Optimal Monetary Policy with (Real) Informational Frictions

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Informational frictions and monetary policy

nominal vs real frictions

- nominal = remove state-contingencies in nominal prices
- real = remove state-contingencies in f real allocations

Informational frictions and monetary policy

pertinent MP literature: info friction = **only nominal friction**

- Ramsey optimum = first best
- flex-price allocations = as in NK model
- price stability is optimal

Informational frictions and monetary policy

this paper: info friction = **nominal + real friction**

- first best not attainable
- flex-price allocations $\neq$ as in NK model
- nature of optimal allocations/optimal policy unclear

Results

- adjust welfare benchmark $\rightarrow$ constrained efficiency
- flexible-price allocations are constrained efficient
- price stability is suboptimal

The Model

- continuum of “inattentive” monopolistic firms
  - produce intermediate goods
  - using capital and labor
  - labor = employment (bodies) + effort (labor utilization)
- representative final-good retailer
- representative household

Firms

- retailer:

$$Y_t = \left[\int_I y_{it}^{\frac{\rho-1}{\rho}} \, di \right]^{\frac{\rho}{\rho-1}}$$

- monopolists:

$$y_{it} = A_t F\left(k_{it}, \ell_{it}\right)$$

$$\ell_{it} = n_{it} h_{it}$$

$$k_{i,t+1} = (1-\delta) k_{it} + x_{it}$$

$$\Pi_{it} = \left(1 - \tau_t\right) p_{it} y_{it} - P_t W_t\left(h_{it}\right) n_{it} - P_t x_{it},$$

Household

$$\sum_{t=0}^{\infty} \beta^t \left\{ U(C_t, \xi_t) - \int_I n_{it} V(h_{it}, \xi_t) di \right\}$$

$$P_t C_t + B_{t+1} = \int_I [\Pi_{it} + P_t W_t(h_{it}) n_{it}] \, di + T_t + R_t B_t$$

Monetary and fiscal authorities

$$P_t Y_t = M_t$$

$$T_t + R_t B_t = (1 - \tau_t) \int_I p_{it} y_{it} di + B_{t+1}$$

Shocks and information

1. Nature draws s_t conditional on s^{t-1}
2. conditional on $s^t = (s^{t-1}, s_t)$, Nature draws $\omega_{it}, \forall i \in I$
3. firm i observes $\omega_i^t = (\omega_i^{t-1}, \omega_{it})$

   - $A_t = A(s^t)$, $\xi_t = \xi(s^t)$
   - s^t may contain news/noise/HOB shocks

Nominal vs Real Friction

- nominal friction: prices p_{it} restricted on ω_i^t
- real friction: employment n_{it} and investment x_{it} also restricted
- market clearing: labor utilization h_{it} free to adjust to s^t

Roadmap

1. feasible and constrained efficient allocations
2. flexible-price allocations
3. sticky-price allocations
4. optimal policy

Feasible and constrained efficient allocations

Definition. A feasible allocation is a collection of plans for (Y_t, C_t) and $(n_{it}, h_{it}, x_{it}, y_{it})_{i \in I}$ that satisfy the following:

(i) resource feasibility

(ii) informational feasibility:

$$\begin{gathered} h_{it} \text{ and } y_{it} \text{ contingent on } (\omega_{it}, s^t) \\ n_{it} \text{ and } x_{it} \text{ contingent only on } \omega_{it}. \end{gathered}$$

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Definition. A constrained efficient allocation is a feasible allocation that maximizes the household's ex-ante utility.

Constrained efficient allocation

Planner's problem. *Choose the functions* (n, h, k, y, C, N, K, Y) *so as to maximize*

$$\max \sum_{t=0}^{\infty} \beta^t \int \left[U\left(C(s^t), \xi(s^t)\right) - \int n(\omega_i^t) V\left(h(\omega_i^t), \xi(s^t)\right) d\mathcal{G}_t(\omega_i^t | s^t) \right] d\mathcal{F}_t(s^t)$$

subject to

$$\begin{aligned}
C\left(s^t\right) + K\left(s^t\right) &= Y\left(s^t\right) + (1-\delta) K\left(s^{t-1}\right) \\
Y(s^t) &= \left[\int y(\omega_i^t, s^t)^{\frac{\rho-\mathbf{1}}{\rho}} d\mathcal{G}_t(\omega_i^t | s^t) \right]^{\frac{\rho}{\rho-\mathbf{1}}} \\
y(\omega_i^t, s^t) &= A(s^t) F\left(k\left(\omega_i^{t-1}\right), n\left(\omega_i^t\right) h\left(\omega_i^t, s^t\right)\right) \\
K\left(s^t\right) &= \int k\left(\omega_i^t\right) d\mathcal{G}_t(\omega_i^t | s^t)
\end{aligned}$$

Constrained efficient allocation

Proposition

A feasible allocation is constrained efficient (CE) if and only if

$$\begin{aligned}
V_h(\omega_i^t, s^t) - U_c(s^t) MP_\ell\left(\omega_i^t, s^t\right) &= 0 \\
\mathbb{E}\left[\ V(\omega_i^t, s^t) - U_c(s^t) MP_\ell\left(\omega_i^t, s^t\right) h(\omega_i^t, s^t) \ \middle|\ \omega_i^t \ \right] &= 0 \\
\mathbb{E}\left[\ U_c(s^t) - \beta U_c(s^{t+1}) \left\{1 - \delta + MP_k(\omega_i^{t+1}, s^{t+1})\right\} \ \middle|\ \omega_i^t \ \right] &= 0
\end{aligned}$$

Constrained efficient allocation

- real friction $\Leftrightarrow$ CE $\neq$ FB
- positive properties of CE allocation very different from FB
  - noise-driven heterogeneity
  - sluggishness in response to TFP
  - noise-driven fluctuations, forces akin to "animal spirits"
- $\exists$ feasible allocations that induce Y_{FB}, but these allocations dominated by CE

Flexible-price vs sticky-price allocations

henceforth focus on Ramsey problem:

planner's power restricted by fiscal and monetary policy instruments

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Definition. Prices are "flexible" or "state-contingent" if and only if p_{it} can be contingent on both ω_{it} and s^t.

Definition. Prices are "sticky" or "non-contingent" if and only if p_{it} can be contingent only on ω_{it}.

Flexible-price allocations

Proposition

A feasible allocation is part of a flexible-price Ramsey equilibrium if and only if there exists a function ϕ such that

$$\begin{aligned}
V_h(\omega_i^t, s^t) - U_c(s^t)\phi(s^t) MP_\ell\left(\omega_i^t, s^t\right) &= 0 \\
\mathbb{E}\left[\ V(\omega_i^t, s^t) - U_c(s^t)\phi(s^t) MP_\ell\left(\omega_i^t, s^t\right) h(\omega_i^t, s^t)\ \middle|\ \omega_i^t\ \right] &= 0 \\
\mathbb{E}\left[\ U_c(s^t) - \beta U_c(s^{t+1})\left\{1 - \delta + \phi(s^{t+1}) MP_k(\omega_i^{t+1}, s^{t+1})\right\}\ \middle|\ \omega_i^t\ \right] &= 0
\end{aligned}$$

Flexible-price allocations

Corollary

The CE allocation is always implementable under flex prices

Sticky-price allocations

Definition. An allocation is "log-separable" if and only if there exist functions Ψ^{ω} and Ψ^{s} such that

$$\log y\left(\omega_i^t, s^t\right) \;=\; \log \Psi^{\omega}(\omega_{it}) \;+\; \log \Psi^{s}(s^t)$$

Sticky-price allocations

Proposition

A feasible allocation can be part of a sticky-price equil iff

(i) there exist functions ϕ *and* χ *such that the following hold:*

$$\begin{aligned}
V_h(.) - U_c(s^t)\phi(s^t)\chi(\omega_i^t, s^t) MP_\ell(.) &= 0 \\
\mathbb{E}\left[V(.) - U_c(s^t)\phi(s^t)\chi(\omega_i^t, s^t) MP_\ell(.) \;\middle|\; \omega_i^t \right] &= 0 \\
\mathbb{E}\left[U_c(s^t) - \beta U_c(s^{t+1}) \left\{ 1 - \delta + \phi(s^{t+1})\chi(\omega_i^{t+1}, s^t) MP_k(.) \right\} \;\middle|\; \omega_i^t \right] &= 0 \\
\mathbb{E}\left[U_c(s^t) Y(s^t)^{1/\rho} y(\omega_i^t, s^t)^{1-1/\rho} \phi(s^t) \left\{ \chi(\omega_i^t, s^t) - 1 \right\} \;\middle|\; \omega_i^t \right] &= 0
\end{aligned}$$

(ii) the allocation is log-separable.

Sticky-price allocations

Corollary

The CE allocation is implementable under sticky prices if and only if it is log-separable

Log-seperability

- stickiness $\Rightarrow$ relative prices must be independent of s^t

  $\Rightarrow$ relative output must be independent of s^t

$$\frac{p(\omega_{it})}{p(\omega_{jt})} = \left[\frac{y(\omega_{it}, s^t)}{y(\omega_{it}, s^t)} \right]^{-\rho}$$

Log-seperability

- stickiness $\Rightarrow$ relative prices must be independent of s^t

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$$\frac{p(\omega_{it})}{p(\omega_{jt})} = \left[\frac{y(\omega_{it}, s^t)}{y(\omega_{it}, s^t)} \right]^{-\rho}$$

- rather innocuous restriction:true for all flex-price allocations if

$$F(k, \ell) = k^{1-\alpha} \ell^{\alpha} \qquad V(h) = 1 + \frac{h^{1+\epsilon}}{1+\epsilon}$$

Optimal Policy

Optimal Monetary Policy

Theorem

The optimal MP replicates flex-price allocations.

- generalizes key lesson from New-Keynesian paradigm, BUT...
- nature of target allocation different because of real friction
- $\exists$ policies that attain Y_{FB}, but these policies are not optimal

Optimal Monetary Policy

- by log-separability

$$y(\omega_i^t, s^t) = \log \Psi^{\omega}(\omega_i^t) + \log \Psi^{s}(s^t)$$

- define aggregate belief proxy by

$$\mathcal{B}(s^t) \equiv \left[\int \Psi^{\omega} \left(\omega_i^t \right)^{\frac{\rho-1}{\rho}} d\mathcal{G}_t(\omega_i^t | s^t) \right]^{\frac{\rho}{1-\rho}}$$

Optimal Monetary Policy

Theorem

The optimal MP "leans against the wind":

$$\log P(s^t) = -\frac{1}{\rho} \log \mathcal{B}(s^t)$$

Optimal Monetary Policy

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Corollary

Suppose employment and capital are procylical. Then the optimal MP targets a countercyclical price level.

Optimal Monetary Policy

- proof:

$$\log p_{it} - \log p_{jt} = -\frac{1}{\rho}\left[\Psi(\omega_i^t) - \Psi(\omega_j^t)\right]$$

$$\log p_{it} = const - \frac{1}{\rho}\Psi(\omega_{it})$$

$$\log P_t = const - \frac{1}{\rho}\mathcal{B}(s^t)$$

- intuition:

  more optimistic firms must produce more, set lower prices

  $\Rightarrow$ price level must fall with average sentiment

Optimal Monetary Policy

As long as optimal employment and capital are procyclical,
the optimal MP targets a countercyclical price level.

$*$ driven solely by real friction

$*$ true even if CE is not implementable

$*$ true no matter info structure

$*$ true no matter shocks

$*$ true even with endogenous information

Variant/Illustration

- add idiosyncratic shocks: $\log A_{it} = \log A_t + \eta_{it}$
- firms know their MC functions (A_{it})
  but not aggregate demand (s^t)

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Proposition

The optimal MP targets

$$\log P(s^t) = -\Gamma \log Y(s^t)$$

(if $\Gamma \approx 1$, then Nominal GDP stabilization)

Conclusion

- methodological contribution:
  - real vs nominal frictions
  - adapt Ramsey primal approach to (real) info frictions
  - bypass need for tractability $\rightarrow$ (nearly) arbitrary info
- applied contribution:
  - output gap stabilization is suboptimal
  - price stability is suboptimal
  - optimal to "lean against the wind"