Failures of Expectation Management

Learning from Counter-Cyclical Signaling Policy

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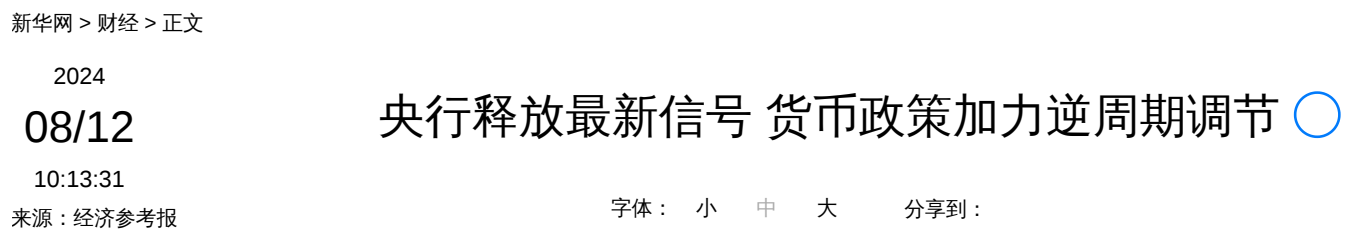
Motivation

Policy signal, as a tool for Expectation management, matters for macro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来源：经济参考报

央行释放最新信号 货币政策加力逆周期调节

字体： 小 中 大 分享到：

- forward guidance
- 房住不炒、去杠杆.....

Evidence that FIRE-benchmark is restrictive

1. Limited information
2. Expectation driven by policy signals

Benchmark macro-models now embrace I. not II.

This Paper:

- A (rational) framework to study signaling effect of policy

This paper

Research question

- signaling effect of policy
- expectation management
- optimal policy transparency

What we do: Chahrour & Gaballo (2021) + Learning from policy signal

- housing & consumption market
- incomplete informed household
- signaling policy: target housing price and interest rate
- misunderstanding of signaling policy rule

Comparasion of Quantitative results

- FIRE scenario (without incomplete info)
- baseline scenario (with incomplete info but without misunderstanding)

Literature review & Contribution

Expectation management & Policy transparency

- exogenous information(Morris & Shin, 2002 and Morris & Shin, 2008)

Signaling effect

- interest rate (Baeriswyl & Cornand, 2010); house prices (Chahrour & Gaballo, 2021); sovereign borrowing(empirical) (Yang K. Lu & Bowen Qu, 2023)

Failure in stimulus policy

- forward guidance puzzle (Del Negro et al.,2012)

Our contribution:

- **flexible and endogenous** signal structure
- misunderstanding of policy rules

Overview of results

- **Policy effects** can split into
  - direct policy effect (well studied)
  - indirect signaling effect (few studies)
- **indirect signaling mechanism**:
  - recession $\rightarrow$ positive policy signal $\rightarrow$ pessimism $\rightarrow$ deeper recession
- signaling effect amplifies the economic fluctuations:
  - more prosperous in boom period
  - more depressed in bust period
- depend on misunderstanding, signaling effect could be amplified/mitigated
  - disclose policy rule in some situation

Elements of the model

- Chahrour & Gaballo (2021) + Learning from policy signal
- six types of players:
  - shopper(incompletely informed)
  - worker-saver
  - housing producer
  - final comsumption producer
  - differentiated intermediate goods sector
  - government: counter-cyclical policy
- specified definition of Timeline and Equilibrium

Household

- households optimization problem based on incomplete infomation:

$$\max_{C_t,\Delta_t,B_t,N_t^c,N_t^h,M_t} E_0 \sum_{t=0}^{\infty} \beta^t \left(\log\left(C_t^{\phi} \mathscr{H}_t^{1-\phi}\right) - v^c \frac{\left(N_t^c\right)^{1+\chi_c}}{1+\chi_c} - v^h \frac{\left(N_t^h\right)^{1+\chi_h}}{1+\chi_h} + v^m \frac{\left(\frac{M_t}{P_t}\right)^{1+\chi_m}}{1+\chi_m} \right)$$

- subject to

$$\frac{B_{it}}{R_t} + C_{it} + P_{it}\Delta_{it|t} = W_{it}N_{it} + B_{it-1} + \Pi_t^c + \Pi_{it}^h$$

- Housing consumption is composed of a sequence of housing vintages.

$$\mathscr{H}_{it} \equiv \prod_{k=-\infty}^{t} \Delta_{it|k}^{(1-\psi)\psi^{t-k}}$$

- Each vintage of housing depreciates at a constant rate $d \in (0,1)$.

$$\Delta_{i\tau+1|k} = (1-d)\Delta_{i\tau|k}$$

Household

- Two types of household: Shopper and Worker-saver.
- Workers maximize based on **full information set** $\{X_0^t\}$ by choosing N_t, B_t and M_t

$$N_t^c, N_t^h, B_t, M_t = \text{argmax}_{\{C_t^*, \Delta_t^*, N_t^c, N_t^h, B_t, M_t\}} E_t \left[U_t \mid X_0^t \right]$$

- Shoppers maximize based on **incomplete information set** $\left\{S_t, X_0^{t-1}\right\}$ by choosing C_t and Δ_t

$$C_t, \Delta_t = \text{argmax}_{\{C_t, \Delta_t, N_t^{c*}, N_t^{h*}, B_t^*, M_t^*\}} E_t \left[U_t \mid S_t, X_0^{t-1} \right]$$

- optimal choice based on behavioral expectation $E_t[X_t \mid S_t, X_0^{t-1}]$:

$$[C_t]: \phi \frac{1}{C_t} = \mathbb{E}_t \left[\lambda_t \mid S_t, \Omega_{t-1} \right]$$

Housing producer

- **representative housing producer** in perfectly competitive housing market

$$\Delta_t = e^{\xi_t^h} (N_t^h)^{\gamma_h}$$

- maximize profit:

$$\Pi_t^h = Q_t \Delta_t - W_t^h N_t^h$$

- aggregate productivity shock ξ_t^h:

$$\xi_t^h = \rho_h \xi_{t-1}^h + \varsigma_t^h$$

- ς_t^h is an i.i.d. exogenous shock, distributed as $N(0, \sigma_{\varsigma^h}^2)$.

Final Consumption sector

- **representative consumption sector**
- final consumption goods are composed of a series of differentiated intermediate goods.

$$Y_t = \left(\int_0^1 Y_{it}^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}$$

- maximize profit:

$$\Pi_t^c = P_t Y_t - \int W_{it}^c N_{it}^c di = P_t Y_t - W_t^c N_t^c$$

Intermediate good

- **Differentiated** intermediate good
- The production function is:

$$Y_{it} = e^{\xi_t^c}(N_{it}^c)^{\gamma_c}$$

- aggregate productivity shock ξ_t^c:

$$\xi_t^c = \rho_c \xi_{t-1}^c + \varsigma_t^c$$

- ς_t^c is an i.i.d. exogenous shock, distributed as $N(0, \sigma_{\varsigma^c}^2)$.

Intermediate good sector

- **Price rigidity** is introduced through a standard Calvo setting.
- A probability θ that the price cannot be adjusted
- total consumption goods price changes as:

$$P_t = \left[\theta P_{t-1}^{1-\varepsilon} + (1-\theta)\left(P_t^*\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)}$$

Government

- government use two types of policies
- monetary policy rule: a Taylor setting

$$R_t = (R_{t-1})^{\rho_R} \left(\Pi_t^{(1+\phi_\Pi)} R \right)^{1-\rho_R} \varepsilon_t^R$$

signaling policy rule: similar to the Taylor rule

$$S_t = \varphi_q Q_t + \varphi_r R_t$$

- capture signals related to housing market policy and monetary policy
- higher house prices Q_t, stronger policy signals S_t
- Households lack information about current variables, but observe related policy signals to form expectations

Extension: Misunderstanding of signaling rule

- households have a subjective signaling policy rule

$$S_t = \tilde{\varphi}_{q,t} Q_t + \tilde{\varphi}_{r,t} R_t$$

- coming from policy opacity (mistrust, economics history, personal experience .....)
- subjective rule differs from true rule

$$S_t = \varphi_q Q_t + \varphi_r R_t$$

- form expectation based on an optimal prediction problem

Inference process:

$$\text{higher} \quad Q_t \xrightarrow{\text{true rule}} \text{stronger} \quad S_t \xrightarrow{\text{subjective rule}} \text{more optimistic} \quad E_t[Q_t \mid S_t, X_0^{t-1}]$$

Extension: Bayesian updating of subjective rule

- in period 0, households have a prior understanding of policy rule $\tilde{\varphi}_{q,0}, \tilde{\varphi}_{r,0}$
- at the end of each period, updated subjective rule using Bayesian methods
- estimation problem as follows: at the end of period t, they have data X_0^t, S^t, estimate $\tilde{P}$

$$S = \tilde{\varphi}_{q,t} Q_t + \tilde{\varphi}_{r,t} R_t = \tilde{P} * X_t$$

- The estimated posterior distribution of the parameter $\tilde{P}_{t+1}$ is used as the perceived signaling policy rule for period t+1

Timeline

1. Household splits into two types.
2. Shocks realize.
3. Government releases policy signals S_t
4. Shoppers observe incomplete info set $\left\{S_t, X_0^{t-1}\right\}$, others observe full info set $\{X_0^t\}$, form expectation based on related info.
5. All players make their choices conditional on their own information set.
6. Market clearing.
7. Family members share information, revealing $\{X_0^t\}$ to shoppers.
8. Shoppers update perceived signaling policy rules based on Bayesian learning.

Equilibrium

Given initial conditions $\{B_{-1}, \mathscr{H}_{-1}, M_{-1}\}$, a rational expectations equilibrium is a set of prices $\left\{P_t, Q_t, W_t^c, W_t^h, R_t\right\}_{t=0}^{\infty}$ and quantities $\left\{B_t, N_t^c, N_t^h, C_t, \mathscr{H}_t, \Delta_t, Y_t\right\}_{t=0}^{\infty}$, which are contingent on the realization of the stochastic processes $\left\{\epsilon_t^R, \xi_t^c, \xi_t^h\right\}_{t=0}^{\infty}$, such that for each $t \geq 0$:

1. Shoppers and worker-savers optimize utility based on different info sets, budget constraint holds.
2. Local housing producers optimize profit
3. Intermediate good producers optimize profit
4. Final consumption producers optimize profit
5. The government announces policy signals S_t based on the realization of the endogenous variables Q_t, R_t.
6. Markets clear.

Quantitative Simulation: Baseline

- employ impulse response function based on monetary policy shock
- focus on baseline model without misunderstanding
- compared to FIRE scenario
- **FIRE scenario + learning from policy signals = baseline scenario**
- we will show the signaling effect

Without Misunderstanding: Comovement of valiables

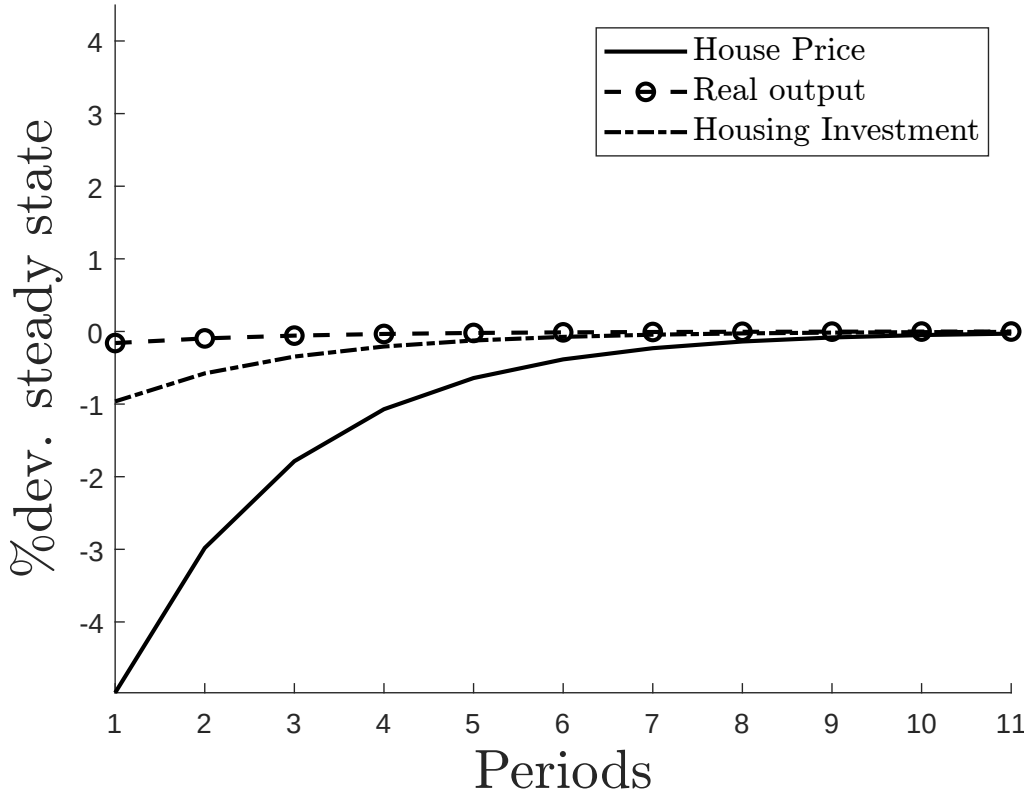

图 1: Comovement in Bust scenario (Bust)

Without Misunderstanding: Expectation Comparasion

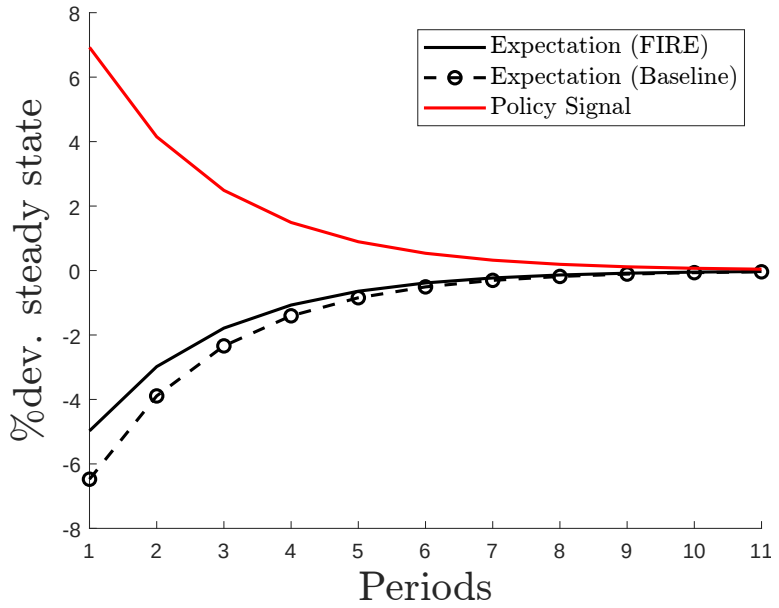

图 2: Expectation of Housing pirce dynamics (Bust)

baseline - FIRE = signaling effect on expectation

- counter-cyclical policy signals lead to pessimistic expectation

Without Misunderstanding: Housing Prices Comparasion

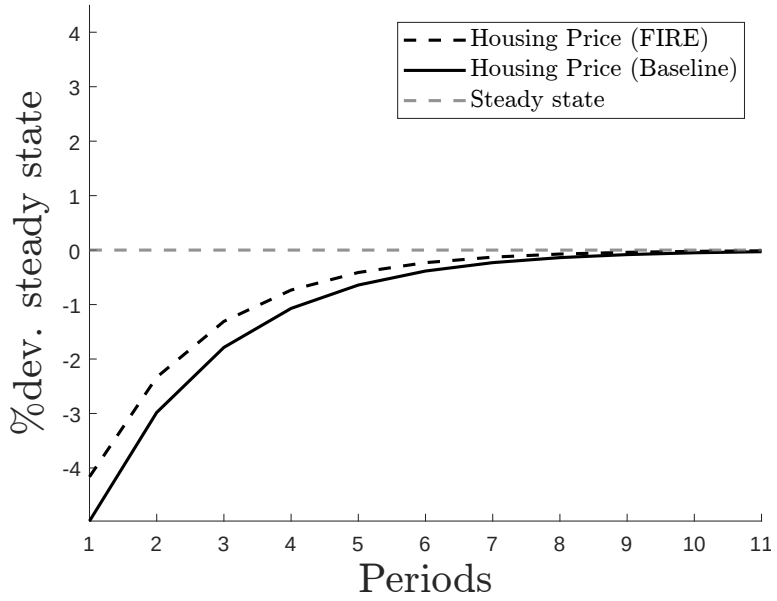

图 3: Housing price dynamics (Bust)

baseline - FIRE = signaling effect

- **direct policy effect:** house price, as an asset price, fall due to substitution effect
- **indirect signaling effect:** house price fall due to pessimistic expectation

Without Misunderstanding: Housing Prices Comparasion

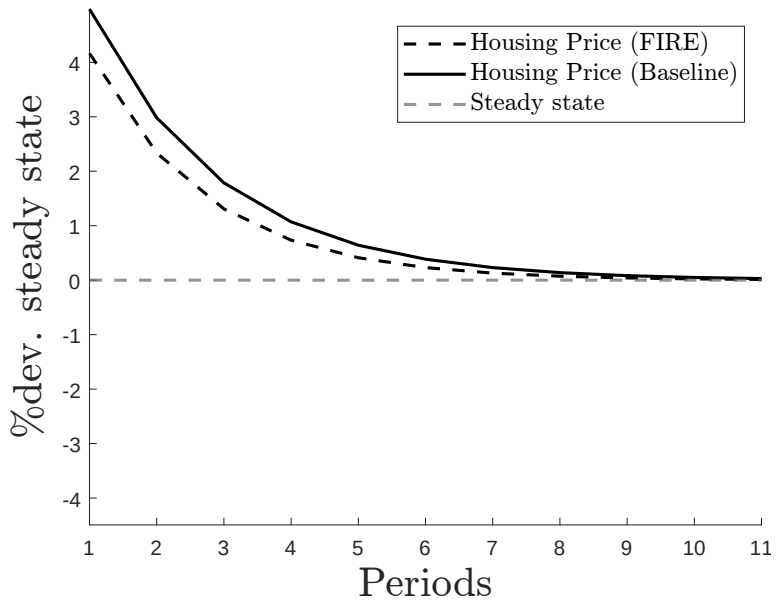

图 4: Housing price dynamics (Boom)

signaling effect amplifies economics fluctuations, leading economy

- more prosperous in boom period
- more depressed in bust period

Quantitative Simulation: Extension

introduce misunderstanding of policy rule

- compared to baseline scenario & FIRE scenario
- **baseline + misunderstanding & learning policy rule = extension**

investigate two type of misunderstanding

- overestimate coef. of signaling rule
- underestimate coef. of signaling rule

With Misunderstanding: Comovement of valiables

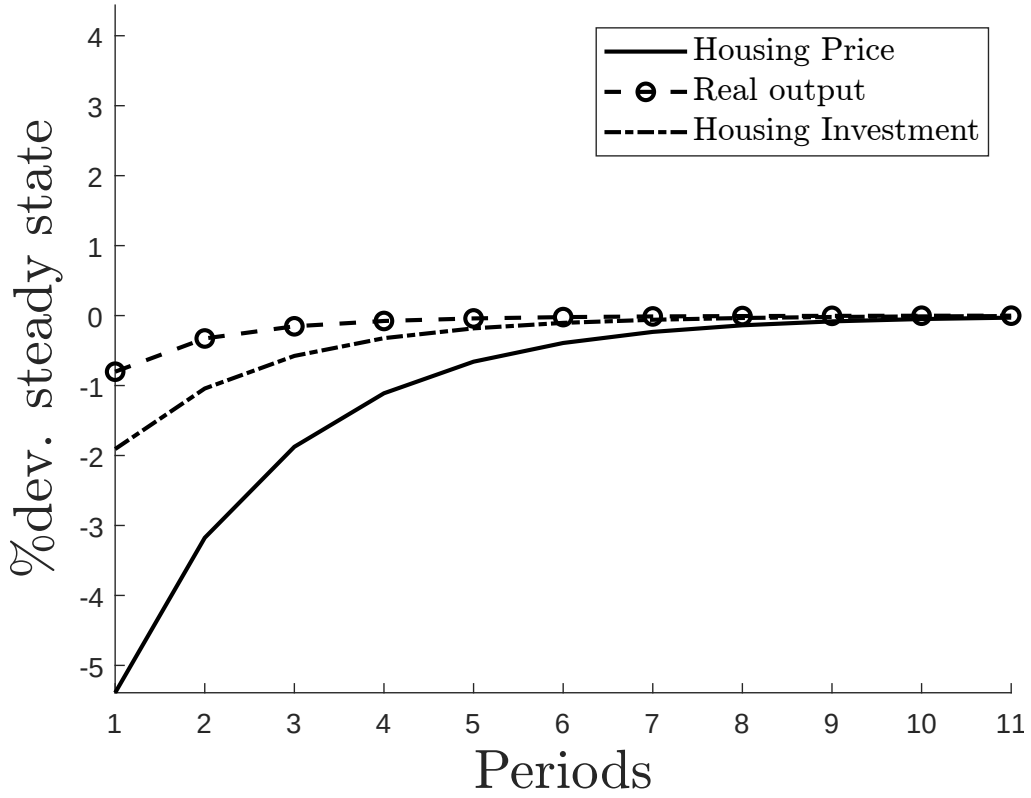

图 5: Comovement in Underestimate scenario

With Misunderstanding: Housing Investment Comparasion

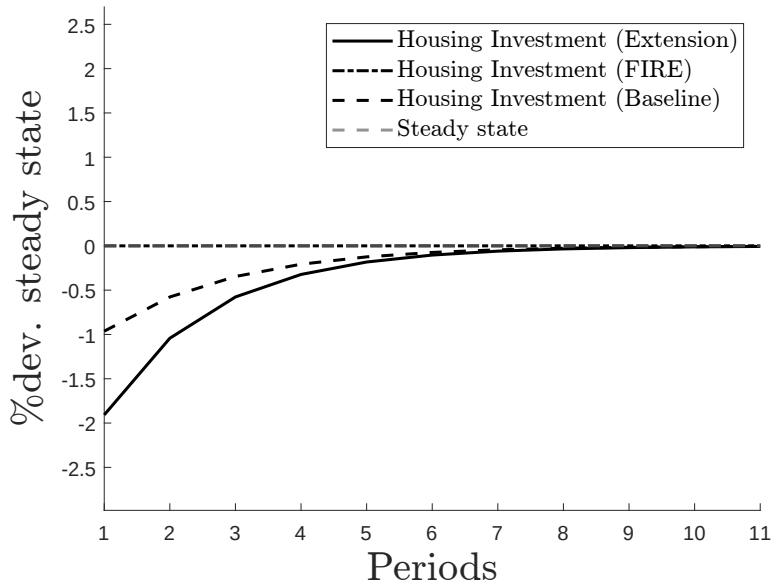

图 6: Housing investment dynamics (Underestimate)

extension - baseline = distorted signaling effect from misunderstanding

- **amplified signaling effect:** due to underestimation
- potential approach: directly disclose policy rule (policy transparency)

With Misunderstanding: Bayesian learning process

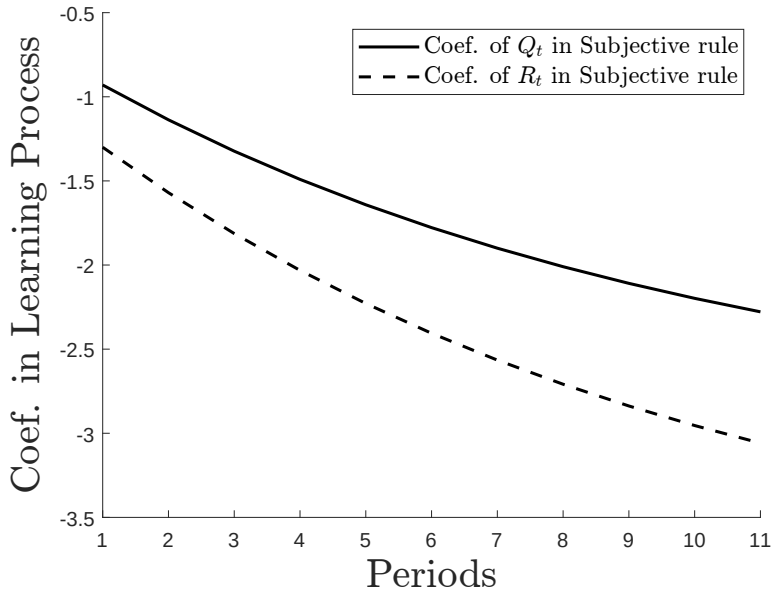

图 7: Coef. in subjective rule (Underestimate)

subjective coef. gradually approaches true coef.

- more periods → more info from simulation data → more accurate estimation

With Misunderstanding: Housing Investment Comparasion

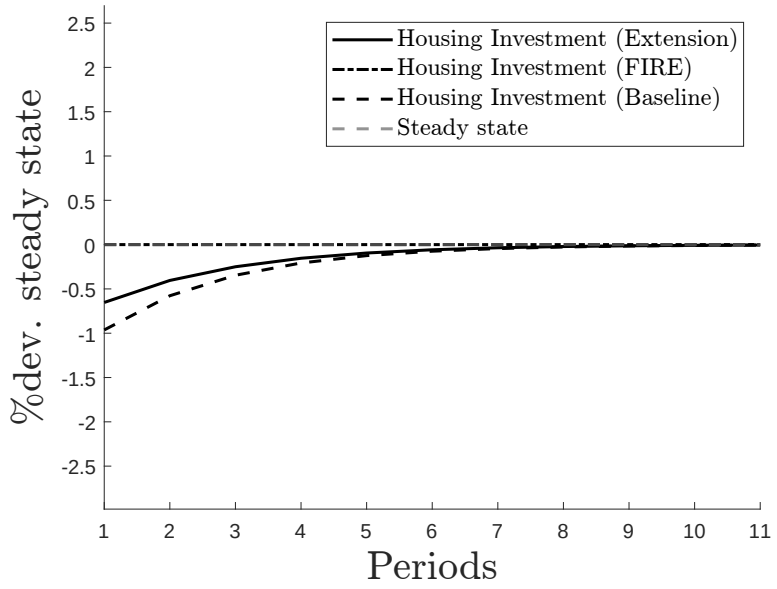

图 8: Housing investment dynamics (Overestimate)

- **mitigated signaling effect:** due to overestimation

overestimating misunderstanding could benefit management expectation
Disclosing the policy rule in this scenario is inappropriate (different from traditional FIRE paper)

Conclusion

- counter-cyclical policy signal trigger rational **optimistic & pessimistic expectation** in market
- policy communication might be negative due to signaling mechanism:
  - recession $\rightarrow$ positive policy signal $\rightarrow$ pessimism $\rightarrow$ deeper recession
- possible explanations for the **failure of stimulus policy**
- signaling effect could be distorted by misunderstanding
- Disclosing policy rules can sometimes mitigate signaling effect, but it depends on situation

Thanks!

Reference

1. Morris, S., & Shin, H. S. (2002). Social value of public information. American Economic Review, 92(5), 1521–1534.
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5. Del Negro, M., Giannoni, M., & Patterson, C. (2012). The forward guidance puzzle.
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Expectation formation

according to Klein (2002), the FIRE model can be solved as follows

$$X_t = H * X_{t-1} + \eta * \epsilon_t$$

- full information set: $\{X_0^t\}$
- incomplete infomation set $\left\{S_t, X_0^{t-1}\right\}$

shoppers don't know current valiable due to incomplete information however, they will observe the related policy signal

$$S_t = \varphi_q Q_t + \varphi_r R_t$$

which is:

$$\text{transition eq:} X_t = H * X_{t-1} + \eta * \epsilon_t$$

$$\text{observation eq:} S_{it} = \tilde{Z}_t * X_t$$

Optimal Prediction Problem

- do **optimal prediction** based on incomplete information
- minimize the expectation of **prediction error**:

$$\min_{E_t[X_t|S_t,X_0^{t-1}]} \mathbb{E}\left[\left(X_t - E_t[X_t \mid S_t, X_0^{t-1}]\right)^2\right]$$

- based on kalman filter, we have

$$E_t[X_t \mid S_t, X_0^{t-1}] = E_{t-1}[X_t \mid S_{t-1}, X_0^{t-2}] + \tilde{K}_t[S_t - \tilde{Z}_t E_{t-1}[X_t \mid S_{t-1}, X_0^{t-2}]]$$

Bayesian method

- Individuals update their beliefs using Bayesian learning.
- A prior distribution at period 0 are $\tilde{\varphi}_{q,0}$ and $\tilde{\varphi}_{r,0}$:

$$\begin{bmatrix} \tilde{\varphi}_{q,0} \\ \tilde{\varphi}_{r,0} \end{bmatrix} \sim \mathcal{N}\left(\begin{bmatrix} \varphi_q^0 \\ \varphi_r^0 \end{bmatrix}, \begin{bmatrix} \sigma_{\varphi_q}^2 & 0 \\ 0 & \sigma_{\varphi_r}^2 \end{bmatrix} \right).$$

- The statistical learning model employed by individuals is:

$$S_t = \tilde{\varphi}_q Q_t + \tilde{\varphi}_r R_t + \varsigma_t^s,$$

- $\varsigma_t^s \sim \mathcal{N}(0, \sigma_{\varsigma^s}^2)$, related to learning speed
- individuals perform Bayesian learning to estimate the posterior distribution:

$$\begin{bmatrix} \tilde{\varphi}_{q,t} \\ \tilde{\varphi}_{r,t} \end{bmatrix} \sim \mathcal{N}\left(\begin{bmatrix} \varphi_q^t \\ \varphi_r^t \end{bmatrix}, \Sigma_\varphi \right).$$