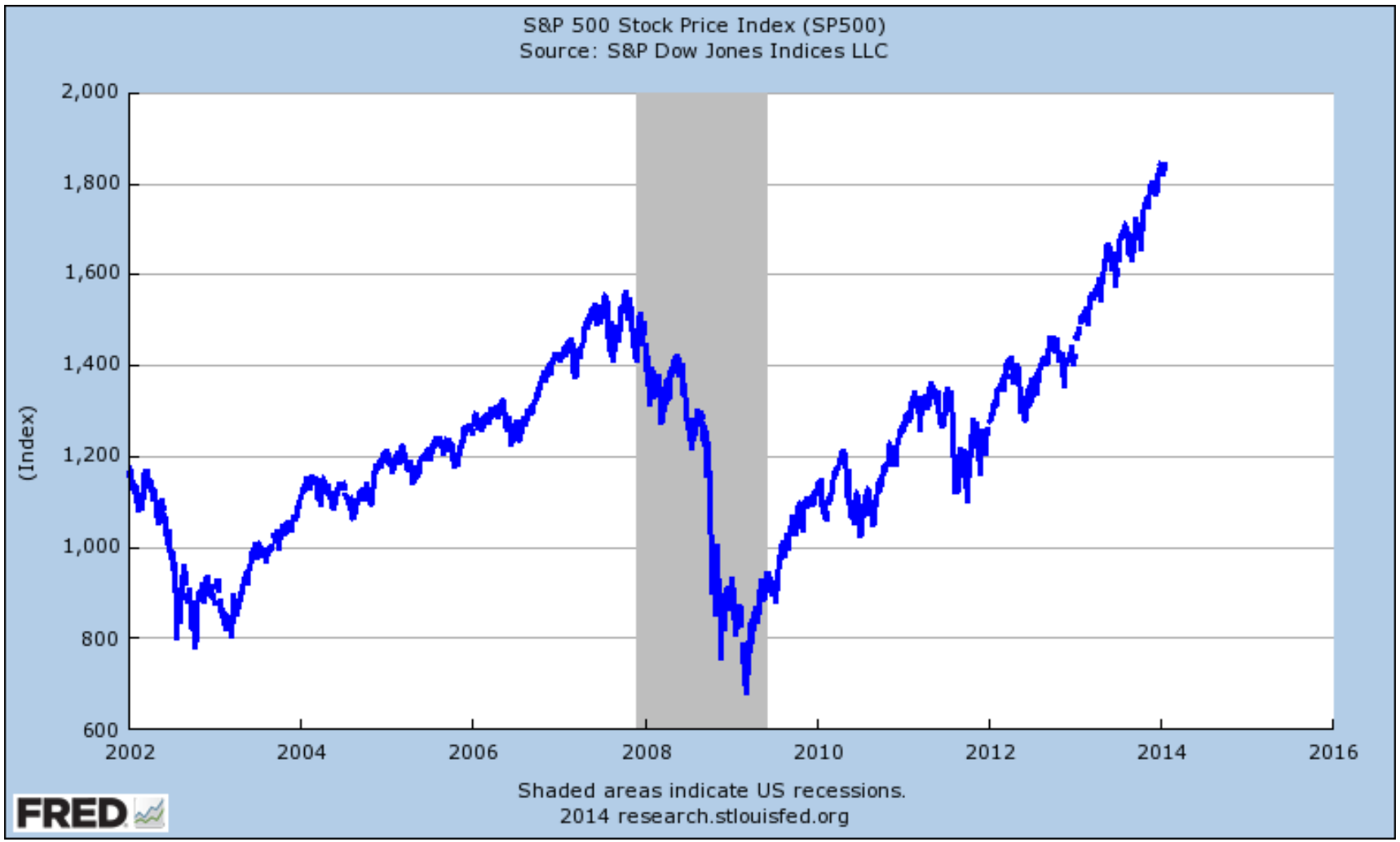
FIGURE 20 : Federal Fund Rate



2. Facts

The US Great Recession

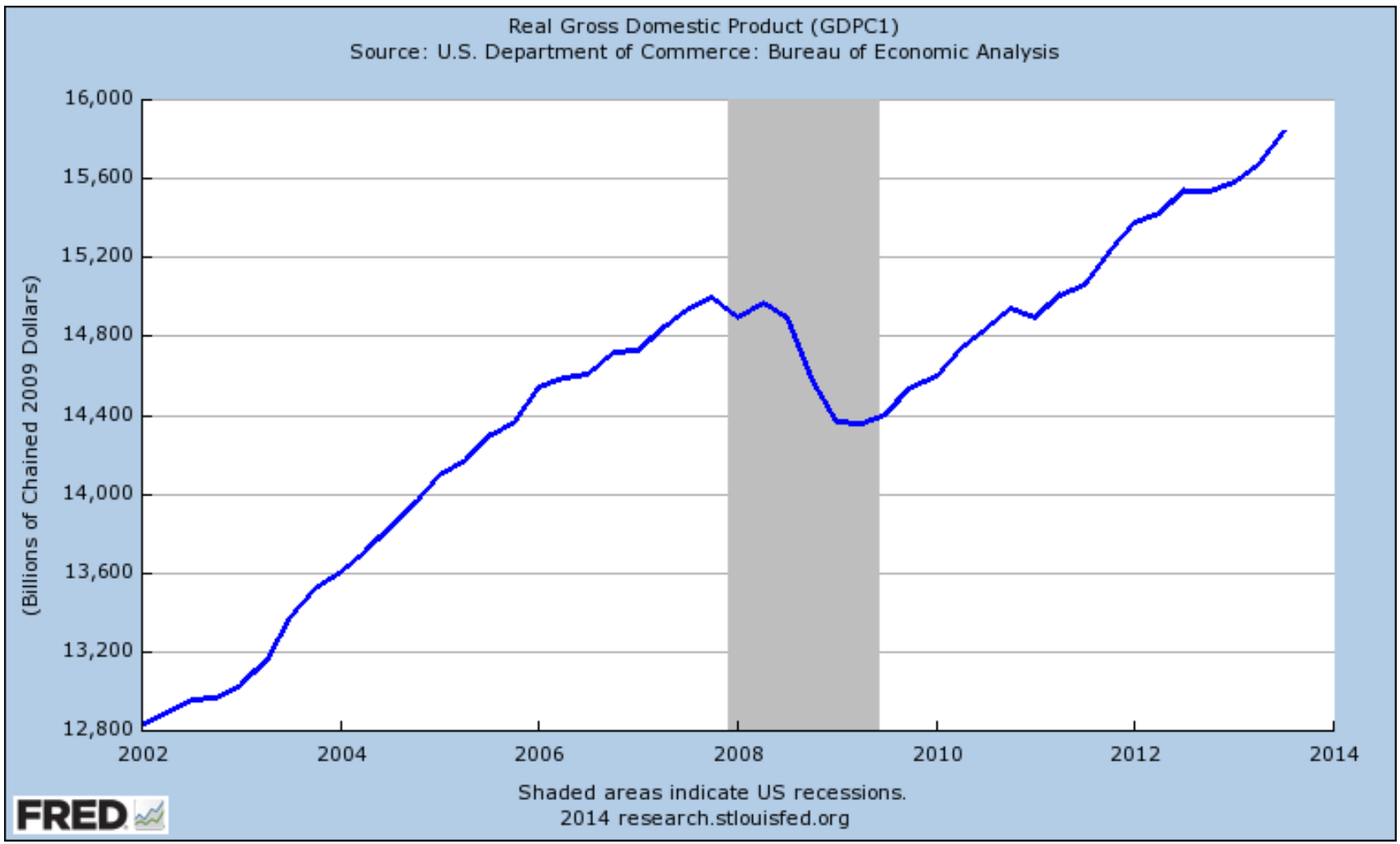
FIGURE 21 : Equity prices (S&P500 Index)



2. Facts

The US Great Recession

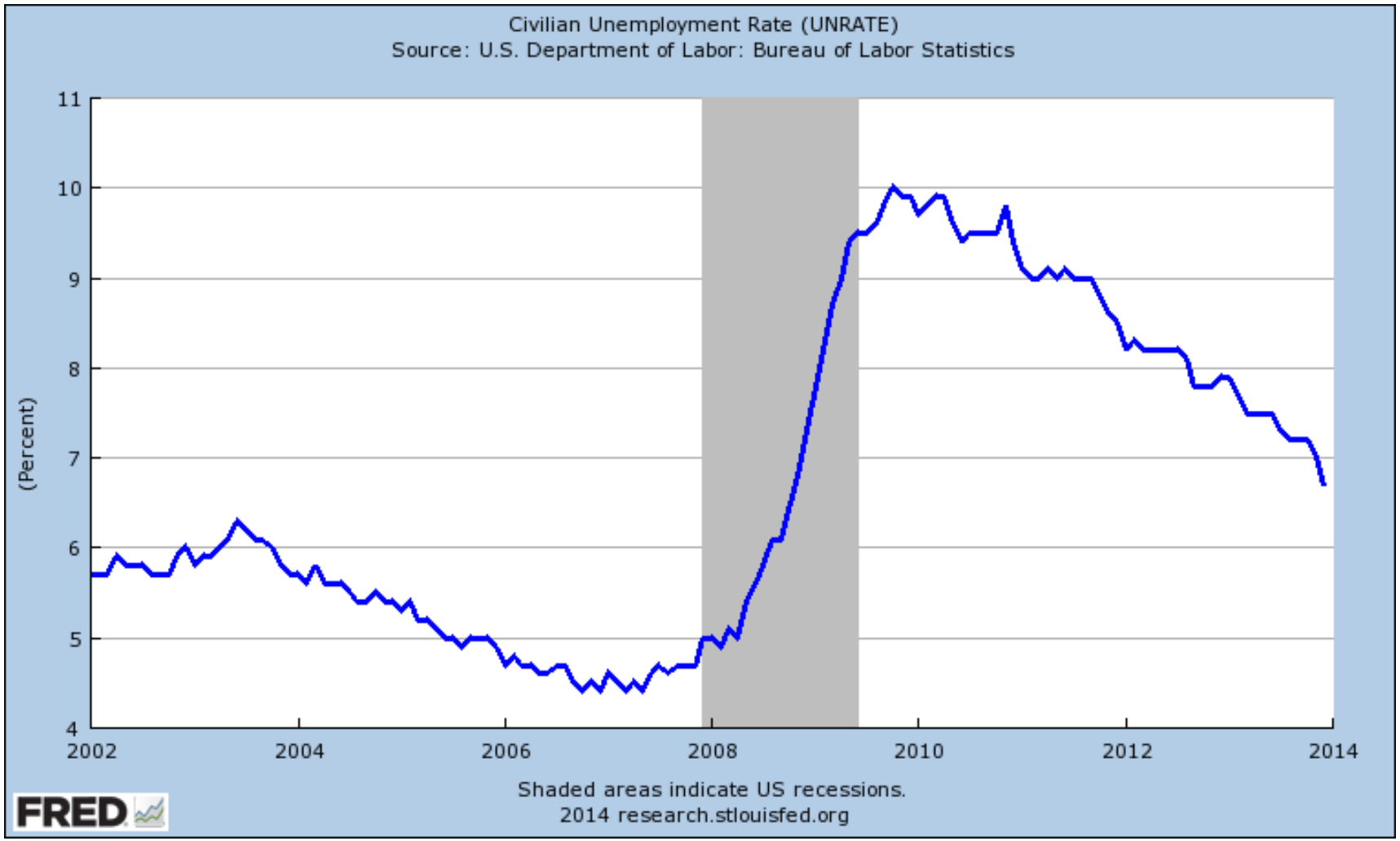
FIGURE 22 : Real GDP



2. Facts

The US Great Recession

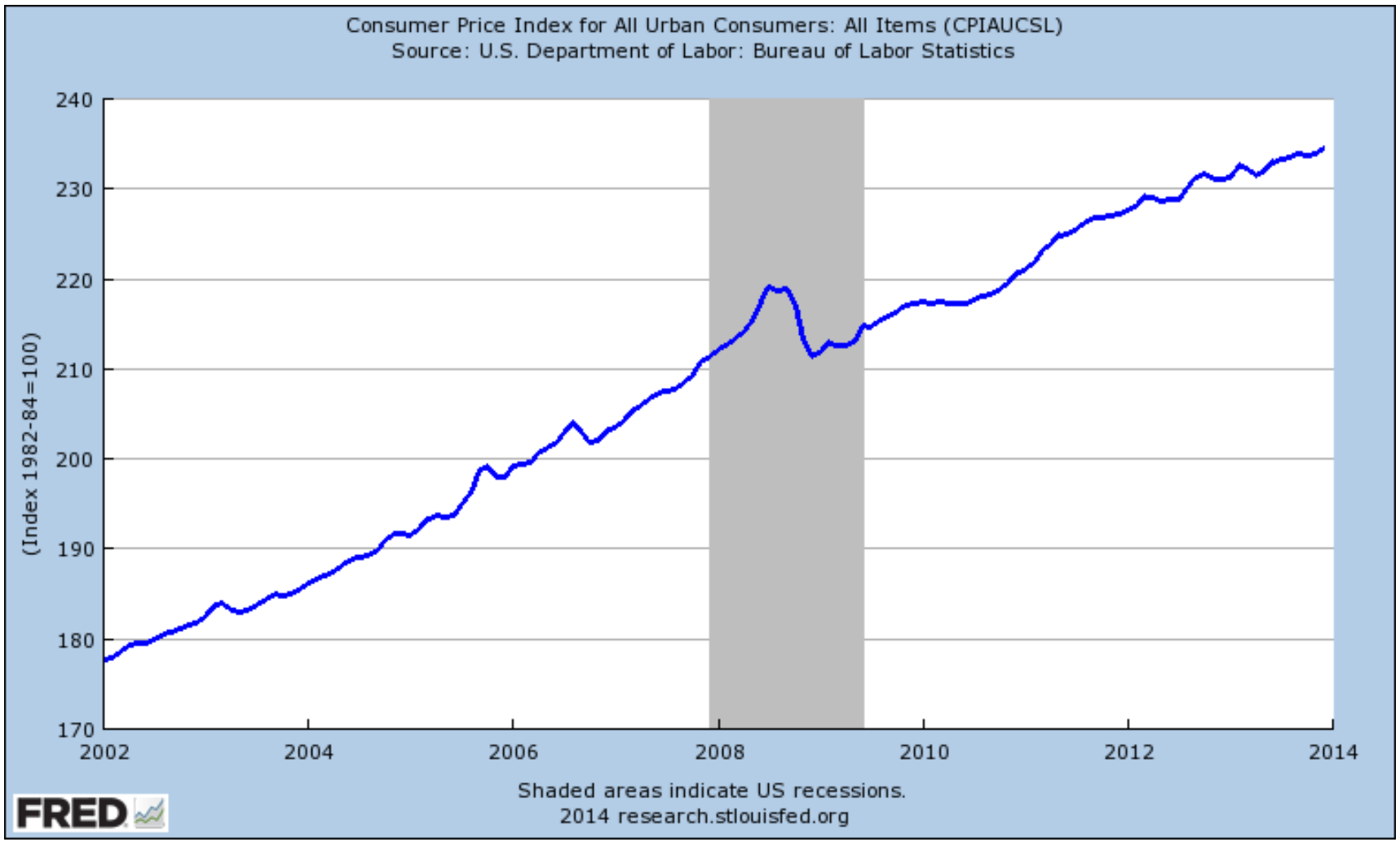
FIGURE 23 : Unemployment rate



2. Facts

The US Great Recession

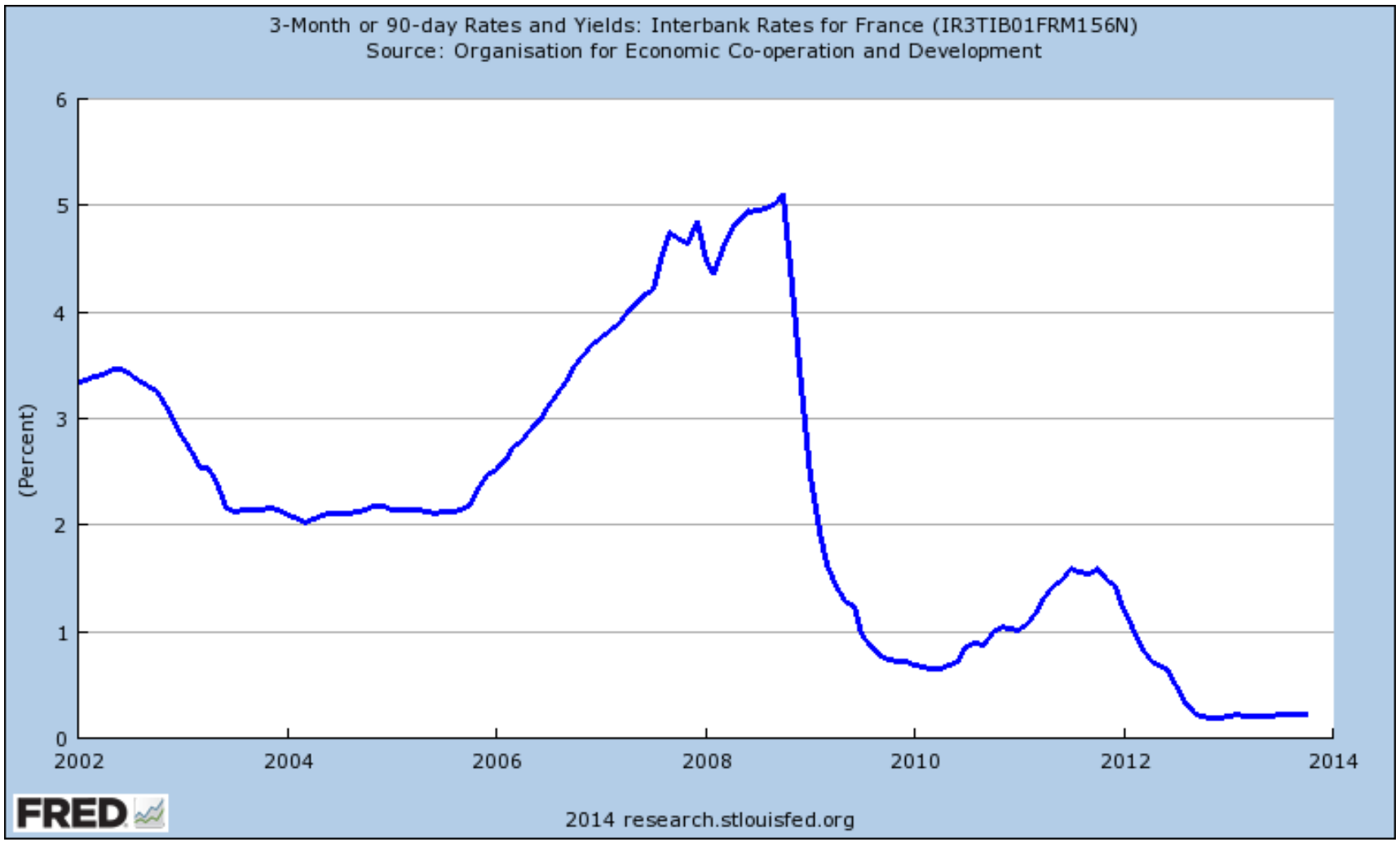
FIGURE 24 : Consumer Price Index)



2. Facts

The French Great Recession

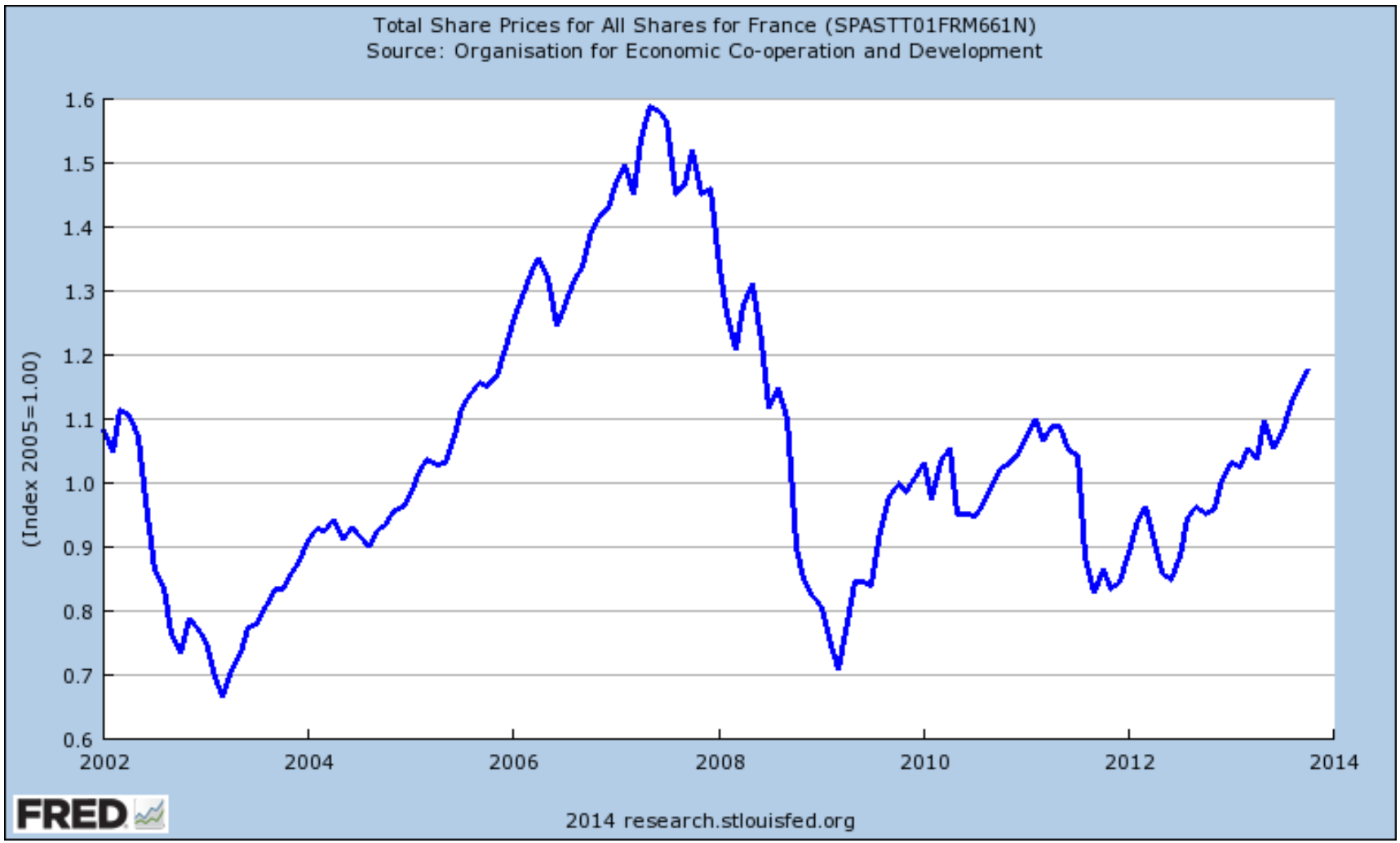
FIGURE 25 : 90-day Interbank Rate



2. Facts

The French Great Recession

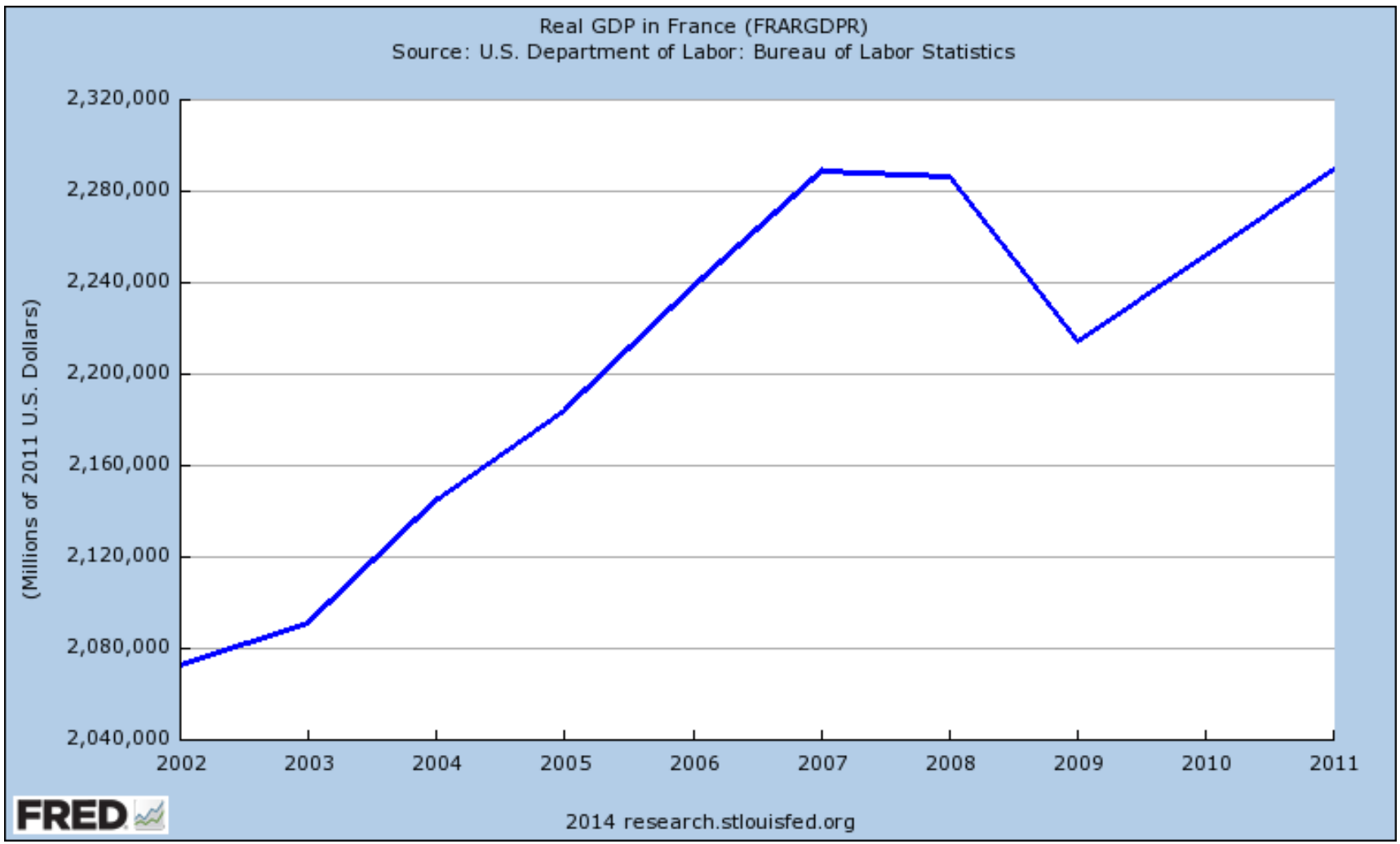
FIGURE 26 : Equity prices (Total Share Price Index)



2. Facts

The French Great Recession

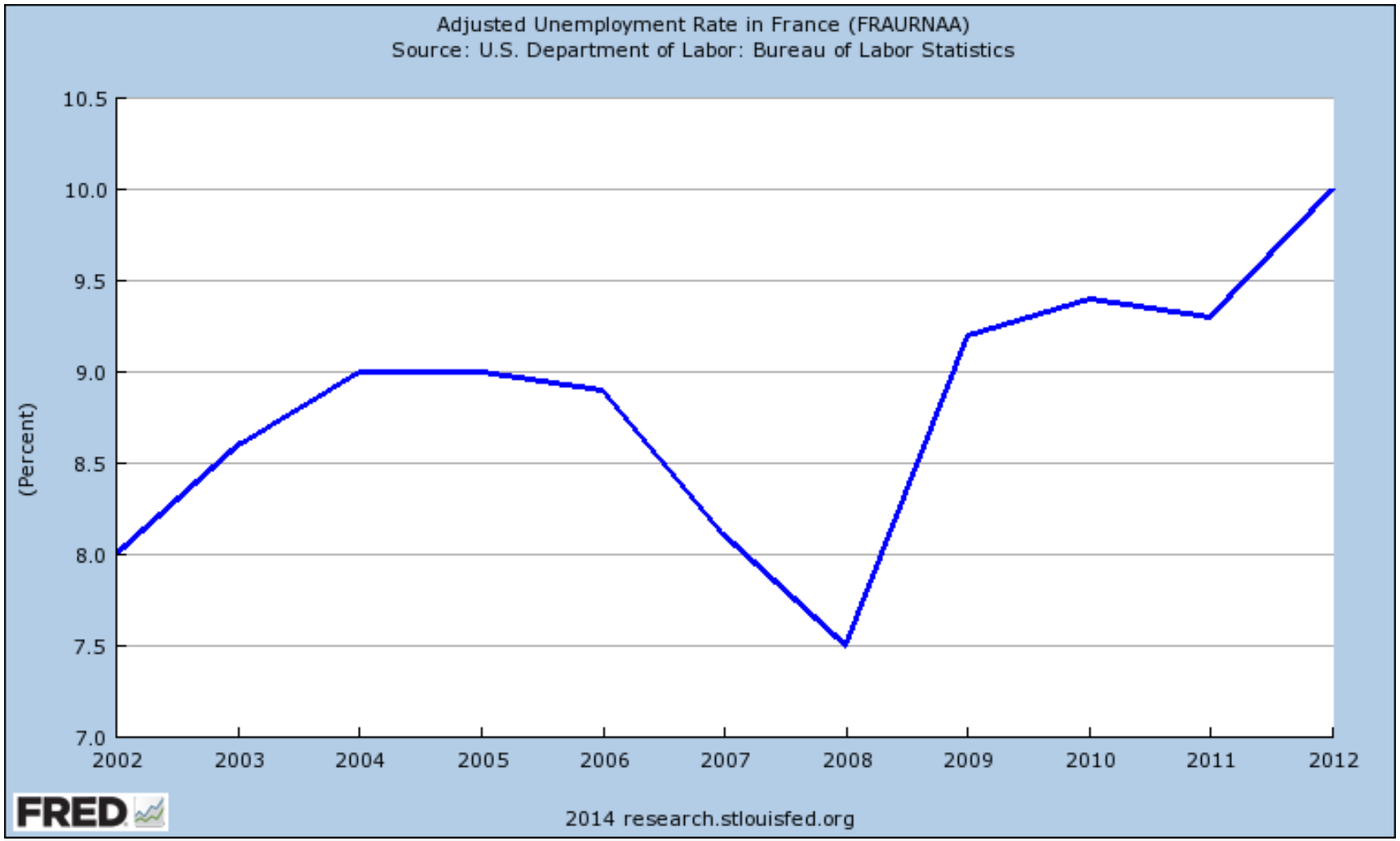
FIGURE 27 : Real GDP



2. Facts

The French Great Recession

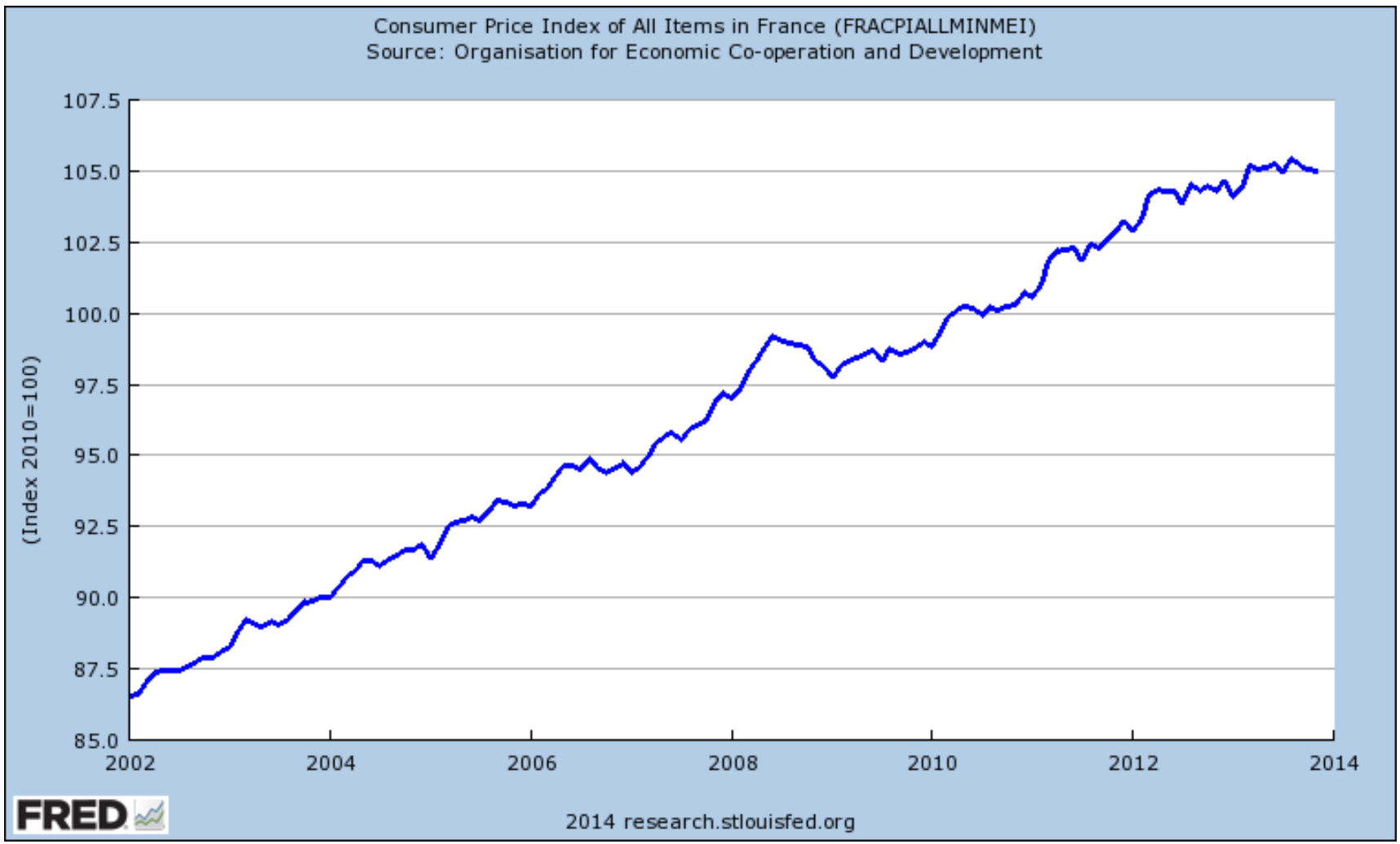
FIGURE 28 : Unemployment rate



2. Facts

The French Great Recession

FIGURE 29 : Consumer Price Index



3. A Microfounded Model

The model

- A model proposed by Paul Krugman (1998)
- It gives a general equilibrium with micro-foundations and dynamics to IS-LM
- Deterministic economy
- One representative household

$$U = \sum_{t=0}^{\infty} \beta^t \log c_t$$

  with $1 > \beta > 0$.
- Endowment economy : y_t given
- The good is perishable
- Two assets : Money M_t and Bonds B_t

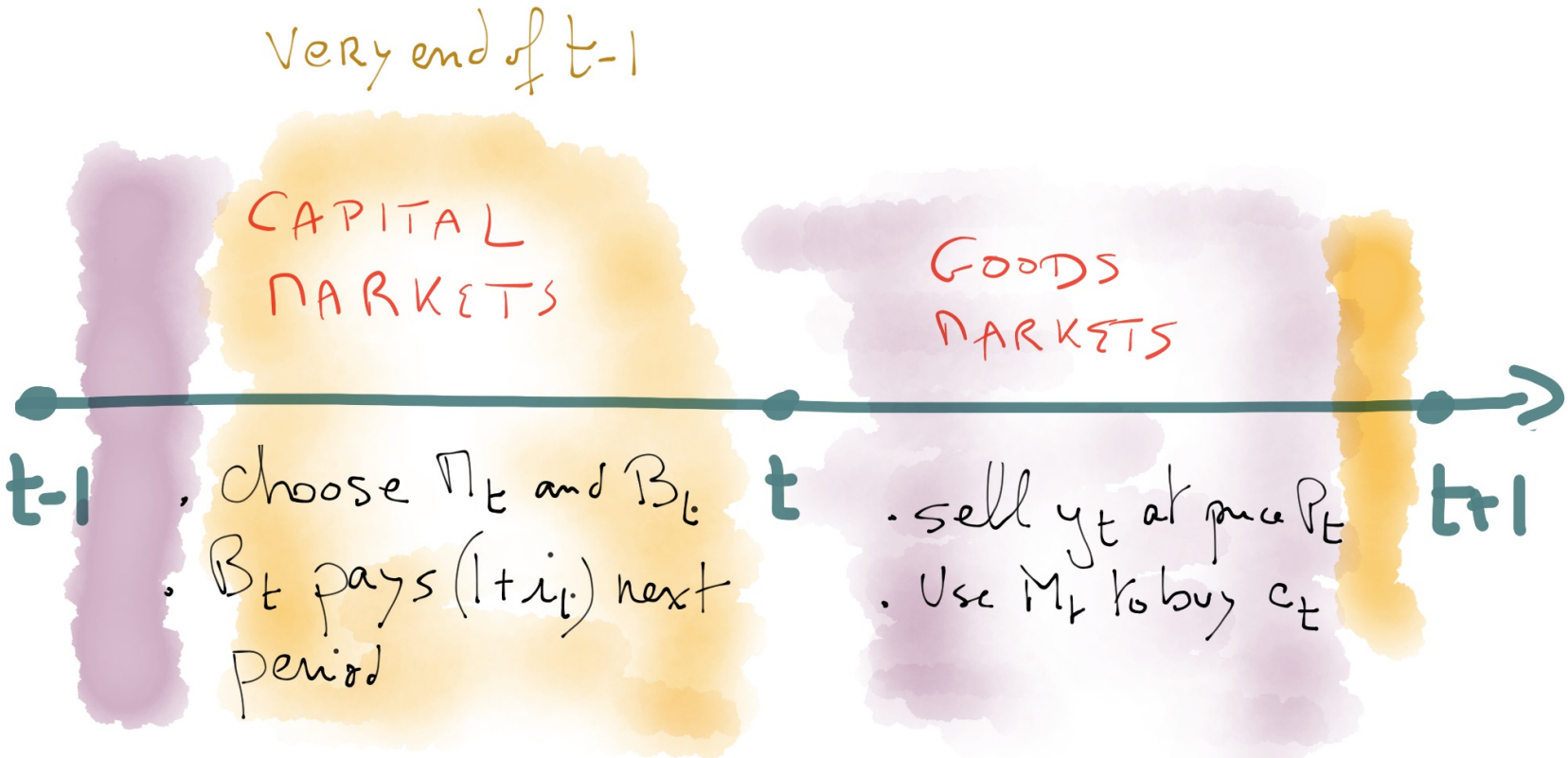
3. A Microfounded Model

The model

- Cash in Advance constraint

$$P_t c_t \leq M_t$$

- Timing :



- The Hh maximizes utility under a sequence of period t budget constraint and cash in advance constraint :

$$\begin{aligned} B_{t+1} + M_{t+1} + P_t c_t &\leq (1 + i_t) B_t + M_t + P_t y_t + X_t && (\lambda_t) \\ P_t c_t &\leq M_t && (\mu_t) \end{aligned}$$

- X is newly created money distributed to Hh
- λ and μ are positive or nul Lagrange multipliers

- The Lagrangian is

$$\begin{aligned}\mathcal{L} &= \sum_{t=0}^{\infty} \beta^t \log c_t \\ &+ \sum_{t=0}^{\infty} \lambda_t \left((1+i_t)B_t + M_t + P_t y_t + X_t - B_{t+1} - M_{t+1} - P_t C_t\right) \\ &+ \sum_{t=0}^{\infty} \mu_t \left(M_t - P_t C_t\right)\end{aligned}$$

3. A Microfounded Model

Solving for the household optimal behavior

- and FOC are $\forall \quad t \geq 0$

$$\begin{array}{lcrcl}
\text{w.r.t. } c_t & : & \beta^t u'(c_t) & = & (\mu_t + \lambda_t) P_t \\
\text{w.r.t. } B_{t+1} & : & \lambda_t & = & (1 + i_{t+1}) \lambda_{t+1} \\
\text{w.r.t. } M_{t+1} & : & \lambda_t & = & \lambda_{t+1} + \mu_{t+1} \\
\text{slackness} & : & \mu_t (M_t - P_t c_t) & = & 0 \\
 & & \mu_t & \geq & 0
\end{array}$$

- There is also a slackness condition for the budget constraint. I do not write it as it will always bind.
- Proof : Assume $\lambda_t = 0$. Then the third FOC implies $\lambda_{t+1} + \mu_{t+1} = 0$. As multipliers are positive or nul, this implies $\lambda_{t+1} = \mu_{t+1} = 0$. Therefore, the first FOC implies $\beta^t u'(c_t) = 0$. This is not possible because $u'(c_t) = 1/c_t > 0$. Therefore $\lambda_t = 0$ is not possible, so that $\lambda_t > 0$ for all t.

- Which gives (*see details in class)*

$$1 + i_t = \underbrace{\left(\frac{u'(c_t)}{\beta u'(c_{t+1}} \right)}_{1+r_t} \left(\frac{P_{t+1}}{P_t} \right)$$

$$P_t c_t = M_t \qquad \text{if} \quad i_t > 0$$

- If $i_t = 0$, then $\mu_t = 0$: the CIA constraint may not be binding : Hh is indifferent between money and bonds.

- All agents are identical (representative household) $\rightsquigarrow$ The equilibrium on the bond market is

$$B_t = 0$$

- Money market equilibrium :

$$M_{t+1} = M_t + X_t$$

- Good market equilibrium

$$c_t = y_t$$

- Remark : the equilibrium quantities can be determined without using the FOC
- The FOC are determining *equilibrium prices*, i.e. the prices P and i such that markets clear.

- In what follows, we restrict to a specific case :
  - for $t \geq 1$, $y_t = y^\star$, $M_t = M^\star$.
  - Period 0 : y, M.
- We can the solve the model in the following way
  - Solve for period 1 and onwards
  - Solve for period 0

3. A Microfounded Model

Equilibrium with flexible prices - Period 1 and onwards

- $c_t = y_t = y^\star$ implies

$$1 + r^\star = \frac{1}{\beta} > 1$$

  such that $r^\star > 0$
- Let us guess an equilibrium in which the CIA constraint binds :

$$P^\star = \frac{M^\star}{y^\star}$$

- In such a case,

$$1 + i_t = \frac{(1 + r_t)P_{t+1}}{P_t}$$

- implies

$$1 + i^\star = \frac{(1 + r^\star)P^\star}{P^\star} = 1 + r^\star$$

- Therefore $i^\star = r^\star > 0$
- Because $i^\star > 0$, the CIA binds, so that our guess was correct.

3. A Microfounded Model

Equilibrium with flexible prices - Period 0

- The equilibrium in period $t \geq 1$ is therefore $y^\star$, $i^\star = r^\star = 1/\beta$, $P^\star = M^\star/y^\star$
- The equilibrium (i, P) in period 0 is given by the equations :

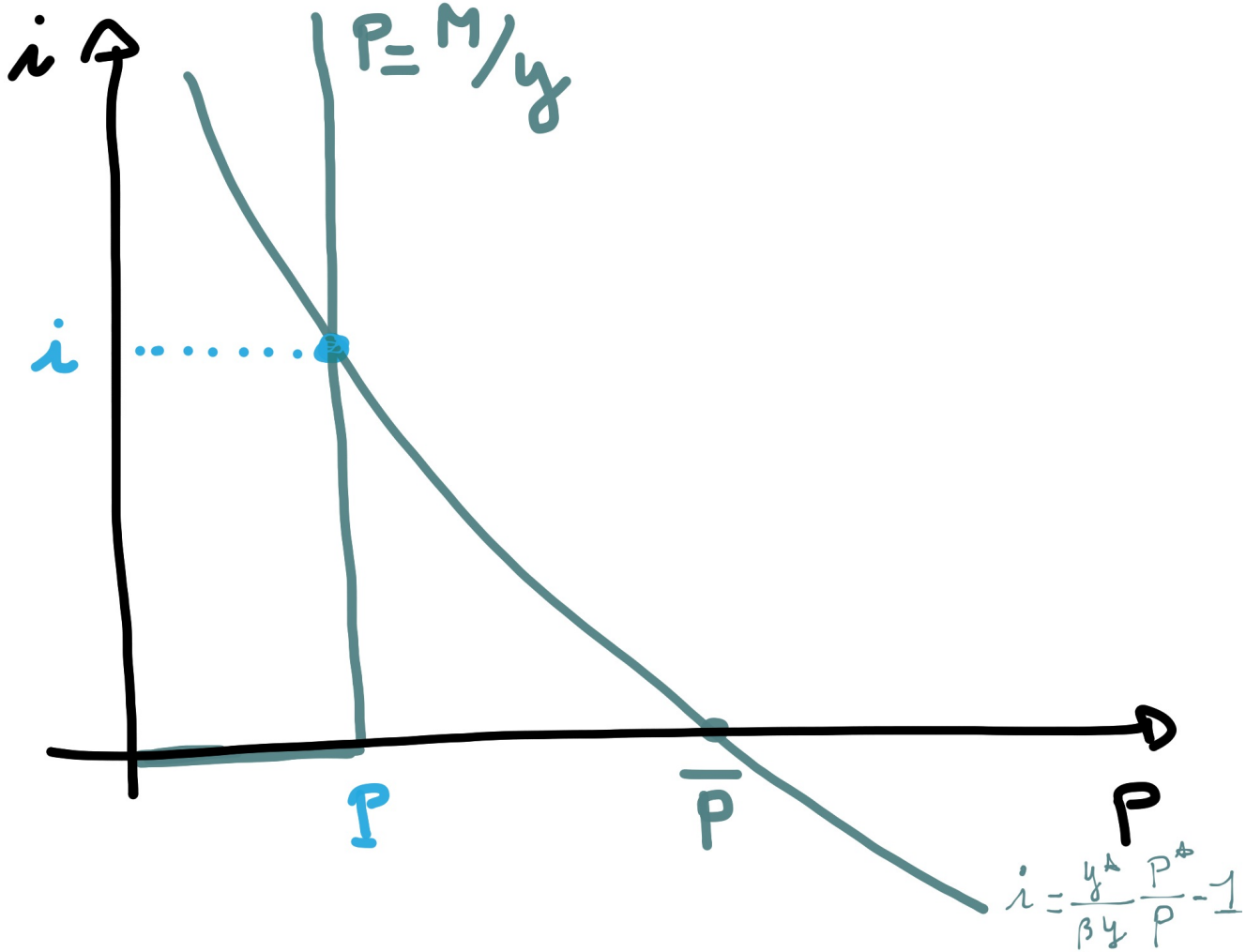
$$\begin{aligned} i &= \frac{y^\star}{\beta y}\frac{P^\star}{P} - 1 \\ P &= \frac{M}{y} \quad \text{if } i > 0 \\ P &= \overline{P} \quad \text{if } i = 0 \end{aligned}$$

- where we have to define $\overline{P}$
- $\frac{P^\star}{P} - 1$ represents expected inflation

3. A Microfounded Model

Equilibrium with flexible prices - Period 0

FIGURE 30 : Equilibrium in period 0 - Flexible prices



3. A Microfounded Model

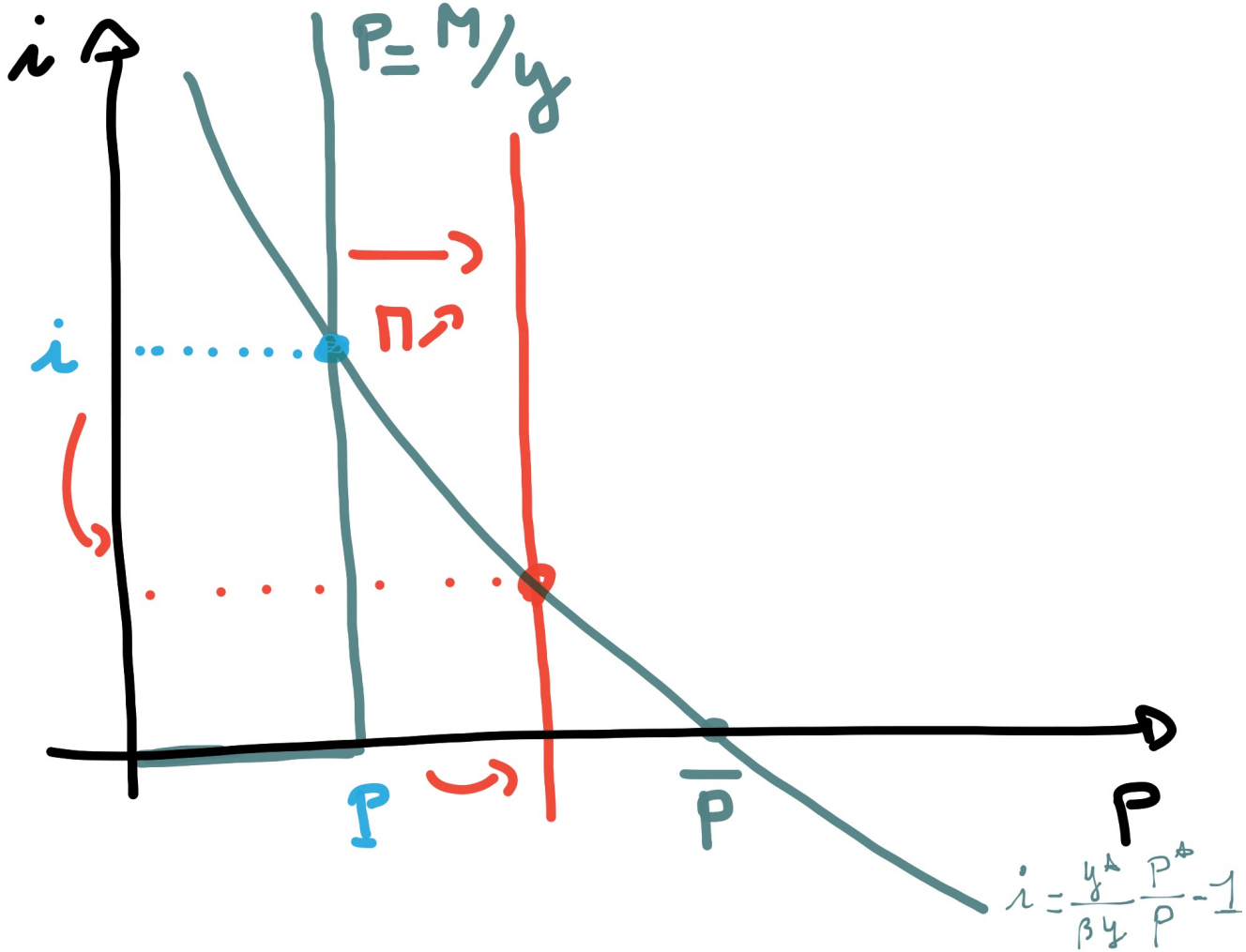
Equilibrium with flexible prices - Period 0

- How does the model works ?
- Suppose an increase in money supply today M
- Prices today P increase
- As $P^{\star}$ is given, inflation is reduced.
- Because consumption is independent of monetary policy, $c = y$ and the real interest rate stays constant
- Therefore, the decrease in inflation decreases i
- Note that money is neutral
- Important : the above analysis is true as long as $P > \overline{P}$, such that $i > 0$ and the CIA binds.

3. A Microfounded Model

Equilibrium with flexible prices - Period 0

FIGURE 31 : Equilibrium in period 0 - Flexible prices

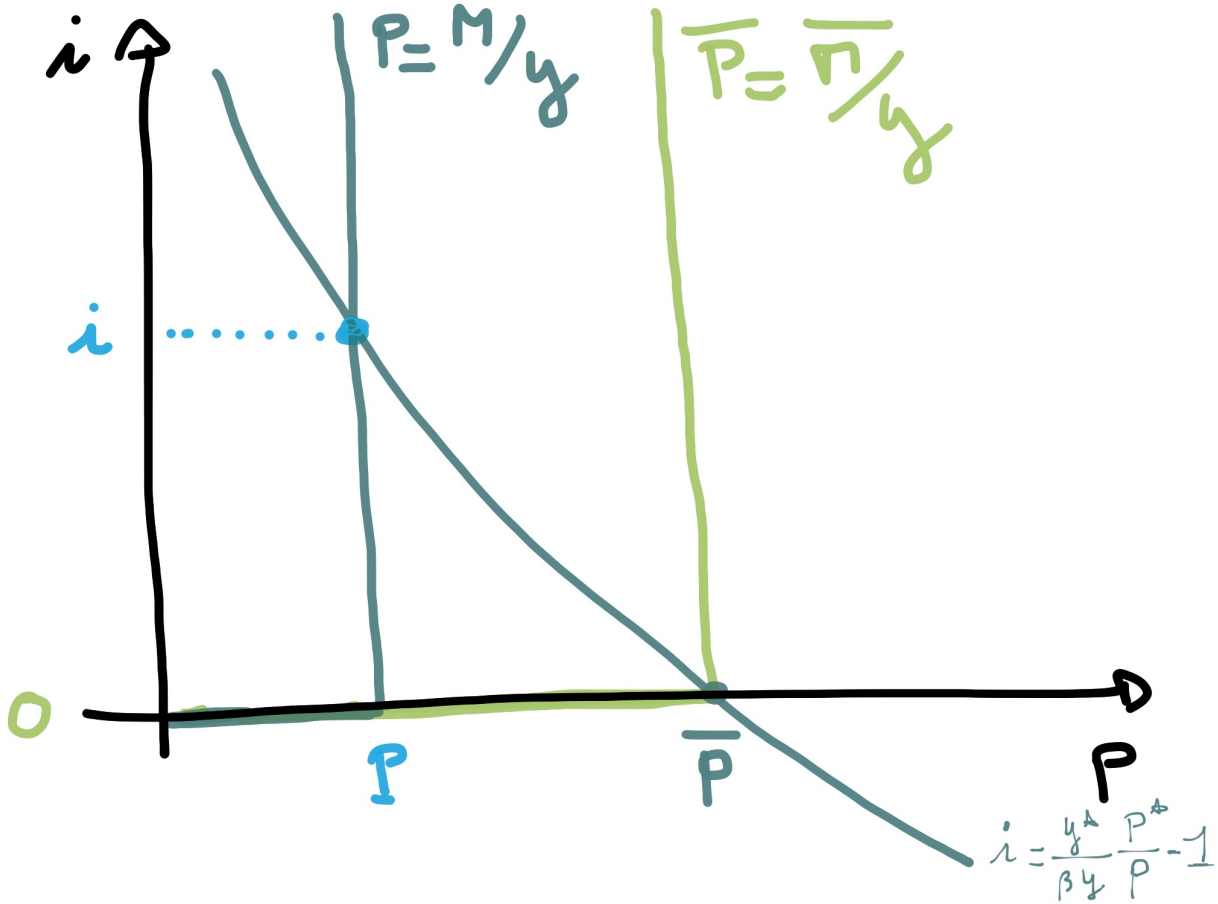


3. A Microfounded Model

Equilibrium with flexible prices - Period 0 - The liquidity trap

- Consider the money supply $\overline{M}$ such that $P = \overline{P}$ and $i = 0$

FIGURE 32 : Equilibrium in period 0 - Flexible prices - $M = \overline{M}$

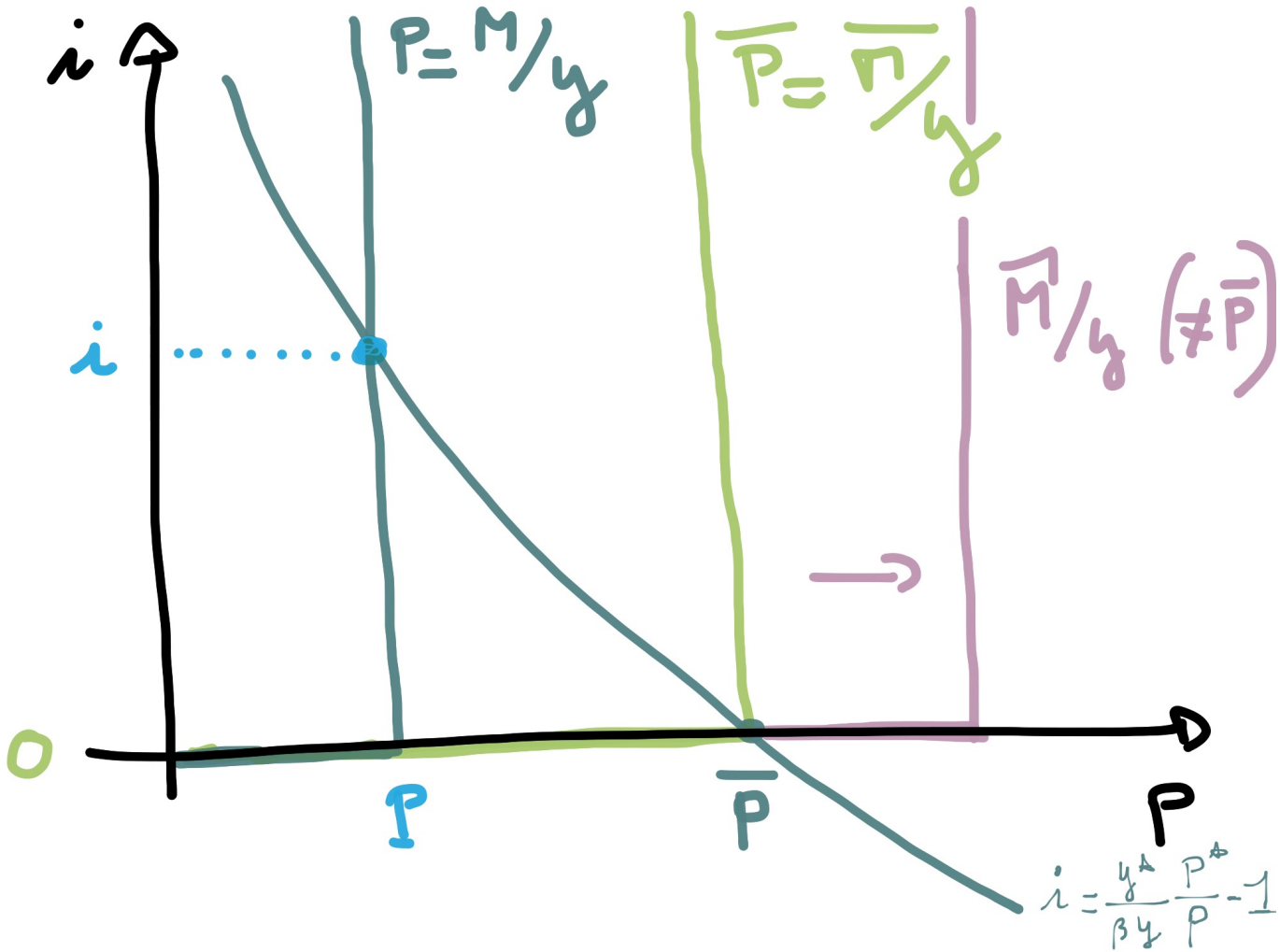


- Consider the money supply $\overline{M}$ such that $P = \overline{P}$ and $i = 0$
- What does happen if M increases above $\overline{M}$ to the level $\widehat{M}$
- If P increases above $\overline{P}$, then $i < 0$ which is not possible.
- Therefore, we must have $i = 0$, and then $P = \overline{P}$
- As $i = 0$, the CIA does not bind
- All the increase in money supply is kept in money (not put in bonds), without any impact on the nominal interest rate i.

3. A Microfounded Model

Equilibrium with flexible prices - Period 0 - The liquidity trap

FIGURE 33 : Equilibrium in period 0 - Flexible prices - $M = \widehat{M}$



- Remark : In the liquidity trap with flexible prices, money cannot reduce inflation below $\frac{P^\star}{\overline{P}}$ (which is actually *deflation*)
- But money is always neutral ... so that we do not care much about the liquidity trap.
- Things will be different if we assume, as in IS-LM, that prices are fixed in period 0.

3. A Microfounded Model

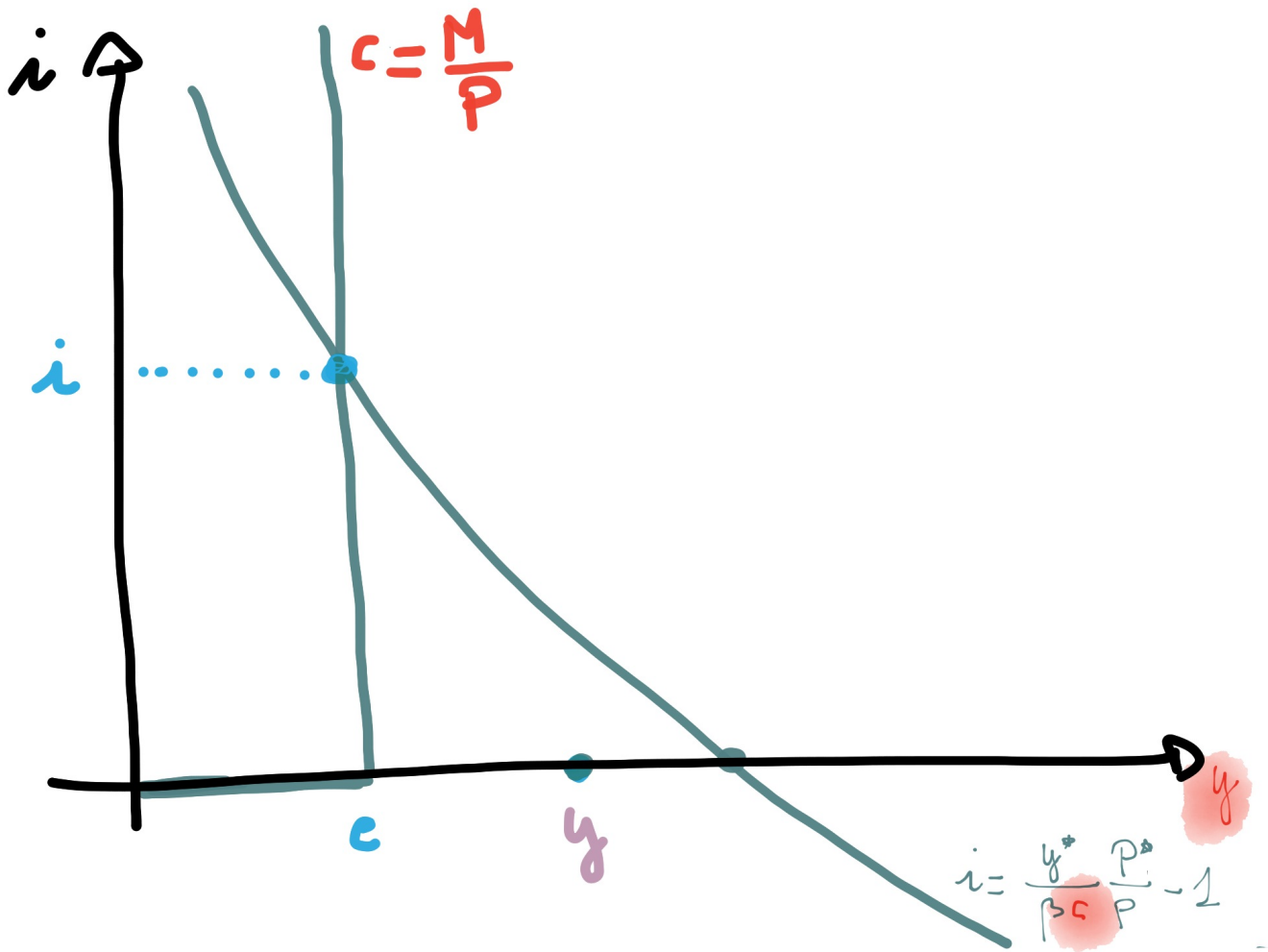
Equilibrium with fix prices - Period 0

- Assume first that $i > 0$, so that the economy is not in the liquidity trap.
- As the CIA constraints binds, we have $Pc = M$,with $c \leq y$
- Monetary policy now determines c as P is fixed

3. A Microfounded Model

Equilibrium with flexible prices - Period 0

FIGURE 34 : Equilibrium in period 0 - Fix prices

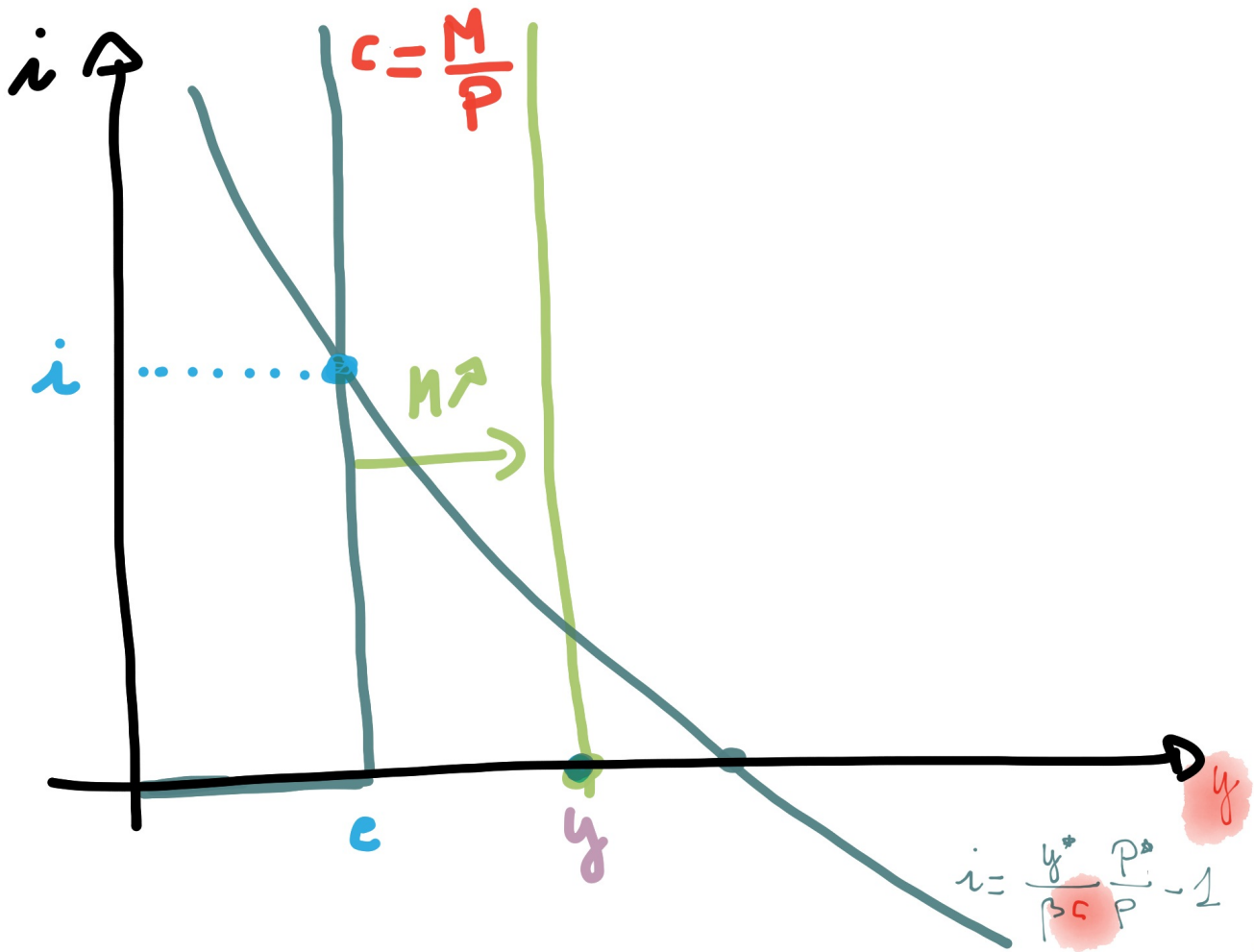


- The economy is in a configuration similar to IS-LM
- As $c < y$, the equilibrium is inefficient (an amount $y - c$ of goods is wasted)
- Assume an increase in M, for given $M^\star$: to clear the money market, i needs to go down. As inflation is fixed, there real interest rate must decrease, which is achieved by an increase in c.

3. A Microfounded Model

Equilibrium with fix prices - Period 0

FIGURE 35 : Equilibrium in period 0 - Fix prices - Monetary policy is efficient

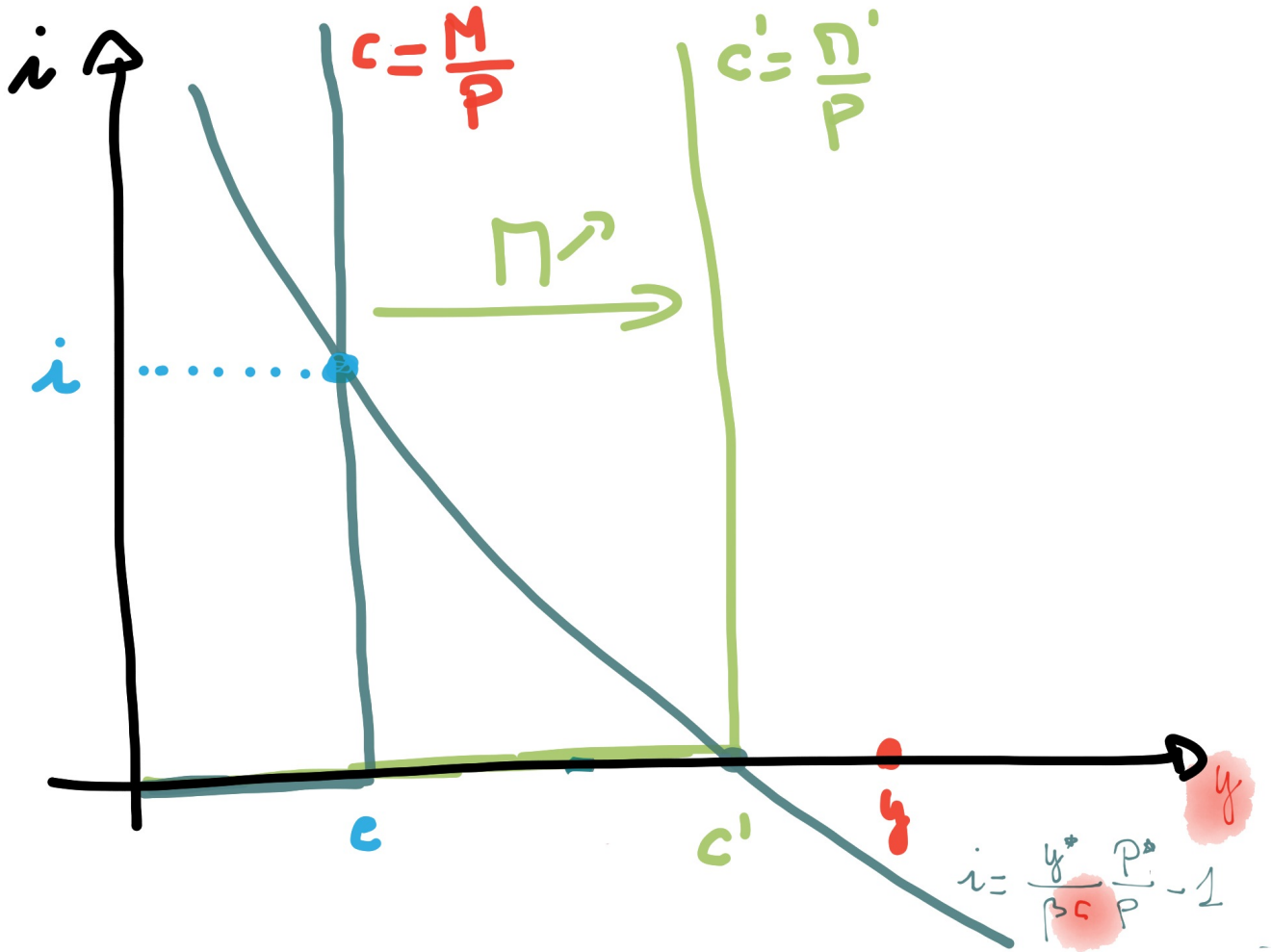


- Now assume that $M = M'$ such that $i = 0$
- The economy enters a liquidity trap
- The CIA is not binding anymore : the money increases will not decrease i
- The economy is stuck at $c < y$ and monetary policy is inefficient.
- For a money supply M'', no increase in c

3. A Microfounded Model

Equilibrium with fix prices - Period 0 - The liquidity trap

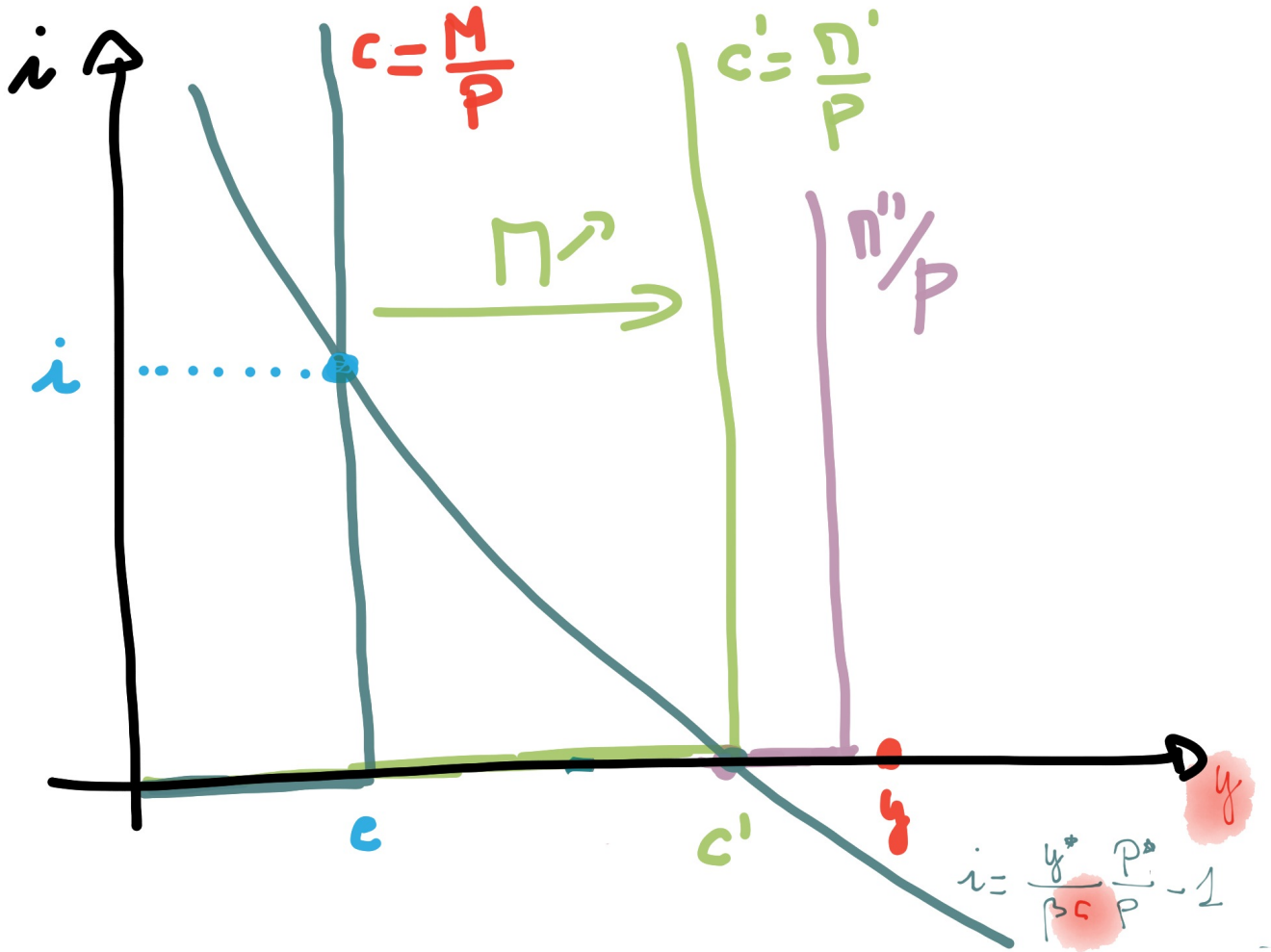
FIGURE 36 : Equilibrium in period 0 - Fix prices



3. A Microfounded Model

Equilibrium with fix prices - Period 0 - The liquidity trap - Monetary policy is inefficient

FIGURE 37 : Equilibrium in period 0 - Fix prices



4. Efficient policy in the liquidity trap

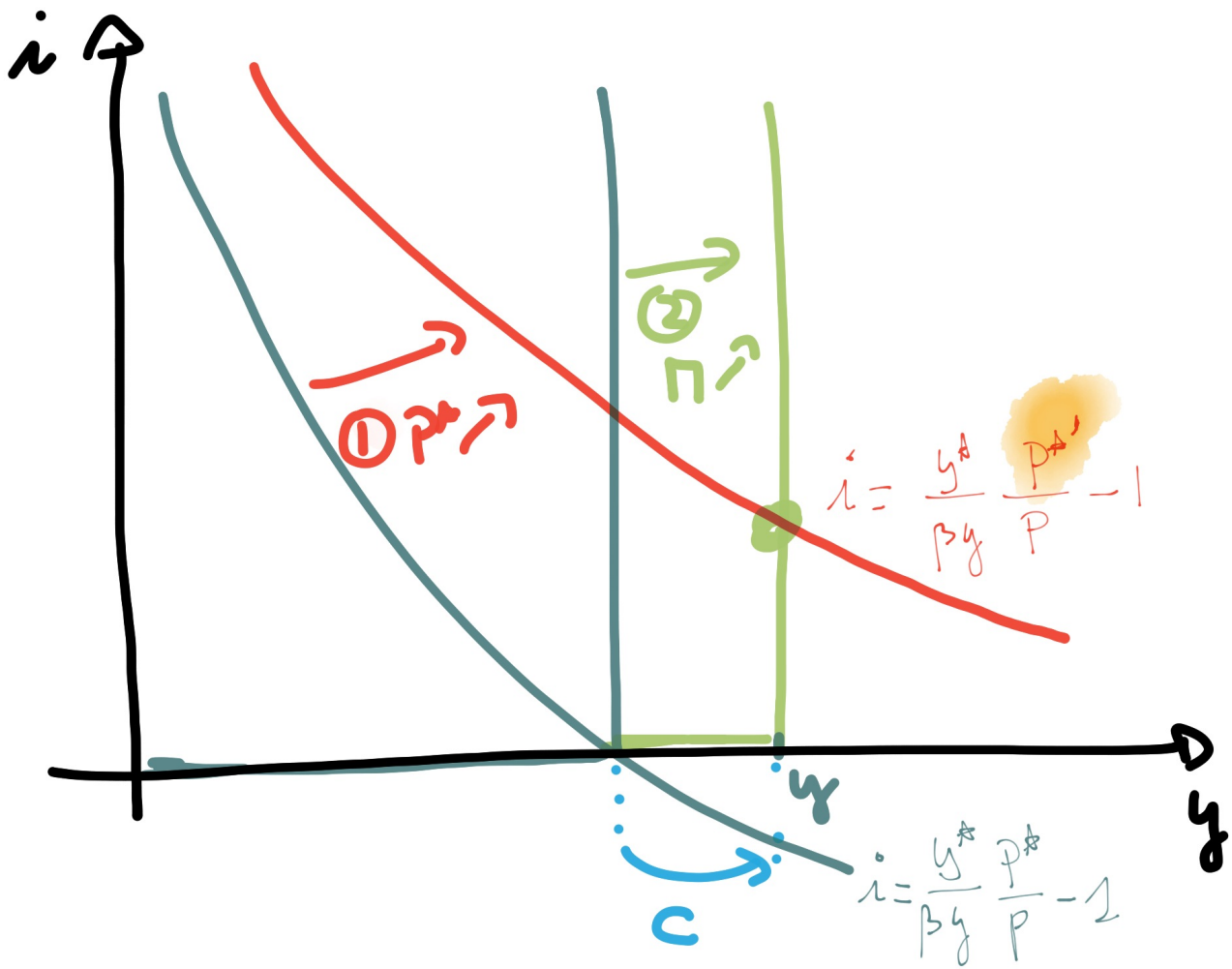
Manipulating expectations : "committing to be irresponsible"

- If the Central Bank can raise the inflation expectations of the agents ($P^\star/P$) by being credible to increase $M^\star$ tomorrow,
- Then in increases the nominal interest rate today,
- and it is therefore possible to increase M and close the gap between c and y.

4. Efficient policy in the liquidity trap

Manipulating expectations : "committing to be irresponsible"

FIGURE 38 : Equilibrium in period 0 - Fix prices - increasing M and committing to increase $M^\star$



4. Efficient policy in the liquidity trap

Fiscal policy

- Assume now that the government taxes agents using lump sum tax and spends on goods, g in period 0 and $g^\star$ after.
- Consider first the flex price case
- Total demand in now $y = c + g$, and consumption is therefore $c = y - g$
- The equilibrium equations become :

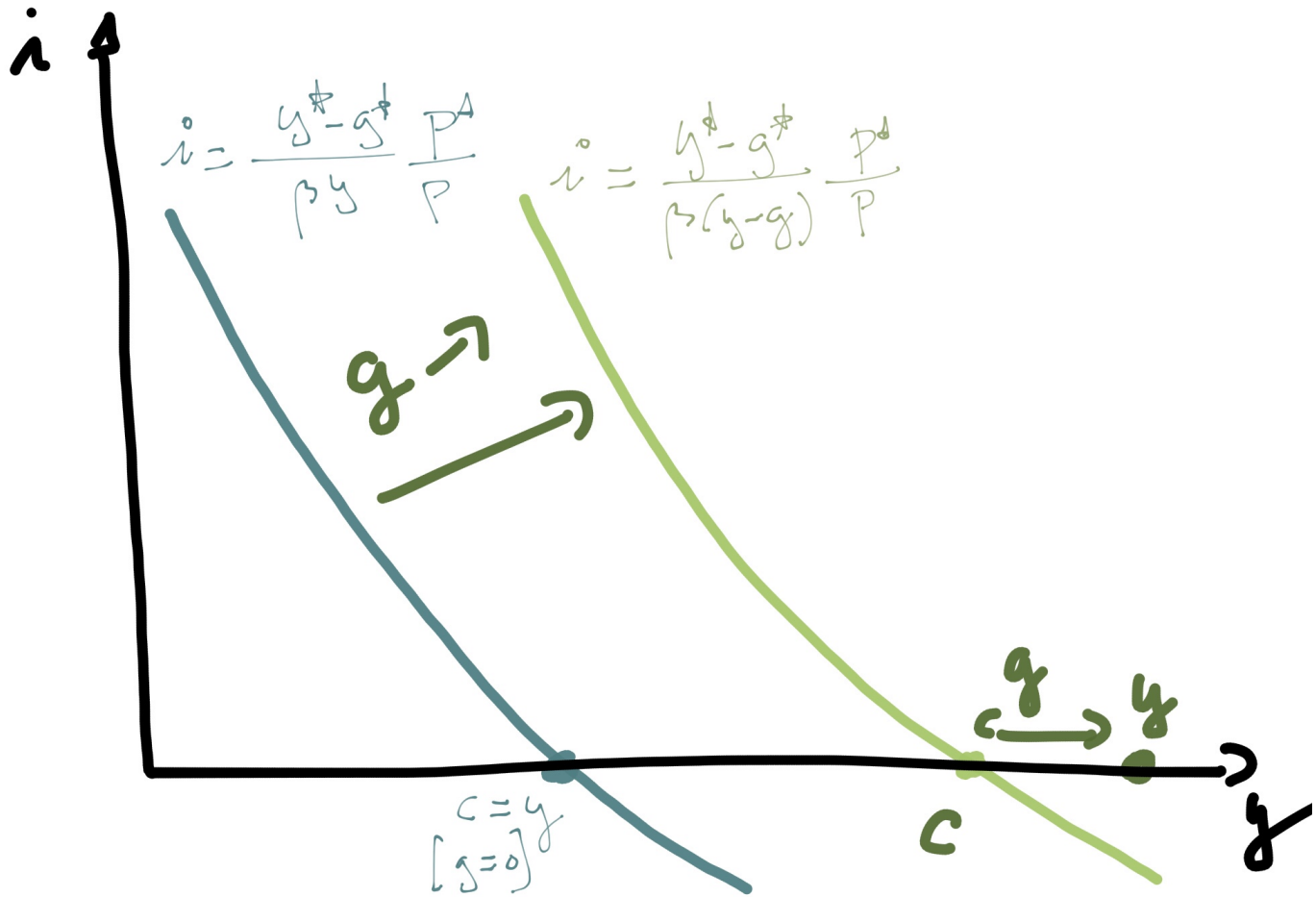
$$\begin{aligned} i &= \frac{y^\star - g^\star}{\beta(y-g)}\frac{P^\star}{P} - 1 \\ P &= \frac{M}{y} \quad \text{if } i > 0 \\ P &= \overline{P} \quad \text{if } i = 0 \end{aligned}$$

- When $g > 0$, the nominal interest curve is shifted up.

4. Efficient policy in the liquidity trap

Fiscal policy

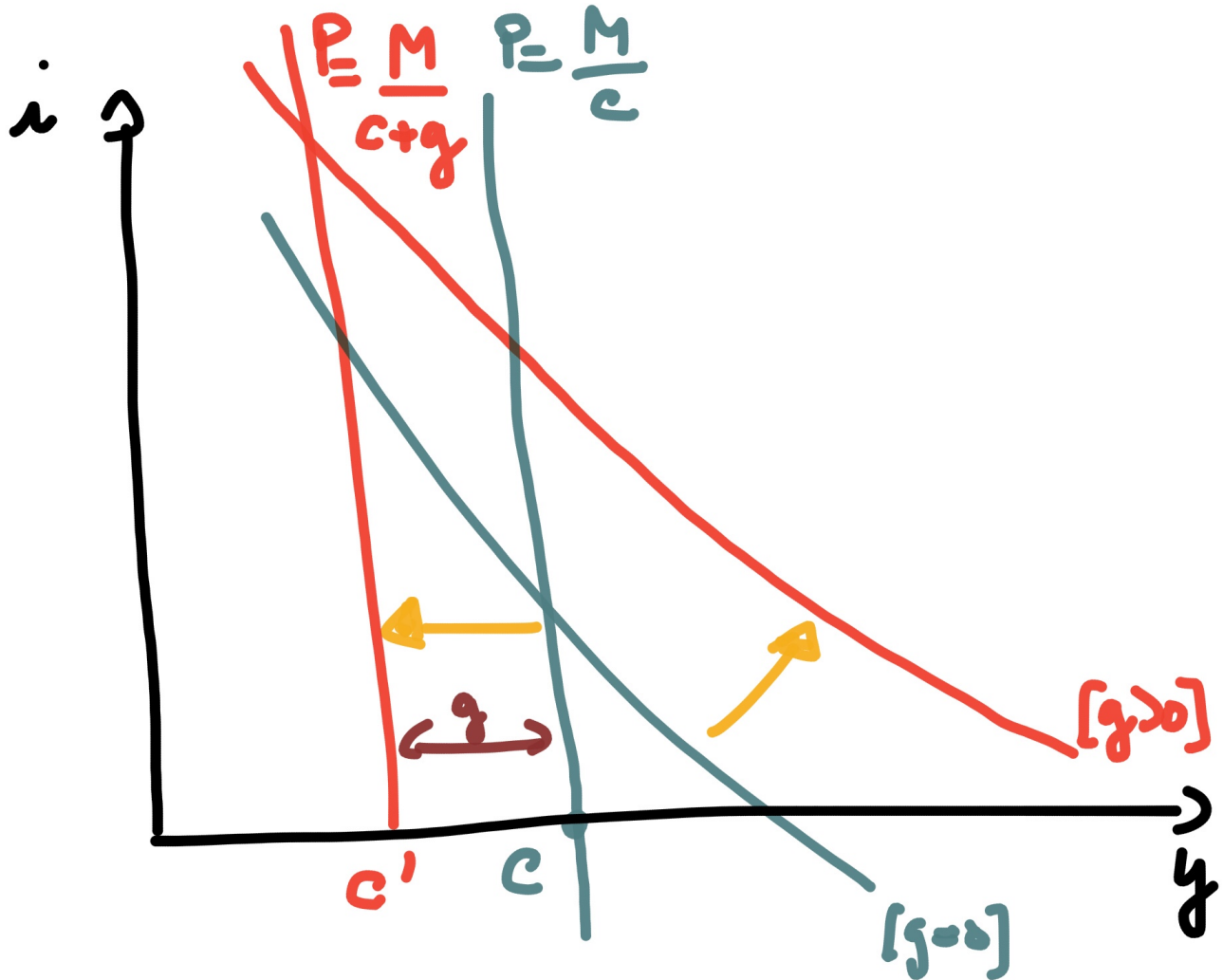
FIGURE 39 : Equilibrium in period 0 - Euler Equation - comparison between $g = 0$ and $g > 0$



4. Efficient policy in the liquidity trap

Fiscal policy

FIGURE 40 : Equilibrium in period 0 - Flex Price - comparison between $g = 0$ and $g > 0$



4. Efficient policy in the liquidity trap

Fiscal policy

- Assume that the economy is in the liquidity trap with fix prices
- Fiscal policy will push up the nominal interest rate by decreasing c
- This will make the CIA constraint binding and c will increase.

4. Efficient policy in the liquidity trap

Fiscal policy

FIGURE 41 : Equilibrium in period 0 - Fix prices - Fiscal policy in the liquidity trap

