Original Research Article

Asymmetric Price Transmission in Agricultural Markets: A Case of Chickpea's in South India

Abstract

Asymmetric price transmission in agricultural markets occurs when price changes at one level of the supply chain, such as at the farm (producer) level, are not fully or uniformly passed on to another level, such as retail prices. This can lead to situations where price increases are transmitted more quickly or fully than price decreases, often disadvantaging consumers or producers. Such asymmetry can be influenced by factors like market power, transaction costs, and supply chain inefficiencies. Understanding these dynamics is essential for designing effective policies that promote fair and efficient market operations. In this paper we empirically assess the vertical price transmission mechanism between producer and consumer prices of chickpeas in Karnataka for the period from January 2016 to January 2019 using monthly wholesale and retail price data. Threshold co-integration models are employed to analyze whether the retail and wholesale markets are co-integrated or not and to check the asymmetric adjustment towards a long-run equilibrium relationship. Both the threshold autoregressive (TAR) and momentum-threshold autoregressive (M-TAR) models reveal that the retail and wholesale prices of Bengal gram are integrated. M-TAR model provided the clear evidence of asymmetric price transmission in the major Bengal gram Markets in south India. This implies that retail prices (downstream prices) respond differently to wholesale (upstream prices) based on whether the upstream prices (wholesale prices) are increasing or decreasing price transmission with special reference to Bengal Gram. The presence of asymmetry in price transmission along the Bengal gram markets in India. This has important implications for policy-making, as it suggests a need for measures to enhance price transmission efficiency, protect consumers from disproportionately high retail prices, and ensure fair pricing practices across the supply chain. Addressing these asymmetries could help stabilize market dynamics and improve outcomes for both producers and consumers in the Bengal gram market.

Keywords: Asymmetry, India, Price, Transmission, Bengal gram, Cointegration.

Introduction

Asymmetric price transmission in agricultural markets occurs when price changes at one level of the supply chain, such as at the farm (producer) level, are not fully or uniformly passed on to another level, such as retail prices. This can lead to situations where price increases are transmitted more quickly or fully than price decreases, often disadvantaging consumers or producers. Such asymmetry can be influenced by factors like market power, transaction costs, and supply chain inefficiencies. Understanding these dynamics is essential for designing effective policies that promote fair and efficient market operations. In this paper we study the price transmission mechanisms of the chickpeas a key crop of food and nutrition security for millions of Indian households, to guide the policy makers on how to device evidence-based policies to smoothen the impact of the emerging food crisis. Price transmission between agricultural markets and between two vertically integrated levels has received a huge attention in agricultural economics research. Price transmission in general means how the price changes at one market affects the price at another market. The price transmission could be either spatial or vertical. Price transmission helps to understand the relationship between prices of different related commodities as well. Price transmission serves the interest of both producers and consumers as both the group of consumers one or the other time believe that they are exploited and not getting the correct price [11, 12, 13, 14].

Pricing efficiency is part of a larger marketing efficiency framework. Free movement of goods and information over form, space, and time is required to achieve vertical and spatial efficiency in the marketing system [1]. This is also critical for the most efficient use of resources in the manufacturing process. In a market-oriented economy, it is maintained that efficient price generation is necessary for efficient resource allocation. The process of asymmetric price transmission is well researched in many agricultural and non-agricultural commodities in developed countries. However, in developing countries like India particularly in agricultural commodities received less focused barring few studies. In Agriculture, Prices are said to asymmetrically transmit as we witness very less producer share in consumer rupee. Asymmetric price transmission is nothing but the price at one market level reacts differently to price changes at another market level depending on whether the price is increasing or decreasing. It is the price which connects different markets which are geographically long and many vertically integrated levels of the marketing channel [2]. Vertical price transmission may be imperfect if price changes at one level are not fully transmitted to another level; if there is a time lag between price adjustments at different levels or if there is an asymmetry in reaction between positive and negative price shocks [3]. In agricultural markets we often observe that an increase of producer prices is transmitted more fully and faster to consumer prices while producer price decrease is passed-through the supply chain to consumer prices incompletely and at a lower speed [5]. The term "asymmetric" reaction of the price at one level of the marketing chain to a price change at another level, depending on whether the initial change is positive or negative," [6]. Negative asymmetry, on the other hand, "denotes a situation in which the retail price reacts more fully or quickly to a reduction in farm price than to an increase in farm price. Empirical studies show that asymmetric price transmission is a rule rather than exception [7]. For example, the retail price of a particular commodity reacts differently when there is an increase and decrease in producer price.

Asymmetric price transmission studies aim to uncover the underlying causes of price changes or the uneven transmission of prices through markets. These studies are valuable for predicting prices based on trends in related commodities. For example, if groundnut prices affect sunflower prices, it becomes possible to forecast sunflower prices, as both crops are oilseeds and serve as close substitutes [6]. This insight can help identify constraints within the agricultural marketing system; for example, limited price transmission between two geographically close markets might indicate transportation issues between them.

Asymmetric price transmission can be classified based on the extent, speed, or both of price changes; by positive or negative reactions as defined by Peltzman; and by the type of transmission, whether vertical (within the supply chain) or spatial (across different regions). Key factors driving asymmetric price transmission include market power and imperfect market conditions, where major players in a collusive oligopoly may increase prices in response to rising input costs but are reluctant to lower them when costs fall, to avoid disrupting implicit collusive arrangements [7, 11, 12, 13].

Other factors contributing to asymmetric price transmission include inventory management, where retailers hold onto stock rather than reducing prices during times of low demand, and menu costs, which are the expenses associated with adjusting prices and informing customers of those changes. Government interventions, like administered pricing, can also lead to asymmetry when retailers view price decreases as temporary and delay their response. Additionally, asymmetric information among market participants and high search costs for finding better prices can further intensify these asymmetries [6, 11, 12, 13].

With this background, This study is to analyze the vertical price transmission mechanisms between producer and consumer prices of chickpeas in Karnataka, with a focus on identifying and understanding the presence of asymmetries in the transmission process. This analysis is particularly important for chickpeas, a key crop for food and nutritional security in

India, as it provides insights into how price changes affect both producers and consumers. By identifying the nature and causes of asymmetric price transmission, the study seeks to inform evidence-based policy-making that can enhance market efficiency, protect stakeholders' interests, and address the challenges posed by emerging food crises. The findings aim to guide policymakers in designing interventions that promote fair and efficient market operations, ensuring that price changes are more equitably distributed across the supply chain.

METHODOLOGY

Data Sources and Data Collection:

Wholesale Prices: Daily wholesale prices of Bengal gram were sourced from Agmarknet, a government portal providing market data on agricultural commodities, for the period from January 2006 to November 2019. Daily wholesale prices were aggregated to calculate average weekly prices, facilitating direct comparison with the weekly retail prices.

Retail Prices: Weekly retail prices were obtained from the Retail Price Information System of the Directorate of Economics and Statistics, Government of India. This dataset covered the same period to ensure consistency and comparability.

Data Processing:

The missing values in both wholesale and retail price series, cubic spline interpolation was utilized. This method effectively smoothens the data by fitting a series of polynomials between the data points, maintaining the overall trend and continuity of the time series.

The study focused on examining how price changes at the wholesale level are transmitted to the retail level, specifically looking at asymmetries in the speed and magnitude of these transmissions. This involved statistical tests and econometric models that quantify the degree and nature of asymmetry in price responses between these market levels. Model Specification

Before testing the symmetry hypothesis for the Indian Pulse market, the cointegrated properties of the data were examined. Particularly, the existence of cointegration between retail and wholesale prices. The hypothesis assumes that price transmission in a vertical market system is symmetric which indicates that the market is highly efficient.

Step1: Long–run relationship among the Retail and Wholesale Prices is estimated using the following equation

$$RP_t = \beta_0 + \beta_1 \, WP_t + \varepsilon$$

Where,

RP_t is weekly retail price at time t

WP_t is weekly wholesale price at time t

After estimating the long run relationship between the retail and wholesale markets

Step 2: Optimum lag and threshold selection

The optimal lag length is determined using Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC). The optimal threshold is identified using the Chan (1993) approach, which involves conducting a grid search over all potential thresholds and selecting the one that minimizes the sum of squared errors [8]. The adjustment process follows the methodology outlined by Enders and Siklos [9].

The adjustment process given by Enders and Siklos is represented as

$$\Delta \mathcal{E}_{\mathrm{t}} = \sum_{k}^{n} \binom{n}{k} x^k a^{n-k}$$

$$\Delta\varepsilon_t = \rho_1 I_t \varepsilon_{t-1} + \rho_2 (1 - I_t)\varepsilon_{t-1} + \sum_{i=1}^{p-1} \delta_t \Delta\varepsilon_{t-i} + \omega_t$$

Where I_t is the Heaviside indicator function such that:

$$I_t = \begin{cases} 1 & if\ \Delta\varepsilon_{t-1} \geq T \\ 0 & if\ \Delta\varepsilon_{t-1} < T \end{cases}$$

Where,

T- Threshold value

Step 3: Testing the null hypothesis of no cointegration

i.e., ρ1 = ρ2 =0

Where,

ρ1= Adjustment coefficient for positive discrepancies

ρ2 = Adjustment coefficient for negative discrepancies

Step 4: Testing the null hypothesis of no asymmetric adjustment

i.e., ρ1 = ρ2

Step 5: Fitting Asymmetric Error Correction Model

Asymmetric Error Correction Model (AECMs) with (M–TAR) adjustment is fitted using the Equation below:

$$\Delta RP_t = \sum_{s=1}^{k} \alpha_s \Delta RP_{t-s} + \sum_{s=0}^{k} \beta_s \Delta PP_{t-s} + \gamma_1 Z\, {plus_{t-1}} + \gamma_2 Z\, minus_{t-1}$$

Where, k is lag-length, $Z\, {plus_{t-1}}$ and $Z\, minus_{t-1}$ are the error correction terms from the threshold cointegration regressions, representing adjustments to positive and negative shocks to marketing margin [6,8, 9]

RESULTS AND DISCSSION

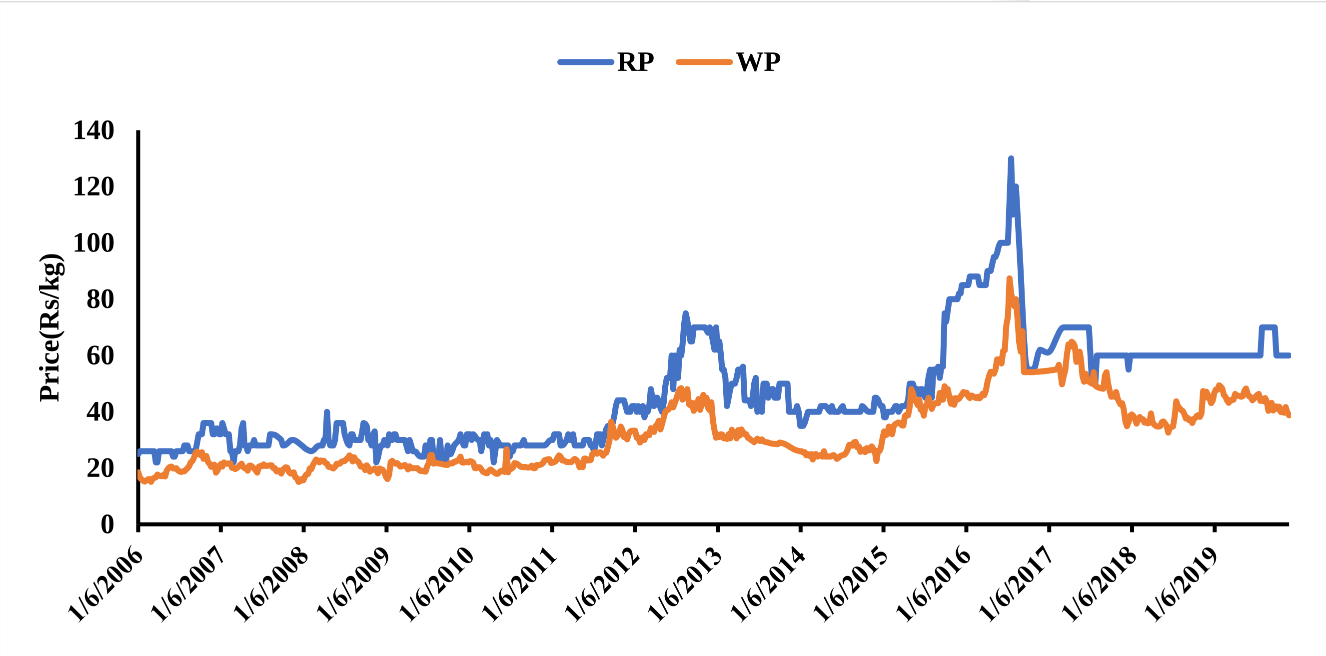

Figure 1: Trends in Wholesale and Retail Prices of Bengal gram in Karnataka

Figure 1 shows the time plot of weekly wholesale prices and weekly retail prices expressed in terms of Rupees per Kg. It depicts the fluctuations in prices of Bengal gram in the state of Karnataka at two market levels i.e., at wholesale level and at retail level. The increase in wholesale prices is always followed by a higher increase in retail prices. In contrast, the decrease in wholesale price is not always followed by the decrease in retail price. This implies that the retail price is not responsive to wholesale prices during corresponding period in the selected markets of Bengal gram in the state of Karnataka.

Table 2: Descriptive Statistics of the Price data

Particulars	Wholesale Price	Retail Price

Mean	46.04	32.37
Median	41.00	28.83
Mode	60.00	32.00
Range	108.00	72.33
Minimum	22.00	15.07
Maximum	130.00	87.40

Source: Authors estimation using secondary data

Cointegration analysis

Non-stationary time series can lead to statistically significant results due to purely spurious correlation. Therefore, we tested for the stationarity of the price series using Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests. The Augmented Dickey-Fuller and Phillips-Perron tests confirmed that all our time series are non-stationary and stationarized them by taking first differences. The tests indicated that all variables were stationary in first differences. The lags of the dependent variable in the tests were determined by Akaike Information Criterion (AIC). The stationarity tests showed that the original time series are non-stationary, which could be used for cointegration analysis.

Table 3: Augmented Dicky fuller Test

Markets	**Price**	**At level**	**At First difference**
Gadag	Wholesale Price	-2.60 (0.32)	-9.10*** < (0.01)
Hubli	Retail Price	-3.35 (0.06)	-12.91*** < (0.01)

Note: 1. Figures in parentheses represent the p value, 2. Significance Codes: '***' 0.01 '**' 0.05

Table 3 shows the Augmented Dickey Fuller unit root test results. The null hypotheses of non-stationarity are tested both at level and at first difference for both wholesale and retail price series. The results revealed that both wholesale prices and retail prices are non-stationary at level and stationary at first difference. Both the wholesale and retail price series exhibit non-stationarity at the level but achieve stationarity after first differencing. This indicates that the time series data for both prices are integrated of order one, I (1). This result is crucial for further econometric analysis, such as cointegration testing, to explore the long-term relationship between wholesale and retail prices.

Table 4: Long Run Relation

Variable	**Estimate**
Intercept	3.13*** (0.00)
Wholesale Price	1.32*** (0.00)

Note: 1. Figures in parentheses represent the p value, 2. Significance codes: '***' 0.01 '**' 0.05

Table 4 provides the estimates of long-run relation between retail and wholesale prices of Bengal gram when retail price is regressed based on wholesale prices. It is clear from the results that for every one rupee increase in wholesale prices the retail prices increase by 1.32 rupees from the mean level in the long run. This finding implies that the retail pricing of Bengal gram is strongly influenced by changes in wholesale prices in the long run. Retailers appear to fully incorporate changes in wholesale prices into retail prices, with an added margin. This could be indicative of a market structure where retail prices are closely aligned with wholesale price movements, reflecting a high degree of pass-through from wholesale to retail prices. The observed long-run relationship has implications for pricing strategies and market policies. It highlights the importance of monitoring wholesale price trends as they directly affect retail prices. Policymakers and stakeholders in the agricultural sector should consider this relationship when formulating policies aimed at stabilizing retail prices or addressing market inefficiencies.

Table 5: Threshold Cointegration Estimates

Estimates	**TAR**	**MTAR**
Lag value	**1**	**1**
Threshold value	-5.72	2.01
ρ1	-0.06*** (0.00)	-0.14*** (0.00)
ρ2	-0.09***	-0.05***

	(0.00)	(0.00)
$\rho1= \rho2=0$	**12.67*** (0.00)**	**15.06*** (0.00)**
$\rho1= \rho2$	**1.09 (0.29)**	**5.72** (0.01)**

Note: 1. Figures in parentheses represent the p value, 2. Significance Codes: '***' 0.01 '**' 0.05

Table 5 shows the threshold cointegration estimates using TAR and MTAR methodologies. The optimum lag length selected by both Akaike's Information Criteria and Bayesian Information Criteria is one. The optimum threshold value in the case of TAR model is -5.72 while it is 2.01 in case of MTAR model. The null hypotheses of no cointegration is tested using both TAR and MTAR methodologies and failed to accept the null hypotheses no cointegration (ρ1=ρ2= 0) using the F test at the 1% level of significance and hence the two-price series (wholesale and retail prices) are said to be cointegrated. The null hypotheses of symmetric adjustment (ρ1=ρ2) in the long run are tested using both TAR and M-TAR methodologies. We failed to reject the null of symmetry (ρ1=ρ2) using TAR methodology, however the same is rejected using MTAR methodology at the 5% level of significance. The MTAR model confirms that there is asymmetric adjustment in the long run. Hence, the asymmetric error correction model is fitted to know the short run and long run dynamics of wholesale and retail prices in Bengal gram.

Table 6: AECM (Asymmetric Error Correction Model) estimates of Gadag Market in Karnataka

	ΔRP		**ΔWP**	
	Coefficient value	**t value**	**Coefficient value**	**t value**
Z plus $_{t-1}$	-0.04**	-1.99	0.02	1.83
Z minus $_{t-1}$	-0.07***	-3.80	0.01	0.83
LB (8)	(0.13)		(0.12)	
DW	2.02 (0.79)		1.97 (0.67)	

Note: 1. Figures in parentheses represents the p-value

2. Significance Codes: '***' 0.01 '**' 0.05

3. LB (8) is the significance level of the Ljung-Box statistic that the first 8 of the residual autocorrelations are jointly equal to zero
4. Z_plus(t-1) and Z_minus(t-1) are error correction terms showing adjustments to positive and negative shocks to marketing margin in the long-run, respectively

Table 6 depicts the results of Asymmetric Error Correction Model (AECM). The estimates for the asymmetric speed adjustment are represented by Z_plus (t-1) and Z_minus (t-1). The t-statistics for Z_plus (t-1) and Z_minus (t-1) for retail prices of Bengal gram revealed that the retail prices of Bengal gram respond strongly/quickly to negative shocks which squeeze the market margin. But positive shocks which expand the marketing margin are also persisting. However, the t-statistics for Z_plus (t-1) and Z_minus (t-1) for wholesale prices of Bengal gram revealed that the producer prices do not respond to either positive or negative shocks to the marketing margin. Thus, the retail prices adjust to correct long-run disequilibrium in retail and wholesale prices, while wholesale prices do not significantly respond to long run disequilibrium. LB (8) is the significance level of the Ljung-Box statistic that the first 8 of the residual autocorrelations are jointly equal to zero and it is clear from the p values that there is no residual auto correlation and Durbin Watson statistic also shows that there is no autocorrelation.

Table 7: Granger Causality Test

Null Hypothesis	F-Statistics	Rejection of Null hypothesis	Direction
Wholesale Price does not granger cause Retail Price	15.65*** (0.00)	Yes	Unidirectional
Retail Price does not granger cause Wholesale Price	3.30 (0.06)	No	

Note: 1. Figures in parentheses represent the *p value*

2. Significance Codes: ‘***’ 0.01 ‘**’ 0.05

Table 7 shows the results of the granger causality test. Granger causality test was carried out to know whether there is a unidirectional causation or bidirectional causation. The null hypotheses of wholesale price do not granger cause retail price is rejected at 1% level of significance. However, the null hypotheses of retail price do not granger cause wholesale price is not rejected. Therefore, it is clearly indicated that there is a unidirectional causation from wholesale to retail price of Bengal gram.

Conclusion

This study analysed the vertical price transmission between wholesale and retail prices of Bengal gram in Karnataka using both TAR and MTAR threshold cointegration models and the analysis confirmed that wholesale and retail prices of Bengal gram are cointegrated, indicating a long-term equilibrium relationship between these market levels. However, the MTAR model provided unambiguous evidence of asymmetric price transmission, demonstrating that retail prices respond differently to increases and decreases in wholesale prices. There is significant variations in price levels at both wholesale and retail stages, with retail prices consistently experiencing greater increases following wholesale price hikes, but not showing corresponding decreases when wholesale prices dropped. This asymmetry suggests that retail prices are less responsive to reductions in wholesale prices, leading to higher consumer costs during periods of falling wholesale prices. The Granger causality test established a unidirectional causation from wholesale to retail prices, confirming that changes in wholesale prices drive retail price adjustments rather than the reverse. This unidirectional relationship emphasizes the dominant role of wholesale prices in setting the trajectory for retail prices in the Bengal gram market in Karnataka.

Overall, the findings underscore the presence of asymmetric price transmission in Bengal gram markets, where retail prices respond more to wholesale price increases than decreases. This has important implications for policy-making, as it suggests a need for measures to enhance price transmission efficiency, protect consumers from disproportionately high retail prices, and ensure fair pricing practices across the supply chain. Addressing these asymmetries could help stabilize market dynamics and improve outcomes for both producers and consumers in the Bengal gram market.

Disclaimer (Artificial intelligence)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of manuscripts.

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