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Persistent Slowdowns, Expectations and Macroeconomic Policy

Lecture at the City University of Hong Kong

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by

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Lecture at the City University of Hong Kong, April 21, 2016

**Views expressed do not necessarily reflect the views of the Bank of Finland.*

I. Introduction

- The great recession of 2008-9 in western market economies and Japan's crisis in the 2nd half of 1990's resulted in protracted slowdowns and very low interest rates, often called as the "zero lower bound" (ZLB).

- These recessions and the ZLB can be approached in different ways. I start with several empirical figures.
  - Consider the real economy developments in terms of GDP per capita.

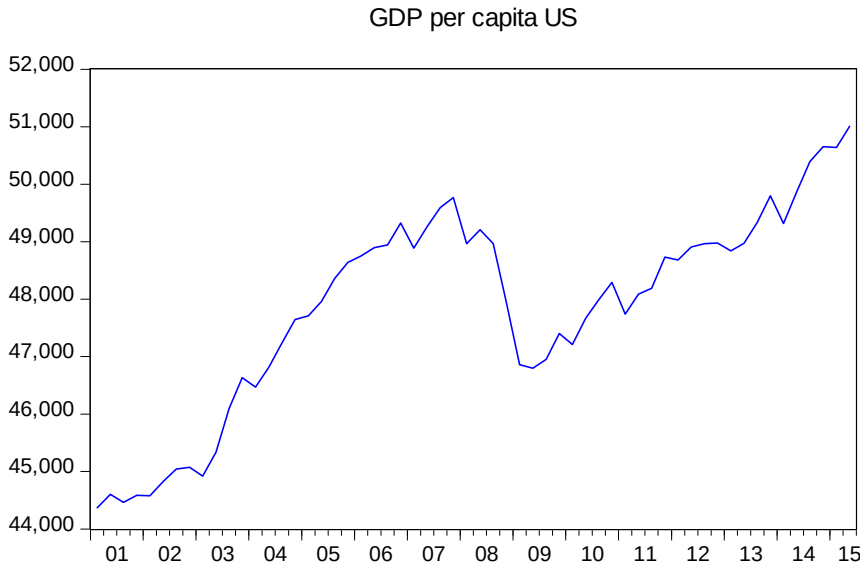

Figure 1a: US real GDP per capita in dollars

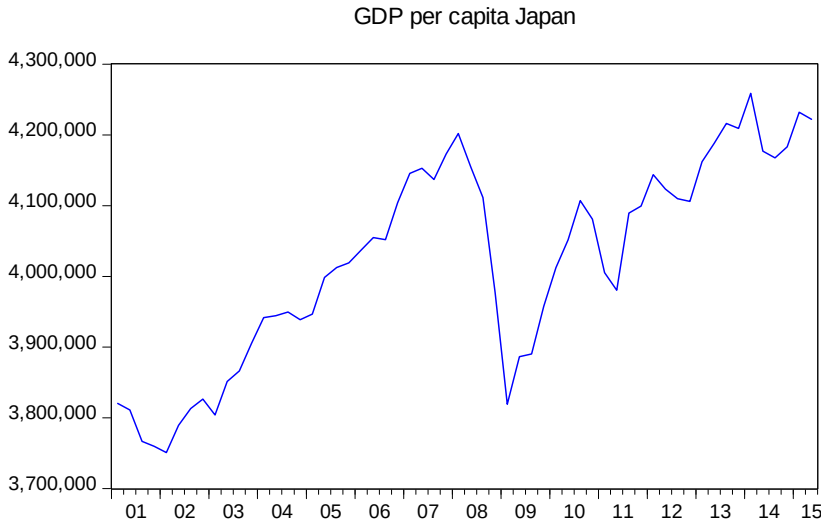

Figure 1b: Japan real GDP per capita in yen

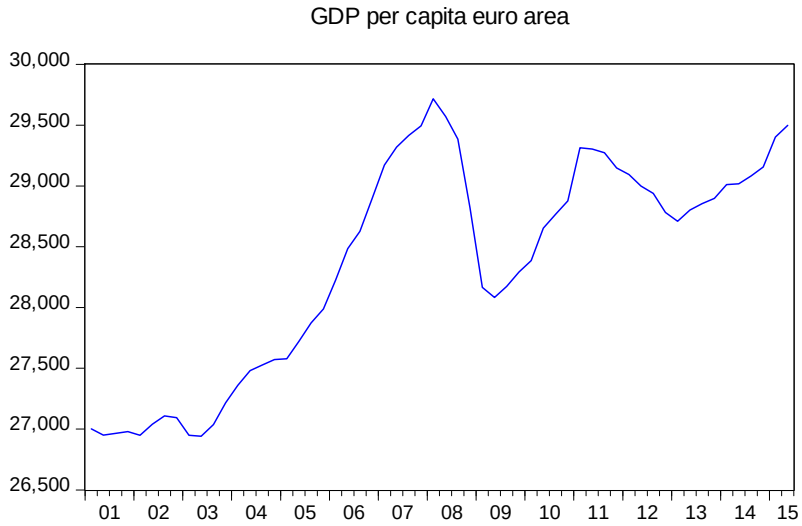

Figure 1c: Euro area real GDP per capita in euros

- The Great Recession seems have caused a persistent slowdown.
  - First, a major decline in GDP per capita and subsequently a slowdown in economic growth.
  - Japan also had a decline of 3.5% from 1997Q1 to 1999Q1 (not shown in the figure) around which ZLB was reached.

- These recessions were associated with financial system problems and consequent responses in monetary policy.
  - Financial crises are major shocks.

- **Analytically, the economy may have multiple equilibria**.
  - This is a major observation: market economies may get persistently stuck in low-actitivity/low-inflation situation.

- Suppose monetary policy is conducted using an interest rate rule

$$R_t = 1 + f(\pi_t),$$

where R_t is the gross interest rate and π_t is the gross inflation rate. Let $\pi^* > 1$ denote a positive inflation target and β be the subjective discount factor.

- In many standard models the Fisher equation

$$R_t = \pi_t/\beta.$$

is in the steady state (π, R), see Figure 1.

- If monetary policy is "active", i.e. $f(\pi^*) > 1/\beta$, then ZLB implies that there are multiple steady states (Reifschneider & Williams 2000, Benhabib et al 2001).

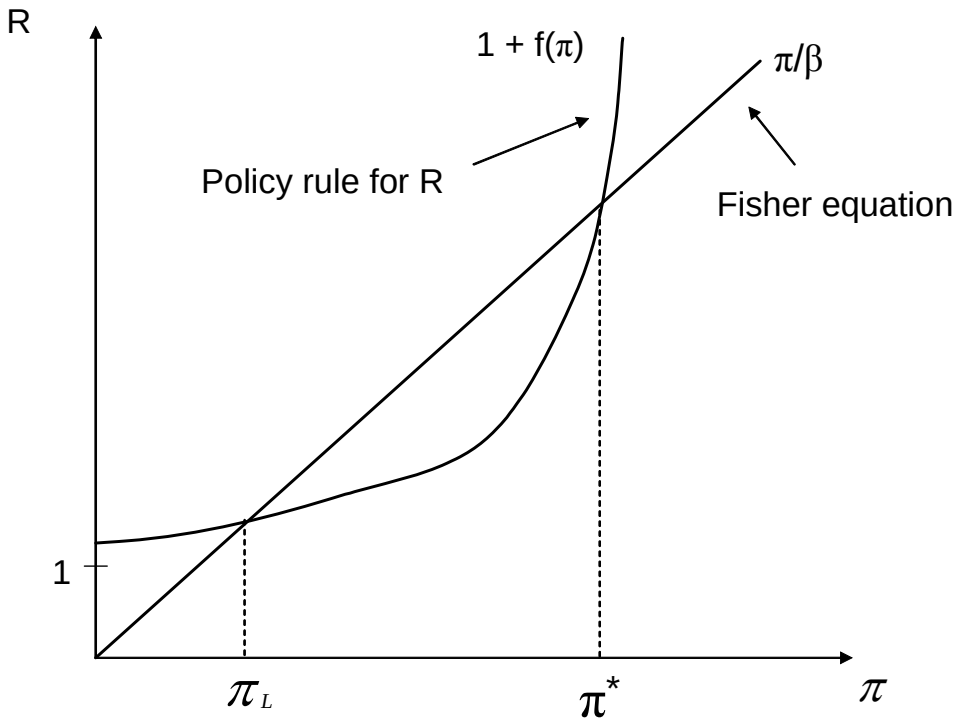

Figure 2: Multiple steady states with ZLB and Taylor rule

- Next: inflation and interest rate data for Japan, the US and the Euro area.

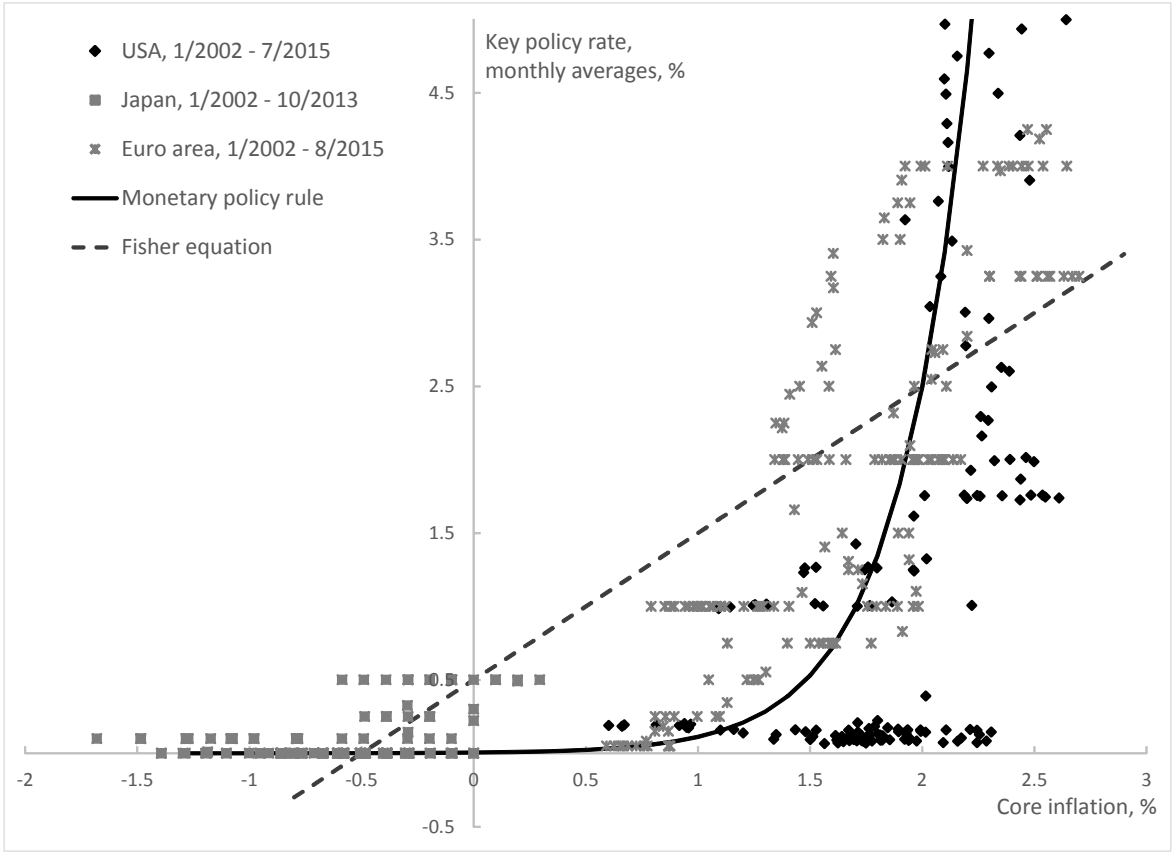

Figure 3: Inflation and interest rate, Japan , USA, Euro area

II. Modeling Approaches

II.1. Expectations-driven liquidity trap

- Above we have **multiple steady states and other dynamic rational expectations (RE) equilibria.**
  - A significant initial shock may set in motion dynamics away from the target equilibrium.
  Different approaches:
  - **Backward-looking models**: e.g. Reifschneider & Williams 2000;
  - **RE models**: Benhabib, Schmitt-Grohe & Uribe 2001, 2002; Mertens & Ravn 2014 etc.
  - **Learning approach**: Evans, Guse & Honkapohja 2008; Benhabib, Evans & Honkapohja 2014 etc.
  - **Details are available in key references given at the end of the slides.**

- **Multiple equilibria** pose methodological challenges.

- This lecture:
  - Overview of modeling macro dynamics, the ZLB, and policies in the context of multiple equilibria.
  - Standard New Keynesian model is employed.
  - Emphasis on imperfect knowledge and learning for expectations formation rather than the RE approach.

- Not covered: Econometric analysis of multiple equilibria.

II. 2. Other Approaches

- A fundamental shock shifts the **target RE equilibrium** to face ZLB:
  - E.g. shock to intertemporal preferences brings down the interest rate associated with inflation target π^* or
  - adverse shock to financial intermediation can make real equilibrium policy rate negative. (Fisher equation shifts down in Figure 2).
  - Literature: Eggertsson & Woodford 2003, Svensson 2003, Christiano et al 2011; Woodford 2011; Coenen et al 2012, etc.
  - Recent research on financial intermediation problems and unconventional monetary policies.

- Empirical literature with estimated DSGE and pure econometric models.
  - With focus on the target REE, this methodologically straight-forward, except for inclusion of ZLB.

III. Basic New Keynesian Model

- A model with monopolistic competition and adjustment costs.
  - Consumers consume goods, supply labor and own firms that produce goods.
  - Consumers hold money and government bonds.
  - Price setting is subject to adjustment costs.
  - Government spends on goods and services, financing this by lump-sum taxes and issuing bonds.

- Monetary policy is assumed to follow a global interest rate rule

$$R_t - 1 = f\left(\pi^e_{t+1}\right).$$

  as above.

III.1. The infinite-horizon Phillips curve

- Assume identical expectations, log utility, point expectations and absence of random shocks. Agents observe that $P_{s,t} = P_t$ and $c_t = y_t - g_t$ in the past.

- Let $r^e_{t+1} = R_t/\pi^e_{t+1}$. Then

$$\begin{aligned} Q_t &= \frac{\nu}{\gamma} y_t^{(1+\varepsilon)/\alpha} + \frac{\nu}{\gamma} \sum_{j=1}^{\infty} \alpha^{-1} \beta^j \left(y^e_{t+j} \right)^{(1+\varepsilon)/\alpha} \\ &\quad - \frac{\nu - 1}{\gamma} \frac{y_t}{y_t - \bar{g}} - \frac{\nu - 1}{\gamma} \sum_{j=1}^{\infty} \beta^j \left(\frac{y^e_{t+j}}{y^e_{t+j} - \bar{g}} \right), \end{aligned}$$

  where $Q_t = (\pi_t - 1)\,\pi_t$ and $\pi_t \geq 1/2$.

III.2. The consumption function

- Consumers are assumed to be **Ricardian:**
  - They combine the intertemporal budget constraints of the consumer and the government, evaluated at expectations of the consumer.
  - Use also the iterated Euler equation.

- This yields the "Ricardian" consumption function

$$c_t = (1-\beta)\left(y_t - g_t + \sum_{j=1}^{\infty}(D^e_{t,t+j})^{-1}(nety_{t+j})^e\right), \text{ where}$$

$$nety_{t+j} = y_{t+j} - g_{t+j}.$$

IV. Temporary Equilibrium and Learning

IV.1. Equilibrium conditions

- Agents form expectations of future inflation and output, denote these by π_t^e and y_t^e.

- The following equations define a **temporary equilibrium**:
  1) Aggregate demand (agents are assumed to know the interest rate rule),
  2) The Phillips curve,
  3) Bond dynamics,
  4) Money demand,
  5) Interest rate rule.

- State variables are b_{t-1}, m_{t-1} and R_{t-1}.

- Expectations formed using "steady-state learning" (details later).

- Focus on the case where $g_t = \bar{g}$. This leads to the aggregate output equation

$$y_t = G_1(y_t^e, \pi_t^e) \equiv \bar{g} + (\beta^{-1} - 1)(y_t^e - \bar{g}) \left(\frac{\pi_t^e}{1 + f(\pi_t^e) - \pi_t^e} \right)$$

- From the nonlinear Phillips curve we get

$$\pi_t = G_2(y_t^e, \pi_t^e) = Q^{-1}[K(G_1(y_t^e, \pi_t^e), y_t^e)].$$

where $K(y_t, y_t^e)$ is from the Phillips curve above.

IV.2 Steady states

- Steady states $\pi_t^e = \pi$ and $y_t^e = y$ for all t :

LEMMA: There are two steady states, (y^*, π^*) and (y_L, π_L) with $\pi_L < \pi^*$.
(i) π^* is locally stable under learning,
(ii) π_L steady state is locally unstable under learning, with the local learning dynamics taking the form of a saddle point.

V. Learning and Expectations Dynamics

- Starting point: Private agents do not have RE.
  - They know their own utility and production functions.
  - They know the per capita government budget constraint.
  - They do not know that other agents are identical to them.

- **Expectations formation**: Agents estimate an econometric model and make forecasts with the estimated model.
  - Model is re-estimated and expectations are updated in later periods as new data becomes available.

- **Steady-state learning**

$$\begin{aligned} y_t^e &= y_{t-1}^e + \omega_t(y_{t-1} - y_{t-1}^e) \\ \pi_t^e &= \pi_{t-1}^e + \omega_t(\pi_{t-1} - \pi_{t-1}^e), \end{aligned}$$

  where ω_t is the "gain sequence," and either $\omega_t = t^{-1}$ ("decreasing gain" learning) or $\omega_t = \omega$ for $0 < \omega \leq 1$ and ω small ("constant gain" learning).

- This corresponds to computing the (possibly weighted) mean from past data.

- In non-stochastic models agents cannot learn both the intercept and lag structures.

- The (small gain) dynamics, i.e. $\omega_t \longrightarrow 0$ or ω sufficiently small, can be approximated by the (E-stability) differential equations

$$\begin{aligned} \frac{dy^e}{d\tau} &= G_1(y^e, \pi^e) - y^e \\ \frac{d\pi^e}{d\tau} &= G_2(y^e, \pi^e) - \pi^e, \end{aligned}$$

  where τ is virtual time (see e.g. Evans and Honkapohja 2001).

- Money and bonds dynamics do not directly affect y_t^e, π_t^e if consumers are Ricardian.

- Global learning dynamics: Set the values $A = 2.5$, $\pi^* = 1.02$, $\beta = 0.99$, $\alpha = 0.7$, $\gamma = 350$, $\upsilon = 21$, $\varepsilon = 1$, and $g = 0.2$.
  Comments:
  - We choose a high value $A = 2.5$ to clearly separate π^* and π_L.
  - $\upsilon = 21$ gives 5 percent as the implied markup of prices over marginal cost, see Basu & Fernald (1997).
  - Kehoe & Midgiran (2010) find price changing frequency to be about 4.8 quarters. Then $\gamma \approx 350$.
  - r^e_{t+j} is assumed to revert to β^{-1} for $j \geq T$. We use $T = 28$.

- The dynamical system is two-dimensional. $=>$ Use the phase diagram technique.

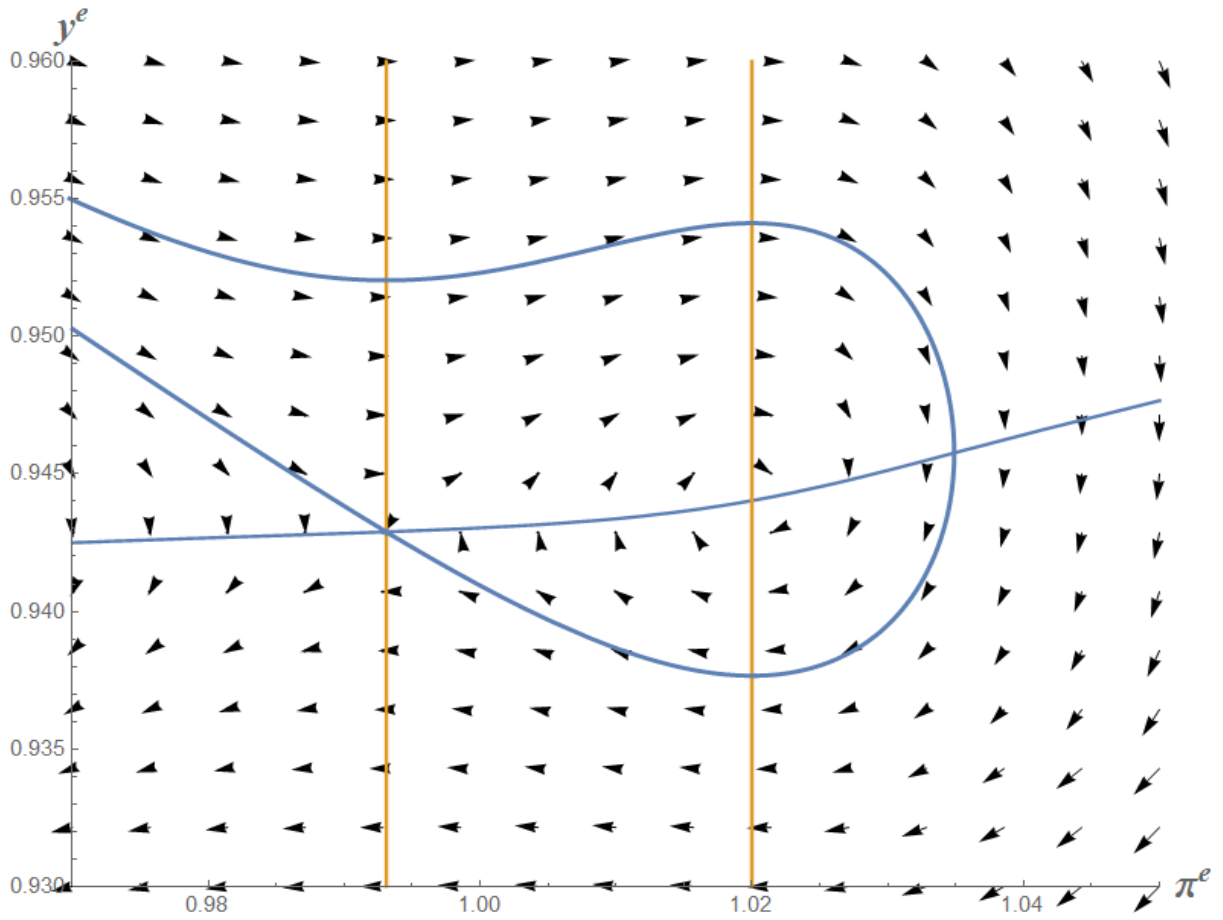

Figure 4: Global learning dynamics – the Ricardian case.

- Main features of global learning dynamics:
  - π^* is locally stable and there is a "corridor of stability" defined by the set of initial expectations that converge to π^*.
  - Convergence to π^* is locally cyclical.
  - From initial points outside the corridor of stability the trajectory of expectations is eventually led into a deflation trap in which (y^e, π^e) fall steadily over time.

- Even though the financial wealth of consumers is getting very large along a deflationary path, Ricardian agents do not respond by sufficiently increasing consumption. They expect offsetting higher future taxes.

VI. Policies to Avoid and/or Escape the Liquidity Trap

VI.1. Monetary policy actions

- Recall Figure 3. Policy interest rates are effectively at their lower bound. The standard monetary policy instrument cannot be used.

- Monetary policy has relied on unconventional measures:
  - **large scale asset purchase programs** (APP) in Japan, Great Britain and United States of America.
  - ECB introduced special loan facilities to banks, specific asset purchase programs during the sovereign debt crisis and APP since March 2015.

- Large scale asset purchase programs (APP):
  - **Japan** had a program in the beginning of 2000's. A new program in 2010 with extensions, latest started in 2014. Ongoing. BOJ balance sheet about 70% of GDP (2015 summer).
  - **United States of America**: three programs 2008-2010, 2010-2011 and 2012-2014. Federal Reserve balance sheet about 25% of GDP.
  - **Great Britain**: a program 2009-2012. BOE balance sheet about 22% of GDP.
  - **Euro area**: ECB program in 2009 (covered bonds) and in 2010 (SMP). A new program in 2014 (some private assets) and 2015 with government and "institution" bonds. Extended in March 2016. ECB balance sheet about 25% of GDP.

VI.2. Some theory for unconventional monetary policy

- Preceding theoretical analysis: Significant shocks can result in unstable expectation dynamics that goes to the deflation regime. How to avoid it?

- Pigou 1943 and Patinkin 1965 argued for **real-balance and wealth effects** as a stabilizing mechanism.
  - With non-Ricardian consumers there is convergence back to target steady state (Benhabib et al JEDC 2014).
  - This requires an appropriate tax policy.
  - Path involves wide cyclical fluctuations in inflation and output.

- Ricardian case: Under a pure Taylor rule policy above, the money stock is determined endogenously by money demand. Bond dynamics are determined as residual and do not have a feedback effect on the real economy.

- In a flexible price economy switching to a **money supply rule** when inflation falls below a lower threshold level is known to be effective.
  - Evans & Honkapohja 2005 take a learning viewpoint.
  - Benhabib et al 2002: similar results hold under RE with some careful design.

- What happens if prices are sticky? (based on Honkapohja 2016).

- Bond purchases by the CB financed by new money change the amount of bonds held by the households in our NK model.
  - These purchases imply corresponding increases in the nominal money stock.
  - With Ricardian consumers, the **effects of asset purchases can be studied as injections of new nominal money** to the economy.

- Given a low threshold for inflation, the policy-maker introduces an asset purchase program.
  - assume: nominal money supply starts to grow at some constant rate (Friedman's rule).

$$M_{t+1} = (1 + dM)M_t.$$

- **Question**: Will the introduction of asset purchases / money growth avoid the liquidity trap?

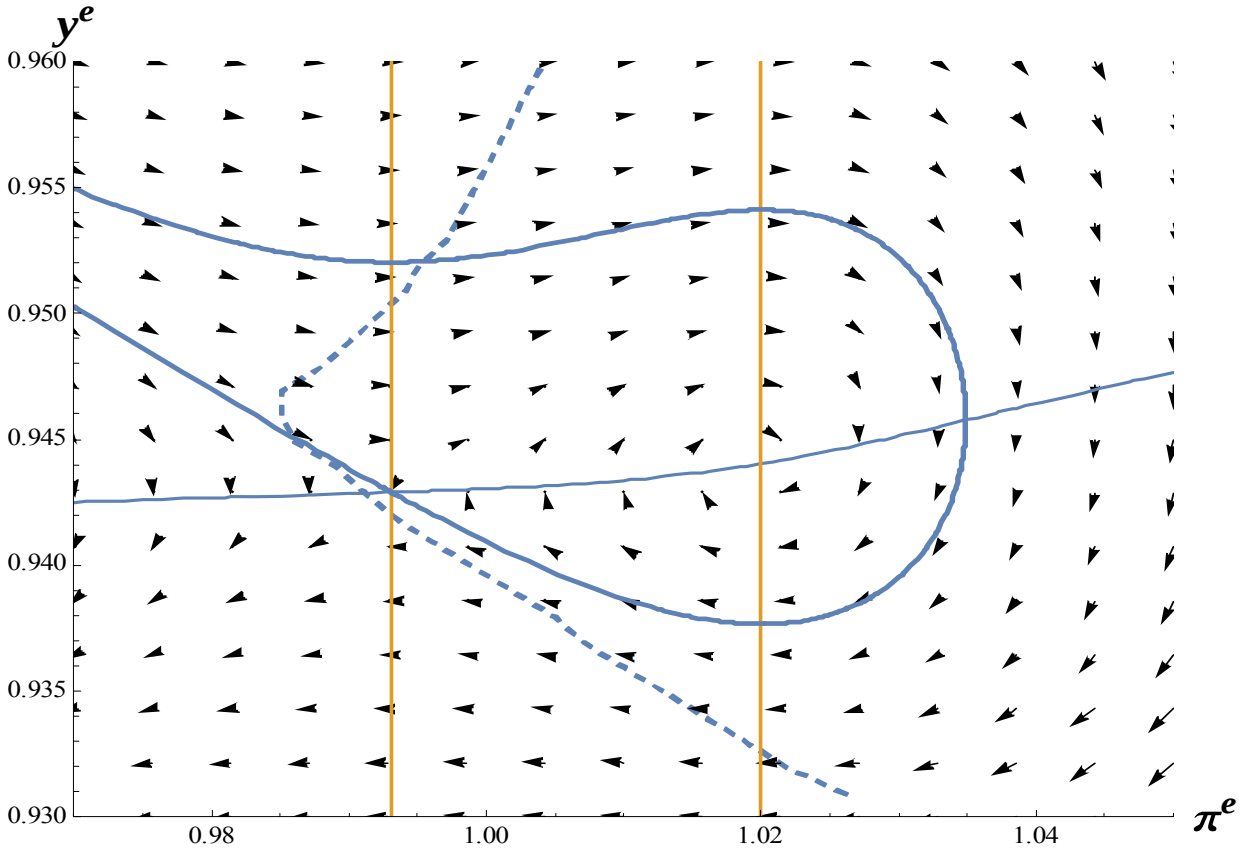

Figure 5: Effectiveness of asset purchases.

- Figure 5 shows that an asset purchase program is effective, provided that inflation has not gotten to very low level.
  - The area to the right of the dashed curves would yield convergence to the targeted steady state.
  - The area to the right of the curve covers most of the domain of attraction for a Taylor rule (except in some unlikely parts of the state space).
  - Asset purchase program is not a "fool-proof" solution.

- **Remark:** Price-level targeting (Honkapohja and Mitra 2015a, b): under certain conditions price level targeting with a Wicksellian interest rate rule is a fool-proof monetary policy regime to avoid and cure the liquidity trap.
  - Essential to have **forward guidance** which the private agents regards fully credible.
  - Similar result holds for nominal GDP targeting.

VII Fiscal Policy

VII.1. Overview

- Fiscal policy during Great Recession:
  - IMF recommended stimulus measures of 2% of GDP.
  - USA, China, Japan, South Korea each introduced fiscal measures.
  - Australia had two stimulus programs in 2008 and 2009.

- EU introduced some stimulus and recommended 1.2% of GDP measures to its members. National responses varied.
  - Some countries (e.g. UK, Ireland, Spain) had to use major public spending because of banking crises. This limited other fiscal programs.

VII.2. Theoretical analysis

- **Fiscal policy under RE**
  (1) **Comparative dynamics**:
  - Effectiveness of different policies depends on whether the liquidity trap is caused by fundamental shock or by expectations and pessimism.
  - A number of studies consider the fundamental liquidity trap and locally unique RE equilibrium.
  - For example, spending multipliers are "large" while cuts in marginal taxes are ineffective.
  - A few studies consider the expectations-driven liquidity trap under RE. Now the effects of fiscal policies can be different.

(2) **Avoiding a liquidity trap** by eliminating the low steady state π_L with FP:

- Under RE promises or threats about "irresponsible" future policies (Krugman 1998, Benhabib et al 2002, Woodford 2013 etc.) to rule out π_L.

- Fiscal policy from learning viewpoint (based on Benhabib et al JEDC 2014).
  - Assume that the government uses spending g_t as policy instrument.
  - **Fiscal expansion**: a temporary increase in $\bar{g}$ taking the form

$$g_t = \begin{cases} \bar{g}_0 \text{ for } t = 0, ..., T_0 \\ \bar{g}_1 \text{ for } t = T_0 + 1, ... \end{cases}, \text{ so } nety_t^e = \begin{cases} y_t^e - \bar{g}_0 \text{ for } t = 0, ..., T_0 \\ y_t^e - \bar{g}_1 \text{ for } t = T_0 + 1, ... \end{cases}$$

where $\bar{g}_0 > \bar{g}_1$. The policy is announced at $t = 0$ and is credible.

- Assume also that

$R_t+1 = f(\pi_t^e, y_t^e)$, with $f(\pi, y) = (R^*-1)\left(\frac{\pi}{\pi^*}\right)^{AR^*/(R^*-1)}\left(\frac{y}{y^*}\right)^{\phi_y}$.

to reduce fluctuations.

- Efficacy of stimulus depends on the length and magnitude of the fiscal expansion as well as the degree of pessimism in expectations.

- Assume

$$\begin{aligned} \pi^e(0) &= 0.993 < \pi_L = 0.99309 \\ y^e(0) &= 0.94289 < y_L = 0.942892 \end{aligned}$$

$T_0 = 8$ and $\bar{g}_0 = 0.202 > \bar{g}_1 = \bar{g} = 0.2$. Then we have convergence to the target steady state.

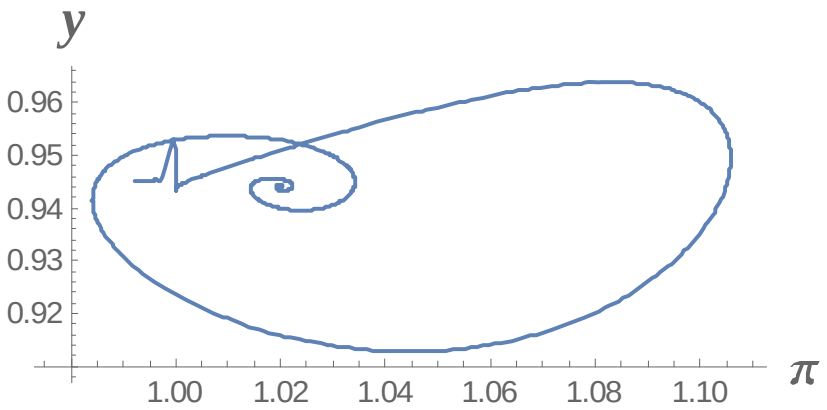

Figure 6: Effective fiscal stimulus

- Assume instead that $\pi^e(0) = 0.991$. Then there is divergence (shown for inflation):

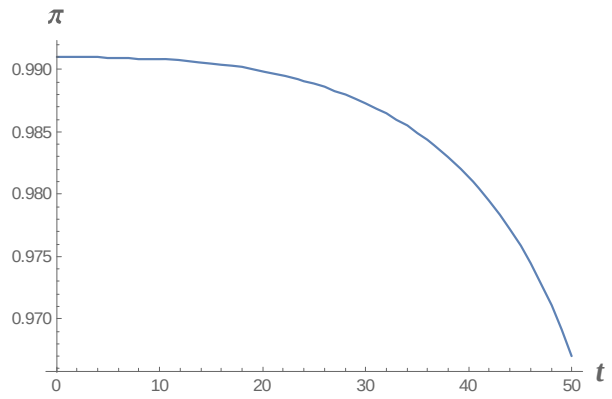

Figure 7: inflation divergence

$=>$ **Success of a fiscal expansion** depends on the state of the economy and the amount and length of stimulus.

- See Evans, Honkapohja and Mitra (2016, forthcoming) for a systematic analysis of fiscal policies as a remedy to stagnation.

- If random shocks are present one can compute **probability of success** for given policy and initial conditions (Evans, Honkapohja & Mitra 2016).

- Other fiscal policies can in principle be considered. **Fiscal switching rules**: ensure that π_t^e eventually $\pi_t^e > \tilde{\pi} > \pi_L$.
  -This kind of rule can ensure convergence to the target steady state.

VIII. Concluding Remarks

- The analysis has focused on the possibility of a persistent slowdown due to pessimistic expectations.
  - **Pessimism leads to demand deficiency**. This can occur without a financial crisis.

- We looked at efficacy of monetary and fiscal policies as remedies using a standard NK macro model.
  - Unconventional monetary policy (asset purchses) is effective unless expectations have gotten very pessimistic.
  - There are also effective fiscal policy remedies. Temporary increases in government spending work, but requite "tuning" in length and magnitude.
  - Sometimes possible to devise a fool-proof fiscal policy.

- In reality other phenomena have been present and there are other possible explanations for stagnation.
  - Financial crisis as an end phase to a **credit cycle**.
  - **Supply-side factors** affecting potential growth: slower technological progress (Gordon), population aging in many countries.

Key References

Benhabib J., G.W. Evans & S. Honkapohja (2014): Liquidity traps and expectations dynamics: fiscal stimulus or fiscal austerity?, *Journal of Economic Dynamics and Control,* vol. 45, 220-238.

Evans, G.W., S. Honkapohja & K. Mitra (2016): Expectations, stagnation and fiscal policy, manuscript (forthcoming soon).

Honkapohja S. (2016), Monetary policies to counter the zero interest rate: an overview of research, *Empirica* (forthcoming). Also Bank of Finland Discussion Paper nr. 18/2015.