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# Asymmetric price transmission: evidence from pulse markets of India

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**Abstract** Pulses have an important role in ensuring nutritional security and environmental sustainability. Despite the wide range of research, India's pulses sector has recorded barely any growth. The studies conducted on pulses have primarily focused on how to increase production at the farm level while the marketing and prices aspect has been given less attention. Further, the studies on market integration have researched only one dimension i.e. spatial integration and not looked into an equally important aspect, that is, whether the process of price transmission in agricultural markets is symmetric or asymmetric. The present study is conducted to test for asymmetric price behaviour of pulses in a vertically integrated market using Von cram on-taubadel model. The markets for pulses are characterized as inefficient and imperfect as reflected by few vertically integrated markets and the presence of asymmetry. The extent of integration and symmetry gives signals for efficient resource allocation, which is considered essential for ensuring greater market efficiency, price stability and food security. So, government policies should be formulated in such a way that ensures greater market efficiency through improved physical and institutional market infrastructure.

**Keywords** Pulses, price behaviour, asymmetric information flow, vertical integration, institutional changes

**JEL codes** Q11,Q13, Q18

Attaining food security for all in countries that are behind in achieving Sustainable Development Goals requires institutional and policy reforms that will help the food and agricultural system become more productive and efficient in using natural resources. Institutional reforms that improve market access, information flow and logistical infrastructure determine the income of agrpicultural households and incentivize the cultivation of diverse crops. Pulses have the potential to help address future global food and nutritional security needs along with ensuring environmental sustainability. It has been acknowledged through the UN declaration of 2016 as 'International Year of Pulses'. Pulses serve as a cost-effective and nutritionally balanced rich source of protein to the people of India who are predominantly vegetarian in dietary habits forming an important constituent of the Indian food basket.

India is the major producer, consumer as well as importer of pulses in the world. India produces around 25 per cent of global pulse production from around 35 per cent of the global area and productivity of 659 kg per ha. Chickpea, pigeonpea, blackgram, greengram and lentil are the major pulses grown and consumed in India, occupying nearly 84 per cent of the area under pulses and accounting for about 85 per cent of pulse production in the country (GoI, 2016).

Although India is the largest pulse-producing country in the world, the production of these crops in the country has shown sluggish growth over the years. Pulses production has increased from 8.41 million tonnes in 1950-51 to 17.15 million tonnes in 2014-15 whereas the area has increased merely from 19.09

million ha to 23.55 million ha over the same period. During this period, pulse production has risen only by 103 per cent as compared with a roughly 450 per cent increase in cereals production. The stagnant production and ever-increasing demand due to the rise in population have widened the demand-supply gap and about 20% of its total demand is met through imports. Import can at best be a short-term measure for augmenting the supply of pulses as suppliers in the international market are few. A cost-effective and viable option to fulfil the increasing demand for pulses, in the long run, can be effectively increasing domestic production in the country. The poor production performance of the pulse sector in the country has been an area of major concern for policymakers.

The shortfall in pulses has been attributed to several factors, the major ones being the increasing population, rising income of the people, geographical shift, abrupt climate change, complex disease–pest syndrome, socioeconomic policies and input constraints (Ali and Gupta 2012). This coupled with other economic factors like lack of assured market and non-linking of pulses to procurement policy make pulses cultivation less remunerative as compared to other crops.

Assurance of a remunerative and stable price environment for growers is very important for increasing agricultural production and productivity. A suitable price policy is likely to accelerate and sustain the growth of output by protecting the interest of the farmers on a long-term basis, particularly in respect of deficit commodities such as pulses. The success of price stabilization policies is dependent upon the efficient assessment of price volatility and price transmission. Price volatility generates uncertainties about the true price level for producers and consumers, and therefore, production and consumption decisions may lead to suboptimal outcomes compared with those attained under stabilized price conditions. Price transmission provides insights into the vertical and horizontal integration of agricultural markets. Price transmission has three aspects to it: completeness, speed and asymmetry. Completeness implies that any change at one level is fully passed on to the next level. Speed refers to the rate at which the prices at two levels adjust to any new information. The extent of integration gives signals for efficient resource allocation, which is considered essential for ensuring greater market efficiency, price stability and food security. Asymmetry in price transmission means that an increase in the prices is passed on at a faster rate than a decrease. Due to asymmetric price transmission, neither the producers benefit adequately from a price increase nor the consumers benefit from a decline in the prices. It leads to an overall welfare loss.

The studies conducted on pulses have primarily focused on how to increase the production at farm level through the dissemination of improved production technologies while the marketing and prices aspect has been given less attention. Scattered attempts have been made to investigate price volatility, price transmission and market integration in India. Further, the studies on market integration have researched only one dimension i.e. spatial integration while vertical integration has not been given adequate attention. The issue of price transmission in a vertical sector has been the subject of much research. The extant literature has not looked into an equally important aspect, that is, whether the process of price transmission in agricultural markets is symmetric or asymmetric. The Asymmetric Price Transmission (APT) process is well-researched in the case of many commodities in developed countries but such studies per se are scarce in the Indian context.

Information on the nature of price transmission is important for policymakers in developing countries like India where the agricultural markets have an overarching government presence. Against the backdrop of the above discussion, this study was conducted to investigate the issues of asymmetric price transmission in vertically integrated pulse markets of India..

## Methodology

The widening gap between demand and supply has led to a secular rise in the prices of pulses. The domestic wholesale-retail price differential has also risen rapidly in the recent past. The retail prices continued to increase without responding to any changes at the wholesale level, which is a matter of great concern not only to producers and consumers but also to academicians and policymakers**.** In the present study, five pulses namely chickpea, pigeonpea, greengram, blackgram and lentil that account for nearly 80 per cent of total pulse production in India have been taken for in-depth investigation. Three major pulse-producing states for each pulse crop have been identified on the basis of

**Table 1 Selection of major states and markets for chosen pulse crops**

| Crops | Major states | Markets selected |
|---|---|---|
| Chickpea | Madhya Pradesh, Maharashtra, Rajasthan | Indore, Mumbai, Jaipur |
| Pigeonpea | Maharashtra, Karnataka, Madhya Pradesh | Mumbai, Bangalore, Indore |
| Blackgram | Madhya Pradesh, Uttar Pradesh, Andhra Pradesh | Indore, Kanpur, Vijaywada |
| Greengram | Rajasthan, Maharashtra, Tamil Nadu | Jaipur, Mumbai, Chennai |
| Lentil | Madhya Pradesh, Uttar Pradesh, Bihar | Indore, Kanpur, Patna |

production for TE 2014-15, and one of the major markets from each state along with Delhi as the central market has been selected to get the data at the market level. The selection of a major market from each selected state was first attempted on the basis of arrivals in the particular markets. Since retail price data were no available for the consequent markets, this criterion was discarded. Finally, the selection of major markets from each state was done based on the extensive review of the literature and various reports published by such institutions as the Indian Institute of Pulse Research, Directorate of Pulse Development, Commodities Control etc., apart from the availability of retail prices. The major states and markets thus, selected for the study are presented in Table 1.

Data on monthly wholesale and retail prices for four selected markets of each pulse crop were collected from the agmarknet portal of Govt. of India for the period from Jan 2009 to Aug 2017. The missing data for a particular month has been obtained through interpolation. Von Cramon-Taubadel model was employed to check the presence of asymmetry in wholesale-retail price transmission of pulses. They proposed a two-step estimation procedure using ordinary least squares. In the first step, Eq. (1) is estimated to get the residuals. The second step involves testing for the unit root properties of the estimated residual $\mathring{a}_t$ as given by Eq. (2). If the null hypothesis ñ = 0 stands rejected, then $y_t$ and $x_t$ are said to be cointegrated. Similarly, an error correction model (ECM) as represented by Eq. (3) is estimated where all the variables are specified in their first differences, while the error correction term, $ECT_{t-1} = \varepsilon_{t-1} = y_t - \alpha - \beta_t x_t$ is in levels.

$$y_t = \alpha + \beta x_t + \varepsilon_t \quad (1)$$

$$\Delta\varepsilon_t = \rho\varepsilon_{t-1} + \eta_t \quad (2)$$

$$\Delta y_t = \beta_0 + \sum_t^\tau \beta_1^+ \Delta x_t^+ + \sum_t^\tau \beta_1^- \Delta x_t^- + \beta_2^+ ECT_{t-1}^+ + \beta_2^- ECT_{t-1}^- + \upsilon_t \quad (3)$$

Using the F-test on the null hypothesis $\beta_2^+ = \beta_2^-$, we can check for asymmetric price transmission. If the null is rejected, then $\beta_2^+ = \beta_2^-$, implying that the price transmission is asymmetric. The software E-views 9.5 version was used for the analysis.

## Results and discussion

Assuming that wholesale prices cause retail prices, the first regression was run between wholesale and retail prices to get residuals. These residuals were checked for unit root properties using ADF and PP tests. If the null hypothesis of the unit root has been rejected, it implies that retail prices and wholesale prices were co-integrated. The results of the unit root test for residuals got through regression are presented in Table 2. PP test was given more priority to check the unit root in the price series. It was revealed from the table that the residuals have no unit root at a five per cent level of significance implying long-run equilibrium between wholesale and retail prices of pulses.

Further, the ECM was run assuming retail prices as the dependent variable and the positive and negative component series of wholesale prices as the independent variable. The results presented in Table 3 show that retail prices behave differently to the positive and negative change in wholesale prices as depicted through different and significant coefficients of positive and negative wholesale price series. The coefficients of error correction terms were tested using the Wald test for their equality. The result showed that the coefficients were unequal, implying that the price

**Table 2 Unit root test for residuals in wholesale and retail price series of pulses**

| Markets | ADF at level | | PP at level | |
|---|---|---|---|---|
| | t-statistics | Prob. | t-statistics | Prob. |
| | | Chickpea | | |
| Delhi | -3.0721 | 0.0320 | -4.6063 | 0.0003 |
| Mumbai | -5.4957 | 0.0000 | -5.4437 | 0.0000 |
| Indore | -2.3480 | 0.1598 | -3.1248 | 0.0285 |
| Jaipur | -5.0727 | 0.0000 | -5.0685 | 0.0001 |
| | | Pigeonpea | | |
| Delhi | -0.8595 | 0.7971 | -4.1976 | 0.0011 |
| Mumbai | -3.2991 | 0.0176 | -3.0861 | 0.0310 |
| Indore | -4.6093 | 0.0003 | -4.6964 | 0.0002 |
| Bangalore | -1.0441 | 0.7349 | -2.9992 | 0.0383 |
| | | Blackgram | | |
| Delhi | -1.578 | 0.4899 | -3.439 | 0.0118 |
| Kanpur | -4.046 | 0.0019 | -4.099 | 0.0016 |
| Indore | -6.132 | 0.0000 | -6.211 | 0.0000 |
| Vijaywada | -5.361 | 0.0000 | -5.594 | 0.0000 |
| | | Greengram | | |
| Delhi | -1.4223 | 0.5685 | -2.9066 | 0.0480 |
| Mumbai | -2.9478 | 0.0437 | -2.9524 | 0.0432 |
| Jaipur | -3.5627 | 0.0085 | -3.3525 | 0.0154 |
| Chennai | -1.6503 | 0.4528 | -2.4844 | 0.1226 |
| | | Lentil | | |
| Delhi | -1.4538 | 0.5529 | -2.3755 | 0.1512 |
| Kanpur | -4.1154 | 0.0015 | -4.1221 | 0.0015 |
| Indore | -3.2396 | 0.0211 | -3.2308 | 0.0216 |
| Patna | -1.4814 | 0.5385 | -1.0016 | 0.7498 |

transmission from wholesale to retail level was asymmetric. The error correction term's rate of adjustment indicates that the positive changes got absorbed more quickly than the negative change. The presence of asymmetry has been reported in many studies related to agricultural commodities (Bathla 2011; Rahman 2015).

Summing up, the price transmission from wholesale to retail was found asymmetric in all the vertically integrated markets of pulses. Asymmetry in price transmission implies inefficiency in markets. A larger gap in the price difference may persist due to inefficient price transmission and the consequent volatility may be passed on to the producers and the consumers causing net welfare loss.

**Table 3 Parameter estimates of asymmetry test in selected markets of pulses**

| Markets | WP(+) | WP(-) | ECT(+) | ECT(-) | $H_0$: $B_2^+=B_2^-$ |
|---|---|---|---|---|---|
| | | | Chickpea | | |
| Delhi | 0.1300 | -0.0059 | -0.2871 | 0.2561 | 77.6717 |
| | (0.0223) | (0.0273) | (0.0323) | (0.03223) | {<0.0001} |
| Mumbai | 0.0990 | -0.0318 | -0.3547 | 0.2512 | 51.6684 |
| | (0.0206) | (0.0202) | (0.0468) | (0.0407) | {<0.0001} |
| Indore | 0.0719 | -0.0988 | -0.3609 | 0.3342 | 57.5876 |
| | (0.0188) | (0.0224) | (0.0469) | (0.0469) | {<0.0001} |
| Jaipur | 0.1307 | -0.0291 | -0.4107 | 0.3870 | 117.3494 |
| | (0.0195) | (0.0214) | (0.0375) | (0.0396) | {<0.0001} |
| | | | Pigeonpea | | |
| Delhi | 0.0701 | -0.0284 | -0.3655 | 0.3418 | 88.8096 |
| | (0.0163) | (0.0184) | (0.0379) | (0.0393) | {0.0000} |
| Mumbai | 0.0754 | -0.0437 | -0.3701 | 0.3285 | 22.3825 |
| | (0.0237) | (0.0254) | (0.0749) | (0.0756) | {0.0000} |
| Indore | 0.0508 | -0.0366 | -0.3395 | 0.3036 | 27.8461 |
| | (0.0159) | (0.0182) | (0.0622) | (0.0619) | {0.0000} |
| Bangalore | 0.0964 | -0.0355 | -0.4729 | 0.3779 | 49.3096 |
| | (0.0173) | (0.0171) | (0.0641) | (0.0592) | {0.0000} |
| | | | Blackgram | | |
| Delhi | 0.0403 | -0.0401 | -0.2498 | 0.2768 | 37.6178 |
| | (0.0219) | (0.0245) | (0.0402) | (0.0480) | {0.0000} |
| Kanpur | 0.1099 | -0.0017 | -0.2504 | 0.2083 | 25.8657 |
| | (0.0284) | (0.0332) | (0.0477) | (0.0452) | {0.0000} |
| Indore | 0.0618 | -0.0570 | -0.5611 | 0.5825 | 62.3113 |
| | (0.0179) | (0.0206) | (0.0705) | (0.0757) | {0.0000} |
| Vijaywada | 0.0755 | -0.0788 | -0.6615 | 0.6630 | 51.1238 |
| | (0.0152) | (0.0156) | (0.0919) | (0.0942) | {0.0000} |
| | | | Greengram | | |
| Delhi | 0.0260 | -0.0301 | -0.6398 | 0.6035 | 53.8822 |
| | (0.01441) | (0.0172) | (0.0831) | (0.0880) | {0.0000} |
| Mumbai | 0.0326 | -0.0282 | -0.6805 | 0.6312 | 14.4078 |
| | (0.0120) | (0.0136) | (0.1733) | (0.1740) | {0.0001} |
| Jaipur | 0.0570 | -0.0272 | -0.6946 | 0.6419 | 54.1977 |
| | (0.0122) | (0.0130) | (0.0918) | (0.0917) | {0.0000} |
| | | | Lentil | | |
| Kanpur | 0.0069 | -0.0654 | -0.3040 | 0.2907 | 21.8181 |
| | (0.0136) | (0.0158) | (0.6291) | (0.0665) | {0.0000} |
| Indore | 0.0535 | -0.0248 | -0.5492 | 0.4772 | 77.0576 |
| | (0.0099) | (0.0107) | (0.0603) | (0.0584) | {0.0000} |

# Figures in parentheses ( ) indicated standard error and { } probability of parameter

## Conclusion

The results of asymmetric price transmission revealed the presence of asymmetry in almost all vertically integrated markets. It implies that retail prices adjust differently to any positive and negative change in wholesale prices. The rate of adjustment was found lower for a decline in prices means the negative shock persists for a longer period in the market. The extent of integration and symmetry gives signals for efficient resource allocation, which is considered essential for ensuring greater market efficiency, price stability and food security.

The markets for pulses were characterized as inefficient and imperfect as reflected by few vertically integrated markets and the presence of asymmetry. Imperfect markets will cause high marketing margins due to poor infrastructure and communication facilities. High marketing margins hinder the transmission of price signals. Imperfect information flow leads to asymmetry and asymmetry was found in all the vertically integrated markets of pulses. It can be concluded that the markets for pulses are imperfect in nature hindering the perfect flow of price transmission. In the context of imperfect information systems, institutions are as important as market forces in determining performances and solving emerging non-economic problems. A sustainable solution and long-term policies like the creation of a competitive, stable and unified national market are needed for the farmer to get better prices.

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