



Monetary policy and inflationary shocks under imperfect credibility[☆]

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ABSTRACT

In this note, we quantify the deterioration of achievable stabilization outcomes when monetary policy operates under imperfect credibility and weak anchoring of long-term expectations. Within a medium-scale Dynamic Stochastic General Equilibrium (DSGE) model, we introduce, through a simple signal extraction problem, an imperfect knowledge configuration in which price and wage setters wrongly have doubts about the determination of the central bank to maintain a fixed long-term inflation objective in the face of inflationary shocks. The magnitude of private sector learning has been calibrated to match the volatility of US inflation expectations at long horizons. We find that the costs of maintaining a given inflation volatility under weak credibility could amount to 0.25 percentage point (pp) of output gap standard deviation.

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1. Introduction

An abundant strand of literature, to which Woodford (2003) is the most representative contribution, has studied monetary policy stabilization under rational expectations and perfect central bank credibility. In this context, a monetary authority committed to delivering a given inflation target can successfully steer expectations in the face of inflationary disturbances and achieve appropriate inflation volatility at reasonable output costs. However, a less extreme description of the macroeconomic landscape would have to account for imperfect credibility of the central bank: credibility is an asset which is built and preserved over time, and it could for example be undermined by an adverse sequence of inflationary shocks which, taken individually, would not have required specific policy actions. In this note, we intend to quantify the deterioration of achievable stabilization outcomes for monetary policy under imperfect credibility. To this aim, we use a medium-scale Dynamic Stochastic General Equilibrium (DSGE) model, in which firms and unions set prices and wages according to their imperfect perception about the central bank's inflation target in the face of cost-push shocks.

2. Analytical framework

We make use of the medium-scale DSGE model presented in Smets and Wouters (2007) and rationalize some misperceptions by private agents on the inflation objective of the monetary authority through a stylized signal extraction problem as cost-push shocks hit the economy. We do not spell out here all the log-linearized equations of the model, and refer to Smets and Wouters for a full description of these relations.

2.1. Model

The core hypothesis of our analysis is that price and wage setters wrongly perceive a time-varying inflation target, denoted $\bar{\pi}_t$. Here we thus present all the Smets and Wouters equations that are modified by this assumption. The linearized version of the price-setting behavior is given by

$$\pi_t = \pi_1 \pi_{t-1} + \pi_2 E_t \pi_{t+1} - \pi_3 \mu_t^p + \varepsilon_t^p + (1 - \pi_1 - \pi_2 \rho_\pi) \bar{\pi}_t, \quad (1)$$

where $\pi_1 = \frac{\iota_p}{1 + \beta \gamma^{(1-\sigma_c) \iota_p}}$, $\pi_2 = \frac{\beta \gamma^{(1-\sigma_c)}}{1 + \beta \gamma^{(1-\sigma_c) \iota_p}}$ and

$$\pi_3 = \frac{1}{(1 + (\phi_p - 1) \varepsilon_p)} \frac{(1 - \xi_p)(1 - \beta \gamma^{(1-\sigma_c) \xi_p})}{\xi_p (1 + \beta \gamma^{(1-\sigma_c) \iota_p})}.$$

The real wage dynamics is governed by

$$\begin{aligned} w_t = & w_1 w_{t-1} + (1 - w_1)(E_t w_{t+1} + E_t \pi_{t+1}) - w_2 \pi_t \\ & + w_3 \pi_{t-1} - w_4 \mu_t^w + \varepsilon_t^w \\ & + (w_2 - w_3 - (1 - w_1) \rho_\pi) \bar{\pi}_t, \end{aligned} \quad (2)$$

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where $w_1 = \frac{1}{1+\beta\gamma^{(1-\sigma_c)}}$, $w_2 = \frac{1+\beta\gamma^{(1-\sigma_c)}\iota_w}{1+\beta\gamma^{(1-\sigma_c)}}$, $w_3 = \frac{\iota_w}{1+\beta\gamma^{(1-\sigma_c)}}$ and $w_4 = \frac{1}{(1+(\phi_w-1)\varepsilon_w)} \frac{(1-\xi_w)(1-\beta\gamma^{(1-\sigma_c)}\xi_w)}{\xi_w(1+\beta\gamma^{(1-\sigma_c)})}$.

The notation is similar to that in Eqs. (10) and (13) of Smets and Wouters (2007).

The monetary authority behavior is strictly similar to that of Smets and Wouters. It is assumed to operate according to an interest rate feedback rule specification in which the central bank has a fixed inflation objective over the long term, corresponding to the steady-state inflation rate. For the sake of clarity, we recall that the rule has, in deviation from the steady state, the following form:

$$r_t = \rho r_{t-1} + (1 - \rho) [r_\pi \pi_{t-1} + r_y y_{t-1}^{gap}] + r_{\Delta y} \Delta y_t^{gap} + \varepsilon_t^r, \quad (3)$$

where a lower-case variable denotes log-deviation of that variable from its deterministic steady-state level. It incorporates terms on lagged inflation, lagged output gap, and its first difference. The output gap is defined as the log-difference between actual and flexible-price output. The fact that the perceived inflation target $\bar{\pi}_t$ does not enter the policy rule reflects our assumption that the central bank does not react to the private sector's wrongly perceived inflation target innovations.

2.2. Private sector learning

We assume that private agents do not have a perfect knowledge of the central bank's inflation target: they have doubts about the commitment of the monetary authority to maintain a fixed inflation target in the face of cost-push shocks. More specifically, we specify an *ad hoc* filtering problem in which price and wage setters do not observe $\bar{\pi}_t$ and ε_t^p separately. We approximate an imperfect knowledge configuration in which price and wage setters only receive a signal on the aggregate markup in the goods market, defined as $\varepsilon_t^\pi = \varepsilon_t^p + (1 - \pi_1 - \pi_2 \rho_\pi) \bar{\pi}_t$, reflecting our focus on the possibility of a wrongly perceived time-varying inflation target triggered by a sequence of cost-push shocks. Private agents face a signal extraction problem that therefore entails backing out the two components. Given their supposed knowledge of the driving process of the shocks and their perceived standard deviation of the inflation target, they form an estimate of the current inflation target shift and expectations of the future target using a simple Kalman filter characterized by the following state-space system:

$$\begin{bmatrix} \bar{\pi}_t \\ \varepsilon_t^\pi \end{bmatrix} = \begin{bmatrix} \rho_\pi & 0 \\ 0 & \rho_p \end{bmatrix} \begin{bmatrix} \bar{\pi}_{t-1} \\ \varepsilon_{t-1}^\pi \end{bmatrix} + \begin{bmatrix} \eta_t^\pi \\ \eta_t^p \end{bmatrix} \quad (4)$$

$$\varepsilon_t^\pi = [(1 - \pi_1 - \pi_2 \rho_\pi) \quad 1] \begin{bmatrix} \bar{\pi}_t \\ \varepsilon_t^p \end{bmatrix}, \quad (5)$$

where $\rho_p, \rho_\pi \in [0, 1]$ and η_t^p, η_t^π are i.i.d. exogenous shocks. An example of such an imperfect information mechanism can be found, although for a different set of shocks, in Erceg and Levin (2003).

2.3. Calibration issues

All the parameter values, if not discussed later, are fixed to the mode of the posterior distribution of the long sample estimates of Smets and Wouters.

Several papers, including Erceg and Levin (2003), have highlighted the fact that price and wage automatic indexation schemes suffer from weak structural foundations. Benati (2008) shows notably that statistical inference on *intrinsic* inflation persistence embedded in traditional hybrid New Keynesian Phillips curves depends on the monetary regime in place. Monetary policy conduct which fails to provide a credible nominal anchor or a

credible commitment to low and stable inflation may increase the backward-looking features of inflation dynamics. Against this background, we preferred, as in Erceg and Levin (2003), to pursue the imperfect credibility exercise at the core of this note in purely forward-looking price and wage settings. We thus set to zero the backward indexation parameters for price and wage settings, ι_p and ι_w . Thereafter, we will nonetheless compare the monetary policy implications of our learning specification to those of higher backward indexation, interpreted as weak central credibility.

While in Smets and Wouters the markup shock follows an ARMA process, we assume, by simplification, an AR(1) process which we calibrate to match almost exactly their model's properties. We thus obtain $\rho_p = 0.25$. Finally, the stochastic distributions of all the exogenous shocks, and notably the one of the markup shock ε_t^p , are again the same as Smets and Wouters.

The learning features will be designed to increase the volatility of 5y–5y forward inflation expectations towards a level consistent with evidence from the break-even inflation rates (BEIRs). Among the available indicators of inflation expectations, the BEIRs derived from nominal and inflation-indexed bond yields constitute an important market-based measure. Notably, the BEIR which measures inflation compensation for the five-year period starting in 5 years' time over a five-year horizon is used by many central banks as a preferred measure of the view of market participants about the delivery of price stability over the medium term. For the US, some studies have documented the excess sensitivity of long-term forward BEIRs to macroeconomic news (see, for example, Beechey et al., 2008). This phenomenon may partly reflect the weak anchoring of long-term expectations when economic agents do not have a perfect knowledge of the central bank inflation objective. To give an order of magnitude, the standard deviation of 5y–5y forward BEIRs (seasonally adjusted) from January 2005 to January 2008 amounts to 0.16 pp of annual inflation. By contrast, the medium-scale DSGE estimated on US data of Smets and Wouters (2007), which features rational expectations as well as a constant inflation objective for the central bank, would point to a much lower unconditional volatility of average inflation at such a distant horizon. Following Erceg and Levin (2003), we set the autoregressive coefficient on the perceived inflation target, ρ_π , to 0.99. We then calibrate the variance of the innovation, η_t^π , in order to achieve an unconditional variance of 5y–5y inflation expectations of 0.16 pp annually.¹

Fig. 1 presents the private sector perception of the price markup disturbance and the inflation target compared with *true* developments. While the markup shock is well perceived by agents, the degree of misinterpretation about the central bank's objective is sizeable in this calibration. Under rational expectations, a high volatility in the inflation target is needed to generate sufficient fluctuations in inflation expectations at long horizons. Overall, a markup shock which implies *ex ante* an inflationary impulse of 0.2 pp leads to initial shift on the perceived inflation target of the same magnitude. The imperfect credibility mechanism introduced in this note could seem rather extreme, but it remains illustrative of the magnitude of misperception required to account for higher volatility in inflation expectations.

¹ Of course, the BEIRs are not unbiased measures of inflation expectations since they incorporate a time-varying risk premium. However, available measures trying to correct for such risk compensations still tend to indicate that market-based inflation expectations for the US economy would feature excessive fluctuations. Thereafter, we examine the implications for monetary policy should expectation instability be due to imperfect credibility.

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