

Volatility Spillover of Crude Palm Oil (CPO) Commodity between Spot and Futures Market in Indonesia

Abel Gandhi, Bayu Dwi Prasetyo & Mareta Gangsar Wilistanti

Department of Management, Universitas Pakuan, Indonesia

Email: gandhi.abel@gmail.com

Abstract

The development of trade globalization has led to the expansion of market interactions between countries, specifically for Crude Palm Oil (CPO) commodities. This study aims to determine the volatility of CPO prices between the Medan spot market and the futures market consisting of the Jakarta futures market, Malaysia futures market, and the Rotterdam forward market. The daily data on CPO prices in each market from January 2016 to December 2020. The data analysis method uses the GARCH model (1.1). The results showed a volatility transmission from the entire futures market to the Medan spot market. Thus, the CPO commodity futures market influences price volatility and the price formation process in the Medan spot market. Therefore, CPO commodity market players must be alert to the information occurring in the futures market to determine investment strategies.

Keywords: Crude Palm Oil, Spillover, GARCH, Indonesia Futures Market.

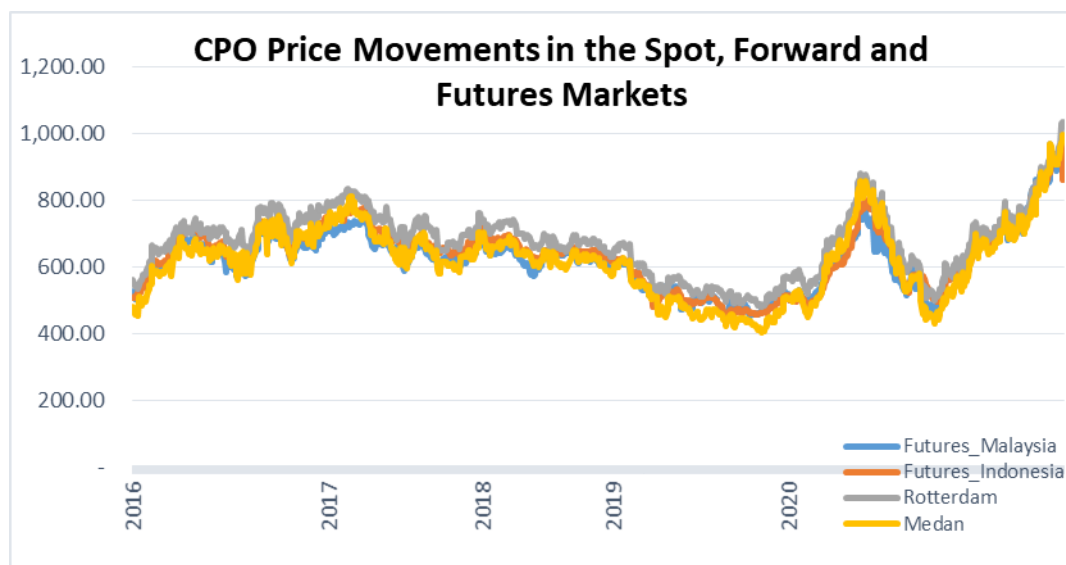
1. Introduction

As the largest palm oil producer, Indonesia has exported the commodity to supply the global market demand. As a result, Indonesia's palm oil export volume has shown a positive trend. In 2020, the CPO production reached 47,18 million tons, or 58% of the global palm production. The total export of palm oil was 37.39 million tons in 2019 (BPS, 2020). Palm products are exported in Crude Palm Oil (CPO), Palm Kernel Oil, Biodiesel, oleochemicals, and other derivative products.

Sellers and buyers can conduct CPO transactions in two types of markets: the physical market (spot) and the futures market. The spot market is where CPO commodity transactions are carried out in cash or directly. The futures market is a financial market that provides a spot for sellers and buyers to conduct futures contract transactions for CPO commodities with an agreement to deliver the CPO commodities in the future. The initial purpose of forming the futures market was to form price formation and hedging for the commodity market participants.

Information obtained by market participants can affect price fluctuations in commodity markets. The market is categorized as efficient if the adjustment of decisions to information is carried out quickly so that the prices are formed to reflect the latest information. Market participants cannot obtain anomalous rewards from their movement when adjustments are made. On the contrary, the market is declared inefficient if the adjustments are not made immediately so that the prices formed do not reflect the latest information that comes in (Sy et

al., 2015). Therefore, the process of adjusting to information causes price fluctuations. The movement of CPO prices on the Medan Spot market, Jakarta Futures market, Malaysia Futures Market, and Rotterdam forward market can be seen in Figure 1.



Figures 1. CPO Price Movement in Indonesian Market and International Market
(references: BAPEBBTI and MPOB. (processed))

From Figure 1, it can be seen that CPO prices for all markets fluctuated over time from January 2019 to December 2020. There were high price fluctuations from January 2016 to January 2017 and July 2012 to January 2013, with a downward trend in CPO prices. Meanwhile, from July 2010 to January 2011 and July 2019 to December 2019, the price relatively fluctuated, followed by an upward price trend. Prices occurring for all markets have different patterns over time. There was a period when the price on the Medan spot market was more remarkable than on the Rotterdam forward market and the Malaysian Futures market, namely in November 2020. Meanwhile, during the period when the Indonesian spot price was lower than the Malaysian forward price. Meanwhile, the Indonesian spot price was lower than the Malaysian forward price, Malaysian futures prices and Indonesian futures prices occurred from June to November 2019.

The condition of price inconstancy in CPO commodities can be obtained by measuring price volatility. Price volatility is a value showing price fluctuations over a certain period. Volatility indicates the risk and uncertainty faced by market participants. Therefore, awareness of CPO price volatility is vital for policymakers to mitigate uncertainty and price volatility. Information about price volatility is also essential for producers and consumers of CPOs to minimize the risks they face (Gandhy et al., 2022). The increase in price volatility in CPO commodities is a concern for all parties in the food commodity marketing chain, especially producers and the

government. Producers are interested in determining the volume of production under certain price conditions. Meanwhile, the government plays a critical role in determining the appropriate policies to protect the parties involved in producing and marketing CPO commodities.

2. Literature Review

The development of globalization has led to the development of market synergy between countries, one of which is the market for CPO commodities. The inter-dependent market relations between countries are getting closer from time to time. This condition exhibits that market integration has become more dynamic than previous periods. This condition enables market participants to react rapidly to new information obtained from international or other major CPO (Lestano & Sucito, 2010). Price volatility in one commodity market can also be transmitted to other markets. This condition causes shocks occurring in one market can generate consternation in other markets. So that unfavorable conditions of one commodity market in one particular country can spread quickly to other countries' markets and, eventually, can lead to an expansion in volatility price (Pradhan et al., 2021). The expertise in the transmission of volatility is necessary since it can assist market participants and lawmakers in identifying the process of absorption and transmission of information occurring from one market to another. Thus, market participants can arrange better risk management strategies.

The results of research conducted by (Sy et al., 2015), (Kumar Mahalik et al., 2014), (Ameur et al., 2021) stated that the volatility of the futures market affected the volatility of the spot market. Meanwhile, other research conducted by (Bohl et al., 2020), (Mallikarjunappa & Afsal, 2010), (Rastogi & Agarwal, 2020), (Zhang & Jaffry, 2015) stated that futures market volatility did not affect the volatility of spot market volatility. However, the current research results still have not revealed any acceptable conclusion. Therefore, further research is required to determine the effect of futures market volatility on the spot market since CPO is one of the essential commodities for Indonesia. Thus, when price volatility is extravagant, it will affect state revenues and ultimately alter Indonesia's economic performance. Hence, a study of volatility is vital so that market participants and the government can mitigate the adverse effects of high price volatility.

3. Research Method

This study discusses the volatility of CPO commodity prices between the spot market and the futures market consisting of the Medan spot market, Jakarta futures market, Malaysia futures market, and Rotterdam forward market. In addition, this study also discusses the relationship between price volatility transitions between CPO commodity futures markets. The data used in this study were daily data of CPO prices in each market, starting from January 1, 2016, to December 31, 2020. The type of data used, the amount, and the source can be seen in table 1.

Table 1. Types of Data, Amount and Data Sources Used

No	Data	Unit	Data Period	Source
1	Medan CPO Spot Prices	US \$/Ton	2016-2020	BAPPEBTI
2	Indonesian CPO Futures Price	US \$/Ton	2016-2020	ICDX
3	Malaysian CPO Futures Price	US \$/Ton	2016-2020	MOB
4	Rotterdam Forward Prices	US \$/Ton	2016-2020	BAPPEBTI
5	Rupiah exchange rate	Rp	2016-2020	Bank Indonesia
6	Ringgit Exchange Rate	ringgit	2016-2020	investing

The data analysis model was used to determine the transmission of CPO price volatility in the Medan spot market, Indonesian futures market, Malaysian futures market, and Rotterdam futures market using the GARCH model (1.1). The GARCH model was popularized by Bollerslev (Engle & Bollerslev, 1986). The residual variance equation in the GARCH model is expressed in the following equation:

$$\sigma_t^2 = \beta_0 + \sum_{i=1}^k \beta_i \sigma_{t-i}^2 + \sum_{j=1}^l \alpha_j e_{t-j}^2 \dots\dots\dots(1)$$

Data analysis commences from a data stationarity test. Data are stationary if they have a constant mean and variance. In addition, the data also do not have any specific movement pattern or contain any element of a trend. Therefore, a data stationarity test is required to prevent spurious regression in the model. Augmented Dicky Fuller (ADF) unit root test can be used to determine the stationarity of the data used in the study. The general equation model for the ADF Test is as follows:

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

Description :

- P_t = Price in t-period
- P_{t-1} = Price 1 month before
- = P_t – P_{t-1}
- ε = Error / error
- α₀, γ, β_i = Parameter Coefficient

The following test stage is to identify the presence of ARCH/GARCH in the residual mean model. The mean equation model between the futures market and the spot market in this study is as follows:

$$SM_t = \alpha_0 + \sum_{i=1}^n \alpha_i FJ_{t-i} + \sum_{k=1}^n \alpha_k FM_{k-i} + \sum_{l=1}^n \alpha_l FR_{t-l} + \dots\dots\dots(3)$$

Tests are carried out to determine the ARCH effect in the mean equation model using the Lagrange Multiplier test (ARCH – LM). If the p-value is less than 0.05, it can be stated that there is an ARCH error in the equation model. Thus, the test phase can be continued using GARCH (1,1) on the variance model. The model used to determine the condition of the volatility transmission between the spot market, and futures market is as follows:

$$\sigma_t^2 = \beta_0 + \sum_{o=1}^n \lambda_o \sigma_{t-o}^2 + \sum_{p=1}^n \delta_p e_{t-p}^2 + \sum_{i=1}^n \theta_i FJ_{t-i} + \sum_{k=1}^n \theta_k FM_{k-i} + \sum_{l=1}^n \theta_l FR_{t-l} + \varepsilon_t \dots (4)$$

Description:

SM	= CPO price on the Medan spot market
FJ	= CPO price on Jakarta futures market
FM	= CPO price on Malaysian futures market
FR	= CPO price on the Rotterdam forward market
σ_{t-o}^2	= ARCH Effect
e_{t-p}^2	= GARCH Effect
α_0, β_0	= Constant
$\lambda_o, \dots, \delta_p, \alpha_i, \alpha_k, \alpha_l, \theta_i, \dots, \theta_k, \theta_l$	= Coefficient
ε_t	= Residual

4. Finding and Discussion

The data in Table 2 show the average price, standard deviation, and coefficient of variation in each market. The immense average price occurs in the Rotterdam market, at approximately \$672. Meanwhile, the lowest average price is in the Medan Spot market at around \$618.43. In addition, the average price in the Jakarta futures market is \$635.28. Thus, the average price on the spot market is flatter than the average price in the futures market of Indonesia. However, the most significant coefficient of variation also occurs in the Medan spot market, with a value of 17.68%. This demonstrates that the price fluctuations in the Medan spot market are the highest compared to other CPO futures markets.

Table 2. Descriptive Statistics of CPO Prices in the Period Before and During the Covid-19 Pandemic

Description	Average	Standard Deviation	Coefficient of Variation
Malaysia Futures	619.27	90.01	14.53%
Futures Jakarta	635.28	97.72	15.38%
Forward Rotterdam	672.81	99.50	14.79%
Medan Spot	618.43	109.31	17.68%

The high risk of price changes challenged by market participants in the spot market compared to the futures market indicates the urgency for activities that can minimize the risk potential encountered. One alternative strategy that is possible to do is hedging. (Zavadzka et al., 2018) stated that hedging carried out by market participants could reduce the risks confronted by market participants due to price fluctuations developed in the future. Hedging is also recommended to be carried out during crisis periods considering the risk of change faced by

market participants is more remarkable than during regular periods(Tadesse et al., 2014).

Table 3. Stationarity Test Results at Level

Description	Level	P-Value	Conclusion
Malaysia Futures	Level	0.8339	Not Stationary
Futures Jakarta	Level	0.7095	Not Stationary
Forward Rotterdam	Level	0.7969	Not Stationary
Medan Spot	Level	0.6415	Not Stationary

The analysis of price volatility transmission between the spot market and CPO commodity futures begins with a price static test in each market. Static data have an average value and constant variance during the analysis (Das & Nason, 2016). Static data are indicated when the p-value is lesser than 0.05. For instance, based on the data in table 4, the p-value of the Medan spot market, Jakarta Futures market, Malaysia futures market, and Rotterdam forward market is more significant than 0.05. Thus, the price of CPO in all markets is not stationary at the level. Therefore, it is necessary to assess the stationarity of prices at the level of the first derivative (first difference).

Table 4. Stationarity Test Results at the First Difference. Level

Description	Level	P-Value	Conclusion
Malaysia Futures	First Difference	0.0000	Stationary
Futures Jakarta	First Difference	0.0000	Stationary
Forward Rotterdam	First Difference	0.0000	Stationary
Medan Spot	First Difference	0.0000	Stationary

Table 4 shows the results of the stationarity test of CPO prices at the first difference level. Repeatedly, the p-value obtained in all markets is lower than 0.05. Consequently, it can be stated that the price of CPO in all markets is stationary at the first difference level, and data analysis can be continued at the ARCH effect test stage on the mean equation.

The ARCH-LM test is used to determine the ARCH effect on the mean equation of the volatility transmission relationship between the spot and futures markets. The mean equation's probability value of less than 0.05 indicates an ARCH effect. Based on the results of the ARCH-LM test on the mean equation, the probability value is lesser than the value of 0.05. Thus, it can be stated that there is an ARCH effect on the mean equation, and an analysis of the transmission of CPO price volatility between markets using the variance equation can be carried out.

Table 5. Volatility Transmission Test Results in the Medan Spot Market

Variable	Coefficient	Probability	Description
ARCH	0.124144	0.0000	Significant
GARCH	0.864692	0.0000	Significant
Jakarta Futures Market	3.676553	0.0000	Significant
Malaysia Futures Market	3.213536	0.0000	Significant
Rotterdam Forward Market	-5.668985	0.0000	Significant

Table 5 shows the GARCH model (1,1) of volatility transmission test outcomes between the CPO commodity futures market and the Medan spot market, consisting of the Malaysia futures market, the Rotterdam forward market, and the Jakarta futures market. The probability value smaller than 0.05 for all futures market variables indicates transmission of price volatility from the futures market to the spot market for CPO commodities. The results of this study are aligned with the research supervised by (Manogna & Mishra, 2019), which researched the analysis of the volatility transmission between the spot and futures markets of agricultural commodities in India. The study results indicate that price volatility in the futures market is transmitted to the spot market. The results also reveal that the relationship between the futures market and the spot market for agricultural commodities in India is efficient. (Mahalik et al., 2009) analyzed the volatility transmission in the futures and spot markets on Multi Commodities Exchange (MCX) India. The sectors studied are agriculture, energy, and metals. The study results indicate the volatility transmission between India's futures and spot markets for metals and energy commodities.

The result of (Wulandari et al., 2019) demonstrates that the futures market's volatility influences the spot market's volatility, affirming the superiority of the futures market beyond the spot market. Additionally, this approves how decisive the futures price data is to the spot market, mainly for producers in general and exclusively for farmers. The admissible shareholders and market contributors might have equal access to the source of information in prices of spot and futures market. The entire coffee supply chain associations, particularly farmers, should be provided with price information. Moreover, the farmers will have a selling price preference which provides them some advantages, having a definitive position on bargaining with collector traders. Thus, they can trade their commodity to the closest spot market, mainly while the futures price plays a price discovery role of the spot prices. As a result, this will benefit farmers in enhancing the profit by appointing which market they prefer to auction.

Volatility transmission indicates a risk transmission mechanism between markets. Some previous researchers have researched the transmission of futures market volatility to the spot market for agricultural commodities. (Malhotra & Sharma, 2016) conducted research about the volatility relationship of five vegetable oils on the spot and futures markets. The study results affirm that information on the futures market plays more substantial domination on the spot market. Additionally, the research outcomes are also supported by the findings of research conducted by (Srinivasan, 2015). The study results imply that futures market volatility is conveyed to the spot market. Thus, traders in the futures market must be alert, observing the

volatility in the futures market. Research conducted by (Kasman & Kasman, 2008) stated that the volatility of the Istanbul futures market is transmitted to the spot market. The positive effect obtained by the existence of the futures market is the decline in volatility occurring in the spot market.

Futures market developed in the early eighteenth century in Chicago, the United States of America. This happened since Chicago was located in the center of agriculture and animal husbandry in western America. Issues caused the early emergence of the futures market during the harvest period where agricultural commodity yields were abundant or during a famine period causing a reduction in the supply of agricultural commodities. Consequently, high price fluctuations were formed in the market. Moreover, this is the basis for the formation of the futures market. In 1848, the first futures exchange, called the Chicago Board of Trade, was formed. The trading activity was still a forward contract for corn on March 13, 1851, since the standardization of forwarding contracts began in 1865. Meanwhile, (ICDX-Group, 2021). By making transactions through contracts, the farmers will agree with the buyer of the corn commodity at the agreed price and time. The agreed time generates a futures contract, which is a hedging tool. The contract will benefit both the seller and the buyer because they conduct transactions on future harvests. Nevertheless, the price has been agreed upon through a signed contract. (Putri, 2020).

Initially, the purpose of the futures market was to protect the price of agricultural products. This price protection can be declared as a contract, where an agreement is made on the current price, and sending and transferring of funds is carried out at a future date to reduce the opportunity of price changes that can be detrimental. Accordingly, this agreement becomes a futures contract.

The role of the futures market is as a hedging instrument for CPO commodity market participants. *Hedging* is a hedge carried out to diminish the risk in futures trading. Hedging works by minimizing exposure by taking over or transferring it to a party who can administer it. Hedging on futures contracts allows sellers, investors, and speculators to minimize the risk in sales due to price fluctuations. This mechanism, of course, allows producers to sell commodities that will only be harvested in the following few months but at a predetermined price. This guarantee benefits producers since they are not disturbed by the price variation. Other parties, such as raw material processing companies, may also benefit from the certainty of goods at stable prices.

Additionally, the futures market can also be used to establish transparent and fair prices of commodities (Pokrivcak & Rajcaniova, 2014). Therefore, futures trading is an alternative to price formation. Regarding CPO commodities, (Zavadska et al., 2018) stated that the CPO futures market played a role in forming CPO prices in the Indonesian CPO spot market. As the markets collaborate, the price discovery and spillover effects are significant gauges in futures markets. Moreover, the prices movement is revealed in the spot market. Obtaining valuable sources about futures prices can assist producers and consumers in price formulation strategy and investment approaches (Dahl, 2019). Thus, lawmakers and legislators should assert the competence of futures markets and develop market assistance by enforcing appropriate trading

designs to facilitate farmers and traders to exploit and derive the benefit of sufficient information (Sinha & Mathur, 2016).

Moreover, producers with adequate liquidity may contemplate the futures market as a hedging instrument, analyzing the futures market's function. It is fundamental for the legislator to determine if futures markets or stock markets control the price-setting mechanism. Based on research conducted by (Arnade & Hoffman, 2015), agrarian policy-making authorities generally concentrate on cash markets, while several financial experts contend that futures markets become convertible can assimilate advanced input rapidly. Hence, this condition may have also played a part in price discovery than cash markets, indicating that producers and policymakers should be more alert to futures markets as they analyze and estimate monetary outcomes in agribusiness. Furthermore, this research supplies factual admission to traders, hedgers, and regulators that the futures market holds control over the spot market may be collided by deliberation that will disarrange the cash market. (Wulandari et al., 2019)

The advancement of sophisticated technology and pace of development in obtaining information has driven the market participants to implement online transactions on the futures market, especially for CPO commodities. Moreover, the transaction has turned more accessible and affordable. This condition allows market participants to adjust the information on price fluctuations in each CPO market. Eventually, the transmission of price volatility between the CPO markets and the futures markets in Indonesia and the international market has become more accelerated in affecting the price volatility in the Indonesian spot market. In addition, the increasing flow of globalization causes a rise in risk through shocks in specific markets (Kim & Lim, 2019).

Volatility in the futures market will influence volatility in the spot market, confirming the futures market dominance beyond the spot market. This affirms the significance of futures price information to the spot market, notably for producers or farmers. The market players and other shareholders obtain equal access to the price disclosure, spot, and futures. Additionally, the coffee supply chain alliances, especially farmers, should be equipped with reliable price sources. Farmers will have a selling privilege of not directly selling their commodities to collector traders. Having said that, they can sell their commodities to the most accessible spot market, mainly as the futures price plays the price discovery function of the spot prices. Consequently, farmers will gain some interest in gaining their income by appointing the market they prefer to trade. Furthermore, producers with sufficient cash resources may examine the futures market as a hedging instrument, contemplating the role of the futures market.

Policymakers require to recognize if futures or cash markets lead the price framework. Agricultural policymakers often focus on cash markets, whereas many economists argue that futures markets are more liquid, absorb new information more immediately, and thus contribute more to price discovery than cash markets. This is provided as an indication that producers and policymakers should be more attentive to futures markets when evaluating and forecasting economic outcomes in agriculture. In addition, this research provides empirical evidence to regulators, hedgers, and traders that the futures market's dominance over the spot market may

be impacted by speculation that it might disarrange the cash market.

5. Conclusion

Price volatility in the futures market, consisting of the Jakarta futures market, the Malaysian futures market, and the Rotterdam forward market, affects price volatility in the Medan spot market. Consequently, the local futures market and international futures market affect price fluctuations and the arrangement of CPO prices in the Indonesian spot market. Therefore, CPO commodity market players are required to be alert to any information occurring in the futures market to determine investment strategies.

References

- Ameur, H. Ben, Ftiti, Z., & Louhichi, W. (2021). Revisiting the relationship between spot and futures markets: evidence from commodity markets and NARDL framework. *Annals of Operations Research*, 0123456789, 1–11. <https://doi.org/10.1007/s10479-021-04172-3>
- Arnade, C., & Hoffman, L. (2015). the Impact of Price Variability on Cash/Futures Market Relationships: Implications for Market Efficiency and Price Discovery. *Journal of Agricultural and Applied Economics*, 47(4), 539–559. <https://doi.org/10.1017/aae.2015.24>
- Bohl, M. T., Siklos, P. L., Stefan, M., & Wellenreuther, C. (2020). Price discovery in agricultural commodity markets: Do speculators contribute? *Journal of Commodity Markets*, 18(May), 100092. <https://doi.org/10.1016/j.jcomm.2019.05.001>
- BPS. (2020). Indonesian Oil Palm Statistics 2019. In *Pusat data dan sistem informasi pertanian*.
- Dahl, R. E. (2019). Dynamics of volatility spillover in commodity markets : Linking crude oil to agriculture. *Journal of Commodity Markets*, 20(C), 1–25. <https://doi.org/10.1016/j.jcomm.2019.100111>
- Das, S., & Nason, G. P. (2016). Measuring the degree of non-stationarity of a time series. *Stat Journal for the Rapid Dissemination of Statistics Research*, 5(1), 295–305. <https://doi.org/10.1002/sta4.125>
- Engle, R., & Bollerslev, T. (1986). Modelling the persistence of conditional variances. *Econometric Review*, 5(1), 1–50.
- Gandhy, A., Harianto, H., Nurmalina, R., & Suharno, S. (2022). The Efficiency of The Spot Market And Crude Palm Oil (CPO) Commodity Futures Market Before and During The Covid-19 Pandemic in Indonesia. *Jurnal Manajemen Dan Agribisnis*, 19(1), 139–151. <https://doi.org/10.17358/jma.19.1.139>
- ICDX-Group. (2021). *Apa itu Bursa Berjangka? ICDX*. Icdx.Co.Id.
- Kasman, A., & Kasman, S. (2008). The impact of futures trading on volatility of the underlying asset in the Turkish stock market. *Physica A: Statistical Mechanics and Its Applications*, 38(12), 2837–2845.

- Kim, K., & Lim, S. (2019). Price discovery and volatility spillover in spot and futures markets: evidences from steel-related commodities in China. *Applied Economics Letters*, 26(5), 351–357. <https://doi.org/10.1080/13504851.2018.1478385>
- Kumar Mahalik, M., Acharya, D., & Suresh Babu, M. (2014). Price discovery and volatility spillovers in futures and spot commodity markets : Some Indian evidence. *Journal of Advances in Management Research*, 11(2), 211–226. <https://doi.org/10.1108/JAMR-09-2012-0039>
- Lestano, & Sucito, J. (2010). Spillover volatilitas pasar saham Indonesia dan singapura periode 2001-2005. *Jurnal Akuntansi Dan Keuangan*, 12(1), 17–25.
- Mahalik, K., Acharya, D., & Babu, S. (2009). Price discovery and volatility spillover in futures and spot commodity markets: Some empirical evidences from India. *Fourth International Conference on Public Policy and Management, Indian Institute of Management, Bangalore*, 49–62.
- Malhotra, M., & Sharma, D. (2016). Oil and Oilseeds Spot and Futures Market in India. *VIKALPA The Journal for Decision Makers*, 41(2), 132–148.
- Mallikarjunappa, T., & Afsal, E. M. (2010). Price discovery process and volatility spillover in spot and futures markets: Evidences of individual stocks. *Vikalpa Journal*, 35(2), 49–62. <https://doi.org/10.1177/0256090920100205>
- Manogna, R. L., & Mishra, A. K. (2019). Price discovery and volatility spillover : an empirical evidence from spot and futures agricultural commodity markets in India. *Journal of Agribusiness in Developing and Emerging Economie*, 1–27. <https://doi.org/10.1108/JADEE-10-2019-0175>
- Pokrivcak, J., & Rajcaniova, M. (2014). Price transmission along the food supply chain in Slovakia. *Post-Communist Economies*, 26(4), 555–568. <https://doi.org/10.1080/14631377.2014.937111>
- Pradhan, R. P., Hall, J. H., & du Toit, E. (2021). The lead–lag relationship between spot and futures prices: Empirical evidence from the Indian commodity market. *Resources Policy*, 70, 1–9. <https://doi.org/10.1016/j.resourpol.2020.101934>
- Putri, S. (2020). *Mengenal Apa itu Bursa Berjangka dan Sejarahnya*. Ajaib.Co.Id.
- Rastogi, S., & Agarwal, A. (2020). Volatility Spillover Effects in Spot , Futures and Option Markets. *Test Engineering*, 83(May-June 2020), 10114–10127.
- Sinha, P., & Mathur, K. (2016). *Impact of Global Financial Crisis and Implied Volatility in the Equity Market on Gold Futures Traded on Multi Commodity Exchange, India*. 72966.
- Srinivasan, S. (2015). Stock Market Volatility – Conceptual Perspective through Literature Survey. *Mediterranean Journal of Social Sciences*, 7(1), 208–212.
- Sy, M., Li, L., & Nguyen, L. T. P. (2015). Volatility Spillover from Soybean Oil Futures to Crude Palm Oil Spot & Futures: An Empirical Evidence. *Proceedings of the 5th Conference on*

Derivative Markets 2015, 1–25.

Tadesse, G., Algieri, B., Kalkuhl, M., & von Braun, J. (2014). Drivers and triggers of international food price spikes and volatility. *Food Policy*, 47, 117–128. <https://doi.org/10.1016/j.foodpol.2013.08.014>

Wulandari, A., Harianto, Arifin, B., & Suwarsinah, H. (2019). The Impact of Futures Price Volatility to Spot Market : Case of Coffee in Indonesia. *Jurnal Organisasi Dan Manajemen*, 15(1), 1–15. <https://doi.org/10.33830/jom.v15i1.5.2019>

Zavadska, M., Morales, L., & Coughlan, C. (2018). The Lead–Lag Relationship between Oil Futures and Spot Prices—A Literature Review. *Internatinal Journal Of Financial Studies*, 6, 1–22.

Zhang, Q., & Jaffry, S. (2015). High frequency volatility spillover effect based on the Shanghai-Hong Kong Stock Connect Program. *Investment Management and Financial Innovations*, 12(2), 8–15.

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