Business Cycle Dynamics under Rational Inattention

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This paper

- Embed Sims’ “rational inattention” mechanism, based on information entropy flow constraint,
  - Motivation: information processing costs
  - The math: from telecommunications engineering inside DSGE framework with standard elements
    - perform standard quantitative exercises (IRFs)

and idiosyncratic shocks.
  - study interaction of multiple information processing tasks
Main findings

- Sluggish response of prices to monetary shocks
- Strong real responses to monetary shocks
- Firms react strongly to their idiosyncratic shocks

- Idiosyncratic shocks *divert attention* from money shocks
- *But greater monetary variance* implies more errors in response to money shocks

- Similar to Calvo, but firms make smaller mistakes
Progress in rational inattention models

- **Sims (2003) “... Rational Inattention”**
  - Choose best predictor of $X$ s.t. information flow constraint
  - Partial equilibrium: $X$ exogenous

  - Monopolistic firm: choose own $p$ s.t. information flow constraint
  - Aggregate $P$ endogenous, also idiosyncratic shocks

- **Mackowiak/Wiederholt (2008) “Business cycle dynamics...”**
  - Monopolistic firm: choose own $p$ s.t. information flow constraint
  - **DSGE context:** firms/workers, idiosyncratic shocks, Taylor rule

- **Adam (2008)**
  - Simplified DSGE; analyze monetary policy independence

- **Woodford (2008)**
  - Use information flow constraint to study decision to buy full info
Why not assume perfect rationality?

**Sims:**
“It is apparent from nearly any VAR study... that most cross-variable relationships among macro time series are smooth and delayed”

- Especially important for monetary nonneutrality
- Lack of extreme contractual contingency
- Apparently excessive bubbles / crashes
Alternatives to rational expectations

(1) Structural models of information processing

- Learning

- Behavioral finance

- Finite automata, etc.
Alternatives to rational expectations

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  - Useful for modelling how players become forgetful about historical precedents (bubbles, inflation, defaults)

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- Finite automata, etc.
  - General problem: arbitrary restrictions on types of strategies
  - Robustness to change in specification?
Alternatives to rational expectations

(2) Exogenous intermittent adjustment

- Calvo (1983)
- Mankiw-Reis (2002)
Alternatives to rational expectations

(2) Exogenous intermittent adjustment

- **Calvo (1983)**
  - Far from optimal (no state contingence)
  - Lucas critique

- **Mankiw-Reis (2002)**
  - Far from optimal (no state contingence)
  - Lucas critique
  - unrealistically complex choice space (choose sequences)
The problem with Calvo and Mankiw-Reis
Alternatives to rational expectations

(2) Exogenous intermittent adjustment

- **Calvo (1983)**
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- **Mankiw-Reis (2002)**
  - Far from optimal (no state contingency)
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  - Unrealistically complex choice space (choose sequences)
  - Mankiw-Reis motivated by information processing costs, instead of menu costs... nonetheless shares many weaknesses of Calvo.
Alternatives to rational expectations

(3) Frameworks “close” to full rationality

- **Smart and stupid populations**
  - Akerlof-Yellen (´85); Galí-Gertler-López (´05); “noise traders”, etc.

- **Sims (´03): information entropy flow constraint**
  - GE versions Mackowiak-Wiederholt (´07/´08); Adam (´08)

- **Woodford (´08): information entropy flow constraint**
  - Fixed costs of info update and menu update

- **“Generalized (S,s)”**
  - Caballero-Engel (´93/´07); Costain-Nakov (´08)
  - All these models can be parameterized arbitrarily close to rational expectations
The main issue

Calvo and Mankiw-Reis models can also be parameterized arbitrarily close to full rationality. What’s the difference?

- Should parameterize distance from rationality in a way that is robust to Lucas critique (and meteors).
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- Should parameterize distance from rationality in a way that is robust to Lucas critique (and meteors).

  - Calvo, Mankiw-Reis: parameterize w.r.t. frequency of adjustment

  - Obviously that’s not a “deep” parameter, so these models will remain vulnerable to Lucas critique
Calvo and Mankiw-Reis models can also be parameterized arbitrarily close to full rationality. What’s the difference?

- Should parameterize distance from rationality in a way that is not vulnerable to Lucas critique (and meteors).

  - “Generalized (S,s)”: parameterize w.r.t. typical value loss.
  - For example: probability of adjustment = 50% when loss = L*  
    - Obviously vulnerable to Lucas critique if we state value in €.
    - Idea: as long as we state values in units of time, model should be largely robust to Lucas critique.
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- Should parameterize distance from rationality in a way that is robust to Lucas critique (and meteors).
  
  - Sims, etc: parameterize w.r.t. maximum information entropy flow
  
  - Amount of effort devoted to collecting information is likely to change if economic situation changes.
  
  - Idea: include cost of information in budget constraint, stated in units of time. Then model should be largely robust to Lucas critique.
Near-rationality: common findings

All 3 models (Generalized Ss / Woodford / Sims) imply:

- Degree of rationality parameterized in Lucas-robust way
- Can calibrate rationality on basis of micro adjustment data
- Respond quickly to idiosyncratic / slowly to agg. shocks
- Damped/delayed effects of aggregate shocks
- Money supply shocks similar to Calvo, but firms make much smaller mistakes
Near-rationality: differences

Generalized \((S, s) / \text{Woodford}\) imply:
- \(\text{Var}(X)\) increases \(\rightarrow\) **frequency** of adjustment increases

**Sims-type / Woodford** models imply:
- \(\text{Var}(X)\) increases \(\rightarrow\) **less attention to Y, Z**...

**Sims-type models** imply:
- \(\text{Var}(X)\) increases \(\rightarrow\) **less accurate response to X**
Near-rationality: DSGE computation

Generalized (S,s) / Woodford:
- must calculate dynamics of distribution

Mackowiak-Wiederholt (2008)
- Guess firm’s pricing policies
- Solve optimal attention problem
- Find implied aggregate price dynamics
- Solve linear DSGE s.t. aggregate price dynamics
- Compute implied firm’s pricing polices ...
James Costain
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