Stagnation Traps

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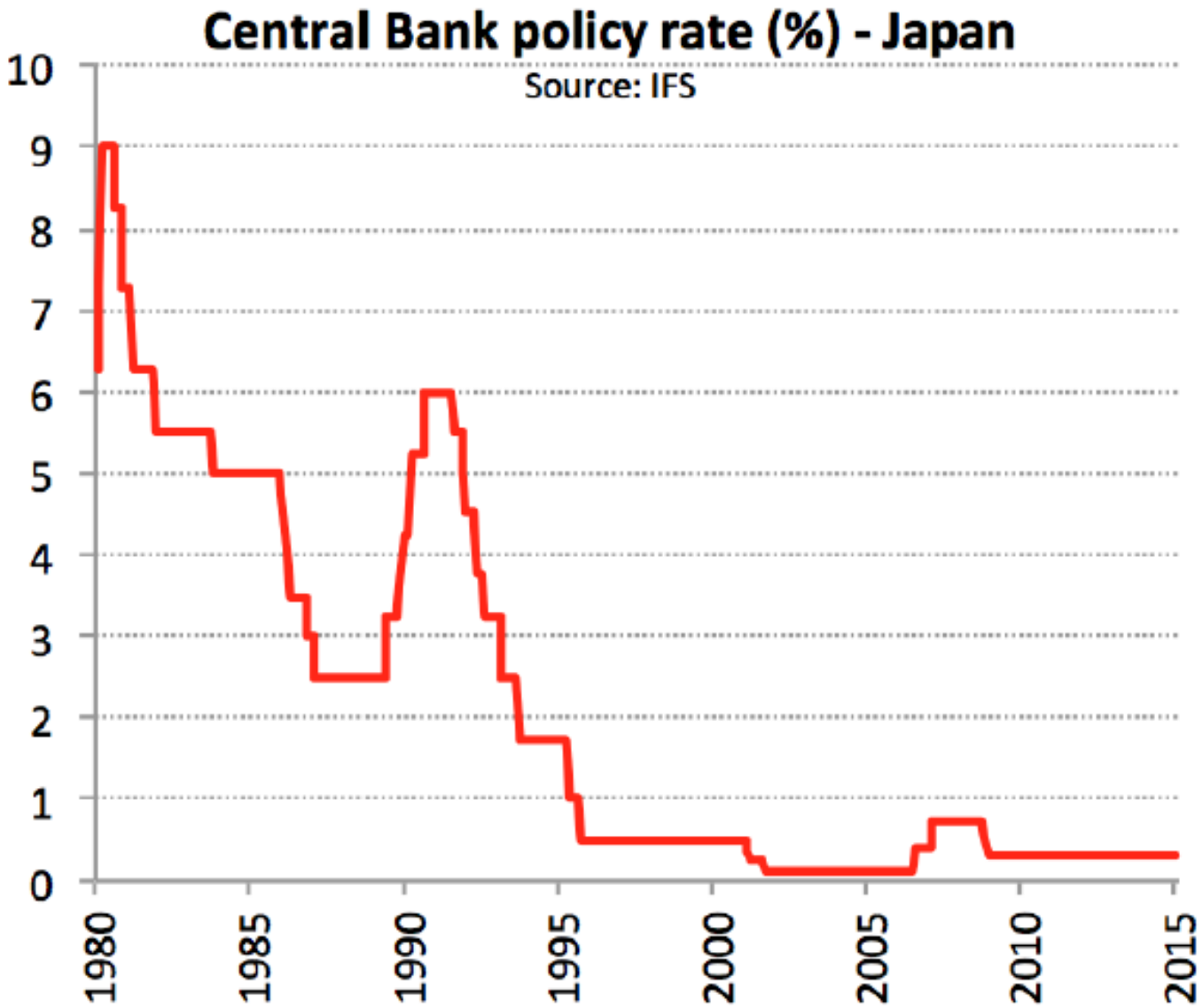
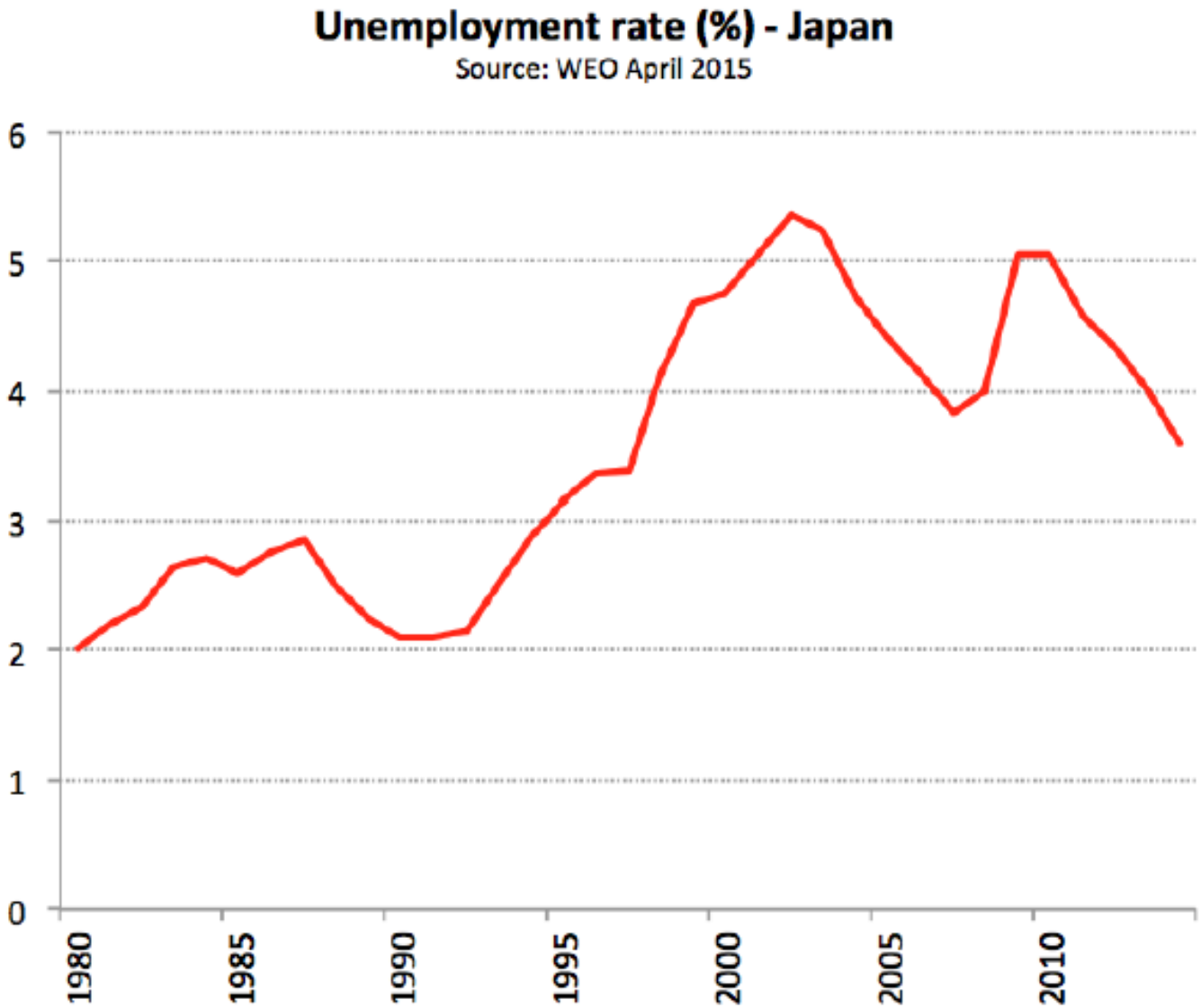
Research Questions and Motivation

- Can insufficient aggregate demand lead to economic stagnation?
- Motivating episodes: long lasting liquidity traps with slowdown in growth and increase in unemployment
  - Two decades-long stagnation affecting Japan since early 1990s;
  - Slow recoveries from the 2008 financial crisis in the US, Europe and UK
- All episodes feature:
  - Long-lasting slumps with policy rates close to the lower bound;
  - Weak (potential) output growth.

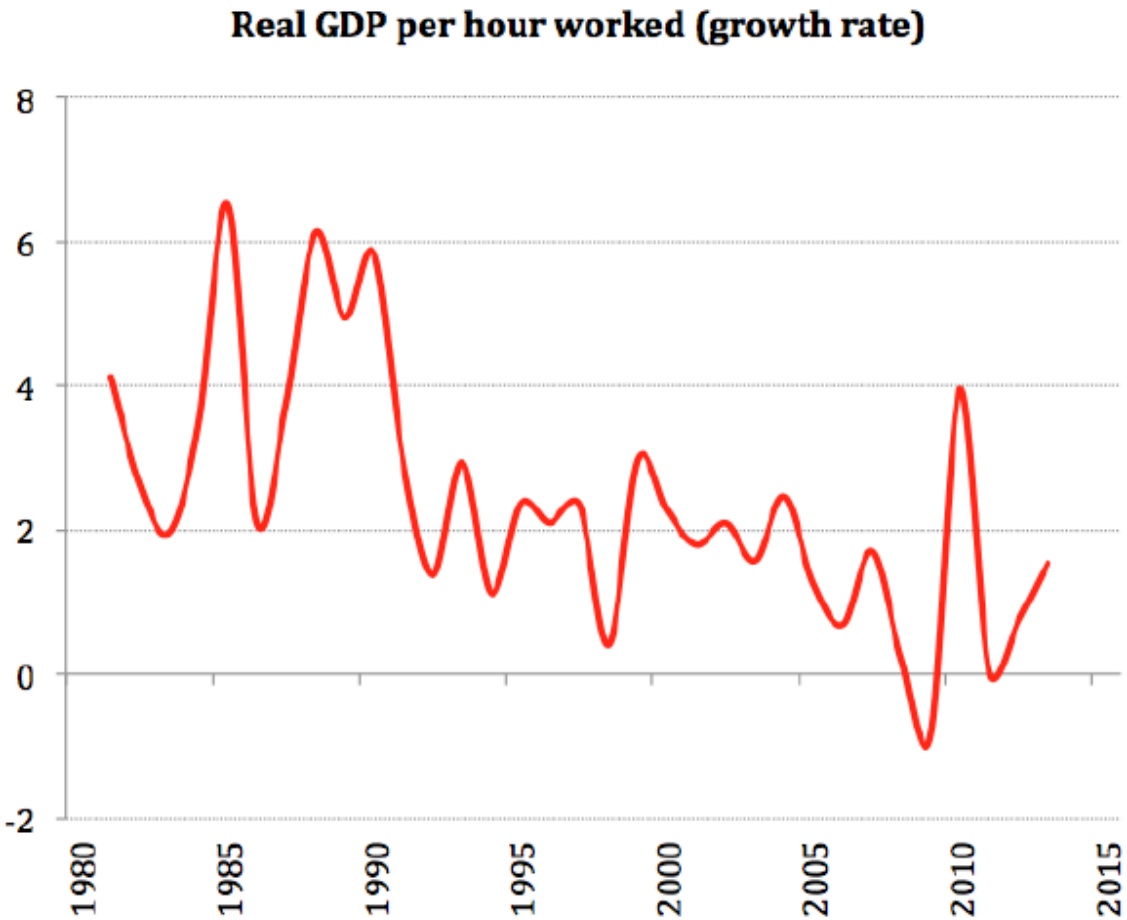
Japan: Policy Rate



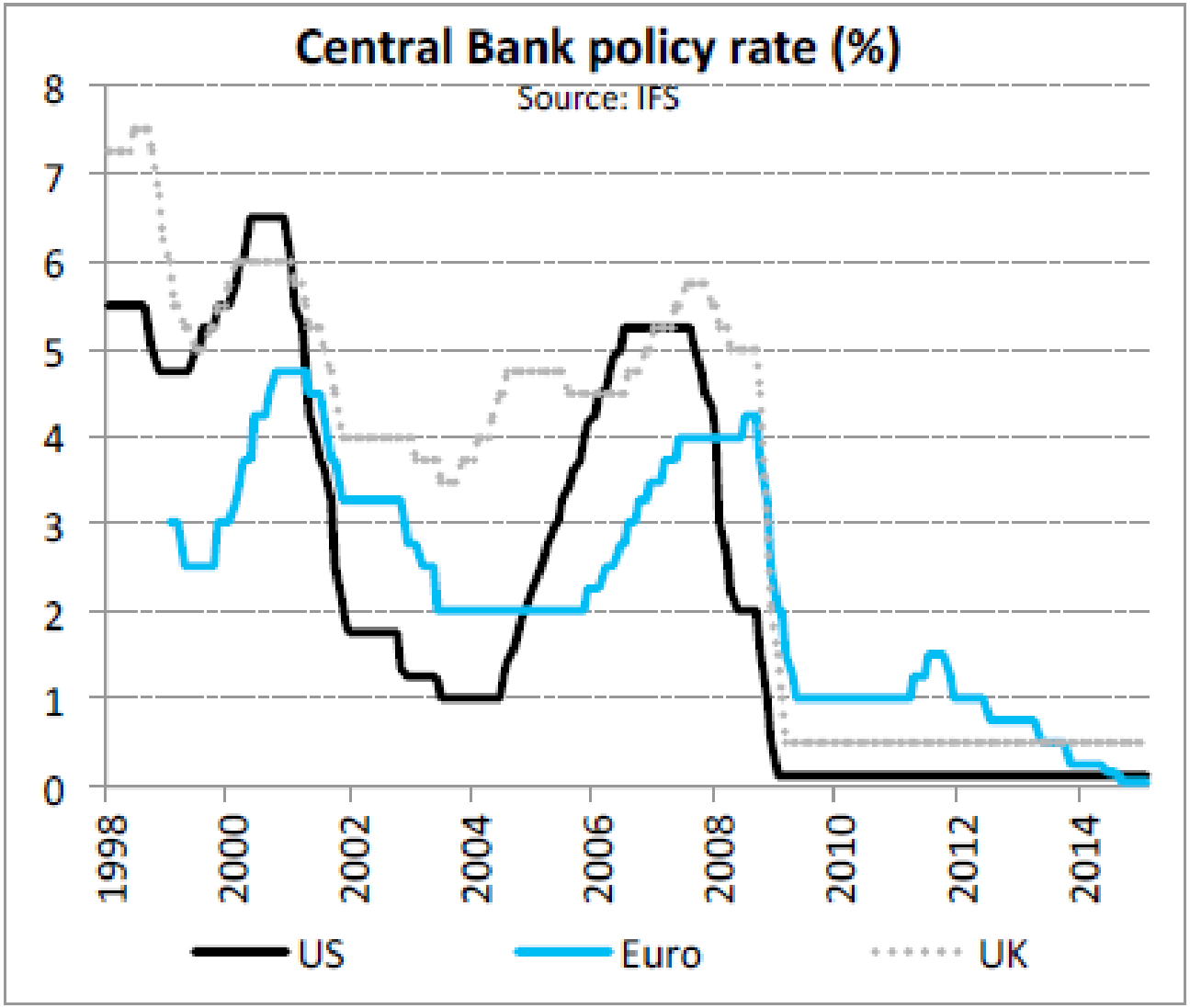
Japan: unemployment rate



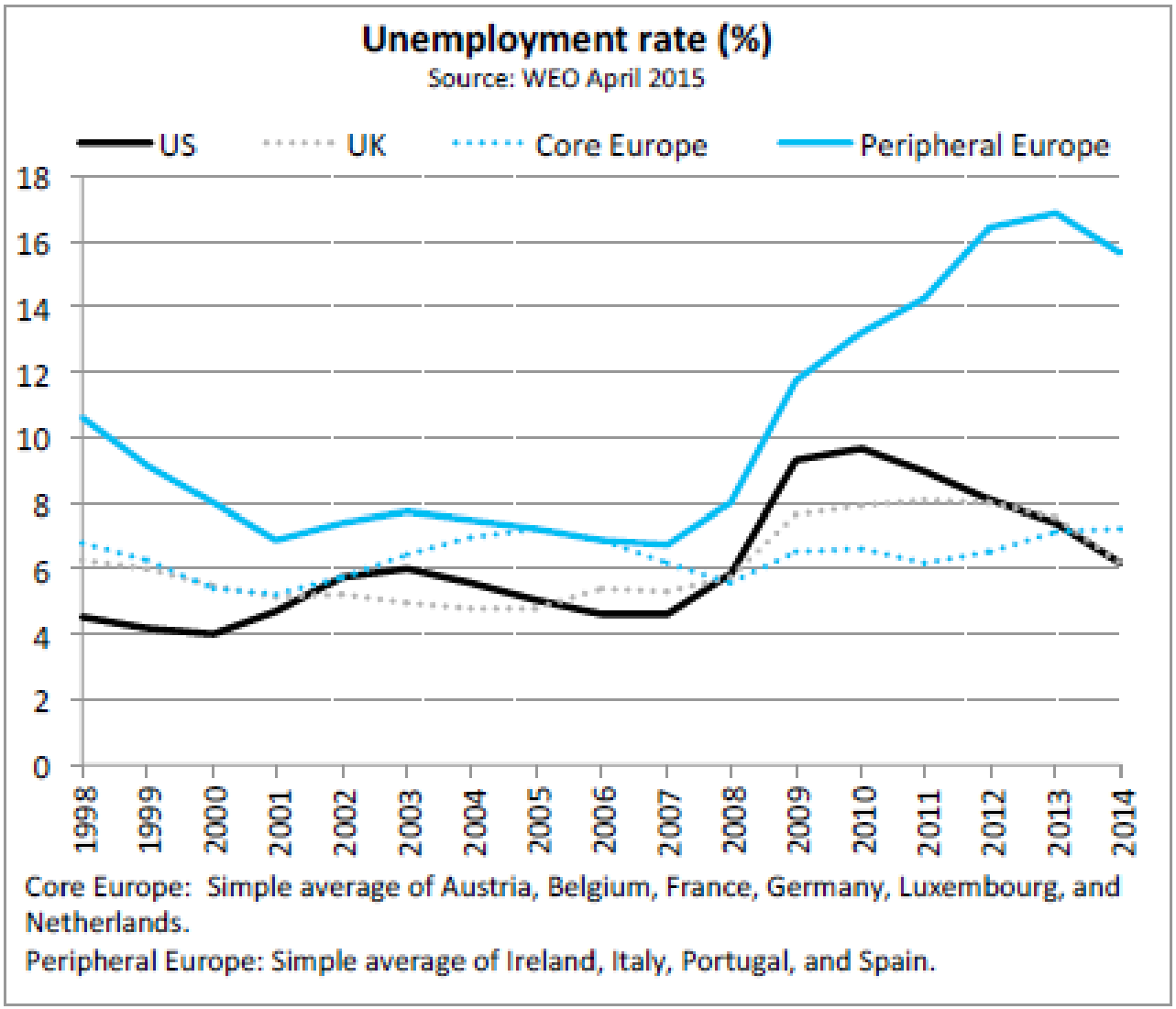
Japan: real GDP per hour worked



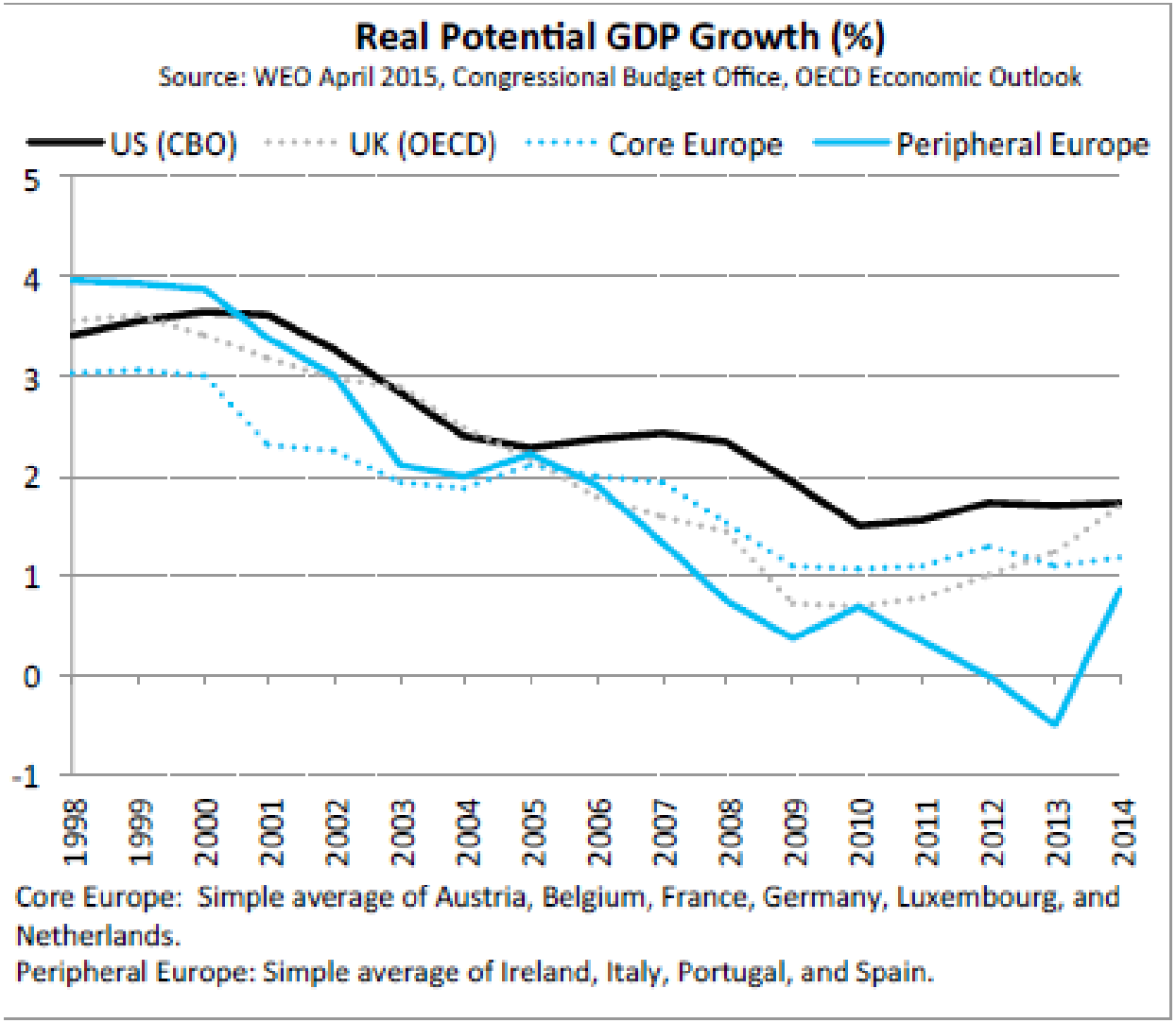
US, UK, Europe: policy rate



US, UK, Europe: unemployment



US, UK, Europe: Real potential GDP growth



This paper

- *Keynesian Growth* framework
  - Unemployment due to weak aggregate demand when monetary policy is constrained at the zero lower bound
  - Growth is the result of investment choices by profit maximizing firms
- Two-way interaction between aggregate demand, interest rates and growth
  - Weak aggregate demand has a negative impact on firms' profits and investment in innovation resulting in low growth;
  - Low growth depress interest rates, undermining the central bank ability to sustain demand by cutting the policy rate.

Key results

- Key result: permanent, or very persistent, slumps characterized by high unemployment and low growth are possible
- Two steady states
  - Full employment, high growth and positive nominal interest rate
  - Unemployment, low growth, zero lower bound that binds $\longrightarrow$ *stagnation trap*
- Fluctuations determined by expectations and sunspots.
- Policies that foster growth can eliminate the stagnation trap equilibrium if they are sufficiently aggressive.

Outline

- *Model*
- Sentiments, growth and stagnation traps
- Policy analysis

The model

- Model of vertical innovation *a la* Aghion and Howitt (1992) and Grossman and Helpman(1991) augmented with nominal wage rigidities and zero lower bound on nominal interest rate
- Inifnite-horizon closed economy, discrete time.
- Continuum of measure one of differentiated goods produced by monopolistic firms
- Continuum of measure one of identical households that supply labor and consume
- Central bank that sets monetary policy

Households

- Representative households with expected lifetime utility

$$E_0\left[\sum_{t=0}^{\infty}\beta^t\left(\frac{C_t^{1-\sigma}-1}{1-\sigma}\right)\right]$$

- Consume differentiated goods. Quality over goods grows over time.

$$C_t \equiv \exp\left(\int_0^1 \ln q_{jt}c_{jt}dj\right) \equiv \underbrace{Q_t}_{\exp\left(\int_0^1 \ln q_{jt}dj\right)} \exp\left(\int_0^1 \ln c_{jt}dj\right)$$

- Unit labor endowment, no labor disutility, but unemployment possible due to nominal wage rigidities.
- Own the firms, Have access to nominal bonds paying the nominal interest rate i.

$$\int_0^1 P_{jt}c_{jt}dj + \frac{b_{t+1}}{1+i_t} = W_tL_t + b_t + d_t$$

Households

- Households' optimization gives the Euler equation

$$c_t^{\sigma} = \frac{g_{t+1}^{\sigma-1}}{\beta(1+i_t)E_t\left[c_{t+1}^{-\sigma}/\pi_{t+1}\right]}$$

where

$$\text{where} \quad g_{t+1} \equiv \frac{Q_{t+1}}{Q_t} \quad \text{and} \quad \pi_{t+1} \equiv \frac{P_{t+1}}{P_t}$$

- Focus on $\sigma > 1$: increase in growth ($\uparrow g_{t+1}$) generates rise in demand for consumption ($\uparrow c_t$)

Research and Innovation

- Outsiders can innovate on a product and capture monopoly profits by investing in research
- Value of a successful innovation

$$V_t = \beta E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \left(\underbrace{y_{t+1} W_{t+1} (\gamma - 1)}_{\text{profits in } t+1} + \underbrace{(1 - \chi \iota_{t+1}) V_{t+1}}_{\text{value of leadership in } t+1} \right) \right]$$

- Growth rate of the economy (productivity growth)

$$g_{t+1} = \exp(\chi \iota_t \ln \gamma)$$

- Growth rate is increasing in investment in innovation (ι_t).

Nominal Wage Rigidities and Monetary Policy

- Assume that nominal wages are downwardly rigid

$$W_t \geq \bar{\pi}\psi(y_t)W_{t-1} \quad \text{with } \psi' > 0,\ \psi(1) = 1$$

- Wages more downwardly flexible if unemployment is higher$\longrightarrow$ non linear Phillips curve
- We consider at first the special case in which there is constant nominal wage inflation

$$W_t = \bar{\pi}W_{t-1}$$

- Prices are proportional to wages so that CPI inflation is constant at $\bar{\pi}$.
- Central bank follows the interest rate rule

$$1 + i_t = \max\left((1+\bar{\imath})y_t^{\phi}, 1\right)$$

- Monetary policy is constrained by the zero lower bound, $i \geq 0$.

Equilibrium in compact form

- Euler equation

$$c_t^{\sigma} = \frac{\bar{\pi} g_{t+1}^{\sigma-1}}{\beta(1+i_t) E_t\left[c_{t+1}^{-\sigma}\right]}$$

- Growth Equation

$$\frac{g_{t+1}^{\sigma-1}}{\beta} = E_t\left[\frac{c_t^{\sigma}}{c_{t+1}^{\sigma}}\left(\frac{\chi(\gamma-1)}{\gamma} y_{t+1} + 1 - \frac{\ln g_{t+2}}{\ln \gamma}\right)\right]$$

- Market Clearing

$$c_t = y_t - \frac{\ln g_{t+1}}{\chi \ln \gamma}$$

- Policy Rule

$$1 + i_t = \max\left((1+\bar{\imath})\, y_t^{\phi}, 1\right)$$

- Rational expectation equilibrium is a set of processes $\{y_t, c_t, g_{t+1}, i_t\}_{t=0}^{+\infty}$ satisfying previous equations.

Outline

- Model
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- Policy analysis

Non-stochastic steady state

- Aggregate Demand

$$\max\left(\left(1+\bar{\imath}\right)y^{\phi},1\right)=\frac{g^{\sigma-1}\bar{\pi}}{\beta} \tag{1}$$

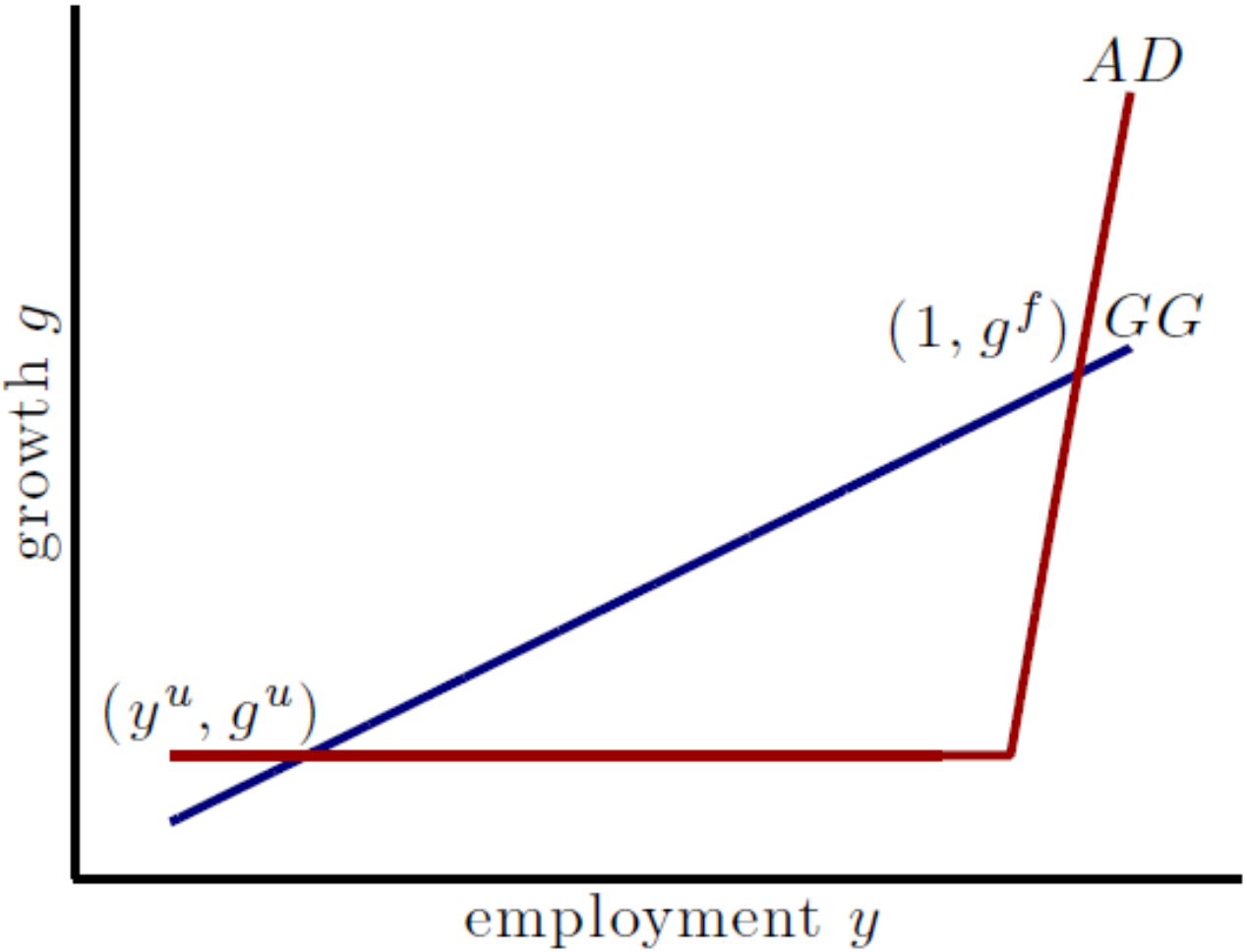
- Growth Equation

$$\frac{g^{\sigma-1}}{\beta}+\frac{\ln g}{\ln \gamma}=\chi\frac{\gamma-1}{\gamma}y+1 \tag{2}$$

- Market Clearing

$$c=y-\frac{\ln g}{\chi \ln \gamma}$$

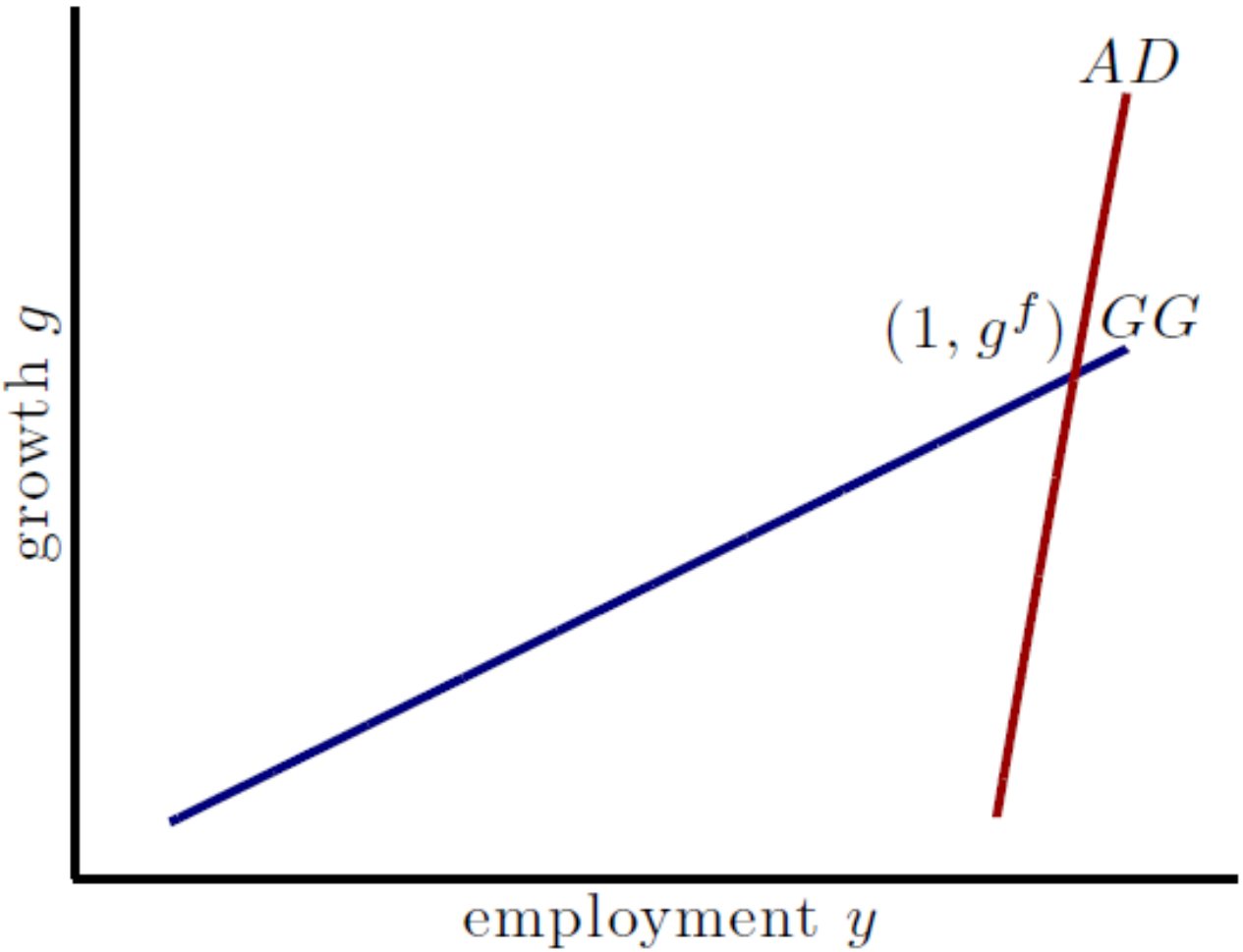
Two Steady States



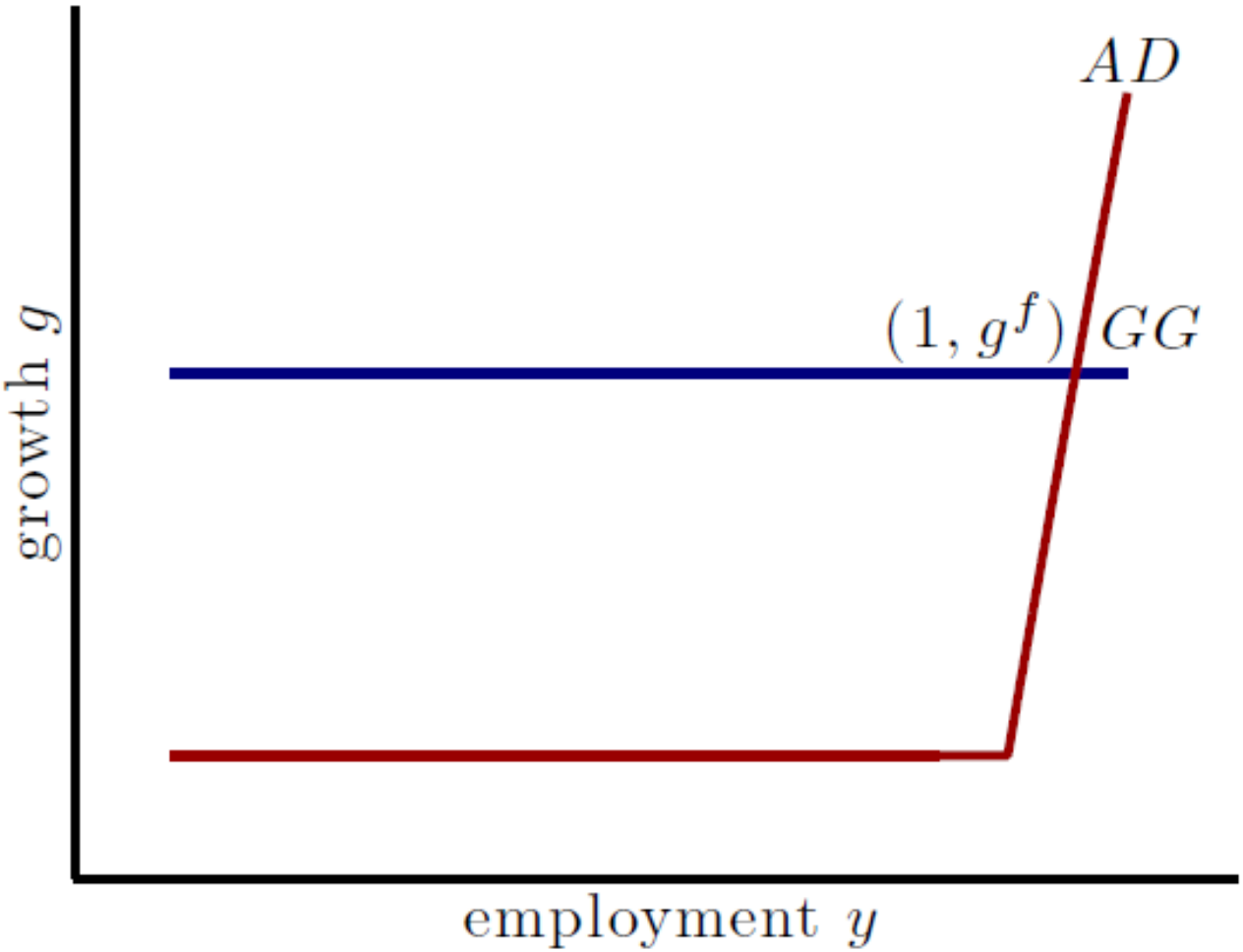
Understanding Stagnation Traps

- Aside from the usual full employment steady state, the economy can find itself in permanent liquidity trap with:
  1. Negative output gap ($y^u < 1$)
  2. Weak growth ($g^u < g^f$)
  3. Monetary policy constrained by the zero lower bound ($i^u = 0$)
- Stagnation trap: the combination of liquidity and growth trap.
- The zero lower bound constraint and the dependence of growth from current output gap are both crucial in generating the stagnation trap.

No zero lower bound



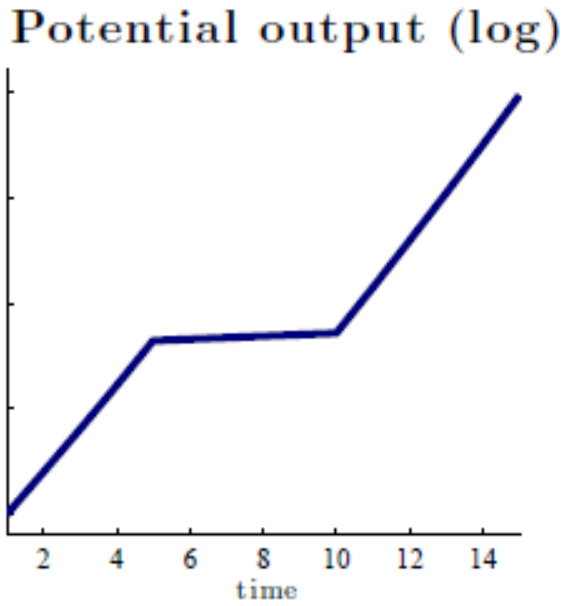
No dependence of growth from output gap

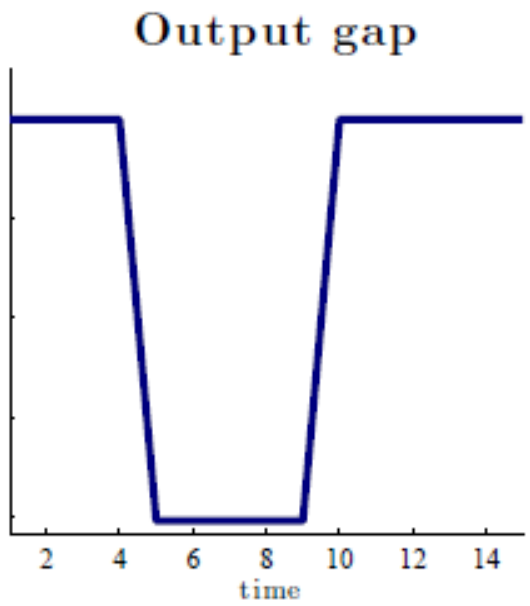


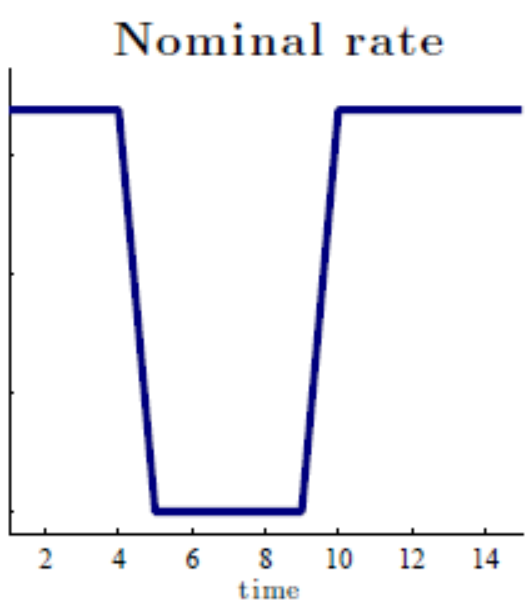
The role of confidence shock

- Equilibrium is determined by expectations and sunspots.
  - Suppose agents expect that growth will be low
  - Low expectations of future income imply low aggregate demand
  - Due to zero lower bound, central bank is not able to lower the interest rate enough to sustain full employment.
  - Firms' profits are low, weak investment in innovation
  - Expectations of weak growth are verified.
- Expectations of low growth can give rise to permanent, or very long lasting, liquidity traps characterized by low growth.

Temporary stagnation traps







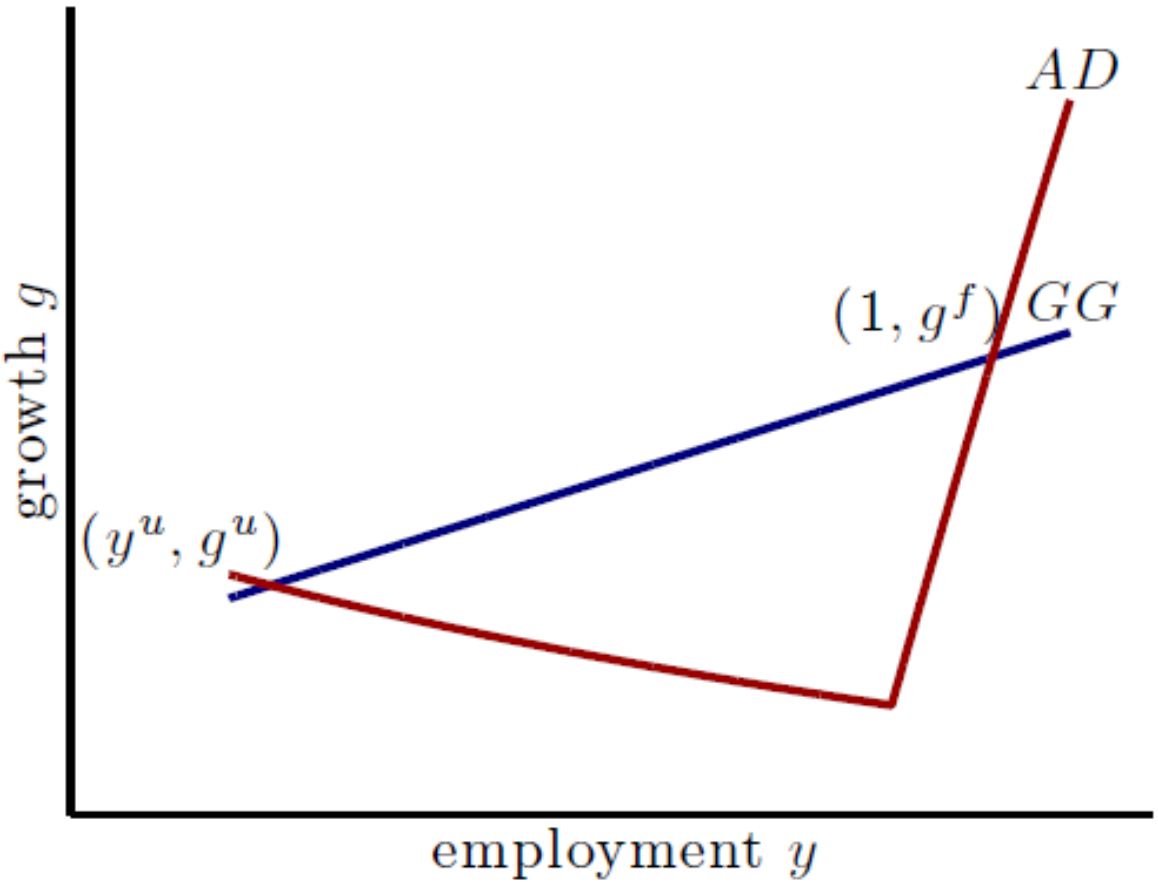
The role of nominal wage rigidities

- Assume that nominal wages follow

$$W_t \geq \bar{\pi}\psi(y_t)W_{t-1} \quad \text{with } \psi' > 0,\ \psi(1) = 1$$

- Higher unemployment implies more flexibility in nominal wages.

Steady State determination with variable inflation



Inflation and the interest rate

- In the benchmark model representative agent model, positive inflation and positive growth cannot coexist in a permanent liquidity trap

$$g^u = \left(\frac{\beta}{\bar{\pi}}\right)^{\frac{1}{\sigma-1}}$$

- Model with uninsurable unemployment risk as in Aiyagari (1991): The unemployment steady state is now characterized by

$$g^u = \left(\frac{\rho\beta}{\bar{\pi}}\right)^{\frac{1}{\sigma-1}}$$

- Since $\rho > 1$, an unemployment steady state in which both inflation and growth are positive is now possible

Outline

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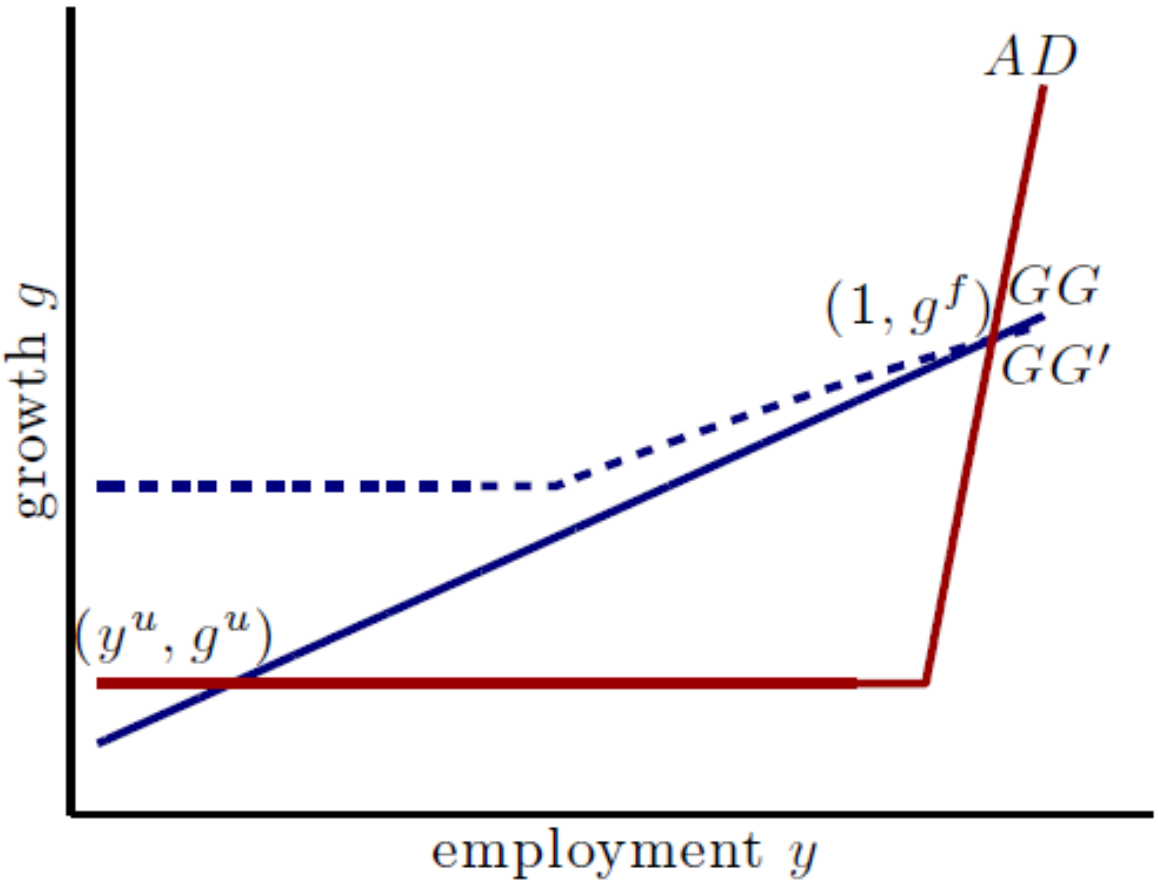
- Sentiments, growth and stagnation traps
- *Policy analysis*

Policy implications:

- Recent emphasis on job creating growth
- Indeed an appropriate designed growth policy can eliminate liquidity traps driven by confidence shocks.
- Consider a countercyclical subsidy $s_t = s(1 - y_t)$.
- If s is sufficiently large, this policy rules out the liquidity trap steady state, while leaving unchanged the full employment steady state.

Countercyclical subsidy



Conclusions

- We develop a *Keynesian growth* model in which endogenous growth interacts with the possibility of slumps driven by weak aggregate demand
- The model features two steady states. One is a *stagnation trap*, a permanent liquidity trap characterized by weak growth.
- Large policy interventions to support growth can lead the economy out of the stagnation trap.

Sunspots and Temporary Liquidity Traps

- We can also have liquidity traps of finite expected duration
- Denote a sunspot by ξ_t. Agents form their expectations after observing ξ.
- Two-state discrete Markov process, $\xi_t \in (\xi_o, \xi_p)$
- ξ_o is an absorbing optimistic equilibrium, in which agents expect to remain forever around the full employment steady state.
- ξ_p is a pessimistic equilibrium with finite expected duration $1/(1-q_p)$. In this state the economy is in a liquidity trap with unemployment.

Sunspots and Temporary Liquidity Traps

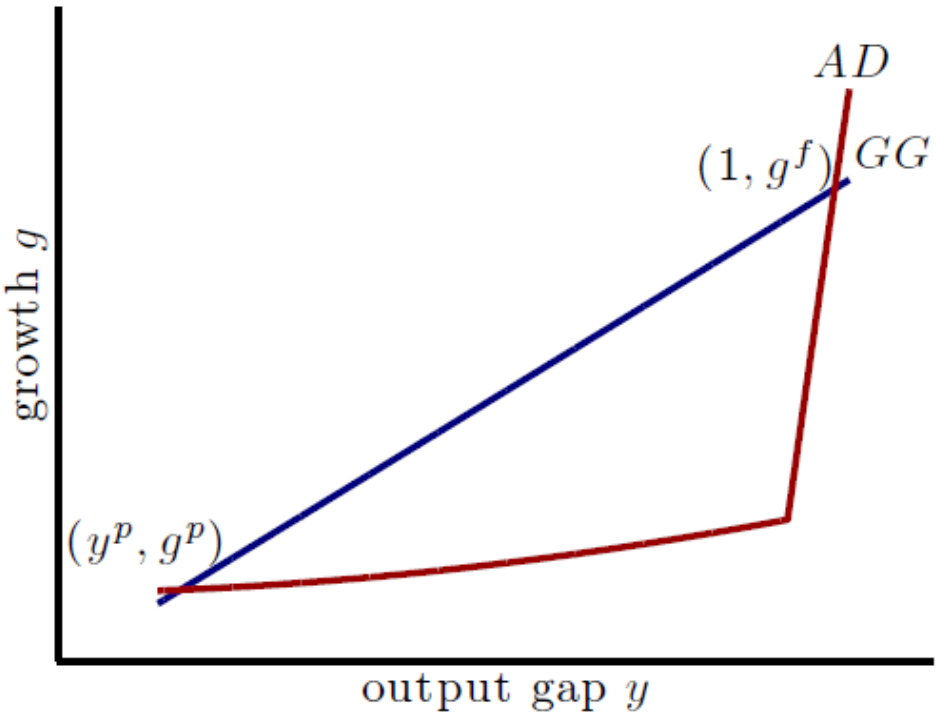
- In the pessimistic sunspot state the equilibrium is described by

$$(g^p)^{\sigma-1} = \frac{\beta}{\bar{\pi}}\left(q_p + (1-q_p)\left(\frac{c^p}{c^f}\right)^{\sigma}\right)$$

$$\frac{(g^p)^{\sigma-1}}{\beta} = q_p\left(\chi\frac{\gamma-1}{\gamma}y^p + 1 - \frac{\ln g^p}{\ln\gamma}\right) +$$
$$+(1-q_p)\left(\frac{c^p}{c^f}\right)^{\sigma}\left(\chi\frac{\gamma-1}{\gamma} + 1 - \frac{\ln g^f}{\ln\gamma}\right)$$

$$\frac{c^p}{c^f} = \frac{y^p - \frac{\ln g^p}{\chi\ln\gamma}}{1 - \frac{\ln g^f}{\chi\ln\gamma}}$$

Sunspots and temporary liquidity traps



Precautionary Savings, Inflation and Growth

- In the benchmark model, positive inflation and positive growth cannot coexist in a permanent liquidity trap

$$g^u = \left(\frac{\beta}{\bar{\pi}}\right)^{\frac{1}{\sigma-1}}$$

- Assume that every period a household becomes unemployed with probability p.
- An unemployed household receives a benefit, such that its income is equal to a fraction b of the income of employed households
- Unemployed households cannot borrow

Precautionary Savings, Inflation and Growth

- Aggregate demand is given by the Euler equation of employed households

$$c_t^{\sigma} = \frac{\bar{\pi} g_{t+1}^{\sigma-1}}{\beta(1+i_t)\rho E_t\left[c_{t+1}^{-\sigma}\right]}$$

$$\rho \equiv 1 - p + p/b^{\sigma} > 1$$

- The unemployment steady state is now characterized by

$$g^u = \left(\frac{\rho\beta}{\bar{\pi}}\right)^{\frac{1}{\sigma-1}}$$

- Since $\rho > 1$, an unemployment steady state in which both inflation and growth are positive is now possible.

Introducing a Phillips Curve

- Assume that nominal wages are downwardly rigid

$$W_t \geq \psi(y_t) W_{t-1} \quad \text{with } \psi' > 0,\ \psi(1) = \bar{\pi}$$

- Wages more downwardly flexible if unemployment is higher$\longrightarrow$ non linear Phillips curve
- Full employment steady state is not affected ($y = 1$, $g = g^f$, $i = i^f$ and $\pi = \bar{\pi} \equiv \pi^f$)
- Growth in the unemployment steady state is now

$$g^u = \left(\frac{\beta}{\psi(y^u)} \right)^{\frac{1}{\sigma - 1}}$$

- $\uparrow$ output gap , $\uparrow$ inflation, $\downarrow$ real interest rate, $\downarrow$ growth.

Steady State determination with variable inflation