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Monetary Theory I

This lecture walks through the development in monetary theory from pre-Keynes era. We will discuss inflationary bias problem and alternative solutions – from conservative central bank to inflation targeting. The lecture focuses on a simple framework with one-shot interaction and direct control over inflation to set stage for multi-period analysis under New Keynesian framework in the lecture that follows. The outline of the lecture is as follows:

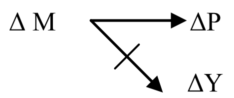
Development in monetary theory:

- Pre-Keynes: Quantity theory of money
- Friedman's Natural Rate Hypothesis and Rational Expectations Hypothesis
- Rule versus discretion and inflationary bias problem (Kydland and Prescott (1977) and Barro and Gordon (1983))
- Solutions to inflationary bias problem:
    - Conservative central bank (Rogoff, 1985)
    - Inflation contract (Walsh, 1995)
    - Inflation targeting (Svensson, 1997)

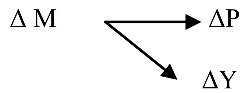
<u>Pre- Keynes: Quantity theory of money</u>

$$MV = PY$$

- Δ M is forced by adherence to the Gold Standard. The ability of a central bank to create currency was limited by its holdings of gold reserves.
- Δ Y can only be influenced by the real variables such as technological and population growth



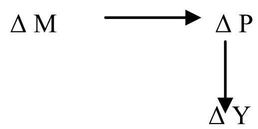
- The collapse of the Gold Standard after WWI due to excessive money creation without sufficient backup of the gold supply. Excessive money creation led to high inflation. Nonetheless, attempts to reduce money supply led to the period of high unemployment.



<u>Friedman's Natural rate hypothesis and rational expectations</u>

- Friedman's Natural rate hypothesis (1968)

    - ΔM leads to *temporary* ΔY due to imperfect information
    - In the long run, agents realized their mistakes and Y would fall back to its original level (natural level of output) or 'classical dichotomy' in the long run.
    - Natural rate hypothesis suggested a possible route through which governments might artificially stimulate the economy



- Rational Expectations Hypothesis: Muth (1960, 1961) and Lucas (1972, 1975)

    - Rational agents exploit their information set fully
    - Only unpredictable (unanticipated) movements in monetary policy could have the real effect

$$\Delta M \longrightarrow \Delta P$$
$$\downarrow$$
$$\Delta Y$$

- governments can also be analysed in much the same way as firms or consumers

  - objective (or loss function) to optimise
  - subject to constraint (in this case: natural rate hypothesis)

The economy is assumed to obey the natural rate hypothesis with a mean value of natural rate at y^* but in any period it is equal to $y^* + \varepsilon$ where ε is a supply disturbance with a constant variance and assumed to be independently distributed around its mean of zero. π is actual inflation and π^e is expected inflation, b is a positive constant.

$$y = y^* + b\,(\pi - \pi^e) + \varepsilon \qquad (1)$$

Assume that expectations of the private sectors are formed, and nominal wage contracts are agreed, prior to observation of ε.

The government aims to minimise the loss function, which is the deviation of output and inflation from their respective targets. Assuming that the desired level of output (ky^*, $k > 1$) is greater than the natural level of output (y^*) and inflation target is zero, the loss function is:

$$L = a\,\pi^2 + (y - k\,y^*)^2 \qquad (2)$$

The government is assumed to set monetary policy after it has observed ε (superior information) before the private sector can revise their wage contract. Its actions will affect prices

<u>Rule versus discretion: the problem of inflationary bias</u>

- Discretion: the problem of the inflationary bias

Under discretionary monetary policy, i.e. a policy framework where the authority sets policy as it sees fit at any time. The analysis was developed by Barro and Gordon (1983) who built on ideas presented in a highly influential paper by Kydland and Prescott (1977).

The government aims to minimise its loss function by selecting π:

$$\text{F.O.C: } \frac{\partial L}{\partial \pi} = 2a\pi + 2b(y^* + b(\pi - \pi^e) + \varepsilon - ky^*) = 0 \qquad \text{(a)}$$

Under rational expectations, taking expectations throughout on F.O.C. we have

$$\pi^e = \frac{b(k-1)y^*}{a} \qquad \text{(b)}$$

substitute (b) in (a) we have

$$\pi = (k-1)\frac{b}{a}y^* - \frac{b\varepsilon}{a+b^2} \qquad \text{(c)}$$

substitue (b) and (c) in (1)

$$y = y^* + \frac{a\varepsilon}{a+b^2} \qquad \text{(d)}$$

from (d), on average $y = y^*$

from (c), on average $\pi = (k-1)\frac{b}{a}y^*$ which is > 0. This is the 'inflationary bias'.

Clearly, average inflation will be positive as k > 1 while the average level of output will be y*. This is suboptimal because we could have had an inflation rate of zero with the same average level of output.

As long as k > 1, the government has an incentive to set policy that generates a positive inflation rate.

- Rule: optimal but infeasible

To avoid sub-optimality, the conduct of monetary policy must be subject to a form of a rule:

$$\pi = \alpha + \beta\varepsilon$$

If such a rule is followed, inflation on average will be α. If the rule is credible, i.e. the private sector believes that the authority will follow the set-out rule above, inflation expectation will be α. ($\pi^e = \alpha$)

Credible rule implies that the private sector agents are confident that the authorities are not intending to set monetary policy to achieve output higher than y* (since they are expecting y*). Therefore, the authorities are setting k =1.

$$L = a\pi^2 + (y - y^*)^2$$

as $\pi = \alpha + \beta\varepsilon$ and from (1)

$$y - y^* = b(\pi - \pi^e) + \varepsilon = b(\beta\varepsilon) + \varepsilon$$

Therefore: $L = a(\alpha + \beta\varepsilon)^2 + (b\beta\varepsilon + \varepsilon)^2$ (3)

Minimise loss function (3) wrt α

F.O.C: $\frac{\partial L}{\partial \alpha} = 2a(\alpha + \beta\varepsilon) = 0$

$$\alpha = -\beta\varepsilon$$

Since the rule is set before observing ε the authority must set $\alpha = 0$ (a')

Minimise loss function (3) wrt β

F.O.C: $\frac{\partial L}{\partial \beta} = 2a\varepsilon(\alpha + \beta\varepsilon) + 2b\varepsilon(b\beta\varepsilon + \varepsilon) = 0$

As $\alpha = 0$

$$a\beta\varepsilon + b^2\beta\varepsilon + b\varepsilon^2 = 0$$

$$\beta = \frac{-b}{a + b^2} \quad \text{(b')}$$

as $\pi = \alpha + \beta\varepsilon$;

$$\pi = 0 - \frac{b}{a + b^2}\varepsilon = -\frac{b}{a + b^2}\varepsilon \quad \text{(c')}$$

substitute (c') into (1), $\pi^e = \alpha = 0$

$$y = y^* + \frac{a}{a + b^2}\varepsilon \quad \text{(d')}$$

from (c') on average $\pi = 0$
from (d') on average $y = y^*$

- Compare

	Rule	Discretion
π on average	0	(k-1)by*/a
Y on average	y*	y*

As long as k >1, discretion produces inflationary bias

If we all know that the outcome of rule is better than discretion, why such a state contingent rule may not be feasible:

- Temptation to renege on the commitment

Barro and Gordon (1983) argued that there is a temptation to renege on the commitment. Given expectations of inflation at zero ($\pi^e = 0$) the loss function becomes:

$$L = a\pi^2 + (y^* + b(\pi - 0) - ky^* + \varepsilon)^2$$

$$\text{F.O.C: } \frac{\partial L}{\partial \pi} = 2a\pi + 2b(y^* - ky^* + b\pi + \varepsilon) = 0$$

$$\pi = \frac{b(k-1)}{a+b^2} y^* - \frac{b}{a+b^2}\varepsilon$$

as long as $k > 1$, π on average is > 0

However, under RE, the private sector will foresee the result, there will be a loss of credibility and the eventual outcome will be equivalent to that achieved under discretion.

If such a rule is not possible and discretion prevails, there are a number of suggestions to alleviate inflationary bias

<u>Solutions to inflationary bias problem</u>

- **Conservative central bank** (Rogoff, 1985)

  The government appoints a conservative central bank, i.e. a central bank which attaches an especially heavy weight to inflation stabilization in its loss function.
  Loss function becomes: $L = (a+d)\pi^2 + (y - ky^*)^2$
  Optimise in a similar fashion as discretion, we'll have

$$\pi = \frac{b(k-1)}{a+d} y^* - \frac{b}{a+d+b^2}\varepsilon$$

$$y = y^* + \frac{a+d}{a+d+b^2}\varepsilon$$

  We now have lower inflationary bias but greater stabilisation bias (higher response in output to supply shock)

- **Inflation contract** (Walsh, 1995)

  The government appoints a central bank with the same preference as the government and influences its incentives by assigning a state-contingent wage contract.

  Central bank's utility: *U* = *T* - *L*

  where *T* is the central bank's pay and *L* its loss function. Maximizing this utility function with respect to the inflation rate gives

$$\frac{\partial U}{\partial \pi} = \frac{\partial T}{\partial \pi} - \frac{\partial L}{\partial \pi}$$

where $$L = a\pi^2 + (y - ky^*)^2$$

It is possible to set a pay contract $T = T_0 + 2b(1-k)y^*\pi$ which will eliminate inflationary bias.

Performance-related remuneration contract may not affect the incentive of the central banker due to:

- opportunity cost of being a central banker is already very high in terms of pay elsewhere
- loss function is expressed in utility units while the pay contract must be expressed in monetary terms

- **Inflation targeting** (Svensson, 1997)

Society assigns a loss function and the central bank is given independednce to minimize this loss function. The target inflation π^b and output y^b may differ from *0* and y^* respectively.

$$L^b = a(\pi - \pi^b)^2 + (y - y^b)^2$$
$$y = y^* + b(\pi - \pi^e) + \varepsilon$$

Minimise loss function wrt AS, to eliminate inflationary bias

$$\pi^b = \frac{b}{a}(y^* - y^b)$$

	Rule	Discretion	Conservative CB	Inflation contract	Inflation targeting
Loss function	With y^* as target to gain credibility	With ky^* as target	With ky^* as target and higher weight on inflation	With ky^* as target	With new tgt: (π^b, y^b)
AS	standard	standard	standard	standard	standard
Policy Maker	government	government	CB	CB with pay from gov	CB with tgt assigned
Specific feature	Stick to pre-annouced rule	Optimise period by period	Optimise period by period	Max utility (=pay – loss fn)	$\pi^b = b(y^*-y^b)/a$
Average Inflation	0	$\pi = b(k-1)y^*/a$	$\pi = b(k-1)y^*/(a+\delta)$	0 If contract set properly	can be 0 if the condition above satisfied
Drawbacks	Temptation	Inflationary bias	Stabilisation bias	Difficult to implement	