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On the Optimality of Delay in 'Monetary Policy as a Process of Search'

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Abstract

Caplin & Leahy (1996) show that, when central bankers learn about the economy by observing its response to policy shock, cautious monetary policy may be ineffectual as private agents correctly anticipate that today's interest rate cuts are likely to be followed by future cuts. The central banker has to account for this strategic response of private agents to small interest rate cuts by acting more aggressively than would otherwise be the case. Caplin & Leahy, however, do not examine whether or not this strategic behavior on the part of private agents represents a constraint on the ability of monetary policy to implement optimal investment outcomes. The purpose of this paper is to show that the kinds of strategic interactions between investors and the central banker highlighted by Caplin and Leahy affect only the policy rule and do not influence the investment outcome in equilibrium.

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1 Introduction

Central bankers frequently respond to recessionary episodes by lowering interest rates in hopes of inducing additional investment. Such a central bank has an incentive to be cautious, however, as excessive stimulation may lead to a rise in inflation. Caplin & Leahy (1996) analyze the implications for expansionary monetary policy when central bankers learn about the economy by observing its response to policy shocks. They show that a cautious approach to monetary policy (i.e. starting with a small interest rate cut and waiting to see what happens), may be ineffectual because private agents correctly anticipate that future rate cuts are likely to follow, and strategically delay investment as a result.

The well known[1] implication of this mechanism is that it changes the form of the optimal interest rate rule. Interest rate cuts that do not take the strategic behavior of private agents into account will be too conservative and lead to excessively long recessions. As a result, when private agents behave strategically, the central banker must act aggressively in the face of an economy operating below potential output.

Caplin & Leahy, however, do not discuss the implications of this mechanism for the equilibrium investment profile. This leads to possible confusion about whether the equilibrium investment profile implemented by the central banker is sub-optimal.[2] In other words, does the strategic behavior of agents represent a constraint on the ability of monetary policy to implement optimal outcomes or does it merely mandate a modification of the optimal policy rule, with no effect on the ability of the central banker to achieve desired outcomes?

This paper shows that strategic interactions between investors and the central banker in this environment only affect the policy rule. The central banker is able to achieves his or her desired outcome despite the strategic behavior of private agents.

This result is shown by studying a problem in which the central banker is able to directly choose the decision rules of the agents. This eliminates the possibility of any strategic interaction between investors and the central banker and sets up a benchmark against which the equilibrium of the original model can be compared. The investment profile which solves this problem is identical to the investment profile which obtains in equilibrium in the original model.

Both the equilibrium and optimal investment profiles do exhibit delay, but this is due to the inherent uncertainty in the economy and is not exacerbated by the strategic interaction between the central banker and private agents. Furthermore, if the central banker were to target the socially optimal level of investment, the equilibrium outcome of the policy game would be identical to the first best outcome.

[1] See Wieland (2000), Yetman(2003), for example.

[2] See Spahn (2001), for example.

2 The Model

This paper re-visits Caplin & Leahy's model to examine whether or not the mechanism they identify affects the equilibrium investment profile. Unlike in their model, where the central banker can only influence private agents via interest rates, here the central banker is allowed to directly choose the decision rules of the agents. This eliminates the possibility of any strategic interaction between investors and the central banker and sets up a benchmark against which the equilibrium of the original model can be compared. The modified model is identical to Caplin & Leahy's original environment, aside from the ability of the central banker to set private agents' decision rules.

Time is discrete, and $t = 1, 2, \ldots, \infty$. At any point in time the economy is in one of three states: a recessionary state, an inflationary state, and a state of full employment and stable prices. The economy begins in the recessionary state. Following Caplin & Leahy, both the full employment and the inflationary state are assumed to be absorbing (i.e. the game ends once the economy enters either of these states).

The central banker has preferences over the three states of the economy as follows: for each period in which the economy remains in recession the central banker receives a payoff of $-\alpha$, upon entering the inflationary state the central banker receives a payoff of $-\beta$, and the central banker suffers no dis-utility in the full employment state. The central banker discounts the future at rate ρ. Since only the relative value of α and β matter, β is normalized to 1.

There are two potential investment projects, indexed $i \in \{1, 2\}$. If neither project is undertaken, the economy is said to be in the recessionary state, if both are undertaken the economy enters the inflationary state, and if one is undertaken the economy reaches full employment with stable prices.

Each project belongs to a private agent and is characterized by a parameter π_i, which reflects the profitability of the agent's investment project. Higher π corresponds to more profitable investment. Each π_i is independently drawn from a uniform distribution on [0,1]. The distribution is known to all players but the realization of each π_i is known only to player i. A project can only be undertaken once.[3]

The central banker chooses the investment strategies, which are decision rules specifying whether an agent with a given π_i invests or not at any date t, subject to the informational constraints of the original model (that the central banker does not observed the realized values of profitability). Thus, the central banker is restricted to specifying a set of values of profitability at each time t, denoted Π_t, such that project i is activated at time t if and only if $\pi_i \in \Pi_t$. Furthermore, the central banker is

[3]In the original model, agents choose the timing of investment to maximize expected profits. An agent investing in period t the agent receives a payoff of $\delta^t \cdot (\pi_i - r_t)$, where δ is the agents discount factor and $r_t \in [0, 1]$ is the interest rate, which is the policy instrument the central banker uses to influence the investment decisions of private investors. If an agent chooses not to invest then the agent receives a payoff of zero in that period but retains the option to invest at some future date.

constrained such that the highest profitability projects are the first to be activate. In other words, Π_t takes the form $[\pi_{t-1}, \pi_t]$, where $\pi_t \geq \pi_{t-1}$ and $\pi_0 = 1$.[4]

Let $v_t(\pi)$ denote the value of the optimal policy for the central banker given that it chose π as the cutoff rule in the previous period. The Bellman equation for the central banker's problem is:

$$v_t(\pi) = \max_{\pi'} \left(\frac{\pi'}{\pi}\right)^2 \cdot (\rho v_{t+1}(\pi') - \alpha) - \left(\frac{\pi - \pi'}{\pi}\right)^2. \tag{2.1}$$

If the "game" continues the central banker faces the same trade-off between inflation and unemployment for every π. Hence, $v_t(\pi)$ is constant and equal to v for all t, implying that $\partial v_{t+1}/\partial \pi = 0$. Hence, the first order condition is given by:

$$\pi' = \frac{1}{1 + \alpha - \rho}\pi. \tag{2.2}$$

Since $\pi_0 = 1$, $\pi_1 = \frac{1}{1+\alpha-\rho}$, $\pi_2 = (\frac{1}{1+\alpha-\rho})^2$, and $\pi_t = (\frac{1}{1+\alpha-\rho})^t$.

Substituting 1.2 back into 1.1 gives:

$$\frac{\pi_t}{\pi_{t-1}} = \frac{\alpha + \rho + 1}{2\rho} - \sqrt{\left(\frac{\alpha + \rho + 1}{2\rho}\right)^2 - \frac{1}{\rho}} \tag{2.3}$$

This is the same investment profile as occurs when the central banker does not choose the cutoffs directly (i.e. it is identical to equation (1) in Caplin & Leahy). This shows that strategic interactions between private agents and the central banker do not affect the profile of investment. The central banker is able to implement his/her preferred outcome as an equilibrium outcome.

An alternate way of making the same point is to ask what would happen if the central banker's objective were to maximize the welfare of agents in the economy, which in this case would mean maximizing discounted expected profits. It is easy to see that the first best is for both agents to invest in the first period. This is because profits are always positive and agents discounts the future.

What would the equilibrium outcome be in the case where the central banker targeted the first best outcome but could only influence investment by changing the interest rate? In this case, it turns out that the central banker is able to implement the first best as an equilibrium outcome in this case. This is achieved by setting $r_1 = 0$. Since 0 is the lowest value the interest rate can take, private agents have no incentive to delay in hopes of lower future interest rates. Furthermore, when the interest rate is zero, all projects are profitable, since $\pi_i \geq 0$. Therefore, both agents invest in the first period.

[4]Since the central banker doesn't care about profitability relaxing this assumption would allow for multiple optima (of which, the optimum solved for here would be one). Essentially, given the central banker's preferences, only the probability of investment matters. The central banker is indifferent between investment profiles where profits are high versus those where profits are low, as long as the probability of investment at each t is identical under each profile. This assumption amounts to forcing the central banker to choose the most profitable of all investment profiles which maximize his/her payoffs.

3 Remarks

This paper shows that strategic interactions between investors and the central banker in this environment only affect the policy rule. The central banker is able to achieves his or her desired outcome despite the strategic behavior of private agents. There is delay in investment in equilibrium, but this is the optimal response to the uncertainty inherent in the economy and is unaffected by any strategic behavior on the part of investors.

Caplin and Leahy are motivated by the "apparent failure of monetary policy to end the recent recession in the United States in spite of a reduction in the discount rate of 400 basis points." In light of the results of this paper, however, it is unclear that one should interpret the observation that central bankers made successive cuts in interest rates and did not end rapidly as a failure of monetary policy. A policy maker with the preferences specified by Caplin and Leahy attempting to implement the optimal policy would follow just such a strategy, and would have successfully implemented his or her preferred outcome. This outcome would involve a delayed recovery from the recession, but this delay would represent the policy maker's optimal response to the uncertainty inherent in the economy rather than a failure of monetary policy.

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