



Optimal Contracts for Central Bankers

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In this Paper ...

- It is shown that Central banker's incentives induce socially optimal policy.
- The Contract between the government and central banker makes such an incentive.

In this Paper ...

- Inflationary bias is eliminated in a discretionary regime.
- Optimal response to the shocks is achieved even in presence of imperfect information.

Previous Researches ...

Rules rather than Discretion ...

- **Kydland & Prescott (1977)**
 - Economic agents are rational.
 - Discretionary Regime does not result in socially optimal Plan.
 - Rules, rather than Discretion proposed.

Previous Researches ...

Rules, Discretion and Reputation ...

- Barro & Gordon (1983)
 - Cheating may be desirable for policy maker.
 - Policy Rule may be unenforceable, for example in zero inflation targeting.
 - Credible Policy Rules should be selected.

Previous Researches ...

Central Bankers have their self incentives ...

- **Rogoff (1985), Lohmann (1992) and Waller (1992)**
 - There are many potential bankers with different preferences
 - We can pick the “preservative”, that is more interested in small inflations.
 - The inflationary bias may be reduced, at the cost of output fluctuation.

Previous Researches ...

Government can affect banker's incentives ...

- Rogoff (1985), Lohmann (1992), Garfinkle & Oh (1993)
 - Banker should be punished when the disturbance is big or the target of rule is not achieved.
 - It is like a "contract" between government and central banker, which affects the conduct of monetary policy.

Previous Researches ...

The Contracts in this Principal-Agent problem...

- Walsh (1993b)
 - Legislated budget procedures, targeting rules or conditions under which the central banker will be fired, can be costly to change.
 - A dismissal rule can be substituted for a state-contingent rule contract.

Previous Researches ...

Problem of studied contracts ...

- Rogoff (1985), Canzoneri (1985), Garfinkle & Oh (1993)
 - Trade-off between inflationary bias and suboptimal stabilization.
 - Private Information of central bank makes it difficult to determine whether the central bank is cheating.

OPTIMAL CONTRACT HAS NOT STUDIED !

The key Questions

- Is there an **optimal** contract, the government should offer to the central banker ?
- How the rewards to the central bank should be structured, in order to **induce** the socially optimal policy ?

Assumptions

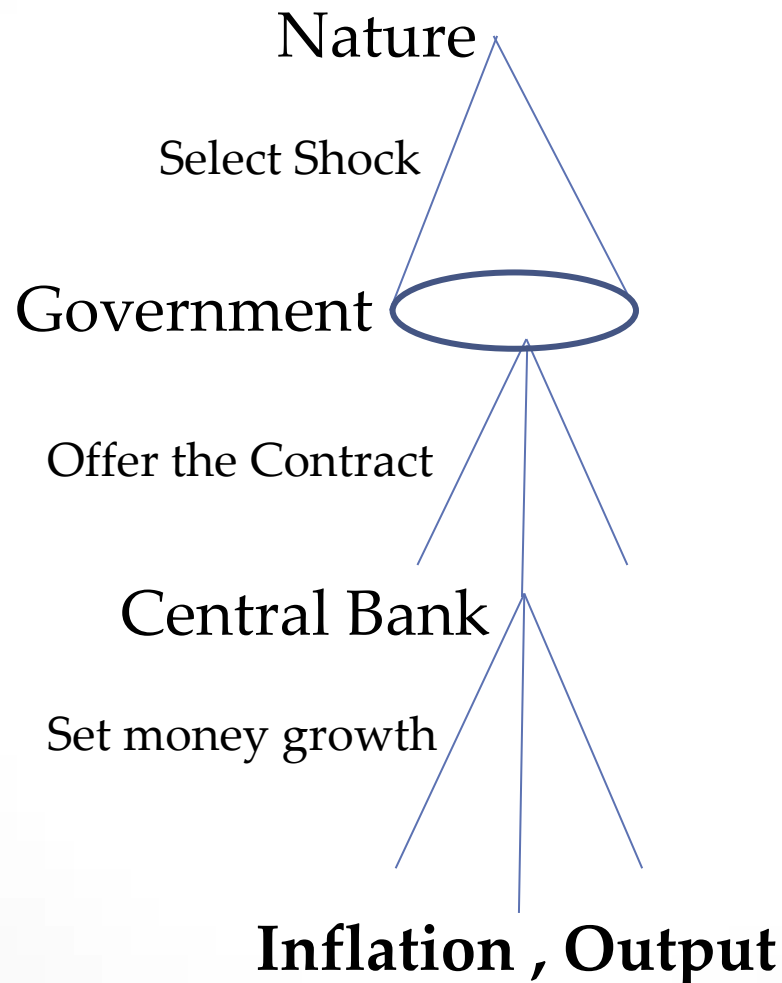
- Preferences are based on the Standard model of time inconsistent monetary policy.
- Government would like to eliminate inflationary bias in the discretionary policy making of central banker.
- Government would like to preserve the ability of central bank in order to response to the shocks, **flexibly**.

Assumptions

- The Government offers the central bank head, a wage contract in the one-period model.
- The Wage should be based on the publicly observable variable of economy.

Is this Contract effective?

Game Theory Approach



The Key Results

- The inflationary bias caused by discretion policy making is eliminated.
- The trade-off between low inflation and stable economy disappears.
- Imperfect information is not important, optimal policy can be achieved.

Model

- The preference of both The Government and people

$$(1) \quad V = (y - y^*)^2 + \beta\pi^2.$$

- Philips curve

$$(2) \quad y = y^c + \alpha(\pi - \pi^e) + \varepsilon$$

- To provide an incentive for the policymaker

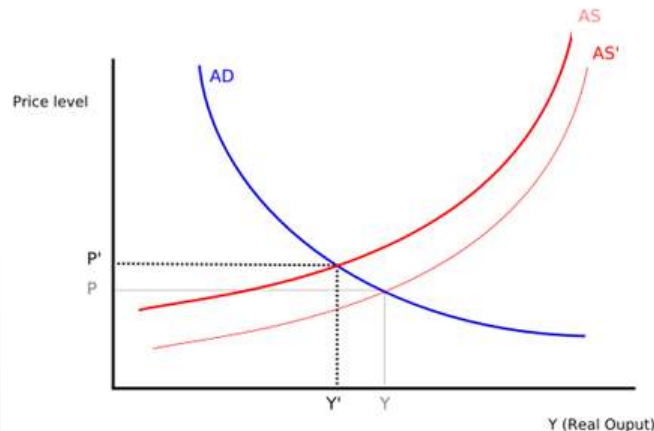
$$(3) \quad k \equiv y^* - y^c > 0.$$

Model

- The examined contracts attempt to influence the central bank's choice of operating procedures.
- It will be useful to distinguish between inflation and the central Bank's policy instrument.

$$(4) \quad \pi = m + v - \gamma \varepsilon$$

- v : either a control error or a velocity shock taken to be W.N. process, whose realization occurs after m is set.
- $\gamma \varepsilon$: allows aggregate supply shocks to have a direct negative impact on inflation.



Solving The Model

The optimal policy rule that minimizes expected social loss function conditional on θ is:

$$(5) \quad m(\theta) = \left(\gamma - \frac{\alpha}{\alpha^2 + \beta} \right) s\theta \equiv \delta s\theta.$$

Intuitions

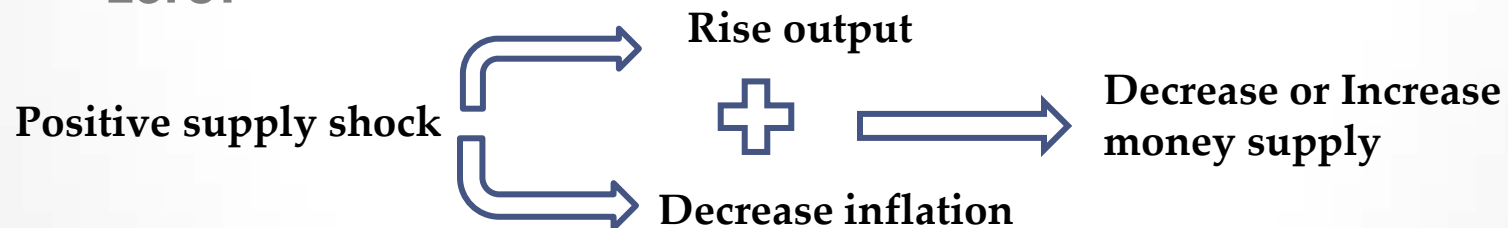
- If the direct effect of aggregate supply shocks on inflation is zero ($\gamma = 0$):

Positive supply shock \implies Rise output \implies Reduce money supply

Stabilization



- If direct effect of aggregate supply shocks on inflation is not zero:



- Decreasing functionality of money growth by β .

Time inconsistency

- The Socially Optimal Policy rule of money growth is **time-inconsistent**
- It is not credible if implemented **directly** either by the government or by a central bank.

Principal-Agent Problem

Agent:(Central Bank)

- Shares the government's preferences
- Is risk neutral
- Receives a monetary transfer payment from the government
- Has preferences, separable in social loss and income

(6)

$$U = t - V.$$

Principal-Agent Problem

Principal: (Government)

- Designs a transfer function.
- Induces the central bank to choose $m = m(\theta)$.

$$m(\theta) = \left(\gamma - \frac{\alpha}{\alpha^2 + \beta} \right) s\theta \equiv \delta s\theta.$$

The contract

- If the government can verify θ ex post: lots of contracts exist.
- The contract must depend only on the observable variables m , π & y .
- The transfer is taken to be a function, solely of either m or π .

The contract

- Maximizing $E_{\theta} (t_m - v)$ in the discretionary policy making by central banker results in

$$\begin{aligned} (7) \quad m^{\text{CB}}(\theta) &= \frac{\alpha k}{\beta} + \left(\frac{1}{2\beta} \right) E_{\theta}(\partial t / \partial m) \\ &\quad + \frac{\alpha^2}{2(\alpha^2 + \beta)\beta} [E(\partial t / \partial m) - E_{\theta}(\partial t / \partial m)] \\ &\quad + \delta s \theta \end{aligned}$$

Optimal Contract

In the Optimal Contract:

Incentives should Conduct the Discretionary policy of central bank toward the Optimal Policy Rule.

In fact, Incentives make the optimal rule, time-consistent, so **credible**.

Optimal Contract

- Setting $m^{CB}(\theta) = m(\theta)$ for all θ :

$$\begin{aligned} (8) \quad & \frac{1}{2}E_{\theta}(\partial t/\partial m) \\ & + \frac{\alpha^2}{2(\alpha^2 + \beta)\beta} [E(\partial t/\partial m) - E_{\theta}(\partial t/\partial m)] \\ & = -\alpha k \leq 0. \end{aligned}$$

- The Transfer function is solved:


$$(9) \quad t(m) = t_0 - 2\alpha km$$

In this Contract ...

- ✓ The inflationary bias is eliminated.
- ✓ The central bank is leaved free to respond with discretion to θ .
- ✓ Private information is not entered in the optimal transfer.

Some Practical Notes

- If the government's loss function in (1) took the form

$$(y - y^*)^2 + \beta(\pi - \pi^*)^2$$


$$t = t_0 - 2\alpha k(m - m^*)$$

- we can use inflation instead of money in contract

$$E_\theta \frac{\partial \pi}{\partial m} = 1 \quad \Rightarrow \quad t = t_0 - 2\alpha k\pi$$

Comparison with Canzonery (1985)

- Canzonery:
 - Central bank claims about θ , it is difficult to find out he is honest or not
 - Impossible to remove its bias from Central bank announcement
- Walsh:
 - Inflation bias could be eliminated.
 - It doesn't depend on θ or v , even if v is observable

Comparison with Rogoff (1985)

Rogoff Contract: $t' = t_0 - (y - y^*)^2 - \beta\pi^2$

- Rogoff talk about optimum beta
- It can't eliminate inflation bias, because of absence of linear term
- Parameterizing contract can eliminate this bias at the cost of no stabilization and variable marginal cost of inflation

Walsh Contract: $t = t_0 - 2\alpha k\pi - (y - y^*)^2 - \beta\pi^2$

- There is no problem because of introducing the new term

Contract based on performance measure

- Central Bank does not care about inflation or Output
- Central Bank has different preferences on output or inflation from government

Our plan:

Find contract function that leads to $m = \delta s\theta$, the Optimal Policy Rule.

Contract based on performance measure

- Transfer function includes reward to desirable inflation and output:

$$T(\pi, y) = b_0 + b_1\pi + b_2\pi^2 + b_3(y - y^*) + b_4(y - y^*) + b_5\pi(y - y^*)$$

- Solving $\max_{\theta} E_{\theta} \tau(\pi, y)$:

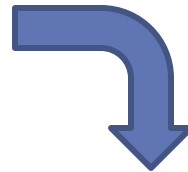
$$(b_1 + b_3\alpha) + 2(b_2 + \alpha^2 b_4 + \alpha b_5)(m - \gamma s\theta) + (2\alpha b_4 + b_5)[s\theta - k + \alpha E(m)] = 0$$

Contract based on performance measure

- Using rational expectation:

$$m^* = [-(b_1 + \alpha b_3) + (2 \alpha b_4 + b_5)k / 2 b_2 + \alpha b_5] - [-(2 \alpha b_4 + b_5) s\theta / 2(b_2 + \alpha^2 b_4 + \alpha b_5)] + \gamma s\theta$$

- m^* should be $\delta s\theta$



$$\alpha b_4 + 0.5 b_5 / (b_2 + \alpha^2 b_4 + \alpha b_5) = \alpha / (\alpha^2 + \beta)$$

$$-(b_1 + \alpha b_3) + (2\alpha b_4 + b_5)k = 0$$

Contract based on performance measure

Parameters are more than we need

By these parameters:

- $b_4 = -1$
- $b_3 = b_5 = 0$
- $b_1 = 2\alpha b_4 k = -2\alpha k$
- $b_2 = \beta b_4 = -\beta$

Contract based on performance measure

The optimal transfer function shape is

$$\tau(\pi, y) = b_0 - 2\alpha k\pi - \beta\pi^2 - (y - y^*)^2 = t(\pi) - v$$

It is the same Optimal Contract obtained in previous approach !

Contract based on performance measure

- ❖ Note: not unique optimum assumption: but it needs output restriction

Inflation is not enough to make optimal incentive

$$\alpha b_4 + 0.5 b_5 / (b_2 + \alpha^2 b_4 + \alpha b_5) = \alpha / (\alpha^2 + \beta) = 0 !!!$$

- ✓ Examples: new Zealand - Europe
- ✓ Notice to the output preference of central bank

Contract based on performance measure

$$\tau(\pi, y) = b_0 + b_1\pi + b_2\pi^2$$

maximization $\longrightarrow m^* = \gamma s \theta - b_1 / 2b_2$

So there is **bias** in inflation, unless $b_1 = 0$.

Optimal Rule is not achieved, unless

$$b_1 = 0$$

$$\left\{ \begin{array}{l} \theta = \varepsilon = 0 \\ \alpha = 0 \\ \beta = \infty \end{array} \right.$$

Question?

Thanks to

F. Najafi

M. Davoudi