Forward Guidance without Common Knowledge

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Outline

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2 Environment

3 GE Attenuation and Horizon Effects

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Motivation

- How does the economy respond to news about the future?
  - e.g. news about future interest rates or government spending

- Key mechanisms:
  - forward-looking expectations (e.g., of inflation and income)
  - general-equilibrium effects (Keynesian multiplier, $\pi - y$ feedback)

- Standard macro analysis assumes **REE and complete info**

- By imposing perfect coordination, we might "overstate"
  - responsiveness of **forward-looking** expectations
  - potency of **GE effects**
  - ability of PM to influence economic outcomes
Forward Guidance Puzzle

Context: A NK Economy at the ZLB

Policy Question: forward guidance & (backloading) fiscal stimuli

Answer: mainly driven by GE effects from inflation and income
  ▶ GE quantitatively large
  ▶ GE explodes with horizon
  ▶ PE effects decreases with horizon
Main Findings

- Key step: recast IS and NKPC as Dynamic Beauty Contests

- Key insight: removing Common Knowledge \( \implies \)
  - anchors expectations of \( y \) and \( \pi \)
  - attenuates GE feedback loops (both within and across two blocks)
    - attenuation larger the longer these loops (horizon effect)

- Implications:
  - lessen forward guidance puzzle
  - offer rationale for front-loading fiscal stimuli
Related Literature

Part I: Higher-order uncertainty in macroeconomics

Part II: Forward guidance
- We maintain micro-foundations & rational expectations
- We focus on
  - a game theoretic representation of the NK model
  - forward looking pricing rules
  - coordination frictions both within consumers and firms and across them
  - horizon effects
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Context

- Starting point: textbook NK model
- Main departure: remove CK of news about fundamentals/policy
- Key friction: uncertainty about how others will respond
  ▶ not uncertainty about the fundamentals/policy per se
Euler/IS WITH Common Knowledge

\[ y_t = -E_t[r_{t+1}] + E_t[y_{t+1}] \]

- Key implication: \( y = f \) (expected path of \( r \))
  - this implication is robust to borrowing constraints
  - even though the aggregate Euler equation itself is different
Euler/IS WITHOUT Common Knowledge

\[ y_t = - \left\{ \sum_{k=1}^{+\infty} \beta^{k-1} E_t[r_{t+k}] \right\} + (1 - \beta) \left\{ \sum_{k=1}^{+\infty} \beta^{k-1} E_t[y_{t+k}] \right\} \]

- **Dynamic beauty contest** among consumers
  - follows from PIH and \( y = c \)
  - modern version of Keynesian income multiplier

- Key implication: \( y \neq f(\text{expected path of } r) \)
  - instead, response of \( y \) to news about path of \( r \) hinges on HOB

- Why no recursive?
  - Law of iterated expectation **do not hold** for \( E_t[\cdots] \)
NKPC WITH/WITHOUT Common Knowledge

\[ \pi_t = m c_t + \beta E_t [\pi_{t+1}] \]

vs

\[ \pi_t = m c_t + \left\{ \sum_{k=1}^{+\infty} (\beta \theta)^k \bar{E}_t^f [m c_{t+k}] \right\} + \frac{1-\theta}{\theta} \left\{ \sum_{k=1}^{+\infty} (\beta \theta)^k \bar{E}_t^f [\pi_{t+k}] \right\} \]

- Dynamic beauty contest among the firms
  - follows from optimal price setting

- Key implication: \( \pi \neq f(\text{expected path of } m c) \)
  - instead, response of \( \pi \) to news about path of \( m c \) hinges on HOB
Three GE Mechanisms

- **Income multiplier:** $\bar{E}_t [y_{t+k}] \Rightarrow y_t$

- **Pricing complementarity:** $\bar{E}_t^f [\pi_{t+k}] \Rightarrow \pi_t$

- **Inflationary spiral:** interaction the two groups
  - $\bar{E}_t [\pi_{t+k}] \Rightarrow \bar{E}_t [r_{t+k}] \Rightarrow y_t$
  - $\bar{E}_t^f [y_{t+k}] \Rightarrow \bar{E}_t^f [mc_{t+k}] \Rightarrow \pi_t$

- **Standard practice:** impose CK = maximize all GE effects

- **Our paper:** relax CK = GE become HOB = attenuate all GE effects
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Dynamic Beauty Contests

- To develop intuition, focus on demand block first
  - treat real interest rate path exogenous
  - e.g. rigid price and CB controls nominal interest rate path

\[
y_t = -r_t - \left\{ \sum_{k=1}^{+\infty} \beta^{k-1} E_t [r_{t+k}] \right\} + (1 - \beta) \left\{ \sum_{k=1}^{+\infty} \beta^{k-1} E_t [y_{t+k}] \right\}
\]

- Question: How does \( y_0 \) respond to news about \( r_T \)?
  - lack of CK = anchored expectations = GE attenuation
  - attenuation increases with horizon (as if extra discounting)

- Results hold for a general class of dynamic beauty contests

\[
a_t = \theta_t + \left\{ \sum_{k=1}^{+\infty} \gamma^{k-1} E_t [\theta_{t+k}] \right\} + \alpha \left\{ \sum_{k=1}^{+\infty} \gamma^{k-1} E_t [a_{t+k}] \right\}
\]

- Inflation beauty contest: \( a_t = \pi_t \) and \( \theta_t = mc_t \)
- Asset pricing: \( a_t = p_t \) and \( \theta_t = \text{dividend} \)
The Role of HOB

Formally:
- hold $r_t$ (& belief about it) constant for all $t \neq T$
- treat $r_T$ as a random variable
- study how $y_0$ covaries with $\bar{E}_0[r_T]$ ($\phi_T$)

By iterating, we can express $y_0$ as a linear function of
- 1st-order beliefs: $\bar{E}_0[r_T]$
- 2nd-order beliefs: $\bar{E}_0[\bar{E}_\tau[r_T]] \forall \tau: 0 < \tau < T$
- and so on, up to beliefs of order $T$

With CK, HOB collapse to FOB, and the "usual" predictions apply

Without CK, we need to understand
- how much HOB co-move with $\bar{E}_0[r_T]$
- how much HOB matter in $y_0$
Two Basic Insights

1. **HOB vary less than FOB**
   - “I am not 100% sure that you heard and paid attention to the news. As a result, I think your beliefs move less than mine”

2. **Longer horizons raise the relative importance of HOB**
   - the distant future enters through multiple rounds of GE effects:
     
     $$ r_T \rightarrow c_T \rightarrow c_{T-1} \rightarrow \ldots \rightarrow c_1 \rightarrow c_0 $$

   - This is akin to ascending the hierarchy of beliefs
   - Longer horizons therefore raise the load of HOB on outcomes
Results

1. **Attenuation at any horizon**
   - $\phi_T$ bounded between PE effect and CK counterpart:
     \[ \beta^{T-1} < \phi_T < \phi^*_T \]
   - “CK maximizes GE effect”

2. **Attenuation effect increases with the horizon**
   - $\phi_T/\phi^*_T$ decreases in $T$
   - the distant future enters through multiple rounds of GE effects:

3. **Attenuation effect grows without limit**
   - $\phi_T/\phi^*_T \to 0$ as $T \to \infty$ even if noise is tiny
Leading Example

- Info structure:
  - Gaussian **private signal** about $r_T$ at 0: $x_i = r_T + \varepsilon_i$,
  - no other info $\tau < T$. $r_T$ becomes known at $T$

- Implication: a simple exponential structure for HOB

\[ \bar{E}_0^h[r_T] = \lambda^{h-1} \bar{E}_0[r_T] \]

where $\lambda \in (0, 1]$ is decreasing in the amount of noise

- Anchoring HOB as modeling device of limited depth of reasoning
Leading Example

- Back to our question: How does $y_0$ vary with $\tilde{E}_0[r_T]$?

- Answer: Same as in a representative-agent model with

$$y_t = -E_t[r_{t+1}] + \lambda'E_t[y_{t+1}]$$

  ➤ $\lambda' \in (0, 1)$
  ➤ as if myopia / extra discounting of future outcomes
  ➤ discounting comes from GE effect attenuation
Going Back to the Full NK model

**Demand block (IS):**
- attenuate GE feedback b/w \( c \) and \( y \) (Keynesian multiplier)
- anchor income expectations
- arrest response of \( c \) to news about future real rates
- as if extra discounting in the Euler condition

**Supply block (NKPC):**
- attenuate GE feedback from future to current \( \pi \)
- anchor inflation expectations
- arrest response of \( \pi \) to news about future marginal costs
- as if extra discounting in the NKPC

**GE feedback b/w demand (IS) and supply (NKPC):**
- joint endogeneity of real rates and real marginal cost
- attenuate GE feedback between two blocks
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ZLB and Forward Guidance

- Let $T$ index length of liquidity trap and horizon of FG
  - $t \leq T - 1$: ZLB binds and $R_t = 0$
  - $t \geq T + \Delta$: “natural level” and $y_t = \pi_t = 0$
  - let $\Delta = 1$ for simplicity

- Forward guidance: policy announcement at $t = 0$ of $R_T$
  - modeled as $z = R_T + \text{noise}$
  - noise captures central banks commitment issues and etc.

- We remove common knowledge of $z$
  - leading example: noisy private signals about $z$

- Remark
  - credibility has to do with how much $\bar{E}_0[R_T]$ varies with $R_T$
  - we focus on how $y_0$ varies with $\bar{E}_0[R_T]$
The Power of Forward Guidance

- Degree of CK indexed by $\lambda \in (0, 1]$

$$\bar{E}^h[R_T] = \lambda^{h-1} \bar{E}^1[R_T]$$

- consumers vs firms: $\lambda_c$ vs $\lambda_f$
- CK benchmark nested with $\lambda_c = \lambda_f = 1$

**Question:** How does $y_0$ vary with $\bar{E}_0[R_T]$?

**Answer:** There exists a function $\phi$ such that

$$y_0 = -\phi(\lambda_c, \lambda_f; T, \kappa) \cdot \bar{E}_0[R_T]$$

- standard: $\phi^*$ increases with $T$ and explodes as $T \to \infty$
- here: $\phi$ vs $\phi^*$
Main Results

- **Attenuation for any horizon**: $\phi/\phi^* < 1$
  - three GE effects at work:
    1. inside IS: income-spending feedback
    2. inside NKPC: inflation-inflation feedback
    3. across two blocs: inflation-spending feedback
  - all three attenuated; but quantitative bite for (2) and (3)

- **Attenuation effect increases with horizon**
  - $\phi/\phi^*$ decreases in $T$
  - $\phi/\phi^* \to 0$ as $T \to \infty$, even if $\lambda \approx 1$
  - for $\lambda_c$ small enough, $\phi \to 0$ in absolute, not only relative to $\phi^*$
A Numerical Illustration (based on Gali, 2008)

- Modest info friction: $\lambda_c = \lambda_f = 0.75$
  - 25% prob that others have failed to hear announcement
- On top of any mechanical effect that first order informational friction
Fiscal Stimuli

- Standard NK under ZLB prediction:
  - fiscal stimuli work because they trigger inflation
  - better to back-load so as to "pile up" inflation effects

- Our twist:
  - such piling up = iterating HOB
  - not as potent when CK assumption is dropped
  - rationale to front-load so as to minimize coordination friction
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Companion Paper


- REE alone ⇒ restrict GE in an interval
  - Standard practice (REE+ CK) -> upper bound of the interval

- Lack of CK = GE dampened

- Non-REE variants often, but not always, attenuate GE
  - level-k, Tatonnement, Cobweb, Sparsity, ε-equilibrium
  - Lack of CK = a structured way to relax REE

- Connection to empirical work a la Mian-Sufi
  - reduce GE = reduce gap between micro and macro elasticities
Conclusion

- Forward-looking expectations crucial in modern macro

- By assuming CK with REE, hardwire a certain kind of perfection in
  - how economic agents to coordinate their expectations
  - maximize policy makers abilities to steer economy

- Remove CK helps accommodate a realistic friction
  - alleviate forward guidance puzzle

- Insights and the techniques may find additional applications
  - fiscal multipliers
  - demand driven business cycles