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Managing disinflation under uncertainty

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ABSTRACT

In this paper we analyze disinflation policy when a central bank has imperfect information about private sector inflation expectations but learns about them from economic outcomes, which are in part the result of the disinflation policy itself. The form of uncertainty is manifested as uncertainty about the effect of *past* disinflation policy on the current output gap. This differs from other studies on learning and control in a monetary policy context (e.g., Ellison, 2006; Svensson and Williams, 2007) that assume uncertainty about the effects of *current* policy actions on the economy. We derive the central bank's optimal disinflation strategy under active learning (DOP) and compare it with two limiting cases—certainty equivalence policy (CEP), or passive learning, and a Brainard-style cautionary monetary policy (CP). It turns out that under the DOP inflation stays between the levels implied by the CEP and the CP. A novel result—e.g., unlike Beck and Wieland (2002)—is that this holds irrespective of the initial level of inflation. At high levels of inherited inflation the DOP moves closer to the CEP, at low levels of inherited inflation the DOP resembles the CP.

1. Introduction

How should central banks manage a disinflation process? The received view in the literature—as expressed by King (1996) at the Kansas City Fed symposium on Achieving Price Stability—seems to be for a gradual timetable, with inflation (reduction) targets consistently set below the public's inflation expectations. As King puts it, "the aim was not to bring inflation down to below 2 percent by the next month, or even the next year. It was to approach price stability gradually …some four to five years ahead". However, King also raises the possibility that a central bank may try to convince the private sector of its commitment to price stability by choosing to reduce inflation towards the inflation target quickly. He calls this 'teaching by doing'. Then the choice of a particular inflation rate influences the speed at which expectations adjust to price stability.

King shows how the optimal speed of disinflation depends crucially on whether the private sector immediately believes in the new low inflation regime or not. If they do, the best strategy is to disinflate quickly, since the output costs are then zero. Of course, if expectations are slower to adapt, the disinflation should be more gradual as well. Teaching by doing effects have also been analyzed by Hoeberichts and Schaling (2000) and Schaling (2003). They find that allowing for teaching by doing effects always speeds up the disinflation process vis-à-vis the case where this effect is absent. Thus, their result is that 'speed' in the disinflation process does not necessarily 'kill', in the sense of creating large output losses.

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In this paper we analyze optimal disinflation policy when the central bank faces uncertainty regarding the prevailing level of inflation expectations and uses data from the economy to learn about them. The process of learning involves updating in real time using standard Kalman filtering methods. We find that when the central bank internalizes the effect of its current disinflation policy on future uncertainty about inflation expectations, it disinflates more than implied by a policy of certainty equivalence but less than implied by a cautionary policy. Under active learning, the optimal disinflation policy is a non-linear function of the state of the economy and the central bank's belief about inflation expectations. It turns out that, given its belief, the optimal policy stays close to a certainty equivalence policy when the inherited level of inflation is high. When the inherited level of inflation is low, the optimal policy stays close to a policy that implies caution (as first shown by Brainard (1967), but now extended to a dynamic context). In our case, a cautionary policy disinflates more than implied by the certainty equivalence policy.

Regarding the focus on learning and control, our paper is related to other studies that have analyzed the role of parameter uncertainty in optimal monetary policy (see, e.g., Bertocchi and Spagat, 1993; Balvers and Cosimano, 1994; Wieland, 2000a,b; Ellison and Valla, 2001; Yetman, 2003; Ellison, 2006; Svensson and Williams, 2007).[1] However, these studies typically assume uncertainty about the effects of *current* policy actions on the economy.[2] Also, a common feature of most of these studies is that the linear economic process subject to central bank control is static. By contrast, in our model, imperfect information about inflation expectations is reflected as uncertainty about the effects of *past* policy actions. Thus, in our case the lag of the policy instrument is crucial for the dynamics of the economy.

The remainder of the paper is organized as follows. Section 2 presents a simple model and discusses private sector (subjective) expectations about the credibility of the central bank's inflation (reduction) target. It also discusses belief updating on the part of the central bank. In Section 3 we derive the optimal degree of disinflation under alternative scenarios—certainty equivalence, the cautionary and the dynamically optimal policies and present sensitivity analysis to changes in the key parameters. In Section 4 we discuss convergence of limit beliefs and policies. Finally, Section 5 presents our concluding remarks.

2. The model

King (1996) discusses disinflation policy using a simple macroeconomic model, which combines nominal wage and price stickiness and slow adjustment of expectations to a new monetary policy regime. The model has three key equations—aggregate supply, monetary policy preferences and inflation expectations. Aggregate supply exceeds the natural rate of output when inflation is higher than was expected by agents when nominal contracts were set. This is captured by a simple short-run Phillips curve (see also Cogley et al., 2007).[3]

$$z_t = \pi_t - \pi_t^e + u_t \tag{1}$$

where π_t is the rate of inflation, z_t is the output gap and π_t^e indicates that the expectation of inflation is the subjective expectation (belief) of private agents. As in King (1996), this belief does not necessarily coincide with rational expectations. The model is not restrictive as long as inflation expectations are in part influenced by past monetary policy (see, e.g., Bomfim and Rudebusch, 2000; Yetman, 2003).[4]

The regime change is represented by a new inflation target $\pi^* = 0$, which is announced to the public at the end of $t-1$. The new target is lower than the initial steady state inflation, denoted by π_0.

The central bank's objective as of period t is to choose a sequence of current and future inflation rates $\{\pi_\tau\}_{\tau=t}^{\infty}$ so as to minimize its intertemporal loss

$$E_{t-1}^c \sum_{\tau=t}^{\infty} \delta^{\tau-t} L(\pi_\tau, z_\tau) \tag{2}$$

where

$$L(\pi_t, z_t) = \frac{1}{2}(z_t - z^*)^2 + \frac{\alpha}{2}(\pi_t - \pi^*)^2 \tag{3}$$

[1] Formally, the numerical methods for solving optimal control under parameter uncertainty originate in the *dual control* literature (see, e.g., Prescott, 1972). The dual control literature has shown that the so-called separation principle may not hold, and a trade-off between estimation and control arises because current actions influence estimation (learning) and provide information that may improve future performance. (See, e.g., Wieland, 2000b) for a detailed discussion.

[2] As our focus is on parameter uncertainty, we abstract from other forms of uncertainty, such as model uncertainty (see, e.g., Cogley et al., 2007), which are also important for monetary policymakers.

[3] In their analysis of U.S. monetary policy experimentation in the 1960s, Cogley et al. (2007) use a model similar to ours but with unemployment instead of output.

[4] In future work we want to investigate disinflation policy in the context of a hybrid New Keynesian (NK) Phillips curve along the lines of $\pi_t = \varphi\gamma\pi_{t-1} + (1-\varphi)\delta E_t \pi_{t+1} + \alpha_1 z_t - u_t$. Note that if $\varphi = \alpha_1 = 1$, $\pi^* = 0$ and using (4) this equation collapses to (1). Further, $\varphi = 0$ results in the standard NK Phillips curve. Finally, $0 < \varphi < 1$ and $\gamma = 1$ yields the hybrid NK Phillips curve (see, e.g., Woodford, 2003). For an analysis that resembles NK macroeconomics but permits non-clearing markets see Chen et al. (2006).