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November 1998

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Price Transmission in Vertical Markets: A Comment and an Extension[1]

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Abstract

This paper examines the impact of dynamic information acquisition by retailers, on the degree of asymmetric price transmission in vertical markets. We propose a generalization of the extant models of asymmetric price transmission, by endogenising the process of dynamic information acquisition. It is found that, this has a significant impact on the degree of asymmetry in the process of price transmission. A test of the functional form by using the restricted version of the model rejects the restricted model.

JEL Classification: C32, D43, Q13, Q18

Keywords: Asymmetric price adjustments, Vertical markets, Non-linear system of equations.

[1] This paper has benefited from the comments given by Professor Ravi Anshuman. Excellent research assistance from Sunila George is also acknowledged.
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I. Introduction

Vertical markets exist for those commodities that have to go through multiple stages of processing before reaching the end user. In such markets the transmission of supply and demand shocks across various hierarchies is not complete. This is usually caused by frictions in the information flows both in the upward and downward directions within the market. For example, it is quite possible that the changes in the rates of arrival of commodities at the wholesale level might not be known at the retail level. Or, the estimate of the expected fluctuations in demand at the retail level could be different at the wholesale level than at the retail level. Frictions in information flows and information asymmetry lead to imbalances in supply and demand at various levels of the vertical market. These imbalances will cause both asymmetric and, lagged price responses from the lower end of the market hierarchy (for example, the retailers). Asymmetric price response is defined in Taubadel (1998) as signifying the reaction of the prices at the retail level to a change in the wholesale and farm prices depending on whether these changes were positive or negative. Hence the speed and magnitude of the reaction of retail prices can be asymmetric. Lagged responses reflect the time taken by the prices at the retail level to adjust to the wholesale, or, farm prices.

Several explanations have been given for asymmetric price responses. Bailey and Brorsen (1989) for example, show that the presence of oligopolies within the trading system can cause the traders to react quickly to shocks that reduce their spreads than to those that expand them. A second source of asymmetry can lie in the nature of the supply and demand shocks (Gardner (1995)). That is, it is quite possible that a change in demand at the retail level can have a differential impact on the wholesalers than a change in the rate of arrivals from the farmers. Finally, government intervention at the farm level and at the retail level can cause the creation of the equivalent of menu costs (Ball and Mankiw (1994)) at the wholesale level. This would make the wholesalers view the increases in support prices as permanent increases in costs and pass them on quickly to the retail level (Kinnucan and Forker (1987)).

Lagged price responses from the retail level have been attributed to inertias associated with storing, transporting and inventory control behavior (Hall (1981) and Wohlgenant (1985)). The second reason could be due to delays in information transmission across markets within the hierarchy. For example, the rate of arrivals at the wholesale level might not be known to the retailers (Ward (1982)).

The literature on asymmetric price transmission (non-reversibility) and, lagged price adjustment in vertical markets is extensive. Houck (1977) and earlier Wolffram (1971) have suggested an approach based on segmenting the explanatory variables involved, into positive and negative changes These are linear models that help us understand whether for example, a positive or negative net relation exists between changes in the retail prices and, changes in the wholesale spreads and farm prices. Gardner (1975) and Heien (1980) offer equilibrium models for explaining differential impacts of changes in supply and demand on wholesale and retail prices that cause asymmetric price transmission. Wohlgenant (1985) offers an explanation based on the inventory control behavior using the rational expectation framework to examine the relationship between retail and wholesale prices. This is perhaps the first model that explains the role of inventories in the relationship between wholesale and retail spreads. Finally, Taubadel (1998) has proposed a model that is consistent with cointegration between prices at various levels in the market hierarchy.

While all the preceding models offer interesting insights into the price transmission process in vertical markets, there still is an important lacuna. For instance, none of these papers examine the role of profit seeking by the retailers in the process of price transmission. Retail price movements are not only a function of the direction of changes in wholesale spread, and the farm price, but also, a function of the degree of stability of the changes in the retail spreads. The retail spreads measure the profit-seeking and information-seeking behavior of the retailers and will influence the degree of asymmetric price adjustments in the market. This issue is especially important in the light of causal relationships that exist between wholesale spreads and retail spreads. If there exists bi-directional causality, then, there can be feedback effects that will influence the degree of asymmetric price adjustments. Another problem with these papers is that, the various markets in a given economy are treated as distinct entities. It is possible that both wholesale and retail markets across space could be informationally linked. This will affect price transmission within any vertical market.

This paper proposes a general method of estimating price transmission in vertical markets by endogenising the profit-seeking behavior of the retailers. This is done by introducing a partial adjustment component (along the lines of Marsh (1994)) into the model for estimating the process of price transmission. Retailers are constantly engaged in dynamic information acquisition. In a perfect foresight world, this will not have any impact on the process of price transmission in vertical markets. However information asymmetry is endemic to vertical markets. In this context dynamic information acquisition will induce instabilities into the system. This is therefore endogenised in the model of price transmission along the lines of Chavas and Holt (1993). The process of information acquisition is modeled in a partial adjustment framework where, the actual spread adjusts towards an unknown target spread. In addition to this, the method of non-linear system estimation is used to capture any possible informational linkages between spatially separated markets.

The rest of the paper is laid out in the following manner. Section II explains the data and the model. The results of the estimation procedures are given in section III. Section IV concludes the paper.

II. Model and Data

Let Y_{it} be the retail price in market i at time t, and, X_{it} and Z_{it}, the corresponding wholesale spread and farm prices. The target spread at the retail level which is unobservable, is V^{*}_{it}. We segment the variables X_{it} and Z_{it}, in the manner prescribed in Houck (1977) into positive and negative changes. Hence;

$X'_{it} = X_{it} - X_{it-1}$ if $X_{it} > X_{it-1}$, and $= 0$ otherwise ...(a)

$X''_{it} = X_{it} - X_{it-1}$ if $X_{it} < X_{it-1}$ and $= 0$ otherwise ...(b)

$Z'_{it} = Z_{it} - Z_{it-1}$ if $Z_{it} > Z_{it-1}$ and $= 0$ otherwise ...(c)

$Z''_{it} = Z_{it} - Z_{it-1}$ if $Z_{it} < Z_{it-1}$ and $= 0$ otherwise ...(d)

Using this, we can write the model of price transmission in each market as:

$$\Delta Y_{it} = \alpha_0 + \alpha_1 \Delta X'_{it} + \alpha_2 \Delta X''_{it} + \alpha_3 \Delta Z'_{it} + \alpha_4 \Delta Z''_{it} + \beta(V^{*}_{it} - V_{it-i}) + \varepsilon_{it} \quad \text{...(1)}$$

The term (V_{it}^{*} - V_{it}), captures the deviation of the retail spread from its target value. The target spread is a function of volume (measuring the order imbalance in the system), and, the wholesale selling price. We can therefore write the target spread as follows

$$V_{it}^{*} = \gamma(vol_{it-1}, wsp_{it-1}) \qquad \ldots(2)$$

Where, vol_{it-1} is the volume at time t-1, and, wsp_{it-1} is the wholesale selling price at time t-1. Substituting equation (2) in equation (1) and expanding, we have

$$\Delta Y_{it} = \alpha_0 + \alpha_1 \Delta X_{it}^{'} + \alpha_2 \Delta X_{it}^{*} + \alpha_3 \Delta Z_{it}^{'} + \alpha_4 \Delta Z_{it}^{*} + \beta\gamma_1 Vol_{it-1} + \beta\gamma_2 wsp_{it-1} - \beta V_{it-1} + \varepsilon_{it} \qquad \ldots(3)$$

We also note that,

$$Y_{it} = Y_{i0} + \sum_{t=1}^{n} \Delta Y_{it} \qquad \ldots(4)$$

Where, Y_0 is the initial value of the retail prices in market i at any point in the time interval. We can write (4) as follows

$$Y_{it} - Y_{i0} = \sum_{t=1}^{n} \Delta Y_{it} \qquad \ldots(5)$$

Which is the sum of the period to period changes in retail prices. Recognizing this for the other segmented variables in (a) to (c), we can rewrite equation (3) as follows

$$Y_{it} - \Delta Y_{i0} = \alpha_0 + \alpha_1 \Sigma\Delta X_{it}^{'} + \alpha_2 \Sigma\Delta X_{it}^{*} + \alpha_3 \Sigma\Delta Z_{it}^{'} + \alpha_4 \Sigma\Delta Z_{it}^{*} + \beta\gamma_1 Vol_{it-1} + \beta\gamma_2 wsp_{it-1} - \beta V_{it-1} + \varepsilon_{it} \quad \ldots(6)$$

Where β measures the rate of overshooting of the retail spread. Equation (6) is now estimated as a nonlinear system of equations for i = 1…n centers in any given economy.

We estimate the model using Indian data on rice for 14 centers that are spatially separated. The Indian rice markets fall into the category of vertical markets (figure (1)) where the middlemen are the wholesalers who purchase grain from the farmer and sell to the retailers. We use weekly data for the period 1990-1994, on wholesale spreads, wholesale selling prices, farm prices, retail spreads and, volumes, to estimate our model. The next section describes the results of this estimation procedure.

III. Results

The results of the estimation are summarized in table (1). There is significant asymmetric price transmission in these markets. The coefficients of X_{it}, X^{*}_{it}, $Z^{'}_{it}$, and Z^{*}_{it} are negative. This suggests that there is a negative net relationship between retail price movements and the movements of wholesale spread and, farm prices. A stronger test for asymmetric price transmission is to test the hypothesis whether, $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4$. This is rejected at the 95% level, for all the centers.

We also estimated a restricted model where the partial adjustment part is inoperative. That is we do not endogenise the likely volatilities imposed on the system by the profit seeking (and dynamic information seeking) by the retailers. The results are reported in Table (2). Even though we continue to detect asymmetry in price transmission, we fail to reject the hypothesis of equality of the coefficients α_1,α_2, α_3 and α_4 at the 95% level. This reinforces our claim that the dynamic information seeking on the part of the retailer influences asymmetric price transmission.

Finally, we have proposed a generalization of the functional forms used in the extant literature on price transmission in vertical markets. We tested this against the restriction that the coefficients of the partial adjustment part of the model are zero. The χ^2 test strongly rejects this. We therefore can conclude that endogenising the overshooting term β is a more suitable representation of the price transmission process in vertical markets.

IV. Conclusion

In this paper we have proposed a generalization of the models that examine asymmetric price transmission in vertical markets. We use the method of non-linear system estimation to detect asymmetric price transmission in rice markets in India. Results indicate that retail prices adjust in a asymmetric fashion to changes in wholesale spreads and farm prices. We also show that the model used here synthesizes the extant models on price transmission.

Table 1

Nonlinear model of price transmission with endogenous overshooting

Centre	Independent Variables							
	trend	ΣΔX′	ΣΔX″	ΣΔZ′	ΣΔZ″	beta	wsp	vol
Ahmedabad	-.09115 (-1.9190)	-.6475 (-2.7452)	-1.6980 (-4.4304)	-1.2135 (-1.8789)	-2.6235 (-3.8251)	.2009 (2.4834)	-1.5443 (-2.1708)	-.0011 (-1.9242)
Amritsar	-.0222 (-1.8694)	-.1491 (-1.2665)	-.4778 (-1.8768)	-.2387 (-.9028)	.07460 (.283)	-.000004 (-.1511)	7702.1 (1.9121)	-8.8739 (-1.9055)
Bhubhaneshwar	.0081 (1.2775)	-.0816 (-.7807)	.0271 (.0558)	-.5164 (-1.0659)	-.6691 (-1.1713)	-.00007 (-.9645)	-2872.8 (-1.8578)	-.0347 (-1.7160)
Bangalore	.0254 (1.8517)	-.6174 (-2.1997)	-.2988 (-1.3980)	-.4561 (-1.1882)	-.2437 (-.4661)	-.00006 (-.5359)	1480.2 (1.8921)	-.5597 (-.7866)
Chandigargh	-.0658 (-2.1977)	-.8172 (-3.8595)	-2.0162 (-4.1517)	-.803 (-2.7005)	-1.9623 (-3.6469)	.1494 (1.4783)	-.5482 (-.6086)	-.0001 (-2.0680)
Cuttack	-.0511 (-1.4695)	-.9753 (-1.3780)	-.3329 (-1.1492)	-.0098 (-.0306)	-.4298 (-1.1088)	.4533 (5.6271)	.9662 (2.2750)	-.000008 (-.6056)
Karnal	-.0343 (-.9275)	-.0269 (-.103)	-1.4621 (-6.0268)	-1.5956 (-4.3205)	-.0804 (-.2115)	.4391 (5.1912)	-1.4814 (-4.0217)	.00006 (1.5688)
Kanpur	.0352 (1.87212)	-.3828 (-2.3398)	-.7866 (-6.3492)	-1.1442 (-4.5723)	-.3856 (-1.8305)	-.00007 (-1.1775)	3012.4 (1.6359)	-.2820 (-2.0143)
Lucknow	-.0335 (-1.0444)	-.6866 (-4.7383)	-.9549 (-6.9645)	-.8954 (-3.6562)	-.4664 (-1.6288)	-.00008 (-1 1477)	-3932.8 (-1.8426)	-.0099 (-.2861)
Ludhiana	-.0024 (-.0913)	-.7834 (-3.6096)	-.9363 (-3.6013)	-.4916 (-2.5189)	-.6052 (-2.3812)	.0004 (1.3239)	770.4 (1.9326)	-.0488 (-1.9898)
Madurai	-.0791 (-2.1190)	-.4204 (-3.8429)	-1.4467 (-5.8132)	-1.3453 (-4.3057)	-.3876 (-3.1120)	.4282 (5.2567)	-1.056 (-2.9760)	-.00004 (-1.0981)
Patna	-.0252 (-1.974)	-1.1117 (-6.4143)	-.9469 (-6.1348)	-1.2757 (-4.2051)	-1.4104 (-4.2867)	-.00006 (-.9021)	-2248.6 (-1.9321)	-2.1670 (-1.4769)
Shimla	-.0388 (-1.9998)	-.9706 (-5.8887)	-.1006 (-4.5326)	-.5127 (-2.9506)	-1.089 (-5.0618)	.1823 (2.4135)	-.1657 (-.2872)	-.0002 (-1.9890)
Vijayawada	-.0028 (-1.7912)	-.761 (-3.8042)	-1.6103 (-3.8965)	-.6093 (-1.8888)	-2.1135 (-3.0816)	.4430 (5.8460)	-.8832 (-4.4265)	-.000001 (-.0938)

Table 2

Nonlinear model with the restriction that the partial adjustment part is inoperative

Centre	Independent Variables				
	trend	ΣΔX'	ΣΔX"	ΣΔZ'	ΣΔZ"
Ahmedabad	-.087 (-1.8321)	-1.0125 (-2.9890)	-1.0728 (-4.2578)	-1.3935 (-1.8308)	-1.3679 (-3.3053)
Amritsar	-.0247 (-.9032)	-.4151 (-.9252)	-.4092 (-1.6277)	-.2113 (-.818)	-.0315 (-.1216)
Bhubhaneshwar	.0130 (.4451)	-.1422 (-1.3633)	-.1702 (-.3551)	-.5497 (-1.1381)	-.5246 (-.8353)
Bangalore	.0308 (1.0422)	-.5311 (-1.8509)	-.4759 (-1.4185)	-.0171 (-1.2545)	-.0025 (-.0048)
Chandigargh	-.0798 (-2.4999)	-1.1091 (-3.2153)	-1.1539 (-4.7457)	-.9627 (-3.1626)	-.9482 (-3.2205)
Cuttack	-.033 (-.7806)	-.4089 (-.8606)	-.4298 (-1.2903)	-.1099 (-.0845)	-.1125 (-.5055)
Karnal	-.0306 (-.8397)	-.1584 (-.2117)	-1.4580 (-6.1898)	-1.893 (-4.4628)	-.0331 (-.0826)
Kanpur	.0022 (.0531)	-.7588 (-2.4219)	-.7963 (-6.7449)	-.9243 (-3.9409)	-.8954 (-1.8431)
Lucknow	-.0523 (-1.6260)	-1.0533 (-4.3524)	-1.1041 (-8.6723)	-.8803 (-3.7597)	-.8501 (-1.5271)
Ludhiana	-.0026 (.0985)	-.5936 (-2.7868)	-.5674 (-3.8453)	-.6036 (-3.0134)	-.5990 (-1.9951)
Madurai	-.1021 (-2.5822)	-1.3975 (-3.1513)	-1.4304 (-5.3177)	-1.1806 (-3.9073)	-1.1693 (-3.4800)
Patna	-.0363 (-1.1434)	-1.1005 (-6.3516)	-1.0065 (-6.4999)	-1.4474 (-4.2016)	-1.4586 (-4.4279)
Shimla	-.0412 (-1.1467)	-1.0634 (-7.0636)	-.9850 (-4.6380)	-1.1243 (-3.1225)	-1.2129 (-5.8385)
Vijayawada	-.0202 (-.6784)	-.6253 (-3.1240)	-.6466 (-2.8680)	-1.1947 (-1.7783)	-1.2304 (-3.3729)

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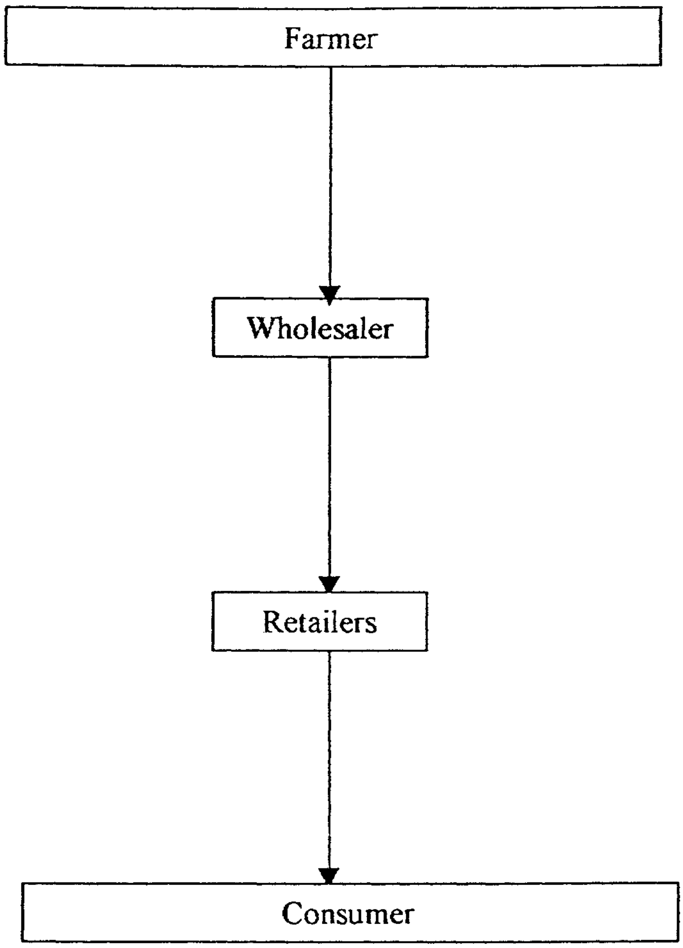

Figure (1)
Structure of Rice Markets in India