

Reputation and the Credibility of Inflation Plans

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RES Systemic Issues
April 2024

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What is credibility?

- Macro models: **expectations** of future policy determine current outcomes
- Policy typically set assuming **commitment** or **discretion**
- Governments actively attempt to influence **beliefs** about future policy
 - Forward guidance, inflation targets, fiscal rules...
- This paper Rational-expectations theory of government **credibility**
... borrowing insights from game-theory literature on **reputation**
- Application in a (modernized) Barro-Gordon setup

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Our approach

- Reputation is other agents' **belief** about my commitments
 - ... conceptualize commitment with private-information behavioral types
- Discipline (rational expectations)
 - ... can only have reputation for **possible** things
 - ... reputation changes through Bayes' rule after actions and announcements
- Setup
 - Initial **announcement** of inflation targets
 - ... collapses the set of reputations
 - Continuation equilibrium *given a plan*
 - ... Crucial assumption: government action observed **imperfectly**
 - ... Dynamics of reputation

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Main results

1. Compare continuation equilibria of different **plans**
 - ... Larger deviations are easier to detect
 - ... 'More time-inconsistent' plans have a more negative average drift of reputation
 - ... Tradeoff between **credibility** and promised **outcomes**
2. Main result choose a back-loaded plan with **gradual** disinflation
 - ... Gradualism helps incentives and slows down reputation losses
 - ... despite no inertia or other *real* reasons for gradualism
3. Take the limit as *initial reputation* vanishes to **zero**
 - ... Gradualism result is preserved

- **Sustainable plans – anything goes**

from Kydland and Prescott (1977), Chari and Kehoe (1990), Abreu, Pearce, and Stacchetti (1990), Phelan and Stacchetti (2001)

- **Reputation without noise – zero inflation at onset**

Milgrom and Roberts (1982), Kreps and Wilson (1982), Barro (1986), Backus and Driffill (1985), Barro and Gordon (1986), Sleet and Yeltekin (2007)

Dovis and Kirpalani (2019) – constant but more than zero

- **Reputation with noise**

Commitment: Lu (2013), Lu, King, and Pastén (2008, 2016)

Static plans: Faingold and Sannikov (2011)

- **Preference uncertainty with noise – announcements irrelevant**

Cukierman and Meltzer (1986), Faust and Svensson (2001), Phelan (2006), etc

Roadmap

- Model
- Continuation equilibria
- Plans
- Initial announcement
- Concluding remarks

Model

- A government dislikes inflation and output away from a target $y^* > 0$

$$L_t = \mathbb{E}_t \left[\sum_{s=0}^{\infty} \beta^s \left((y^* - y_{t+s})^2 + \gamma \pi_{t+s}^2 \right) \right]$$

- A Phillips curve relates output to current and expected future inflation

$$\pi_t = \kappa y_t + \beta \mathbb{E}_t [\pi_{t+1}]$$

- The government controls inflation only imperfectly (through g_t)

$$\pi_t = g_t + \epsilon_t$$

with $\epsilon_t \stackrel{iid}{\sim} F_\epsilon$

Reputation

- The government can be **rational** or one of many *behavioral* types
 - Behavioral types $c \in \mathcal{C}$
 - Type c is **committed** to an inflation plan $\{a_t\}_{t=0}^{\infty}$
 - For simplicity let all plans have $a_{t+1} = \phi_c(a_t)$ [Finding the state is an art]
- Behavioral types have (total) probability **z** (initial reputation)
 - Conditional on behavioral, probability ν over \mathcal{C}
- Private sector knows z and ν
 - Does *inference* over the government's type
 - Uses **announcements** and inflation **observations**

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Behavioral types

- What is the set \mathcal{C} ?
 - ... and associated possible ϕ_c functions
- Consider $\{a_t\}_t$ paths characterized by
 - Starting point a_0
 - Decay rate ω
 - Asymptote χ

$$a_t = \chi + (a_0 - \chi)e^{-\omega t}$$

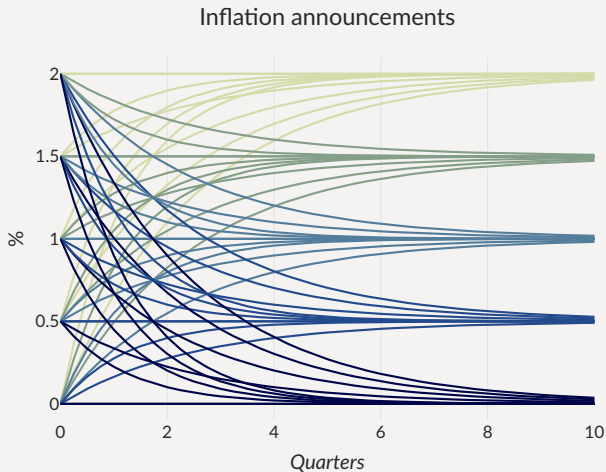
$$\phi(a) = \chi + e^{-\omega}(a - \chi)$$

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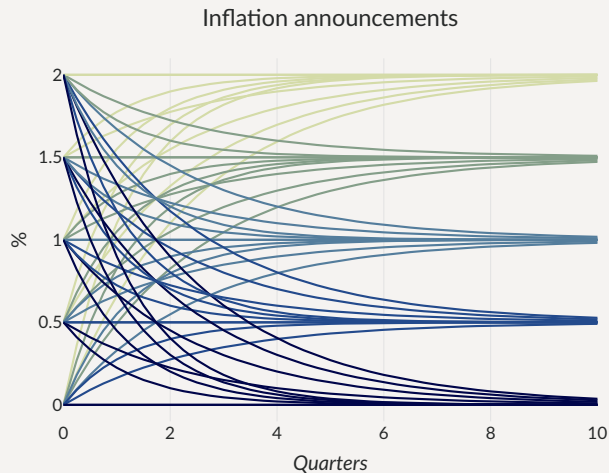
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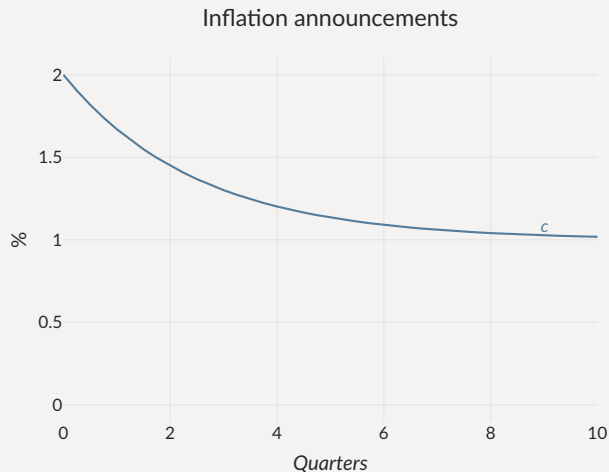
Gameplay

- At $t = 0$, inflation **targets** are announced
 - Type $c \in \mathcal{C}$ says c
 - Rational type **strategizes** announces r possibly $\in \mathcal{C}$
- At time $t \geq 0$, the government sets inflation
 - Behavioral type $c \in \mathcal{C}$ implements $g_t = a_t^c$
 - Rational type acts **strategically** chooses $g_t \leq a_t^c$



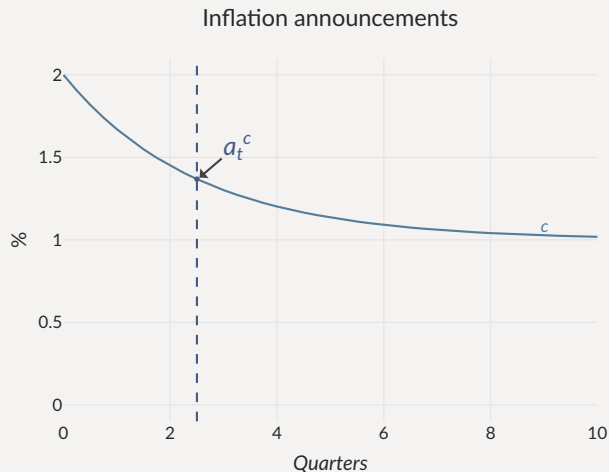
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Continuation equilibria

Reputation and Outcomes

- Output is determined by **beliefs** $\mathbb{E}_t [\pi_{t+1}]$ and **actual inflation** $\pi_t = g_t + \epsilon_t$

$$\pi_t = \kappa y_t + \beta \mathbb{E}_t [\pi_{t+1}] = \kappa y_t + \beta \mathbb{E}_t [\mathbb{1}_c a_{t+1}^c + (1 - \mathbb{1}_c) g_{t+1}^*]$$

- Private sector solves a **signal extraction problem** to update beliefs

$$\mathbb{P}(c \mid \pi_t, \mathcal{F}_{t-1}) = \frac{\mathbb{P}(c \mid \mathcal{F}_{t-1}) \cdot f_\epsilon(\epsilon_t | c)}{\mathbb{P}(c \mid \mathcal{F}_{t-1}) \cdot f_\epsilon(\epsilon_t | c) + (1 - \mathbb{P}(c \mid \mathcal{F}_{t-1})) \cdot f_\epsilon(\epsilon_t | r)}$$

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$$p_{t+1} = \frac{p_t \cdot f_\epsilon(\pi_t - a_t^c)}{p_t \cdot f_\epsilon(\pi_t - a_t^c) + (1 - p_t) \cdot f_\epsilon(\pi_t - g_t^*)}$$

Rational type's problem

Given an announcement c ,

- The problem of the rational type is, given expectations g_c^\star

$$\mathcal{L}^c(p, a) = \min_g \mathbb{E} \left[(y^\star - y)^2 + \gamma \pi^2 + \beta \mathcal{L}^c(p', \phi_c(a)) \right]$$

subject to $\pi = g + \epsilon$

$$\pi = \kappa y + \beta [p' \phi_c(a) + (1 - p') g_c^\star(p', \phi_c(a))]$$

$$p' = p + p(1 - p) \frac{f_\epsilon(\pi - a) - f_\epsilon(\pi - g_c^\star(p, a))}{p f_\epsilon(\pi - a) + (1 - p) f_\epsilon(\pi - g_c^\star(p, a))}$$

- Rational expectations requires g_c^\star to be the policy associated with \mathcal{L}^c

Continuation Equilibrium

Definition

Given an announcement c , a *continuation equilibrium* is a pair (\mathcal{L}^c, g_c^*) such that

- \mathcal{L}^c is the rational type's value function at expectations g_c^*
- g_c^* is the policy function associated with \mathcal{L}^c

A First Look at Different Plans

Observation

- Plans $c \in \mathcal{C}$ are

$$c = (a_0, \chi, \omega)$$

- For $a, b \in \mathbb{R}$

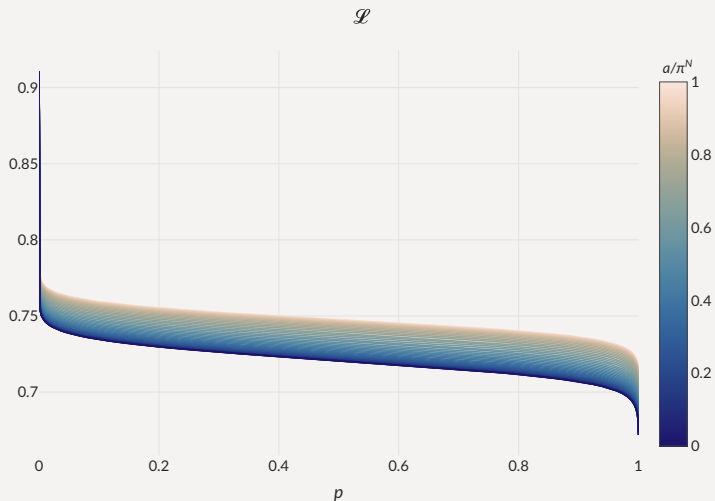
(\mathcal{L}, g^*) is a continuation
equilibrium for (a, χ, ω)



(\mathcal{L}, g^*) is a continuation
equilibrium for (b, χ, ω)

- Means $a \mapsto \mathcal{L}^c(p, a)$ compares the same plan at different plans and different times

The Value Function



- \mathcal{L} decreasing in p
- \mathcal{L} convex-concave in p
- \mathcal{L} increasing in a for large p only

Lemma 1

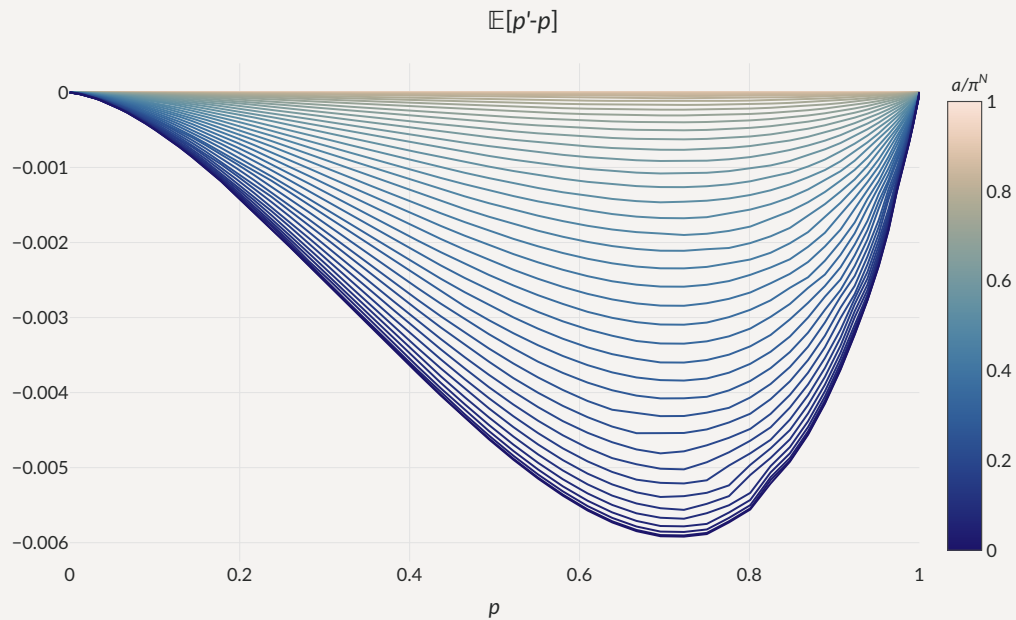
► Idea

In any continuation equilibrium,

$$\mathbb{E}_t [p_{t+1} \mid \text{rational}] \leq p_t$$

So $\{p_t\}_t$ is a supermartingale

Reputation Dynamics



From the Phillips curve

$$\frac{\partial y}{\partial \pi} = \frac{1}{\kappa} \left[1 - \beta \frac{\partial p'}{\partial \pi} \left(\phi_c(a) - g^*(p', \phi_c(a)) + (1 - p') \frac{\partial g^*(p', \phi_c(a))}{\partial p'} \right) \right]$$

- More inflation

1. Increases output by $\frac{1}{\kappa}$
2. Shifts inflation expectations from $\phi_c(a)$ towards $g^*(p', \phi_c(a))$
... p' decreases with higher π when $g^*(p, a) > a$
3. Shifts expectations of the rational type's future choice

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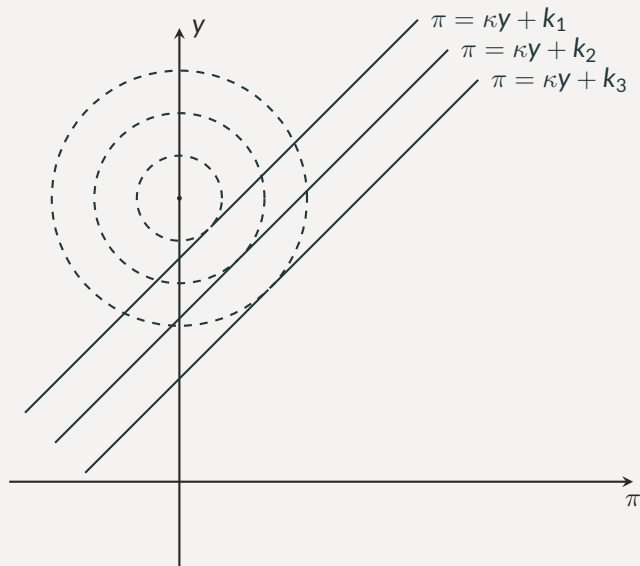
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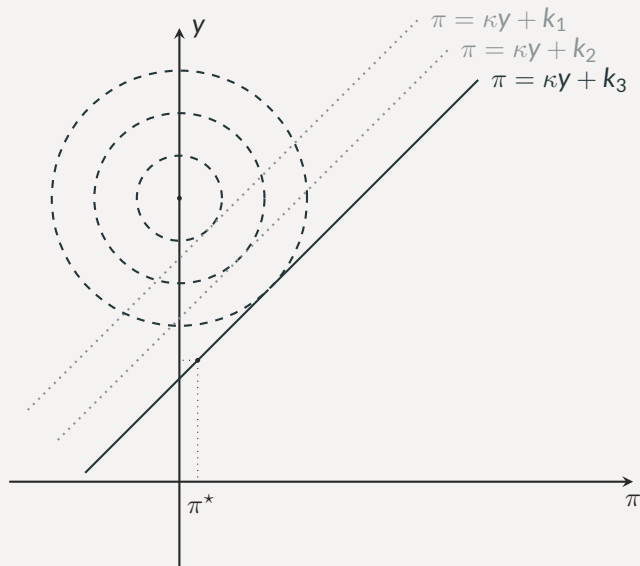
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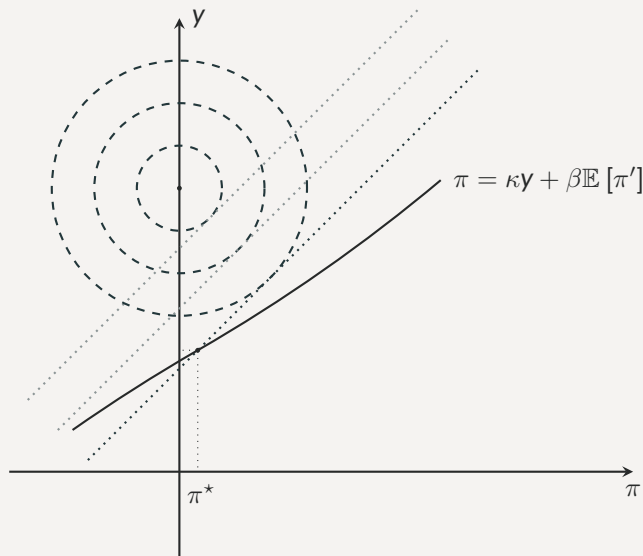
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- Without reputation:
if $\beta \mathbb{E} [\pi'] = k_j$
choose point on j th PC
- If announced a
and in eq'm
 $g^*(p, a) = a$
 \implies get straight PC
- If $g^*(p, a) > a$
 $\implies \frac{\partial p'}{\partial \pi}$ matters

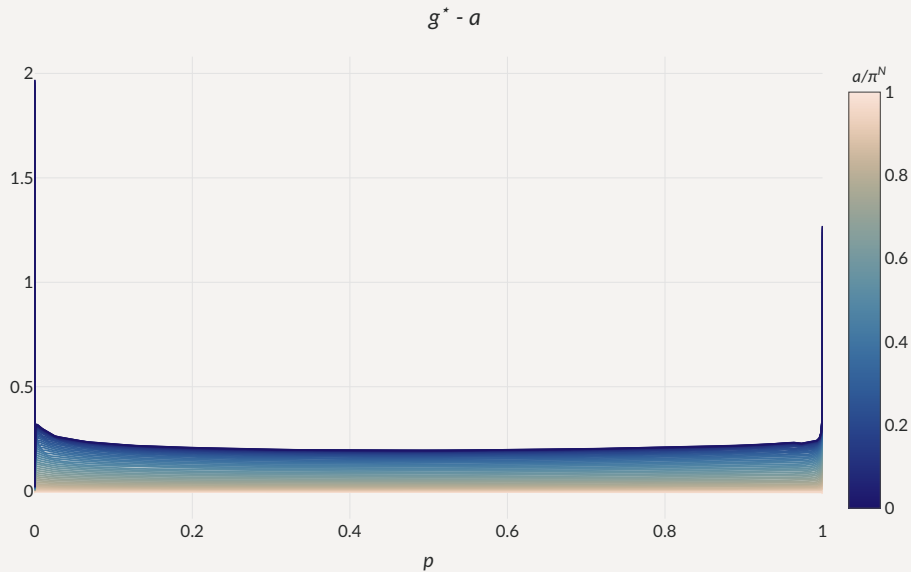


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Equilibrium Deviations



Credibility

- Let π^N be the Nash equilibrium inflation of the stage game. Then

$$\forall c \in \mathcal{C} : \quad g_c^*(p, a) \leq \pi^N$$

- Define the *remaining credibility* of a plan as

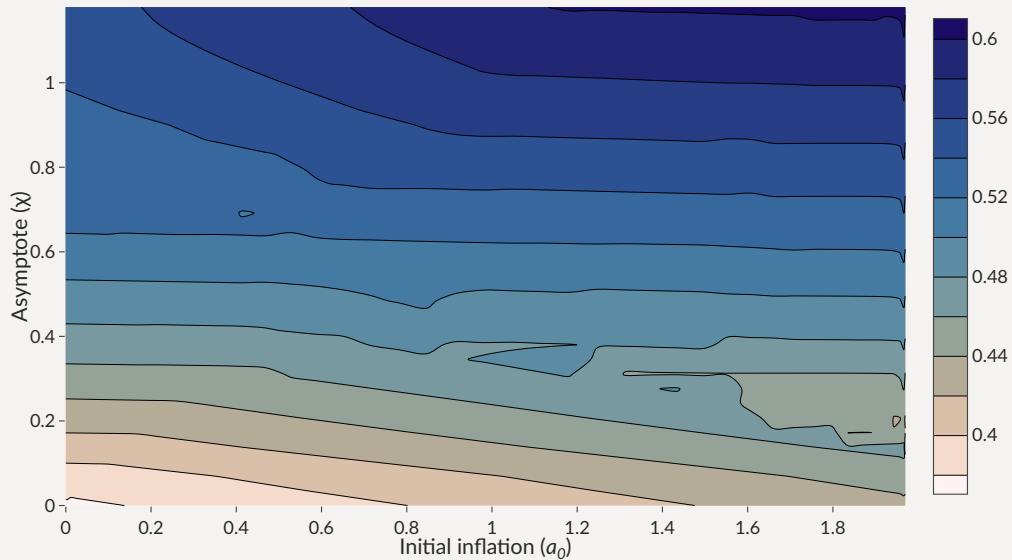
$$C_c(p, a) = (1 - \beta) \frac{\pi^N - g_c^*(p, a)}{\pi^N - a} + \beta \mathbb{E} [C_c(p'_c(p, a), \phi_c(a))]$$

- If $0 \leq g^*(p, a) \leq \pi^N$ always, then $C_c \in [0, 1]$

Plans

Credibility

$$\lim_{p \rightarrow 0} C(p, a, \omega^*, \chi)$$

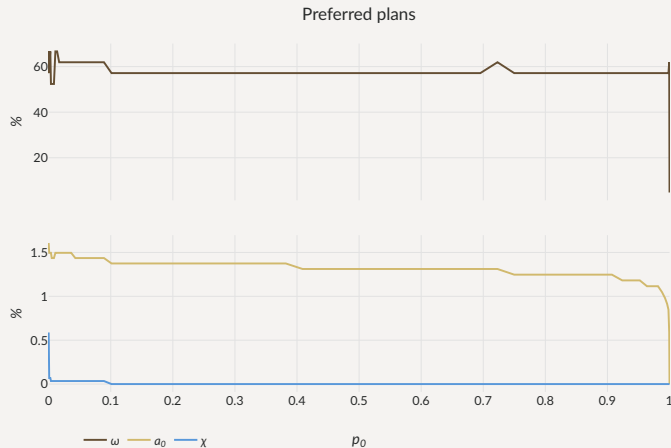


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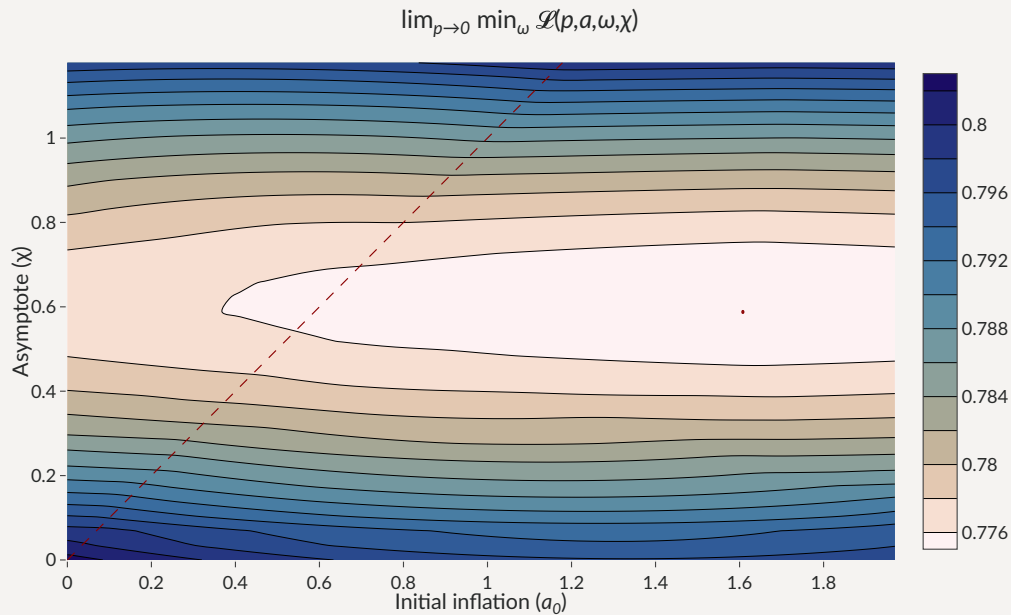
- For each $c \in \mathcal{C}$, find $\mathcal{L}^c(p, a), g_c^*(p, a)$.
- Generates big matrix $\mathcal{L}(p, a; \omega, \chi)$
- First pass: preferred plan **at each p**

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K-equilibrium



Initial announcement

What plan to choose?

Back to the initial announcement: two notions

- Kambe (1999): gov't announces type c and *becomes committed* to c with **exogenous** p_0 probability

- Tractable: p_0 independent of c

- So the limit we consider is

$$\lim_{p_0 \rightarrow 0} \min_{a_0, \omega, \chi} \mathcal{L}(p_0, a_0, \omega, \chi)$$

- Not entirely arbitrary
 - For given p_0 , plans that minimize \mathcal{L} should be played **often**

- If in **equilibrium** gov't announces type c with density $\mu(c)$,

$$p_0(c; z, \mu) = \frac{z\nu(c)}{z\nu(c) + (1-z)\mu(c)}$$

- So study

$$\lim_{z \rightarrow 0} \min_{\mu} \int \mathcal{L}(p_0(a_0, \omega, \chi; z, \mu), a_0, \omega, \chi) d\mu$$

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Equilibrium for given z

- We want k and μ such that

$$\int_{\mathcal{C}} \mu(c) = 1$$

$$p_0(c) = \frac{z\nu(c)}{z\nu(c) + (1-z)\mu(c)}$$

$$\mathcal{L}(p_0(c), c) = k \quad \text{if } \mu(c) > 0$$

$$\mathcal{L}(p_0(c), c) \geq k \quad \text{if } \mu(c) = 0$$

- We do

- Start with $k_0 \leq \mathcal{L}(0, c) = \mathcal{L}^N$
- Partition states

$$\mathcal{L}(1, c) \geq k \rightarrow \mu(c) = 0$$

$$\mathcal{L}(1, c) < k$$

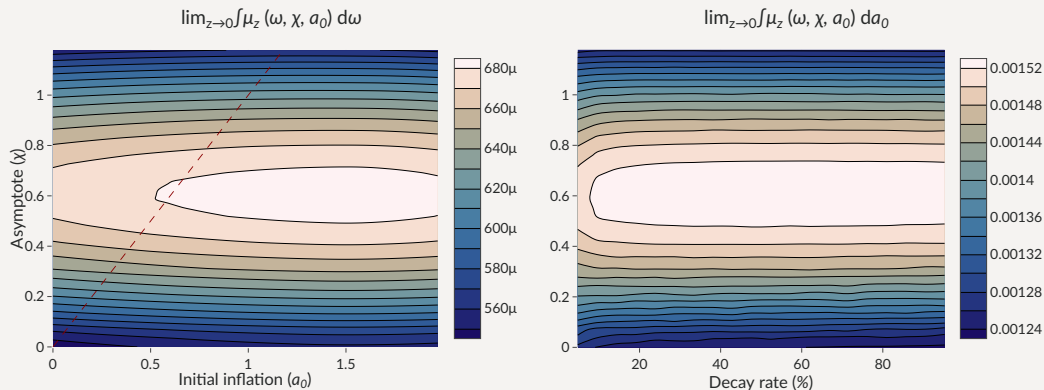
- In second case find $\mu(c)$ such that

$$\mathcal{L}(p_0(c), c) = k$$

This is possible if $k \leq$ value in static Nash

- Set $\mu(c) = \mathcal{B}^{-1}(p_0(c); \nu, z)$ if unset
- Check whether $\int_{\mathcal{C}} \mu(c) = 1$

Equilibrium distribution of announcements

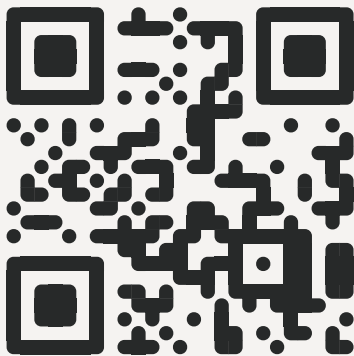


- Gradualism: $\mathbb{P}(a_0 > \chi) = 65\%$. $\mathbb{P}(a_0 > 5\chi) = 16.7\%$. $\mathbb{P}(\text{decay} \leq 10\%) = 9.97\%$.
- Imperfect credibility: $\mathbb{P}(\chi = 0) = 2.49\%$.

Concluding remarks

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- Model of reputational dynamics and policy
 - Simple environment
 - Focus on low reputation limit
- Credibility dynamics concerns influence choice of policy
 - Tradeoff between **promises** and **incentives**
 - Gradual plans boost reputation-building incentives for **future** decision-makers
- Structure of reputation maps into the incentive constraint of a planner's problem
 - ... creating large option values of complying
 - ... which are larger when the plan is backloaded



Scan to find the paper