Rules, Discretion and Reputation
In
a Model of Monetary Policy

Barro & Gordon (1983b)

Navid Raeesi
Fall 2013
Barro and Gordon (1983b):
Rules, Discretion and Reputation in a Model of Monetary Policy

In a discretionary regime the monetary authority can print more money and create more inflation than people expect. But, although these inflation surprises can have some benefits, they cannot arise systematically in equilibrium when people understand the policymaker's incentives and form their expectations accordingly. Because the policymaker has the power to create inflation shocks ex post, the equilibrium growth rates of money and prices turn out to be higher than otherwise. Therefore, enforced commitments (rules) for monetary behavior can improve matters. Given the repeated interaction between the policymaker and the private agents, it is possible that reputational forces can substitute for formal rules. Here, we develop an example of a reputational equilibrium where the outcomes turn out to be weighted averages of those from discretion and those from the ideal rule. In particular, the rates of inflation and monetary growth look more like those under discretion when the discount rate is high.
Barro and Gordon (1983a): A Positive Theory of Monetary Policy in a Natural Rate Model

Introduction

The Model

Rule vs. Discretion

Cheating and Temptation

Enforcement of Rules

Concluding Remarks

A discretionary policymaker can create surprise inflation, which may reduce unemployment and raise government revenue. But when people understand the policymaker’s objectives, these surprises cannot occur systematically. In equilibrium people form expectations rationally and the policymaker optimizes in each period, subject to the way that people form expectations. Then, we find that (1) the rates of monetary growth and inflation are excessive; (2) these rates depend on the slope of the Phillips curve, the natural unemployment rate, and other variables that affect the benefits and costs from inflation; (3) the monetary authority behaves countercyclically; and (4) unemployment is independent of monetary policy. Outcomes improve if rules commit future policy choices in the appropriate manner. The value of these commitments—which amount to long-term contracts between the government and the private sector—underlies the argument for rules over discretion.

The primary purpose of this paper is to develop a positive theory of monetary policy and inflation.
The Problem of Time Inconsistency in Monetary Policy

- **If inflation is costly** (even a little), and if there is no real benefit to having 5 percent inflation on average as opposed to 1 percent inflation or 0 percent inflation, why do we observe average rates of inflation that are consistently positive?

- Many explanations of positive average rates of inflation have built on the *time inconsistency* analysis of Kydland and Prescott (1977) and Calvo (1978).

- The basic insight is that while it may be optimal to achieve a low average inflation rate, such a policy is not time consistent. If the public were to expect low inflation, the central bank would face an incentive to inflate at a higher rate. Understanding this incentive, and believing that the policymaker will succumb to it, the public correctly anticipates a higher inflation rate. The policymaker then finds it optimal to deliver the inflation rate the public anticipated.
The analysis of time inconsistency in monetary policy is important for two reasons:

- **First**, it forces one to examine the incentives faced by central banks. So time inconsistency is important for **positive** theories of monetary policy (how it is actually implemented).

- **Second**, if time inconsistency is important, then models that clarify the incentives faced by policymakers and the nature of the decision problems they face are important for the **normative** task of designing policy-making institutions (how they should be).

The proposed solutions for time inconsistency problem of monetary policy can be grouped into **reputational** solutions, delegation, **optimal contract**, and inflation targeting.
Relevance in Practice: Inflation in Norway and USA (1970-2005)
The analysis of time inconsistency in so far rests on the assumption that the game between the policy maker and the private sector is a one-shot game.

The argument against discretion may be weaker if a dynamic game is considered. The policy maker may then be willing to sacrifice some short-term gains by investing in reputation today and harvest the gains in the future.

Two alternative ways of modeling "reputation" are applied in the literature:

- One approach is to model reputation as the use of a "trigger strategy", as applied by e.g. Barro and Gordon (1983b).
- A second approach to modeling reputation, as applied by e.g. Backus and Driffil (1985), is to assume that the private sector is uncertain about the true preferences of the policy maker.
A problem with the reputational solutions to the time-inconsistency problem is that they quickly become very complex and give rise to multiple equilibria, which gives the approach limited predictive power.

Multiple equilibria also arises the problem of how the government and private agents can coordinate on one particular equilibrium.

Moreover, although improving the one-shot discretionary equilibrium, reputational solutions do not implement the second-best equilibrium, i.e. the outcome of the optimal rule under commitment.
The Policymaker’s Objective Function

- The monetary authority’s objective reflects the preferences of the “representative” private agent.
- The policymaker’s objective involves a cost for each period, $z_t$, which is given by

\[ z_t = (a/2)(\pi_t)^2 - b_t(\pi_t - \pi_t^e), \quad a, b_t > 0 \]

- The first term is the cost of inflation. Notice that the use of a quadratic form means that these costs rise at an increasing rate with the rate of inflation. The second term is the benefit from inflation shocks.
- The policymaker’s objective at date $t$ entails minimization of the expected present value of costs:

\[ Z_t = E \left[ z_t + \frac{z_{t+1}}{1+r_t} + \frac{z_{t+2}}{(1+r_t)(1+r_{t+1})} + \cdots \right] \]

- where $r_t$, is the discount rate that applies between periods $t$ and $t + 1$. 

\[ z_t = (a/2)(\pi_t)^2 - b_t(\pi_t - \pi_t^e), \quad a, b_t > 0 \]
The Benefits from Surprise Inflation: Expansion of Economic Activity

- One source of benefits derives from the expectational Phillips curve. Unanticipated monetary expansions, reflected in positive values of \( \pi_t - \pi_t^e \), lead to increases in real economic activity. Equivalently, these nominal shocks lower the unemployment rate below the natural rate.

- The natural rate need not be optimal.

- The Model of Unemployment and Inflation in Barro & Gordon (1983a):
  - Policy objective
    \[
    z_t = a(U_t - kU_t^n)^2 + b(\pi_t)^2, \quad a, b > 0, 0 \leq k \leq 1
    \]
  - The economy:
    \[
    U_t = U_t^n - \alpha(\pi_t - \pi_t^e), \quad \alpha > 0
    \]
    \[
    U_t^n = \lambda U_{t-1}^n + (1 - \lambda)\bar{U}_n + \varepsilon_t, \quad 0 \leq \lambda \leq 1
    \]
The Benefits from Surprise Inflation: Governmental Revenues

- Other sources of benefits from surprise inflation involve governmental revenues.

- Barro (1983) focuses on the proceeds from inflationary finance.

  ✓ The expectation of inflation, $\pi_t^e$, determines people’s holdings of real cash, $M_{t-1}/P_{t-1}$. Surprise inflation, $\pi_t - \pi_t^e$, depreciates the real value of these holdings, which allows the government to issue more new money in real terms, $(M_t - M_{t-1})/P_t$, as a replacement.

  ✓ The policymaker values this inflationary finance if alternative methods of raising revenue - such as an income tax - entail distortions.
The Benefits from Surprise Inflation: Governmental Revenues

- The revenue incentive for surprise inflation relates to governmental liabilities that are fixed in nominal terms, rather than to money, *per se*. Thus, the same argument applies to nominally-denominated, interest-bearing public debt.

✓ Suppose that people held last period the real amount of government bonds, \( B_{t-1}/P_{t-1} \). These bonds carry the nominal yield, \( R_{t-1} \), which is satisfactory given people’s inflationary expectations over the pertinent horizon, \( \pi_e^t \). Surprise inflation, \( \pi_t - \pi_e^t \), depreciates part of the real value of these bonds, which lowers the government’s future real expenditures for interest and repayment of principal.

✓ In effect, surprise inflation is again a source of revenue to the government.
The Benefits from Surprise Inflation: Governmental Revenues

- Quantitatively, this channel from public debt is likely to be more significant than the usually discussed mechanism, which involves revenue from printing high-powered money.

- The attractions of generating revenue from surprise inflation are clear if we view the depreciation of real cash or real bonds as an unexpected capital levy.

✓ As with a tax on existing capital, surprise inflation provides for a method of raising funds that is essentially non-distorting, ex-post.
The Costs of Inflation

- The second major element in this model is the cost of inflation.
- Costs are assumed to rise, and at an increasing rate, with the realized inflation rate, $\pi_t$.

✓ Although people generally regard inflation as very costly, economists have not presented very convincing arguments to explain these costs.

✓ Further, the present type of cost refers to the actual amount of inflation for the period, rather than to the variance of inflation, which could more easily be seen as costly.
The Costs of Inflation

- Shoe leather costs
- Menu costs
- Relative price variability and the misallocation of resources
- Inflation–induced tax distortion
- Arbitrary redistribution of wealth
- Confusion and inconvenience
The Setup of the Model

- The policymaker’s objective involves a cost for each period, \( z_t \), which is given by

\[
z_t = \left(\frac{a}{2}\right)(\pi_t)^2 - b_t(\pi_t - \pi_t^e), \quad a, b_t > 0
\]

- The benefit parameter, \( b_t \), can change over time (a supply shock, a sharp rise in government spending, etc.).

- The benefit parameter, \( b_t \), is distributed randomly with a fixed mean, \( \bar{b} \), and variance, \( \sigma_b^2 \) (Hence, neglecting serial correlation in the natural unemployment rate, government expenditures, etc.).
The Setup of the Model

- The policymaker’s objective at date $t$ entails minimization of the expected present value of costs:

$$Z_t = E_t \left[ z_t + \frac{Z_{t+1}}{(1 + r_t)} + \frac{Z_{t+2}}{(1 + r_t)(1 + r_{t+1})} + \ldots \right]$$

- where $r_t$, is the discount rate that applies between periods $t$ and $t + 1$.
- $r_t$, is generated from a stationary probability distribution (therefore, again neglecting any serial dependence), which is independent of the benefit parameter, $b_t$.
- For the first period ahead, the distribution of $r_t$, implies a distribution for the discount factor, $q_t = 1/(1 + r_t)$.
- The mean and variance of $q_t$, are denoted by $\bar{q}$, and $\sigma_q^2$, respectively.
The Setup of the Model

- The policymaker controls a monetary instrument, which enables him to select the rate of inflation, $\pi_t$, in each period.
- We study a symmetric case where no one knows the benefit parameter, $b_t$, or the discount factor for the next period, $q_t$, when they act for period $t$.

✓ Hence, the policymaker chooses the inflation rate, $\pi_t$, without observing either $b_t$ or $q_t$. Similarly, people form their expectations, $\pi^e_t$, of the policymaker’s choice without knowing these parameters.

✓ We do not study other informational structures in this lecture!
Discretionary Policy

- The discretionary policy in the present context is the solution of a **non-cooperative game** between the policymaker and the private agents.

  ✓ In particular, the policymaker treats the current inflationary expectation, $\pi_t^e$, and all future expectations, $\pi_{t+i}^e$ for $i > 0$, as given when choosing the current inflation rate, $\pi_t$.

  ✓ Given rational expectations, people predict inflation by solving out the policymaker’s optimization problem and forecasting the solution for $\pi_t$, as well as possible.

- Hence,

  \[ \hat{\pi}_t = \frac{b}{a} \]

  \[ \pi_t^e = \hat{\pi}_t = \frac{b}{a} \]

  \[ \hat{z}_t = (1/2) \frac{b^2}{a} \]
Policy under the Ideal Rule

- Suppose now that the policymaker can commit himself in advance to a rule for determining inflation.

- This rule can relate $\pi_t$, to variables that the policymaker knows at date $t$. Given the informational structure assumed, the policymaker can condition the inflation rate, $\pi_t$, only on variables that are known also to the private agents.

- Therefore, the policymaker effectively chooses $\pi_t$, and $\pi_t^e$ together, subject to the condition that $\pi_t = \pi_t^e$.

- Hence,

  $\pi_t^* = 0$

  $\pi_t^e = \pi_t^* = 0$

  $z_t^* = 0$
The general point is that the costs under the rule \( z_t^* = 0 \), are lower than those under discretion \( \hat{z}_t = \left(1/2\right) \bar{b}^2 / a \).

The lower cost reflects the value of being able to make commitments – that is, *contractual agreements* between the policymaker and the private agents.

Without these commitments, inflation ends up being excessive – specifically, \( \hat{\pi}_t > 0 \) – but, no benefits from higher inflation result.
The policymaker is tempted to renege on commitments.

In particular, if people expect zero inflation – as occurs under the rule – then the policymaker would like to implement a positive inflation rate in order to secure some benefits from an inflation shock.

How much can the policymaker gain in period $t$ by cheating?

Assume that people have the inflationary expectation, $\pi^e_t = 0$, which they formed at the start of period $t$. Hence,

$$\tilde{\pi}_t = \frac{b}{a}$$

$$E[\tilde{z}_t] = -(1/2) \frac{b^2}{a}$$

We refer to the difference between the expected costs under rule and cheating as the temptation to renege on the rule:

$$\text{temptation} = E[z^*_t - \tilde{z}_t] = (1/2) \frac{b^2}{a}$$
Ranging from low costs to high, three types of outcomes are:

- **Cheating** (when people expecting the ideal rule),
  \[ E[\hat{z}_t] = -\left(\frac{1}{2}\right) \frac{\bar{b}^2}{a} , \]

- **Rule**, \( z_t^* = 0 \),

- **Discretion**, \( \hat{z}_t = \left(\frac{1}{2}\right) \frac{\bar{b}^2}{a} \).

Notice that the rule is only a second-best solution. Cheating – when people anticipate the ideal rule – delivers better results.

But, the cheating outcome is feasible only when people can be systematically deceived into maintaining low inflationary expectations which cannot happen in equilibrium.

However, the incentive to cheat determines which rules are sustainable without legal or institutional mechanisms to enforce them.
Generally, a credible rule comes with some enforcement power that at least balances the temptation to cheat.

Barro and Gordon consider the enforcement that arises from the potential loss of reputation or credibility. This mechanism can apply here because of the repeated interaction between the policymaker and the private agents.

Consider a rule that specifies the inflation rate, $\pi^*_t$, for period $t$. Barro and Gordon postulate the following form of expectations mechanism:

\[
\begin{align*}
\pi^e_t &= \pi^*_t & \text{if} & & \pi_{t-1} = \pi^e_{t-1} \\
\pi^e_t &= \hat{\pi}_t & \text{if} & & \pi_{t-1} \neq \pi^e_{t-1}
\end{align*}
\]

Why is this expectations mechanism eventually rational?

What is the length of the punishment interval?
Consider our previous rule where $\pi_t^* = 0$ and suppose that the policymaker has credibility in period $t$, so that $\pi_t^e = 0$.

If the policymaker cheats during period $t$, then his best choice of inflation is $\tilde{\pi}_t = b/a$, and the policymaker gains the temptation, $E[z_t^* - \tilde{z}_t] = (1/2) \bar{b}^2 / a$.

The cost of this violation is that discretion, rather than the rule, applies for period $t + 1$, Hence, the policymaker realizes next period the cost, $\hat{z}_{t+1} = (1/2) \bar{b}^2 / a$, rather than, $z_{t+1}^* = 0$.

Since costs for period $t + 1$ are discounted by the factor $q_t = 1/(1 + r_t)$, the expected present value of the loss is

$$enforcement = E[q_t(\hat{z}_{t+1} - z_{t+1}^*)] = \bar{q}(1/2) \bar{b}^2 / a$$

The term, enforcement is used to refer to the expected present value of the loss from transgressions.
Enforceability Restriction

- Rules that can apply in equilibrium are those that have enough enforcement to motivate the policymaker to abide by them.
- That is, the equilibrium satisfies two properties:
  - **First**, the expectations are rational. In particular, each individual’s projection, $\pi_e^t$, is the best possible forecast of the policymaker’s actual choice, $\pi_t$, given the way the policymaker behaves and given the way others form their expectations.
  - **Second**, the policymaker’s choice $\pi_t$, maximizes his objective, given the way people form their expectations.
- In equilibrium rules satisfy the enforceability restriction,

\[
\text{temptation} \leq \text{enforcement}
\]

\[
E[z_t^* - \tilde{z}_t] \leq E[q_t(\hat{z}_{t+1} - z_t^*)] 
\]

- Is the rule $\pi_t^* = 0$ enforceable?
We look here for the best enforceable rule – that is, the one that minimizes expected costs, subject to the constraint that the enforcement be at least as great as the temptation.

In the present setting, where the parameters, $b_t$ and $q_t$ are unobservable at date $t$, the best rule has the simple form, $\pi^*_t = \pi$.

That is, the rule specifies constant inflation (a ‘constant-growth-rate rule’).

We can calculate the temptation and enforcement associated with the best enforceable rule,

\[
temptation = E[z^*_t - \tilde{z}_t] = \left(\frac{a}{2}\right)\left(\bar{b} - \pi\right)^2
\]

\[
enforcement = E[q_t(\hat{z}_{t+1} - z^*_{t+1})] = \bar{q}\left(\frac{a}{2}\right)\left[\left(\frac{\bar{b}}{a}\right)^2 - \pi^2\right]
\]
Temptation and Enforcement

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5. Enforcement of Rules
6. Concluding
The Best Enforceable Rule

- Notice that, the enforcement is at least as large as the temptation for values of $\pi$ in the interval, $\left(\frac{1-\bar{q}}{1+\bar{q}}\right)\left(\frac{\bar{b}}{a}\right) \leq \pi \leq \left(\frac{\bar{b}}{a}\right)$. Specifically, there is a range of announced inflation rates that can be equilibria, among which, we focus on the value of $\pi$ that delivers the best results in the sense of minimizing the expected costs.

- The best of the enforceable rules occurs where the curves for temptation and enforcement intersect.

- Hence, the announced inflation rate is

  $$\pi^* = \left(\frac{1-\bar{q}}{1+\bar{q}}\right)\left(\frac{\bar{b}}{a}\right)$$

- Notice that, with $0 < \bar{q} < 1$, the inflation rate, $\pi^*$, is intermediate between the ideal rule, 0, and discretion, $\bar{b}/a$. 

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- For this announced inflation rate, the expected cost in each period is

\[ E[z_t^*] = \left( \frac{1 - \bar{q}}{1 + \bar{q}} \right)^2 \left( \frac{\bar{b}^2}{2a} \right) \]

- Since \( 0 < \bar{q} < 1 \), the expected cost is also intermediate between that from the ideal rule, which is zero, and that for discretion, which is \((1/2) \bar{b}^2 / a\).
The best enforceable rule is a weighted average of the ideal rule and discretion, with the weights depending on the mean discount factor. Any force that influences the mean discount factor (such as war), has a corresponding effect on inflation.

The ideal rule is itself a second-best solution, which is inferior to cheating when people anticipate the ideal rule. But, cheating cannot occur systematically when people understand the policymaker’s incentives and form their expectations accordingly. Rather, the lure of the better outcome from cheating creates the temptation, which makes the ideal rule non-enforceable.

Hence, the attraction of the first best makes the second best unattainable. We end up with a cost that exceeds the second best (the ideal rule), but which is still lower than the third best (discretion).
Determinants of Inflation

- **The effect of the discount factor:**
  - A relatively small value of $\bar{q}$, implies a relatively high weight on discretion - that is, a high value of $\pi^*$.  
  - That’s because a decrease in $\bar{q}$ weakens the enforcement, which requires $\pi^*$ to increase in order to maintain the equality between the enforcement and the temptation.

- **The effect of the ratio of the cost parameters:**
  - An Increase in the ratio, $\bar{b}/a$, raises the temptation, relative to the enforcement, which requires $\pi^*$ to increase.
  - If inflation is not very costly, so that the parameter $a$ is small, then we end up with a lot of inflation. Also, anything that raises the mean benefit attached to an inflation shock, $\bar{b}$, leads to higher inflation (but, not to more benefits from inflation shocks).
The theory accounts for

- a rise in the mean inflation rate along with a rise in the natural unemployment rate,
- countercyclical response of monetary policy,
- high rates of monetary expansion during wartime,
- high rates of monetary growth in some less developed countries, and
- an inflationary effect from the outstanding real stock of public debt.
Barro and Gordon (1983b): Concluding Observations

Our analysis provides an example of a reputational equilibrium for monetary policy. The results amount to a combination of the outcomes from discretion with those from the ideal rule. Previously, we analyzed discretion and rules as distinct possible equilibria. Now, the relative weights attached to the discretionary and rules solutions depend on the policymaker’s discount rate and some other factors. From a predictive standpoint for monetary growth and inflation, the results modify and extend those that we discussed previously.

In some environments the rules take a contingent form, where inflation depends on the realization of the benefit parameter or the discount factor. Here, the policymaker sometimes engineers surprisingly low inflation, which is costly at a point in time. Thus, the monetary authority ‘bites the bullet’ and pursues a contractionary policy, given some states of the world. By acting this way, the policymaker sustains a reputation that permits surprisingly high inflation in other states of the world.

We have difficulties with multiplicity of equilibria, which show up also in the related game-theory literature. Here, the problem arises in determining how long a loss of reputation persists. In an extended version of the model, we can figure out the optimal length for this interval of punishment. But, from a positive standpoint, it is unclear which equilibrium will prevail.
Thanks for Your Attention!