When should policymakers make announcements?

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The question

A policymaker learns (or decides) today that at a future date an aggregate change will happen. Can communicate this to the public right away, at the date of the event, or anytime in between. But can only do so imperfectly, and agents have to devote limited attention to learn more. When should the policymaker make the announcement?

- The private trade-offs in allocating attention.
- The public trade-off with increasing precision of announcement and strategic complementarities.

Motivation / applications

1. Central bank communication: Blinder et al "*Over the last two decades, communication has become an increasingly important aspect of monetary policy. These real-world developments have spawned a huge new scholarly literature on central bank communication—mostly empirical and almost all of it written in this decade.*"

2. Social policy: implementation of changes in public services or intervention in a neighborhood.

3. Legal theory: delay between proposal of a law and when it comes into effect.

4. The switch to digital TV.

Literature review

- Optimal communication:
  - Blinder et al (2008), Eusepi and Preston (2010), Morris and Shin (2007), Chahrour (2011).
- Transparency:
  - Morris and Shin (2002), Hellwig (2005), Roca (2006), Morris, Shin and Teong (2006), Svensson (2006), Angeletos and Pavan (2007), Lorenzoni (2010), Amador and Weill (2010), Myatt and Wallace (2008, 2009).
- Rational inattention:
  - Sims (2003), Mackowiack and Wiederholt (2009), van Niewerburgh and Veldkamp (forthcoming), Moscarini (2004), Kasa (2006).
- Timing policies: actions and attention
  - House and Shapiro (2006), Domeij Klein (2005), Mertens Ravn (2010)
- Other considerations on policy communication:
  - Alesina Drazen (1991), Dewatripont and Roland (1992, 2005), Moscarini (2007), Athey, Atkeson and Kehoe (2005), Bolton Faure-Grimaud (2010).

Outline for today

1. Introduction
2. The model
3. The competitive equilibrium
4. Optimal attention allocation
5. Optimal announcement date
6. Conclusion

2. The model

The model: agents

- $t \in \Re_0^+$, agents $i \in [0,1]$ maximise:

$$W_i = \mathbb{E}_{i0}\left[\int_0^\infty e^{-\rho t}\mathbb{E}_{it}\left[a_{it} - \omega u_{it} - \alpha r_t - (1-\alpha)a_t\right]^2 dt\right]$$

- Individual circumstances u_{it}.

$$du_{it} = -\eta u_{it}dt + \sqrt{\phi}B_{it} \quad \text{with} \quad \int u_{it}di = 0$$

- Aggregate regime r_t.
  - $r_0 = 0$ all know it. With probability p, may change to a draw from $N(0,\sigma^2)$.
  - Policymaker knows at 0 that from T onwards, $r_t = r \neq 0$.

- Aggregate actions $a_t = \int a_{it}di$

The model: announcements

- Policymaker chooses announcement date $\tau \in [0, T]$.
  - Statement that (i) there is a new regime, (ii) its value is r.
  - But each agent has limited attention, or noisy channel.

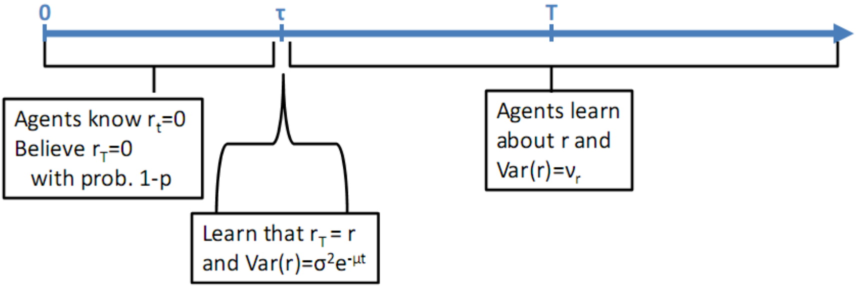
- Announcement leads to perception that r is normal and variance falls from σ^2 to:

$$\mathbb{E}_{it} \left(r - \mathbb{E}_{it} r \right)^2 = \sigma^2 e^{-\mu\tau}.$$

- *Assumption:* Only one signal and $\mu > 0$, so as get closer to event, can be more precise.

- Policymaker problem: choose τ to max $\int_0^1 W_i di$.

Timeline and policy announcements



The model: private attention

- Information on fundamental $\mathbf{f}_t = (r_t, u_{it})$ is normal signals $\mathbf{z}_t$:

$$\begin{aligned} dz_{it}^{r} &= r_t dt + \sqrt{\theta_{it}^{r}} dB_{it}^{\prime}, \\ dz_{it}^{u} &= u_{it} dt + \sqrt{\theta_{it}^{u}} dB_{it}^{\prime\prime}. \end{aligned}$$

- As in "rational inattention", signals are smooth, normal, agents choose θ_{it}^{r} and θ_{it}^{u}.

- Information constraint is the change in entropy:

$$H(\mathbf{f}^t) - H(\mathbf{f}^t \,|\, \mathbf{z}^t) = \int \ln\left(\frac{d\mathbb{P}_{\mathbf{fz}}}{d\left(\mathbb{P}_{\mathbf{f}} \times \mathbb{P}_{\mathbf{z}}\right)}\right) d\mathbb{P}_{\mathbf{fz}} \leq kt.$$

3. The competitive equilibrium

Equilibrium actions

- Optimal $(a_{it}, \theta^r_{it}, \theta^u_{it})$ conditional on $(z^r_{is}, z^u_{is}, w_{i\tau})_{0 \leq s \leq t}$ and $\tau \in [0, T]$.

- Equilibrium in actions follows from certainty equivalence. For $t < T$, we have $a_t = 0$, while for $t \geq T$:

$$\begin{aligned} a_t &= \gamma_t r, \\ \gamma_t &= \frac{\alpha \delta_t}{1 - \delta_t + \alpha \delta_t}, \\ \delta_t &\equiv 1 - e^{-\mu\tau - \int_\tau^t (\nu^r_s / \theta^r_s) ds}. \end{aligned}$$

- Two features:
  - Incomplete reaction: $\gamma_t < 1$.
  - Payoff externality: Agents take γ as given, but more attention (θ^r_t lower) implies higher γ, implies r gets higher weight on payoffs through a_t.

Attention allocation problem

- From date T on, let v_{it}^r and v_{it}^u denote posterior variances

$$V^*(v_{iT}^r, v_{iT}^u) = \max_{x_{it}, y_{it}} \left\{ - \int_T^\infty e^{-\rho(t-T)} \left[\omega^2 v_{it}^u + [(1-\alpha)\gamma_t + \alpha] v_{it}^r \right] d$$

- Constraints, from Kalman-Bucy filter:

$$\begin{aligned} \frac{\dot{v}_{it}^r}{v_{it}^r} &= -\frac{v_{it}^r}{\theta_{it}^r} \equiv -x_{it} \leq 0 \\ \frac{\dot{v}_{it}^u}{v_{it}^u} &= \frac{\phi}{v_{it}^u} - 2\eta - \frac{v_{it}^u}{\theta_{it}^u} = \frac{\phi}{v_{it}^u} - 2\eta - y_{it}. \end{aligned}$$

- Duncan (1970) result:

$$\int \ln \left(\frac{d\mathbb{P}_{\mathbf{fz}}}{d\left(\mathbb{P}_{\mathbf{f}} \times \mathbb{P}_{\mathbf{z}}\right)} \right) d\mathbb{P}_{\mathbf{fz}} = \frac{1}{2} \int_0^t \left(x_{is} + y_{is}\right) ds.$$

Attention allocation after an announcement

$$\max_{\{x_{it}, y_{it}\}} \left\{ -\int_{\tau}^{T} e^{-\rho(t-\tau)} \omega^2 v_{it}^u dt + e^{-\rho(T-\tau)} V^*(v_{iT}^r, v_{iT}^u, T) \right\}$$

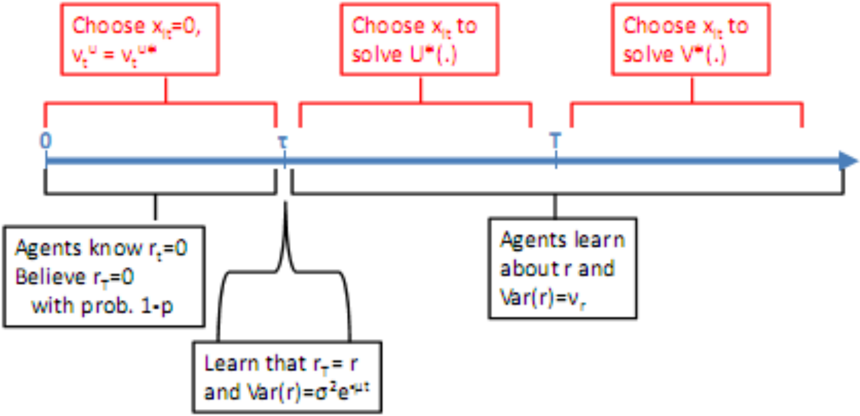
$$\begin{aligned} \frac{\dot{v}_{it}^r}{v_{it}^r} &= -x_{it} \quad \text{and} \quad \frac{\dot{v}_{it}^u}{v_{it}^u} = \frac{\phi}{v_{it}^u} - 2\eta - y_{it} \\ x_{it} + y_{it} &\leq 2k \quad \text{and} \quad x_{it} \geq 0,\ y_{it} \geq 0 \end{aligned}$$

- Value function $U^*(v_{i\tau}^r, v_{i\tau}^u, \tau)$
- Note that no disutility from v_{it}^r right now, only from v_{iT}^r in the future.

Attention allocation before an announcement

- In principle, need to solve for Perfect Bayesian Equilibrium, where agents are updating their probability that there has been a change in regime conditional on no announcement.
- *Assumption*: $p \to 0$, before an announcement, agents thought regime switch was highly unlikely. Then, before announcement, $t \in [0, \tau)$, $x^*_{it} = 0$.
- Conjecture: Assuming $p < \bar{p}$ is enough to generate $x^*_{it} = 0$

Main result



Dynamic allocation of attention boils down to optimal control.

4. Solving the attention problem

Attention allocation after T

Proposition 2 *Define the following steady-state levels of attention:*

$$v_*^r \equiv \frac{\rho\omega\phi}{2(\eta+k)\left[\rho+2(\eta+k)\right]} \tag{23}$$

$$v_*^u = \frac{\phi}{2(\eta+k)} \tag{24}$$

After the regime change at date T,

a) If the uncertainty on the aggregate regime is low, $\nu_T^r \leq v_*^r$, then $x_t = 0$ and $\nu_t^r = \nu_T^r$ for all $t \geq T$. If $\nu_t^u > v_*^u$, it approaches v_*^u asymptotically, whereas if $\nu_t^u = v_*^u$ it stays there forever.

b) If $\nu_T^r > v_*^r$, then x_t approaches 0 asymptotically from above, and as it does $\nu_t^u \to v_*^u$ and $\nu_t^r \to v_*^r$ asymptotically as well. As for the initial path of attention, let $f(.)$ be the increasing function that solves to the first-order ordinary differential equation:

$$(f + v_u f')\left(\frac{v_u}{f} - \frac{v_*^u}{v_*^r}\right) = \frac{2\phi}{\rho}\left(1 - \frac{v_u}{v_*^u}\right) \tag{25}$$

with particular solution $v_r^* = f(v_u^*)$. Then:

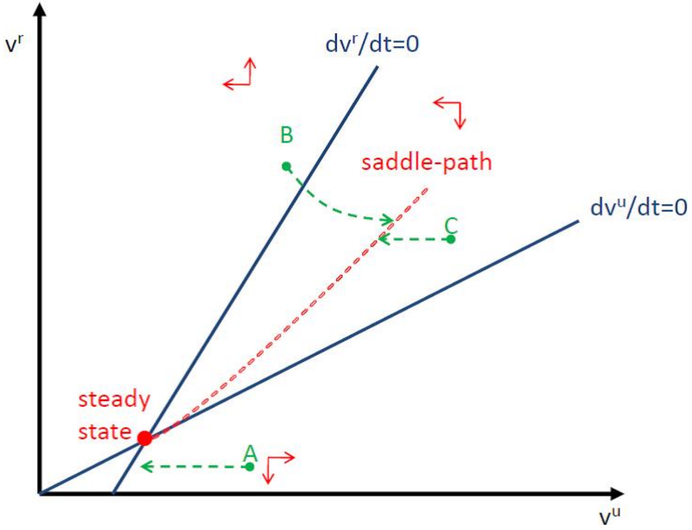
(b-i) If $v_{rT} = f(v_{uT})$, initially $x_T \in (0, 2k)$, and x_t and v_t^r decline monotonically over time.

(b-ii) If $v_{rT} < f(v_{uT})$, initially $x_T = 0$, and at some finite date after T, x_t jumps up to a positive value between 0 and $2k$, after which x_t and v_t^r decline monotonically over time.

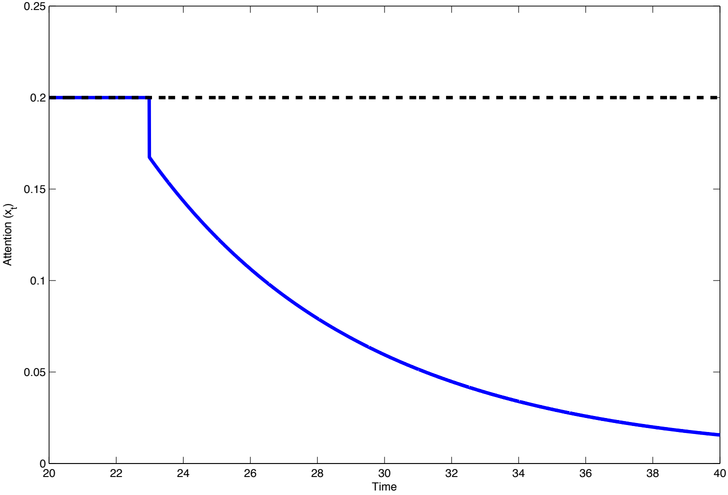
(b-iii) If $v_{rT} > f(v_{uT})$, initially $x_T = 2k$, and at some finite date after T, x_t jumps down to a value between 0 and $2k$, after which x_t and v_t^r decline monotonically over time.

The phase diagram, after T

Figure 1. Phase diagram for dynamics with interior attention



Attention to the aggregate regime after T



Attention after the announcement

Proposition 3 *Given an announcement at date τ, at date T, all attention is devoted to the aggregate regime: $x_T = 2k$. Before,*

a) if $\sigma^2 e^{-\mu\tau} > \bar{\sigma}_\tau$, where $\bar{\sigma}_\tau$ is defined in the appendix and is increasing in τ, then $x_t = 2k$ for $t \in [\tau, T]$.

b) If $\sigma^2 e^{-\mu\tau} < \bar{\sigma}_\tau$, define

$$d = \frac{2}{\rho} \ln\left[\frac{2(\eta+\kappa)}{2\eta + (\rho/2)}\right]. \tag{26}$$

Then, if $\tau < T - d$, the time path for attention and the posterior variance is: initially, for $t \in [\tau, t^*)$, $x_t = 0$, so $v_t^r = \sigma e^{-\mu\tau}$ and $v_t^u = v_*^u$ for a date $t^* < T - d$; at t^*, attention jumps to $x_{t^*} = \rho/2$; for $t \in (t^*, t^* + d)$, attention x_t increases, v_t^r decreases, and v_t^u increases, all monotonically according to:

$$x_t = \frac{\rho}{2} + 2(\eta+\kappa) - \frac{\phi}{v_{ut^*} e^{\frac{\rho}{2}(t-t^*)}} \tag{27}$$

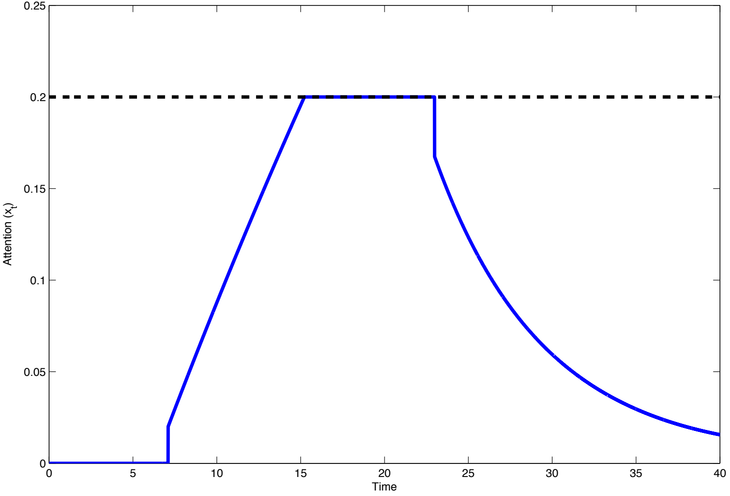
$$v_{ut} = v_{ut^*} e^{\frac{\rho}{2}(t-t^*)} \tag{28}$$

$$v_{rt} = v_{rt^*} e^{-\left(\frac{\rho}{2}+2(\eta+\kappa)\right)(t-t^*)+\frac{2}{\rho}(\eta+\kappa)\left(1-e^{-(\rho/2)(t-t^*)}\right)} \tag{29}$$

Finally, for $t \in (t^* + d, T)$, attention is solely devoted to the aggregate regime $x_t = 2k$, so v_t^r falls at a rapid rate and v_t^u increases.

c) If $\sigma^2 e^{-\mu\tau} < \bar{\sigma}_\tau$ and instead $\tau > T - d$, depending on parameters, either (i) $x_t = 0$ for $t \in [\tau, t^*)$ and $x_t = 2k$ for $t \in [t^*, T]$, (ii) $x_t = 2k$ for $t \in [\tau, t^*)$, followed by $x_t \in (0, 2k)$ according to (27) reaching $2k$ before date T and staying there until T.

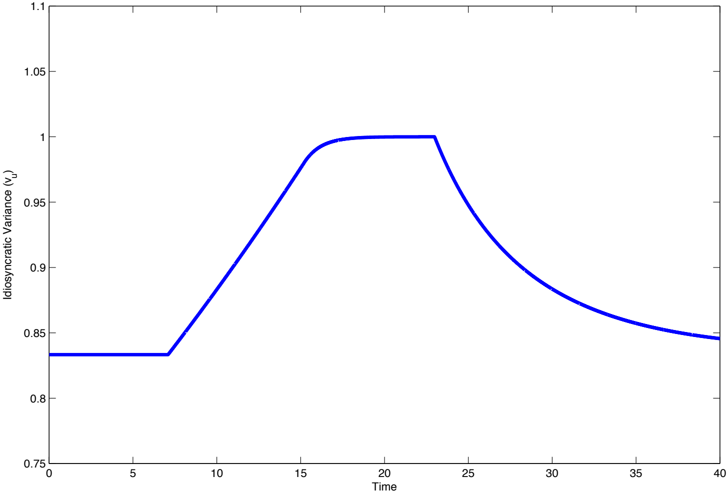
Attention after early announcement



Four properties of attention

1. At date T, all attention is devoted to the aggregate regime: $x_T = 2k$
2. If $\tau \to 0$, then $x_\tau = 0$ and becomes positive only at some date $\tau < t^* < T$.
3. The date t^* at which pay attention to the regime comes earlier as there is more: total attention (k), uncertainty about the regime (σ^2) importance of the regime (ω^{-1}), and patience (ρ^{-1}).
4. In interior, attention to the aggregate regime is weakly increasing over time.

Dynamics of uncertainty for early announcement



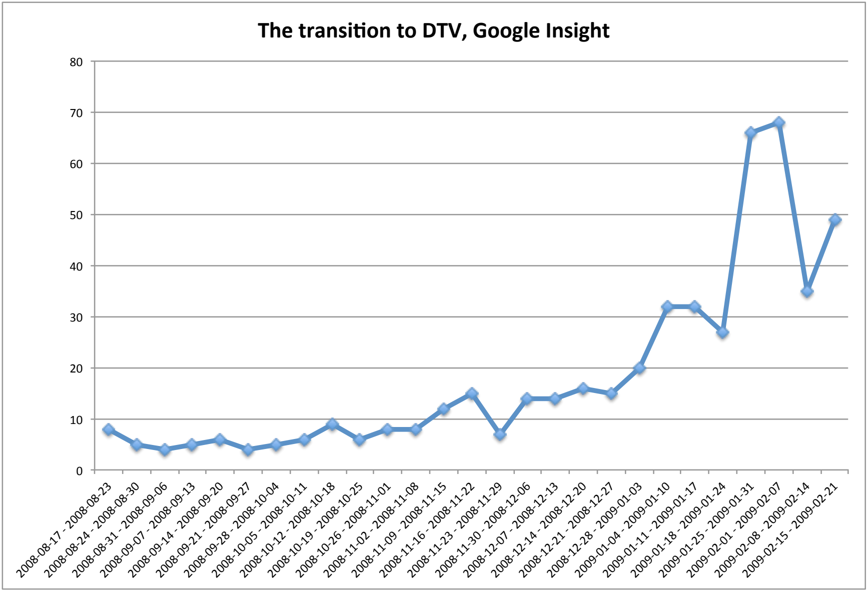
With strategic complementarities

- Solution has to be numerical because optimal control problems no longer time-invariant.

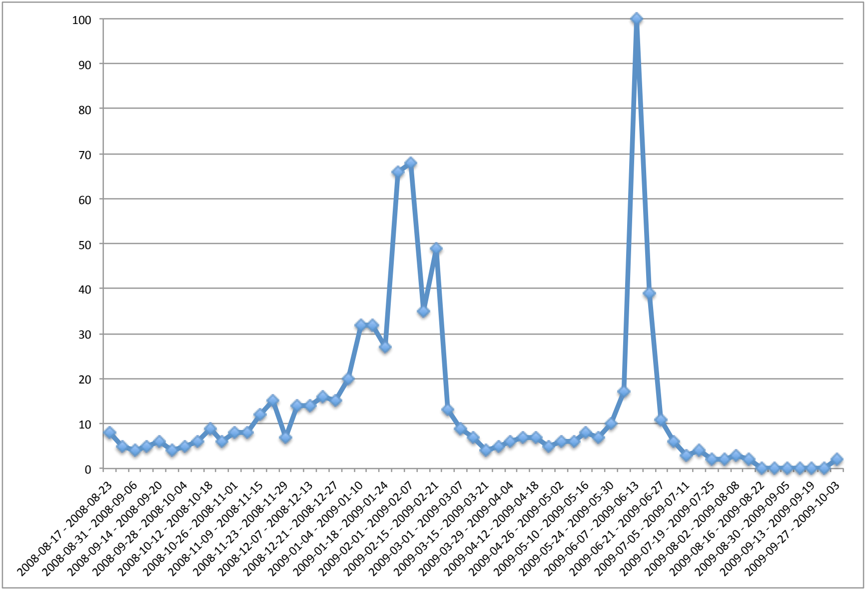
- Can prove one result: For α close to 1, stronger strategic complementarities induce more attention to the aggregate regime. For $\alpha \leq 1$, the optimal t^* is earlier.

- Intuition: with strategic complementarities, agents want to do what others are doing. This leads them to want to know what others know. They devote too much attention to the aggregate regime.

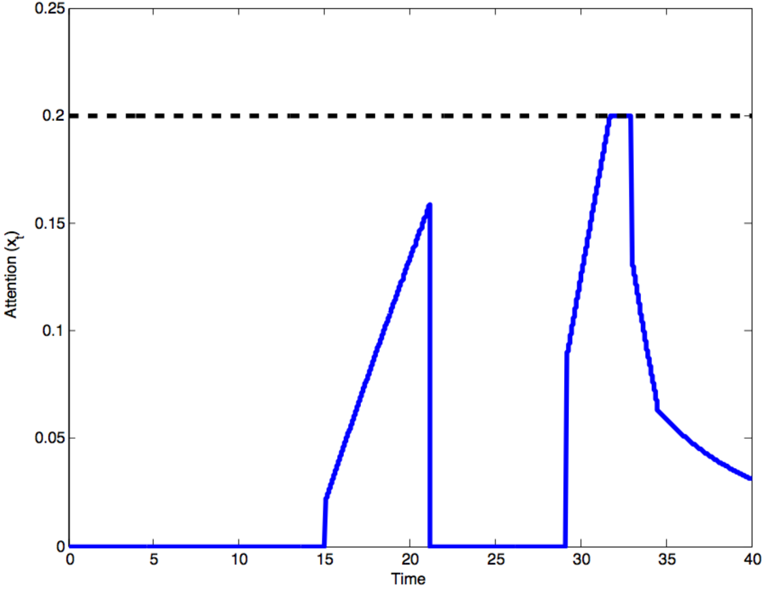
The DTV transition



Government makes life harder...



Working it through the model



5. The announcement problem

Announcement problem

Definition: The announcement problem is to choose $\tau \in [0, T]$ to maximize:

$$W = -\omega^2 v_*^u \left(\frac{1 - e^{-\rho\tau}}{\rho} \right) + e^{-\rho\tau} U^*(\sigma^2 e^{-\mu\tau}, v_u^*, \tau)$$

First order condition:

$$-\omega^2 v_u^* e^{-\rho\hat{\tau}} + e^{-\rho\hat{\tau}} \left[\frac{\partial U^*}{\partial t} - \frac{\partial U^*}{\partial \sigma_\tau^2} \left(\mu\sigma^2 e^{-\mu\tau} \right) \right] = 0$$

Properties of the solution

Result 1:If $\alpha = 1$ and $\mu \to 0$, then $\tau^* = t^*$. Full disclosure not optimal if it will be ignored. And recall that t^* is decreasing in k, σ^2, ω^{-1}, and ρ^{-1}.

Result 2:As μ increases, τ^* increases, so there is a range $[t^*, \tau^*]$ when agents are curious but policymaker keeps mum.

Result 3:With $\alpha < 1$, too much attention to announcement, incentive to delay τ^*.

6. Extensions

Three simple extensions

- If $r = 0$, do not make announcement. Unnecessary announcements confuse people.
- If can affect r, then move it to $r = 0$. If can fix it, do it, don't talk about it.
- If a rumor starts, then quash it immediately with an announcement.

Extending the model of attention

In the basic model, only learn about r_t and u_{it}.

- One extension: third use of attention, entering additively objective function as $W_{it} + g(w_{it})$ with $x_{it} + y_{it} + w_{it} \leq 2k$.
- Another extension: learning from other sources. If third activity gives information about aggregate regime, just orthogonalize.
- Higher prior probability of a change $p \geq \bar{p}$. Then have to keep track of posterior probability conditional on no announcement.

Policy signals/actions beyond announcements

In basic model, could only give a signal once and for all

- Multiple policy signals, every instant in $[\tau, T]$, their total effectiveness being still $e^{-\mu\tau}$.
- Public noise in public signal. Then global game. If $\alpha = 1$, no change, otherwise only role of α changes.

7. Conclusion

Conclusion

- When should a policymaker make an announcement about an impending change that will affect everyone?

- Four contributions

  1. Suggest a new question.

  2. Develop methodologically rational inattention problems in continuous time.

  3. Propose a limited-attention answer. Focus on private attention trade-off, increased precision of announcements, and on strategic complementarities and over-attention.

  4. Predictions on life-cycle of attention by solving rational-inattention continuous-time problem.