Economic Modelling 56 (2016) 1–10

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Parameter uncertainty and inflation dynamics in a model with asymmetric central bank preferences

Laban K. Chesang, Ruthira Naraidoo *

University of Pretoria, Department of Economics, Pretoria 0002, South Africa

ARTICLE INFO

Article history:
Received 8 October 2015
Received in revised form 1 March 2016
Accepted 1 March 2016
Available online xxxx

JEL classification:
E31
E52
E58
E61

Keywords:
Monetary policy
Asymmetric preferences
Inflation
Uncertainty

ABSTRACT

This paper builds on the Lucas' (1973) signal extraction model to study the time-varying effect of uncertainty in the output-inflation trade-off on inflation, using a monetary model with asymmetric central bank preferences whereby deviations of output (relative to target) from above are weighted differently from deviations from below. The model is investigated empirically using data from the South African Reserve Bank (SARB). We show that the implication of the uncertainty element is to cause the authority to change its indirect control, output by less (and hence change it direct control, interest rate by less) whenever inflation is below or above the target, in line with Brainard's attenuation principle. We also find that SARB's asymmetric output stabilization explains inflation movements significantly, and that the monetary authority seems to be more averse to business cycle recessions than expansions, hence more keen to avoid recessions than expansions. Overall, a more transparent and committed monetary policy practice that would reduce uncertainty over the output-inflation trade-off would be helpful for economic stability.

1. Introduction

Since the year 2000, the South African Reserve Bank (SARB) has remained committed to inflation targeting as the anchor of monetary policy with the aim of achieving long term price stability. Indeed, most economists hold the view that monetary policy has real effects on the economy in the short run, but in the long run, the effects fall entirely on prices. As such, the central bank plays a critical role in determining the path of inflation (and output) in the economy. The possibility that monetary policy may induce an inflationary bias, as first suggested by Barro and Gordon (1983), has been investigated in a number of empirical studies including Ruge-Murcia (2003, 2004), Sweidan (2009) and Doyle and Falk (2010), among others. Their results vary. Our paper uses a similar framework used in these studies to consider the role of uncertainty about the output-inflation trade-off in interpreting the inflation rate.

We focus on a model with asymmetric preference over output, although we initially start with quadratic preferences. A huge body of empirical work on monetary policy reaction functions and estimation of central bank preference parameters offer evidence supporting asymmetries in either inflation or output gap in the central bank loss function (see e.g., Nobay and Peel (2003); Ruge-Murcia (2003, 2004) and Surico (2007) for evidence from developed countries, and Naraidoo and Raputsoane (2011) and Kasaï and Naraidoo (2013) for evidence from South Africa). Empirical contributions such as Sweidan (2009) and Doyle and Falk (2010) have shown that when central bank preferences are asymmetric, policymakers care about the sign as well as the extent of the deviations of output and inflation from target. Then, monetary policy suffers the time inconsistency problem, allowing for the variances of both inflation and output to influence the equilibrium rate of inflation.

The choice of asymmetric preference over output only is motivated both from theoretical and empirical grounds. From a theoretical point of view, a model that features asymmetries over both inflation and output gap suffers identification problems arising from asymmetric aversion to inflation (Surico, 2008), where preference parameters and inflation target cannot be identified separately unless restrictions are imposed (Surico, 2007). In fact Surico (2008) shows that output asymmetries are relatively more important than inflation asymmetries. At an empirical level, evidence for South Africa (see e.g. Naraidoo and Raputsoane, 2011) has shown the SARB's response to output fluctuations to be asymmetric.

The relevant literature for our work dwell on the Barro and Gordon (1983) inflationary bias hypothesis. Ruge-Murcia (2003) for instance shows that the central banks' preferences significantly explain inflation

* Corresponding author at: Faculty of Economics and Management Sciences, Department of Economics, University of Pretoria, Pretoria 0002, South Africa.
E-mail addresses: claban_2010@yahoo.com (L.K. Chesang), ruthira.naraidoo@up.ac.za (R. Naraidoo).

http://dx.doi.org/10.1016/j.econmod.2016.03.004
0264-9993/

rates for Canada, Sweden and the UK, and that inflation has generally been below target. Ruge-Murcia (2004) provides evidence in support of the proposition that an inflation (or a deflation) bias is proportional to the conditional variance of unemployment for the G7 countries. Moreover, the overall results are consistent with the view that positive unemployment deviations from the target are weighed more severely than negative ones in the loss function. His study was motivated by Cukierman (2002) who first showed that two conditions should be satisfied for an inflation bias to arise when the central bankers target the natural rate of unemployment, i.e. (i) uncertainty about next period's realizations of inflation and unemployment, and (ii) asymmetric unemployment preference. Cassou et al. (2012) find similar results as Ruge-Murcia (2003, 2004). They show that the monetary authority targets permanent output rather than some higher level of output which would be required in a Barro–Gordon type model.

Although Surico (2007) does not explicitly investigate the role of variances of inflation and output, he examines the possible effect of changes in the degree of asymmetry in preferences, and finds that such changes seem to account for a sizable fraction of the historical decline in US inflation. Sweidan (2009) finds that the variances of both output and inflation influenced Jordanian inflation rates over the period 1992–2007 and that Jordanian central bank preferred higher inflation and higher level of output. In a related study, Doyle and Falk (2010) observe that previous studies suffer from a spurious regression problem, and thus control for this problem by estimating their model as a cointegration relationship. Their results do not support the view that volatility of unemployment does explain inflation trends, except in only three out of the sample of thirteen countries.

The literature reviewed above has often assumed an observable state of the economy. In this paper however, we go further and examine how, in a similar framework uncertainty about the output-inflation trade-off may be useful in interpreting inflation dynamics. The literature on parameter uncertainty and monetary policy is grounded on Brainard's (1967) attenuation principle, which hypothesizes that uncertainty dampens the monetary authorities' response to target variables of monetary policy relative to when monetary policy decisions are made under complete certainty. Numerous empirical studies including Wieland (2000), Orphanides et al. (2000) and Svensson and Williams (2008) present evidence in support of Brainard's result. On the contrary Giannoni (2002), Söderström (2002), Kimura and Kurozumi (2007) and Tillman (2011) present evidence in support of an aggressive reaction of monetary policy under uncertainty.[1] According to Söderström (2002) for instance, in the face of uncertain inflation dynamics, the monetary authority faces even greater degree of uncertainty about the state of the economy so that the rate of inflation drifts even farther from target. To reduce the amount of uncertainty about the future path of inflation, optimal policy becomes more aggressive, pushing inflation closer to target. In a related study, the implication of modeling uncertainty in the central bank preference parameters is investigated by Peel (2001). He demonstrates that expected inflation (and hence actual inflation) is higher when the weight on inflation stabilization is uncertain, and it is lower when the weight on output stabilization is uncertain.

The contribution of this paper is to examine the implication of parameter uncertainty for the behavior of inflation when central bank preferences are asymmetric over output. Specifically, our modeling approach takes into account uncertainty about the slope of the Phillips curve, whereby the slope varies inversely with innovations in money supply. In the New Keynesian type models, this parameter appears in the targeting rule describing optimal monetary policy, and hence is expected to affect optimal dynamics in the model. Empirical evidence on the effect of central bank preferences and changing volatility on inflation trends is limited and virtually inexistent in sub Saharan Africa in particular. What we do in this paper is to derive analytically the optimum process for inflation facing the policymaker, and then take the model to the data, with particular interest of the role of the variance of output as well as parameter uncertainty in interpreting inflation.

The results show that uncertainty about the output-inflation trade-off introduces an interaction (term) of output gap and volatility of money supply in inflation dynamics. As suggested in an optimal rule, this additional determinant causes output to increase (decrease) by less whenever inflation is below (above) the target. In other words, whenever inflation is above (below) the target, the monetary authority increases (decreases) nominal interest rate by less, than it does under certainty equivalence due to the higher uncertainty that it faces, as suggested originally by the attenuation principle of Brainard (1967). Empirical results indicate that the Reserve Bank's asymmetric aversion to output plays an important role in interpreting inflation. More specifically, the bank seems to dislike low output more than it dislikes high output levels. This result seems consistent with the expansionary bias hypothesis.

The remainder of the paper is organized as follows. Section 2 presents the model and solves for the reduced form process for inflation. Section 3 describes the data and estimation technique, and discusses the results. Section 4 draws some conclusions.

2. The model

2.1. Structure of the economy

The model starts with the common short run aggregate supply curve,[2] which is motivated by classical contributions of Friedman (1968) and Lucas (1973). It is given by.

$$Y_t = Y_t^N + \theta(P_t - P_t^e) + u_t, \quad \theta > 0 \tag{1}$$

where Y_t is the real (observed) output, Y_t^N denotes the natural or potential output at time t, P_t is the price level at time t, P_t^e is the expected price level at time t given information at time $t-1$. The parameter θ indicates by how much output responds to unexpected changes in the price level. u_t is a supply shock that is required to generate a short-run trade-off between inflation and output stabilization. The basis of the Lucas supply curve in Eq. (1) above is that firms observe the price of their own product and not the aggregate price. As a result, they sometimes confuse aggregate price increase (say, when the policymaker raises money supply, to which they should not respond) with relative price increase (to which they should respond by increasing output). According to Lucas (1973) the positive slope of the aggregate supply curve $(1/\theta)$ depends on the volatility of aggregate demand.[3]

In order to take into account changes in the output-inflation trade-off over time, and introduce parameter uncertainty about the slope of the aggregate supply Eq. (1) above, we make use of Lucas (1973) signal extraction model, in which firms are unable to distinguish between aggregate and relative price shocks. While these shocks are not directly observable, their magnitude must be inferred from the behavior of

[1] Most of these studies employ robust control problem solving techniques, and have shown that under parameter uncertainty robust optimal Taylor rules prescribe in general a stronger monetary policy response to fluctuations in inflation and output gap.

[2] A huge body of empirical work (including, among others Ruge-Murcia (2003, 2004), Surico (2008), Sweidan (2009), Doyle and Falk (2010) and Cassou et al. (2012) apply this framework.

[3] Specifically, when aggregate demand fluctuates, aggregate prices fluctuate too, and since most price changes do not represent changes in relative prices, producers should have learnt not to respond much to unexpected price movements. In this case, the aggregate supply curve becomes relatively steep (θ will be small). On the contrary, when aggregate demand is relatively stable, producers should have learnt that most price changes they observe are relative price changes, and should therefore respond to unanticipated price movements. In this case, the aggregate supply curve becomes relatively flat (θ will be large).