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Monetary policy regimes and inflation in the new-Keynesian model

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ABSTRACT

This paper shows that plausible modifications to the Taylor rule for monetary policy can help explain several empirical anomalies to the behavior of inflation in the new-Keynesian general equilibrium model. The key anomalies considered are (1) the persistence of inflation, both in reduced form and after conditioning on inflation's driving processes, (2) the positive correlation between the output gap and the change in the inflation rate, and (3) the apparent bias in survey measures of expected inflation.

The Taylor rule in this model includes the now standard assumption that the central bank smoothes changes to its target interest rate. It also includes Markov switching of a persistent inflation target between a low target rate and a high target rate. The model is calibrated to match Benati's (2008) result that, historically, changes in monetary policy lead to a statistically significant change in the persistence of inflation.

Matching Benati's result requires a reduction in an exogenous, hence structural, source of persistence. However, inflation in the model inherits additional, non-structural, persistence from the process that governs the inflation target. As a result, the model is able to replicate measures of inflation persistence, even after conditioning on inflation's driving processes. Agents with rational expectations and knowledge of the current inflation target will be aware of the possibility of a future target switch, causing their expectations to appear biased in small samples. Finally, with sticky nominal prices a discrete drop to the low-inflation target requires a loss of output while previously-set prices adjust.

1. Introduction

The new-Keynesian Phillips curve, in particular the Calvo (1983) aggregate supply curve, is very widely used in general equilibrium models of monetary phenomena. This is because it provides a description of sticky nominal prices that is both tractable and well-grounded in microeconomic theory. Unfortunately, a number of stylized empirical facts are difficult to explain as the endogenous outcome of models that include the new-Keynesian Phillips curve.

Perhaps the most widely studied of these facts is the persistence of inflation. In a pure version of the Calvo aggregate supply curve, one derived solely from the profit maximizing behavior of monopolistically competitive firms, inflation is a forward-looking variable. That is, current inflation depends on expected future inflation and on current marginal costs; lagged inflation should have no explanatory power. Yet, empirical studies consistently show that inflation is persistent: lagged values of inflation have a statistically significant effect on current inflation. One possible explanation is that inflation

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inherits persistence from its driving variable, marginal costs, or from serially correlated "cost-push" shocks. Indeed, general equilibrium models designed to give a realistic representation of the data usually include features that impart persistence to inflation's driving variables. For example, habit persistence causes optimal consumption to depend on lagged as well as expected-future consumption. Consequently, current output will depend on lagged and expected future output. Since marginal cost is proportional to output, marginal cost will be persistent and inflation may inherit that persistence.

The persistence puzzle has therefore been deepened by results in, for example, Fuhrer (2009), Kiley (2007), and especially Rudd and Whelan (2005, 2006) showing that lags of inflation retain their power to explain current inflation even after conditioning on variables such as unemployment, output, marginal cost, or the present discounted value of expected future marginal costs. In other words, the observed persistence of inflation does not appear to be inherited from output or from marginal costs.

Another common modification to sticky-price models that imparts persistence to inflation is to assume that those firms unable to reset their price optimally in a given period will instead update their price using a rule of thumb, for example in proportion to the CPI.[1] This brings lagged inflation directly in to the aggregate supply (AS) equation and renders inflation persistent, although it does so by assumption diminishing the appeal of the resulting AS equation by undermining its microeconomic foundation.

However, the persistence puzzle has again been deepened by results in Benati (2008) showing that historically a change in monetary policy often leads to a statistically significant change in the persistence of inflation. Benati concludes that "inflation persistence is not structural in the sense of Lucas (1976)," that is, it is not invariant with respect to changes in monetary policy. If the persistence properties of inflation change when monetary policy changes, inflation persistence cannot solely be caused by structural sources such as rule-of-thumb price setting, habit persistence, or, importantly, serially correlated shocks.

Inflation persistence is not the only empirical fact anomalous to general equilibrium models based on the new-Keynesian Phillips curve. Another anomalous stylized fact is the acceleration phenomenon, the observed positive correlation between the change in the inflation rate and the GDP gap. Mankiw and Reiss (2002, p. 1297) refer to the acceleration phenomenon as "the central finding from the empirical literature on the Phillips curve ..." and argue that the acceleration phenomenon is inconsistent with the standard sticky-price model.

The difficulties explaining the persistence of inflation, the persistence of inflation after conditioning, and the acceleration phenomenon have led several authors to suggest departures from rational expectations. Kiley (2007) argues that the assumption that some firms are rule-of-thumb price setters, discussed above, can be viewed as one such departure. Fuhrer (2009) and Rudd and Whelan (2006) both suggest that adaptive expectations or adaptive learning could explain the persistence of inflation. Milani (2007) shows that when agents learn the behavior of endogenous variables using a constant-gain algorithm the need for other sources of persistence – for inherited persistence – is reduced. Mankiw and Reiss (2002) replace sticky prices with sticky expectations, the assumption that agents form rational expectations but only update their information periodically, to explain a number of stylized facts; including the persistence of inflation, the acceleration phenomenon, and the fact that disinflation causes recession.

Alternatives to rational expectations seem to gain support from evidence of bias in survey measures of expected inflation. Survey measures of expected inflation appear to systematically underestimate inflation when it is rising and overestimate inflation when it is falling.[2] However, departures from rational expectations diminish the original appeal of the Calvo (1983) aggregate supply curve, because they undermine the discipline imposed by full rationality. Furthermore, the idea that the apparent bias in survey measures of expected inflation must represent a departure from rational expectations is not fully supported either by theory or by the data. Theoretically, deviations from rational expectations are by no means necessary to explain the appearance of bias. Evans and Wachtel (1993) argue that, if the inflation rate follows a two-state Markov switching process, expectations of inflation will appear biased even if they are formed rationally. Erceg and Levin (2003) develop a model in which the target inflation rate is governed by an unobserved near random walk and optimal forecasts are formed using the Kalman filter. In their model a large and persistent decline in the target inflation rate, such as occurred during the Volcker period, will lead to a sacrifice ratio near empirical estimates and to rational expectations that over predict a falling inflation rate. Andolfatto et al. (2008), also show that when the inflation target is an unobserved random draw the filtering problem can explain the apparent bias of expectations. Empirically, Ang et al. (2007) show that survey measures of expected inflation are better at forecasting actual inflation than asset markets, time series models, or Phillips-curve regressions that predict inflation from measures of real economic activity.

In this paper, I argue that several of the stylized facts that appear anomalous to the new-Keynesian general equilibrium model can to a significant extent be explained by two plausible modifications to the monetary policy rule, interest-rate smoothing and inflation-target switching. Interest-rate smoothing is the now broadly accepted idea that the Fed adjusts the nominal federal funds rate towards its ultimate target gradually. This is modeled by assuming that the current fed funds rate is a weighted average of the lagged fed funds rate and the ultimate target rate; the weights summing to one. Inflation-target switching is here modeled by assuming that the target inflation rate is a two-state Markov switching process, so that the fed switches between a high-inflation-target policy and a low-inflation-target policy.

[1] See, for example, Christiano et al. (2005).

[2] See, for example, Evans and Wachtel (1993) or Thomas (1999).