Optimal monetary policy when asset markets are incomplete

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Outline

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Inflation-output tradeoff in the representative-agent framework

- In the standard sticky price model, the optimal monetary policy is approximately given by complete inflation stabilization.
    - Schmitt-Grohé and Uribe (2007), etc.
- Concerning the output-inflation tradeoff, the monetary authority should place exclusive weight on the inflation stabilization.
- The welfare cost of business cycles is nil in the representative-agent framework used in the standard New Keynesian model.

Uninsured idiosyncratic shocks

- Idiosyncratic income shocks are very persistent and their variance fluctuate countercyclically.
    - Storesletten, Telmer and Yaron (2004), Meghir and Pistaferri (2004), etc.
- The existence of such idiosyncratic shocks may generate a large welfare-cost of business cycles.
    - Krebs (2003), De Santis (2007), etc.
- How does it affect optimal monetary policy? In particular, how does it change the weight the monetary authority should place on the inflation stabilization?

This paper

- Individuals face uninsured idiosyncratic income shocks with countercyclical variance.
- The model is otherwise standard new Keynesian model with:
  - monopolistic competition;
  - Calvo price setting;
  - capital accumulation.
- Consider optimal monetary policy (Ramsey policy).

Main findings

- Countercyclical idiosyncratic risk can generate a very large welfare-cost of business cycles.
- But it does not affect the inflation-output tradeoff much.
  - The optimal monetary policy is essentially characterized as complete price-level stabilization.
  - Thus, the monetary authority should place almost exclusive weight on the stabilization of inflation.

Outline

Composite good

- Y_t = aggregate output of a composite good:

$$Y_t = \left(\int_0^1 Y_{j,t}^{1-\frac{1}{\zeta}} \, dj \right)^{\frac{1}{1-\frac{1}{\zeta}}}$$

which can be consumed or invested:

$$Y_t = C_t + I_t$$

- P_t = price index:

$$P_t = \left(\int_0^1 P_{j,t}^{1-\zeta} \, dj \right)^{\frac{1}{1-\zeta}}$$

Preferences of individuals

- A continuum of ex-ante identical individuals.
- Preferences:

$$u_{i,0} = E_0^i \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\gamma} \left[c_{i,t}^{\theta} (1 - l_{i,t})^{1-\theta} \right]^{1-\gamma}$$

- Let $1/\gamma_c$ = elasticity of intertemporal substitution of consumption for a fixed level of leisure:

$$\gamma_c \equiv 1 - \theta(1 - \gamma)$$

Idiosyncratic shocks

Two assumptions for tractability

- In general, with uninsured idiosyncratic shocks, the wealth distribution, an infinite-dimensional object, must be included in the state variable.
- We circumvent this problem by assuming that
  - idiosyncratic shocks follow random walk processes;
  - idiosyncratic shocks affect both labor and capital income.

Idiosyncratic shocks

Random walk with countercyclical variance

- $\eta_{i,t}$ = the idiosyncratic shock for individual i:

$$\ln \eta_{i,t} = \ln \eta_{i,t-1} + \sigma_{\eta,t}\epsilon_{\eta,i,t} - \frac{\sigma^2_{\eta,t}}{2}$$

where

- $\epsilon_{\eta,i,t}$ is i.i.d., and $N(0,1)$.
- $\sigma_{\eta,t}$ = variance of innovations to idiosyncratic shocks, which is assumed to fluctuate countercyclically.

Idiosyncratic shocks

Flow budget constraint

- Assume that $\eta_{i,t}$ affects i's income in two ways.
  - $\eta_{i,t}$ equals the productivity of individual i's labor.
  - $\eta_{i,t}$ also affects the return to savings of individual i.
- The flow budget constraint of i is given by

$$\begin{aligned} & c_{i,t} + k_{i,t} + s_{i,t} \\ & \qquad = \frac{\eta_{i,t}}{\eta_{i,t-1}} \left(R_{k,t} k_{i,t-1} + R_{s,t} s_{i,t-1} \right) + \eta_{i,t} w_t l_{i,t} \end{aligned}$$

where $k_{i,t}$ = physical capital and $s_{i,t}$ = value of shares.

Idiosyncratic shocks

Remarks

- The assumption that $\eta_{i,t}$ also operates as a shock to the return to individual savings is artificial, but ...
- Without this assumption, the wealth distribution would have to be included as a state variable.
- With this assumption, the effect of the presence of idiosyncratic shocks would be overemphasized.
  - Our finding is that the tradeoff faced by the monetary authority is little affected by the presence of idiosyncratic shocks.
  - Hence, dropping this assumption would strengthen our result.

Associated representative-agent problem

- Consider a representative-agent's utility maximization problem:

$$\max\ U_0 = E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\gamma} \nu_t \left[C_t^{\theta} (1-L_t)^{1-\theta} \right]^{1-\gamma}$$

subject to

$$C_t + K_t + S_t = R_{k,t} K_{t-1} + R_{s,t} S_{t-1} + w_t L_t$$

- Here, ν_t is a preference shock defined by

$$\nu_t \equiv \exp\left[\frac{1}{2} \gamma_c (\gamma_c - 1) \sum_{s=0}^{t} \sigma_{\eta,s}^2 \right]$$
$$= E_t[\eta_{i,t}^{1-\gamma_c}]$$

Aggregation result

Proposition

Suppose that $\{C_t^*, L_t^*, K_t^*, S_t^*\}_{t=0}^{\infty}$ *is a solution to the representative agent's problem. For each* $i \in [0, 1]$*, let*

$$c_{i,t}^* = \eta_{i,t} C_t^*$$

$$l_{i,t}^* = L_t^*$$

$$k_{i,t}^* = \eta_{i,t} K_t^*$$

$$s_{i,t}^* = \eta_{i,t} S_t^*$$

Then $\{c_{i,t}^*, l_{i,t}^*, k_{i,t}^*, s_{i,t}^*\}_{t=0}^{\infty}$ *is a solution to the problem of individual* i*.*

Remark 1

- The utility of the representative agent is indeed the cross-sectional average of individual utility:

$$U_0 = E_0[u_{i,0}]$$

Remark 2

- How idiosyncratic shocks affect the aggregate economy can be understood by looking at the "effective discount factor":

$$\tilde{\beta}_{t,t+1} \equiv \beta \frac{\nu_{t+1}}{\nu_t} = \beta \exp\left[\frac{1}{2}\gamma_c(\gamma_c - 1)\sigma^2_{\eta,t+1}\right]$$

Thus

$$\uparrow \sigma^2_{\eta,t+1} \quad \Longrightarrow \quad \begin{cases} \uparrow \tilde{\beta}_{t,t+1} & \text{if } \gamma_c > 1 \\ \downarrow \tilde{\beta}_{t,t+1} & \text{if } \gamma_c < 1 \end{cases}$$

Remark 3

- The SDF used by individual i is

$$\beta \frac{\lambda_{i,t+1}}{\lambda_{i,t}} = \beta \frac{\lambda_{t+1}}{\lambda_t} \left(\frac{\eta_{i,t+1}}{\eta_{i,t}} \right)^{-\gamma_c}$$
$$= \beta \frac{\lambda_{t+1}}{\lambda_t} \exp \left(-\gamma_c \sigma_{\eta,t+1} \epsilon_{\eta,i,t+1} + \frac{\gamma_c}{2} \sigma^2_{\eta,t+1} \right)$$

- It follows that individuals agree on the present value of the profit stream of each firm.
- In particular, they agree with the representative agent, whose SDF is given by $\beta \frac{\lambda_{t+1} \nu_{t+1}}{\lambda_t \nu_t}$.

Firms

- Standard model with monopolistic competition and Calvo price setting.
- Production technology of firm j:

$$Y_{j,t} = z_t^{1-\alpha} K_{j,t}^{\alpha} L_{j,t}^{1-\alpha} - \Phi_t$$

where z_t is aggregate productivity shock, and Φ_t is a fixed cost of production.

- Demand for variety j:

$$Y_{j,t} = \left(\frac{P_{j,t}}{P_t} \right)^{-\zeta} Y_t$$

- $1 - \xi$ = probability of arriving an opportunity to change the price of each variety.

Aggregate shocks

Productivity shock is either permanent or temporary.

1. The case of permanent productivity shock:

$$\ln z_t = \ln z_{t-1} + \mu + \sigma_z \epsilon_{z,t} - \frac{\sigma_z^2}{2}$$

$$\sigma_{\eta,t}^2 = \bar{\sigma}_\eta^2 + b\sigma_z \epsilon_{z,t}$$

Aggregate shocks

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$$\sigma_{\eta,t}^2 = \bar{\sigma}_\eta^2 + b\sigma_z \epsilon_{z,t}$$

2. The case of temporary productivity shock:

$$\ln z_t = \rho_z \ln z_{t-1} + \sigma_z \epsilon_{z,t} - \frac{\sigma_z^2}{2(1+\rho_z)}$$
$$\sigma_{\eta,t}^2 = \bar{\sigma}_\eta^2 + b \ln z_t$$

Government

- Fiscal policy: no taxes, no debt, etc.
- Monetary policy: Set the state-contingent path of the inflation rate $\{\pi_t\}$.
- Two monetary policy regimes:
  1. Ramsey regime: Set $\{\pi_t\}$ so as to maximize the ex ante utility of individuals.
  2. Inflation-targeting regime: Set $\pi_t = 1$ at all times.

Outline

Experiments

- Most parameters are calibrated following Boldrin, Christiano and Fisher (2001) and Schmitt-Grohé and Uribe (2007).
- We compare the following cases:
  - $\gamma_c = 0.7, 2$;
  - $b = 0, -0.8$;
  - productivity shock is either permanent or temporary;
  - the monetary policy regime is either Ramsey or inflation-targeting.

Welfare measures

- Δ_{bc} = welfare cost of business cycles:

$$\sum_{t=0}^{\infty} \beta^t \bar{\nu}_t \frac{1}{1-\gamma} \left[((1-\Delta_{\text{bc}})\bar{C})^{\theta} (1-\bar{L})^{1-\theta} \right]^{1-\gamma}$$
$$= E_{-1} \sum_{t=0}^{\infty} \beta^t \nu_t \frac{1}{1-\gamma} \left[(C_t^{\text{rbc}})^{\theta} (1-L_t^{\text{rbc}})^{1-\theta} \right]^{1-\gamma}$$

- Δ_{inf} = welfare cost of the inflation-targeting regime:

$$E_{-1} \sum_{t=0}^{\infty} \beta^t \nu_t \frac{1}{1-\gamma} \left[((1-\Delta_{\text{inf}}) C_t^{\text{ram}})^{\theta} (1-L_t^{\text{ram}})^{1-\theta} \right]^{1-\gamma}$$
$$= E_{-1} \sum_{t=0}^{\infty} \beta^t \nu_t \frac{1}{1-\gamma} \left[(C_t^{\text{inf}})^{\theta} (1-L_t^{\text{inf}})^{1-\theta} \right]^{1-\gamma}$$

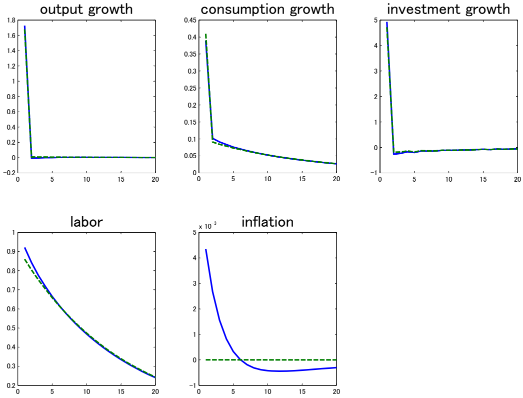
Permanent productivity shock

Welfare costs of business cycles and the inflation-targeting regime

γ_c	0.7	0.7	2	2
b	0	-0.8	0	-0.8
Δ_{bc} (%)	-0.8191	-1.2983	2.0938	7.3301
Δ_{inf} (%)	0.0000	0.0000	0.0002	0.0006

Permanent productivity shock

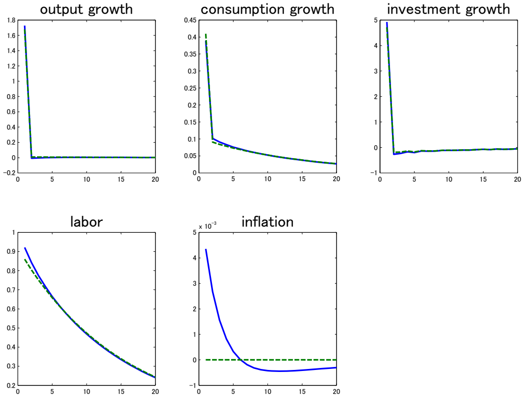
Impulse responses when $\gamma_c = 0.7$ and $b = 0$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

Permanent productivity shock

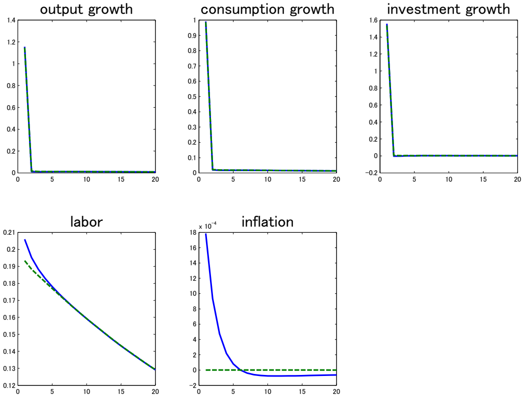
Impulse responses when $\gamma_c = 0.7$ and $b = -0.8$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

Permanent productivity shock

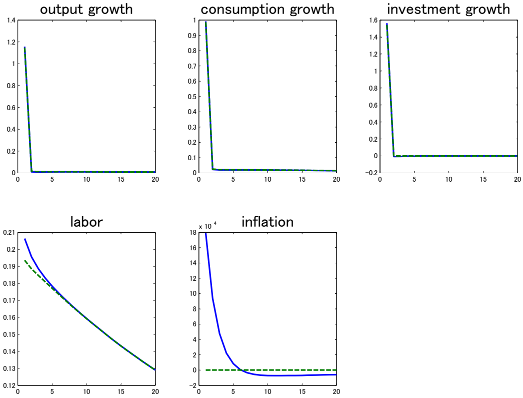
Impulse responses when $\gamma_c = 2$ and $b = 0$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

Permanent productivity shock

Impulse responses when $\gamma_c = 2$ and $b = -0.8$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

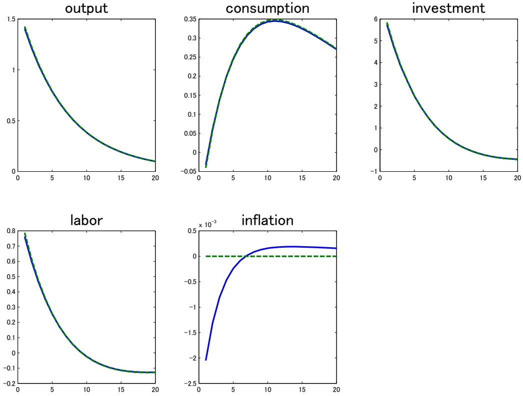
Temporary productivity shock

Welfare costs of business cycles and the inflation-targeting regime

γ_c	0.7	0.7	2	2
b	0	-0.8	0	-0.8
Δ_{bc} (%)	-0.0171	-0.6191	-0.0073	12.2258
Δ_{inf} (%)	0.0000	0.0001	0.0000	0.0024

Temporary productivity shock

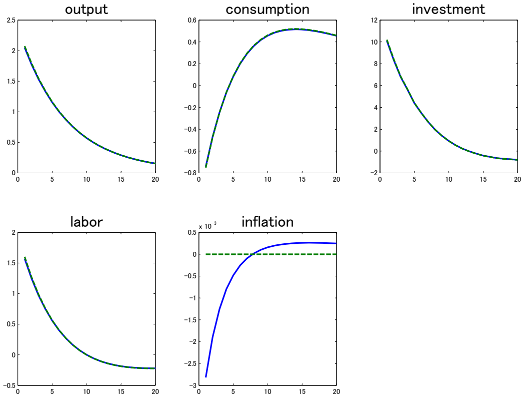
Impulse responses when $\gamma_c = 0.7$ and $b = 0$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

Temporary productivity shock

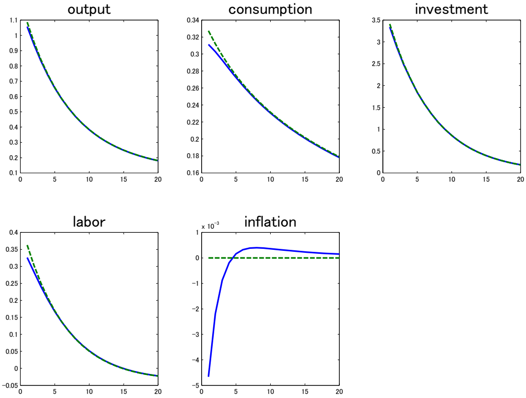
Impulse responses when $\gamma_c = 0.7$ and $b = -0.8$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

Temporary productivity shock

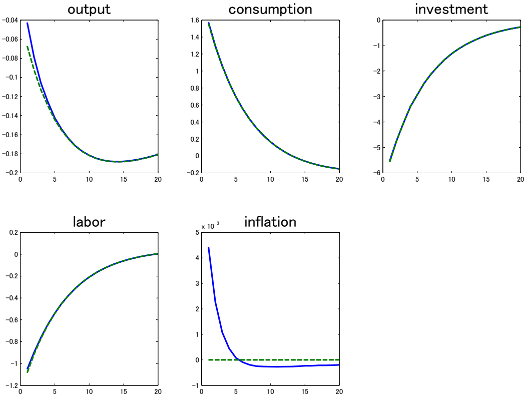
Impulse responses when $\gamma_c = 2$ and $b = 0$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

Temporary productivity shock

Impulse responses when $\gamma_c = 2$ and $b = -0.8$.



Solid lines: Ramsey policy; dashed lines: inflation targeting.

Outline

Conclusion

- We have developed a New Keynesian model with uninsurable idiosyncratic income shocks.
- The welfare cost of business cycles can be very large when the variance of idiosyncratic shocks fluctuates countercyclically.
- Nevertheless, the optimal monetary policy is roughly the same as the zero-inflation policy. The presence of countercyclical idiosyncratic shocks does not affect the inflation-output tradeoff.