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# Asymmetric price adjustment – evidence for India

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ABSTRACT

This study examines whether there exists asymmetry in the price adjustment of firms, as anticipated by Ball and Mankiw (1994), in an error correction framework. We used monthly time series data on prices of 419 commodities, which constitute 97% of commodity price basket used in the construction of wholesale price index in India. The empirical evidence indicates that the price adjustment of most of the firms exhibits strong asymmetry; shocks that increase firms' desired prices cause quicker and larger rise in prices whereas shocks that lower desired prices cause smaller or no fall in prices. Also, we identify a threshold value for each firm below which it does not allow its relative price to fall. These evidences imply that larger relative price variability can trigger inflation even in the absence of demand shocks. Moreover, the distribution of output is likely to be negatively skewed even if the demand shocks are symmetric.

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## 1. Introduction

Number of empirical studies in literature have provided evidence in favor of proposition that negative monetary shocks effect output more strongly than the positive shocks of same magnitude (Cover, 1992; DeLong & Summers, 1988; Karras & Stokes, 1999; Rhee & Rich, 1995).[1] Theoretically, in traditional models this asymmetric impact of monetary shocks is explained by models based on the assumption of rigidity in the price and/or wage levels that generate convex aggregate supply curve. More recently, Ball and Mankiw (1994, 1995) and Ball and Romer (1989, 1990) provided micro foundations for such nominal rigidities while assuming the existence of menu costs and trend in inflation. In particular, Ball and Mankiw (1995) demonstrate that in presence of menu costs, it is optimal for firms to adjust prices only in response to large shocks but not to small ones. Also, Ball and Mankiw (1994) have shown that in presence of positive trend in inflation it is optimal for firms to respond more quickly to positive shocks than negative shocks of same size. Their argument is based on the rationale that due to the positive trend inflation the relative price of a particular firm falls continuously over time thereby making downward (upward) price adjustments, in response to negative (positive) shocks to desired prices, less (more) likely to occur as it incurs menu cost. Therefore, under these circumstances, the upward adjustments in prices are expected to occur more quickly than the downward adjustments. Hence, in both the theoretical models, the asymmetry in the output effects of aggregate demand shocks basically originates from such asymmetries in the price adjustment of firms.

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[1] On the other hand, another stream of literature such as Dolado and Maria-Dolores (2002), Garcia and Schaller (2002), Kaufmann (2002), and Peersman and Smets (2001) examined this asymmetry in the business cycle phases and found that monetary policy actions have stronger effects on output during recession.

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On empirical front, however, most of the studies have mainly focused on asymmetric output effects of aggregate shocks and only a few studies have examined the asymmetry in price adjustment of firms.[2] The first attempt in this direction was made by Buckle and Carlson (2000). Using the survey data he found the evidence in favor of the proposition that firms adjust prices upwards more quickly in response rise in costs whereas the down word adjustment in response to reduction in costs occurs very slowly. Another attempt in this direction was made by Senda (2001). Although, he found that the effects of monetary shocks on output are asymmetric, however, he could not found any asymmetry in the effects of monetary shocks on the aggregate price. He attributed these inconsistent results to the lack of appropriate price equation.

We argue that such contradictory results found by Senda (2001) might arise due to the use of aggregate price index which is constructed as the weighted average of individual price indices in the model. As firms may differ in their response to a particular shock, depending on various factors, the use of aggregate price is unlikely to reveal any asymmetry in the price adjustment of firms. More specifically, it is quite possible that some firms may exhibit asymmetry in price adjustment whereas others may not depending on the degree of price rigidity (as some prices are less flexible prices than others) which in turn may depend on size of menu costs and other factors (Balke & Wynne, 2004). It is also quite possible for a particular firm to respond asymmetrically to some kinds of disturbances whereas respond symmetrically to others (Kuran, 1983). Hence, the empirical studies based on *aggregated* price indices may quite often fail to reveal any asymmetry in price adjustment of firms and might lead to wrong inferences.

In this study, we examine whether there exists asymmetry in the price adjustment of firms while using the commodity wise whole sale price indices belonging to three different sectors – primary, manufacturing and fuel-power and lubricants – from India.[3] To this end, unlike the conventional manner of using linear regression models, we examine the price adjustment process of each firm separately in the threshold cointegration framework. We used the threshold autoregression (TAR) model as proposed by Enders and Granger (1998) and Enders and Siklos (2001). The advantage of this procedure is that it allows us to examine the price adjustment process of each firm in response to negative and positive deviations from equilibrium level. Further, it also allows examining the thresholds values between which a particular firm chooses inaction and allows its relative price to deviate in either direction from the equilibrium level. The rest of the paper is organized as follows: in Section 2 of the paper the methodology is discussed, in Section 3 empirical results are presented and Section 4 provides the concluding remarks.

## 2. Modeling asymmetric price adjustment within a cointegration framework

Unlike earlier studies, we examined the asymmetries in price adjustment in threshold error correction framework.[4] The advantage of modeling price adjustments in this framework is that it provides insights about short-run price adjustments in either direction. Also, the threshold error correction model make more appropriate as theoretical models predict nonlinear adjustments in response to positive and negative deviations (Meyer, 2004). Under this framework, first we test for cointegration by using standard cointegration tests. Next, we examine the asymmetries in the price adjustment process in error correction framework following the procedure of Enders and Granger (1998) and Enders and Siklos (2001).

Under Engle and Granger (1987) two-stage procedure, we first estimate a static cointegrating regression. Given the price series of commodity $i$, depicted as $(P_{it})$ and the general price $(P_t)$, the cointegrating relationship can be represented as[5]:

$$P_{it} = \alpha_i + \beta_i P_t + \varepsilon_{it} \tag{1}$$

Unlike the standard (Engle & Granger, 1987) approach which assumes that $\varepsilon_{it}$ from Eq. (1) behaves as an auto-regressive process in the form of[6]:

$$\Delta\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \mu_{it} \tag{2}$$

where $\rho_i$ measures the speed of convergence of the system and $\mu_{it}$ is a white-noise disturbance, Enders and Granger (1998) and Enders and Siklos (2001) introduced asymmetric adjustment by letting $\varepsilon_{it}$ to behave as a TAR process:

$$\Delta\varepsilon_{it} = \rho_{i1}(I_t)\varepsilon_{it-1} + \rho_{i2}(1 - I_t)\varepsilon_{it-1} + \sum \psi_k \Delta\varepsilon_{it-k} + \mu_{it} \tag{3}$$

[2] Most of empirical studies in this line of literature have mainly focused on vertical price transmission. For a survey of this literature see Peltzman (2000).

[3] This is the first attempt in this direction.

[4] Earlier studies have used simple linear regression models by first estimating the money equation and then examining the effect of monetary shocks on the output in piece wise linear regression (see Ravn & Sola, 2004; Senda, 2001).

[5] Given that $P_t = w_i P_{it} + (1 - w_i)P_{jt}$, where $P_{jt}$ is the price of the rest of commodities except the $i$th commodity and $w_i$ is the weight of commodity $i$. Eq. (1) can be alternatively written as $\varepsilon_{it} = (1 - w_i\beta_i)P_{it} - \beta_i(1 - w_i)P_{jt} - \alpha_i$. This implies that the error term represents a weighted difference between the prices of commodity $i$ and the rest of the commodities. If this is true, then the error term in Eq. (1) is related to the weights of the commodities, which may create biased measure of the idiosyncratic error $\varepsilon_{it}$. To ensure the insignificant relationship between weights and the variance of residuals, the following auxiliary model is estimated: $\sigma_i = \alpha + \beta w_i + u_i$. We found that the estimated parameter $(\beta)$ turns out to be statistically insignificant with a value of 7.25 and standard error of 6.73 implying that weights are not influencing the error term.

[6] Including explicitly the wage costs on the right hand side of the equation would have improved the model specification. The unavailability of relevant time series data on wages in Indian economy makes any such exercise impossible. However, the general price series, which implicitly includes wage costs and appears on the right hand side of the model, is likely to capture the influence of wage costs on the price adjustment process of an individual commodity.

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