Optimal Monetary and Fiscal Policy with Investment Spillovers and Endogenous Private Information

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This Paper

- Economies with
  - investment spillovers
  - endogenous private information
  - real and nominal rigidities

- Optimal fiscal rule
  - usual subsidy/tax on revenues/employment correcting for market power
  - NOVEL subsidy to innovating firms
    - constant (exogenous information)
    - state-dependent (**endogenous information**)
    - co-moves with optimal monetary policy
- Optimal policies with exogenous information need not be optimal with endogenous information

- Optimal monetary policy
  - pro-cyclical
  - stabilizes prices within (endogenous) groups
  - must co-move with fiscal policy to create **right incentives for information acquisition**

Literature – Incomplete

- **Policy with dispersed Information**
  - Angeletos and Pavan (2009)
  - Paciello and Wiederholt (2013)
  - Angeletos and La'O (2019)
  - La'O and Tahbaz-Salehi (2020)
  - ..
- **Inefficiency in information acquisition**
  - Colombo, Femminis, Pavan (2014)
  - Pavan (2017)
  - Hebert and La'O (2020)
  - ...

Plan

1. Introduction
2. Model
3. Efficient allocation
4. Real Rigidities
    1. exogenous information
    2. endogenous information
5. Nominal + Real Rigidities
6. Conclusions

Model

Model

- Economy populated by
  - representative household
  - (measure 1) continuum of agents
  - (measure 1) continuum of monopolistically-competitive firms producing differentiated intermediate goods
  - competitive retail sector producing final good
  - benevolent planner controlling monetary and fiscal policy

Model

- Each firm run by single entrepreneur
  - initially located on "island" with imperfect information about TFP Θ
  - chooses whether to "upgrade" technology for intermediate good $i \in [0,1]$

$$y_i = \begin{cases} \gamma\Theta\left(1+\beta N\right)^{\alpha} l_i^{\psi} \text{ when } n_i = 1 \quad \text{(new)} \\ \\ \Theta\left(1+\beta N\right)^{\alpha} l_i^{\psi} \text{ when } n_i = 0 \quad \text{(old)} \end{cases}$$

with $\gamma > 1$, $\beta \geq 0$, $\alpha \geq 0$, $\psi \leq 1$

- $N = \int n_i di$: **aggregate investment** in new technology
- l_i: undifferentiated labor (more below)

- Differential $y_i(n_i = 1) - y_i(n_i = 0)$ increasing in Θ and N
  - dependence on N: **spillover** (within and across technologies)
  - human capital
  - physical capital
- Cost of new technology: $k > 0$ (effort)

Model

- Final good (produced by competitive retail sector):

$$Y = \left(\int y_i^{\frac{v-1}{v}} di \right)^{\frac{v}{v-1}}$$

- Profits of competitive retail sector $\Pi = PY - \int p_i y_i di$
  - P: price of final good
  - p_i price of intermediate good of variety i

Model

- Entrepreneurs are members of representative household with utility

$$U = \frac{C^{1-R}}{1-R} - k \int n_i di - \frac{l^{1+\varepsilon_l}}{1+\varepsilon_l} - \int \mathcal{I}(\pi_i^x) di$$

  - C: consumption of final good
  - $\mathcal{I}(\pi^x)$: disutility of info of precision π^x
    - $\mathcal{I}^{'} > 0$, $\mathcal{I}^{''} \geq 0$, $\mathcal{I}'(0) = 0$.

Model

- Each entrepreneur maximizes her firm's market valuation

$$C^{-R}\left(\frac{p_i y_i - W l_i + T_i}{P}\right) - k n_i - \mathcal{I}(\pi_i^x)$$

  - W: wage rate
  - T_I: fiscal transfer

Model

- Cash-in-advance' constraint:

$$PY \leq M$$

  - M: money provided by planner (returned at end of period)

- Benevolent planner maximizes ex-ante utility of representative household
  - monetary rule $M(\theta)$
  - fiscal rule $T_n(r_i, \theta)$
    - $r_i = p_i y_i$: firm's revenue

- Alternatively, $T(P, p_i, l_i)$

Model: Timing

1. Nature draws θ from $N(\theta_0, \pi_\theta^{-1})$
2. Each entrepreneur i chooses π_i^x and receives signal $x_i = \theta + \xi_i$, with ξ_i drawn from $N\left(0, (\pi_i^x)^{-1}\right)$, independent from θ, independently across i
3. Each entrepreneur chooses
    1. whether or not to upgrade technology
    2. p_i (nominal rigidities)
4. After θ revealed,
    1. government supplies $M = M(\theta)$
    2. each entrepreneur posts price p_i (flexible prices)
5. Retail sector chooses demand y_i of each intermediate good
6. Entrepreneur i hires l_i to meet demand
7. Representative consumer chooses C

Model

1. Both retail sector and representative consumer take price P as given
2. Retail sector also takes prices of intermediate goods p_i as given
3. Labor l_i acquired on competitive market

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Efficient Allocation

Efficient Allocation

Definition 1

Efficient allocation is given by π^{x*}, $n^*(x)$, and $l^*(x, \theta)$ that jointly maximize $\mathbb{E}_0[U]$

Efficient allocation

Proposition 1

Under appropriate parameters' restrictions, efficient upgrade policy given by $\hat{n}(x) = \mathbb{I}(x \geq \hat{x})$.
Efficient employment policy given by $\hat{l}_0(\theta)$ *for firms retaining old technology and by* $\hat{l}_1(\theta) = \gamma^{\varphi}\hat{l}_0(\theta)$ *for those innovating, where* $\varphi \equiv \frac{v-1}{v+\psi(1-v)}$.
Efficient precision $\hat{\pi}^x$ *given by*

$$\underbrace{\mathbb{E}\left[\hat{C}(\theta)^{1-R}\left(\frac{\alpha\beta}{1+\beta\hat{N}(\theta)} + \frac{v}{v-1}\frac{\gamma^{\varphi}-1}{(\gamma^{\varphi}-1)\hat{N}(\theta)+1}\right)\frac{\partial\hat{N}(\theta)}{\partial\pi^x}\right]}_{\text{effect on } C}$$

$$\underbrace{\mathbb{E}\left[\hat{l}_0(\theta)^{1+\varepsilon}\left[(\gamma^{\varphi}-1)\hat{N}(\theta)+1\right]^{\varepsilon}(\gamma^{\varphi}-1)\frac{\partial\hat{N}(\theta)}{\partial\pi^x}\right]}_{\text{effect on disutility of labor}}$$

$$-k\mathbb{E}\left[\frac{\partial\hat{N}(\theta)}{\partial\pi^x}\right] = \frac{d\mathcal{I}(\hat{\pi}^x)}{d\pi^x}$$

where $\hat{N}(\theta) = 1 - \Phi(\hat{x}|\theta)$.

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Real Rigidities

Exogenous Information

Proposition 2

Suppose information is exogenous and let $r = py$. Any monetary and fiscal policy M and T satisfying following conditions are optimal

$$T_1(\theta, r) = s(\theta) + \frac{1}{v-1} r$$

$$T_0(\theta, r) = \frac{1}{v-1} r$$

$$\mathbb{E}\left[\hat{C}(\theta)^{-R} \frac{s(\theta)}{\hat{P}(\theta)} \middle| \hat{x} \right] = \mathbb{E}\left[\hat{C}(\theta)^{1-R} \frac{\alpha\beta}{1+\beta\hat{N}(\theta)} \middle| \hat{x} \right]$$

with $\hat{C}(\theta)^{-R} s(\theta)/\hat{P}(\theta)$ *non-decreasing.*

Exogenous Information

- No spillovers:
  - $s(\theta) = 0$
  - familiar subsidy $T = \frac{1}{v-1} r$
- Spillovers:
  - subsidy to innovating firms

$$T_1 - T_0 = s(\theta)$$

    corrects for externality in investment

$$\mathbb{E}\left[\hat{C}(\theta)^{1-R} \frac{\alpha\beta}{1+\beta\hat{N}(\theta)}\right] = \mathbb{E}\left[\hat{C}(\theta)^{-R} \frac{\partial \hat{C}(\theta)}{\partial N}\right]$$

  - Single-crossing: $\hat{C}(\theta)^{-R} s(\theta)/\hat{P}(\theta)$ non-decreasing
    - guarantees efficient investment
  - multiple combinations of mon and fiscal policy yielding efficiency

Endogenous Information

Proposition 3

In addition to previous conditions policy must satisfy

$$\mathbb{E}\left[C^*(\theta)^{-R}\,\frac{s(\theta)}{P^*(\theta)}\,\frac{\partial \hat{N}(\theta;\pi^{x*})}{\partial \pi_i^x}\right] = \mathbb{E}\left[C^*(\theta)^{1-R}\left(\frac{\alpha\beta}{1+\beta N^*(\theta)}\right)\frac{\partial \hat{N}(\theta;\pi^{x*})}{\partial \pi^x}\right]$$

Endogenous Information

Corollary 1

Policies that are optimal with exogenous info need not be optimal with endogenous info

- However, policies exist correcting inefficiencies in **both usage and acquisition**

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Nominal + Real Rigidities

Stickiness

Proposition 4

No matter whether information is exogenous or endogenous, optimal monetary policy given by

$$\hat{M}(\theta)^{1-R} = m\hat{l}_0(\theta)^{1+\varepsilon}\left((\gamma^{\varphi}-1)\,\hat{N}(\theta)+1\right)^{\frac{(1+\varepsilon)(v-1)+R-1}{v-1}}$$

with $m > 0$.

- **Group-dependent price stability**: All entrepreneurs choosing same technology set **same price**.

- But then, necessarily $s(\theta)$ state dependent with endogenous information

- Example:

$$s(\theta) = \hat{P}(\theta)\hat{C}(\theta)\frac{\alpha\beta}{1+\beta\hat{N}(\theta)}$$

  - $P^*(\theta)$ pinned down by mon. policy

Conclusions

- Optimal fiscal policy
  - standard subsidy correcting for market power
  - NOVEL subsidy to innovating firms
    - sensitivity of fiscal policy to fundamentals higher when information is endogenous
- Optimal monetary policy
  - pro-cyclical
  - stabilizes prices within groups
  - supports efficient investment and information acquisition

Most Important Slide

THANKS!