Information Updating and Inertia*

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Abstract

We evaluate the ability of the sticky information model to generate inertia in inflation and output within a DSGE model. We show that the model needs two elements in order to have good properties: Real rigidities. And information stickiness that follows a *fixed* (Taylor) –rather than a random (Calvo)– updating scheme.

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Introduction

The sticky information model has been proposed as an alternative to the sticky price model (Mankiw and Reis, 2002). The main idea is that if information disseminates slowly throughout the population then different agents' expectations may end being based on different information sets. The resulting Phillips curve contains past expectations of current economic conditions, giving rise to inertial inflation behavior. Mankiw and Reis (2002) demonstrate that such a model can give rise to hump shaped responses of inflation and output following a monetary shock.

Collard and Dellas (2003) and Dupor and Tsuruga (2005) argue that sticky information model cannot generate inertia in inflation if the degree of information stickiness is plausibly modest. But they do not take into account real rigidities. Trabandt (2005), and Coibin (2006), argue that it can generate inertia if it contains a high degree of strategic complementarity[1].

While suggestive, this result (and also the original Mankiw and Reis, 2002, one) is not definite because of the framework within which the analysis has been conducted. In particular, Coibin uses a "reduced" form specification where the degree of strategic complementarity proxies for real rigidities. In Trabandt, complementarity is due to specific labor markets. In both models, investment is missing. These assumptions make it difficult to judge whether the dynamic properties of the model would obtain under the standard DSGE formulation employed by sticky price models (see Christiano et al., 2005).

Our objective is to examine the dynamic properties of the sticky information model in a fully specified DSGE model with conventionally modelled and calibrated real rigidities. We incorporate the standard real rigidities, namely, habit persistence, variable capital utilization and capital or investment adjustment costs[2]), that have proved useful in amplifying the effects of nominal frictions in the NK model.

We find that, under the standard random updating scheme (Calvo), the DSGE model with sticky information does not have good properties, even for high levels of information stickiness. But this is not a failure of the sticky information assumption *per se* but rather of the particular form of the updating scheme. Employing instead a fixed updating scheme (Taylor) allows the model to produce inertial inflation dynamics even under a modest amount of information stickiness

[1] Coibin also argues that the model cannot generate inertia even for high degrees of sticky information and complementarity in the case of an interest rate rule. This may not be a relevant exercise as an interest rate rule in the sticky information model may require some modifications in the information structure.

[2] These are the real rigidities Christiano et al., 2005 identify as the key ingredients for their model's ability to generate inertial behavior of output and inflation following a monetary policy shock. We too find that adding more features is of no consequence.

($N = 4$). The main weakness is in output dynamics, where the model needs somewhat more information stickiness in order to produce inertia (six quarters or more). It thus appears that, in a properly specified DSGE model, the distinction between fixed and random updating of information is crucial for the properties of the sticky information model. And that in spite of the popularity of the latter[3], it is the former that gives the model a better a chance of generating inertial behavior in the key macroeconomic variables.

1 The Model

1.1 The Household

Household preferences are characterized by the lifetime utility function:

$$\mathbb{E}_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left[\log(c_{t+\tau} - \vartheta c_{t+\tau-1}) + \frac{\nu^m}{1-\sigma_m} \left(\frac{M_{t+\tau}}{P_{t+\tau}} \right)^{1-\sigma_m} - \frac{\nu^h}{1+\sigma_h} h_{t+\tau}^{1+\sigma_h} \right] \tag{1}$$

where $0 < \beta < 1$ is a constant discount factor, c denotes consumption , M/P real balances and h work supplied by the representative household. ϑ is the habit persistence parameter.

The budget constraint is

$$E_t B_{t+1} Q_t + M_t + P_t(c_t + i_t + z(u_t)k_t) = B_t + M_{t-1} + P_t v_t u_t k_t + W_{jt} h_{jt} + \Omega_t + \Pi_t \tag{2}$$

where W_t is the real wage; P_t is the nominal price of the domestic final good; c_t is consumption and i is investment expenditure; k_t is the amount of physical capital owned by the household and leased to the firms at the real rental rate v_t. Only a fraction u_t of the capital stock is utilized in any period. M_{t-1} is the amount of money that the household brings into period t, and M_t is the end of period t money holdings. N_t is a nominal lump–sum transfer received from the monetary authority; T_t is the lump–sum taxes paid to the government and used to finance government consumption. The capital stock evolves according to

$$k_{t+1} = \left(1 - \Phi\left(\frac{i_t}{i_{t-1}}\right)\right) i_t + (1-\delta)k_t \tag{3}$$

where $\delta \in [0, 1]$ denotes the rate of depreciation. We assume that $\Phi(\cdot)$ satisfies $\Phi(1) = \Phi'(1) = 0$ and $\varphi = \Phi''(1) > 0$. This investment adjustment cost specification is the one used by Christiano et al. (2005).

The household determines consumption/savings, money holdings and leisure plans by maximizing utility (1) subject to the budget constraint (2) and the evolution of physical capital (3).

[3] And the popular presumption to the opposite.

1.2 Final sector

The final good is produced by combining intermediate goods. This process is described by the following CES function

$$y_t = \left(\int_0^1 y_t(i)^\theta \mathrm{d}i \right)^{\frac{1}{\theta}} \tag{4}$$

where $\theta \in (-\infty, 1)$. θ determines the elasticity of substitution between the various inputs. The producers in this sector are assumed to behave competitively. The final good may be used for consumption — private or public — and investment purposes.

1.3 Intermediate goods producers

Each firm i, $i \in (0,1)$, produces an intermediate good by means of capital and labor according to a constant returns–to–scale technology, represented by the production function

$$y_t(i) = \begin{cases} (u_t(i)k_t(i))^\alpha h_t(i)^{1-\alpha} - \Psi & \text{if } A_t(u_t(i)k_t(i))^\alpha h_t(i)^{1-\alpha} \geqslant \Psi \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

where $\alpha \in (0,1)$. $u_t(i)k_t(i)$ and $h_t(i)$ respectively denote the capital services and the labor input used by firm i in the production process. $\Psi > 0$ denotes the fixed cost of production.

We now describe the pricing decisions under the random and fixed duration schemes.

1.3.1 Random Duration

All firms set a price every period, but the information set differs across firms. In each period, only a fraction γ of firms is able to update its information about the state of the economy. The remaining set their prices based on information collected earlier. The information arrival scheme follows Calvo: each firm has the same constant probability, γ, of updating its information when taking price decisions. A firm that updated its information set j periods ago sets a price

$$P_t(j) = E_{t-j} P_t^\star$$

The aggregate price index is given by

$$P_t = \gamma \sum_{j=0}^{\infty} (1-\gamma)^j E_{t-j} \left(\frac{P_t s_t}{\theta} \right)$$

The sticky information Phillips curve has an infinite state space due to the infinite sum of past expectations. In solving the model we use an undetermined coefficient method recently developed by Wen and Wang (2006), and truncate the sum to include forty lags[4]

[4]Trabandt, 2005, uses 20 lags.

1.3.2 Fixed Duration

In each an every period, all intermediate good producers reset their price. The population of firms is split into N parts, each of them indexed by $i \in [0, N-1]$. Each fraction of firms i/N uses information available in period $t-i$.

The optimal price is

$$P_t^\star(i) = E_{t-i}\left(\frac{P_t s_t}{\theta}\right) \tag{6}$$

hence the aggregate intermediate price index is

$$P_t = \left(\frac{1}{N}\sum_{\tau=0}^{N-1}\left(E_{t-\tau}\left(\frac{P_t s_t}{\theta}\right)\right)^{\frac{\theta}{\theta-1}}\right)^{\frac{\theta-1}{\theta}} \tag{7}$$

1.4 The monetary authorities

Monetary policy follows an exogenous money supply rule:

$$M_{t+1} = M_t + \Omega_t \tag{8}$$

The process for Ω_t will be specified below.

2 Parametrization

The parametrization (table 1) follows closely Christiano et al. (2005).

Gross money growth takes the form

$$\mu_t = (1-\rho_m)\overline{\mu} + \rho_m \mu_{t-1} + \epsilon_{mt}$$

where $|\rho_m| < 1$, $\overline{\mu} = E(\mu_t)$ and ϵ_{mt} is a white noise process (this is the parametrization of Mankiw and Reis).

Results

We focus on the most important stylized facts that have been singled out by Mankiw and Reis (2002) in their attempt to establish the good performance of the sticky information model. Namely, hump shaped responses of output and inflation following a – one standard deviation– monetary policy shock.

Table 1: Calibration: Benchmark case

Discount factor	β	0.988
Inverse labor supply elasticity	σ_h	1.00
Habit persistence	ϑ	0.65
Elasticity of money in the utility function	σ_m	10.62
Capital elasticity of intermediate output	α	0.232
Adjustment costs parameter	φ	2.500
Depreciation rate	δ	0.025
Capital utilization	σ_z	0.01
Parameter of markup	θ	0.833
Length of information stickiness	N	2 to 8
Probability of information updating	γ	0.5 to 0.125
Shocks and policy parameters		
Persistence of money shock	ρ_m	0.500
Volatility of money shock	σ_m	0.009
Steady state money supply growth (gross)	μ	1.012

The inclusion of real rigidities ought to help the sticky information model because, by making nominal cost more sluggish, they make the firms' desired prices depend largely on the prices set by other firms and less so on tracking the exogenous monetary shock.

Figure 1 reports the IRFs under the two updating schemes. As can be seen, the sticky information model with the Calvo specification does not have good dynamic properties. It cannot generate any humps in either inflation or output, even for high degrees of information stickiness (8 periods or more). It does generate some inertial behavior in output, though.

These results are in contrast to those that have been obtained outside the DSGE framework. They may not, however, represent a fatal blow to the sticky price model. The IRFs obtained under a fixed updating scheme exhibit much better behavior[5]. In particular, there is inertia and a hump in inflation for a standard value of information updating (N=4). Things are not as favorable at the output front, where in order to get the hump, a higher degree of information stickiness is required (N=6), but still a hump obtains there too. It thus appears, that while the random updating scheme is quite popular in the context of sticky information model, it cannot match the nice dynamic properties generated by the fixed updating version.

[5]It should be kept in mind that the presence of real rigidities plays a critical role.

3 Conclusions

Sticky information models have been used to tackle the issue of inertia in inflation and economic activity. In this paper we evaluate the dynamic properties of these model using a properly and conventionally specified DSGE model, of the type employed in the sticky price literature for similar purposes. We show that the sticky information model can have good dynamic properties for a plausible amount of information stickiness but *only* when the popular, random –Calvo– information updating scheme is replaced by its fixed updating –Taylor– counterpart.

4 References

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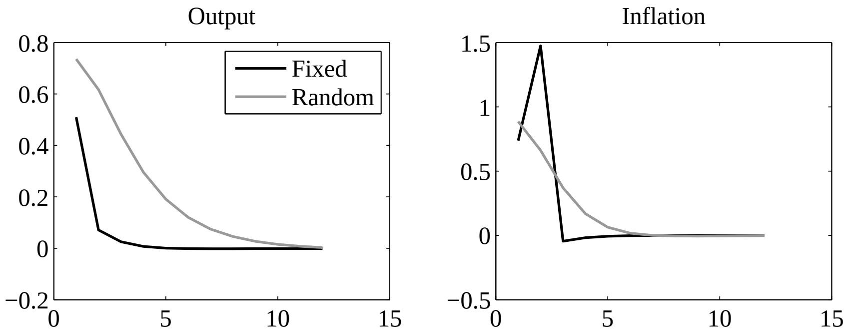
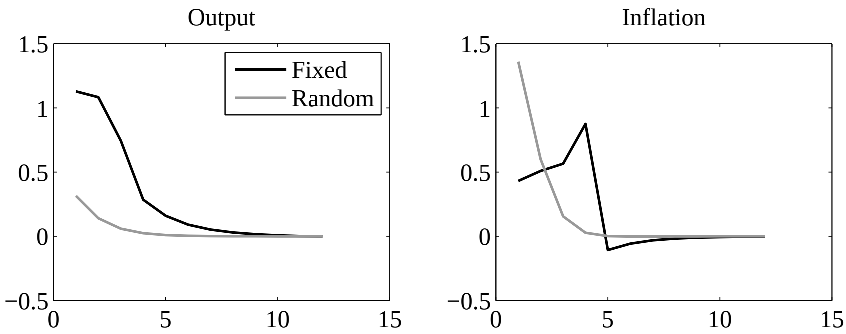
Figure 1: Fixed (Taylor) vs Random (Calvo) Resetting

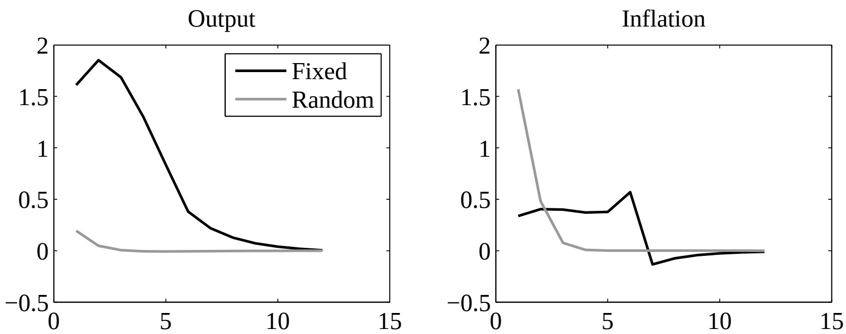
(a) 2 periods



(b) 4 periods



(c) 6 periods



(d) 8 periods