Managing Expectations: Instruments versus Targets

George-Marios Angeletos[1] **and Karthik Sastry**[2]
[1]MIT and NBER, [2]MIT

NBER Summer Institute, July 12, 2019

Motivation: How to Offer Forward Guidance

- To manage expectations, can talk about...
  - Instruments: "will maintain 0% interest rates"
  - Targets: "will do whatever it takes for 4% unemployment"
- Reason to prefer one type of forward guidance over the other?

Motivation: How to Offer Forward Guidance

- To manage expectations, can talk about…
  - Instruments: "will maintain 0% interest rates"
  - Targets: "will do whatever it takes for 4% unemployment"
- Reason to prefer one type of forward guidance over the other?
- No in the benchmark with

  (i) Full commitment

  (ii) No future shocks (or policy contingent on them)

  (iii) Rational Expectations + Common Knowledge

"Ramsey world"

Motivation: How to Offer Forward Guidance

- To manage expectations, can talk about...
  - Instruments: "will maintain 0% interest rates"
  - Targets: "will do whatever it takes for 4% unemployment"
- Reason to prefer one type of forward guidance over the other?
- No in the benchmark with

  ~~"Ramsey world"~~

  (i) Full commitment

  (ii) No future shocks (or policy contingent on them)

  (iii) ~~Rational Expectations + Common Knowledge~~

Our focus

Relax (iii) and explore role of bounded rationality

Our Approach

Set-up

- Formalize question in simple "beauty contest" game
  - stylizes NK at ZLB
- Add "bounded rationality"
  - belief inertia (lack of CK, level-k thinking)
  - other forms (belief over-reaction, animal spirits)

Our Approach

Set-up

- Formalize question in simple "beauty contest" game
  - stylizes NK at ZLB
- Add "bounded rationality"
  - belief inertia (lack of CK, level-k thinking)
  - other forms (belief over-reaction, animal spirits)

Form of forward guidance

- REE = knife-edge case of instrument/target irrelevance
- Otherwise, choice determines bite of bounded rationality

Main Result

What to do and why

Minimize agents' need to "reason about the economy" (i.e., about the behavior of others/equilibrium effects) with

- Instrument communication when GE feedback is weak
- Target communication when GE feedback is strong

e.g., talk about Y rather than R when faced with

- steep Keynesian cross
- long liquidity trap

Literature

- Instruments vs Targets

  Poole (1970), Weitzman (1974)

- Micro-foundations of Beauty Contests

  RBC: Angeletos & La'O (2010, 2013), Huo & Takayama (2015)

  NK: Angeletos & Lian (2018), Farhi & Werning (2018)

- Forward Guidance, GE Attenuation and Myopia

  Angeletos & Lian (2016, 2018): HOB

  Farhi & Werning (2018), Garcia-Schmidt & Woodford (2018): Level k

  Gabaix (2018): cognitive discounting

- Communication in Beauty Contests, Information Design

  Morris & Shin (2002, 2007), Angeletos & Pavan (2007)

  Kamenica & Gentzkow (2011), Bergemann & Morris (2013, 2018)

Model

Notation and Behavior

$K = \int_i k_i \, \mathrm{d}i$ = average action today

Y = outcome (target) in the future

τ = instrument in the future

Notation and Behavior

$K = \int_i k_i \, \mathrm{d}i$ = average action today

Y = outcome (target) in the future

τ = instrument in the future

$$k_i = (1-\gamma)\mathbb{E}_i[\tau] + \gamma \mathbb{E}_i[Y]$$

$\gamma \in (0,1)$ parameterizes GE feedback

Notation and Behavior

$K = \int_i k_i \, \mathrm{d}i$ = average action today

Y = outcome (target) in the future

τ = instrument in the future

$$k_i = (1 - \gamma)\mathbb{E}_i[\tau] + \gamma \mathbb{E}_i[Y]$$

$\gamma \in (0, 1)$ parameterizes GE feedback

Story (microfoundation in paper)

ZLB today, but not tomorrow

K = spending today; Y = income today plus tomorrow

τ = (negative of) interest rate tomorrow

Forward guidance via substitution (PE) or income (GE) effect

Outcomes

Policy also has direct effect

$$Y = (1 - \alpha)\tau + \alpha K$$

$$\alpha \in (0, 1)$$

Outcomes

Policy also has direct effect

$$Y = (1-\alpha)\tau + \alpha K$$
$$\alpha \in (0,1)$$

Story (microfoundation in paper)

Loose policy tomorrow $\rightarrow$ higher output tomorrow

The Key Equations, and the Key Issue

$$k_i = (1-\gamma)\mathbb{E}_i[\tau] + \gamma\mathbb{E}_i[Y]$$
$$Y = (1-\alpha)\tau + \alpha K$$

- **No guidance**: Agents have to forecast both τ and Y

The Key Equations, and the Key Issue

$$k_i = (1-\gamma)\mathbb{E}_i[\tau] + \gamma\mathbb{E}_i[Y]$$
$$Y = (1-\alpha)\tau + \alpha K$$

- No guidance: Agents have to forecast both τ and Y
- **Instrument communication**: know τ, have to think about Y

The Key Equations, and the Key Issue

$$k_i = (1-\gamma)\mathbb{E}_i[\tau] + \gamma\mathbb{E}_i[Y]$$
$$Y = (1-\alpha)\tau + \alpha K$$

- No guidance: Agents have to forecast both τ and Y
- Instrument communication: know τ, have to think about Y
- **Target communication**: know Y, have to think about τ

Putting it Together

$$\min_{\theta \mapsto (\tau, Y)} \mathbb{E}[(1-\chi)(\tau-\theta)^2 + \chi(Y-\theta)^2]$$

s.t. (τ, Y) is implementable in equil, given eq. (1)-(2) and announcement of τ or Y

Timing

$t = 0$ (FOMC meeting): Policymaker sees θ, makes announcement

$t = 1$ (liquidity trap): Agents form beliefs and choose k_i

$t = 2$ (exit): τ and Y are realized

Frictionless, REE Benchmark

Benchmark $\equiv$ representative, rational and attentive agent

(CK of both announcement and rationality)

$\Longrightarrow$ no error in predicting behavior of others:

$$\mathbb{E}_i[K] = K$$

$\Longrightarrow$ any equilibrium satisfies

$$k_i = K = Y = \tau$$

$\Longrightarrow$ irrelevant whether PM announces τ or Y

(equivalence of primal and dual problems)

Friction: Lack of CK / Anchored Beliefs

- Assumption: Lack of CK of announcement

  Let $X \in \{\tau, Y\}$ be the announcement. Agents are rational and attentive but think only fraction $\lambda \in [0, 1]$ of others is attentive:

$$\mathbb{E}_i[X] = X \qquad \mathbb{E}_i[\bar{\mathbb{E}}[X]] = \lambda \mathbb{E}_i[X]$$

- Mimics role of HOB in incomplete-info settings

Friction: Lack of CK / Anchored Beliefs

- Assumption: Lack of CK of announcement

  Let $X \in \{\tau, Y\}$ be the announcement. Agents are rational and attentive but think only fraction $\lambda \in [0,1]$ of others is attentive:

$$\mathbb{E}_i[X] = X \qquad \mathbb{E}_i[\bar{\mathbb{E}}[X]] = \lambda \mathbb{E}_i[X]$$

- Mimics role of HOB in incomplete-info settings
- Implication: Anchored Beliefs

$$\bar{\mathbb{E}}[K] = \lambda K$$

Friction: Lack of CK / Anchored Beliefs

- Assumption: Lack of CK of announcement

  Let $X \in \{\tau, Y\}$ be the announcement. Agents are rational and attentive but think only fraction $\lambda \in [0, 1]$ of others is attentive:

$$\mathbb{E}_i[X] = X \qquad \mathbb{E}_i[\bar{\mathbb{E}}[X]] = \lambda \mathbb{E}_i[X]$$

- Mimics role of HOB in incomplete-info settings
- Implication: Anchored Beliefs

$$\bar{\mathbb{E}}[K] = \lambda K$$

- Level-K Thinking:
  - similar flavor: relaxing CK of rationality
  - identical results except for one "bug"
- Cognitive discounting: same, minus PE

Main Results

Game after Announcing τ

$$K = (1 - \gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

Game after Announcing τ

(reasoned by agents)

$$= (1-\alpha)\bar{\mathbb{E}}[\tau] + \alpha\bar{\mathbb{E}}[K]$$

$$K = (1-\gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

$= \tau$ (fixed by FG)

Game after Announcing τ

(reasoned by agents)

$= (1-\alpha)\bar{\mathbb{E}}[\tau] + \alpha\bar{\mathbb{E}}[K]$

$$K = (1-\gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

$= \tau$ (fixed by FG)

$$K = (1-\delta_\tau)\tau + \delta_\tau\bar{\mathbb{E}}[K]$$

$\alpha\gamma \in (0, 1)$

Game after Announcing τ

(reasoned by agents)

$$= (1-\alpha)\bar{\mathbb{E}}[\tau] + \alpha\bar{\mathbb{E}}[K]$$

$$K = (1-\gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

$= \tau$ (fixed by FG)

$$K = (1-\delta_\tau)\tau + \delta_\tau\bar{\mathbb{E}}[K]$$

$\alpha\gamma \in (0,1)$

- Game of **complements**

  "I expect less spending and income, so I spend less"

- Friction **reduces** effectiveness of FG

  Stylizes Angeletos & Lian (2018), Farhi & Werning (2018), Gabaix (2018), Garcia-Schmidt & Woodford (2018)

Game after Announcing Y

$$K = (1 - \gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

Game after Announcing Y

(reasoned by agents)

$$= \frac{1}{1-\alpha}\bar{\mathbb{E}}[Y] - \frac{\alpha}{1-\alpha}\bar{\mathbb{E}}[K]$$

$$K = (1-\gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

$= Y$ (fixed by FG)

Game after Announcing Y

(reasoned by agents)

$$= \frac{1}{1-\alpha}\bar{\mathbb{E}}[Y] - \frac{\alpha}{1-\alpha}\bar{\mathbb{E}}[K]$$

$$K = (1-\gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

$= Y$ (fixed by FG)

$$K = (1-\delta_Y)Y + \delta_Y\bar{\mathbb{E}}[K]$$

$$-\frac{(1-\gamma)\alpha}{1-\alpha} \leq 0$$

Game after Announcing Y

(reasoned by agents)

$$= \frac{1}{1-\alpha}\bar{\mathbb{E}}[Y] - \frac{\alpha}{1-\alpha}\bar{\mathbb{E}}[K]$$

$$K = (1-\gamma)\bar{\mathbb{E}}[\tau] + \gamma\bar{\mathbb{E}}[Y]$$

$= Y$ (fixed by FG)

$$K = (1-\delta_Y)Y + \delta_Y\bar{\mathbb{E}}[K]$$

$-\frac{(1-\gamma)\alpha}{1-\alpha} \leq 0$

- Game of **substitutes**

  "I expect less spending, so I expect looser policy and spend *more*"

- Friction **increases** effectiveness of FG

  Turns FG literature upside down

Implementability

Proposition: implementable sets

The implementable sets of (τ, Y) pairs for each strategy are

$$\{(\tau, Y) : \tau = \mu_\tau(\gamma, \lambda) Y\} \qquad \{(\tau, Y) : \tau = \mu_Y(\gamma, \lambda) Y\}$$

Instrument communication — Target communication

For any $\gamma \in (0, 1)$ and $\lambda \in (0, 1)$,

attenuation ← $\mu_\tau(\gamma, \lambda) > 1 > \mu_Y(\gamma, \lambda)$ → amplification

Implementability

Proposition: implementable sets

The implementable sets of (τ, Y) pairs for each strategy are

$$\{(\tau, Y) : \tau = \mu_\tau(\gamma, \lambda) Y\}$$

Instrument communication

$$\{(\tau, Y) : \tau = \mu_Y(\gamma, \lambda) Y\}$$

Target communication

For any $\gamma \in (0, 1)$ and $\lambda \in (0, 1)$,

attenuation ← $\mu_\tau(\gamma, \lambda) > 1 > \mu_Y(\gamma, \lambda)$ → amplification

Implementability

Proposition: implementable sets

The implementable sets of (τ, Y) pairs for each strategy are

$$\{(\tau, Y) : \tau = \mu_\tau(\gamma, \lambda) Y\} \qquad \{(\tau, Y) : \tau = \mu_Y(\gamma, \lambda) Y\}$$

Instrument communication — Target communication

For any $\gamma \in (0, 1)$ and $\lambda \in (0, 1)$,

attenuation ← $\mu_\tau(\gamma, \lambda) > 1 > \mu_Y(\gamma, \lambda)$ → amplification

Implementability

Proposition: implementable sets

The implementable sets of (τ, Y) pairs for each strategy are

$$\{(\tau, Y) : \tau = \mu_\tau(\gamma, \lambda) Y\} \qquad \{(\tau, Y) : \tau = \mu_Y(\gamma, \lambda) Y\}$$

Instrument communication — Target communication

For any $\gamma \in (0,1)$ and $\lambda \in (0,1)$,

attenuation ← $\mu_\tau(\gamma, \lambda) > 1 > \mu_Y(\gamma, \lambda)$ → amplification

Remarks

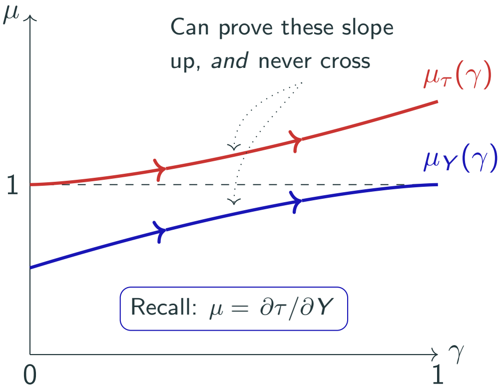
- Friction $\neq$ "everything is dampened"
- TC keeps powder dry: what about forward guidance puzzle?

Distortion and GE Feedback

Proposition

$\partial \mu_\tau / \partial \gamma > 0$

$\partial \mu_Y / \partial \gamma > 0$



Distortion and GE Feedback

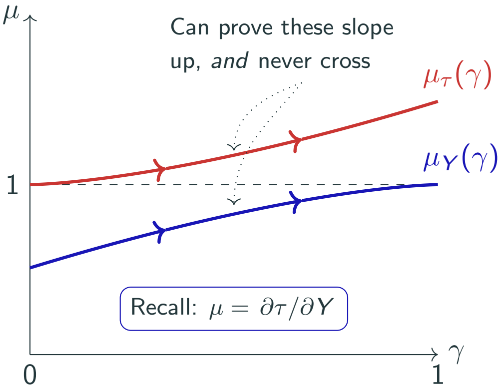
Proposition

$\partial\mu_\tau/\partial\gamma > 0$
$\partial\mu_Y/\partial\gamma > 0$

Quick intuition

Distortion from reasoning about what is not announced

High $\gamma \rightarrow$ very important to figure out Y, not so much τ



as γ (GE) increases $\Rightarrow$ $\begin{cases} \text{distortion under IC increases} \\ \text{distortion under TC decreases} \end{cases}$

Main Result

Theorem: optimal communication

There exists a $\hat{\gamma} \in (0, 1)$ ("critical GE feedback") such that

- $\gamma < \hat{\gamma}$: optimal to communicate instrument
- $\gamma \geq \hat{\gamma}$: optimal to communicate target

Main Result

Theorem: optimal communication

There exists a $\hat{\gamma} \in (0,1)$ ("critical GE feedback") such that

- $\gamma < \hat{\gamma}$: optimal to communicate instrument
- $\gamma \geq \hat{\gamma}$: optimal to communicate target

Additional result in paper:

precise value of announced τ or Y

Broader Scope

Other Frictions

Assumption: generalized form of incorrect reasoning

Let ϵ be noise orthogonal to θ.

$$\bar{\mathbb{E}}[K] = \lambda K + \sigma\epsilon \qquad \lambda, \sigma > 0$$

nests: under-reaction ($\lambda < 1$), over-reaction ($\lambda > 1$), and noise or animal spirits ($\sigma > 0$)

- Optimal policy result goes through
- Intuition: all about limiting the role of $\bar{\mathbb{E}}[K]$
    - i.e., the "more thinking = more distortion" result extends

Policy Rules

Announce a linear policy rule: $\tau = A - BY$

Optimal (A, B) indeterminate in RE benchmark

Policy Rules

Announce a linear policy rule: $\tau = A - BY$

Optimal (A, B) indeterminate in RE benchmark

Proposition: optimal linear policy with distorted beliefs

For each γ, there exists $(A^*(\gamma), B^*(\gamma))$ that uniquely solves the policy problem for all (λ, σ). $B^*(\gamma)$ increases in γ.

- High $\gamma \rightarrow$ tilt toward TC ("smoothed result")
- New perspective on policy rules
  - Optimal = reduces bite of bounded rationality
  - Uniqueness in tiny deviations from frictionless case

Conclusion

Managing (Distorted) Expectations

- *Goal:* optimal policy rules and communication given frictional coordination or bounded rationality
- *Lesson:* ease the burden of reasoning about the economy
- *More in the paper:* unobserved shocks; relation to Poole/Weitzman; more policy options; other settings