# Stochastic Optimisation and Worst-Case Analysis in Monetary Policy Design

S. Žaković, B. Rustem, V. Wieland

January 21, 2003

## 1 Abstract

In recent years, an increasing number of contributions to the literature on monetary policy design have proposed robust control or worst–case analysis as a viable alternative to traditional expected value optimisation in determining a desirable decision rule for monetary policy under uncertainty. The advantage of worst-case analysis relative to stochastic optimisation is that the recommended decision rule will effectively minimise the central bank's loss under a worst-case scenario, such as a particularly bad realization of economic shocks or structural parameter values. Furthermore, the decision maker need not necessarily take a stand on the probability distribution of different outcomes in determining the policy rule that minimise the loss under the worst-case scenario. However, the suitability of worst-case analysis or robust control to monetary policy design has also been questioned because its recommendation may be quite sensitive to the choice of worst-case scenario while not providing much guidance on which worst-case scenario to focus on.

In this paper, we show how stochastic optimisation and worst-case analysis can be used together in order to provide central banks with a straightforward tool for selecting a policy rule that limits worst-case outcomes while at the same time providing reasonably good performance on average. We conduct this analysis within a simple estimated model of the euro area with adaptive expectations discussed in Orphanides and Wieland (EER 2000). In particular, we consider not only uncertainty due to additive shocks but also uncertainty with respect to all the parameters of the model, including multiplicative parameters and potential nonlinearities in the inflation-output relationship. In terms of monetary policy design, we focus on the optimal choice of response coefficients in a Taylor-style interest rate rule that responds to inflation and the output gap and we evaluate the performance of

this type of rule by means of a standard quadratic loss function in output and inflation.

First, we obtain optimised coefficients for the monetary policy rule by worst-case analysis and by expected value optimisation. For worst-case analysis we use the minimax algorithm in Rustem and Howe (2002). The policy rule derived in this manner will guarantee to limit the central bank's loss in a given worst-case scenario. Such a scenario is defined by setting the bounds of the range of possible parameter values and shock realizations in the linear or nonlinear version of our small macroeconomic model. We consider alternative bounds in the analysis that are motivated as multiples of the standard deviations of parameters and shocks in the empirical model. For stochastic optimisation we use an efficient algorithm that can accommodate multiplicative parameter uncertainty as well as nonlinearity of the underlying macroeconomic model.

We then compare the rules obtained by the two different methods by comparing their respective performance in the worst-case scenario as well as the overall expected performance given the empirical probability distributions. Based on this comparison, we can discuss the problem of monetary policy design under uncertainty in terms of the following straightforward tradeoff.: namely, what is the price of a given limit on worst-case losses in terms of average performance, or put in words relevant to a strict inflation-targeting central bank, what is the price of a given limit on the worst-case inflation deviation from target in terms of increased inflation variability on average.