

# Rules versus Discretion

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# Summary

- ① A new message in the 80's
- ② Discretion: the inflation game
- ③ Commitment: the inflation game
- ④ Discretion vs commitment in the presence of uncertainty

# 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 <sup>1</sup>
- 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,  $\pi_t$  is the inflation rate,  $r_t^n$  is the natural real interest rate,  $y_t$  is output, the asterisk ( $\pi_t^*, y_t^*$ ) represents the desired levels for each variable,  $\gamma_{(\pi,y)}$  are parameters.

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<sup>1</sup>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  $t + i, i = 0, \dots, N$ .
- 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

$$y = y^n + a(\pi - \pi^e) \quad (1)$$

$y$  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

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

- ① What happens when  $\lambda > 1$ ? And when  $\lambda < 1$ ?
- ④ And the rational expectations equilibrium

$$\pi^e = \pi \quad (3)$$

## 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 order conditions with respect to of  $\pi$  only: CB optimizes inflation **taking the expectations of private agents as given** ( $\pi^e$  as given)
- 4 Therefore,  $\pi^e$  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

$$y - y^* = a(\pi - \pi^e) - k \quad (4)$$

## 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  $\pi^e$  as a constant, to solve for the optimal level of  $\pi$  (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

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

## 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  $\pi_d$ . 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

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

- 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

	<i>discretion</i>	<i>commitment</i>
<i>optimal</i> $\pi$ :	$\pi_d = a\lambda k$	$\pi_c = 0$

<i>optimal loss</i> :	$L_d = \frac{\lambda k^2}{2}(1 + a^2\lambda)$	$L_c = \frac{\lambda k^2}{2}$
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- 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

From this slide onwards, material not covered this year.

## 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  $\pi^e$  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

$$\pi_d = \frac{a^2\lambda}{1 + a^2\lambda} \pi_d^e + \frac{a\lambda}{1 + a^2\lambda} (k - e) \quad (6)$$

## Solution to the inflation game: discretion

- 1 We have just arrived at

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

- 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

$$E\pi_d = a\lambda k \quad (8)$$

## Solution to the inflation game: discretion (cont.)

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

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

$$E\pi_d = a\lambda k$$

- 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  $\pi_d$  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)

$$L = \frac{1}{2}E \left\{ \lambda \left[ \underbrace{(1 + ab_1)e}_{=a(\pi - \pi^e) + e} - k \right]^2 + \underbrace{(b_0 + b_1e)^2}_{\pi} \right\} \quad (10)$$

- 3 Now we have two unknowns

$$b_0 = ??$$

$$b_1 = ??$$

## Solution to the inflation game: commitment (cont.)

- 1 We got this Loss function

$$L = \frac{1}{2} E \left\{ \lambda [(1 + ab_1)e - k]^2 + (b_0 + b_1e)^2 \right\}$$

- 2 The FOC with respect to  $b_0$  is

$$\begin{aligned} \frac{\partial L}{\partial b_0} &= 0 = E(b_0 + b_1e) \\ b_0 &= 0 \end{aligned}$$

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

$$\begin{aligned} \frac{\partial L}{\partial b_1} &= 0 = E \{ [(1 + ab_1)e - k] \lambda a e + (b_1e) e \} \\ b_1 &= -\frac{a\lambda}{1 + a^2\lambda} \end{aligned}$$

## 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.

$$\begin{aligned} y &= y^n + a(\pi - \pi^e) + e \\ &= y^n + a[(b_0 + b_1 e) - \pi^e] + e \\ &= y^n + ab_0 + ab_1 e - a\pi^e + e \end{aligned}$$

- 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

$$\frac{\partial L}{\partial b_1} = 0 = E \{ [(1 + ab_1)e - k] \lambda a e + (b_1 e) e \}$$

- ② Which can be written as

$$0 = E \left\{ (1 + ab_1) \lambda a (e)^2 - k \lambda a e + b_1 (e)^2 \right\}$$

- ③ Now, consider that  $e$  follows a **standard normal distribution** (mean = 0, variance = 1), which is normal in economics. So

$$E(e) = 0 \quad , \quad E(e)^2 = 1$$

- ④ Therefore, the previous eq. can be written as

$$0 = [(1 + ab_1) \lambda a + b_1$$

- ⑤ From where we get

$$b_1 = -\frac{a\lambda}{1 + a^2\lambda}.$$