

Discussion of:  
"Wanting robustness to misspecification"  
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# Disclaimer!

**The views expressed in this discussion are those of the author only and are not necessarily shared by the Federal Reserve Board, the Committee, or any of the staff. All errors are mine.**

## Being a discussant...it's a tough job!...

- ...mostly because this paper is long, dense...and excellent.
- So go back to the mandate: "Help the authors improve the chapter before publication..."
- Focus on what the volume is: "Handbook of Monetary Economics"

## What I will be talking about:

- The Hansen-Sargent research agenda and where it fits
- Some quibbles
  - ① descriptive (or positive) motivation versus normative
  - ② multiplier approach versus constraint approach. How to choose?
  - ③ there is little that is explicitly monetary economics in this paper
- *Providing context*: the robust control approach v. parametric treatments of uncertainty
- Some alternatives in the spirit of the normative interpretation
  - ① robust performance versus robust stability
  - ② structured uncertainty
  - ③ real-time error detection

## What's the point?

- 1 Formal acknowledgement that models are gross simplifications of reality.
- 2 Relax a severe information assumption: *put economic agents on similar footing as econometricians.*
- 3 Keep the models close to the existing RE econometrics paradigm.
- 4 Explain anomalies that behavioral linear RE models cannot; e.g., equity premium puzzle.
- 5 Provide some guidance on monetary policy design

## Some history

- Started off with almost clean port from electrical engineering (e.g., Hansen-Sargent (1995) *IEEE Trans.*)
- Lots of paranoia in  $H^\infty$  applications subsequently disciplined by *relative entropy* and *detection error probabilities*
- Introduction of positive aspects—from, e.g., *ambiguity aversion*—into the previously normative problem
- Multiple agent settings and heterogeneous concerns for model uncertainty
- Hidden states and *robust filtering*.

# The positive versus the normative perspective

**"Our experience is that your temperament determines whether you find an axiomatic or a robust control justification for max-min expected utility theory more attractive. We appreciate aspects of both approaches." (p. 10)**

- The two methodological approaches give rise to two modeling approaches:
  - normative  $\rightarrow$  robust control  $\rightarrow$  *constraint preferences*
  - positive (or descriptive)  $\rightarrow$  axiomatic  $\rightarrow$  *multiplier preferences*
- These are not semantic distinctions: the results often differ in important ways
- On what basis would one choose? "Temperament" seems like an unsatisfactory basis

# Is the central bank just another agent?

- If the CB is just another agent, then the axiomatic treatment is fine.
- But the traditional approach from robust control and the vast rules literature suggests otherwise
- Much of the literature on targeting rules and simple (instrument) rules is more utilitarian
- Effectively, the CB's objective is less a "dual mandate" than "staying out of trouble".
- This tradition points to taking a robust control perspective (constraint preferences) for CBs

# Why not be Bayesian?

- Bayesian rules minimize *expected losses*, given a set of priors.
- Minmax rules minimize the *maximum loss* given an admissible set of models
- But, critics say, the latter can be rewritten as the former, except with degenerate priors
- So minmax is a method of automatically generating priors

## **So what is the payoff? Why not just specify those priors directly?**

- 1 *Ex ante*, the set of possible misspecifications is too large
- 2 The difficulty in justifying a set of prior probabilities over models

# "YOU ARE HERE" (Where on the map is H-S?)

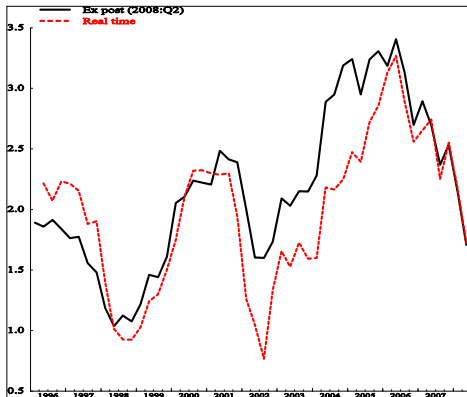
## For the monetary economist, a taxonomy of approaches is useful

- *Data uncertainty* (generally approached as a parametric, i.e., Bayesian, problem)
- *Parameter uncertainty* (could be parametric or nonparametric)
- *Model uncertainty*. (also could be parametric or nonparametric)
- the Hansen-Sargent work is primarily in the model uncertainty category, but where *structured model uncertainty* comes up (e.g., chapters 13 & 14), it can be in parameter uncertainty as well.

# Data uncertainty

*[W]e face new challenges in maintaining price stability...[T]here is a especially pernicious, albeit remote, scenario in which inflation turns negative...engendering a corrosive deflationary spiral...*

— Alan Greenspan before the House Committee on Finance, July 15, 2003



# Parameter uncertainty

"Uncertainty should make policymakers conservative in the following sense: they should compute the direction and magnitude of their optimum policy...then do less" – Blinder (1998), p. 11.

$$\underset{y}{\text{MIN}} (1/2)E[\pi^2] \quad \text{s.t.} \quad \pi = \pi^e + (\tilde{\alpha} + \varepsilon_\alpha) \cdot y + \varepsilon_\pi$$

$$\text{Certainty equivalent: } \varepsilon_\alpha \equiv 0 \rightarrow y^{\text{ce}} = -\pi^e / \alpha$$

$$\text{Brainard: } \varepsilon_\alpha \sim N(0, \sigma_\alpha^2) \rightarrow y^b = -\pi^e / (\alpha + \sigma_\alpha^2 \cdot \alpha^{-1}) < y^{\text{ce}}$$

$$\underset{y}{\text{MIN}} (1/2)E(\pi^e + \alpha \cdot y + c \cdot w)^2 - \theta \log E[\exp[(1/(2\theta))(\pi^e + \alpha \cdot y + c \cdot w)^2]]$$

$$\text{Robust control: } y^{\text{rc}} = -\pi^e / \alpha = y^{\text{ce}}$$

## Adding structured model uncertainty to the mix...

(but in the style of Giannoni (2002), a bit different from H-S s. 13.5):

$$\text{Structured uncertainty: } \underset{y}{\text{MIN}} \underset{\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]}{\text{MAX}} (1/2) \{ [\pi^e + (\tilde{\alpha} + \varepsilon_\alpha) \cdot y]^2 + \sigma_\pi^2 \}$$

$$\varepsilon_\alpha \in [\underline{\varepsilon}, \bar{\varepsilon}] \rightarrow y^{su} = -\pi^e / [\alpha - (1/2)(\underline{\varepsilon} + \bar{\varepsilon})] \text{ so } y^{su} \geq y^{ce} \text{ as } \underline{\varepsilon} + \bar{\varepsilon} \leq 0$$

## Punchlines:

- "Caution" need not imply attenuation
- Concern for robustness need not imply aggressiveness.

# The meaning of robustness.

**For policymakers, there are classes of robustness, of which two are:**

## ① *Performance robustness*

- A rule is chosen that performs well across a set of models where "well" is defined in terms of a loss function
- It can be done in a formal Bayesian (parametric) set-up, or in a minmax (non-parametric) environment
- Or a rival models method, e.g., McCallum (1988), Levin and Williams (2003), Tetlow and Ironside (2007).

## ② *Stability robustness*

- A rule is chosen that maximizes the set of models for which the system is
  - ① *stable* [e.g., Onatski and Stock (2002); Tetlow and von zur Muehlen (2001)]
  - ② *determinate* [e.g., Bernanke and Woodford (2007)]
  - ③ *learnable* [Bullard and Mitra (2005), Tetlow and vzM (2009), Evans and Honkapohja (various)]

## **There are few links to other strands of literature that could be fleshed out:**

- Equivalence of "robustly optimal targeting rules" of Giannoni-Woodford and robust control [Walsh (2005)]
- Equivalence of rational inattention and robust filtering [Kasa (2006)]
- Connection, if any, to rare events literature [e.g., Weitzman's "dismal theorem" stuff]
- Homilies on policy design from robust control match those from learnability, particularly persistence.

# Where might the applied literature go next?

## ① *More structured model uncertainty problems*

- Unstructured robust control is sometimes the cure that is worse than the disease [e.g., Onatski-Williams (2003)]
- Thus, problems where uncertainty is constrained to certain places [e.g., Woodford (2008)]

## ② *The financial crisis*

- The financial crisis as an escape from a self-confirming equilibrium of a misspecified model (finance doesn't matter...usually)
- But is the financial crisis a local phenomenon? Would local robustness of policy have done anything to help?
- Technical note: because financial crisis perturbs the monetary authority's rule, the Isaacs condition will not hold

## ③ *Real-time filtering and error detection*

- The information content of the data is falling [Stock-Watson (2007)].
- This suggests that real-time filtering will not be reliable
- **How do we design policy to get *good performance*; *flexibility to adjust to new perceptions*; and *information content*?**

# Conclusions

- Smart, sophisticated and challenging summary of the Hansen & Sargent approach to model uncertainty
- I particularly liked part IV where more structured model uncertainty was considered, and chapter 19 on expectations management
- But the monetary economics part is submerged