



Optimal monetary policy in a small open economy with inflation and output persistence

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ABSTRACT

We study optimal monetary policy for a small open economy in a model where both inflation and output show persistence. We incorporate habit formation into intertemporal consumption decision and modify the Calvo price setting to include indexation to past inflation. The message conveyed from this study can be viewed as twofold. First, full stabilization of domestic prices or the output gap is not optimal policy. This is because stabilization of the output gap leads to serial correlation in domestic inflation, whereas under full stabilization of domestic prices the output gap displays some serial correlation. It is, however, shown that at the zero inflation steady state, stabilizing domestic prices is equivalent to stabilizing the output gap. Second, in the presence of foreign income shock inflation and the output gap are more stable under flexible CPI inflation targeting than under other alternative policy regimes considered.

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1. Introduction

The New Keynesian model, which is now the standard framework for analysis of monetary policy in both the closed and open economy setup, fails to account for important features of inflation and output dynamics. In particular, the observed inertial behavior of inflation found in numerous empirical studies (Estrella and Fuhrer, 2002; Nelson, 1998; Rudebusch, 2002) cannot be elucidated by the inflation dynamics obtained from the standard Calvo (1983) type price-setting specification. This gap between theory and empirical evidence induced development of theoretical models that introduce inflation persistence into the New Keynesian model (Galí and Gertler, 1999; Roisland, 2006; Steinsson, 2003).

It has also been argued that the standard aggregate demand arising from the Euler equation cannot produce inertial, hump-shaped, impulse responses for output found in structural VAR models (e.g., Fuhrer, 2000; Fuhrer and Rudebusch, 2004; Rudebusch and Svensson, 1999), and that the specification of aggregate demand should allow for persistence in demand. In the recent generation of DSGE models, it has become standard to assume some form of habit formation in household's utility function (Amato and Laubach, 2004; Bouakez et al., 2005; Dennis, 2009).

Following Christiano et al. (2005) and Smets and Wouters (2003), a growing number of studies incorporate both inflation and output persistence into the New Keynesian model. Most of the literature, however, focuses on the closed-economy framework. Relatively few papers deal with inflation inertia and/or persistence in aggregate output in the small open economy framework. Some recent contributions include Adolfson et al. (2007, 2008), Flamini (2007), Kuralbayeva (2011), Linde et al. (2009). Adolfson et al. (2007, 2008) and Linde et al. (2009) focus mostly on estimating their model, whereas we derive some theoretical implications for several monetary policy rules for a small open economy that exhibit inflation and output persistence. The focus in Flamini (2007) is the relationship between imperfect exchange rate pass-through and monetary policy, while our paper assumes a complete pass-through and studies properties of various inflation targeting monetary policy rules. Kuralbayeva uses a rule-of-thumb price-setting mechanism similar to that in Steinsson (2003) and studies how the resulting inflation persistence affects the dynamical behavior of an oil-rich economy when it experiences a terms-of-trade shock. However, her model does not have habit formation and thus output persistence.

The main purpose of this paper is to provide a theoretical analysis of monetary policy rules in a small open economy within a model that incorporates both inflation and output persistence. Based on a second-order approximation to the household's utility, we characterize the optimal monetary policy rule and its implications. We also discuss the welfare implications of alternative policy rules such as (flexible) CPI and domestic inflation targeting. For this purpose, we modify the New Keynesian open economy model of Clarida et al.

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(2002) and Galí and Monacelli (2005) in two ways. First, we assume external habit formation in agents' intertemporal consumption decision (Abel, 1990; Campbell and Cochrane, 1999); this results in (1) persistence in aggregate demand for domestic output, (2) an inertial effect of foreign output on the domestic natural real interest rate, and (3) existence of a lagged output gap in inflation dynamics.

Second, following Christiano et al. (2005), we assume that a fraction of domestic firms reset their prices using backward-looking price indexation whereby prices are updated by the rate of inflation in the past. This indexation imparts persistence to domestic inflation that is consistent with empirical findings. In addition, the habit formation mentioned above leads to dependence of current domestic inflation on both the current and lagged output gap. Therefore, movements of the output gap have persistent effect on inflation dynamics.

We derive a second-order approximation to the average welfare losses experienced by households as a result of fluctuations around a steady state with zero inflation. The resulting welfare function is similar to that derived in Galí and Monacelli (2005), but has, in addition, lagged domestic inflation and output gap terms. This implies an additional source of welfare losses associated with domestic inflation and output volatility. We use this approximation to the welfare function to evaluate alternative policy rules.

Next, we characterize optimal monetary policy. In the standard New Keynesian small open economy model (Galí and Monacelli, 2005), the optimal monetary policy requires stabilization of the output gap. Then domestic prices are also stabilized under the same policy. Blanchard and Galí (2007) call this property of the New Keynesian model the 'divine coincidence'. In this study, we show that stabilization of the output gap causes domestic inflation to vary with lagged inflation, generating fluctuations in domestic inflation. Under full stabilization of domestic prices the output gap displays some intrinsic persistence, i.e., some serial correlation. Therefore, full stabilization of domestic prices or the output gap is not optimal policy. It is, however, shown that at the zero inflation steady state, stabilizing domestic prices is equivalent to stabilizing the output gap—the divine coincidence is restored.

We use our framework to analyze welfare implications of alternative policy rules. We consider two measures of inflation, domestic inflation and CPI inflation; for each of these measures we study two inflation targeting regimes. In other words, we analyze four simple policy rules. The first rule, which is referred to as flexible domestic inflation targeting, requires that the interest rate respond systematically to domestic inflation and the output gap. The second rule called strict domestic inflation targeting, on the other hand, assumes that the interest rate responds to domestic inflation only. Similarly, we study both flexible and strict inflation targeting in the case of CPI inflation.

We rank these regimes in terms of their implied volatility of domestic inflation and the output gap, and show that in the presence of a foreign income shock, both CPI and domestic inflation, as well as the output gap are more stable under flexible CPI inflation targeting than under any other alternative policy regime. The critical element that distinguishes the CPI inflation targeting rule from the other targeting rules is a more muted response of the exchange rate. The smoothness of the (first-differenced) nominal exchange rate leads to low volatility of the CPI inflation. It also stabilizes the output gap by reducing the expenditure switching effects. The systematic response of the domestic interest rate to the output gap under flexible targeting is another factor that explains a relatively low volatility of the output gap. The smoothness of the output gap in turn leads to lower volatility of domestic inflation. This result is quite different from policy implication of the standard New Keynesian model (Clarida et al., 2002; Galí and Monacelli, 2005).

Our findings are not only of interest to macroeconomic theory. Central bankers in small open economies do pay attention to persistence of inflation and output. For example, John McDermott, Assistant

Governor of the Reserve Bank of New Zealand, was clearly concerned about both output and inflation persistence in his recent speech when commenting on how the inflation targeting framework coped with the most recent business cycle in New Zealand: "In setting monetary policy we had to take a view both on how these shocks would unfold and how they might change the inflationary pressure in the economy, as summarised by our view of the output gap. Throughout the recent boom we expected the output gap to dissipate rapidly. However, as it turned out the output gap remained positive for an extended period. With an extended period of excess demand pressure, average inflation tracked in the upper half of our target zone. While the persistent component of inflation was higher than we would have ideally liked during the business cycle expansion, it did remain anchored within the target zone. However, the interaction of a persistent aggregate demand shock and inertia in the economy can considerably prolong the time for which the economy is in a state of excess demand pressure" (McDermott, 2012). Another issue addressed in this paper and pertinent to the practice of central banking in small open economies is definition of inflation. Although most of the countries use CPI inflation, Sveriges Riksbank, Sweden's central bank, considers the possibility of "changing to another measure of inflation than the CPI if there are good reasons for doing so" (Wickman-Parak, 2009). One such measure is domestic inflation, which is computed using GDP deflator. While the use of domestic inflation is supported by the mainstream literature on open economy macroeconomics (Clarida et al., 2002; Galí and Monacelli, 2005), our findings support the use of CPI inflation.

The plan of this paper is as follows. We present the basic model in Section 2, while Section 3 describes the equilibrium conditions and dynamic system of the model. Section 4 analyzes optimal monetary policy in a small open economy. The implications and performance of alternative policy regimes are discussed in Section 5. In Section 6, we draw the main conclusions.

2. The model

We consider a dynamic stochastic general equilibrium model with sticky prices, monopolistic competition, complete asset markets, and complete pass-through. The model has a small open economy called home (H) and a large country called foreign (F)¹. We can think of the foreign country as the rest of the world. We assume symmetry across countries in terms of preferences, technology, and market structure.

Following the literature (see Galí, 2008; Woodford, 2003), money is not incorporated into the model explicitly but is rather used as a unit of account. As has been shown in Woodford (2003), such an economy could be considered as a limiting case of a model in which money is explicitly present and is valued by agents. As a related point it is worthwhile mentioning here that recent monetary theory based on the New Keynesian model suggests that monetary policy should be conducted by setting short-term interest rates that react to variables such as inflation forecasts and output gaps but not monetary aggregates. Woodford (2008) studies several leading arguments for inclusion of the money supply into the formulation of monetary policy and finds none of them convincing. These theoretical findings support the practice of de-emphasizing the role of monetary aggregates adopted by the Federal Reserve in the U.S. as well as many central banks in inflation-targeting countries. On the other hand, the European Central Bank has a monetary pillar in its two-pillar policy (Beck and Wieland, 2007), and some economists emphasize an important role monetary aggregates should play in monetary policy (Barthelemy et al., 2011; Lucas, 2007). While appreciating the significance of the latter view this paper adheres to the former which both simplifies the analysis and allows us to compare our results with the current literature.

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