Forward Guidance without Common Knowledge

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Forward Guidance: A Pretext?

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

- Key mechanisms:
  - expectations of choices of others (e.g., of inflation and spending)
  - GE effects (e.g., Keynesian multiplier, π-y feedback)

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- Standard practice: RE with CK
- This paper: RE without CK
  - formalizes frictional coordination
  - structured substitute to relaxing RE

Main Insight and Applications

- Removing CK
  - anchors expectations of the choices of others
  - attenuates GE effects
- Effects increase with horizon
  - as if extra discounting on future outcomes
- Application to ZLB context
  - anchors $\mathbb{E}[\pi]$ and $\mathbb{E}[y]$, for given $\mathbb{E}[R]$ or $\mathbb{E}[g]$
  - lessen forward guidance puzzle
  - offer rationale for the front-loading of fiscal stimuli
  - ...

Roadmap

1. Recast IS and NKPC as Dynamic Beauty Contests
2. Show GE Attenuation and Horizon Effects
3. Application to Forward Guidance and Fiscal Stimuli
4. Related Work

Framework

- Starting point: textbook NK model
  - key ingredients: forward-looking c and π
- Main departure: remove CK of news about future R or g
- Auxiliary: enough "noise" to prevent revelation through prices
  - variant: rational inattention
- Key friction: uncertainty about how others will respond
  - not uncertainty about the policy per se
  - to understand how it matters $\rightarrow$ IS and NKPC as beauty contests

The Euler/IS Curve with Common Knowledge

$$c_t = -E_t[r_{t+1}] + E_t[c_{t+1}]$$

- $\Rightarrow$ $c = f$ (expected path of r)

The Euler/IS Curve without Common Knowledge

$$c_t = -\left\{\sum_{k=1}^{+\infty} \beta^{k-1} \bar{E}_t[r_{t+k}]\right\} + (1-\beta)\left\{\sum_{k=1}^{+\infty} \beta^{k-1} \bar{E}_t\left[c_{t+k}\right]\right\}$$

- $\Rightarrow$ $c \neq$ f(expected path of r)
- Key: E[behavior of other consumers]

The NK Philips Curve with Common Knowledge

$$\pi_t = mc_t + \beta E_t [\pi_{t+1}]$$

- $\Rightarrow \pi = f$ (expected path of mc)

The NK Philips Curve without Common Knowledge

$$\pi_t = mc_t + \left\{ \sum_{k=1}^{+\infty} (\beta\theta)^k \, \bar{E}_t^f \left[mc_{t+k} \right] \right\} + \frac{1-\theta}{\theta} \left\{ \sum_{k=1}^{+\infty} (\beta\theta)^k \, \bar{E}_t^f \left[\pi_{t+k} \right] \right\}$$

- $\Rightarrow$ π $\neq$ f(expected path of MC)
- Key: E[behavior of other firms]

So Far, and What's Next

- So far:
  - represent IS and NKPC as dynamic beauty contests
- What's next:
  - consider a more abstract setting
  - develop broader insights

An Abstract Dynamic Beauty Contest

- Euler-like condition:

$$a_{i,t} = \theta_t + \gamma E_{it}[a_{i,t+1}] + \alpha E_{it}[a_{t+1}]$$

  - θ_t = fundamental, a_{it} = individual outcome, a_t = aggregate outcome
  - $\gamma > 0$ parameterizes PE (e.g., response to own interest rates)
  - $\alpha > 0$ parameterizes GE (e.g., effect through aggregate income)

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- With CK $\Rightarrow$ representative-agent Euler

$$a_t = \theta_t + (\gamma + \alpha) E_t[a_{t+1}]$$

$\Rightarrow$ distinction between PE and GE is irrelevant

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- Without CK $\Rightarrow$ dynamic beauty contest

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

  $\Rightarrow$ distinction between PE and GE becomes crucial

Question of Interest

- How does a_t responds to news about θ_{t+T} ?
  - c_t and π_t to news about R_{t+T} or g_{t+T}

- Formally:
  - hold θ_τ constant (say, at 0) for all $\tau \neq t+T$
  - treat θ_{t+T} as a random variable (Normally distributed with mean 0)
  - specify information structure about θ_{t+T}
  - study $\phi_T \equiv$ projection coefficient of a_t on $\bar{E}_t[\theta_{t+T}]$

RE = HOB

- By iterating, we can express a_t as a linear function of
  - 1st-order beliefs: $\bar{E}_t [\theta_{t+T}]$
  - 2nd-order beliefs: $\bar{E}_t \left[\bar{E}_\tau [\theta_{t+T}]\right] \ \forall \tau : t < \tau < t+T$
  - 3rd-order beliefs: $\bar{E}_t \left[\bar{E}_\tau \left[\bar{E}_{\tau'} [\theta_{t+T}]\right]\right] \ \forall \tau, \tau' : t < \tau < \tau' < t+T$
  - and so on, up to beliefs of order T

- Understanding $\bar{E}_t$ of a_{t+k} (e.g., inflation or income)
  $=$ understanding HOB of θ_{t+T} (e.g., interest rate after the ZLB)

Three Basic Insights

1. Expectations of outcomes = HOB of fundamentals
   - by iterating, we can express $\bar{E}_t[a_{t+k}]$ in terms of HOB of θ_{t+T}
   - this is true regardless of info structure
   - but CK controls how much $\bar{E}_t[a_{t+k}]$ moves relative to $\bar{E}_t[\theta_{t+T}]$

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3. Longer horizons raise the relative importance of HOB
   - the distant future enters through multiple rounds of GE effects:

$$R_{t+T} \to (c_{t+T}, \pi_{t+T}) \to (c_{t+T-1}, \pi_{t+T-1}) \to \ldots \to (c_t, \pi_t)$$

   - but 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
   - ϕ_T bounded between PE effect and CK counterpart:

$$\gamma^T < \phi_T < \phi_T^* = (\gamma + \alpha)^T$$

   - "CK maximizes GE effect"

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2. Attenuation effect increases with the horizon
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3. Attenuation effect grows without limit
   - $\phi_T / \phi_T^* \to 0$ as $T \to \infty$ even if noise is tiny*

Leading example

- Information structure:
  - each agent receives a private Gaussian signal about θ_{t+T} at t
  - no other info arrives up to $t+T$, at which point θ_{t+T} becomes known

- Implication: a simple exponential structure for HOB

$$\bar{E}_t^h[\theta_{t+T}] \;=\; \lambda^{h-1} \cdot \bar{E}_t[\theta_{t+T}]$$

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

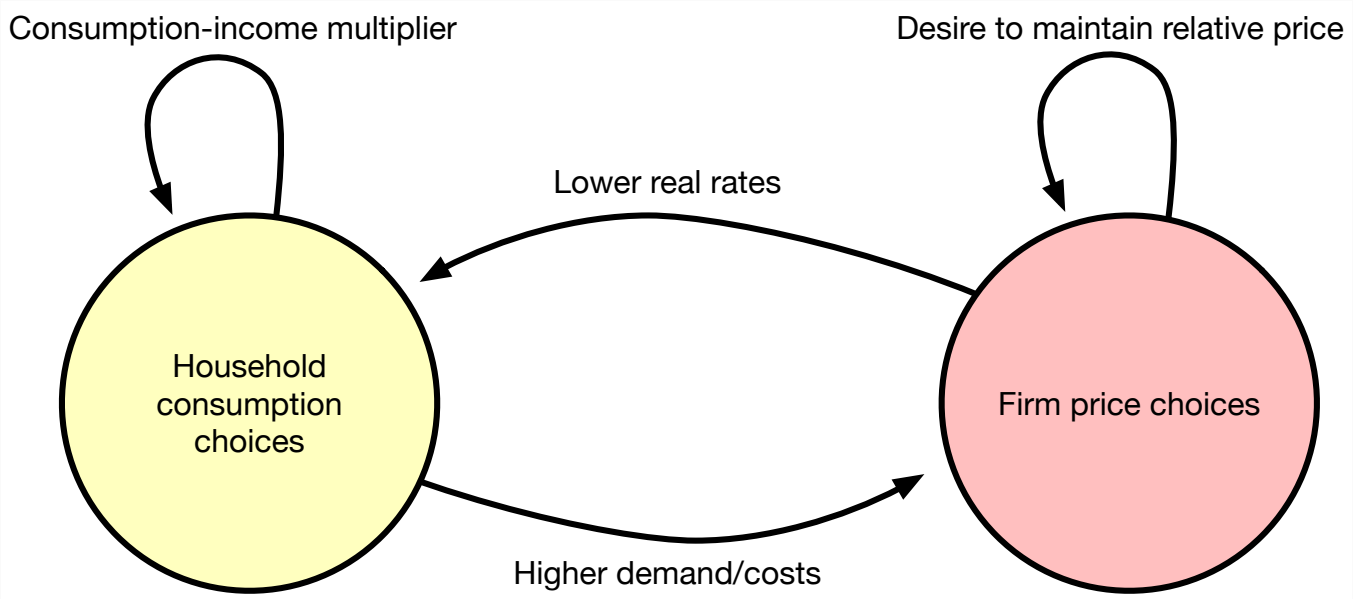
Leading Example

- Back to our question: How does a_t vary with $\bar{E}_t[\theta_{t+T}]$?
- Answer: Same as in a representative-agent model with

$$a_t = \theta_t + (\gamma + \lambda\alpha)E_t[a_{t+1}]$$

  - GE effect reduced from α to $\lambda\alpha$
  - as if myopia / extra discounting

Back to the NK model: Three GE Mechanisms



- Removing CK dulls all these feedback loops
  - as if fewer loops or level-k thinking (but consistent with RE)

ZLB and Forward Guidance

- Let T index length of liquidity trap and horizon of FG
  - $t < T - 1$: ZLB binds and $R_t = 0$ for all
  - $t \geq T + \Delta$: "natural level" and $y_t = \pi_t = 0$
  - let $\Delta = 1$ for simplicity
- Forward guidance
  - policy announcement at $t = 0$ of likely R_T
  - modeled as $z = R_T + noise$
- Our twist: lack of CK about z
  - credibility = precision of z, or how much $\bar{E}_0[R_T]$ varies with z
  - we bypass this and focus on how y_0 varies with $\bar{E}_0[R_T]$
  - think of this as studying the response of spending and inflation relative to the response of the term structure of interest rates

Leading Example

- Gaussian private signals about R_T, no endogenous learning
  - degree of CK indexed by $\lambda \in (0, 1]$ such that $\bar{\mathbb{E}}^h[R_T] = \lambda^{h-1}\bar{\mathbb{E}}^1[R_T]$
  - consumers vs firms: λ_c vs λ_f

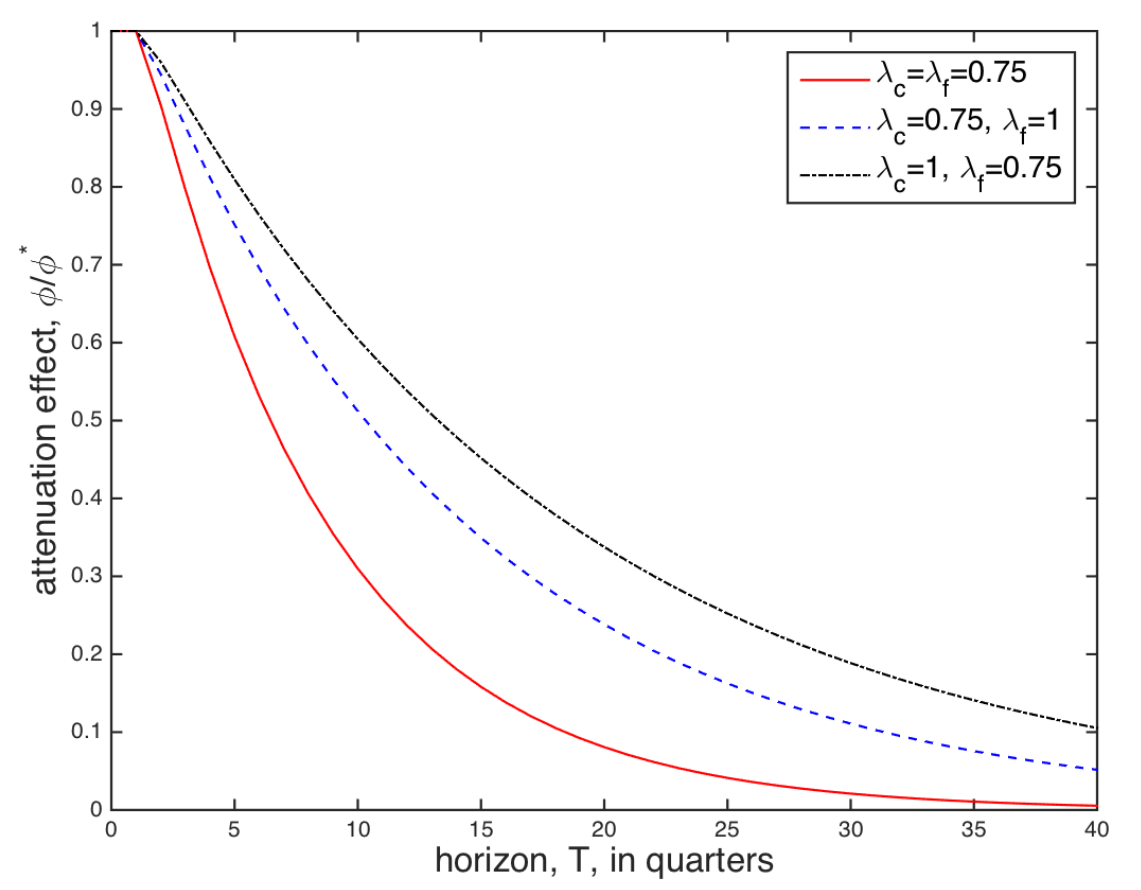
- The power of FG: there exists a function ϕ such that

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

  - measures how much y moves relative to expectations of R
  - CK benchmark nested with $\phi^*(T) = \phi(1, 1; T)$

A Numerical Illustration

- Standard parameters as in Gali's textbook
- Modest friction: 25% prob that *others* failed to hear announcement
- Large effect: at $T = 5 years$, ϕ is less than 1/10 of ϕ^*



Remarks

- Three GE effects at work:
  (1) inside IS: income-spending feedback
  (2) inside NKPC: inflation-inflation feedback
  (3) across two blocks: inflation-spending feedback

- All three attenuated when removing CK, but
  - in textbook version of NK, most quantitative bite for (2) and (3)
  - (1) becomes more relevant with short horizons or liquidity constraints

Fiscal Stimuli: Back- vs Front-Loading

- Standard NK 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 for front-loading: "minimize coordination friction"

Summary

- Removing CK
  - accommodates frictional coordination
  - attenuates GE effects
  - anchors expectations of inflation and income
  - lessens forward guidance puzzle (and paradox of flexibility too)
  - justifies front loading of fiscal stimuli
  - ...

Related Work

- Related work that arrests GE by dropping RE
  - cognitive discounting as in Gabaix (2016)
  - level-k as in Garcia & Woodford (2015), Farhi & Werning (2017)

- Our approach has similar implications, but:
  - robust to settings in which GE=strategic substitutability
  - consistent with RE $\Rightarrow$ immune to Lucas critique, plus no conundrum with what agents do when they see the actual outcomes
  - implies not only discounting but also backward-lookingness $\Rightarrow$microfoundation of hybrid NKPC, IAC, habit

- Companion papers:
  - "Dampening GE" with Chen Lian
  - "Anchored Expectations" with Zhen Huo
  - ...