Near-Rational Exuberance

James Bullard George Evans Seppo Honkapohja

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- Example: "financial headwinds" early to mid-1990s.
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- The conventional wisdom is that judgement is beneficial.

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- Results apply even with some relationship between judgement and fundamentals.

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- Supplement econometric forecasts with judgement.
- Structure: (1) General framework, (2) Scalar case: asset pricing (3) Multivariate case: monetary policy.

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- Learnability.

Main findings

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- Relationship with indeterminacy and sunspot equilibria: "Sunspot-like behavior without indeterminacy."
- Designing policy to avoid exuberance.

Environment

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$$y_t = \beta y_{t+1}^e + u_t$$

with forecasts

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- $E^\star_t y_{t+1}$ = econometric forecast and ξ_t = judgemental add-factor.
- We mostly focus on the case in which the fundamentals u_t and judgement ξ_t evolve independently.

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- The forecasted future impact is

$$\frac{\partial y_{t+1+j}}{\partial \eta_t} = \psi_{t,j}, \text{ for } j = 1, 2, 3, \ldots$$

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- Then

$$\xi_t = \sum_{j=0}^{\infty} \psi_{t-j,j} \eta_{t-j} = \sum_{j=0}^{\infty} \rho^j \eta_{t-j} = (1 - \rho L)^{-1} \eta_t$$

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- The total judgemental adjustment in y^e_{t+1} satisfies

$$(1 - \rho L)\, \xi_t = \eta_t.$$

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- With judgement, ARMA(1,1) allows this (multivariate case)

$$y_t = \theta(L) v_t$$

where

$$\theta(L) = (I - bL)^{-1}(I - aL).$$

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- Use of judgement induces actual law of motion:

$$y_t = \beta y^{e}_{t+1} + u_t = M\left(L\right)^{-1} \beta \left(I - \rho L\right)^{-1} \eta_t + M\left(L\right)^{-1} u_t$$

where

$$M\left(L\right) \equiv I - \beta \left[b - a\theta\left(L\right)^{-1} \right]$$

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- Also require learnability (Evans and Honkapohja 2001).
- *Exuberance equilibrium* meets CEE, individual rationality, and learnability requirements.

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- More generally: see Figure 1.

Figure 1

Figure 1. Including Judgement.

Scalar case.

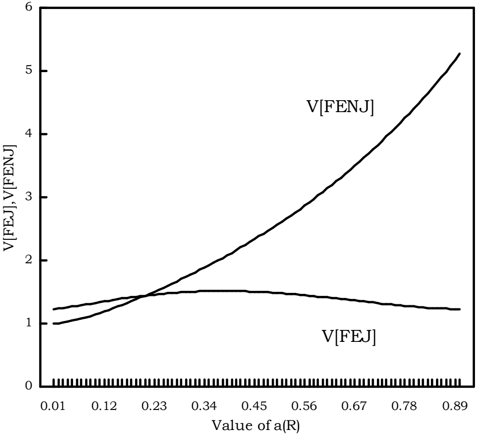

Figure drawn for ß=.9, rho=.9.

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- Approximate CEE: agents use $AR(p)$ PLM. Check E-stability condition numerically.

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  - for appropriate AR(1) judgement processes there exists an exuberance equilibrium, and
  - the exuberance equilibrium has a higher asymptotic variance than the rational expectations equilibrium.

Asset pricing example

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- Shiller (1981): standard deviation of US stock prices relative to SD of fundamentals price lies between 5 and 13.
- Exuberance equilibria exist when ρ and β are relatively close to but less than unity. See Table 1 for excess volatilities.

Excess volatility

Table 1. Excess Volatility

	σ_y/σ_u			
	0.50	1.00	1.50	2.00
$\rho = 0.70$	1.54	2.74	–	–
$\rho = 0.80$	1.85	3.62	5.58	–
$\rho = 0.90$	2.70	5.82	9.11	12.43
$\rho = 0.95$	3.99	8.75	13.64	18.56

Table: Exuberance equilibria in the asset pricing model. A dash indicates that exuberance equilibrium does not exist. The entries in the table give one measure of the degree of excess volatility generated, namely, the ratio of the standard deviation of y to the standard deviation of u. The model can easily generate substantial excess volatility like that estimated by Shiller (1981).

Correlated judgement

- We can extend the model to allow judgement to be based on variables correlated with fundamentals:

$$\begin{aligned} y_t &= \beta y^e_{t+1} + u_t + z_t, \text{ where } y^e_{t+1} = E_t y^*_{t+1} + \xi_t \\ \xi_t &= \rho \xi_{t-1} + \eta_t \\ \eta_t &= f z_t + \varepsilon_t, \text{ where } f \geq 0. \end{aligned}$$

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- In this case exuberance equilibria can in part be interpreted as an over-reaction to fundamentals.

Discussion

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  - The incentive condition is dichotomous. This also seems realistic and tests of whether "all" of ξ_t should have been included would (often) have low power.
  - Attempts to "downweight" judgement by averaging across past unique events do not make sense.

New Keynesian macro

- Canonical New Keynesian model (Woodford 2003):

$$\begin{aligned} x_t &= x^e_{t+1} - \sigma^{-1}\left[r_t - \pi^e_{t+1}\right] + \tilde{u}_{x,t}, && (1) \\ \pi_t &= \kappa x_t + \delta \pi^e_{t+1} + \tilde{u}_{\pi,t}, && (2) \\ r_t &= \varphi_\pi \pi_t + \varphi_x x_t. && (3) \end{aligned}$$

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- Condition for determinacy and learnability is known to be

$$\kappa\left(\varphi_\pi - 1\right) + \left(1 - \beta\right)\varphi_z > 0.$$

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- CEE and learnability: assume a $VAR(p)$, $p = 3$ PLM and calculate E-stability condition for approximate CEE.

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- CEE is *indefinite* if diagonals vary in sign and exhibits *non-exuberance* if diagonals are negative.

Calibration

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- Shocks: assume $\Sigma_{\tilde{u}} = \text{diag}[1.1, 0.03]$.

Results

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  and it is pd. => (strong) exuberance.
- $\varphi_\pi \to 1.5$ and $\varphi_x = 0.1 \implies$ no exuberance. More generally, see Figures 2 and 3.

Figure 2

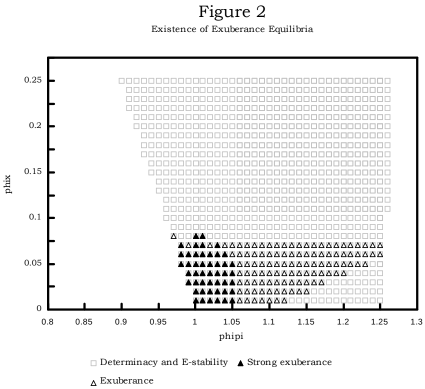

Figure: Exuberance equilibria in the New Keynesian model. Open boxes indicate points where the REE is determinate. Triangles indicate points where exuberance equilibria exist.

Figure 3

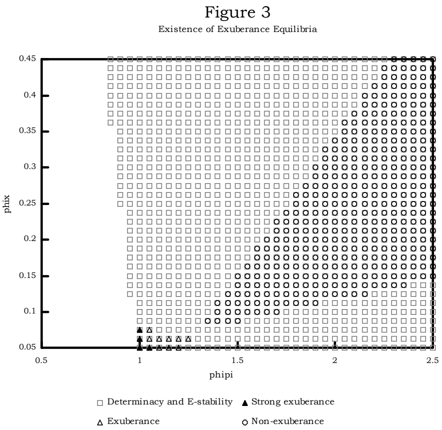

Figure: A sufficiently aggressive Taylor-type policy is associated with non-exuberance, denoted by open circles.

Forward-looking monetary policy rule

Figure 4
Exuberance with Forward-Looking Rules

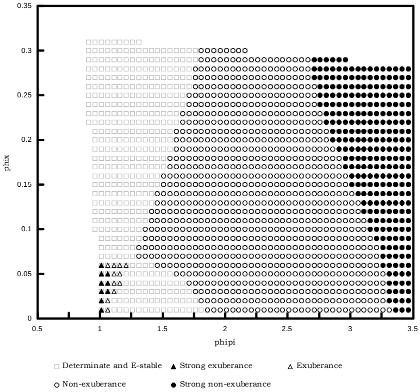

Figure: Sufficiently aggressive policy is again associated with non-exuberance when the policy rule is forward-looking.

Optimal monetary policy rules

- Optimal discretionary policy as in Evans and Honkapohja (2003):

$$r_t = \varphi_\pi^\star \pi_{t+1}^e + \varphi_x^\star x_{t+1}^e + \varphi_{u,x}^\star \tilde{u}_{x,t} + \varphi_{u,\pi}^\star \tilde{u}_{\pi,t}.$$

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  where $\varphi_x^\star = \varphi_{u,x}^\star = \sigma$ and $\varphi_u^\star = \delta^{-1}\left(\varphi_\pi^\star - 1\right)$. Optimal $\varphi_\pi^\star$ depends on α, the output gap weight.
- $\alpha \to 0$ (an inflation hawk) implies $\varphi_\pi^\star = 1 + \sigma\delta\kappa^{-1} \approx 7.47$. $\alpha \to \infty$, (an inflation dove) yields $\varphi_\pi^\star \to 1$.

More on optimal rules

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- For $\varphi_{\pi}^{\star} \in (1, \bar{\varphi}_{\pi})$ the equilibrium is indefinite. For $\varphi_{\pi}^{\star} \in (\bar{\varphi}_{\pi}, 7.47)$, non-exuberance.
- The cutoff is $\bar{\varphi}_{\pi} \approx 1.557$. Policy must have a sufficiently small α. $\varphi_{\pi}^{\star} = 1.557$ corresponds to $\alpha \approx 0.00612$.

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- Sunspot-like behavior in determinate economies.

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- We study an "exuberance equilibrium" concept.
- Agents may be tempted to include judgemental adjustments if all others do so.
- Sunspot-like behavior in determinate economies.
- A new danger for policymakers.