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# On the optimal monetary policy response to noisy indicators

Kosuke Aoki\*

*CREI, Universitat Pompeu Fabra, Ramon Trias Fargas 25–27, Barcelona 08005, Spain*

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## Abstract

We describe a behavior of a central bank when its measures of current inflation and output are subject to measurement errors, in a framework of optimizing models with nominal price stickiness. In our model, a central bank sets the interest rate equal to its current estimate of the so-called Wicksellian natural rate of interest. This is shown to imply that the interest rate responds to the central bank's estimates of both current inflation and output gap, as advocated by Taylor (1993). It is also shown that the noise contained in the indicators justifies a degree of policy cautiousness. A reduced-form representation of optimal policy should exhibit interest-rate smoothing, which is often found in the empirical literature on monetary policy reaction functions.

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## 1. Introduction

In the recent studies of monetary policy, simple policy rules have received attention as a means to a more transparent and effective monetary policy. The policies of this family, which is originally proposed by Taylor (1993), are feedback rules which vary interest rate responding to current and lagged output gap, inflation, and interest rates. There has been considerable amount of research suggesting that simple feedback rules achieve good results in simulated small macroeconomic

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\*Tel.: +34-93-542-2871; fax: +34-93-542-1860.

*E-mail address:* [kosuke.aoki@crei.upf.es](mailto:kosuke.aoki@crei.upf.es) (K. Aoki).

models.<sup>1</sup> At the same time, many empirical studies report that the policy specifications of this kind fit the actual behavior of the central banks in several countries.<sup>2</sup>

An issue in the implementation of rules is the availability of relevant data. A central bank has only preliminary measures of current conditions with considerable measurement errors when it makes its policy decision. Accurate measures of these variables, which are required for the implementation of an optimal rule, are not known until much later. For example, [Orphanides \(1998a\)](#) reports that more than 30 percent of the fluctuations in the preliminary measures of the output gap and the GDP deflator may be caused by measurement errors. Thus the measurement problem of this kind is not negligible. This information constraint would be particularly important for a central bank which follows a Taylor-type policy rule. When the central bank has only preliminary data, the interest rate chosen by a feedback rule is affected by measurement errors. A good candidate for practical policy feedback rule might have undesirable properties once we recognize the fact that the central bank has only noisy data.

In this paper, we describe the behavior of a central bank under data uncertainty, using a simple dynamic sticky price model. Specifically, we consider a central bank under [Svensson's \(1999\)](#) flexible inflation targeting regime, formulate how the central bank optimally extracts information about economic shocks from noisy indicators, and derive some properties of the optimal monetary policy. As is shown in [Svensson and Woodford \(2003b\)](#), even if the central bank and the private agents have asymmetric information, certainty equivalence holds in the sense that optimal policy response to estimates of the state of the economy is independent of degree of uncertainty. In our model, this implies that the central bank sets the nominal interest rate equal to the conditional estimate of the so-called “Wicksellian natural rate of interest” conditional on its information set. Next we consider optimal information extraction from noisy indicators, and derive an optimal policy in terms of observable variables. Here it is shown that separation principle does not hold under our information structure, since estimation is not independent of policy chosen ([Svensson and Woodford, 2003b](#)). We show that the interest rate should respond to the central bank's estimates of both current inflation and the current output gap, as advocated by [Taylor \(1993\)](#), even if the bank's objective is purely to stabilize inflation. It is also shown that, when an indicator is noisy, the central bank should respond to it cautiously. A classic paper by [Brainard \(1967\)](#) shows that uncertainty about parameters (i.e., multiplicative uncertainty), and hence uncertainty about policy multipliers, may make policy-makers more cautious. He also argues that additive uncertainty may not justify policy cautiousness. On the contrary, we show that noise contained in indicators is also a reason for policy cautiousness, even if it is additive uncertainty. However, this does not contradict to the certainty equivalence property. We also consider the optimal response of the interest rates to lagged *endogenous* variables. Optimal policy has a unique representation in terms of a

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<sup>1</sup> See, for example, [Rotemberg and Woodford \(1999\)](#), and [Rudebusch and Svensson \(1999\)](#).

<sup>2</sup> See, for example, [Clarida et al. \(1998\)](#).

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