Christiano, Eichenbaum and Johannsen: "Does the New Keynesian Model Have a Uniqueness Problem?"

A Discussion

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Introduction

New Keynesian model remains an important tool for macroeconomists

- Used as a tool for understanding stabilization policy
- Used by policy makers in practice
- Has been very successful empirically in terms of accounting for inflation dynamics
- Christiano, Eichenbaum and Evans, JPE, 2005 established the empirical content of the model

The New Keynesian Model

A main prediction of NK model: **Sufficiently aggressive interest rate policy** solves two issues in one go:

- **Helps root out multiplicity of equilibria in vicinity of targeted equilibrium** - equilibrium becomes locally determinate
- **Can implement optimal outcome** - aggressive monetary policy stabilizes inflation expectations and addresses the inefficiences that arise from nominal rigidities
- Monetary policy powerful and flexible stabilization policy

Zero Lower Bound

Krugman, 1998:

> *"Over the past several years, Japanese money market rates have been consistently below 1 percent, and the Bank of Japan plausibly claims that it can do no more; yet the Japanese economy, which has been stagnant since 1991, is sliding deeper into recession. Since Japan is such an important economy, and its slump threatens to shatter the already fragile prospects for economic recovery in the rest of Asia, understanding what is going wrong there has become quite urgent. And there is also a deeper reason for concern: if this can happen to Japan, perhaps it can happen elsewhere."*

- **Zero lower bound** prevents use of "conventional" instrument in a liquidity trap
- Price level targeting, forward guidance, unconventional monetary policies or **FISCAL POLICY**

Fiscal Policy and the Zero Lower Bound

A **Divine Coincidence** in the New Keynesian model

- **Positive nominal interest rates**: The appropriate monetary policy (super) effective
- **Zero lower bound**: The appropriate fiscal policy super effective
- Christiano, Eichenbaum and Rebelo, JPE 2011: Government spending multipliers well above 1 when interest rate is constant
- Eggertsson, Macroannual 2010: ITC and sales tax cuts super effective at ZLB, labor income tax cuts counterproductive
- Woodford, CER: Large increase in government spending at ZLB is optimal

Uniqueness

The **elephant in the room**:

- Benhabib, Schmitt-Grohe and Uribe (2001, 2002): Interest rate policies produce **global indeterminacy** due to the zero lower bound - there is a 2nd steady-state at the ZLB
- Mertens and Ravn (2014) model the latter as a stochastic sunspot

There are two types of equilibria at the ZLB:

- **Fundamental liquidity traps** - the type of equilibria explored by Krugman, Eggertsson, Woodford and by Christiano, Eichenbaum and Rebelo
- **Expectations driven liquidity traps** - the type of equilibria explored by Benhabib, Schmitt-Grohe and Uribe, Mertens and Ravn

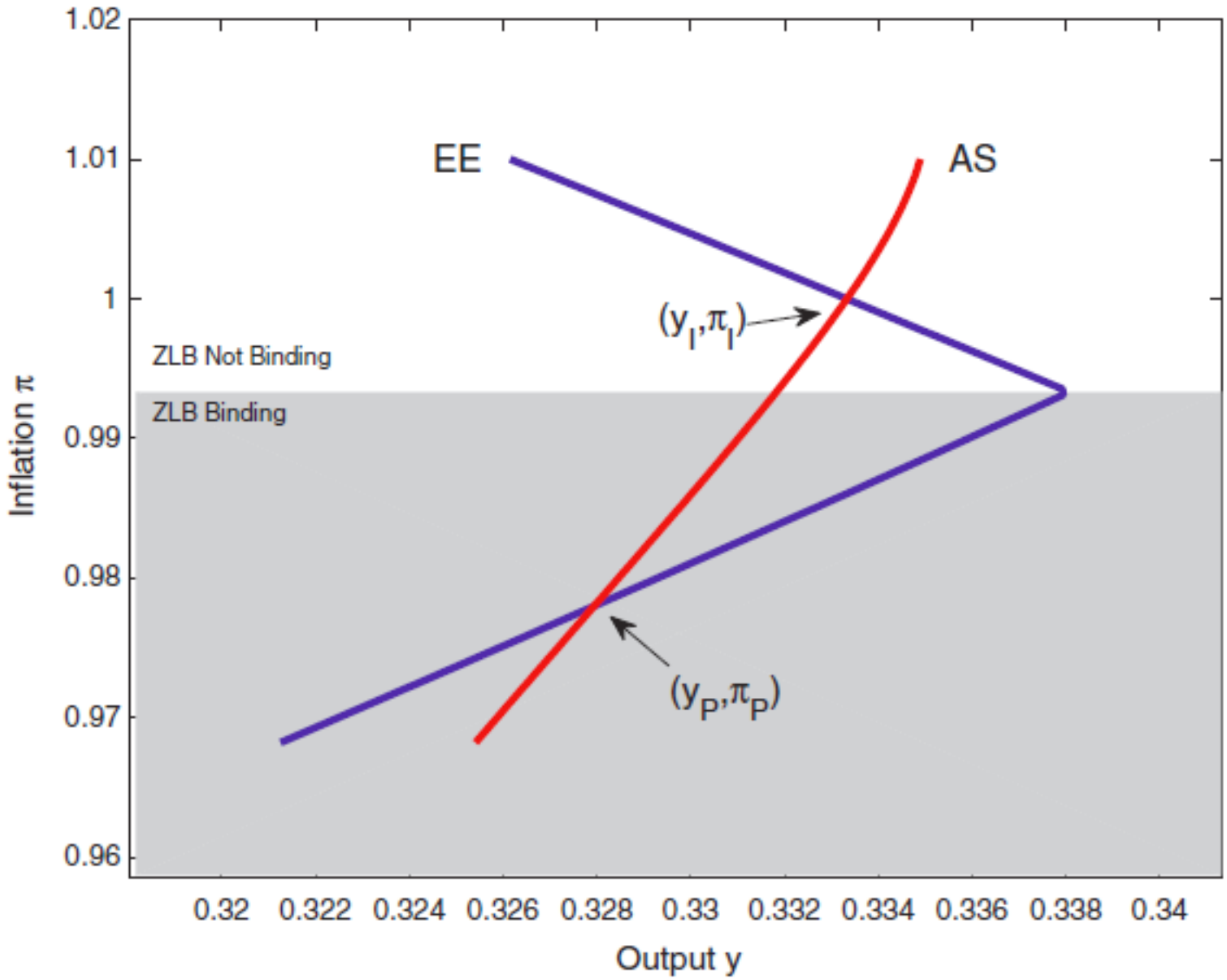
New Keynesian (Calvo) Model

- The equilibrium allocation and prices must solve the following set of stochastic difference equations:

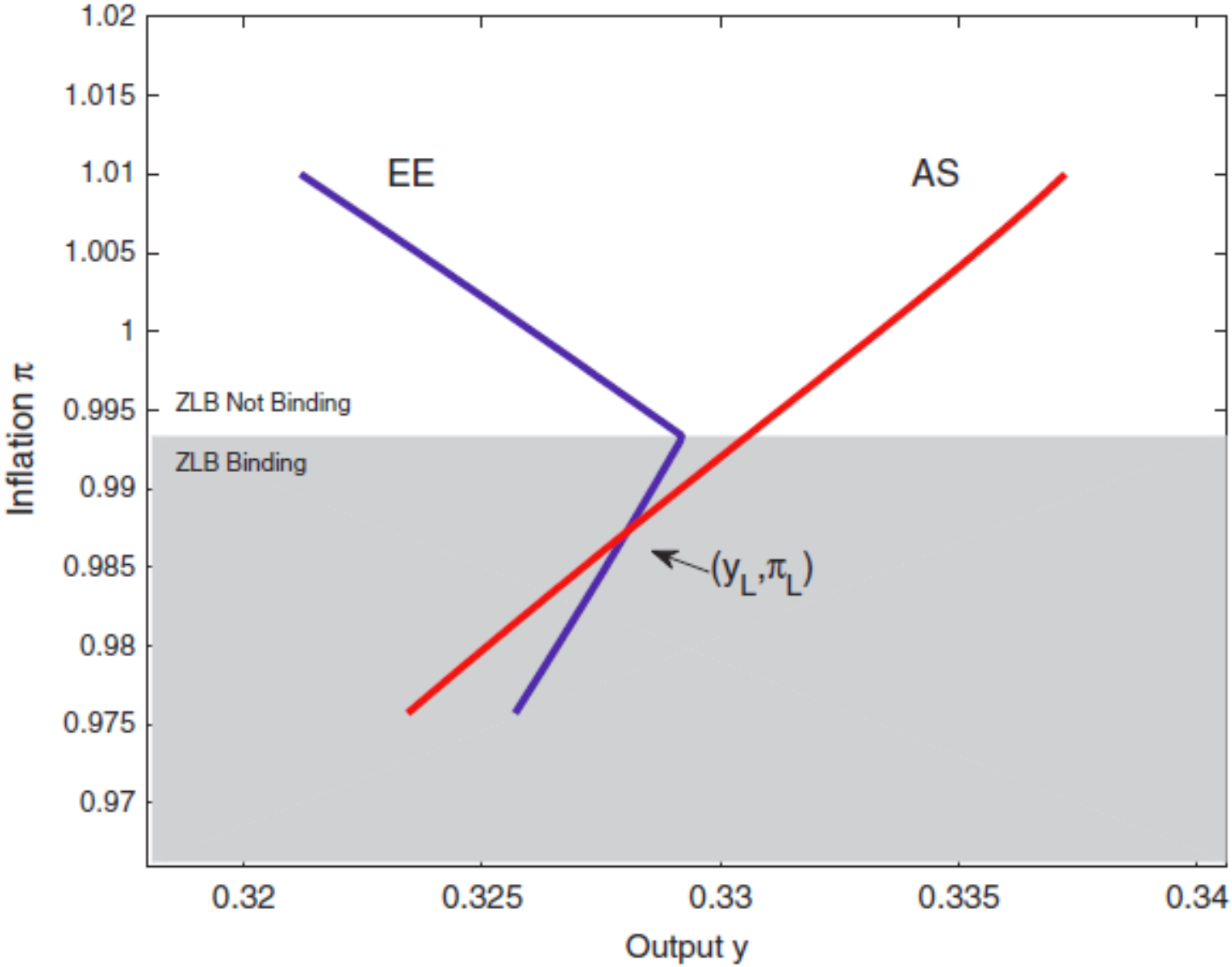
$$
\begin{aligned}
1 &= \beta R\left(\pi_t\right) \mathbb{E}_t\left[\frac{1}{\pi_{t+1}} \frac{\omega_{t+1}}{\omega_t} \frac{U_{c,t+1}}{U_{c,t}}\right] \\
p_t^* &= \frac{1}{\pi_t} \frac{\mathbb{E}_t \sum_{s=t}^{\infty}\left(\beta\xi\right)^{s-t} \omega_s U_{l,s}\left(\prod_{j=0}^{s-t} \pi_{t+j}\right)^{\eta} y_s}{\mathbb{E}_t \sum_{s=t}^{\infty}\left(\beta\xi\right)^{s-t} \omega_s U_{c,s}\left(\prod_{j=0}^{s-t} \pi_{t+j}\right)^{\eta-1} y_s} \\
v_t &= \xi \pi_t^{\eta} v_{t-1} + \left(1-\xi\right) p_t^{*-\eta} \\
1 &= \xi \pi_t^{\eta-1} + \left(1-\xi\right) p_t^{*1-\eta}
\end{aligned}
$$

- for a given initial condition v_{-1}, Ricardian fiscal policies and law of motion for the preference shock ω_t

Expectational LT: Wave of Pessimism



Fundamental LT: Temporary Drop in Discount Factor



Two Types of Liquidity Traps

	Type of liquidity trap	
	Fundamental	**Expectational**
Source	Shock so that $r^n < 0$	Pessimism
Expected duration	Not too long	Not too short
Higher G	$\pi \uparrow$, $dY/dG >> 1$	$\pi \downarrow$, $dY/dG < 1$
Lower τ^n	$\pi \downarrow$, $dY/d\left(-\tau^n\right) < 0$	$\pi \uparrow$, $dY/d\left(-\tau^n\right) >> 0$

- Design of fiscal policy depends on its source
- But how do you know which one you're in?
- Close to observational equivalence for some parameters

Equilibrium Selection

Benhabib et al: Construct policies that rule out expectational liquidity traps as rational expectations equilibria

- Fiscal expansion: Make the self-fulfilling LT fiscally unsustainable (threaten to break transversality condition)
- Switch from interest rate rule to money growth rate peg (but may not always work)
- **Problem**: Requires knowledge of the source of the LT?
- Benhabib, Evans and Honkapohja (2014) suggest similar fiscal remedies to ruling out expectational LT under learning

Equilibrium Selection

CEJ, Mertens and Ravn, Evans and Honkapohja: Explore robustness of liquidity traps to "small" deviations from rational expectations

- Replace Rational Expectations with learning
- McCallum (2003): Dismiss equilibria that are not E-learnable =stable under learning
- The idea is that the economy will converge to these equilibria with probability 0 under learning
- It is an asymptotic argument

Learnability

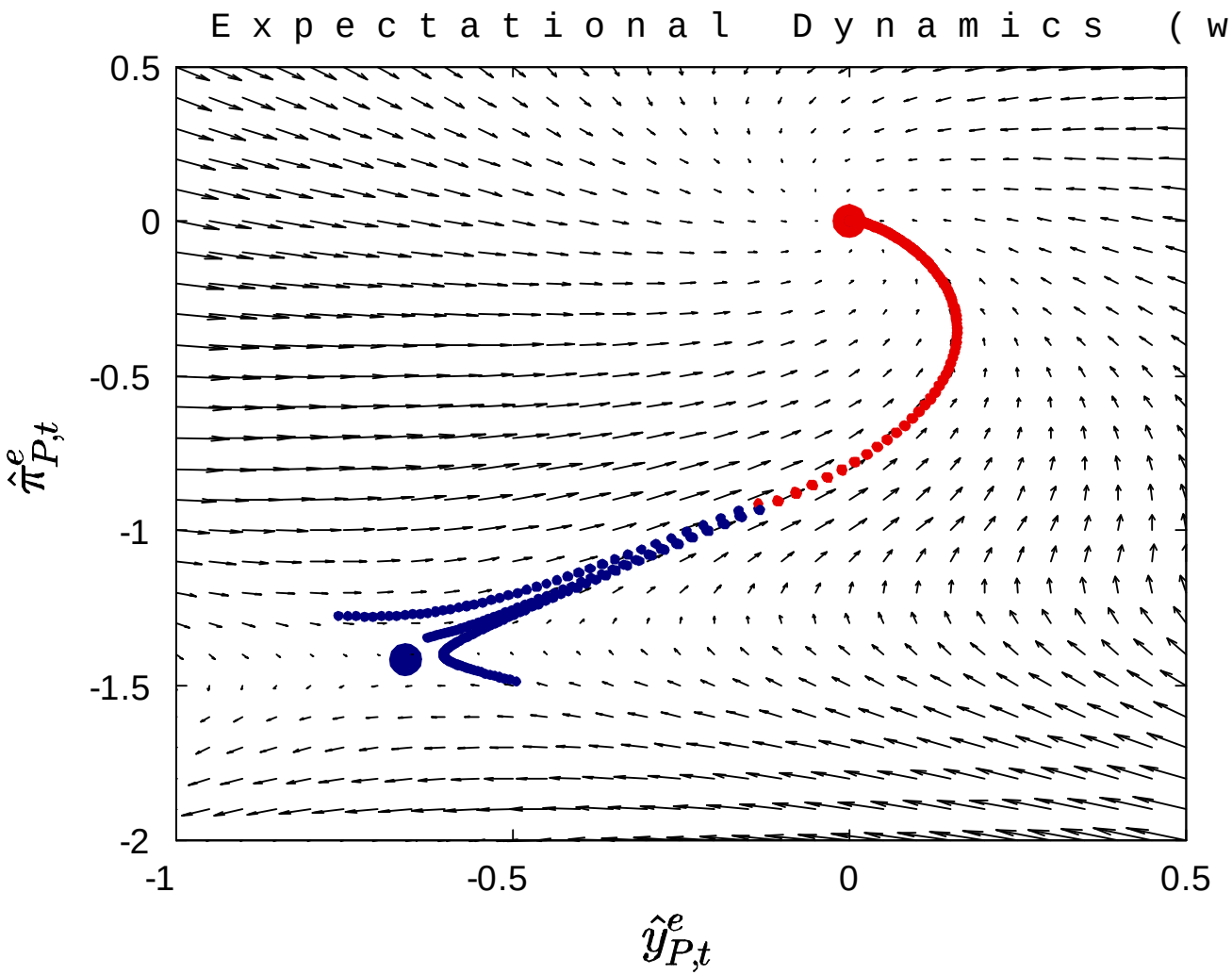
Mertens and Ravn (2014):

- E-stability condition is equivalent to indeterminacy condition
  - RE sunspot limit exists when $q \geq q^*$
  - RE sunspot limit is not E-stable when $q \geq q^*$ (it's a saddle path)
- Assume adaptive learning as in Evans and Honkapohja

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

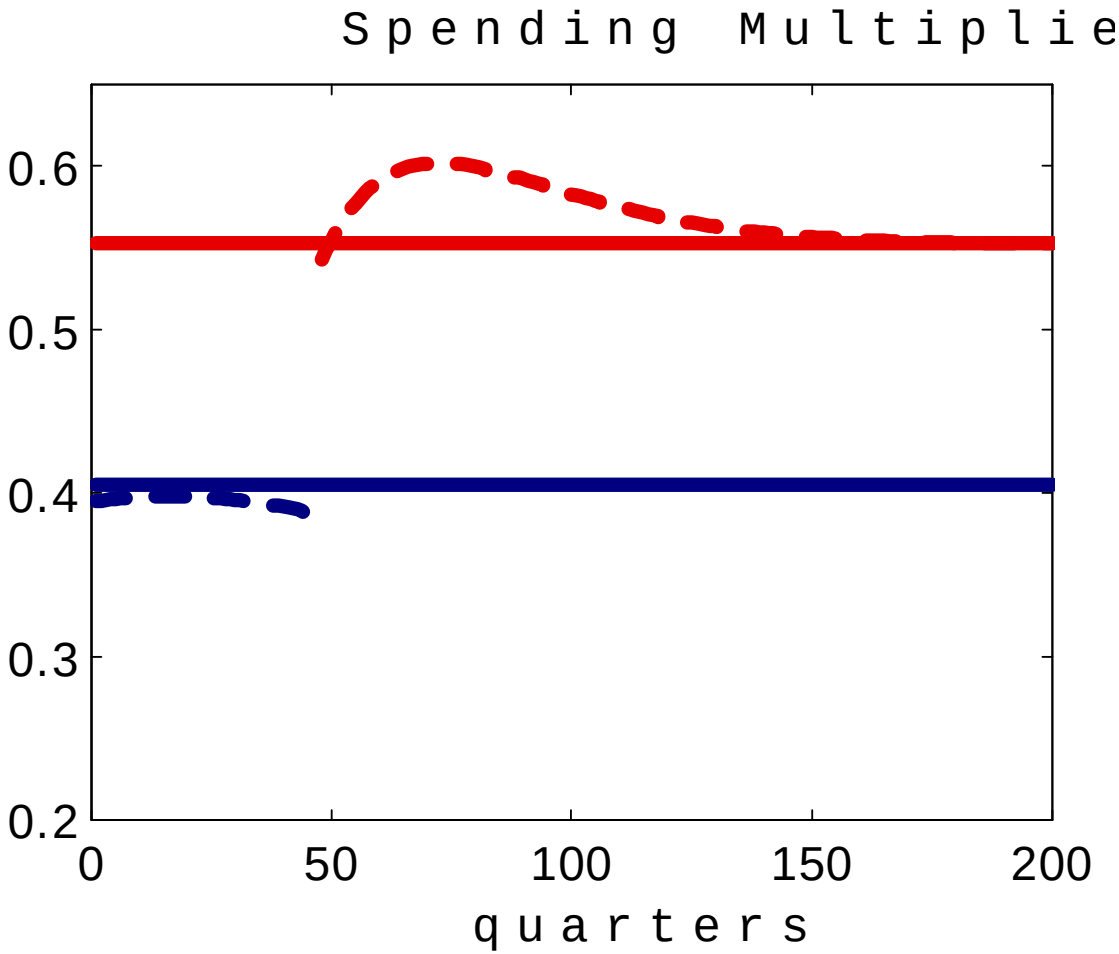
- and assume $\phi = 0.10$ (highest value considered by Evans and Honkapohja

Phase diagrams



- With a zero lower bound, the LT is a very strong attractor

Multipliers



- Spending multiplier smaller than usual for first 50 quarters

Learnability

Christiano, Eichenbaum and Johannsen (2015) overturn these:

- Fast convergence to not so bad liquidity trap (different from our experiment)
- Multipliers large
- Because of fast convergence: E-learnability is appealing as selection mechanism

This is important:

- Restores the appealing features of the NK model
- Simple prescriptions for economic policy

Learnability

What's different:

- Mertens and Ravn look at convergence to intended steady state
- CEJ look at convergence to discount-factor induced ZLB
- Evans and Honkapohja, Mertens and Ravn: Agents see current price level when setting the price
- CEJ: Agents don't see the current aggregate price level when setting today's price
- CEJ assume much higher gain than is standard in the learning literature
- CEJ assume static forecasts

All of these are valid objections and are interesting to question

Convergence to what?

- Mertens and Ravn look at convergence to intended steady state
- CEJ look at convergence to discount-factor induced ZLB

Both experiments are valid

- Mertens and Ravn: Look at convergence conditional upon a "pure" expectational equilibrium
- CEJ: Look at convergence conditional upon discount factor shock

Expectational equilibrium closer to discount factor induced ZLB

- Is this the source of faster convergence?

The Price Level

- **Evans and Honkapohja**: Current price level is observed. Agents form expectations about future variables
- **CEJ**: Current price level is not observed. Agents form expectations about current price level and future variables

Which is more appropriate?

- **Standard Cournot model**: Agents know the reaction function of other players
- It is possible to introduce imperfect information but then one needs to worry about higher order beliefs or look at conjectural equilibria
- **Monopolistic model**: No strategic interaction, all firms identical.
- Lack of knowledge about aggregate price similar to assuming lack of knowledge of other firms' actions?
- But: Why doesn't lack of knowledge about current price level imply SLOWER convergence?

No Pain, No Gain

How large is the gain?

- Evans et al (2008): $\gamma = 1/30$
- Eusepi and Preston (2011): $\gamma = 0.002$
- Mertens and Ravn (2014): $\gamma = 1/10$ - we were trying to be conservative
- CEJ (2015): $\gamma = 3/4$

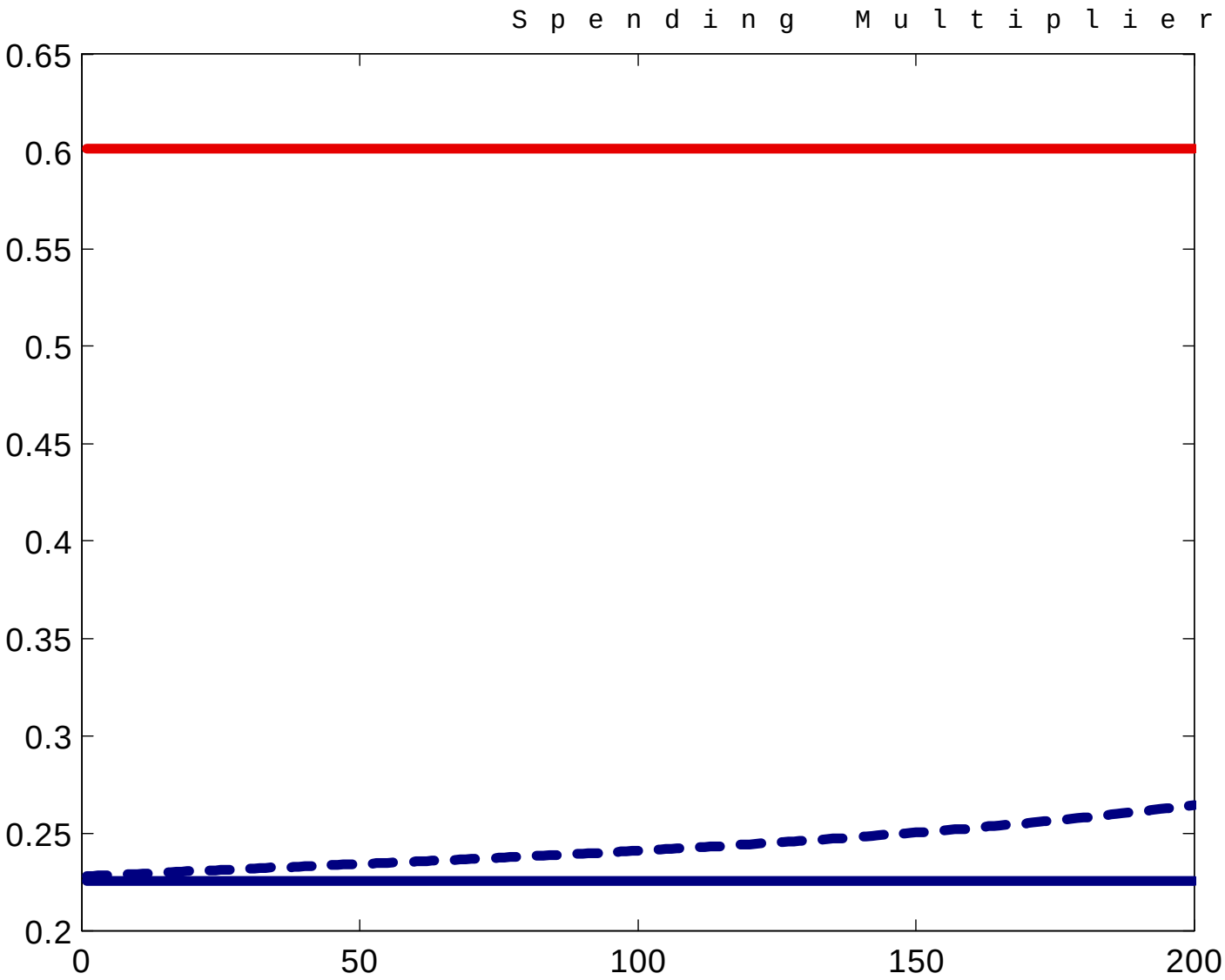
- Reasonable to think of w as low because economy was in SS and people might adjust their expectations to a change slowly.

- Might think the opposite for the ZLB: it's a very novel situation.

- A standard argument for constant gain learning is that it is useful for "structural change" experiments
- How much does this matter for the results?

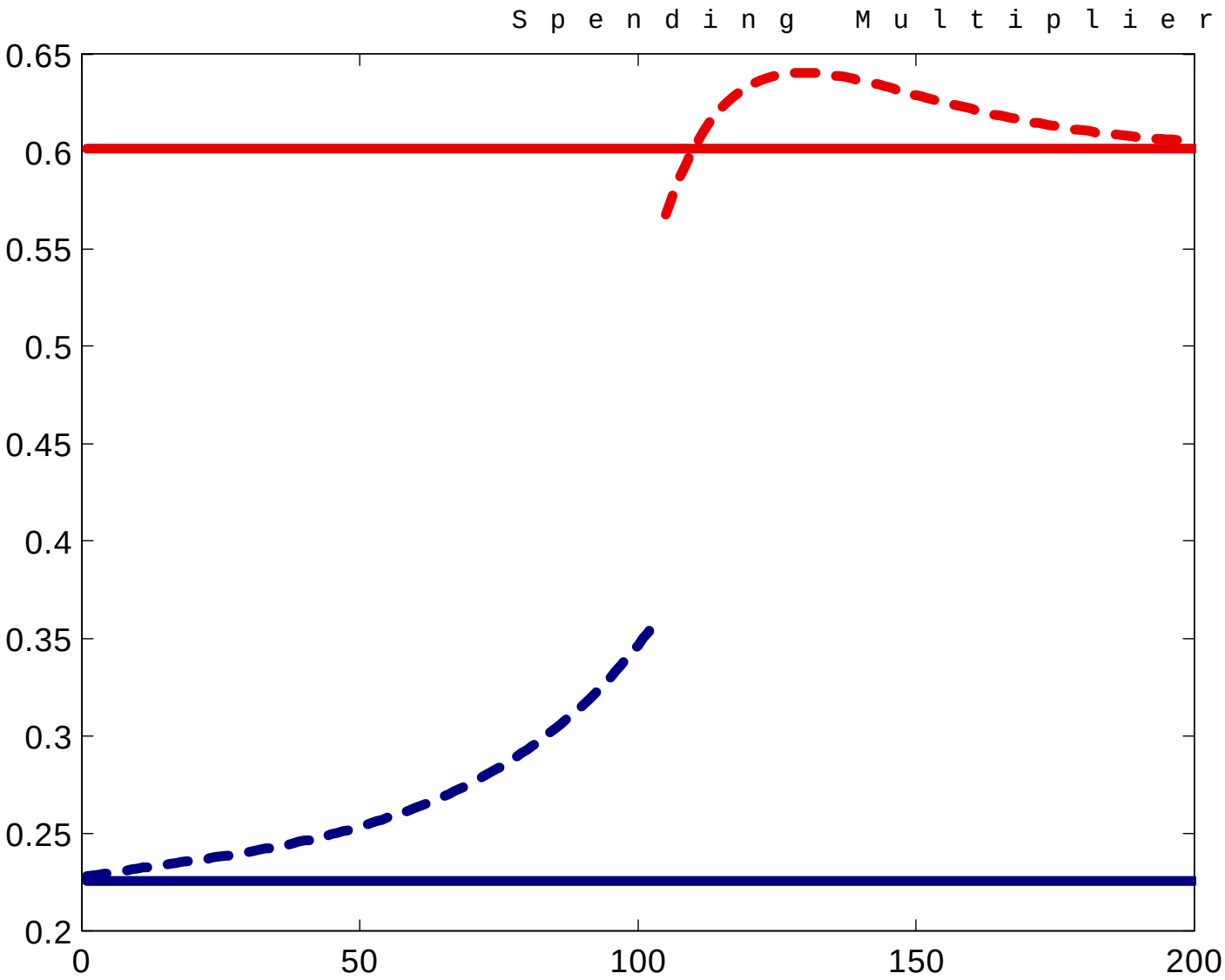
No Pain, No Gain:

$\omega = 0.03$



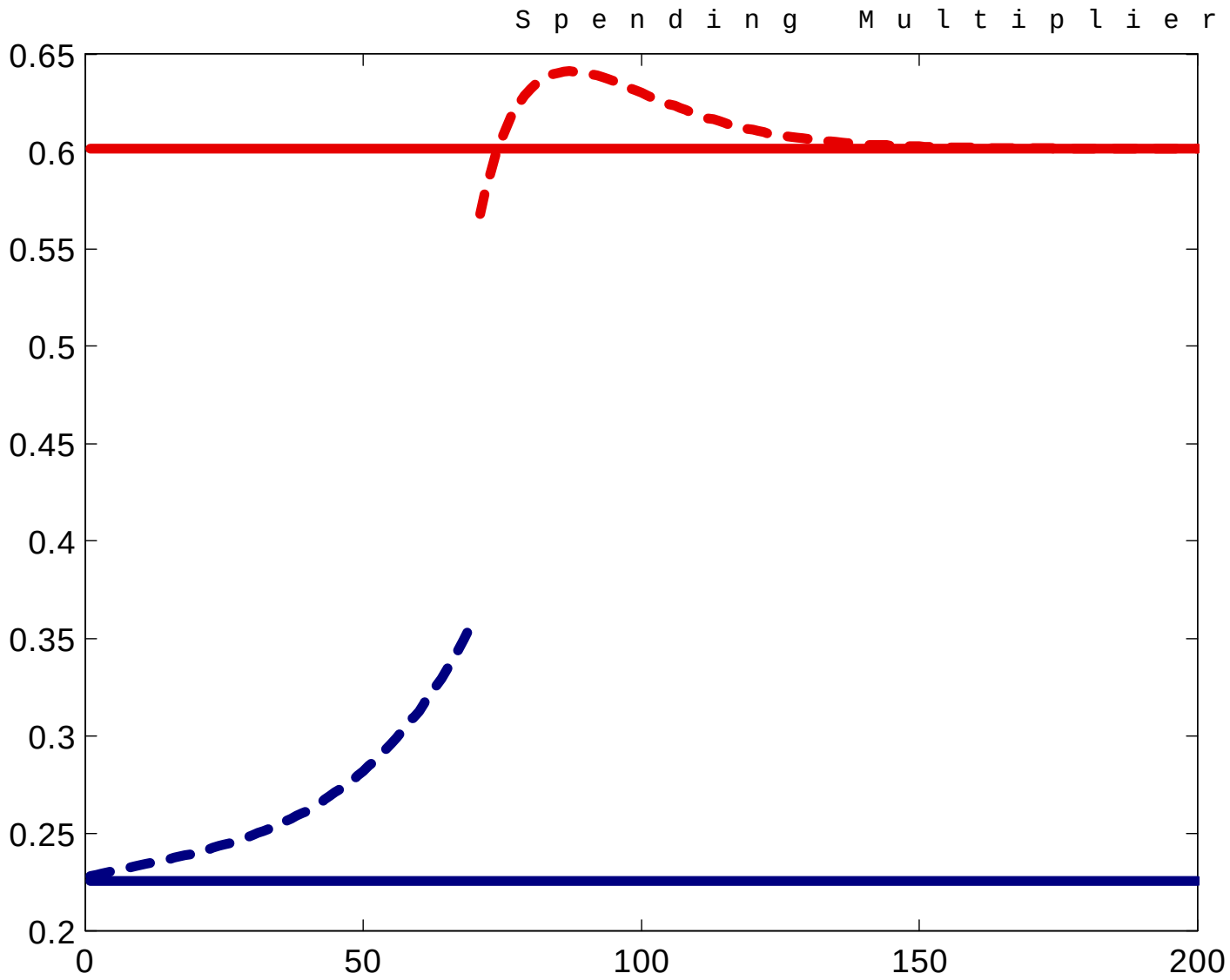
No Pain, No Gain:

$\omega = 0.1$



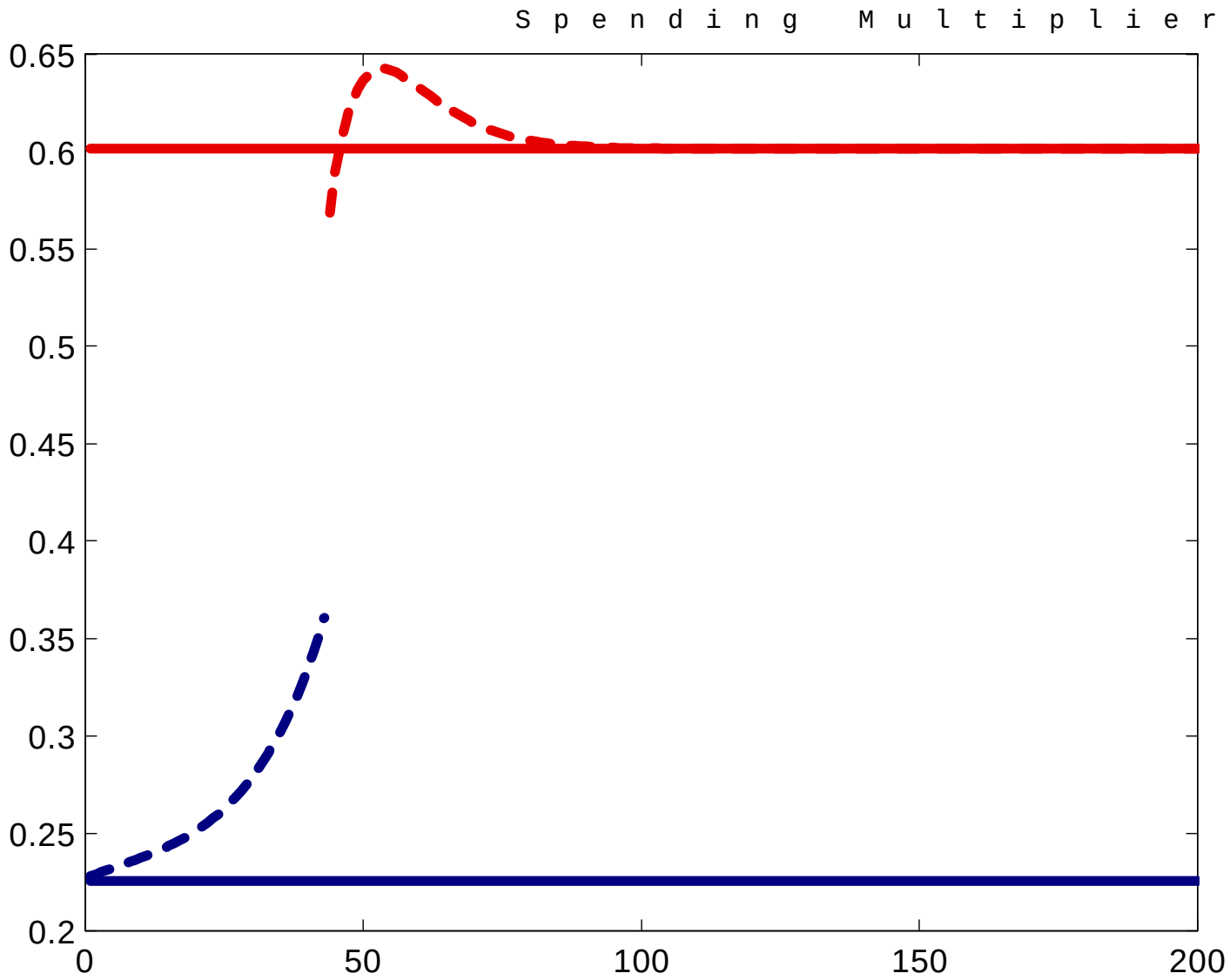
No Pain, No Gain:

$\omega = 0.15$



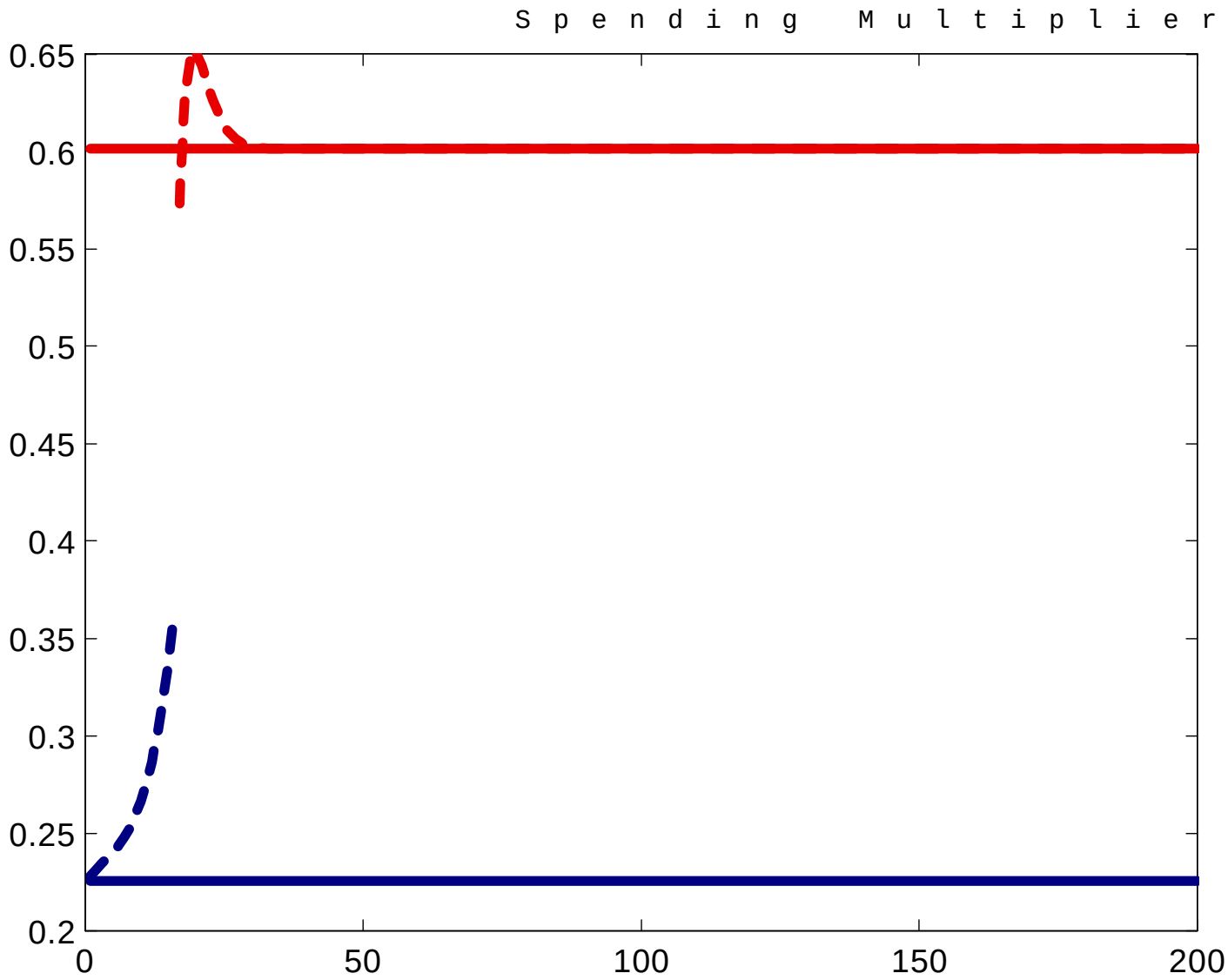
No Pain, No Gain:

$\omega = 0.25$



No Pain, No Gain:

$\omega = 0.75$



Static Forecasts

CEJ assume that:

$$\begin{aligned} X_t^{e,f} &= \omega X_{t-1} + (1-\omega) X_{t-1}^{e,f} \\ X_{t+1}^{e,f} &= X_t^{e,f} \end{aligned}$$

- The latter seems a bit odd although it may be seen as following logically from the adaptive expectations assumptions made here
- It is a rather extreme implication of the learning model assuming complete lack of knowledge about the structure of the economy

Conclusion

I really like this paper

- Important and policy relevant result

Also left slightly confused

- What is the source of the fast convergence result? High gain?
- Which set of alternative assumptions are more appropriate?
- But, CEJ's results do show that the results coming from learning models may be feeble

A Puzzle

The current slump:

- The long duration of the current LT is consistent with an expectational equilibrium under RE and under Mertens-Ravn results for learning
- If the current results are correct, how come we are still in a LT?
- Discount factor-induced ZLB must be relatively short in expected duration to exist
- Fast divergence from expectational ZLB

Deterministic Steady-States

1. **The intended steady-state**: Inflation is on target and output is efficient

$$\begin{aligned} \pi^I &= \widetilde{\pi} = 1 \\ y^I &= n^I = y^E \\ v^I &= 1 \end{aligned}$$

Deterministic Steady-States

1. **The intended steady-state**: Inflation is on target and output is efficient

$$\begin{aligned} \pi^I &= \widetilde{\pi} = 1 \\ y^I &= n^I = y^E \\ v^I &= 1 \end{aligned}$$

2. **The unintended steady-state**: Interest rate at lower bound and inefficiently low output:

$$\begin{aligned} \pi^U &= \beta \\ y^U &< y^E \\ v^U &> 1 \text{ and } p^* < 1 \end{aligned}$$

Stochastic Sunspot Equilibria at the ZLB

- Sunspot variable ψ_t follows a two-state discrete Markov chain

$$\psi_t \in [\psi_O, \psi_P] \quad , \quad R = \begin{bmatrix} 1 & 0 \\ 1-q & q \end{bmatrix} \quad , \quad 0 < q < 1$$

Stochastic Sunspot Equilibria at the ZLB

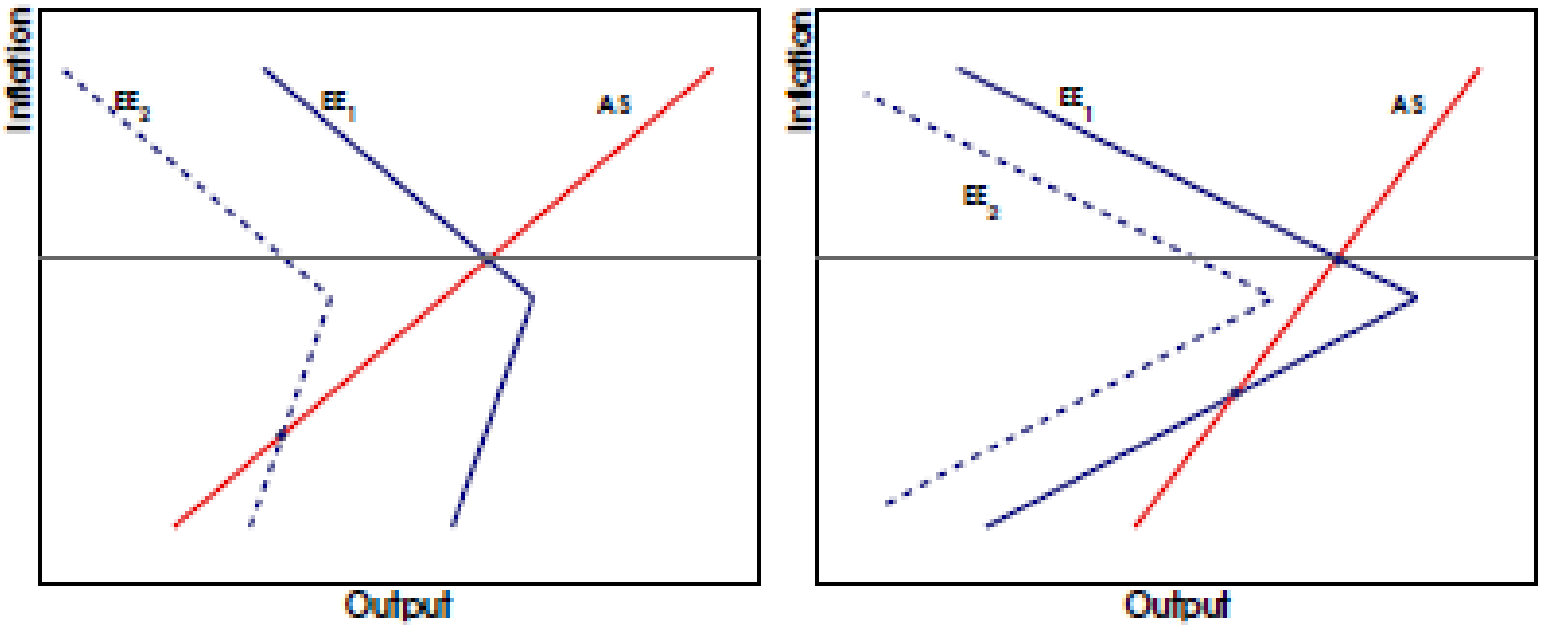
- Sunspot variable ψ_t follows a two-state discrete Markov chain

$$\psi_t \in [\psi_O, \psi_P] \quad , \quad R = \begin{bmatrix} 1 & 0 \\ 1-q & q \end{bmatrix} \quad , \quad 0 < q < 1$$

- **Markov equilibria** that can be generated from

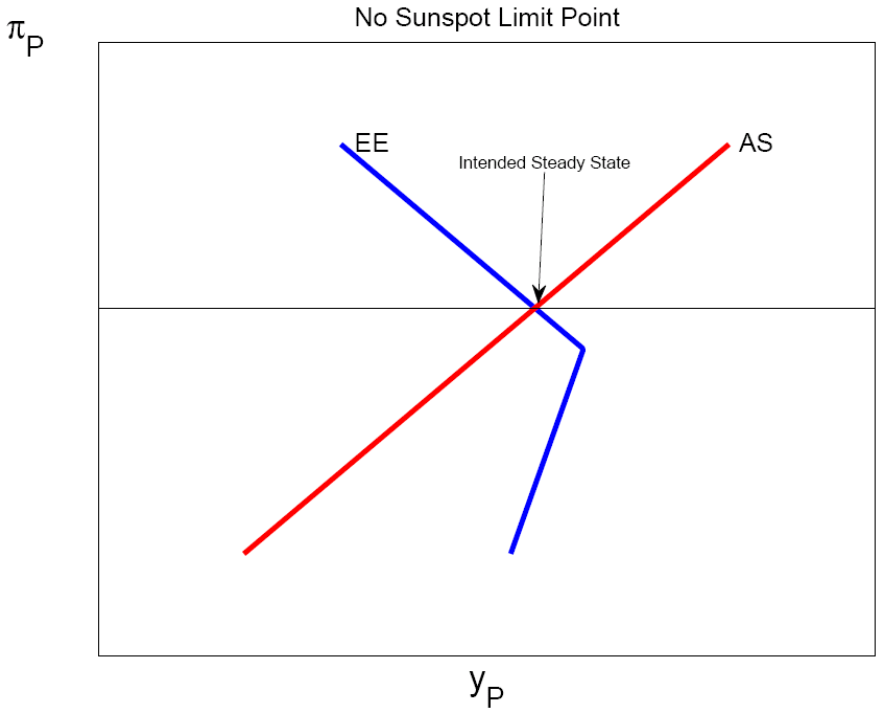
$$\begin{aligned} u_t &= f(s_t) \\ s_t &= h(s_{t-1}) + \mu\varepsilon_t, \ s_0 \text{ given} \end{aligned}$$

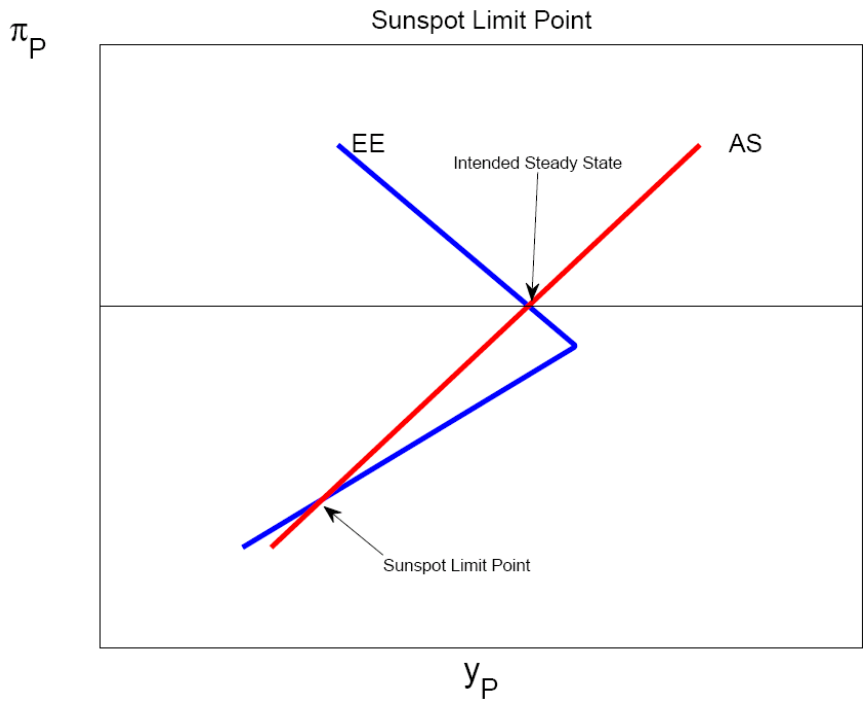
Existence of a Fundamentals Driven Liquidity Trap



- **In the left picture**: Kink is moderate because of low persistence of low confidence state - an increase in savings rate can lead to LT
- **In the right picture**: More persistent low confidence state - we cannot have fundamentals driven LT

Existence of an Expectations Driven Liquidity Trap





- **In the left picture**: Kink is moderate because of too low persistence of low confidence state - only the intended steady-state prevails
- **In the right picture**: More persistent low confidence state - we can end up in unintended equilibria