Rules versus Discretion

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Summary

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A new message in the 80's

Economic policy in the 60's up the 80's

1. **Three basic principles**: economic policy was conducted in a framework with:
   1. Changes in policy should be implemented in a **sudden manner**, in order to "surprise" the private agents and avoid anticipation
   2. Policy should be conducted as a **gradual process** (remember the famous gradual devaluation remedy of the IMF in the 70's and 80's)
   3. Policy agencies should conduct policy with **discretion**, not committed to any specific rule or set of rules
2. Permanent trade–off between inflation and unemployment: exploit it
3. Main message: **Disinflation is a painful process, it costs a lot of employment and output**

The new message in the 80's

1. Disinflation can be a **painless process** if:
    1. central banks are committed to fight inflation
    2. if their attitude is credible
    3. if private agents have rational expectations
2. This changed dramatically the way the world looked at central banks
3. Most central banks:
    1. Became independent from governments
    2. Started to target inflation as the only main objective
    3. Implemented a rule to inform private agents of what they will do in the future

Seminal Steps (papers)

1. **Kydland and Prescott (1977)** set up the problem of **time consistency** in optimal policy in general [1]
2. **Barro and Gordon (1983)** applied the result to monetary policy, and has become the cornerstone model to deal with this issue
3. **John Taylor (1993)** presented evidence in favor of the application of **rules** to conduct monetary policy

$$i_t = \pi_t + r_t^n + \gamma_\pi(\pi_t - \pi_t^*) + \gamma_y(y_t - y_t^*)$$

4. i_t is the nominal short term interest rate, π_t is the inflation rate, r_t^n is the natural real interest rate, y_t is output, the asterisk (π_t^*, y_t^*) represents the desired levels for each variable, $\gamma_{(\pi,y)}$ are parameters.

[1] Kydland, F. and E. Prescott (1977), "Rules rather than discretion: The inconsistency of optimal plans", Journal of Political Economy, 85, 473-92. Barro, R. and D. Gordon, (1983), "Rules, Discretion and Reputation in a Model of Monetary Policy," Journal of Monetary Economics, 12, 101-20. Taylor, J. (1993), "Discretion versus Policy Rules in Practice," Carnegie-Rochester Conference Series on Public Policy, 39, 195-214

Rules vs discretion: the intuition

1. K&P showed that many policy decisions are subject to a fundamental problem of **time consistency**
2. Take a rational and **benevolent government** that intends to max the welfare of its citizens, and for that chooses at t a time plan for its policy to be implemented in $t+i, i=0,...,N$.
3. If the government is allowed to **revise its plan** after some time in the future, the government has incentives to change its plan, and will generally do that
4. Notice that:
    1. there is no conflict between the government and its citizens,
    2. nor is the benevolence removed from the framework,
    3. and the original plan was chosen in an optimal way.

Rules vs discretion: the intuition (continued)

1. The result comes out from a pure logical deduction from:
    1. rational expectations and dynamic policy making
    2. remember the ice-cream story of father and child: **"just one ice-cream" is good if it is credible.**
2. So, for policy decisions to be time consistent, we need **credible policies**
3. We end up having a game between **current policymakers and future policymakers**
4. K&P showed that in a REE, **discretionary policymaking leads to lower welfare** than if the government is committed (or forced to be committed) to a specific and unchangeable rule

Discretion

Discretion: the inflation game

1. **Very important**: firstly, private agents set their expectations, and then the central bank sets policy.
   1. The central bank does not commit to any rule, so ...
2. As policy makers optimize after private agents expectations are set: temptation of taking advantage of this.
3. In equilibrium, the **temptation leads to no benefit**.
4. A commitment to avoid the temptation is beneficial.

Functions of the inflation game (cont.)

1. The economy is characterized by **three functions** in this game:
    1. The aggregate supply curve (AS) : the private sector behavior
    2. The policy loss function (L) : The Central Bank behavior
    3. The rational expectations equilibrium $(\pi_t^e = \pi_t)$
2. The game: let's study a game between the central bank and the private agents in a one period game (can be repeated many times)

The three functions

1. The AS is the augmented Lucas-supply curve

$$y = y^n + a(\pi - \pi^e) \tag{1}$$

   y is real output, y^n is the natural level of output, and a is a parameter.

   1. What happens when $\pi = \pi^e$?

2. **"Natural level":** the level associated with the existence of *no nominal rigidities* (the *long term trend*) in the economy.
3. The Central Bank's loss function is given by

$$L = \frac{1}{2}\left[\lambda(y - y^*)^2 + (\pi - \pi^*)^2\right] \tag{2}$$

   1. What happens when $\lambda > 1$?And when $\lambda < 1$?

4. And the rational expectations equilibrium

$$\pi^e = \pi \tag{3}$$

Solution to the inflation game

1. What is the optimal level of inflation under discretion?
2. First, insert eq.(1) into eq.(2)
3. Then take first oder conditions with respect to of π only: CB optimizes inflation **taking the expectations of private agents as given** (π^e as given)
4. Therefore, π^e is taken as a constant by the central bank.
5. For simplicity assume that:
    1. the desired level for inflation is zero $(\pi^* = 0)$
    2. the gap between desired and natural output is defined as $k \equiv y^* - y^n$, then eq.(1) can be written

$$y - y^* = a(\pi - \pi^e) - k \tag{4}$$

Solution to the inflation game (cont.)

1. Insert eq.(4) into eq.(2) and we get

$$L = \frac{1}{2}\left\{\lambda[a(\pi - \pi^e) - k]^2 + (\pi)^2\right\}$$

2. Calculate the first order condition (FOC), taking π^e as a constant, to solve for the optimal level of π (subscript d for discretion)

$$\frac{\partial L}{\partial \pi_d} = 0 \Rightarrow a\lambda[a(\pi_d - \pi^e) - k] + \pi_d = 0$$

3. From where we can get

$$\pi_d = \frac{a^2\lambda}{1+a^2\lambda}\pi_d^e + \frac{a\lambda}{1+a^2\lambda}k \tag{5}$$

Solution to the inflation game (cont.)

1. Now impose the condition that REE is fulfilled $\pi^e = \pi$.
2. Apply this to eq. (5) and solve for π_d. We obtain

$$\pi_d = a\lambda k$$

3. Notice that there is an **inflation bias**:
   1. the central bank desires to have $\pi^* = 0$,
   2. but the optimal level of inflation is positive (a positive function of the desired output gap k)
4. To obtain the loss, we have to use the L function and after some simple but tedious algebra we get

$$L_d = \frac{\lambda k^2}{2}(1 + a^2\lambda)$$

Commitment

Commitment: the inflation game

1. With commitment, the central bank knows that its commitment will affect the determination of inflation expectations
2. The game has to be played with this rule: **inflation expectations can not be a constant anymore**
3. Therefore, **from the start of the game** we know that Rational Expectations (REE) imply

$$\pi_c = \pi_c^e$$

Commitment: solution

1. Inserting the REE condition into the Loss function, we get

$$
\begin{aligned}
L &= \frac{1}{2}\{\lambda[a\underbrace{(\pi_c - \pi_c^e)}_{=0} - k]^2 + (\pi_c)^2\} \\
&= \frac{1}{2}\{\lambda(-k)^2 + (\pi_c)^2\}
\end{aligned}
$$

2. First order condition

$$\frac{\partial L}{\partial \pi_c} = 0 \Rightarrow \pi_c = 0$$

3. Inflation is always at zero, independently of the level of the desired output gap (k)
4. To obtain the loss, use the L function and after some simple but tedious algebra we get

$$L_c = \frac{\lambda k^2}{2}$$

Rules vs discretion: the fundamental result

- If we compare the two policies for inflation and social loss

$$\begin{array}{lcc} & \textit{discretion} & \textit{commitment} \\ \textit{optimal } \pi : & \pi_d = a\lambda k & \pi_c = 0 \\ \\ \textit{optimal loss} : & L_d = \frac{\lambda k^2}{2}(1 + a^2\lambda) & L_c = \frac{\lambda k^2}{2} \end{array}$$

1. Commitment always leads to better results
2. How can we assure that the central bank always behaves with commitment:
    1. **Reputation** of central banks as tough on inflation
    2. **Delegation** to an **independent** central banker that dislikes inflation more than private agents
    3. **Contracts**: in some countries the Constitution establishes the objectives that central banks should achieve
3. **These issues are central to the analysis of the New Keynesian Model**

Discretion in the presence of uncertainty

Uncertainty into the model: discretion

1. Everything in the model will remain exactly the same, with one exception
2. The only thing that changes is the supply function (AS): now comes with a shock e_t
$$y_t = y_t^n + a(\pi_t - \pi_t^e) + e_t$$
3. The Loss function remains the same (omitting time subscripts for simplicity)
$$L = \frac{1}{2}\left\{\lambda[a(\pi - \pi^e) + e - k]^2 + \pi^2\right\}$$
4. FOC, taking π^e as a constant
$$\frac{\partial L}{\partial \pi_d} = 0 \Rightarrow a\lambda[a(\pi_d - \pi^e) + e - k] + \pi_d = 0$$
5. From where we can get
$$\pi_d = \frac{a^2\lambda}{1+a^2\lambda}\pi_d^e + \frac{a\lambda}{1+a^2\lambda}(k-e) \tag{6}$$

Solution to the inflation game: discretion

1. We have just arrived at

$$\pi_d = \frac{a^2\lambda}{1+a^2\lambda}\pi_d^e + \frac{a\lambda}{1+a^2\lambda}(k-e) \tag{7}$$

2. Now uncertainty: apply expectations to both sides of the previous equation

$$E\pi_d = \frac{a^2\lambda}{1+a^2\lambda}E\pi_d^e + \frac{a\lambda}{1+a^2\lambda}(k-Ee)$$

3. The hypothesis of Rational Expectations implies

$$E\pi_d^e = E\pi_d$$

4. And so, using the two last equations, we get

$$E\pi_d = a\lambda k \tag{8}$$

Solution to the inflation game: discretion (cont.)

1. Now we have two results given by eq(6) and (8):

$$\begin{aligned} \pi_d &= \frac{a^2\lambda}{1+a^2\lambda}\pi_d^e + \frac{a\lambda}{1+a^2\lambda}(k-e) \\ E\pi_d &= a\lambda k \end{aligned}$$

2. Insert the second into the first equation, and we get

$$\pi_d = \frac{a^2\lambda}{1+a^2\lambda}a\lambda k + \frac{a\lambda}{1+a^2\lambda}(k-e)$$

3. Solving for π_d we get

$$\pi_d = a\lambda k - \frac{a\lambda}{1+a^2\lambda}e$$

4. This is the optimal level of inflation under discretion.

Commitment in the presence of uncertainty

Solution to the inflation game: commitment

1. The central bank announces a rule for inflation and this rule is credible:
$$\pi = b_0 + b_1 e$$
2. Expected inflation is
$$\pi^e = b_0$$
3. Using the AS function
$$y = y^n + a(\pi - \pi^e) + e$$
4. We get
$$\begin{aligned} y &= y^n + a(b_1 e) + e \\ &= y^n + (1 + ab_1) + e \end{aligned} \tag{9}$$

Solution to the inflation game: commitment (cont.)

1. Now let's bring in the Loss function

$$L = \frac{1}{2}E\left\{\lambda[a(\pi - \pi^e) + e - k]^2 + (\pi)^2\right\}$$

2. Inserting eq. (9) into this Loss function (see **Appendix 1** for details)

$$L = \frac{1}{2}E\left\{\lambda[\underbrace{(1 + ab_1)e}_{=a(\pi - \pi^e)+e} - k]^2 + \underbrace{(b_0 + b_1 e)}_{\pi}{}^2\right\} \tag{10}$$

3. Now we have two unknowns

$$\begin{aligned} b_0 &= ?? \\ b_1 &= ?? \end{aligned}$$

Solution to the inflation game: commitment (cont.)

1. We got this Loss function

$$L = \frac{1}{2} E \left\{ \lambda [(1 + ab_1)e - k]^2 + (b_0 + b_1 e)^2 \right\}$$

2. The FOC with respect to b_0 is

$$\begin{aligned} \frac{\partial L}{\partial b_0} &= 0 = E(b_0 + b_1 e) \\ b_0 &= 0 \end{aligned}$$

3. The FOC with respect to b_1 is (see **Appendix 2** for details)

$$\begin{aligned} \frac{\partial L}{\partial b_1} &= 0 = E\left\{ [(1 + ab_1)e - k]\lambda ae + (b_1 e)\, e \right\} \\ b_1 &= -\frac{a\lambda}{1 + a^2\lambda} \end{aligned}$$

Solution to the inflation game: commitment (cont.)

1. Finally we can obtain the optimal level of inflation under commitment
2. We know that

$$\pi = b_0 + b_1 e$$

3. And that

$$b_0 = 0 \quad , \quad b_1 = -\frac{a\lambda}{1 + a^2\lambda}$$

4. So

$$\pi = 0 - \frac{a\lambda}{1 + a^2\lambda} e$$

5. And therefore

$$E\pi = Ee = 0$$

Other possible alternatives

1. **Strict commitment:** the CB reacts to no shocks

$$\pi = b_0$$

2. **Delegation and discretion:** Monetary policy is delegated to a central bank whose loss function is

$$L = \frac{1}{2}\left\{\lambda[a(\pi - \pi^e) + e - k]^2 + (1+\delta)(\pi)^2\right\}$$

with $\delta > 0$: the CB is more concerned about inflation than the private sector

3. **Optimal contract and discretion:** The central banker maximizes a function that includes a payoff in addition to the social loss

$$L = (t_0 - t_1\pi) - \frac{1}{2}\left\{\lambda[a(\pi - \pi^e) + e - k]^2 + (1+\delta)(\pi)^2\right\}$$

Appendix 1

1. We know from the beginning that the AS function is given by
$$y = y^n + a(\pi - \pi^e) + e$$
2. Now insert the information we have about the commitment case into this eq.
$$\begin{aligned} y &= y^n + a(\pi - \pi^e) + e \\ &= y^n + a\left[(b_0 + b_1 e) - \pi^e\right] + e \\ &= y^n + ab_0 + ab_1 e - a\pi^e + e \end{aligned}$$
3. Notice that (see above)
$$\pi^e = b_0$$
4. So, we end up having
$$\begin{aligned} y &= y^n + ab_1 e + e \\ &= y^n + e(1 + ab_1) \end{aligned}$$

Appendix 1 (cont.)

1. Notice that the last eq. in the previous slide can be written as

$$y - y^n = (1 + ab_1)e$$

2. Now remember that from the beginning the As function is given by

$$y = y^n + a(\pi - \pi^e) + e$$

3. From which we can obtain

$$y - y^n = a(\pi - \pi^e) + e$$

4. Therefore, in this current case we obtain that

$$a(\pi - \pi^e) + e = (1 + ab_1)e$$

5. This is why $(1 + ab_1)e$ appears in the Loss function (eq. 10).

Appendix 2

1. The FOC with respect to b_1 is
$$\frac{\partial L}{\partial b_1} = 0 = E\left\{[(1+ab_1)e - k]\lambda ae + (b_1 e)\, e\right\}$$
2. Which can be written as
$$0 = E\left\{(1+ab_1)\lambda a\,(e)^2 - k\lambda ae + b_1\,(e)^2\right\}$$
3. Now, consider that e follows a **standard normal distribution** (mean $= 0$, variance $= 1$), which is normal in economics. So
$$E(e) = 0 \qquad , \qquad E(e)^2 = 1$$
4. Therefore, the previous eq. can be written as
$$0 = [(1+ab_1)\lambda a + b_1$$
5. From where we get
$$b_1 = -\frac{a\lambda}{1+a^2\lambda}.$$