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Evaluating monetary policy rules under fundamental uncertainty: An info-gap approach

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ABSTRACT

Monetary transmission mechanisms after the financial crisis are poorly understood. This implies that monetary policy decisions are made under very high and immeasurable uncertainty. We evaluate alternative Taylor rules that reflect different views, assuming fundamental uncertainty on the parameters and shocks. Rather than selecting rules based on their econometric fit, we apply info-gap theory to rank the rules according to a different criterion: the trade-off between robustness to uncertainty and performance. We find that in the euro area a standard Taylor rule, based on a traditional and well understood macroeconomic model, outperforms more complicated rules that include a credit spread or a debt-to-GDP ratio. It implies that monetary policy that refrains from aiming at financial stability is most robust to uncertainty.

1. Introduction

Central banks have used different types of unconventional monetary policy measures to support demand and raise inflation following the financial crisis. As pointed out by Borio and Disyatat (2010), the distinguishing feature of these measures is that the central bank actively uses its balance sheet to affect market prices and conditions beyond a short-term interest rate. The questions that arise are how effective they have been in achieving their objectives, what unforeseen risks they might entail and what is the way forward. While monetary policy will be normalised, it is increasingly unlikely that it will go back to the way that it was applied before the crisis. Interest rates – the central banks' main conventional tool – might remain at a lower level than historical standards and closer to the zero-lower bound because of a fall in the neutral rate. This implies two things: less of a scope of using it to stimulate demand in the future, and a much greater need to rely on balance sheet policies. Coupled with the fact that it is not advisable to reduce balance sheets quickly, monetary policy in the new normal will look different (Claeys and Demertzis, 2017). By implication, what was considered "unconventional" is shifting to the more conventional tool box of monetary authorities.

But balance sheet effects on the financial system and the real economy are not well known or indeed understood. Similarly, while the "new normal" will be different, it is not clear how different. In addition, there are other factors in the euro area that add to the difficulty of understanding the way forward. A changing global macroeconomic and financial environment, fragmented euro area governance in most economic areas, and an unprecedented combination of high private and public debt, all add to the degree of uncertainty in the system to which monetary policy is applied. In this environment, central banks begin to think about new rules and new monetary policy frameworks. In this process, it is advisable to assume that the system no longer operates under measurable probabilistic uncertainty (risk) but under Knightian uncertainty. The latter refers to fundamental uncertainty where probability distributions are less informative or even lacking. In such a situation, an approach for managing Knightian uncertainty is more appropriate than aiming at an optimal outcome (e.g. a specific inflation target) based on probabilistic models. To this end we apply the info-gap approach to managing Knightian uncertainty (Ben-Haim, 2006, 2010).

The info-gap approach, as distinct from the alternative Knightian uncertainty method of robust control, has at its core a fundamental trade-off: that between *performance* and *robustness*. If policymakers aim for very ambitious outcomes, they will have to accept having little confidence in achieving them, as very good outcomes occur only in very specific

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circumstances. By contrast, if policymakers are prepared to accept less good outcomes, then their confidence in achieving them increases. Robustness, equivalent to confidence here, is the knowledge of achieving specific outcomes for as wide a set of circumstances as possible. We will use this method to rank alternative monetary policy rules. This will allow us to choose rules according to their ability to produce good enough outcomes (as defined by policymakers) for the greatest set of circumstances. This is the first contribution of our article.

The second contribution is to consider alternative monetary policy (Taylor) rules that account for various possible "new" mechanisms. We will therefore consider both rules that are derived from traditional mechanisms that are well understood, as well as alternative rules. In particular rules that consider mechanisms, like financial channels, that are less known but are increasingly considered relevant. We will then rank them according to how well they do in the trade-off between *performance* and *robustness*.

Estimations of a Taylor rule for the euro area indicate that since the 2007-08 crisis, unconventional monetary policy has significantly reacted to financial developments, in addition to the inflation and output gap (Pattipeilohy et al., 2017). Drakos and Kouretas (2015) come to a similar conclusion by showing that the ECB monetary policy followed the traditional Taylor rule before the crisis but deviated from it in the post-crisis period. Mallick et al. (2017) find that such monetary policy responses have led to a decline in both expected stock and bond market volatilities and the term premium, but that bond purchases had no significant real effects post-crisis. The influence of balance sheet policies on financial markets also implies that monetary policy potentially can have adverse side effects in the financial sphere. By encouraging financial risk taking for instance, quantitative easing (QE) may contribute to financial imbalances and excessive asset price developments (Van den End, 2016). Since such effects may only be revealed in the long run, they are particularly uncertain at the time policies are formed.

Our article relates also to the ongoing debate in the literature on whether monetary policy should take into account financial stability objectives, or should leave these to macroprudential policy (see Smets, 2014, for an overview). The different positions in this debate have been defended on theoretical as well as empirical grounds by augmenting macro-economic models, monetary policy rules in particular, with financial variables (e.g. by Svensson, 2017; Gambacorta and Signoretti, 2014; Gourio et al., 2016). While according to Stein (2014), measures of risk premiums may be useful inputs into the monetary policy framework, he concludes that there is a long way to go - in terms of modelling and calibration - before it can be used to make quantitative statements. This comes close to the starting point in our article that the process that is being modelled is prone to Knightian uncertainty. Ajello et al. (2016) follow a similar reasoning in their standard new-Keynesian model augmented with an endogenous financial crisis event. They assume fundamental uncertainty on the model parameters (with regard to monetary transmission) and the shock (severity of crises). Based on a robust-control approach they conclude that optimal policy can call for larger adjustments to the policy rate than in a situation without financial stability concerns. This is consistent with more conventional predictions of robust control min-max techniques, which lead to more aggressive than otherwise policies. In section 2 below we will discuss the difference between robust control and info-gap, as methods to manage Knightian uncertainty.

In this article, we define four semi-structural models to account for these mechanisms. Model 0, our benchmark model, is a standard macro model that has a Phillips curve, an aggregate demand curve and a traditional Taylor rule. Model 1 extends the benchmark model by augmenting the Taylor rule with a financial variable (credit spread), allowing for monetary policy to react to financial stress. In model 2 we introduce the concept of financial imbalances by including a debt variable in the demand curve. This takes into account the long-term implications of unconventional monetary policy for the economy that become manifest through the debt channel (model 2 includes the traditional Taylor rule). Model 3 is the full model that includes both the augmented Taylor rule as well as financial imbalances. For each of these models, we provide simulations where we consider both additive (shocks) as well as multiplicative (parameters) uncertainty. This will allow us to map the trade-off between performance and robustness for each one.

We summarize our main findings as follows:

- The cost of robustness (in terms of loss in performance) increases significantly when the simulation horizon is extended, in all four models. This is natural, because uncertainty propagates and magnifies over time and confidence in certain future outcomes is greater if that future is near rather than far.
- Our benchmark model is the one that is most robust to uncertainty in almost all experiments we have run. The choice of a relatively parsimonious specification reduces its vulnerability to modeling uncertainty, by excluding the uncertain effects of financial stress and debt on the macroeconomy and monetary policy.

In terms of policy implications, our results show the following:

- Including financial stability objectives in the monetary policy framework can reduce the robustness of policy decisions. Modelling such complex mechanisms requires deep knowledge of the underlying structures, which is missing when the system is fundamentally uncertain. So, while complicated models may produce better outcomes in specific and known circumstances, simpler rules perform better for greater ranges of, and therefore less known, circumstances. This is in line with the literature on heuristics (e.g. Gigerenzer et al., 2011) that points to the ability of simple rules to handle complex situations better.
- But this also means that price stability should remain the primary objective of monetary policy, particularly given the uncertainties of financial imbalances long run effects on the economy.
- However, when considering financial imbalances, our results show that augmenting the Taylor rule with a credit spread is preferable to including the debt-to-GDP ratio in the demand equation. This suggests that a debt overhang is better dealt with through macroprudential policies.

The article is organised as follows: Section 2 compares and contrasts the two Knightian uncertainty methods of dealing with uncertainty: robust control and info-gap robust satisficing. In section 3, we then specify the four alternative models. In section 4, we derive the putative outcomes of the model estimations. Section 5 formulates the info-gap method, including the performance requirement, definitions of uncertainty and robustness. Section 6 shows the model simulations and robustness curves for the benchmark model, including uncertainty in the value of the coefficients. This is extended in section 7 for all four models. Section 8 introduces uncertainty on the shocks to inflation in addition to parameter uncertainty. Section 9 discusses the results and section 10 concludes.

2. Info-gap theory versus robust control

Two main strategies for managing Knightian uncertainty have emerged in the literature: robust control and info-gap. Robust control insures against the maximally worst outcome (min-max) as defined by the policymaker (see Hansen et al., 2006; Hansen and Sargent, 2008; Williams, 2007). Olalla and Gómez (2011) apply the robust control tool to a Neo-Keynesian model to study the effect of model uncertainty in monetary policy. Typically, policies derived through min-max are more aggressive by comparison to those derived under no uncertainty. Intuitively, when mechanisms at work are poorly understood, aggressive policies allow decisions makers to learn about them. The literature has raised two objections to this: (i) policymakers do not like experimenting for the purposes of learning; (ii) worst events are rare and hence poorly