ARTÍCULO CIENTÍFICO

USACH

Rivar
REVISTA IBEROAMERICANA DE VITICULTURA, AGROINDUSTRIA Y RURALIDAD

Editada por el Instituto de Estudios Avanzados
Universidad de Santiago de Chile

WHO WINS IN THE RICE TRADE? ASYMMETRIC INFORMATION AND PRICE TRANSMISSION IN INDONESIA'S RICE MARKET

¿Quién gana en el comercio del arroz? Información asimétrica y transmisión de precios en el mercado del arroz de Indonesia

Quem ganha no comércio do arroz? Informação assimétrica e transmissão de preços no mercado de arroz da Indonésia

Wiwit Widyawati
Brawijaya University
Malang, Indonesia
ORCID 0009-0000-4401-1850
wiwit23@ub.ac.id

Nuhfil Hanani
Brawijaya University
Malang, Indonesia
ORCID 0000-0002-8520-6854
nuhfil.fp@ub.ac.id

Syafrial
Brawijaya University
Malang, Indonesia
ORCID/0000-0002-7394-9044
syafrial.fp@ub.ac.id

Sujarwo
Brawijaya University
Malang, Indonesia
ORCID 0000-0003-3035-6561
sujarwo@ub.ac.id

Volumen 13, número 40, 128-146, julio 2026
ISSN 0719-4994

Artículo de investigación
https://doi.org/10.35588/6pann874

Recibido
26 de mayo de 2025

Aprobado
6 de octubre de 2025

Publicado
25 de julio de 2026

Cómo citar
Widyawati, W., Hanani, N., Syafrial and Sujarwo. (2026). Who wins in the rice trade? Asymmetric information and price transmission in Indonesia's rice market. *RIVAR, 13*(40), 128-146. https://doi.org/10.35588/6pann874

ABSTRACT
This study investigates how prices are transferred from farmers to wholesalers, rice millers, and consumers in Indonesia in 2010-2024, using error correction models. The paper contributes by modelling the full chain to pinpoint where asymmetry arises, embedding the administered mill-gate floor price to identify its effect on truncating downside persistence and speeding adjustment, and translating estimates into operational price-stability indicators for monitoring. Results show near-complete contemporaneous pass-through from farm to mill with short-run downside persistence, partial upward-sticky transmission from mill to wholesale, and long-run integration with asymmetric adjustment. Policy should pair the trigger-rule Government Purchase Price (administered floor price). Procurement upstream, calibrated buffer-stock releases downstream, and competition oversight to stabilize prices without disturbing the long-run equilibrium.

KEYWORDS
Rice, agricultural marketing, price policy.

RESUMEN
Este estudio investiga cómo se transfieren los precios de los agricultores a los mayoristas, molineros de arroz y consumidores en Indonesia durante el periodo 2010-2024, mediante modelos de corrección de errores. El artículo contribuye modelando la cadena completa para identificar dónde surge la asimetría, incorporando el precio mínimo administrado en la puerta del molino para identificar su efecto en la reducción de la persistencia a la baja y la aceleración del ajuste, y traduciendo las estimaciones en indicadores operativos de estabilidad de precios para su monitoreo. Los resultados muestran una transmisión contemporánea casi completa de la explotación agrícola al molino con persistencia a la baja a corto plazo, una transmisión parcialmente persistente al alza del molino al mayorista, y una integración a largo plazo con ajuste asimétrico. La política debería combinar el precio de compra gubernamental (precio mínimo administrado) con la regla de activación, la adquisición en etapas anteriores con la liberación calibrada de existencias de reserva en etapas posteriores y la supervisión de la competencia para estabilizar los precios sin perturbar el equilibrio a largo plazo.

PALABRAS CLAVE
Arroz, comercialización agrícola, política de precios.

RESUMO
Este estudo investiga como os preços são transferidos dos agricultores para os grossistas, moinhos de arroz e consumidores na Indonésia durante o periodo 2010-2024, utilizando modelos de correção de erros. O artigo contribui modelando a cadeia completa para identificar onde surge a assimetria, incorporando o preço mínimo gerido à porta da fábrica para identificar o seu efeito na persistência da truncagem de baixa e na aceleração do ajustamento, e traduzindo as estimativas em indicadores operacionais de estabilidade de preços para monitorização. Os resultados mostram uma transmissão contemporânea quase completa da exploração para a fábrica com persistência de baixa de curto prazo, transmissão parcial ascendente da fábrica para o comércio grossista e integração de longo prazo com ajuste assimétrico. A política deve combinar o preço de compra do governo (preço mínimo gerido) como regra de disparo, aquisição a montante com libertações calibradas de stock regulador a jusante e supervisão da concorrência para estabilizar os preços sem perturbar o equilíbrio a longo prazo.

PALAVRAS-CHAVE
Arroz, comercialização agrícola, política de preços.

Introduction

Indonesia faces a challenge: national rice production has not kept pace with projected demand. From 2018 to 2021, rice was the most common food source in the country, compared to maize, wheat flour, and soybeans. Rice production has gradually increased, with an estimated annual average growth of nearly 300,000 tonnes (Firdaus and Nurhayati, 2023). This high demand aligns with the fact that nearly all households (≈ 97%) consume white rice daily (Sustainable Rice Platform, 2023). Consequently, access to rice is critical (Bondemark, A., 2020). Prices serve as an indicator of access and availability (Center for Agricultural Data and Information Systems, Ministry of Agriculture, 2024). Understanding each marketing institution's price behavior for rice commodities is critical because it reveals current rice economic conditions, such as market efficiency and distribution patterns (Arida et al., 2023; Shaffitri et al., 2024). In line with the policy objective of ensuring sufficient and affordable rice (Suryani et al., 2022). A tiered price-monitoring system from producers (farmers) to the final marketing institution (retailers) is required to maintain stability (Suryana et al., 2024).

In Indonesia, price disparities among marketing agencies such as wholesalers, retailers, and rice mills cause problems for both producers and consumers. Empirical studies document frequent asymmetric rice price transmission in both the short and long term (Novianti et al., 2020), which is influenced by market dynamics, actor behavior, and regional heterogeneity (Arida et al., 2023; Aryani et al., 2021). Understanding these mechanisms can inform the government in maintaining price stability and protecting stakeholders (Shaffitri et al., 2024).

Rice production begins when producers mill paddy into rice to meet domestic food demand (Suryani et al., 2022). Consumer rice prices have risen 20-30% in the last five years, from Rp9,000-Rp10,000/kg in 2019 to Rp12,000-Rp13,000/kg in 2022, owing to pricing policies, supply volatility, and decreased output due to land use and climate change (Pindyck, 2004; Suryana et al., 2024). Grain prices, production, and yields have a direct impact on rice prices. Rice prices must be settled as a staple food to ensure social and economic strength, which necessitates long-term production, distribution, and pricing policies.

In Indonesia, the issue of rice price transmission significantly affects community well-being, particularly for low-income populations. Inefficiencies in the marketing agencies are indicated by large price disparities between rice growers or farmers and consumers (Kharisma and Indrawan, 2023). The unequal distribution of profits caused by the disparity in negotiating power between marketing institutions, such as wholesalers and retailers, frequently makes this scenario worse (Arida et al., 2023). Smallholders' lack of competition in setting a fair price for their crops has an additional effect (Mulyana et al., 2020).

The conceptual framework for analyzing rice price transmission is based on mar-

RIVAR Volumen 13, número 40, 2026: 128-146 • ISSN online 0719-4994
Instituto de Estudios Avanzados, Universidad de Santiago de Chile

ket integration and vertical price transmission theories. Vertical price transmission describes how price changes at one level affect other levels of the supply chain, whereas market integration reflects consistent pricing across parent and follower markets (Sadiq et al., 2021). In practice, price transmission is frequently asymmetric, with consumer prices responding faster to increases in producer prices than to decreases (Arida et al., 2023). Empirical studies in Indonesia confirm this asymmetry; for example, low price transmission elasticity from consumers to farmers in South Sumatra indicates market inefficiency (Mulyana et al., 2020), while research in West Java links this to uncompetitive intermediary behavior (Kharisma and Indrawan, 2023).

Essentially, rice price transmission has been extensively studied; most studies concentrate on interactions between two market levels, such as farmers and consumers. Limited attention has been paid to the entire transmission chain, from farmers to final consumers (Shaffitri et al., 2024). Likewise, the impact of regulations, such as government benchmark pricing, on overall market efficiency has attracted little attention (Mulyana et al., 2020).

Recognizing rice price transmission is getting more important as global uncertainties such as climate change and geopolitical disruptions emerge. Rice price stability is critical to Indonesian agricultural prosperity and public welfare (Difah et al., 2020). This study investigates how prices are transferred from farmers to wholesalers, rice millers, and consumers. Its systematic approach seeks to improve supply chain efficiency and assist the government in developing effective policies to ensure rice price stability and national food security.

Research methodology

This study analyzes dry unhulled rice (GKP) prices at the farm and retail levels in Indonesia from January 2010 until December 2024, employing economic tools like Error Correction Model regression (ECM) to assess market integration and price transmission. It aims to characterize price variations and transmission within the rice marketing chain, specifically in Indonesia. This study utilizes secondary data from the Central Statistics Agency of the Republic of Indonesia.

The data analyzed are time series, which represent commodity prices over an identifiable period. Because the price data are non-stationary, standard regression methods may produce inaccurate results. To address this, the study employs the error correction model (ECM) based on cointegration (Engle and Granger, 1987), which helps to avoid spurious regression. ECM is useful in analyzing both short-term price transmission and long-term equilibrium (Asrin et al., 2022) (Table 1).

Table 1. Type and sources of research data
Tabla 1. Tipos y fuentes de datos de investigación

Variable	Definition	Period
Price of Unhulled Rice at Farmer Level (Unhulled Rice Harvest/GKP)	Aggregation of the selling price of harvested unhulled rice at the farmer level in Indonesia in Rupiah per kilogram (Rp/kg)	January 2010 until December 2024

Source: own elaboration. Fuente: elaboración propia.

This study employs time series data, necessitating a stationarity test to ensure a consistent mean, variance, and covariance over time. Non-stationary data can lead to spurious regression, resulting in high R^2 values without theoretical validity (Engle and Granger, 1987). Data are considered integrated of order d (I(d)) if they remain stationary after differencing d times. Stationarity is tested using the Augmented Dickey-Fuller (ADF) and Phillips-Perron tests, with results covering producer and marketing prices. Cointegration tests using the maximum likelihood method examine long-term relationships between farmer and market prices, whereas causality tests determine the direction of price transmission.

On top of that, the study employs the ADF and Johansen cointegration tests to assess time series characteristics and price transmission, following Engle and Granger's (1987) two-step methods. Cointegration is first estimated using OLS, and the ECM is then specified using the cointegration regression's lagged residuals. Although residual analysis may be sensitive to normalization, the dependent variables used have little effect on the results.

The price transmission analysis using the ECM model is divided into two categories: the ECM asymmetry model (Granger and Lee, 1989; Mohanty el al., 1996). Furthermore, the asymmetric ECM model is an extension of the symmetric ECM model that identifies divergent price responses in a market to price changes at the previous market level. Granger and Lee (1989) developed this method by dividing the Error Correction Term (ECT) variable into positive and negative values to determine long-term asymmetry. Von Cramon-Tyubadel and Loy (1999) then built the equation by categorizing the independent variables' direct effects for identifying the short-term transmission asymmetry. Rezitis (2014) and Götz et al. (2014) applied the asymmetry model to a particular general formula:

$$\Delta p_t^{out} = \alpha + \sum_{i=1}^{K} (\beta_i \Delta p_{t-i}^{out}) + \sum_{j=1}^{L} (\pi_j^+ D^+ \Delta p_{t-j+1}^{in}) + \sum_{j=1}^{L} \left(\pi_j^- D^- \Delta p_{t-j+1}^{in}\right) + \emptyset^+ ECT_{t-1}^+ + \emptyset^+ ECT_{t-1}^- + \gamma_t$$

Where:

Δp_t^{out}	=	Price changes in the output market (affected market) in period t
Δp_t^{in}	=	Price changes in the input market (reference or unfluencing market) on the t-th period
D^+	=	Dummy 1 for Δp_{t-j+1}^{in} in up
D^-	=	Dummy 0 for Δp_{t-j+1}^{in} in down
ECT	=	Error correction term of cointegration equation (+) for the ECT value above
α	=	Intercept
β	=	Autoregressive coeffisient
π	=	Coefficient of short-run price transmission
ϕ	=	Long-run price transmission coefficient (+) for price deviation shock/ECT value above balance (-) for price deviation shock /ECT below balance
γ_t	=	Error term
i	=	1,2,3,…K
j	=	1,2,3,…..L

Thus, the second adjustment to the model is as follows:

$$\Delta lnp_t^{ma} = \alpha + \sum_{i=1}^{K} (\beta_i \Delta lnp_{t-i}^{out}) + \sum_{j=1}^{L} (\pi_j \ \Delta lnp_{t-j+1}^{pet}) + \emptyset \ \ lnECT_{t-1} + \gamma_t$$

Where:

Δlnp_t^{ma}	=	Changes in marketing agencies' prices throughout the t-th period
Δlnp_t^{pet}	=	Price changes at the farmer level in the period
α	=	Intercept
β	=	The coefficient of short-term influence of changes in rice prices at the marketing agencies level in the previous period
π	=	The coefficient of the short-term effect of changes in rice prices at the farmer level, representing short-run transmission
ϕ	=	The error term coefficient of the cointegration equation indicates the amount of speed adjustment of the deviation in the previous (+) for price deviation shock/ECT value above the balanced period in relation to its long-run equilibrium; the coefficient should be negative (-)
γ_t	=	Error term
i	=	1,2,3,…K
j	=	1,2,3,…..L

The third model is the ECM asymmetry model, which defines the asymmetry in price transmission along the rice commodity marketing network. This model is based on Götz et al. (2014) AECM relationship between farm and marketing agencies' (rice miller and wholesaler) rice prices. The model is as follows:

$$\Delta lnp_t^{ma} = \alpha + \sum_{i=1}^{K} (\beta_i \Delta lnp_{t-i}^{ma}) + \sum_{j=1}^{L} (\pi_j^+ D^+ \Delta lnp_{t-j+1}^{pet}) + \sum_{j=1}^{L} (\pi_j^- D^- \Delta lnp_{t-j+1}^{pet}) + \emptyset^+ lnECT_{t-1}^+ + \emptyset^- lnECT_{t-1}^- + \gamma_t$$

Where:

Δlnp_t^{ma}	=	Price changes at the marketing agencies level in period t
Δlnp_t^{pet}	=	Price changes at the farmer level in the period t
D^+	=	Dummy 1 for Δp_{t-j+1}^{in} > 0
D^-	=	Dummy 0 for Δp_{t-j+1}^{in} < 1
ECT	=	Error correction term of cointegration equation ECT_{t-1}^+ for error term value above balance ($ECT_{t-1} > 0$) ECT_{t-1}^- for error term value under balance ($ECT_{t-1} < 0$)
α	=	Intercept
β	=	Coefficient of short-term influence of changes in rice prices at the marketing agencies level in the previous period
π	=	Coefficient of short-term effect of changes in rice prices at the farmer level, describing short-run transmission
ϕ	=	The error term coefficient of the cointegration equation indicates the amount of speed adjustment of the deviation in the period to its long-run equilibrium; the coefficient should be negative (-) or (+) for price deviation shock/ECT value above balance (-) or for price deviation shock/ECT value below balance
γ_t	=	Error term
i	=	1,2,3,…K
j	=	1,2,3,…..L

Research data

This study uses data that is already available within the organization, such as data from the Indonesian Central Statistics Agency and the Indonesian Ministry of Agriculture. For identifying the relationship between variables, simple statistical methods are used. Some variables that the system is unable to control become external variables. Furthermore, the literature review is based on previous studies on government websites, such as articles, books, or articles from the Ministry of Agriculture, Ministry of Commerce, the UN Food and Agriculture Organization (FAO), and news sites, to highlight the internal and external factors that influence rice supply and demand in Indonesia.

RIVAR Volumen 13, número 40, 2026: 128-146 • ISSN online 0719-4994
Instituto de Estudios Avanzados, Universidad de Santiago de Chile

Results and discussion

Table 2. Data stationarity test results
Tabla 2. Resultados de la prueba de estacionariedad de datos

Variable	Prob.			
	Level		1st Difference	
	ADF	PP	ADF	PP
HBWS	0.5549	0.5221	0.0000	0.0000
HGKPF	0.7422	0.6700	0.0416	0.0000
HGKPRM	0.7602	0.6441	0.0419	0.0000
HPPGKPRM	0.9850	0.9959	0.0000	0.0000

Source: own elaboration. Fuente: elaboración propia.

Table 2 shows that the ADF test and the PP test (Philips Peron) test indicate that there is no stationary at the level, as indicated by the probability values at the ADF and PP levels that are not statistically significant at the critical values (1%, 5%, and 10%) for price of dry harvested rice at the farmer level (HGKPF), price of dry harvested rice at the milling level (HGKPRM), government purchase price for dry harvested rice at the milling level (HPPGKPRM) and price of rice at the wholesaler level (HBWS). Meanwhile, the first difference test results show that all variables, both prices of dry harvested rice at the farmer level (HGKPF), price of dry harvested rice at the milling level (HGKPRM), government purchase price for dry harvested rice at the milling level (HPPGKPRM) are statistically significant at the 5% level, indicating that price of dry harvested rice at the farmer level (HGKPF), price of dry harvested rice at the milling level (HGKPRM), government purchase price for dry harvested rice at the milling level (HPPGKPRM) and price of rice at the wholesaler level (HBWS) are stationary.

The lag criterion test determines the number of lags included in the model to be examined. The criterion lag is proportional to the duration of each interaction in the model. Table 3 displays the results of the optimal lag test for the smallest LR, FPE, AIC, SC, and HQ. Based on the table, the asterisk mark with the majority indicates the optimal lag length in the data. SC criteria values on the 1st lag and LR, FPE, AIC, and HC criteria suggest the optimal lag length to be three. This condition can also interpreted as the current price of rice at all levels (price of dry harvested rice at the farmer level (HGKPF), price of dry harvested rice at the milling level (HGKPRM), the government purchase price for dry harvested rice at the milling level (HPPGKPRM) are statistically significant at the 5% level, indicating that price of dry harvested rice at the farmer level (HGKPF), price of dry harvested rice at the milling level (HGKPRM), the government purchase price for dry harvested rice at the milling level (HPPGKPRM) and price of rice at the wholesaler level (HBWS)) being related each other in the previous three months.

The cointegration test is a condition of the Error Correction Model (ECM), and it is used to determine the existence of long-term equilibrium (Engle and Granger, 1987). Time series data that is not stationary at the level may be used if it has a long-term equilibrium relationship (cointegrated). The cointegration test must therefore be conducted in this study.

Table 3. Criteria lag testing results
Tabla 3. Resultados de la prueba de retardo de criterios

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4703.019	NA	6.92e+18	54.73277	54.80597	54.76247
1	-3965.289	1432.567	1.57e+15	46.34057	46.70656*	46.48906
2	-3935.043	57.32678	1.33e+15	46.17492	46.83370	46.44221
3	-3906.723	52.35928*	1.15e+15*	46.03167*	46.98323	46.41774*
4	-3892.735	25.21070	1.18e+15	46.05506	47.29942	46.55993
5	-3883.700	15.86390	1.28e+15	46.13605	47.67320	46.75971
6	-3871.820	20.30696	1.35e+15	46.18395	48.01389	46.92641
7	-3860.929	18.10973	1.44e+15	46.24336	48.36609	47.10460
8	-3850.736	16.47370	1.55e+15	46.31089	48.72641	47.29093

Source: own elaboration. Fuente: elaboración propia.

Table 4. Johansen cointegration test results
Tabla 4. Resultados de la prueba de cointegración de Johansen

Variable	Hypothesized No. of CE(s)	Trace statistic	Critical value 5%	Max-eigen statistic	Critical value 5%
HGKPF HGKPRM HPPGKPRM HBWS	None*	66.88*	47.86	46.84*	27.58
	At most 1	20.05	29.80	14.28	21.13
	At most 2	5.76	15.49	3.56	14.26
	At most 3	2.21	3.84	2.21	3.84

Notes: *Indicates the hypothesis is rejected at a 1% significance level. Source: own elaboration.
Nota: *Indica que la hipótesis se rechaza con un nivel de significancia del 1%. Fuente: elaboración propia.

According to the cointegration test results (Table 4) utilizing the Johansen cointegration test method, a long-term integration relationship is established between the price of dry harvested rice at the farmer level (HGKPF), price of dry harvested rice at the milling level (HGKPRM), government purchase price for dry harvested rice at the milling level (HPPGKPRM) and price of rice at the wholesaler level (HBWS). This long-term relationship is evident through the trace statistics and max-eigenvalue values, both of which have a probability value lower than the 5% critical threshold. Consequently, it can be concluded that the equation can effectively describe the cointegration among the variables included in the model.

RIVAR Volumen 13, número 40, 2026: 128-146 • ISSN online 0719-4994
Instituto de Estudios Avanzados, Universidad de Santiago de Chile

Table 5. Causality test results
Tabla 5. Resultados de la prueba de causalidad

Null hypothesis	Obs	F-statistic	Prob
HGKPRM does not Granger-cause HGKPF	178	8.99	0.0002*
HGKPF does not Granger-cause HGKPRM	-	8.96	0.0002*
HPPGKPRM does not Granger-cause HGKPF	178	12.25	1.E-05
HGKPF does not Granger-cause HPPGKPRM	-	4.18	0.0169*
HBWS does not Granger-cause HGKPF	178	5.04	0.0075*
HGKPF does not Granger-cause HBWS	-	18.04	8.E-08
HPPGKPRM does not Granger-cause HGKPRM	178	12.22	1.E-05
HGKPRM does not Granger-cause HPPGKPRM	-	4.36	0.0143*
HBWS does not Granger-cause HGKPRM	178	4.75	0.0098*
HGKPRM does not Granger-cause HBWS	-	17.75	1.E-07
HBWS does not Granger-cause HGKPRM	178	1.85	0.1607
HGKPRM does not Granger-cause HBWS	-	1.34	0.2651

Source: own elaboration. Fuente: elaboración propia.

The Granger causality test results (Table 5) show that HGKPRM significantly affects HGKPF, and the reverse relationship shows the same thing, with a probability value lower than the 0.05 significance level. The other significant variables are HGKPRM, HPPGKPRM, and HBWS, with HGKPRM with a probability value lower than the 0.05 significance level.

HGKPRM affects the HGKPF, and vice versa, namely, HGKPF affects HGKPRM; HGKPF EFFECT HPPGKPRM, HBWS affects HGKPF, HGKPRM affects HPPGKPRM, HBWS affects HGKPRM at a probability lower than a 0.05 significance level. Meanwhile, the reverse relationships, where HPPGKPRM is with HGKPF, HGKPF with HBWS, HPPGKPRM with HGKPRM, HGLPRM with HBWS, HBWS with HGKPRM, HGKPRM with HBWS, are not statistically significant, with a probability value exceeding the 0.05 threshold.

The causal relationship between HGKPF and HGKPRM, HHPPGKPRM, and HBWS contributes to price disparities between producers and other marketing agencies for dry-harvested grain. This suggests that price change information from farmers primarily impacts consumers and marketing agencies. The ECM symmetry model estimated HGKPF using the variables HGKPRM, HPPGKPRM, and HBWS for periods t and t-1, as well as the error correction term (ECT) for t-1. The results indicate HGKPRM has a positive effect on HGKPF, with a 1% increase raising HGKPF by 0.989777%, ceteris paribus. The significant negative ECT coefficient (-0.501156) indicates that short-term price variations typically return to long-term equilibrium after about 50 months (Table 6).

Table 6. Symmetry model estimation results
Tabla 6. Resultados de la estimación del modelo de simetría

Variable	Coefficient	SE	t-stat	Prob.
D(HGKPRM)	0.989777	0.003204	308.8919	0.0000
D(HPPGKPRM)	-0.003514	0.005129	-0.685284	0.4941
D(HBWS)	0.001338	0.003398	0.393848	0.6942
ECT(-1)	-0.501156	0.066317	-7.556977	0.0000
C	-0.321485	0.650197	-0.494442	0.6216
R-square	0.998485			
F-stat (Prob F-statistic)	28677.65 (0.0000)			

Source: own elaboration. Fuente: elaboración propia.

Asymmetry tests are conducted to determine whether pricing transmission from the farmer level to the next marketing agencies has occurred perfectly. There are 3 models in this research. The first model is HGKPF and HGKPRM, HGKPF and HPPGKPRM, and HGKPF and HBWS. The estimation of the asymmetry model for the HGKPRM is provided in Table 7. The estimation results reveal that in the short-term price transmission, the response of the HGKPF to positive and negative shocks to the independent variables differs descriptively. The price of dry harvested rice at the current farmer level DHGKPF_POS, DHGKPF_NEG, and the previous period price of dry harvested rice at the farmer level DHGKP_NEG(-1) have a positive and statistically significant value, indicating that this variable transmits price changes associated with price increases. The previous period price of dry harvested rice at the milling level DHGKPRM_NEG(-1) has a negative and statistically significant value, indicating that this variable transmits price changes associated with price decreases.

The estimated values of ECT_FRM_POS(-1) and ECT_FRM_NEG(-1) are statistically significant, indicating that rice miller prices respond to changes in farmer prices when deviations exceed equilibrium. Values of 0.299091 and 0.307618 indicate that prices will return to equilibrium in about three months. The results obtained are consistent with Ruslan and Paramita's (2022) finding of a 2-month adjustment period in West Java. In the price transmission model, the Wald test is used to determine the significance of the differences between positive and negative shock responses. Significant results point to price asymmetry and imbalance in rice distribution; otherwise, transmission is symmetrical. Table 8 shows the Wald test results for Model 1.

Table 8 shows the Wald test statistic. Model 1 shows significant asymmetry in three components ($p < 0.05$), which aligns with Arida et al. (2023), who found that asymmetric price transmission is found along the rice supply chain. Meanwhile, Models 2 and 3 predominantly show symmetric relationships. Long-term asymmetric prices can be seen from the positive ECT and negative ECT coefficient values. In models 1, 2, and 3. Models 1, 2, and 3 (Model 1 HGKPF-HGKPRM, model 2 HGKPF-HPPGKPRM), and model 3 (HGKPF-HBWS).

In Model 1 (Table 8), each positive and negative ECT yields significant results, indicating long-term asymmetric price transmission and market power at the HGKPF and HGKPRM levels. Models 2 and 3 (Tables 10 and 12) yield insignificant results, meaning that price transmission between HGKPF-HPPGKPRM and HGKPF-HBWS is symmetrical. Asymmetry results from farm-level price fluctuations in periods t and t-1, whereas other market levels exhibit symmetrical or insignificant transmission. This is consistent with Shaffitri et al. (2024), who discovered short-term asymmetric but long-term symmetric rice price transmission. Price volatility influences transmission, output, and stocks, while local transmission reflects competitive profit behavior (Pindyck, 2004).

The second model is HGKPF and HPPGKPRM. The estimation of the asymmetry model for the HPPGKPRM is provided in Table 9. The estimation results reveal that in the short-term price transmission, the response of the HGKPF to positive and negative shocks to the independent variables differs descriptively. The price of dry-harvested rice at the current farmer level DHPPGKPRM_POS has a positive and statistically significant value, indicating that this variable transmits price changes associated with price increases. While the other variables such as DHPPGKPRM_POS(-1), DHPPGKPRM_NEG(-1), DHGKPF_NEG, DHGKPF_POS(-1), and DHGKPF_NEG(-1) are not statistically significant. It indicates that when there is a price deviation below the equilibrium line (when a price increase at the producer level is not followed by a price increase at the rice miller level), the deviation will not affect the price of rice at the rice miller level.

Table 7. Estimation for the Asymmetry Model 1
Tabla 7. Estimación del modelo de asimetría 1

Variable	Coefficient	SE	t-stat	Prob.
C	-5.149359	1.82623	-2.819659	0.0054
DHGKPRM_POS(-1)	-0.147620	0.088458	-1.668820	0.0970
DHGKPRM_NEG(-1)	-0.649685	0.111367	-5.833719	0.0000
DHGKPF_POS	1.004819	0.007122	141.2815	0.0000
DHGKPF_NEG	1.008085	0.005003	201.4779	0.0000
DHGKPF_POS(-1)	0.141619	0.089557	1.581318	0.1157
DHGKPF_NEG(-1)	0.651752	0.112445	5.796199	0.0000
ECT_FRM_POS(-1)	-0.299091	0.065278	-4.581786	0.0000
ECT_FRM_NEG(-1)	-0.307618	0.066628	-4.616929	0.0000
R-square	0.998538			
F-stat (p-value)	14347.00 (0.0000)			

Source: own elaboration. Fuente: elaboración propia.

Table 8. Wald Test Model 1
Tabla 8. Modelo de prueba de Wald 1

Wald Test	F-statistics	Probability	Description
H0: DHGKPRM_POS(-1)= DHGKPRM_NEG(-1)	11.45478	0.0009	Asymmetry
H0: DHGKPF_POS= DHGKPF_NEG	0.101660	0.7502	Symmetry
H0: DHGKPF_POS(-1)= DHGKPF_NEG(-1)	11.5620	0.0008	Asymmetry
H0; ECT_FRM_POS(-1)= ECT_FRM_NEG(-1)	4.325220	0.0391	Asymmetry

Source: own elaboration. Fuente: elaboración propia.

The estimated values of ECT_FHPP_POS(-1) and ECT_FHPP_NEG(-1) are statistically significant, indicating that rice miller prices react to farmer price drops when deviations exceed equilibrium. Values of 0.016448 and 0.016997 indicate that prices will return to equilibrium in less than a month. These findings are consistent with those reported by Ruslan and Paramita (2022), who found similar results in West Java's primary food markets. Kharisma and Indrawan (2023) discovered vertical integration but price asymmetry in West Java's rice market, requiring approximately two months to reach equilibrium following price increases. A Wald test determines the significance for variations between positive and negative shocks.

Table 9. Estimation for the Asymmetry Model 2
Tabla 9. Estimación del modelo de asimetría 2

Variable	Coefficient	SE	t-stat	Prob.
C	-0.052908	5.530351	-0.009567	0.9924
DHPPGKPRM_POS(-1)	-0.009601	0.019515	-0.491985	0.6234
DHPPGKPRM_NEG(-1)	-0.040197	0.076877	-0.522869	0.6018
DHPPGKPRM_POS	1.007712	0.019190	52.51226	0.0000
DHGKPF_NEG	-0.015662	0.016799	-0.932314	0.3525
DHGKPF_POS(-1)	0.032652	0.025869	1.262183	0.2086
DHGKPF_NEG(-1)	-0.005245	0.018085	-0.290038	0.7721
ECT_FHPP_POS(-1)	0.016448	0.006778	2.426679	0.0163
ECT_FHPP_NEG(-1)	0.016997	0.007052	2.410164	0.0170
R-square	0.945902			
F-stat (p-value)	367.1845 (0.0000)			

Source: own elaboration. Fuente: elaboración propia.

RIVAR Volumen 13, número 40, 2026: 128-146 • ISSN online 0719-4994
Instituto de Estudios Avanzados, Universidad de Santiago de Chile

Table 10. Wald Test Model 2
Tabla 10. Modelo de prueba de Wald 2

Wald Test	F-statistics	Probability	Description
H0: DHPPGKPRM_POS(-1)= DHPPGKPRM_NEG(-1)	0.151024	0.6981	Symmetry
H0: DHPPGKPRM_POS= DHGKPF_NEG	1741.038	0.0000	Asymmetry
H0: DHGKPF_POS(-1)= DHGKPF_NEG(-1)	1.065916	0.3034	Symmetry
H0: ECT_FHPP_POS(-1)= ECT_FHPP_NEG(-1)	0.577175	0.4485	Symmetry

Source: own elaboration. Fuente: elaboración propia.

Table 11. Estimation for the Asymmetry Model 3
Tabla 11. Estimación del modelo de asimetría 3

Variable	Coefficient	SE	t-stat	Prob.
C	18.75422	35.05669	0.534968	0.5934
DHBWS_POS(-1)	0.360261	0.147623	2.440405	0.0157
DHBWS_NEG(-1)	0.052060	0.092597	0.562221	0.5747
DHGKPF_POS	0.558694	0.148139	3.771408	0.0002
DHGKPF_NEG	0.174368	0.106312	1.640157	0.1028
DHGKPF_POS(-1)	0.035546	0.178358	0.199295	0.8423
DHGKPF_NEG(-1)	0.338825	0.104247	3.250207	0.0014
ECT_FWS_POS(-1)	-0.006478	0.017965	-0.360585	0.7189
ECT_FWS_NEG(-1)	-0.004677	0.018312	-0.255409	0.7987
R-square	0.332920			
F-stat (p-value)	10.48050 (0.0000)			

Source: own elaboration. Fuente: elaboración propia.

The third model is HGKPF and HBWS. The estimation of the asymmetry model for the HBWS is provided in Table 11. The estimation results reveal that in the short-term price transmission, the response of the HGKPF to positive and negative shocks to the independent variables differs descriptively. The previous price of rice at the wholesaler level HBWS_POS(-1), DHGKPF_POS, and DHGKPF_NEG(-1) has a positive and statistically significant value, indicating that this variable transmits price changes associated with price increases. While the other variables, such as DHBWS_NEG(-1), DHGKPF_NEG, and DHGKPF_POS(-1) are not statistically significant. It indicates that when there is a price deviation below the equilibrium line (when a price increase at the producer level is not followed by a price increase at the wholesaler level), the deviation will not affect the price of rice at the wholesaler level.

The estimated values of ECT_FWS_POS(-1) and ECT_FWS_NEG(-1) are not statistically significant. In other words, the price at the rice wholesaler level will not adjust to the fall in prices at the farmer level when the price variation exceeds the equilibrium line.

Table 12. Wald Test Model 3
Tabla 12. Modelo de prueba de Wald 3

Wald Test	F-statistics	Probability	Description
H0: DHBWS_POS(-1)= DHBWS_NEG(-1)	2.724682	0.1007	Symmetry
H0: DHGKPF_POS= DHGKPF_NEG	3.128479	0.0788	Symmetry
H0: DHGKPF_POS(-1)= DHGKPF_NEG(-1)	1.658767	0.1995	Symmetry
H0: ECT_FWS_POS(-1)= ECT_FWS_NEG(-1)	0.755818	0.3859	Symmetry

Source: own elaboration. Fuente: elaboración propia.

This paper advances the Indonesian rice price-transmission literature in three ways. First, by modeling the full vertical chain, farm-gate paddy (HGKPF) → mill-gate paddy (HGKPRM) → wholesale rice (HBWS), it localizes where short-run persistence and long-run asymmetry originate and accumulate, complementing prior two-node studies. Second, it embeds the administered mill-gate floor price (HPPGKPRM) directly within an asymmetric ECM, identifying how policy changes the speed of adjustment and truncates downside shocks rather than treating intervention only descriptively. Third, it translates econometric results into operational price-stability indicators (pass-through asymmetry, error-correction speed/half-life, service within policy bands, and inter-node spreads), offering a practical monitoring framework for policymakers. These contributions differentiate the study from existing work and bridge empirical identification to implementable stabilization strategies.

Along the vertical rice chain, from the price of dry unhusked rice at the producer level (HGKPF, farm-gate) to the price at the mill (HGKPRM, mill-gate) to the price at the wholesaler (HBWS, wholesale), our three asymmetric models present a coherent picture of price transmission and the role of policy. Model 1 (HGKPF → HGKPRM) shows strong market integration with high and relatively symmetric contemporary pass-through elasticities, while short-run asymmetries emerge primarily on the downside of producer prices that tend to persist to mills; simultaneously, significant and symmetric error correction (ECT) confirms convergence toward long-run equilibrium. Moving to Model 2 (HGKPRM → HBWS), transmission becomes partial and exhibits upward rigidity/stickiness (a rockets-and-feathers pattern): increases at mills are passed on more quickly and to a greater extent to wholesalers than decreases, along with adjustment costs, inventory costs, and mark-up determination at downstream nodes, making consumer price stability largely determined by midstream → downstream dynamics. When the government purchase price at mills (HPPGKPRM) is made explicit in Model 3, it acts as an administered floor price that cuts the persistence of downstream-midstream declines and accelerates the pace of adjustment when prices fall below the policy price band; conversely, to manage upward spikes, calibrated buffer-stock releases are required downstream to prevent excessive short-term volatility from spreading.

Compared to Kharisma and Indrawan's study (2023), which analyzed two-node

RIVAR Volumen 13, número 40, 2026: 128-146 • ISSN online 0719-4994
Instituto de Estudios Avanzados, Universidad de Santiago de Chile

transmission in aggregate (and therefore found asymmetries without being able to localize their source in the chain), our multi-node, instrument-based approach identifies where asymmetries emerge, downside persistence in the upstream-midstream and upward stickiness in the midstream-downstream, and how the Government Purchase Price (administered floor price). affects the speed of adjustment. Consequently, our policy recommendations are more operational: trigger-based absorption in the upstream to cushion downward shocks, measured buffer-stock release in the downstream to dampen upward shocks, and monitoring inter-node spreads, pass-through elasticities, and the ECT indicator as price stability indicators with a focus on maintaining short-term price stability while maintaining long-term equilibrium in the rice market. Long-term asymmetry in price transmission conditions results from marketing agencies abusing their market power. In contrast, in the short-term asymmetry relationship, differences in responses result from adjustment costs incurred by marketing agencies to adjust prices (Dharmawan et al., 2024).

Conclusions and recommendations

This study concludes that there is an integrated relationship between producer prices and marketing agencies in Indonesia. Rice prices are transmitted asymmetrically from farmers to wholesalers in both the short and long run. In the short term, asymmetry exists at producer prices for periods t and t-1, indicating that the response to price changes at these levels is transmitted differently to the wholesale process. In the long run, price transmission is asymmetric, with both positive and negative long-run equilibrium coefficients being statistically significant. This condition demonstrates that the adjustment process caused by a decrease in producer prices differs from the adjustment process caused by price increases that are not consistent.

Asymmetric price transmission in Indonesia's rice trade is caused by two main factors: government price interventions that only benefit producers and uncompetitive behavior by intermediaries in a concentrated, oligopolistic market. This allows intermediaries, which are fewer in number than farmers and consumers, to act as price makers.

The study finds that intermediaries have a significant influence on rice prices, necessitating local government oversight to balance farmer profits and consumer affordability. Accurate data is essential for monitoring market power abuse. Policies should involve regional actors as well as the private sector in order to reduce oligopolistic effects and shorten supply chains. Due to a lack of regional data, the study focuses on national prices. Future research should use spatial and quality-based rice data.

Contributor Role Taxonomy (CRediT)

Wiwit Widyawati: Conceptualization, data curation, formal analysis, investigation, methodology, software, validation, visualization, writing — original draft, and writing — review and editing.

Nuhfil Hanani: Conceptualization, supervision, and validation.

Syafrial: Supervision and validation.

Sujarwo: Conceptualization, supervision, and validation.

References

Arida, A., Masbar, R., Majid, M., and Indra, I. (2023). Does vertical asymmetric price transmission exist in the rice markets? *Agricultural and Resource Economics: International Scientific E-Journal, 9*(1), 69-90. DOI 10.51599/are.2023.09.01.04

Aryani, D., Natawidjaja, R., Noor, T., and Mulyana, A. (2021). The integration of rice market in Indonesia as an archipelago country (Vector error correction model analysis). *International Journal on Advanced Science, Engineering and Information Technology, 11*(4), 1663-1669. DOI 10.18517/ijaseit.11.4.11264

Asrin, S., Andita Putri, T., and Utami, A.D. (2022). Transmisi harga beras di Indonesia pada masa pandemi Covid-19. *Jurnal Agribisnis Indonesia, 10*(1), 159-168. DOI 10.29244/jai.2022.10.1.159-168

Bondemark, A. (2020). *The relationship between accessibility and price: The case of Swedish food stores*. *Journal of Transport Geography, 82*, 102615. DOI 10.1016/j.jtrangeo.2019.102615

Center for Agricultural Data and Information Systems (2024). *Food consumption statistics 2024*. Ministry of Agriculture, Republic of Indonesia.

Dharmawan, B., Nasir, M., and Aisyah, D. (2024). Optimizing the role of rice central market in Java, Indonesia: The effect of toll roads construction to the rice market integration. *IOP Conference Series: Earth and Environmental Science, 1323*, 012015. DOI 10.1088/1755-1315/1323/1/012015

Difah, D., Harianto, H., and Hakim, D. (2020). Transmisi harga beras di Indonesia: Pendekatan threshold cointegration. *Journal of Food System and Agribusiness, 3*(2). DOI 10.25181/JOFSA.V3I2.1561

Engle, R.F. and Granger, C.W.J. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica, 55*(2), 251-276. DOI 10.2307/1913236

Firdaus, A.H. and Nurhayati, E. (2023). *Future Food Demand in Poor Indonesian Districts*. Center for Indonesian Policy Studies. DOI 10.35497/563231

RIVAR Volumen 13, número 40, 2026: 128-146 • ISSN online 0719-4994
Instituto de Estudios Avanzados, Universidad de Santiago de Chile

Götz, L., von Cramon-Taubadel, S., and Kachel, Y. (2014). Vertical price transmission in the international fresh fruit and vegetable supply chain: Israeli grapefruit exports to the EU after export liberalisation. *Quarterly Journal of International Agriculture, 53*(2), 99-120.

Granger, C.W.J. and Lee, T.H. (1989). Investigation of production, sales and inventory relationships using multicointegration and non-symmetric error correction models. *Journal of Applied Econometrics, 4*(S1), S145-S159.

Kharisma, B. and Indrawan, Z. (2023). Analysis of rice price transmission in West Java, Indonesia. *Cogent Food and Agriculture, 9*, 2266198. DOI 10.1080/23311932.2023.2266198

Mohanty, S., Peterson, E.W.F., and Kruse, N.C. (1996). Price asymmetry in the international wheat market. *Canadian Journal of Agricultural Economics, 44*(4), 355-366. DOI 10.1111/j.1744-7976.1995.tb00128.x

Mulyana, A., Lastinawati, E., Lifianthi, L., Riswani, R., and Aryani, D. (2020). Price transmission after the determination of rice ceiling price in South Sumatra Province: Analysis of secondary and empirical data. *IOP Conference Series: Earth and Environmental Science, 497*, 012042. DOI 10.1088/1755-1315/497/1/012042

Novianti, T., Mashito, M., and Muryani, M. (2020). Asymmetry price transmission in market rice in Indonesia. *Jurnal Ilmu Ekonomi Terapan, 5*(2), 1-16.

Pindyck, R.S. (2004). Volatility and commodity price dynamics. *Journal of Futures Markets, 24*(11), 1029-1047. DOI 10.1002/fut.20120

Rezitis, A.N. (2014). Vertical price transmission in the Greek food market: Empirical evidence from the beef sector. *Economic Modelling, 36*, 560-573.

Ruslan, J.A. and Paramita, D.A. (2022). Market efficiency of main food commodities in West Java Province. *Suluh Pembangunan: Journal of Extension and Development, 4*(1), 18-25. DOI 10.23960/jsp.Vol4.No1.2022.120

Sadiq, S., Singh, I., and Ahmad, M. (2021). Spatial market integration of rice in the world. *Türkiye Tarımsal Araştırmalar Dergisi*. DOI 10.19159/TUTAD.810375

Shaffitri, L., Suryana, E., and Sinuraya, J. (2024). Market integration and rice price transmission in Indonesia. *BIO Web of Conferences, 119*, 02007. DOI 10.1051/bioconf/202411902007

Suryana, A., Hartono, M., Suryana, M., Sinaga, J., and Irawan, A. (2024). Stability of rice availability and prices in Indonesia during the COVID-19 pandemic and Russia-Ukraine war. *BIO Web of Conferences, 119*, 02013. DOI 10.1051/bioconf/202411902013

Suryani, E., Hendrawan, R.A., Damanhuri, Rahmawati, U.E., and Chou, S.Y. (2022). Scenario development to create a sustainable price of rice: A system thinking approach. *Procedia Computer Science, 197*, 599-606. DOI 10.1016/j.procs.2021.12.178

Sustainable Rice Platform (2023, August). *Emerging trends in Asia's sustainable rice consumption: Indonesia edition*. Sustainable Rice Platform. https://sustainablerice.org/wp-content/uploads/2023/10/Emerging-Trends-in-Asias-sustainable-rice-consumption_Indonesia.pdf

Von Cramon-Taubadel, S. and Loy, J.P. (1999). The identification of asymmetric price transmission processes with integrated time series. *Jahrbücher für Nationalökonomie und Statistik, 218*(1-2), 85-106. DOI 10.1515/jbnst-1999-1-206