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Volatility effects of news shocks in New Keynesian models with optimal monetary policy☆

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HIGHLIGHTS

- We study optimal monetary policy in the presence of anticipated cost shocks.
- We consider (i) sufficiently flexible and (ii) nearly strict inflation targeting.
- Under (i): The anticipation of shocks raises the central bank's loss.
- Under (ii): The reverse holds if the Phillips curve is sufficiently backward-looking.
- Our results hold for optimal unrestricted monetary and discretionary policy.

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ABSTRACT

This paper studies the volatility implications of anticipated cost-push shocks (i.e. news shocks) in a hybrid New Keynesian model both under optimal unrestricted and discretionary monetary policy. In both regimes, the volatility of the output gap and the central bank's loss are increasing with the anticipation horizon under sufficiently flexible inflation targeting. By contrast, under nearly strict inflation targeting, an anticipated cost-push shock leads to a smaller central bank's loss than an unanticipated shock of the same size if additionally the Phillips curve is sufficiently backward-looking.

1. Introduction

Several empirical studies emphasize the importance of news shocks for business cycle fluctuations. These shocks materialize in the future, but their size and maturity time is anticipated in advance by the agents. Most prominently, Schmitt-Grohé and Uribe (2012) find in an estimated real business cycle model that about 50% of economic fluctuations can be attributed to anticipated disturbances.[1]

A theoretical branch of the literature indicates that news shocks destabilize the economy, i.e. lead to a higher volatility than unanticipated shocks of the same form. Fève et al. (2009) demonstrate in a purely forward-looking rational expectations model that news shocks increase the volatility with increasing length of anticipation. If the economy includes both forward- and backward-looking elements, the volatility results are ambiguous as it is shown by Winkler and Wohltmann (2012) in an univariate model. However, they find that the anticipation of cost shocks – as considered here – greatly amplifies the volatility of all key macroeconomic variables in the estimated model of Smets and Wouters (2003).[2]

These (empirical and theoretical) findings rely on the assumption of forward-looking rational expectations. By contrast, in a purely backward-looking model, the volatility is independent of

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[1] Note that we limit our discussion to cost-push shocks which are found to be highly relevant for business cycle fluctuations, see e.g. Schmitt-Grohé and Uribe (2012).

[2] Further related to this branch of literature is the paper by Offick and Wohltmann (2013), who study the properties of the lag polynomial associated with news shocks.

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the anticipation horizon.[3] Backward-looking behavior can be introduced via price indexation, rule-of-thumb behavior or bounded rationality.[4]

So far, optimal monetary policy has been studied almost exclusively in the presence of unanticipated disturbances. One exception is the study of Winkler and Wohltmann (2011), who analyze optimal simple interest rules. They find that the inclusion of forward-looking elements in an instrument rule is welfare enhancing in the case of anticipated shocks. However, they focus on purely forward-looking private expectations and the resulting welfare effects.

In light of these findings, our paper contributes to the existing literature in three ways: First, we combine the theory of news shocks and optimal monetary policy in a New Keynesian framework. Second, we study the (de)stabilizing effects of anticipated cost shocks in a multivariate environment. Third, we analyze how the relative volatility results of news shocks change with increasing degree of backward-looking price setting behavior, where we distinguish between flexible and nearly strict inflation targeting (cf. Svensson, 1999). We provide analytical results for the limit case of purely forward-looking price setting behavior.[5]

2. News shocks and optimal monetary policy

We assume that the inflation rate is governed by a hybrid New Keynesian Phillips curve that follows from partial price indexation[6]:

$$\pi_t = \omega_1 E_t \pi_{t+1} + \omega_2 \pi_{t-1} + \omega_3 x_t + \varepsilon_{t-q} \tag{1}$$

where π_t and x_t are the inflation rate and the output gap measured as percentage deviations from the steady state, respectively. $\omega_1 = \beta/(1+\beta\gamma)$, $\omega_2 = \gamma/(1+\beta\gamma)$, and $\omega_3 = \kappa/(1+\beta\gamma)$ where γ is the degree of price indexation.[7] For $\gamma = 0$, the Phillips curve (1) collapses to the standard purely forward-looking one. However, it does not nest a purely backward-looking Phillips curve as special case. In fact, the limit case of full price indexation ($\gamma = 1$) leads to a hybrid Phillips curve in which expected future and past inflation equally affect current inflation.

For convenience, we assume that the central bank aims to minimize the weighted sum of variance of the inflation rate and the output gap[8]:

$$Loss_q = \text{Var}_q(\pi_t) + \lambda \text{Var}_q(x_t). \tag{2}$$

We compute the optimal unrestricted monetary policy response under (timeless) commitment and the discretionary policy.[9] The optimal targeting rule under commitment, in which the central bank is able to commit to future policies, includes forward- and backward-looking elements:

$$\pi_t = \beta\omega_2 \frac{\lambda}{\omega_3} E_t x_{t+1} - \frac{\lambda}{\omega_3} x_t + \frac{\lambda}{\omega_3}\frac{\omega_1}{\beta} x_{t-1}. \tag{3}$$

Note that in both limit cases ($\gamma = 0$ and $\gamma = 1$) the system remains hybrid. This is due to the inverse relation between the price-setting behavior and the optimal monetary strategy as described in Leitemo (2008).

Contrarily, the optimal discretionary policy is independent of backward-looking elements:

$$\pi_t = \beta\omega_2 \frac{\lambda}{\omega_3} E_t x_{t+1} - (1 - \omega_1 \rho_\pi)\frac{\lambda}{\omega_3} x_t. \tag{4}$$

The undetermined coefficient ρ_π follows from the reduced form of inflation. ρ_π is independent from the anticipation horizon q and is the stable solution of the following polynomial equation of order three:

$$(\omega_1\omega_2 + \omega_1^2)\lambda\rho_\pi^3 - (2\omega_1 + \beta\omega_2)\lambda\rho_\pi^2 + [(1 + \omega_1\omega_2 + \beta\omega_2^2)\lambda + \omega_3^2]\rho_\pi - \lambda\omega_2 = 0. \tag{5}$$

Note that under purely forward-looking price setting ($\gamma = 0$), we obtain $\rho_\pi = 0$ and the discretionary policy is not forward-looking, but given by $\pi_t = -(\lambda/\kappa)x_t$. Both targeting rules (3) and (4) are independent of the lead time q. Before we turn to the general case of hybrid private price-setting behavior, we discuss the limit case of purely forward-looking price setting.

2.1. Purely forward-looking price setters

We first discuss the volatility results in the regime commitment. For $\gamma = 0$, the system can be reduced to an univariate hybrid equation of the form

$$x_t = aE_t x_{t+1} + bx_{t-1} + c\varepsilon_{t-q} \tag{6}$$

with $a = \beta b$, $b = \lambda/(\lambda(1+\beta)+\kappa^2)$, and $c = -\kappa/(\lambda(1+\beta)+\kappa^2)$. Since $1 > \beta > 0$, $sgn(a) = sgn(b)$. This implies that the variance of x_t is unambiguously increasing in q as it is shown by Winkler and Wohltmann (2012).

The volatility of the inflation rate, on the other hand, may also be decreasing in q. Its variance is given by

$$\text{Var}(\pi_t) = \frac{2\beta_0^2}{(1+\alpha)(1+\delta)(1-\alpha\delta)}\left(\frac{\lambda}{\kappa}\right)^2 \times \left[1 - \frac{1-\alpha\delta}{\alpha-\delta}\delta^{2(q+1)} + \frac{(1-\alpha)(1+\delta)\delta\alpha}{\alpha-\delta}(\alpha\delta)^q\right] \tag{7}$$

where $|\alpha| < 1$ is the stable root of $\alpha_{1,2} = \left(1 \pm \sqrt{1-4ab}\right)/(2a)$, $\beta_0 = c/(1-a\alpha)$, and $\delta = a/(1-a\alpha)$. An unanticipated shock may generate a higher inflation volatility than a cost-push shock that is anticipated in the infinite past:

$$\text{Var}_{q=0}(\pi_t) > \text{Var}_{q\to\infty}(\pi_t)$$
$$\text{iff} \quad \frac{\kappa^2}{\lambda} > \sqrt{1+4\beta} - (1+\beta) \quad (\lambda > 0). \tag{8}$$

The reason for the ambiguity in the inflation volatility are two opposing effects: On the one hand, the longer the length of anticipation, the higher is the variance of the output gap, which – in isolation – also leads to a higher variance in inflation. On the other hand, the response of the output gap becomes smoother, i.e. x_t is more autocorrelated, with increasing q. Since the inflation rate depends via the targeting rule on the change in the output gap,

3 To see this, consider the model $y_t = \rho y_{t-1} + \varepsilon_{t-q}$, where $\varepsilon_{t-q} \sim N(0, \sigma^2)$ is an i.i.d. news shock that is anticipated q periods in advance. Assuming stationarity, the variance of this model is given by $\text{Var}(y_t) = \sigma^2/(1-\rho^2)$, i.e. independent of q.

4 Bounded rationality assumes that agents have cognitive limitations and use simple heuristics (rule of thumbs) to guide their behavior and are recently under growing investigation, see e.g. De Grauwe (2012) and Lengnick and Wohltmann (2016).

5 Details on the derivation of our results can be found in the technical appendix to this paper which is available in Offick and Wohltmann (2016).

6 A similar Phillips curve is used by Smets and Wouters (2003).

7 Assuming separable preferences and neglecting capital, $\kappa = (\sigma+\eta)(1-\theta)(1-\beta\theta)/\theta$ where θ is the Calvo parameter, σ the inverse of the intertemporal elasticity of substitution, and η the inverse of the Frisch elasticity of labor supply. During our simulations below, we assume: $\beta = 0.99, \theta = 2/3, \sigma = \eta = 2$, implying $\kappa = 0.68$.

8 Note that under purely forward-looking price setting behavior, the loss (2) is of the same form as the welfare theoretic loss with $\lambda = \kappa/\chi$, where χ denotes the elasticity of substitution between differentiated goods. If not stated otherwise, we assume in the simulations below $\lambda = 0.05$ which roughly corresponds to a steady state mark-up of 10%, i.e. $\chi = 11$.

9 For simplicity, we refer in the following to the optimal unrestricted monetary policy as the policy under commitment.