The Phillips Curve under state-dependent pricing

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Summary of the paper

Time dependent pricing (TDP): exogenous timing of price changes.

It does not explain why firms change their price. We may still be in quest of a structure.

State dependent pricing: firms adjust the time pattern of their price adjustment in response to change in macroeconomic conditions. Sheshinski and Weiss (1983), Caplin and Leahy (1991), Dotsey, King and Wolman (DKW,1999)

This paper: derives a closed form solution (SDPC) for short term inflation in the model of Dotsey et al. (1999) and evaluates its properties.

SDP a la DKW (1999)

Firm j decides to adjust its price if benefit of doing so outweighs the cost. I.e. $V_{0,t} - \xi_t w_t - V_{j,t} \geq 0$

ξ_t ~G(x)=P($\xi_t \leq x$) iid menu cost drawn from nature for each firm at time *t*

$\Rightarrow \alpha_{j,t} = G(\frac{V_{0,t} - V_{j,t}}{w_t})$.

State dependent probability of resetting the price for a firm that last did it *j* periods ago.

Optimal adjustment price for lucky draws.

$P_{0,t}=\frac{\vartheta}{1-\vartheta}\ (Q_{t,t+j}, MC_t...MC_{t+j}, P_t....P_{t+j}, C_t...C_{t+j}, \frac{\omega_{j,t+j}}{\omega_{0,t}})$

Forward looking as in Calvo, but state dependent probability and finite horizon.

Aggregation of individual prices

$P_t=(\sum_{j=0}^{J-1} \omega_{j,t} P_{0,t-j}^{1-\vartheta})^{\frac{1}{1-\vartheta}}$

Changes in economy state affects the persistence of aggregate price level through re-weighting of individual prices.

This paper.

State Dependent Phillips Curve

$$\pi_t = \mathsf{E}_t \sum_{j=1}^{J-1} \delta_j(\omega, \Pi, \vartheta)\pi_{t+j} + \mathsf{E}_t \sum_{j=1}^{J-1} \psi_j(\omega, \Pi, \vartheta)\mathsf{mc}_{t+j} + \sum_{j=0}^{\infty} \eta_j(\omega, \Pi, \vartheta)\Omega_{t-j} + \sum_{j=0}^{\infty} \eta_j(\omega, \Pi, \vartheta)\pi_{t-j}$$

- Finite leads of inflation and marginal costs

- Infinite lags of inflation (endogenously) and price vintages

- Coefficients vary with economic conditions.

Some results

SDPC coefficients

- Microfoundation of lagged inflation in Phillips Curve

- Higher trend inflation $\Rightarrow$ higher probabilities of adjusting soon and smaller number of price vintages.

- Coefficients on marginal costs bigger than usually estimated

SDPC versus NKPC

- NKPC is a special case of SDPC

- NKPC estimation on SDPC economy: relevance of inflation lag.

Discussion

4 main points.

Point 1 and 2: are TDP and purely forward looking Phillips Curve so bad?

Point 3 and 4: is there something missing in the State Dependent Phillips Curve?

1 Nature of costs of price adjustment

SDPC: random menu costs incurred when firm changes its price.

Zbaracki, Ritson, Levy, Dutta and Bergen (2004)

Study of a large US industrial manufacturer and its customers.

Managerial costs: gathering information, managerial decision on price, communicating the logic of the price change to different members of the firm

Customer costs: developing communication strategy to convey logic of price changes to consumers and negotiating with resistant customers.

Managerial and customer costs, respectively, 6 and 20 times the cost of physically changing the prices.

Firm changes its prices annually even despite strong reasons and ample opportunities to change prices during the year.

2 Lagged inflation in NKPC. Do we need ad hoc agents? And do we need lagged inflation?

Baseline (exclusively forward looking) NKPC can not properly replicate the dynamics of US inflation, Fuhrer and Moore (1995).

Ad hoc lagged inflation term needed. NKPC with backward looking term inappropriate for policy exercises.

However, alternative explanations for inflation inertia.

- Probability of resetting price function of the time price was held fixed (Goodfriend and King (1997), Wolman (1999), Dotsey (2002), Mash (2004) and Sheedy (2005)).

- Time varying trend inflation rate (Cogley and Sbordone, 2005). Longer leads, their measure of trend inflation is correlated with lagged inflation.

- Departures from rationality. Collard and Dellas (2004), Erceg and Levin (2003), Milani (2005), Roberts (1997) and Paloviita (2004).

Lagged inflation term can be rationalized in different ways, with better behavioral interpretation than ad hoc price setters or price setting strategies or it can be considered a proxy for something else.

This type of explanations do not generally invalidate the optimal monetary policy prescriptions derived by means of the forward looking PC (Woodford 2006).

In addition, need for lagged term of inflation in PC is not completely uncontroversial from an empirical point of view.

Papers above: apparent existence of intrinsic inflation persistence.

Christiano, Eichenbaum and Evans (2005): assuming variable capital utilization and nominal wage rigidities, lagged inflation terms become (empirically) unimportant to explain inflation dynamics.

Intuition: sluggish marginal costs enough to replicate inflation persistence.

Relevance of lagged inflation terms in the NKPC is still open issue

3 Relative importance of backward and forward looking terms of inflation in NKPC.

Estimation of Gali-Gertler equation. Linear GMM estimation. Sample 1970q1 - 2006q2.

$$\pi_t = \gamma_f E_t \pi_{t+1} + \gamma_b \pi_{t-1} + \lambda \mathrm{mc}_t$$

π_t GDP deflator and mc_t non farm business sector labor income share.

As in BKR, $\gamma_f + \gamma_b = 1$.

	Full Sample	1970q1-1984q4	1985q1-2006q2
Average Inflation	4.02	6.30	2.45
BKR			
γ_f	NA	0.610	0.614
γ_b	NA	0.390	0.386
Actual Data			
γ_f	0.72	0.510	0.840
γ_b	0.28	0.490	0.160

Lagged inflation term is always significant.

Degree of intrinsic inertia seems time varying.

Exercise in the paper: same coefficients in 3% and 6% economies.

Is something missing in SDPC?

4 SDPC: something relevant missing in the structure?

4.1 Real rigidities

Calibrated coefficients on current and expected marginal costs high compared to estimates.

Real rigidities missing from the picture.

Is this relevant for price setting behavior?

Real rigidities dampen the response of prices to marginal costs. Coenen and Levin (2004), Eichenbaum and Fischer (2004) and Christoffel, Coenen and Levin (2006) .

1) Elasticity of goods demand increasing in price, Kimball (1995).

Less incentive to raise price if demand becomes more elastic.

2) Firm specific inputs (capital)

Firm realizes that marginal cost depends on its output. Aggregate shock $\Rightarrow$ Firms willing to raise price $\Rightarrow$ Lower output. Smaller incentive to raise prices.

Adding these two features: standard Calvo model can reproduce key features of US inflation without relying on excessive inflation inertia.

However, real rigidity parameters unidentified in baseline NKPC.

Coenen and Levin (2004) and Christoffel, Coenen and Levin (2006) specify a generalized Calvo model (staggered contracts of multiple duration).

Effects of real rigidity parameters are identified and estimated on US (83-03) and German (75-98) data.

Very small and statistically significant value. Real rigidities are relevant to explain low sensitivity of inflation to marginal costs.

4.2 Hazard functions and heterogeneous price setters

- Hazard functions are downward sloping (survey in Alvarez, Burriel and Hernando (2005)).

Firms have a lower probability of changing their price the longer they have kept it unchanged.

At odds with theoretical models. Among those, SDP. Why?

- Heterogeneity in price setting (Bils and Klenow (2004), IPN)

Leading explanation to reconcile theoretical models and (aggregate) hazard functions.

Intuition: aggregate hazard function considers price changes for all firms in the economy. As the horizon increases, the share of firms with flexible

pricing rules decreases with respect to those with more rigid prices.

Heterogeneity of price setters is an important empirical feature with consequences that are not captured by baseline TDP and SDP models.

It should be incorporated in a model of price setting since it has also relevant policy implications:

- Target a different concept of inflation, Aoki (2001), Woodford (2003) and Benigno (2003).

- Imply a different optimal policy with respect to the baseline case with homogenous price setters, Lenza (2006).