

Analisis of Shallot Price Transmission in North Sumatera

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Abstract

The short-term dynamics of shallot prices at the producer level generally have the same pattern as the dynamics of shallot prices at the wholesale and retail levels because the partnership faced by producer farmers is a derivative of demand at the retail level. The purpose of this study is to analyze the transmission of North Sumatra shallot prices formed at the producer, wholesale and retail levels and analyze the movement of shallot prices in the future period. This study uses price panel data at the producer, wholesale and retail levels for January - December from 2017 - 2024. The price data is obtained from the Central Bureau of Statistics and the Ministry of Trade. The research methods used are ECM (Error Correction Model) and ARIMA (Auto Regressive Integrated Moving Avarange) models in analyzing price transmission and price movements of shallots in North Sumatra. The results show that price transmission between producers, wholesalers and retailers takes place asymmetrically in the short term and long-term asymmetry. Meanwhile, price transmission between producers and wholesalers takes place symmetrically in both the short and long term. In addition, price forecasting at the producer and retail levels shows relatively stable prices while at the retail level shows relatively declining prices.

Keywords: Price Asymmetry, Price Transmission, Shallot



INTRODUCTION

Shallot (*Allium ascalonicum*) is a type of seasonal crop whose development direction is a national strategic commodity that is the target of strengthening food sovereignty in increasing production and stabilizing prices. Shallot is a strategic commodity because it is an important commodity in the needs of the food industry and consumers where the government's main goal of creating supply and price stability is to improve the welfare of business actors involved in it. This can be seen in the 2018-2021 RPJMN where shallots are a commodity that will be supervised by a system of development planning, budgeting, implementation, and supervision by paying attention to the use of farming resources efficiently, effectively, equitably and sustainably for the creation of Good Governance, (Kementan 2020).

The main problem of shallots in Indonesia lies in the processing of shallots and the availability of shallots where this is due to seasonal and perishable commodity production, so that it can cause problems in the aspects of availability, storage and distribution time of the commodity concerned. As a result, with the uncertainty of the availability of shallot supply, it will cause fluctuations in shallot prices in Indonesia. According to Irawan (2021) the shallot commodity in Indonesia involves explaining that agricultural commodity agribusiness is generally a system that involves at least three main actors, namely producers (in this case carried out by farmers), marketing actors (traders), and retail. The relationship between producers and retailers is bridged by intermediary traders, by supplying goods according to market supply and demand needs. Based on this, it can be said that traders have two roles, namely as intermediary retailers for farmers (lowering retail demand to farmers) and intermediary producers for retailers (forwarding farmers' offers to retailers).

Onion price issues in North Sumatra are complex and have a significant impact on the welfare of farmers and consumers. Fluctuations in shallot prices in this area are often caused by various factors, including production costs, market demand and government policies. Research by Gulo shows that shallot prices in North Sumatra experience significant fluctuations, which impact farmers who have weak market power (Gulo, 2023). This is reinforced by the findings of Pratiwi et al. who state that unstable market mechanisms can cause shallot prices to fluctuate sharply, with prices in traditional markets can jump up to 80% of the price at the farm level (Pratiwi et al., 2022).

These price fluctuations are also influenced by external factors such as transportation and distribution costs. Research by Panjaitan et al. revealed that the price gap between different markets is caused by high transportation costs and variable

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production costs, which contribute to price volatility (Panjaitan et al., 2020). In addition, research by Huda et al. highlighted the importance of price transmission between farmers, wholesalers and consumers, indicating that farm-gate prices do not always reflect consumer-level prices (Huda et al., 2023). This suggests imbalances in the supply chain that can exacerbate price fluctuations.

On the demand side, factors such as consumer income and the price of substitute commodities also play an important role. The demand for shallots is strongly influenced by domestic prices and income, which suggests that when shallot prices increase, demand may decrease if consumer income does not increase in line (Wibowo, 2023). In addition, research by Kustiari emphasizes that managing shallot production and supply in the market is critical to maintaining price stability nationally (Kustiari, 2018). Government policies also play an important role in addressing shallot price issues.

Some studies show that policies that support farmers, such as subsidies for agricultural inputs, can help stabilize prices (Rahmadona & Fariyanti, 2018). However, if such policies are inappropriate, they can disincentivize farmers and exacerbate the price problem (Rahmadona & Fariyanti, 2018). Therefore, a comprehensive and integrated approach is needed to address shallot price fluctuations in North Sumatra, including improved market infrastructure, appropriate policy support, and strengthening farmers' bargaining position. Overall, the shallot price problem in North Sumatra is the result of complex interactions between production factors, market demand, and government policies. Further research is needed to understand these dynamics and formulate effective solutions to stabilize prices and improve farmers' welfare.

The short-term dynamics of shallot prices at the producer level generally have the same pattern as the dynamics of shallot prices at the wholesale and retail levels because the partnership faced by producer farmers is a derivative of demand at the retail level. If there is an increase in the price of shallots in the retail market due to increased demand, the price of shallots at the wholesale level will pass on the price increase to farmers so that the price of shallots at the wholesale and producer levels also increases. However, the transmission process from the retail market to the producer market is generally imperfect and asymmetrical, meaning that if there is an increase in shallot prices in the retail and wholesale markets, the price increase will be passed on to farmers slowly and imperfectly and asymmetrically. If the price of shallots tends to respond more to price increases or with a greater magnitude than when there is a price decline, it can cause losses for retailers. Therefore, the second objective of this study is to analyze the possibility of asymmetry in price transmission between institutions involved in shallot

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marketing using the Error Correction Model (ECM) approach. Through this approach, it can be analyzed whether there is efficiency in shallot marketing institutions.

Price asymmetry is caused by several factors, one of which is the uncompetitive behavior of intermediary traders. Varva and Goodwin (2005) explain that generally intermediary traders will maintain their profits so that they do not easily increase or decrease prices according to the prevailing price signals. This behavior can lead to price asymmetry between farmers and retailers.

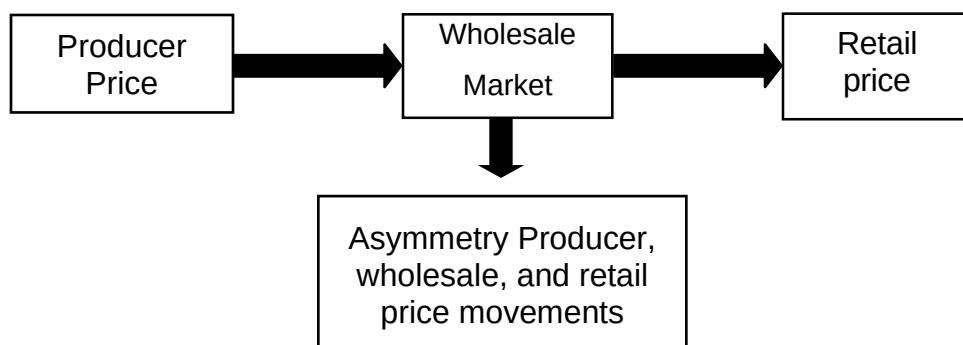


Figure 1. Behavior Can Lead To Price Asymmetry Between Farmers And Retailers

RESEARCH METHOD

This study analyzes the price asymmetry of shallots between producers and retailers in North Sumatra using daily secondary data from January to December in the period 2012-2024. The data consists of price data at the producer, wholesale and retail levels. The price data was obtained from the Central Bureau of Statistics and the Ministry of Trade.

The data analysis used is to use an inferential analysis model that analyzes the price asymmetry of shallots in North Sumatra. Inferential analysis is carried out using the ECM method. The ECM concept used to analyze asymmetric price transmission was developed by Von Cramon-Taubadel and Loy (1996) by looking at the significance of deviations (errors) from the long-term equilibrium model. In the concept of cointegration, if there is a deviant price movement, it will be included as a form of error correction (Error Correction Term/ECT) (Vavra and Goodwin 2005) with the following steps:

Data Stationarity Test (Unit Root Test)

Before entering into the main test, to analyze the existence of asymmetry in shallot price transmission between marketing institutions, a pre-estimation test is first conducted to check the stationarity of time series data using Augmented Dickey Fuller (ADF). According to Gujarati (2004) Stationary data has a constant mean, variance, and covariance over time. Meanwhile, non-stationary data is indicated by changes in mean, variance, and covariance. The ADF test model formulation is as follows:

$$P_t = \alpha_0 + \gamma P_t + \sum_{i=1}^j \alpha_i P_{t-i} + \varepsilon_t \dots\dots\dots (1)$$

$$\Delta P_t = \alpha_0 + \gamma P_t + \sum_{i=1}^j \alpha_i \Delta P_{t-i} + \varepsilon_t \dots\dots\dots (2)$$

The statistical hypotheses tested are:

H0: $\gamma = 0$; time series data contains unit roots, is non-stationary.

H0: $\gamma \neq 0$; time series data does not contain unit roots, is stationary.

Determination of Optimal Lag

In Firdaus (2011) optimal lag is useful to see how long a variable reacts to other variables and avoid the possibility of residual autocorrelation in the VAR system. Determination of the number of lags used in the model can be determined based on the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), or Hannan-Quinn Criterion (HQ) criteria. In this study, the criteria used are:

$$SIC(k) = T \ln \left(\frac{SSR(k)}{T} \right) + n \ln T \dots\dots\dots (3)$$

Where:

T = Number of observations

k = Lag length

SSR = Sum Squares Residual

n = Number of parameters estimated

Cointegration Test

The cointegration test aims to see if there is a long-term relationship between the variables used in the model. The cointegration test is carried out if the data concerned is not stationary at the level level. A variable is said to be cointegrated or have a long-term relationship if the stationary variable at the same level moves with the same wave length.

$$\lambda_{trace} = -T \sum_j^n = k + 1 (1 - \lambda_i) \dots\dots\dots (4)$$

$$\lambda_{max} = -T \ln (1 - \lambda_{r+1}) \dots\dots\dots (5)$$



Where:

$k = 0, 1, \dots, n-1$

T = Number of observations used

λ_i = Estimated value of the i -th order eigenvalue of the matrix Π

r = The vector sum of the cointegration vectors in the null hypothesis The hypothesis zero used in testing λ_{trace} and λ_{max} , namely:

$H_0 : r \leq 0$ or there is no cointegration relationship

$H_0 : r \leq 1$ or there is at most one cointegrating equation

$H_0 : r \leq n-1$ or there are at most $n-1$ cointegrating equations

If the test statistic is greater than the critical value in the Johansen table then H_0 is rejected meaning there is a cointegration relationship.

Causality Test

In price transmission analysis, the causality test aims to ascertain the direction of the cause-and-effect relationship between the variables tested. The relationship that occurs in this test can be one-way or two-way. This study uses the Engle & Granger causality test because it can be used on co-integrated variables.

$$\Delta PI_t = \mu_1 + \sum_{i=1}^n \beta_{pi} \Delta PI_{t-i} + \sum_{i=0}^n \beta_{pp} \Delta PP_{t-i} + \pi_1 Z_{t1-i} + e_{t1} \dots \dots \dots (6)$$

$$\Delta PP_t = \mu_1 + \sum_{i=1}^n \beta_{pp} \Delta PP_{t-i} + \sum_{i=0}^n \beta_{pi} \Delta PI_{t-i} + \pi_1 Z_{t1-i} + e_{t1} \dots \dots \dots (7)$$

$$\Delta PK_t = \mu_2 + \sum_{i=1}^n \beta_{pk} \Delta PK_{t-i} + \sum_{i=0}^n \beta_{pi} \Delta PI_{t-i} + \pi_2 Z_{t2-i} + e_{t2} \dots \dots \dots (8)$$

$$\Delta PI_t = \mu_2 + \sum_{i=1}^n \beta_{pi} \Delta PI_{t-i} + \sum_{i=0}^n \beta_{pk} \Delta PK_{t-i} + \pi_2 Z_{t2-i} + e_{t2} \dots \dots \dots (9)$$

This study uses the Granger method to test causality. This is done to analyze whether price movements that occur in the upstream sector are the main determinants of price movements that occur in the downstream sector, or vice versa.

Price Asymmetry Model

This study was conducted to analyze the asymmetry of producer prices, wholesale prices and retail prices using the ECM method. This ECM research certainly involves variables such as independent and dependent. This method is used in analyzing long and short-term relationships.

When Producer price (PP) affects wholesale price (PI)

$$\Delta PI_t = \alpha_0 + \sum_{i=1}^n \beta_{PI} \Delta PI_{t-i} + \sum_{i=0}^n \beta_{PP} \Delta PP_{t-i} + ECT^- + \sum_{i=1}^n \beta_{PI}^+ \Delta PI_{t-i}^+ + \sum_{i=0}^n \beta_{PP}^+ \Delta PP_{t-i}^+ + ECT^+ + \epsilon_t \dots \dots \dots (10)$$



When wholesale prices (PI) affect Producer prices (PP)

$$\Delta PP_t = \alpha_0 + \sum_{i=1}^{n-1} \beta_{PP}^- \Delta PI_{t-i} + \sum_{i=0}^{n-1} \beta_{PI}^- \Delta PI_{t-i} + ECT^- + \sum_{i=1}^{n-1} \beta_{PP}^+ \Delta PP_{t-i} + \sum_{i=0}^{n-1} \beta_{PI}^+ \Delta PI_{t-i} + ECT^+ + \varepsilon_t \dots (11)$$

When wholesale price (PI) affects retail price (PK)

$$\Delta PK_t = \alpha_0 + \sum_{i=1}^{n-1} \beta_{PK}^- \Delta PK_{t-i} + \sum_{i=0}^{n-1} \beta_{PI}^- \Delta PI_{t-i} + ECT^- + \sum_{i=1}^{n-1} \beta_{PK}^+ \Delta PK_{t-i} + \sum_{i=0}^{n-1} \beta_{PI}^+ \Delta PI_{t-i} + ECT^+ + \varepsilon_t \dots (12)$$

When retail price (PK) affects wholesale price (PI)

$$\Delta PI_t = \alpha_0 + \sum_{i=1}^{n-1} \beta_{PI}^- \Delta PI_{t-i} + \sum_{i=0}^{n-1} \beta_{PK}^- \Delta PK_{t-i} + ECT^- + \sum_{i=1}^{n-1} \beta_{PI}^+ \Delta PI_{t-i} + \sum_{i=0}^{n-1} \beta_{PK}^+ \Delta PK_{t-i} + ECT^+ + \varepsilon_t \dots (13)$$

Where:

PP_t = Price of shallots at the producer level on day t (Rp / Kg)

PI_t = Price of shallots at the wholesale level on day t (Rp / Kg)

PK_t = Price of shallots at the retail level on day t (Rp / Kg)

PI_{t-1} = Price of shallots at the wholesale level on the previous day (Rp / Kg)

PK_{t-1} = Shallot price at retail level on the previous finger (Rp/Kg)

At = Intercept

ECT = Error correction term

E = Error

PI_{t-1} = Price of shallots at the wholesale level on the previous day (Rp / Kg)

PK_{t-1} = Price of shallots at retail level on the previous day (Rp / Kg)

α_t = Intercept

ECT = Error correction term

ε = Error

A positive ECT value indicates the adjustment of the dependent variable to changes in the independent variable when the price deviation is above its equilibrium. Meanwhile, a negative ECT value indicates the adjustment of the dependent variable to changes in the independent variable when there is a price deviation below its equilibrium. Price transmission is said to be asymmetric if there is a significant difference between the positive ECT and negative ECT values, proven statistically through the Wald test (Taubadel and Loy, 1996), with the following hypothesis:

H0: π₁ = π₂

H1: π₁ ≠ π₂



If we reject H_0 , it means that there is a difference in the long-run upward and downward deviation adjustment where price transmission is asymmetric.

Wald Test

The Wald test is used to statistically prove the occurrence of an asymmetric price transmission through the coefficient identity test. Hypothesis testing is done using the F-test, with the hypothesis:

$$H_0: \sum_{i=1}^n \beta^- = \sum_{i=1}^n \beta^+ = \text{Symmetric in the short run}$$

$$H_0: ect_1 = ect_2 = \text{Symmetric in the long run}$$

Coefficient of Variation

To describe price movements, the Coefficient of Variation (CoV) is used. The coefficient of variation is the ratio between the standard deviation and the mean. The coefficient of variation is expressed as a percentage and is useful to see the distribution of data from the mean (Walpole, 2007). The smaller the coefficient of variation of a group of data, the more homogeneous the data is and this means that prices are more stable or do not fluctuate.

DISCUSSION

Price Transmission Analysis

In the marketing of agricultural commodities, relatively low price transmission from the retail market to the producer market is one indicator that reflects the existence of monopsony or oligopsony power in traders. This is because traders who have monopsony or oligopsony power can control the purchase price of farmers so that even though the price at the retail level is relatively fixed, these traders can suppress the purchase price of farmers to maximize their profits.

According to Izzah, et.al (2019) in his research on shallot price volatility stated that the movement of shallot prices fluctuates with different patterns of movement between prices at the producer, wholesale, and retail levels of shallot price transmission indicating that there has been a short-term asymmetry between marketing institutions both from the producer level to the wholesale level and the wholesale level to the producer level. This means that in the short term producers do not benefit from price increases that occur at the wholesaler.

Symmetrical price transmission between farmers and exporters in the long term indicates no abuse of market power, so that price changes that occur at the farm level in

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the long term are perfectly transmitted to exporters. Asymmetric price transmission in the short term is generally caused by cost adjustment factors and the behavior of marketing institutions in the pricing mechanism and the performance of each level/marketing institution (Juliaviani et al., 2017).

Imperfect price transmission between two related markets causes inefficiency in resource allocation and decreases economic welfare, meaning that perfect price transmission will lead to an efficient market. In the short run, price transmission is asymmetric and in the long run it is symmetric. Symmetric price transmission between farmers and exporters in the long run indicates that there is no abuse of market power, so that price changes that occur at the farm level in the long run are perfectly transmitted to exporters. Symmetric price transmission in the short term is generally caused by cost adjustment factors and the behavior of marketing institutions in the pricing mechanism and the performance of each level/marketing institution (Juliaviani et al., 2017).

To analyze price transmission in describing shallot price asymmetry during 2023 from January to May, the following steps can be taken:

Stationarity Test (unit root test)

The first stage performed on a commodity is a stationarity test. This test is carried out to prevent spurious regression and involve data movement. In this study, the test was conducted with the Philips-perron test at the level and first difference. The test results on the data require that the data be stationary at least at the first difference level.

Table 1 Data stationary test

Price	Level		First difference	
	ADF Test	Probability	ADF Test	Probability
Producer	- 1.885352	0.3385	-12.11648	0.0000
Wholesale	- 1.707907	0.4252	- 11.84174	0.0000
Retail	- 3.251560	0.0190	-	-

The test results of the data stationarity test show that the producer, wholesale and commodity prices of shallots are not stationary at the level. While the retail price of shallots shows stationary at the level. Different results are obtained when the data is tested at the first difference cost. In the first difference condition using pp. all variables in shallot commodities are stationary except retail prices.



Optimal Lag Determination

Determination of the optimal lag is done to see how long a variable reacts to other variables. The results of determining the optimal lag on shallot prices at the producer, wholesale, and retail levels are as shown in table 2 below.

Table 2. Optimum Lag Determination Result

Lag	LogR	Criteria	
		SC	HQ
0	-505.3661	7.273606	7.236361
1	399.5589	6.088673*	5.939696*
2	-398.8887	6.395046	6.134335
3	-398.2119	6.701324	6.328880
4	-387.7682	6.869064	6.384888
5	-386.7912	7.171084	6.575174
6	-382.9102	7.431912	6.724269
7	-378.4062	7.683905	6.864528
8	-371.8921	7.907384	6.976274

Based on Schwarz Information Criterion (SIC) and Hannan-Quinn information criterion (HQ) shallot prices at the producer, wholesale, and retail levels can react to other variables for 1 day (-1).

Cointegration test

The cointegration test is conducted to see if the variables have a long-term relationship or balance. The presence or absence of a cointegration relationship can be seen from the trace statistic value. If the trace statistic is greater than the critical value, it can be concluded that there is a cointegration relationship.

This study uses a cointegration test through the Johansen cointegration test approach. Where equation testing is carried out based on SC and HQ criteria, namely on lag one (-1) with the assumption chosen is intercept (no trend). the results of the cointegration test on the shallot price variable at the producer, wholesale, and retail levels are as shown in table 3.



Tabel 3. Hasil Johansen Cointegrasi Test

Price Variable	Hypotesis Zero	Trace Statistic	Critical Value (0,05%)	Max-eigen Value	Critical Value (0,05%)
Produser – Wholesale	None* At most 1	31,138 4,476	15,494 3,841	0.156 0.044	14,264 3,841
Wholesale – Retail	None* At most 1	30,460 3,042	15,494 3,841	0.169 0.020	14,264 3,841
Produser – Retail	None* At most 1	21,142 3,783	15,494 3,841	0.110 0.025	14,264 3,841

Notes : *Decline H0

The results of the cointegration test as contained in table 5 conclude that throughout January - May 2023 there has been vertically integrated in the shallot market in North Sumatra. However, a cointegrated market does not guarantee that the price transmission that occurs in the market has run perfectly. For this reason, further price transmission analysis needs to be carried out.

Causality Test

The causality test is used to determine the direction of price transmission, in this case, the direction of price transmission explains whether producer prices, wholesale prices and retail prices affect each other. In addition to knowing the direction of price transmission, the causality test can also be conducted to determine whether there is a one-way or two-way relationship. This study aims to see the direction of vertical price transmission, so it is necessary to conduct a causality test on the three levels of institutions involved in shallot marketing, namely producers, wholesalers, and retailers. The results of the causality test can be seen in table 6.

Granger Casualy estimation results with a significant level at the real level of 0.05 percent as shown in table 6 show that in the shallot marketing chain, the price at the wholesale level has the power to affect prices both at the producer and retail levels.



Table 4. Granger Casualty Estimation Results between Shallot Marketing Institutions

Relationship	Lag Number	F-Statistic	Prob
Produser – Wholesale	1	0.946	0.332
Wholesale – Produser	1	9.211	0.002**
Retail – Wholesale	1	6.527	0.011**
Wholesale – Retail	1	7.632	0.006**

Notes: ** Significant at 0.05% real level Affect

The relationship between wholesalers and producers is two-way, with wholesale prices influencing producer prices and producer prices influencing wholesale prices. This is in line with the fact in the field that prices formed at the farm level tend to be influenced by prices at the wholesale level. Conversely, prices formed at the wholesale level will also be influenced by prices at the farm level, for example when there is a harvest season, prices at the wholesale level will automatically adjust to the prices formed at the farm level.

Meanwhile, the causality test formed between market prices and retail prices shows a one-way relationship, where retail prices will affect wholesale prices, while wholesale prices do not affect retail prices. This is also in accordance with the facts in the field that show that retailers will set the selling price of shallots based on the wholesale purchase price. When there is an increase in shallot prices at the wholesale level, it will also be followed by an increase in shallot prices at the consumer level. This is also in accordance with the research of Ruslan, et.al (2016) through his research on price transmission and shallot market behavior shows that price transmission between shallot marketing institutions is asymmetrical both in the producer-wholesaler and wholesaler-retailer relationships. Price transmission asymmetry between producers-wholesalers is influenced by short-term factors, namely adjustment costs, while wholesalers-retailers are influenced by the existence of market power at the retailer level.

Suitability of Price Transmission Model

Price transmission is divided into 2, namely symmetry and asymmetry. If price transmission takes place symmetrically, then the price shock (increase or decrease) in the reference market will be responded similarly by the follower market, both in terms of speed and magnitude. However, if price transmission takes place asymmetrically, then



the price shock that occurs in the reference market is not perfectly responded to by the follower market in terms of both speed and magnitude of price changes.

This model generally separates the transmission that occurs in the short term and long term. The difference in price transmission that occurs in the short and long term is seen based on the coefficient value of the independent variable and the coefficient value of the Error Correction Term (ECT). If both are identical, it can be concluded that there has been asymmetrical price transmission in the shallot marketing chain.

The ECT coefficient contained in the model describes the condition of price misalignment at one of the levels with its equilibrium price. ECT + describes the condition of price deviation when it is above the long-term imbalance line. That is, when there is a decrease in the price of onions in the reference market, it is not followed by a price decrease in the follower market. Meanwhile, ECT - shows the condition of price deviations when it is below the long-term equilibrium line, which is when there is an increase in broiler prices in the reference market and is not followed by an increase in prices in the follower market. Price movements can be said to be on the equilibrium line, if the price increase or decrease that occurs at one level will be followed perfectly, both the magnitude and length of time of adjustment by the market at the other level.

The short-term relationship will be analyzed through each independent variable that significantly affects price formation in the reference market by looking at its probability value. The difference in the coefficient value of each variable indicates the difference in the response given by the follower market due to a price shock (increase or decrease) in the reference market. The more identical the coefficient value of a variable will indicate a similar response due to price decreases and increases, or in other words, the more identical the coefficient value of a variable indicates the asymmetric nature of price transmission from both markets. However, to suspect the existence of asymmetry in a market must be strengthened by using the Wald test.

Meanwhile, the long-term relationship will be analyzed through the Error Corerection Model Term (ECT) of each market. ECT+ is a condition where the price is above the equilibrium line, namely when the price in the follower market does not fall when there is a decrease in the price in the reference market. Meanwhile, ECT - is a condition where prices are below the equilibrium line, namely when the price increase in the reference market is not accompanied by an increase in the price of the follower market. Meanwhile, the coefficient value of the ECT shows the adjustment time needed for the follower market to increase or decrease the price in accordance with the price formed in the reference market in order to reach the equilibrium line.

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The ECM approach used to analyze asymmetry in shallot price transmission is done by separating each producer, wholesaler, and consumer price variable into positive and negative respectively. This difference is based on the shock of price increases or decreases. Based on the previously conducted causality test, the asymmetric model contained in this study consists of three parts, namely between wholesale prices and producers, producer prices and wholesalers, and retail prices and wholesalers. The test results of the three asymmetric models can be seen in Table 5.

Table 5. Estimation Results of Asymmetric Model of Price Transmission in the Marketing Chain

Variable	Produser – Wholesale	Variable	Wholesale – Produser	Variable	Wholesale – Retail
Konstanta	0.312 (0.004)***	Konstanta	-7.869 (-0.692)	Konstanta	3.844 (0.012)**
$\Delta HI+t-1$	0.559 (0.082)*	$\Delta HP+t-1$	1.172 (0.001)***	$\Delta HK+t-1$	0.853 (0.000)***
$\Delta HI-t-1$	-0.283 (0.380)	$\Delta HP-t-1$	-0.022 (0.949)	$\Delta HK-t-1$	-0.122 (0.164)*
$\Delta HP+$	0.122 (0.213)	$\Delta HI+$	0.089 (0.213)	$\Delta HI+$	0.079 (0.602)
$\Delta HP-$	0.298 (0.203)	$\Delta HI-$	0.193 (0.046)**	$\Delta HI-$	0.064 (0.368)
$\Delta HP+t-1$	-0.945 (0.028)**	$\Delta HI+t-1$	0.068 (0.805)	$\Delta HI+t-1$	0.098 (0.722)
$\Delta HP-t-1$	0.007 (0.985)	$\Delta HI-t-1$	0.012 (0.964)	$\Delta HI-t-1$	0.006 (0.973)
ECT+t-1	0.496 (0.152)*	ECT+t-1	-0.181 (0.045)**	ECT+t-1	0.006 (0.011)**
ECT-t-1	0.260 (0.530)	ECT-t-1	0.019 (0.055)**	ECT-t-1	-0.057 (0.030)**
R-adj	0.915		0.963		0.758
F-Statistic	216.963 (0.000)		550.905 (0.000)		66.783 (0.000)

Notes: * Significant at 10% real level



** Significant at 5% real level

*** Significant at 1% real level

() Probability

First, the results of the analysis of the producer-wholesaler price transmission relationship will be explained. In the short term, based on the significance of the probability value, it can be seen that the price formation at the wholesale level will be influenced by the increase in the price of shallots at the wholesale level in the previous period, and also influenced by the increase and decrease in shallot prices at the producer level at this time. The variable price of shallot at the wholesale level in the previous period shows a different coefficient value between $\Delta HI +t-1$ and $\Delta HI -t-1$. Likewise with the price variable at the producer level, where $\Delta HP +$ and $\Delta HP -$ also show different coefficient values. Both of these indicate differences in the response of wholesale prices due to shocks (increases or decreases) from each of the variables that significantly affect prices at the wholesale level.

Meanwhile, the long-term analysis of the producer - wholesale price transmission relationship shows a difference in the significance of ECT+ and ECT-, where only ECT+ is significant with a coefficient of 0.496. This means that prices are above the equilibrium line, which is when prices at the wholesale level do not fall when there is a decline in prices at the producer level. Wholesale prices will slowly fall to match producer prices.

The second analysis explains the price transmission relationship that occurs between wholesalers and producers. In the short term, it is known that the factors that influence changes in shallot prices at the producer level include the increase in producer-level prices in the previous period, and are influenced by the increase and decrease in wholesale prices in the current period. Meanwhile, the long-term relationship can be seen from the probability of the two ECTs, both ECT+ and ECT- show significant values with coefficients of -0.181 and 0.019 respectively.

The third analysis explains the price transmission relationship that occurs between wholesale and retail. Based on the analysis, it is known that price formation at the retail level in the short term is influenced by the decline in retail prices in the previous period. Meanwhile, the long-term analysis shows that ECT+ and ECT- both have significant probability values with coefficients of 0.006 and -0.057 respectively.



Wald Test

To get a more convincing conclusion, the Wald Test is conducted. The Wald test will test the coefficient values obtained from the model and compare whether the coefficients of price increases and decreases are identical. If the test shows a significant value, it can be concluded that there is asymmetric price transmission.

This study shows the same results as Yutiningsih's research (2012) which shows that there is a long-term price asymmetry of shallots. In this study, the cause of long-term price asymmetry is the abuse of market power by marketing institutions. In addition, Hutami (2018) also states that price asymmetry is a result of uncompetitive market competition. In agricultural commodities, the market structure formed in companies (sole agents) and intermediary traders leads to an imperfect competitive market structure compared to the farmer and retail levels. This causes companies (sole agents) and intermediary traders to act as price makers, while farmers and retailers act as price takers.

In the shallot commodity, farmers experience high competitive intensity during the harvest season. The abundant stock of shallots makes farmers have no bargaining position in setting prices. While companies (sole agents) and fewer intermediary traders will tend to have the power to influence prices, they can even form cartels by making price agreements in the market.

The seasonal nature of the shallot crop means that farmers cannot increase their production volume when there is an increase in shallot prices in the market. This makes profits during the lean season fully enjoyed by companies (sole agents) and intermediary traders. The limited infrastructure owned by farmers also prevents them from storing excess production. This makes farmers sell all of their shallot production during the harvest season and only save a little for their own consumption.

Policies issued by the government can also cause price asymmetry. An example is the price floor policy, where the government intervenes directly in the market through price fixing. When there is a decline in producer prices, traders will believe that the price decline is temporary because the government will intervene in the market. This makes traders not immediately adjust their selling prices, making prices asymmetrical. Conversely, when there is a price increase at the producers, traders will assume that the change is permanent so that they immediately adjust their selling prices.

Rigidity in price adjustments at the producer and retail levels can also be affected by adjustment costs. Adjustment costs are costs incurred to adjust price changes, such as the cost of changing price labels and catalogs, advertising costs, and costs that must be incurred to convey price changes to clients (Meyer and von Cramon-Taubadel, 2002).

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Price asymmetry caused by adjustment costs only delays the price adjustment process, but in the long run there will be a perfect price adjustment.

Table 6. Wald Test Results

Relationship	Hipotesis Nol	F-stat	Prob.
Produser – Wholesale	$\Delta HI+t-1 = \Delta HI-t-1$	1.649	0.195*
	$\Delta HP+ = \Delta HP-$	5.237	0.006***
	ECT+ = ECT-	3.392	0.036**
Wholesale – Produser	$\Delta HP+ = \Delta HP-$	11.814	0.000***
	$\Delta HI+t-1 = \Delta HI-t-1$	0.078	0.924
	ECT+ = ECT-	0.249	0.779
Wholesale – Retail	$\Delta HK+t-1 = \Delta HK-t-1$	59.767	0.000***
	ECT+ = ECT-	0.641	0.528

Notes: * Significant at 10% real level

** Significant at 5% real level

*** Significant at 1% real level

Based on the results of the Wald test, it is known that the price transmission between the wholesale - producer market shows a different relationship, where there is an asymmetrical relationship in the short term and symmetrical in the long term relationship. The same thing also happens in the price transmission between the producer - wholesale and wholesale - retail markets. The results of the Wald test support the descriptive test, which is the difference in response due to positive and negative shocks on each of the observed variables.

Table 9. Summary of Analysis Results of Price Asymmetry of Shallot in Indonesia

Relationship	Asymetris	
	Short Term	Long Term
Produser – Wholesale	√	√
Wholesale – Produser	√	x
Wholesale – Retail	√	x



The results show that shallot price transmission takes place asymmetrically in the short term in the producer, wholesale and retail channels. This means that price increases that occur at the wholesale level are not perfectly transmitted to producers and retail. Meanwhile, the transmission of shallot prices takes place asymmetrically both in the short and long term in the marketing channel between producers and wholesalers. This means that both the increase and decrease in prices that occur at the retail level are not perfectly transmitted to wholesale prices.

Forecasting Shallot Prices at the Producer Price Level

Forecasting the price of shallots at the producer level is done with the AR arima selection method. Because the R-squared value of AR is greater than MA. In addition, the Adjusted R-squared value is also greater than MA. The Akaike info criterion value is also smaller than MA. And the Schwarz criterion value is smaller than MA.

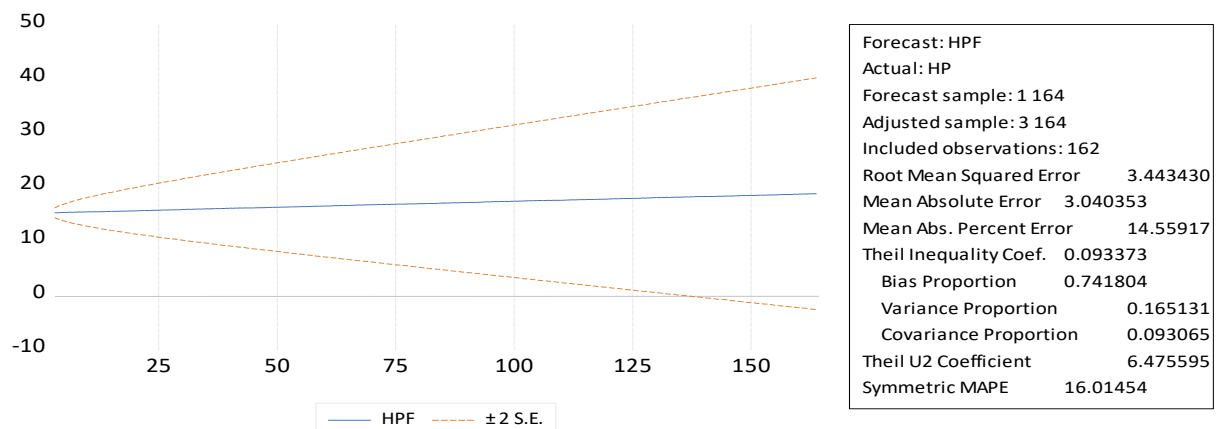


Figure 2. Onion price forecasting graph at producer prices.

In the graph above, it can be seen that the forecasting of shallot prices at the producer level shows a stable price condition. In the next 1 year of forecasting, the average price of IDR 18,641 per kg is obtained.

Onion Price Forecasting at the Wholesale Price Level

Forecasting shallot prices at the wholesale level is also done with the AR selection method. Because the R-squared value, the Adjusted R-squared value is greater than MA. And also the Akaike info criterion value, the Schwarz criterion value is smaller than MA.

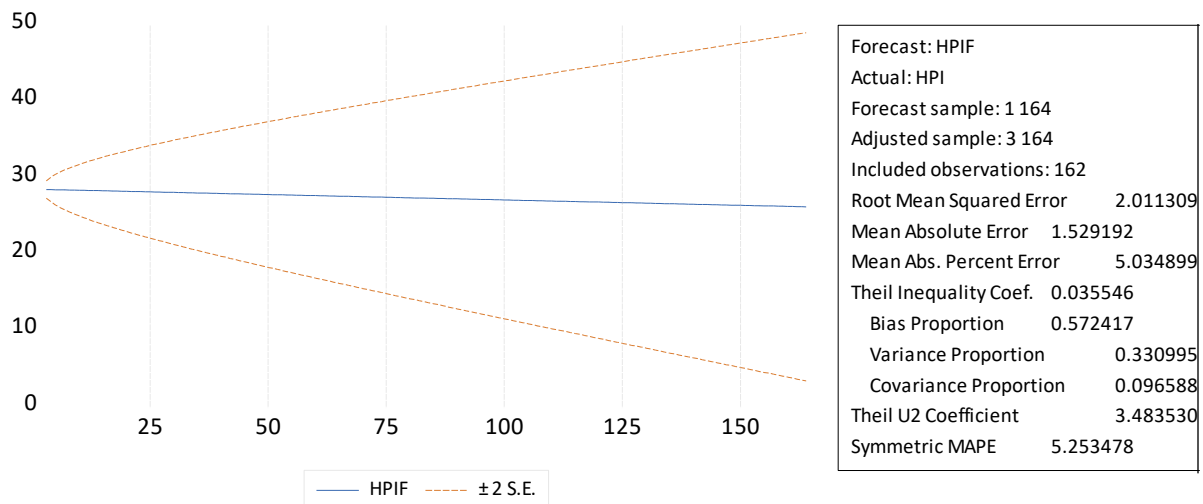


Figure 3. Forecasting chart of shallot prices at wholesale prices.

In the graph above, it can be seen that the forecasting of shallot prices at the wholesale level shows a declining price condition. In forecasting 1 year ahead, the average price of Rp 26,352 per kg is obtained.

Onion Price Forecasting at the Retail Price Level

Forecasting shallot prices at the consumer level is also done with the AR selection method. Because the R-squared value, the Adjusted R-squared value is greater than MA. And also the Akaike info criterion value, the Schwarz criterion value is smaller than MA.

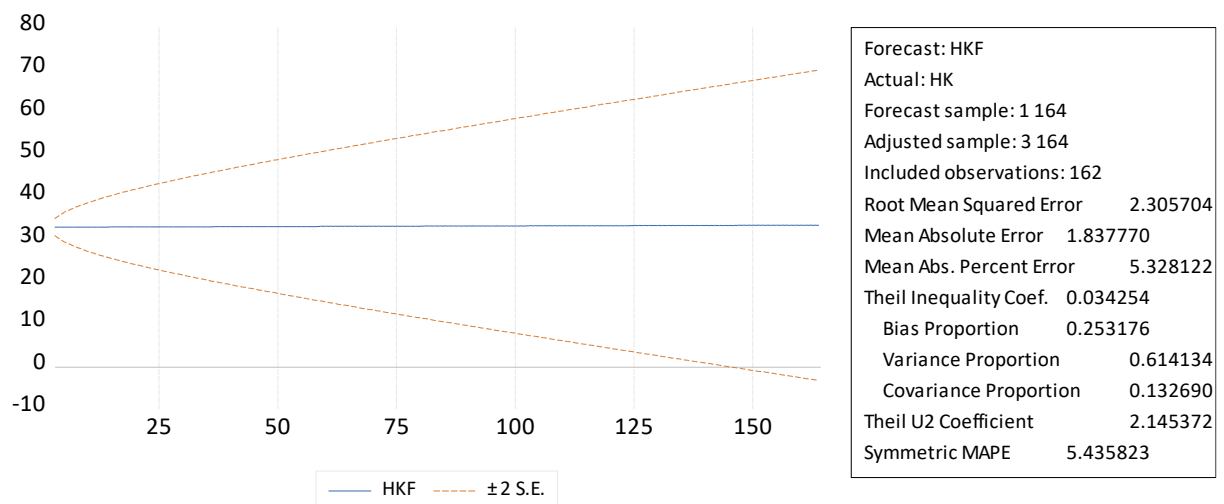


Figure 4. Chart of shallot price forecasting at retail prices.

In the graph above, it can be seen that the forecasting of shallot prices at the retail level shows a stable price condition. In forecasting 1 year ahead, the average price of Rp 34,185 per kg is obtained.

Table 7. Forecasting Shallot Prices at the Producer, Wholesale and Retail Levels. December 2024 to January 2026.

Year	Produser	Wholesale	Retail
Desember 2024	18,500	26,450	33,248
January 2025	18,521	26,436	33,250
February 2025	18,543	26,422	33,253
March 2025	18,565	26,408	33,256
April 2025	18,587	26,394	33,258
May 2025	18,609	26,380	33,261
Juni 2025	18,631	26,366	33,264
July 2025	18,652	26,352	33,266
August 2025	18,674	26,338	33,269
September 2025	18,696	26,234	33,272
October 2025	18,718	26,309	33,274
November 2025	18,740	26,295	33,277
Desember 2025	18,761	26,281	33,280
January 2026	18,783	26,267	33,283

Based on Table 7, it can be seen that the producer price forecast has increased in the next 1 year by 1.06%. Meanwhile, the wholesale price has fluctuated by 1.1% and the retail price has increased by 1.03% in the next 1 year.

CONCLUSION

Price transmission between producers, wholesalers and retailers takes place asymmetrically in the short term and asymmetrically in the long term. Meanwhile, price transmission between producers and wholesalers takes place symmetrically both in the short and long term. In addition, price forecasting at the producer and retail levels shows relatively stable prices while at the retail level shows relatively declining prices.



The recommendation offered is that the prices that occur in all marketing actors should run in symmetry through cooperative efforts or partnerships or networking among them.

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