Monetary Policy Modeling – What Is the New Normal?

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An Econometrician's Perspective

- Monetary policy decisions are based (in part) on the input from formal econometric models.
- Econometric models...
  - come in different shapes and forms;
  - place a probability distribution over what might happen tomorrow
    - conditional on what we have observed until today
    - and conditional on parameters that need to be determined based on historical information;
  - can be used to track and forecast the GDP growth, inflation, etc.;
  - can be used to assess the effects of policy interventions.

How Good are these Econometric Models?

- Forecasting performance:

$$error = forecast - actual$$

- Forecast performance is easy to assess because forecasts can be computed from reduced form time series models.
- policy predictions:

$$policy\ effect = counterfactual\ outcome - actual\ outcome$$

- Policy predictions are more difficult to assess because in the absence of controlled trials the calculation of counterfactual outcomes requires elaborate structural macroeconomic models.

Examples of Modern Macroeconometric Models

- Vector autoregressions:
  - vector of variables, e.g., GDP growth, inflation, interest rates;
  - tomorrow's values are linear functions of today's (and yesterday's...) values plus some shocks; shocks may have economic interpretation, e.g., unanticipated change in interest rate policy.
- Dynamic stochastic general equilibrium (= DSGE) models:
  - tightly rooted in modern dynamic macroeconomics;
  - household and firm behavior explicitly derived from optimization problems, taking prevailing policy regime into account.
- Others...

The Old Normal – Prior to Great Recession

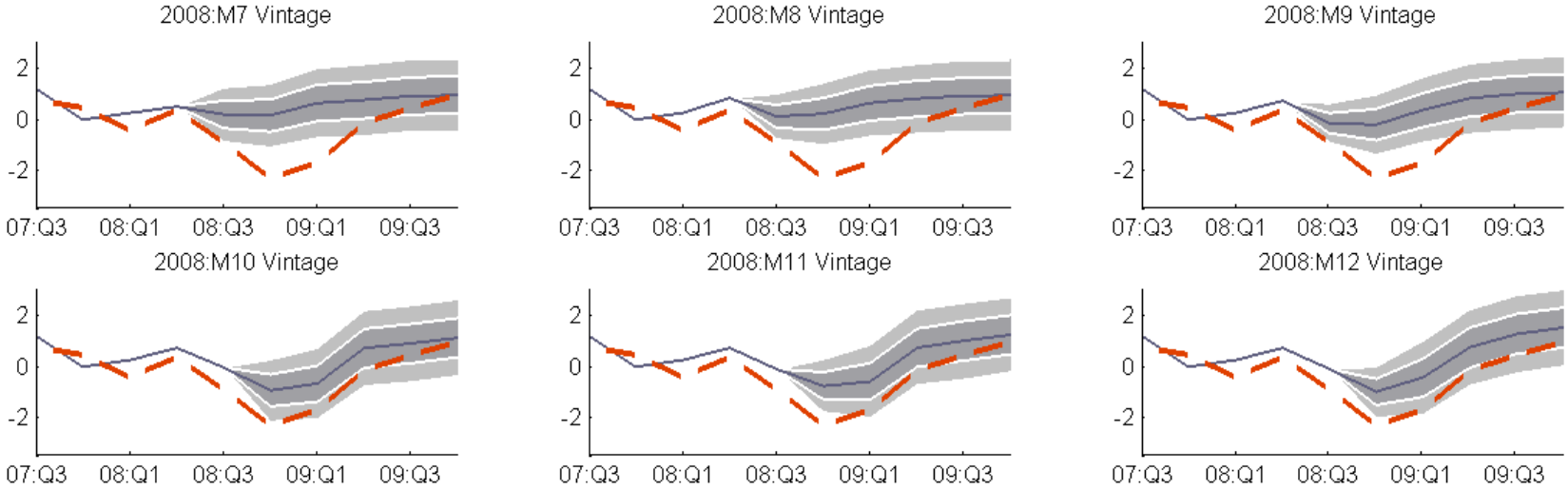
- Low macroeconomic volatility after 1984.
- Monetary policy was well described by interest rate feedback rule:
  - Roughly:

    $$\text{Fed Funds Rate}_t = \text{Systematic Component}_t + \text{Unanticipated Deviations}_t$$

  - "Rule" represents public's perception of monetary policy.
  - Feed *unanticipated deviations* to assess the effect of fed funds rate changes on the economy.
- Financial variables were not particularly important for macroeconomic forecasting with VARs and DSGE models.

How Did VARs Forecast During the Great Recession?

GDP Growth Forecasts from July to December 2008

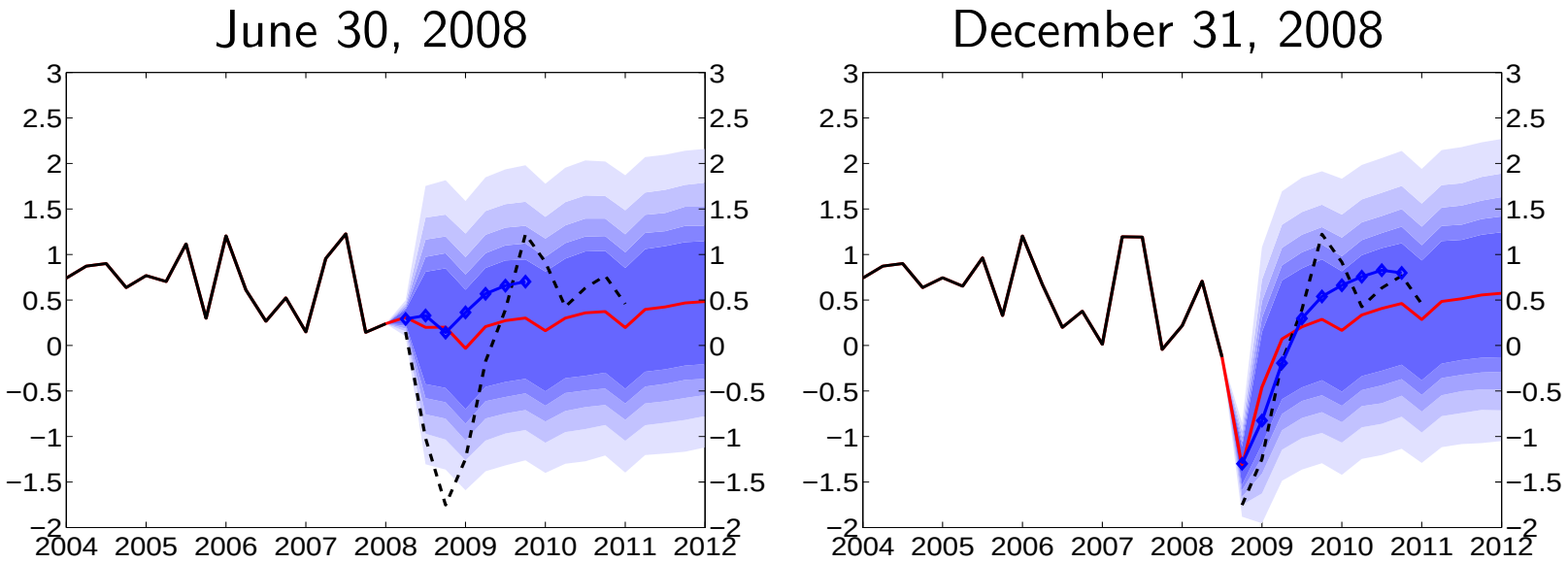


- VAR uses mixed frequency (quarterly and monthly data) including unemployment, industrial production, fed funds rate, treasury bond yield, and stock mkt index;
- large drop in GDP growth in 2008:Q4 very difficult to predict;
- even based on within-quarter monthly information in Nov/Dec 2008.

Source: Schorfheide and Song (Forthcoming) "Real-Time Forecasting with a Mixed-Frequency VAR," *Journal of Business & Economic Statistics*.

How Did DSGEs Forecast During the Great Recession?

GDP Growth Forecasts



- Smets-Wouters DSGE model with Bernanke-Gertler-Gilchrist financial frictions;
- real-time forecasts, conditional on current quarter fed funds rate and spreads;
- DSGE forecasts similar to Blue Chip professional forecasts.

Source: Del Negro and Schorfheide (2013): "DSGE Model-Based Forecasting," In *Handbook of Economic Forecasting*.

What Are Some of the Modelling Challenges after the Great Recession?

1. Should we:
   - Discard data from the Great Recession?
   - Use new models or revert to the old ones?
   - Pay more attention to financial variables?

2. Fed funds is essentially zero in many countries, which is difficult to capture in "linear" time series models. ZLB generates nonlinearities with important policy implications.

3. Unconventional monetary policies:
   - forward guidance: statement about the current state of economy vs. promise of a looser policy in the future even if conditions improve, i.e., anticipated deviations from policy rule in the future;
   - large-scale asset purchases: in standard DSGE models quantities of assets do not matter!

I will talk more about my research related to (1) and (2).

"New" Models versus "Old" Models

- Macroeconomists/econometricians have been criticized for relying on models that abstract from financial intermediation / frictions.
- With hindsight it turned out that financial frictions were important to understand the Great Recession. But are they also important in normal times?
- We need tools that tell us in real-time when to switch models...
- Linear prediction pool:

$$\begin{aligned}\text{Density Forecast}_t \\ = \quad & \lambda_t \cdot \text{Forecast from "Normal" Model}_t \\ & +(1-\lambda_t) \cdot \text{Forecast from "Fin Frictions" Model}_t\end{aligned}$$

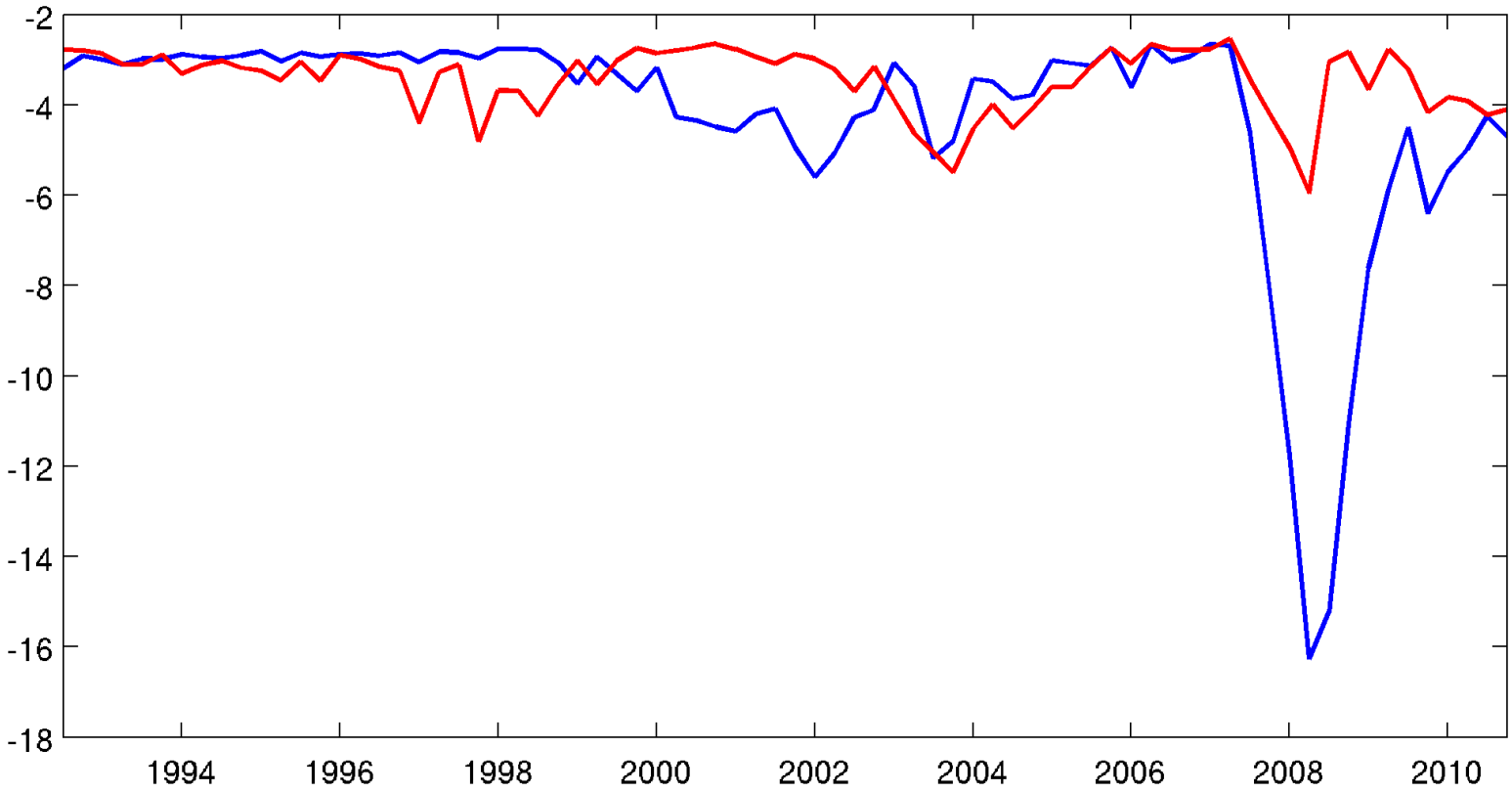
- Determine weight λ_t in real time based on historical forecast performance.

Source Del Negro, Hasegawa, Schorfheide (2014): "Dynamic Prediction Pools: An Investigation of Financial Frictions and Forecasting Performance," *NBER Working Paper 20575*.

"New" Models versus "Old" Models

Relative forecasting performance changes over time

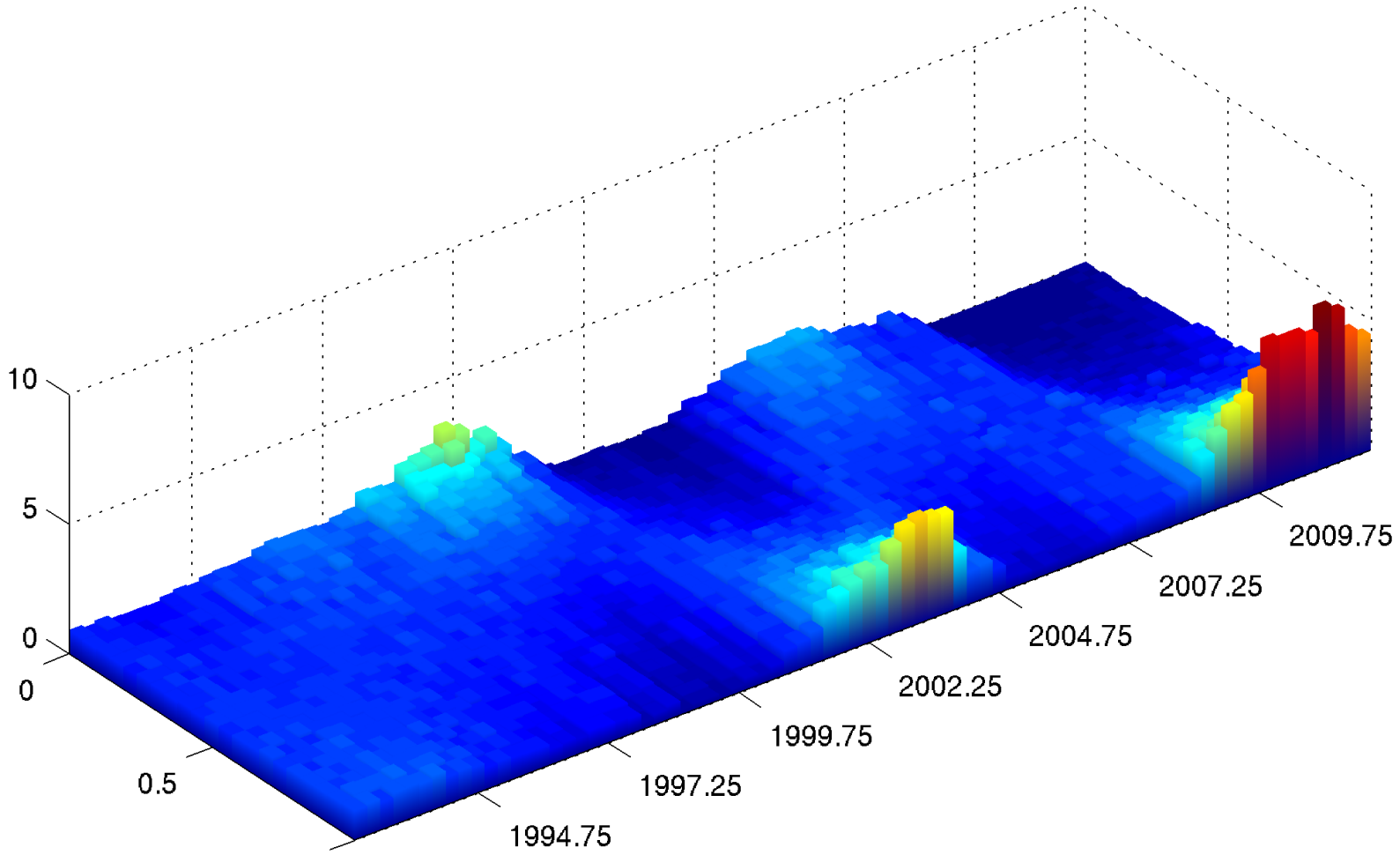
"Old" Smets-Wouters Model vs. "New" DSGE with Financial Frictions



It's easy to see with hindsight which model we should have used.

"New" Models versus "Old" Models

Time-Varying Weight λ_t (Posterior Distribution) on "New" DSGE with Financial Frictions

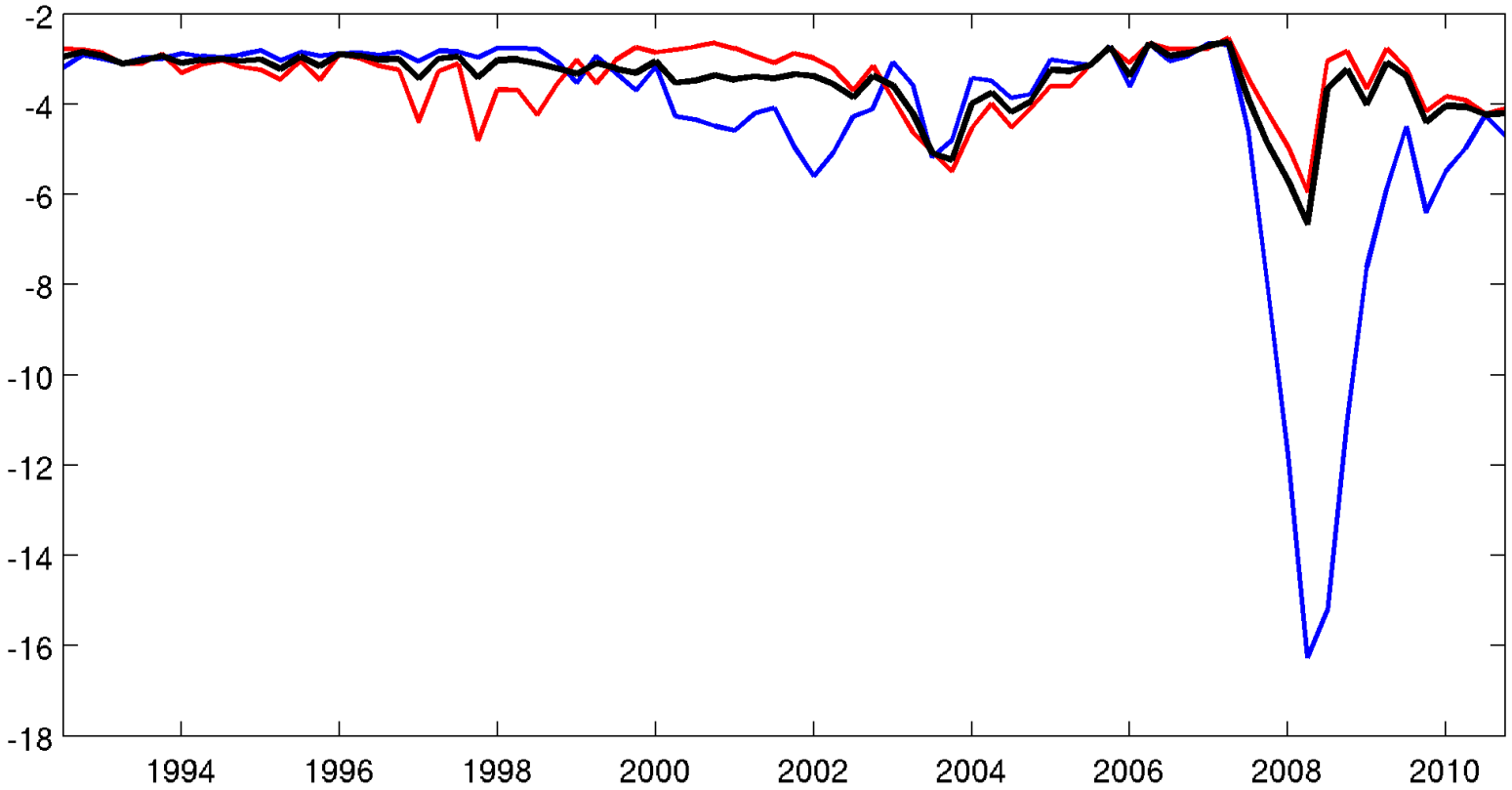


It's more difficult to determine the best model in real time...

"New" Models versus "Old" Models

"Old" Smets-Wouters Model vs. "New" DSGE with Financial Frictions

vs. Dynamic Prediction Pool with Real-Time Weights



Techniques for determining the best model in real time are available.

Zero Lower Bound (ZLB) On Nominal Interest Rates

- ZLB is an important nonlinearity that complicates the analysis of DSGE (and other) models.

- Many DSGE models are built around the following relationships ($\psi > 1$):

$$\text{"Fisher" Equation} \quad : \quad i_t = r + \mathbb{E}_t[\pi_{t+1}]$$

$$\text{Monetary Policy Rule} \quad : \quad i_t = \max\left\{0,\ r + \pi_* + \psi(\pi_t - \pi_*)\right\}$$

- Two long-run solutions:

$$\text{"Targeted Inflation" Regime} \quad : \quad \bar{\pi} = \pi_*, \quad \bar{i} = r + \pi_*$$

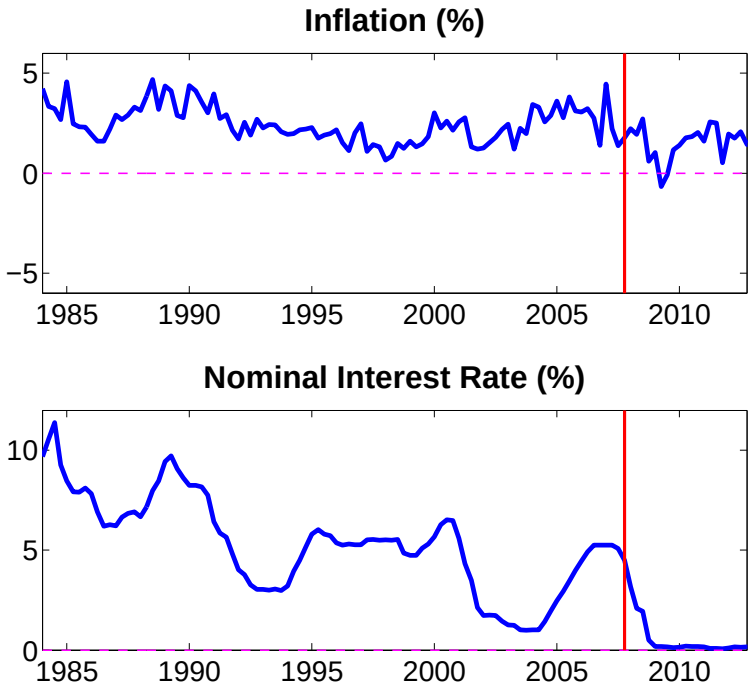
$$\text{"Deflation" Regime} \quad : \quad \bar{\pi} = r, \quad \bar{i} = 0$$

- Let's take a look at US vs. Japan through the lens of an estimated DSGE model.

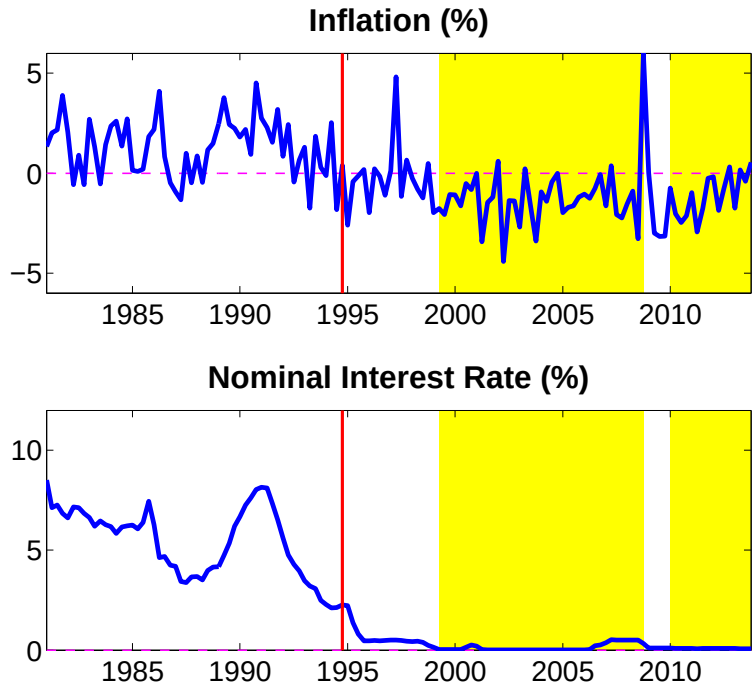
Source: Aruoba, Cuba-Borda, and Schorfheide (2014); "Macroeconomic Dynamics Near the ZLB: A Tale of Two Countries," *NBER Working Paper 19248*.

ZLB: US vs. Japan

US



Japan

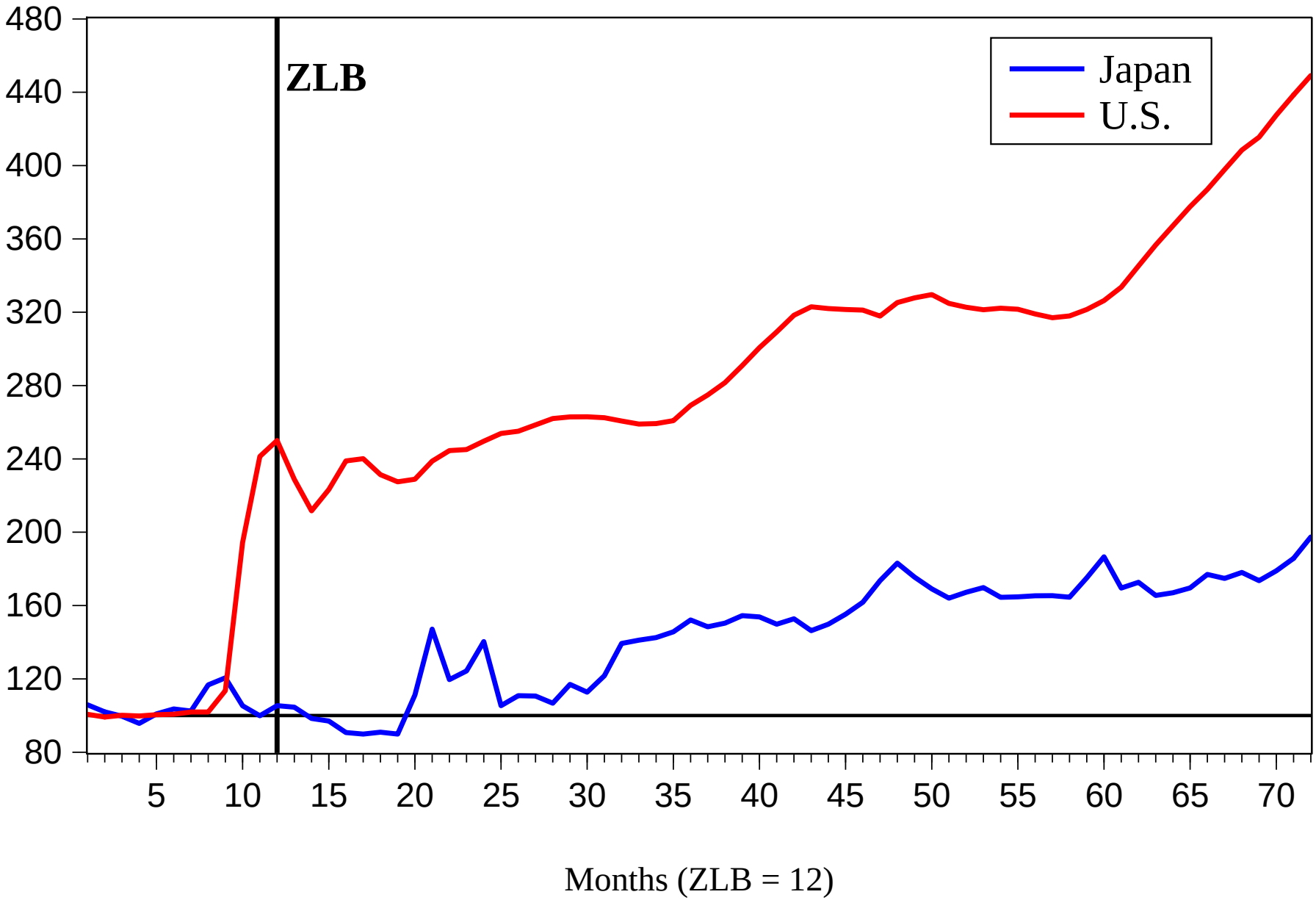


Note: Yellow-shaded area indicates high probability of "Deflation" Regime.

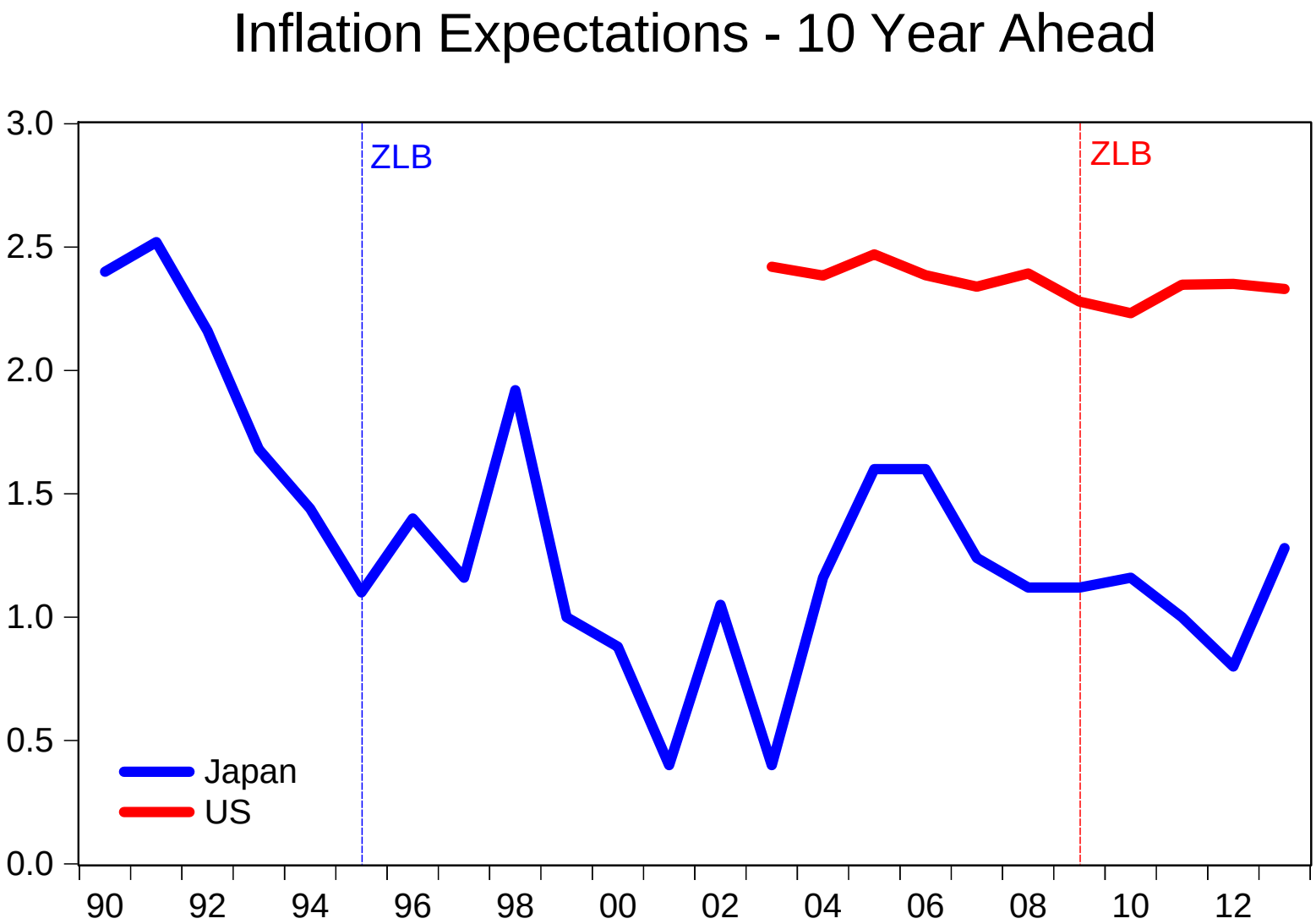
ZLB: US vs. Japan

- Both countries have been subject to negative exogenous shocks prior to their ZLB episodes.
  - **US**: Financial crisis of 2007-2008
  - **Japan**: Burst of housing bubble (1992), East-Asian / Korean crisis (1997), Russian crisis (1998)
- While in targeted-inflation regime, policy rates approached / reached ZLB.
- Very different monetary policy stance against deflation between two countries.

Central Bank Balance Sheets: US vs. Japan



Inflation Expectations: US vs. Japan



ZLB: US vs. Japan

Japan:

- After ZLB in 1999, any further action (committing to an inflation target or QE) was expressly ruled out.
- When QE was implemented in 2001, it wasn't explained clearly nor previous policy statements refuted.
- Ito and Mishkin (2006): "The Bank of Japan had a credibility problem, particularly under the Hayami Regime [1998-2003], in which the markets and the public did not expect the Bank of Japan to pursue expansionary monetary policy in the future, which would ensure that deflation would end."

US:

- Very aggressive reaction to the financial crisis.
- Use of unconventional tools, balance sheet early on.
- Adoption of a formal inflation target
- Forward Guidance

Bottom line: Fed was able to anchor inflation expectations, Bank of Japan did not convince public that it would fight deflation, triggering a change in expectations.

In Closing

- The Great Recession and its aftermath has posed many challenges for macroeconometric modeling and policy analysis.
- We discussed two in detail:
  - we might have to select different models in different times $\longrightarrow$ dynamic pooling in real time;
  - the ZLB gives rise to complex nonlinearities; understanding how an economy got to the ZLB and what the forces are that keep it there is crucial for assessing the effects of macroeconomic policies
- The academic literature is quickly adapting to the modeling challenges posed by the Great Recession and to contribute to our understanding of new monetary and macroprudential policies.