Discussion of Angeletos and La'O

"INCOMPLETE INFORMATION, HIGHER-ORDER BELIEFS AND THE INERTIA OF PRICES IN THE CALVO MODEL"

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Federal Reserve Board

"Monetary Policy under Imperfect Information"
SNB/JME conference at Study Center Gerzensee
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OVERVIEW

Ingredients:

1. Calvo Staggering plus Dispersed Information (Woodford, 2003)
2. Nominal GDP is exogenous,
   $\Rightarrow$ demand side/ welfare/ policy are given
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   (aggregate state revealed at end of each period)

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5. Model variants: Disconnect first-order from HOE

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- Seamless combination of mechanics from Calvo and HOE
- Specification of HOE is part of calibrating persistence
- Interesting dynamics from disconnecting HOE

AGENDA

1. Research Agenda
2. Common vs Dispersed Signals
3. Invariance of Calvo Persistence under HOE

"CALVO MEETS HOE"

Interesting idea:

- **Info frictions are potentially important** (Woodford, 2003)
- ... but maybe not full story.

⇒ **Retain a bit of Calvo Staggering** to approximate other frictions

(See companion work for next steps: Welfare, Policy etc.)

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Concern:

- Calibration should fix persistence and trade-off HOE vs frequency of staggering (λ)
- As usual: Beware of free parameters

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THREE HOE VARIANTS

BACKUP

1) Uncertainty about Others' Precision

- Divorce first-order from HOE
- Price rigidity even in full info / flex price version due to strategic uncertainty

2) & 3) Beliefs about Others' Bias

- Erroneous belief that other's signals are biased
- Shocks to bias behave like "cost push"

How sensible when priors and entire model "are common knowledge"?

Does this need Calvo?

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“HOE generate . . . ”

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Common signals model:

Info set at morning is noisy signal of spending:

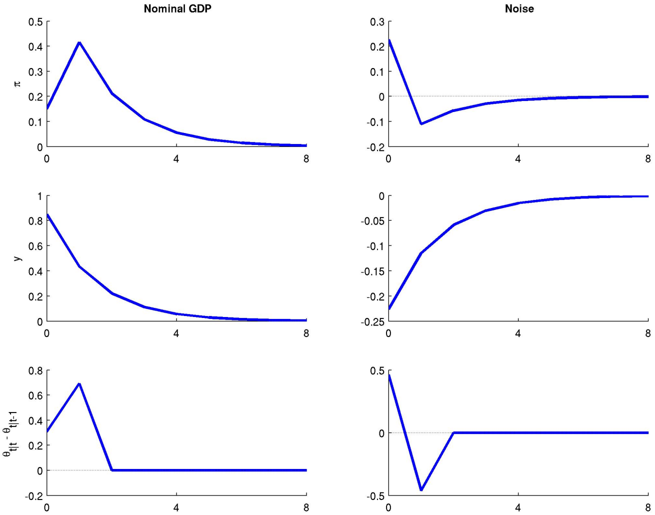
$$I_t = \begin{bmatrix} \theta_t + n_t \\ \theta_{t-1} \end{bmatrix}$$

$$\theta_t = \theta_{t-1} + v_t \qquad v_t, n_t \sim \ iid$$

$$\frac{1-\lambda L}{1-\lambda} p_t = \frac{1-\beta\lambda}{1-\beta\lambda F} E\left\{(1-\alpha)\theta_t + \alpha p_t | I_t\right\}$$

$$y_t = \theta - p_t$$

IRF WITH COMMON SIGNALS



DISCUSSION

Common Signals

- IRF under firms' measure identical to Calvo
- Persistent forecast errors (morning to morning) of agents "reshape" structural IRF

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In the evening, shocks and IRF observable:

What would econometricians observe in richer model?

(VARs vs unobserved components filter)

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HOE-cum-Calvo Problem

$$p_t = \lambda p_{t-1} + \bar{\boldsymbol{E}}_{\boldsymbol{t}}(1-\lambda)(1-\beta\lambda)\sum_{k=0}^{\infty}(\beta\lambda)^k\left((1-\alpha)\theta_{t+k} + \alpha p_{t+k}\right)$$

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A&L solution: Undetermined coefficients

$$p_t = c_1 p_{t-1} + c_2\theta_t + c_3\theta_{t-1} + \ldots$$

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In all four model variants, c_1 same as full-info Calvo:

$$(1-c_1 L)(1-\mu F)\cdot\bar{c} = \frac{1-\lambda L}{1-\lambda}\frac{1-\beta\lambda F}{1-\beta\lambda} - \alpha$$

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Can show: Holds in general as long as $p_{t-1} \in I_{i,t}$
and if p_{t-1} not necessary for forecasting other state variables.

INVARIANCE OF CALVO PERSISTENCE

Proof (Sketch)

$$\left[\frac{1-\lambda L}{1-\lambda}\frac{1-\beta\lambda F}{1-\beta\lambda} \qquad \right] \boldsymbol{E}_t p_t = (1-\alpha)\bar{E}_t\theta_t + \alpha \boldsymbol{\bar{E}_t p_t}$$

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Dependence of p_t on p_{t-1} irrelevant
for Higher Order Wedge since $(\bar{E}_t - E_t)p_{t-1} = 0$
and θ_{t-1} sufficient statistic for $\bar{E}_{t-1}\theta_t$

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Higher Order Wedge:

$$(\bar{E}_t - E_t)p_t = (1-\mu F)^{-1}\bar{c}^{-1}\left((1-\alpha)(\bar{E}_t^2 - \bar{E}_t)\theta_t + \alpha(\bar{E}_t - E_t)^2 p_t\right)$$

CALVO'S PV CONSTRAINT ON HOE

"Average first vs Integrate first"

Asset Pricing (Morris/Shin, Bacchetta/van Wincoop)

$$p_t = \boldsymbol{\bar{E}_t}\theta_t + \beta \boldsymbol{\bar{E}_t} p_{t+1}$$

$$\Rightarrow \bar{E}_t p_t = \sum \beta^k \bar{E}_t^{\boldsymbol{k}} \theta_{t+k}$$

Calvo FOC of Firm i

$$p_{it} = (1-\beta\lambda) E_{it} p_{it}^* + (\beta\lambda) \boldsymbol{E_{it}} p_{i,t+1}$$

$$\Rightarrow \sum \beta^k \bar{E}_t p_{i,t+k}^* = \sum \beta^k \bar{E}_t^{\boldsymbol{k}} p_{i,t+k}^*$$

- LHS derived from "integrate first, then average"
- RHS is "average first, then integrate"
- Is this "PV identity of expectation" useful?
  (Of course, need to consider endeogeneity of p_{it}^*)

GREAT PAPER!

Key Lessons:

- As usual: Strategic complementarity is key
- Combine features of Calvo with HOE and retain effects from both
- Specification of HOE is part of calibrating persistence
- "Non standard" signal structure disconnects first-order from HOE w/interesting dynamics

My Suggestions:

1. Delineate HOE against Calvo and Imperfect Info
2. Punch up HOE variants (Separate paper?)
3. Generalize invariance of Calvo persistence (c_1)