



Discussion of Fabio Milani, “Learning and Time-Varying Macroeconomic Volatility.”

James Bullard

President and CEO

Federal Reserve Bank of St. Louis

27 June 2008, Frankfurt am Main

International Research Forum on Monetary Policy

ECB, FRB, CGES, CFS

Views expressed are those of the author and do not necessarily reflect official positions of the FOMC or the Federal Reserve System.

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Summary

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- Widespread agreement on the nature of the great moderation in the U.S.
 - The volatility of HP-filtered real output fell by about 1/2 after 1984.
 - Volatility of many other macroeconomic variables also fell significantly.
- Explanations.
- This paper focuses on the third possibility.



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Summary

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- Widespread agreement on the nature of the great moderation in the U.S.
 - The volatility of HP-filtered real output fell by about $1/2$ after 1984.
 - Volatility of many other macroeconomic variables also fell significantly.
- Explanations.
 - Tighter monetary policy.
 - Changes in private sector behavior.
- This paper focuses on the third possibility.



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- Explanations.
 - Luck.
 - Better monetary policy.
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- Replace rational expectations with learning.
- Learning takes place via recursive algorithms.
 - With expectational stability, equilibrium will still be REE.
- Suppose agents suspect structural change.
 - Large shocks may indicate structural change is occurring.
 - Agents discount past data more.
 - Decisions are based on recent, volatile data.
 - This increases volatility still further.



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- Replace rational expectations with learning.
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 - With expectational stability, equilibrium will still be REE.
- Suppose agents suspect structural change.
 - They may need to track the system to which they expect.
 - They may use model uncertainty.
- Large shocks may indicate structural change is occurring.
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Summary

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- Standard, stylized NK model.
- Standard learning via recursive algorithms.
- Critical: Time-varying gain.
● *Journal by Marcell and Nicola (2008)*
● *Journal*
- Estimate using Bayesian methods.



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Summary

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- Model can generate time-varying volatility.
- Right order of magnitude to contribute to explaining the great moderation.
- Standard naive econometric exercise would wrongly conclude shock volatility has declined.
- The time-varying volatility is endogenous.



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Summary

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- Relatively standard NK model.
- Three shocks, including a monetary policy shock.
- Monetary policy is a Taylor-type rule with inertia.
- Preference and sticky price parameters are constant.
- Inertia parameter and policy parameters are time-varying.
- Policy rule is operational in the sense of McCallum.
- Shock innovations have constant variance.



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Summary

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- Replace the RE assumption with learning.
- Agents have a perceived law of motion that corresponds to the REE.
- They update coefficients in the PLM using standard recursive algorithms.
- Importantly, the gain is time-varying:
$$g_{t,y} = \begin{cases} t^{-1} & \text{if } \frac{\sum_{j=0}^J (|y_{t-j} - E_{t-j-1} y_{t-j}|)}{J} < v_t^y \\ \bar{g}_y & \text{if } \frac{\sum_{j=0}^J (|y_{t-j} - E_{t-j-1} y_{t-j}|)}{J} \geq v_t^y \end{cases} \text{ for}$$
$$y = \pi_t, x_t, i_t.$$
- Reasonable? Something more continuous?



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- Calibrated case, with large gain threshold.
- Clear evidence of volatility clustering, even though the innovation variances are constant.
- If there were no switching in the gain, there would be no volatility clustering.
- Reasonable?
- “Times of great uncertainty and large shocks are also times when past data is discounted most heavily.”



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- Bayesian methods allow joint estimation of structural and learning parameters.
- $J = 4$, window of one year, results not too sensitive to this.
- Gain parameters are relatively high in volatile periods.
- Taylor principle is satisfied.
- Simulation with estimated parameters: 10,000 samples of 185.
- Time-varying volatility.



Estimation

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• Inflation std. ratio 0.39 versus 0.35 in the data.

• Output gap s.d. ratio 0.42 versus 0.50 in the data.

• $\rho = 0.99$

• $\rho = 0.99$ implies that the model is nearly non-stochastic



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 - Inflation s.d. ratio 0.39 versus 0.35 in the data.
 - Output gap s.d. ratio 0.42 versus 0.50 in the data.
 - Interest rates?
 - Interesting. These ratios would be unity without the gain changes.



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What a standard econometric analysis would find

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Summary

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- More standard econometrics tends to argue for the “less frequent and smaller shocks” explanation.
- This paper has some endogenous interaction between shocks and decisions of agents.
- Large shocks cause agents to react more aggressively to incoming data.
- It is a good idea.



What a standard econometric analysis would find

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Summary

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- More standard econometrics tends to argue for the “less frequent and smaller shocks” explanation.
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What a standard econometric analysis would find

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- More standard econometrics tends to argue for the “less frequent and smaller shocks” explanation.
- This paper has some endogenous interaction between shocks and decisions of agents.
- Large shocks cause agents to react more aggressively to incoming data.
- It is a good idea.
 - It is often difficult to get the shock variances to matter a lot to the agents.
 - This is more direct.



What a standard econometric analysis would find

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Summary

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- Many feel that recursive learning should be Bayesian.
- Bullard and Suda (2008).
- Standard recursive learning exercise, but replace classical econometricians with Bayesian econometricians.
- Main results still hold:
- *Stability still an issue.*



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Summary

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- Many feel that recursive learning should be Bayesian.
- Bullard and Suda (2008).
 - Standard recursive learning exercise, but replace classical econometricians with Bayesian econometricians.
 - Main results still hold:
 - *“Forecast” error is the actual loss of interest.*
 - *Stability still an issue.*



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Summary

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- Many feel that recursive learning should be Bayesian.
- Bullard and Suda (2008).
 - Standard recursive learning exercise, but replace classical econometricians with Bayesian econometricians.
 - Main results still hold:
 - “extra” term in the actual law of motion.
 - New expectational stability condition required.
 - *Stability still an issue.*



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Final thoughts

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Summary

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- Very nice paper in a very nice conference.
- This paper has a compelling endogenous explanation for clustered macroeconomic volatility.
- I think further research and exploration of this idea is warranted.
- Important implications for how we perceive the role of stabilization policy.
- Stabilization policy keeping agents within thresholds produces an extra measure of volatility reduction.



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