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The Impact of Futures Price Volatility to Spot Market: Case of Coffee in Indonesia

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Abstract
Indonesia is the world 4th largest coffee producer after Brazil, Vietnam and Colombia with export potential and higher national consumption concluded in 2017 while the coffee production was relatively stagnant. This was led the producer to not only the production risk but also the price risk which then emphasize the importance of futures markets existence as price risk management. This study is performed to examine the impact of futures price volatility to spot market using ARCH-GARCH toward primary data of coffee futures and spot prices of 1172 trading days starting from January 2014 to June 2018. The ARCH-GARCH analysis result indicates that futures price volatility and monetary variables are impacting the volatility of spot price. Arabica spot price volatility is impacted by volatility of Arabica futures price, inflation and exchange rate while Robusta spot price is impacted by Robusta futures price volatility and exchange rate. This is confirming that futures market plays dominant role in spot price discovery. Local futures and spot prices are also found to be significantly influenced by volatility of offshore futures prices which indicates that emerging country futures market is actually influenced by offshore futures market which the price itself used as price reference.

Introduction

Indonesia is an agricultural country with agricultural activity which reached 7.6 million hectare of land used for commodity crop in 2016. Coffee crops itself reach 1.2 million hectares across 34 provinces in Indonesia and supports domestic consumption and export to various countries. Main coffee producers are located in Aceh, North and South Sumatera, Bengkulu, Lampung and East Java which dominates 70 percent Indonesia coffee production. Indonesia export volume was relatively fluctuated within the last 10 years (2007-2017). Coffee export volume reached 321.400 ton in 2007 and increased to 346.400 metric ton in 2011. It was even reached 534.000 ton in 2013, however it's then declined in 2017 to 467.800 ton in 2017 (DIRJENBUN, 2017) with coefficient of variance of 14,5 percent. Most of them were exported to United States, United Kingdom, Germany and Italy. Domestic consumption has shown increasing trend and showed 5.8 percent increasing number from 259.900 metric ton in 2015 to 276.000 metric ton back in 2017 (ICO, 2017). Indonesia coffee production (recorded in 2017)

was the 4th largest in the world after Brazil, Vietnam and Columbia. The coffee production was relatively stagnant with the decreasing trend from 639.400 metric ton in 2015 to 637.500 ton in 2017. Indonesia produce higher number of Robusta compare to Arabica with the composition of approximately 80 percent of Arabica coffee against total domestic coffee production. Coffee contributes not only export revenue but also labor opportunity which reach 1.795 million smallholders farmer in 2016 although decrease in 2017 to 1.792 million householders (DIRJENBUN, 2017) who were mostly smallholder farm and become the only one source of income for the farmer.

Price risk is effected not only by supply and demand but also affected by market mechanism in each level from the coffee farmer up to the coffee processor who demand large coffee supply. One of the price risk indicator may be seen through coffee price volatility and price level between the market along the supply chain. Putri et al. (2013) mentioned that farmer is a price taker which reflected on the unintegrated coffee market between farmer level both long and short term also coffee market in collector, cooperation and exporter level. Coffee price has certain spike behavior as shown in Figure 1 and 2. Both spot price volatility of coffee is plotted in standard deviation using 15 days of moving average numbers. Volatility of Robusta coffee was high by the end of 2014 until mid-2015 due to the impact of the decreasing of world coffee prices. It was impacted by natural factor (hard rainy season) in main coffee producer countries (Brazil, Vietnam and Indonesia). Indonesia spot prices is still found using offshore market prices as reference in price determination and therefore when the LIFFE (London International Financial Futures and Options Exchange) market price impacted by the aforementioned conditions, Robusta Lampung spot price as local reference was also impacted. Considering the seasonality which impacted by the weather, Indonesia was also experiencing decreasing number of Lampung Robusta export by 30 percent in 2015 while the demands captured with higher trend. This is also applied for Arabica coffee which using ICE Futures Coffee New York as reference.

Price volatility plays important role in boosting future supply and allocating existing supply, volatility in prices may generating uncertainty about future price levels, investment and production decision for commodity producers (Dwyer et al. 2011). Volatility has become an issue and widely discussed among researcher and become regulatory concern as the price may become disincentive factor toward agricultural productivity (Kargbo, 2005). How farmers manage this risk is dictated by the institutional mechanisms in place and the state of the markets in an economy. While in the developed world, market-based price risk management instruments like commodity futures, options and swaps have existed for a long time, developing economies are only recently exploring the usage of these instruments (UNCTAD, 2009).

As shown in Figure 1 and 2, coffee prices have certain spike behavior. Both spot price volatility of coffee are plotted in standard deviation using 15 days of moving average numbers. Volatility of Robusta coffee was high by the end of 2014 until mid 2015 due to the impact of the decreasing of world coffee prices. It was impacted by natural factor (hard rainy season) in main coffee producer countries (Brazil, Vietnam and Indonesia). The exchange rate of US Dollar found appreciated against local currencies and hence the producers decided to sell the coffee stock. Uganda as the main producer for Robusta coffee was also reportedly experiencing declining production 2,43 percent year-on-year and total export was also declining by 25,2 percent year on year. Indonesia spot prices is still found include the offshore market prices as reference in price determination and therefore when the LIFFE market price impacted by the aforementioned conditions, Robusta Lampung spot price as local reference was also impacted. Considering the seasonality which impacted by the weather, Indonesia was also experiencing decreasing number of Lampung Robusta export by 30 percent in 2015 while the demands captured with higher trend.

Natural factor seems not the only factor contribute to the coffee price volatility but also the market behavior. In this stage, speculators may possibly have earned huge profits by

manipulating spot prices, building positions in futures and hoarding physical market stocks in collusion with spot market traders (Sharma, D.K and Malhotra, 2015). Futures market may provide selling option to the coffee producers should they are aware of the benefit and risk, have the access to the liquidity and technology which provide ability for the coffee producer to access information in both markets. Futures market in Indonesia was introduced in 1997 after the issuance of Law No. 32 year 1997 and coffee futures was started to be actively traded in 2013 and require extra hard work to create the efficient futures market in this such premature conditions. Since the first trading, coffee futures contract has grown significantly by each 0,71 percent for ACF and 13,73 percent for RCF in 2017 from 19.93 percent for ACF and 25,12 percent for RCF in 2016 compared to previous year. Commodity futures trading growth in overall is associated with external and internal factors. The external factor is the increasing trend of commodity futures which encourage market participant's interest to commodity futures and the internal factor is the economic growth, political stability condition and market positive response to government regulation on tax amnesty (Bappebti, 2017). This study is important to examine the information flow of futures and spot market and their role in price discovery and hedging instrument to coffee producers.

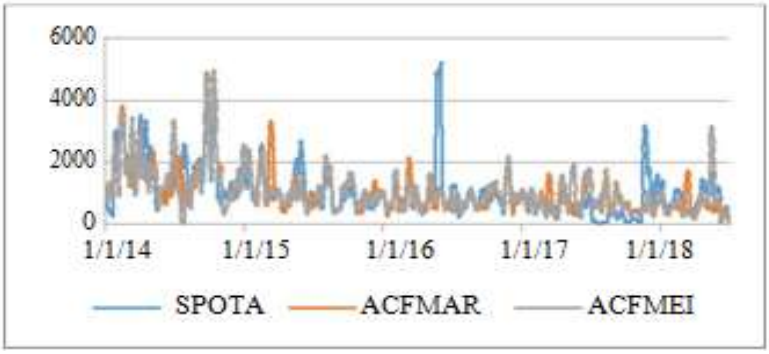

Figure 1. Arabica coffee price volatility

Futures market has been established to provide price stability, reduce poverty and ensure growth to the economy. Futures is also providing the investors an opportunity to hedge the risk of their positions in cash market. Hedging is the procedure of offsetting price risk in any cash market position by taking equal and opposite position in futures market. Traders use to buy or sell futures contract against the corresponding sale or buy of equivalent commodity to hedge the potential future price risk. On the other hand, futures market offers a wide range of contracts for a commodity. As a result, there is always flexibility of pricing for the traders. Thus, two major economic functions of a commodity futures market are price risk management and price discovery (Bose, 2007).

Small scale coffee producers in Indonesia with low level of liquidity and limited access to financing stimulates farmers to choose the selling option which sells directly to collector trader rather than in spot markets, perform commodity storage and hedging in futures market. Coffee producers may have the cash faster without considering whether the price can cover their production cost. They may obtain the cash by selling to collector trader and use for their daily live expenses also for continuing their production or harvesting process. Farmer will accept whatever price offered by the collector trader as they are unable to access price information due to their technical limitation. Should farmer may access the price information, they may use coffee spot price as their reference prior selling their stock. Arabica coffee use Medan spot price and Robusta use Lampung spot price as reference. The regulator assigns several contributors prior the spot price is published on the next day. Under well-developed futures market the information flows from futures to spot market and coffee producer may take the benefit and

contribute selling decision to provide optimum income to the coffee producers in line with "Efficient Markets Hypothesis" [EMH].

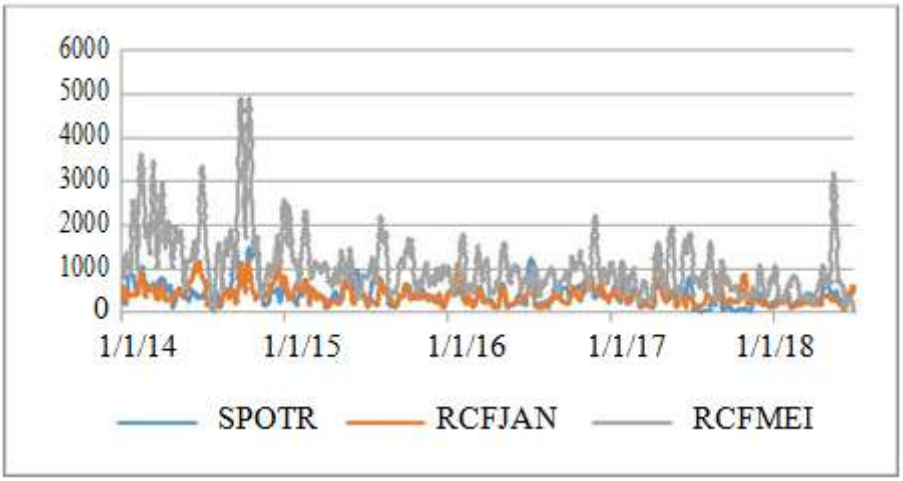

Figure 2. Robusta coffee prices volatility

Fama (1970) define EMH as markets in which asset prices always fully and instantaneously reflect all available information. The EMH describes an efficient market as one which consistently incorporates all information in determining prices. The three well-known assumptions of the EMH are: (1) that there are no transaction costs; (2) information is costlessly available to all market participants; and (3) the implications of current information for both the current price and distributions of future prices are accepted by all market participants. In efficient market, prices will become unpredictable and no arbitrage opportunity. Efficient market is the confidential zone for the market participants without seeking for additional information related to the respective market and hence the information have to be properly analyzed prior transact in the market. In efficient market, commodity price will follow systematic pattern which may become basis to gain profit. In general, EMH is formulated as follows:

$$E_t\left(S_{t+n} - F_{t,t+n} \mid j_1\right) = 0 \quad (1)$$

whereas $S_{(t+n)}$ is the estimated spot price in time t+n, $F_{(t,t+n)}$ is futures price quotation in time t for delivery in time t+n, φt is information in time t. Equation (1) enforced $F_{(t,t+n\ )}$ have to predict $S_{(t+n)}$ perfectly unless there is a random error. In other word, futures price $F_{(t,t+n)}$ is unbiased predictor to spot price $S_{(t+n)}$ with available information in time t when the futures price is available/quoted. Systematic bias or strong pattern in predicting error represent a profit possibility through error pattern for price prediction. Initially, the empirical investigation of market efficiency is as follows:

$$S_t = \alpha + \beta F_{t-1,t} + \varepsilon_t \quad (2)$$

whereas St is spot price in time t, F(t-1) is futures price in time t-1, εt is white noise error term, α =0 and β=1 is constant parameter which then cause market will be deemed as efficient if the following:

$$E_t\left(S_{t+1} - F_t\right) = 0 \quad (3)$$

Under the above condition, futures price in time t from the futures which mature in t+1 will equal to spot price in time t+1, which then mentioned as unbiasedness hypothesis or futures price is the unbiased predictor of spot price in time t+1. Refer to the previous findings, the imperfect market and the failure of market participants in receiving expensive information and symmetrical causing the rejection of EMH with B≠1. The ability of the market participants analyzing the

available information may cause bias in commodity price in which the processing ability from the small amount of participants are higher than the participants and therefore Et $(S_{(t+1)}-F_t) \neq 0$. This might be causing risk premium. This research is performed to confirm whether as per EMH, futures market plays dominant role over spot market which then confirm that volatility in futures market impacting volatility in spot market and hence price discovery in futures market.

Literature review

Many research have been performed to examine the impact of price volatility in commodity market. Sharma (2010) research result indicates that volatility in spot market is higher prior the introduction of futures market. After futures market has been introduced, high price volatility was still found prior and during the harvesting period.

Research performed by (Sharma, D.K and Malhotra, 2015) also indicates that guar seed spot market in India is impacted by volatility in trader and hedger that over speculation and manipulation in futures market will disturb physical market which then claim that futures market is unable to be used as price discovery and risk mitigation. In Indonesia, a few researcher are discussing efficiency in futures market Ajao (2012) mentioned if markets were efficient, futures prices would be unbiased predictors of future spot prices and a simple prediction model would suffice, but should the markets are not efficient such predictions cannot be accurately made. The relationship between the two markets and flow information are very critical to be examined whether such condition whereas the information flowing from futures to spot market is reflected considering the very premature market condition. Futures prices give necessary indications to producers and consumers about the likely future ready price and demand and supply conditions of the commodity traded. The cash market or ready delivery market on the other hand is a time-tested market system which is used in all forms of business to transfer title of goods. Futures and cash prices present an interesting case for application of causality-type relationships (Peck, 1985 in Jackline, S., and Deo, 2011). Several similar researches have been performed previously such as (Sharma, D.K and Malhotra, 2015) which examining the causality relationship in guar seed in India, (Sharma, 2016) which examining the dynamic relationship between spot price volatility and futures trading activity in India, (Gupta and Varma, 2015) which investigating the relationship between the futures trading activity and the spot price volatility and (Radha and Balakrishnan, 2017) have studied similar to understand the relationship between spot and futures price. This research is important to be conducted to fill the gap in investigating the relationship between futures and spot market in Indonesia. Few studies on futures market. This research provides empirical evidences to regulator commodity futures have been performed in Indonesia such as (Pertiwi, 2016) and (Dewi and Siregra, 2011) that tested the coffee market efficiency and Olein in Jakarta Futures Exchange. Maulida et al. (2018) also investigated the efficient market for cocoa commodity. Wibowo (2017) serve empirical evidence that Jakarta Futures Exchange provides fairly good opportunities to take hedge positions in futures contracts which can reduce the volatility of portfolio returns up to 70% of naked position in the spot market. Overall are discussing futures market relationship with spot market. More study is required to enrich research in futures market. This study is to investigate the impact of volatility of coffee futures prices to spot price volatility by examining the optimum model between Arabica and Robusta spot price, futures price both local and offshore and also the macroeconomic variables to confirm whether the futures price volatility influence the spot price volatility or the vice versa together with other macroeconomic variables.

Methods

Data series of futures and spot prices are used in this study to identify price volatility and relationship between the two markets. Data consist of 1172 trading days starting from January

2014 to June 2018. Futures prices refer to the coffee contract prices traded in Jakarta Futures Exchange (JFX) covers all month of contracts (delivery). Spot prices refers to certain spot market in Indonesia and include the offshore futures market price as reference for price determination with the same period. The offshore futures market used in this study are published in regulator's website.

Table 1. Definition of Variables

Variables	Description
Arabica spot price (SPOTA)	Applicable price from Medan spot market. Local spot price determines from certain formula and use off shore futures price as reference.
Robusta spot price (SPOTR)	Applicable price from Lampung spot market with equal condition with Arabica spot price.
Arabica futures price	Settlement price of Arabica futures contract price (ACF) with several delivery date of March, May, July, September and December
Robusta futures price	Settlement price of Robusta futures contract price (RCF) with several delivery date of January, March, May, July September and November
ACF	Arabica Commodity Futures
RCF	Robusta Commodity Futures
Inflation (INF)	Consumer price index on month basis calculation.
Interest rate (INT)	Interest rate reference issued by Bank Indonesia
Exchange rate (FX)	Exchange rate of Indonesian Rupiah to US Dollar
Arabica futures price first delivery (FUTAD1)	Futures prices of Arabica coffee refer to ICE New York with delivery of March
Arabica futures price second delivery (FUTAD2)	Futures prices of Arabica coffee refer to ICE Futures New York with several delivery other than March (September and December)
Robusta futures price first delivery (FUTRD1)	Futures price of Robusta coffee refer to London Robusta Coffee Futures (LIFFE-London International Financial Futures and Options Exchange) with delivery of January
Robusta futures price first delivery (FUTRD2)	Futures price of Robusta coffee refer to London Robusta Coffee Futures (LIFFE) with delivery other than January (September and November)

Unit root test for stationarity test

Futures price, spot prices of coffee Arabica and Robusta and also the monetary variables are first examined for stationary with Augmented Dickey Fuller (ADF) unit root test (Dickey and Fuller 1979). Should the data series of prices be not stationary, then first difference shall be taken which eliminates unit root problem and the analysis is done on the differenced series. ADF unit root is tested using the following:

$$\Delta X_t = b_0 + b_1 X_{t-1} + \sum_{t-1}^{T} b_i \Delta X_{t-1} + \varepsilon_t \quad (1)$$

Xt is the first order or difference of the variable, $\Delta X_t = X_t - X_{(t-1)}$ is spot price and futures price variable, T is deviation white noise, b_0 and bi is the estimated coefficient and εt is white noise. Hypothesis of the stationary test is null hypothesis of non-stationary and alternative hypothesis is no unit root or stationary. We will reject null hypotheses should the p-value is less than 5 percent that is, series is non-stationary or series has unit root. So we will accept the alternative hypotheses, that is, series is stationary and there is no unit root.

ARCH effect in the data is rejected at 5 percent level of significance, indicating presence of ARCH effect. This proves the presence of time-varying volatility or volatility clustering in the spot and futures markets of coffee commodities which become one of the requirement to

continue with GARCH (1,1) analysis. Should the clustering volatility have been confirmed then analysis using GARCH (1,1) used to determine variables influence volatility of spot and futures prices of Arabica and Robusta. GARCH (1,1) refers to 1 ARCH term and 1 GARCH term with the following equation through mean and variance equations. Mean equation (1.1):

$$P_{(j)t} = \alpha_0 + \sum_{i=1}^{n} \alpha_i P_{(j)(t-i)} + \sum_{i=1}^{n} \beta_i F_{(j)(t-i)} + \gamma_1 FUTD1_{(j)t} + \gamma_2 FUTD2_{(j)t} + \varphi_1 INF_t + \varphi_2 INT_t + \varphi_3 FX_t + e_{1t} \quad (1)$$

$P_{(j)t}$ represent coffee spot price type j in time t, $F_{(j)t}$ represent coffee futures price type of j in certain time t and j represent type of coffee i.e. Arabica, Robusta. FUTD1 is offshore futures price first delivery in time t and FUTD2 is offshore futures price second delivery in time t, INF is the inflation changes in time t; INT represent the changes of applicable in interest rate in time t and FX represent changes in exchange rate in time t. Variance equation (1.2):

$$h_t = \gamma_0 + \gamma_1 \varepsilon^2_{t-1} + \gamma_2 \varepsilon^2_{t-2} + ... + \gamma_k \varepsilon^2_{t-m} + \theta_1 h_{t-1} + ... + \theta_m h_{t-m} + \alpha_i P_{(j)(t-i)} + \sum_{t-1}^{n} \beta_i F_{(j)(t-i)} + \delta_1 FUTD1_{(j)t} + \delta_2 FUTD2_{(j)t} + \varphi_1 INF_t + \varphi_2 INT_t + \varphi_3 FX_t + + e_{4t} \quad (2)$$

h_t represent variance of coffee prices, γ_0 is constant, $P_{(j)t}$ represent spot price type j in time t, $F_{(j)t}$ represent coffee futures price type of j in certain time t and j represent type of coffee i.e. Arabica, Robusta. $P_{(j)(t-1)}$ represent changes in coffee spot price in time t; $F_{(j)(t-i)}$ is the changes in coffee futures price, e^2_{t-1} represent the ARCH term/volatility in period t-1, e^2_{t-m} is ARCH term/volatility in period t-k, $\gamma_0 \ldots \gamma_k$ coefficient in order 1 to m which estimated; … is GARCH term (variance of coffee price volatility) in period 1to m; represent GARCH coefficient; FUTD1 is offshore futures price first delivery in time t and FUTD2 is offshore futures price second delivery in time t, INF is the inflation changes in time t; INT represent the changes of applicable in interest rate in time t and FX represent changes in exchange rate in time t. e is residual.

Further analysis is required to examine whether the exogenous factor i.e. offshore futures market impacting the volatility of local futures market. The optimum model then will be checked against 5 percent significant value ($p < 0,05$).

Mean equation (1.1):

$$F_{(j)t} = \alpha_0 + \sum_{i=1}^{n} \alpha_i P_{(j)(t-i)} + \sum_{i=1}^{n} \beta_i F_{(j)(t-i)} + \gamma_1 FUTD1_{(j)t} + \gamma_2 FUTD2_{(j)t} + \varphi_1 FUTD1 + \varphi_2 FUTD2 + \varphi_3 INF_t + \varphi_4 INT_t + \varphi_5 FX_t + + e_{3t} \quad (3)$$

Variance equation (1.2):

$$h_t = \gamma_0 + \gamma_1 \varepsilon^2_{t-1} + \gamma_2 \varepsilon^2_{t-2} + ... + \gamma_k \varepsilon^2_{t-m} + \theta_1 h_{t-1} + ... + \theta_m h_{t-m} + \alpha_i P_{(j)(t-i)} + \sum_{t-1}^{n} \beta_i F_{(j)(t-i)} + \delta_1 FUTD1_{(j)t} + \delta_2 FUTD2_{(j)t} + \varphi_1 INF_t + \varphi_2 INT_t + \varphi_3 FX_t + + e_{4t} \quad (4)$$

The same information explains the aforementioned equation. Null hypothesis is the model has ARCH effect and no clustering activity while the alternative hypothesis is no ARCH effect and the model has clustering volatility which then confirm the GARCH may be performed to examine whether the variables responsible for coffee spot or futures price movement.

Furthermore, the ARCH and GARCH term have to be significant in level 5% to confirm that the independent variables responsible for the coffee spot and futures price movement.

Results and discussions

Coffee Price Information

Arabica coffee price volatility within 2014-2018 reflected by the coefficient of variation (CV) of 10.9 percent with the prices ranging between IDR54,312 (the lowest) and IDR 69,170 (the highest) per kg. Arabica coffee price highest fluctuation within the last 4 years occurred in 2014 with coefficient of variation of 13,3 percent and still reflected with high coefficient of variation of 11,4 percent in 2015. This was impacted by global factor i.e. harvesting failure in Brazil in 2014 which impacting the low volume of coffee stock in the market and many sellers tried to fulfill market expectation by selling the coffee stock and expect that coffee supply will be sufficient in the next harvesting period. The impact was still occurred until 2015 (Bappebti, 2015).

Arabica coffee price discovered to be more fluctuated compare to Robusta. This is due to the production composition whereas the Arabica coffee has smaller volume of production compare to Robusta and market expectation toward Arabica coffee is lower than Robusta which causing demand to Robusta is higher after market loss Arabica coffee stock considering the substitution effect of the two coffees (Nicholson and Snyder, 2008). The coefficient of variation of Robusta coffee spot price between 2014 to 2018 lied in 7,8 percent while Arabica 10,9 percent in the same period. The same factor found impacting this price movement. As the biggest producing country in the world, Brazil contribute significant impact to the world coffee price movement. Brazil was experiencing harvesting failure due to high rain intensity which then causing failure in flowering process and declining the coffee production in 2014 and the impact was continued until 2015.

Table 2. Statistic Descriptive ef Arabica Spot Prices[a]

Year	Min	Max	Mean	SD[C]	CV
2014	46 989	69 170	46 989	5 901	0,133[b]
2015	53 998	59 741	53 998	5 858	0,114
2016	54 659	63 117	54 659	5 834	0,111
2017	56 585	60 360	56 585	5 814	0,106
2018	57 703	54 116	57 703	5 796	0,103
2014 s.d 2018	54 312	69 170	54 312	5 776	0,109

[a]in IDR/kg; bhighest price fluctuation; [c]in IDR/kg

Table 3. Statistic Descriptive of Robusta Spot Prices[a]

Year	Min	Max	Mean	SD[c]	CV
2014	17 033	26 940	20 085	1 744	0,087
2015	17 198	22 778	18 914	1 742	0,092[b]
2016	15 258	26 817	21 650	1 734	0,080
2017	22 087	27 465	25 056	1 731	0,069
2018	24 277	24 277	25 414	1 728	0,068
2014 s.d 2018	15 258	27 465	22 130	1 726	0,078

[a]in IDR/kg; [b]highest price fluctuation; [c]in IDR/kg

Futures contract price was also varying. As shown in Table 3 contract with delivery of September hold highest coefficient of variation (8,4 percent) followed by contract delivery of March (8,0 percent). As coffee is very dependence on season, September delivery reflects market demand by end of the harvesting season and September delivery shows the market expectation just prior the harvesting period started.

Table 4. Statistic Descriptive of Arabica Futures Contract (ACF)[d]

Delivery month[e]	Min	Max	Mean	SD[f]	CV
MAR	59 100	87 800	68 505	5 475	0,080
MEI	59 600	88 350	68 457	5 331	0,078
JUL	59 600	88 450	68 386	5 273	0,077
SEP	57 500	88 750	68 410	5 776	0,084
DEC	60 100	86 800	68 514	4 850	0,071

[d]2014-2018 in IDR/kg; [e] delivery month; [f]in IDR/kg

Price risk mitigation of spot market may be hedged through taking position in futures market. Various deliveries are set in futures market and provide ability for the market participants to choose which delivery best fit for them to hedge their position either sell or buy position for coffee producer or processor. Arabica coffee futures contract (ACF) has 5 deliveries while Robusta coffee futures contract has 6 deliveries which may align with the harvesting period or buying season on the coffee consumer/processor. Arabica futures contract prices lied between IDR57,500 in minimum and maximum of IDR88,700 while Robusta coffee futures price ranging between IDR18,020 in minimum and maximum of IDR 31,010 per kg. Highest coefficient of variation of RCF found in contract of September (5,4 percent) and November (5,4 percent) (nearly end of harvesting season and after harvesting period). While ACF contract coefficient of variation found highest in September (8,4 percent) nearly end of harvesting season and March (8.0) just before the harvesting season is started. Price movements are also affected by a number of extraordinary events such as foreign exchange price movements that are used as a reference and by extraordinary events in major coffee producing countries such as Brazil, Vietnam and Colombia, namely crop failure due to weather and also due to speculative transaction in offshore futures market (short covering) by market participants (Bappebti, 2014).

Robusta coffee futures contract prices lied between IDR18,020 in minimum and maximum of IDR 19,580 per kg. Highest coefficient of variation shown in contract delivery of September and November with CV of 5,4 percent. This is confirming that these contract demand information of coffee production by the end of harvesting period and also the afterward. After harvesting period, the futures price reached the highest level of IDR31,010 per kg compare to other delivery period.

Table 5. Statistic Descriptive of Robusta Futures Contract (RCF) [d]

Delivery month[e]	Min	Max	Mean	SD[f]	CV
JAN	18 610	31 010	24 808	1 203	0,048
MAR	18 020	30 810	24 787	1 179	0,048
MEI	18 550	30 730	24 748	1 199	0,048
JUL	18 970	30 870	24 914	1 234	0,050
SEP	19 310	30 590	24 875	1 345	0,054

[d]2014-2018 in IDR/kg; [e] delivery month; [f]in IDR/kg

Instability of commodity prices has brought the interest to futures market considering the function as the hedging instrument and tools to mitigate the risk vulnerability. Lence (2009) mentioned that risk vulnerability is the most important matter faced by the commodity producers in developing and developed countries. Furthermore, this new interest has expanded the utilization of futures market and food security option as it has been proposed as one of price volatility management in importing countries (Sarris et al. 2011 in Revoredo-Giha and Zuppiroli, 2013). Hence, futures price is worth consider as one of hedging instrument should the analysis confirms that futures price may actually influence the spot market or plays dominant role over the spot market.

Augmented Dickey Fuller (Unit Root Testing)

Prior performing further analysis, the stationary of the data is required to be checked. The stationary of spot prices, Arabica spot price (SPOTA) and Robusta spot price (SPOTR), also all futures prices of Arabica (ACF) all delivery dates (ACFMAR, ACFMEI, ACFJUL, ACFSEP, ACFDEC) and Robusta (RCFJAN, RCFMAR, RCFMEI, RCFJUL, RCFSEP, RCFNOV) including offshore futures prices (FUTAD1, FUTAD2, FUTRD1 and FUTRD2) have been checked by Augmented Dickey-Fuller (ADF) test. Stationary is required as regression using nonstationary series provides unreliable result. The first difference data (stationary data) then use for further analysis. The stationary test is also included all monetary variables which used in the analysis. The result of ADF test shows the non-stationary data in level and hence first difference data (all stationary) are used in this research as presented in Table 7 based on analysis result in Table 6.

Table 6. Statistical Report of Unit Root Test (in level)

	ACFMAR	ACFMEI	ACFJUL	ACFSEP	ACFDES	SPOTA	FUTAD1	FUTAD2	INF	INT
ADF Data	In level	In level	In level	In level	In level	In level	In level	In level	In level	In level
t-stat	-3.745	-3.702	-3.636	-3.747	-3.839	-5.886	-2.455	-2.196	-2.749	-0.402
p-values	0.0574	0.0041	0.0051	0.0035	0.0025	0.0000	0.1268	0.2076	0.0659	0.9098
Coefficient	-0.0087	-0.0157	-0.0155	-0.0164	-0.0175	-0.0369	-0.0075	-0.0058	-0.0083	-0.0002
Decision	Accept H_0	Accept H_0	Accept H_0	Reject H_0	Reject H_0	Reject H_0	Accept H_0	Accept H_0	Accept H_0	Accept H_0
	RCFJAN	RCFMAR	RCFMEI	RCFJUL	RCFSEP	RCFNOV	SPOTR	FUTRD1	FUTRD2	FX
ADF Data	In level	In level	In level	In level	In level	In level	In level	In level	In level	In level
t-stat	-2.970	-2.904	-3.245	-2.806	-2.823	-2.773	-2.637	-2.317	-2.093	-1.664
p-values	0.0378	0.0449	0.0175	0.0574	0.0550	0.0623	0.0856	0.1666	0.2472	0.4495
Coefficient	-0.0101	-0.0095	-0.0120	-0.0087	-0.0086	-0.0083	-0.0088	-0.0064	-0.0053	-0.00376
Decision	Accept H_0	Accept H_0	Reject H_0	Accept H_0	Accept H_0	Accept H_0	Accept H_0	Accept H_0	Accept H_0	Accept H_0

MacKinnon (1996) 5% critical value: -2.860; p-value is significant in 5% significant level

Table 7. Statistical Report of Unit Root (first difference)

	ACFMAR	ACFMEI	ACFJUL	ACFSEP	ACFDES	SPOTA	FUTAD1	FUTAD2	INF	INT
ADF Data	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff
t-stat	-41.500	-41.607	-42.606	-43.369	-43.202	-52.991	-43.871	-43.480	-42.760	-40.516
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coefficient	-1.0261	-1.0285	-1.0519	-1.0696	-1.0659	-1.2640	-1.0809	-1.0719	-1.0000	-1.0020
Decision	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0
	RCFJAN	RCFMAR	RCFMEI	RCFJUL	RCFSEP	RCFNOV	SPOTR	FUTRD1	FUTRD2	FX
ADF Data	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff	1st diff
t-stat	-45.139	-44.425	-46.415	-43.962	-43.922	-44.710	-51.420	-44.402	-43.088	-40.492
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coefficient	-1.1064	-1.0936	-1.1409	-1.0852	-1.0842	-1.1013	-1.2360	-1.0921	-1.0612	-1.0003
Decision	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0

MacKinnon (1996) critical value: -2.860; p-value is significant in level 5%

ARCH-GARCH Analysis

Further coffee price volatility is examined with GARCH (1,1) model with 1 ARCH term and 1 GARCH term with 2 important steps through mean equation estimation and variance equation. Mean equation model is used to examine whether there is clustering volatility and ARCH effect which the confirm that ARCH-GARCH analysis can be further proceed. Variance equation model will define the variables that have significant influence to the futures and spot prices. Unit root test shall be performed to check whether the data is stationary prior proceed with further analysis. Clustering volatility explained volatility pattern that high volatility will be followed by high volatility and low volatility will be followed by low volatility as well in certain period of time. This is estimated through ARCH analysis to confirm whether H0 in which there is no ARCH effect and no clustering volatility is rejected in 5 percent significant level ($p < 0,05$). ARCH and GARCH have to be significant to confirm that the variables are responsible for coffee spot and futures price movement using decision rule of p-value is significant in level 5 percent. ($p < 0,05$). The ARCH analysis result confirms that there is no ARCH effect and the equation has clustering volatility (null hypothesis is rejected in significant level of 5 percent) and hence continue with GARCH analysis. The presence of ARCH effect in the data series are revealed through the ARCH LM test and hence the application of GARCH models to model the volatility of futures and spot price are justified. The mean models shows the presence of ARCH which confirm on the result of the LM test of prob > chi2 in 0,000 or $p < 0,05$ and proceed with GARCH analysis.

GARCH (1,1) analysis as shown in Table 8 resulted variance equation which shows that volatility of Arabica spot price is affected significantly by the future price volatility and also monetary variable (inflation and exchange rate) confirming the composition of Indonesia coffee mostly sell as export commodity other than sell in local market. This phenomenon is also occurred the same for Robusta spot price that it is also influenced by volatility in futures price and also monetary variable i.e exchange rate. The analysis result also confirms the influenced of offshore price volatility to both Arabica and Robusta spot price which confirm the significant influence of offshore futures prices utilization as one of local spot price determination. Fortenbery and Zapata (2004) studied the similar and resulted that transaction in futures market increases the coffee price volatility and serves price discovery function. Further, the research confirms the role of speculative trading which causing the price volatility.

The analysis result is also confirming the influence of offshore futures market to local futures price which confirming the influence of mature futures market to local futures market which previously the ARCH analysis This result support previous research performed by (Kumar and Shollapur, 2015) that the presence of ARCH effect shows the variance of volatility from time to time of the selected commodities i.e. soybean oil, soybean and mustard seed. The analysis result also shows that volatility of Robusta spot prices is influenced by the volatility of Robusta futures price and also exchange rate. Offshore futures price is consistently impacting local spot price both offshore futures prices of first and second delivery. This result in line with research performed by (Giot, 2003) toward several agricultural commodity futures contract which shows that volatility in futures market affected spot market as the underlying of the futures market. GARCH p-value shows that previous trading days of futures prices both onshore and offshore define today's Arabica and Robusta spot prices volatility. This is confirming the use of offshore futures market as reference for local spot price determination. Fortenbery and Zapata (2004) examines the relationship between New York coffee futures and cash export prices in Guatemala and Honduras. Further, the study suggests that cash market price risk in exporting countries may actually increase as a result of futures trading activity in developed country futures exchanges. This study confirms similar whereas the changes in offshore futures market are found impacted significantly by both local spot and futures price volatility.

Significant influence of exchange rate toward spot price volatility confirming the Indonesia as the exporting country. The result in line with study performed by Chakrabarty and Das (2010) that the demand and supply of a commodity may depend on the amount of export of the commodity. A significant amount of export may cause a shortage of supply of the commodity in the market. This may affect the futures prices of a commodity. Again, the amount of export of a commodity may depend on the dollar exchange rate. The econometric analysis by Joshi and Little (1994) and Srinivasan and Wallack (2003), show that real exchange rate appreciation negatively affects India's aggregate merchandise exports.

Table 8. ARCH Estimation Result

Y	ARCH term e^2_{t-1}	GARCH term H_{t-1}	Futures Price		Spot price	Macroeconomic variables	R^2 (Adjusted R^2)
D(SPOTA)	0.0833 (0.019)*	0.7044 (0.000)*	D(ACFMEI) 0.0004 (0.000)* D(ACFDES) 0.0006 (0.000)* D(FUTAD1) 0.0507 (0.000)*	D(ACFSEP) 0.0003 (0.000)* D(FUTAD2) 0.1178 (0.000)*		D(INF) -146.0067 (0.000)* D(FX) -0.0012 (0.029)*	0.4061 0.4031
D(SPOTR)	-0.0097 (0.000)*	0.7288 (0.000)*	D(RCFJAN) 0.0006 (0.000)* D(FUTRD1) 0.0104 (0.000)*	D(RCFJUL) 0.0017 (0.000)* D(RCFNOV) -0.0003 (0.000)* D(FUTRD2) -0.0183 (0.000)*		D(INF) -55.6224 (0.039)*	0.4342 0.4314
D(ACFMAR)	0.2264 (0.000)*	0.5555 (0.000)*	D(ACFMEI) -0.0008 (0.000)* D(ACFSEP) -0.0009 (0.000)*	D(FUTAD1) 0.0127 (0.797) D(FUTAD2) 0.1327 (0.009)*	D(SPOTA) 00351 (0.000)*	D(INT) -3.9423 (0.000)* D(INF) -76.7232 (0.038)*	0.4187 0.4158
D(RCFJAN)	0.1320 (0.000)*	0.173 (0.000)*	D(RCFMEI) 01781 (0.000)* D(FUTRD1) -0.0208 (0.000)*	D(RCFNOV) 0.4429 (0.000)* D(FUTRD2) 0.0096 (0.001)*	D(SPOTR) 0.1056 (0.000)*	D(INF) -238.4774 (1.000)*	0.2835 0.2800

*) significance in level 5%

Furthermore, analysis is also performed to confirm whether the volatility of local futures prices is impacted by the volatility of offshore futures price, spot price and monetary variables. The result confirms that Arabica local futures prices volatility is influenced by Arabica offshore futures prices volatility which reflected by the significant influence of offshore futures price volatility and also influences by spot price volatility and monetary variables especially interest rate and inflation. Robusta futures prices volatility shows the same phenomenon whereas the futures price is significantly influenced by the volatility of Robusta offshore futures, local spot price and monetary variable especially inflation. This confirms that the volatility of local futures market moves together in similar manner with offshore futures market (both deliveries) and confirm the strong influence of offshore futures market to local coffee market. Both deliveries influence delivery of Arabica offshore futures prices (other than March) impacted local Arabica futures prices which indicates market demand during the harvesting seasons while Robusta futures price shows the same phenomenon. Macroeconomic variables are also found significant but not consistent between the two prices. The volatility of Arabica futures price found to be influenced by the volatility of interest rate and inflation while Robusta futures price volatility is influenced by inflation only. This may be due to the dominance of offshore futures prices and hence local monetary variables are intimidated.

Offshore futures markets are very much influenced by global coffee movement/condition. Brazil as the main producers which produce a third of world supply has the most influence to

global coffee futures market. As recorded, Arabica-coffee prices have risen 8,7% and 5,1% through the year in the futures market, as dwindling rains in Brazil, the world's largest grower, spur traders to once again bet on higher prices. In 2014 coffee harvest in Brazil, was the smallest in three years. Year of 2014 is an off-year in Brazil's two-year coffee cycle, meaning production would already have been lower without the unusual weather. Colombia, the world's No. 2 Arabica grower, has been ramping up production, helping to alleviate some of the concerns about global supplies. But Colombia only produces about a quarter as much coffee as Brazil (Wexler, 2015). Further, as also mentioned in Bappebti monthly analysis report especially in the same period, the significant risen of coffee prices is impacted by the dry weather in Brazil which lead into pessimistic of coffee production approaching harvesting period happened in June-July. The investor was worried of the damage level in Brazil which predicted lower than the previous occurrence, however they were still taking their waiting position until the harvesting information was released. Price was recorded weaken 2,10 percent during the period impacted by the withdrawal of speculator from the market due to the uncertainty of the Brazil's coffee output (Bappebti, 2014).

Important information to the policy maker that price volatility is not always bring negative impact to the commodity market. Arnade and Hoffman (2015) mentioned that price variability may accelerate price adjustment in spot market. Policy which reduce the price variability may prevent spot market to reach the equilibrium. Policies that reduce price fluctuations may harm the commodity markets participants to detect the right price signals and slow down the price adjustment process. This will confuse not only producers but also traders/hedgers in the market itself.

Managerial Implication

Analysis result indicates that volatility in futures market will be impacting volatility in spot market which confirm the futures market domination over spot market. This is then confirm the importance of futures price information to spot market especially producer in general or farmer specifically. All market participants and also other relevant stakeholders shall have the same access to the price information both spot and futures prices. Should all parties in the whole coffee supply chain, especially farmer, equipped by price information, farmer will have selling option which not directly sell to collector trader but have possibilities to sell coffee to the nearest spot market especially when the futures price plays price discovery function of the spot prices which then benefit farmer in optimizing their income by choosing the market they wish to sell the coffee. Further, producer with sufficient liquidity may consider futures market as hedging instrument considering the role of futures market.

For policy makers, it is important to know whether futures markets or cash markets dominate the setting of price. Based on research performed by Arnade and Hoffman (2015), agricultural policy makers often focus on cash markets, whereas many economists argue that futures markets are more liquid, can absorb new information more quickly, and thus contribute more to price discovery than cash markets. This serves as a reminder that both producers and policy makers should pay closer attention to futures markets when evaluating and forecasting economic outcomes in agriculture. This research provides empirical evidence to regulator, hedgers and traders that futures market took domination over spot market may be impacted by speculation it will disturb cash market.

Conclusions

Volatility in futures market influences the volatility of spot prices for both Arabica and Robusta which then confirm the domination of futures market over spot market and hence confirm price discovery in futures market. Exchange rate is also found influencing Arabica spot

price which confirms Indonesia position as exporting county. The same phenomenon is seen for Robusta, in which the volatility of Robusta spot price influenced by volatility of Robusta futures price and also inflation. Volatility of offshore futures prices also evidences impacting volatility of local spot and futures prices and hence monetary factors seems seen less impact to spot and futures prices. This confirms that mature country futures market has strong influence to emerging futures market. This may be impacted by the utilization of offshore futures market in one of local spot price component which formally declared by the commodity trading regulator.

References

[BAPPEBTI] Badan Pengawas Perdagangan Berjangka Komoditi. (2014). Analisis Harga Kopi Robusta Pekan Keempat Mei 2014. Jakarta, Indonesia: Bappebti.

[BAPPEBTI] Badan Pengawas Perdagangan Berjangka Komoditi. (2015). Analisis Harga Kopi Robusta 2015. Jakarta, Indonesia: Bappebti.

[BAPPEBTI] Badan Pengawas Perdagangan Berjangka Komoditi (2017). Jakarta, Indonesia: Bappebti.

[DIRJENBUN] Direktorat Jenderal Perkebunan. (2017). Statistik Perkebunan Indonesia: Kopi. Jakarta, Indonesia: DIRJENBUN.

[ICO] International Coffee Organization. (2017). Coffee Market Report July 2017. Retrieved from https://www.indonesia-investments.com/id/bisnis/komoditas/kopi/item186.

[UNCTAD] United Nation Conference of Trade and Development. (2009). Trade and development report 2009. Geneva.

Ajao, Y. (2012). Performance Prediction of Commodity Prices using Foreign Exchange Futures. Walden, US: Walden University.

Arnade, C and 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.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroschedasticity. *Journal of Econometrics*, 31, 307–327.

Bose, S. (2007). Commodity futures market in India: A study of trends in the notional multi-commodity indices. *ICRA Bulletin*, 3 (3) (Money & Finance), 125–158.

Chakrabarty, R and Das, R. (2010). Effect of Futures Trading on the Volatility of Spot Market in the Context of Indian Agricultural Commodity Market. *GITAM Review of International Business*, 3 (1), 41–61.

Dewi, A., Siregra, H. and M. A. H. (2011). Analisis Kontrak Berjangka Olein di Bursa Berjangka Jakarta. *Jurnal Manajemen Dan Agribisnis*, 8 (1), 1–9.

Dwyer, A., Gardner, G and William, T. (2011). *Global Commodity Markets – Price Volatility and Financialisation.* Report/Bulletin. Australia (AU): Reserve Bank of Australia.

Engle, R. F. (1982). Autoregressive conditional heteroschedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, 50 (4), 987–1008.

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, 25, 383–423.

Fortenbery, R and Zapata, H. (2004). Developed Speculation and Underdeveloped Markets – The Role of Futures Trading on Export Prices in Less Develop Countries. *European Review of Agricultural Economics*, 31, 451–471.

Giot, P. (2003). The information content of implied volatility in agricultural commodity markets. *Journal of Futures Markets*, 23 (5), 441–453.

Gupta, A and Varma, P. (2015). Impact of Futures Trading on Spot Markets: An Empirical Analysis of Rubber in India. *Eastern Economic Journal*, 42 (4210), 373–386.

Jackline, S and Deo, M. (2011). Lead-lag relationship between the futures and spot prices. *Journal of Economics and International Finance*, 3 (7), 424–427.

Joshi, V and Little, I. M. D. (1994). India: macroeconomics and political economy. Washington DC and New Delhi (US & IN): World Bank and Oxford University Press.

Kargbo, J. (2005). Impacts of Monetary and Macroeconomic Factors on Food Prices in West Africa. *Agrekon*, 44 (2), 205–224.

Kumar, M and Shollapur, M. (2015). Price Discovery and Volatility Spillover in the Agricultural Commodity Futures Market in India. IUP *Journal of Applied Finance*, 21 (1), 54–60.

Lence, S. (2009). Do futures benefit farmers? *American Journal of Agricultural Economics*, 91 (1), 154–167.

Maulida, R., Anggraeni, L and Pasaribu, S. H. (2018). Testing of Market Efficiency of the Cacao Commodity for the Futures Market in Jakarta Futures Exchange. *Jurnal Manajemen & Agribisnis*, 15 (1), 53–60.

Nicholson, W and Snyder, C. (2008). Microeconomic Theory: Basic Principles and Extension. In Ohio (US): Thomson South-Western.

Pertiwi, D. (2016). Pengujian Efisiensi Pasar dan Tingkat Konvergensi Harga Komoditas Kopi Arabika dan Kopi Robusta (Studi Kasus pada Pasar Komoditas Berjangka di Indonesia). *Jurnal Manajemen Pemasaran*, 9 (2), 43–53.

Putri, M.A., Fariyanti, A and Kusnadi, N. (2013). Struktur dan Integrasi Pasar Kopi Arabika Gayo di Kabupaten Aceh Tengah dan Bener Meriah. *Buletin RISTI*., 4 (1), 47–54.

Radha, K and Balakrishnan, K. (2017). The Role of Commodity Futures in Risk Management: A Study of Select Agricultural Commodities. *The IUP Journal of Financial Risk Management*, 14 (14), 7–29.

Revoredo-Giha, C and Zuppiroli, M. (2013). Commodity Futures Markets: Are They an Effective Price Risk Management Tool for the European Wheat Supply Chain? *Journal of Bio-Based and Applied Economics*, 2 (3), 237–255.

Sarris, A., Conforti, P and Prakash, A. (2011). *Using Futures and Options to Manage Price Volatility in Food Imports: Theory. In Prakash A*. (ed.). Safeguarding food security in volatile global markets. In Rome (IT): Food and Agriculture Organization of the United Nations.

Sharma, D.K and Malhotra, M. (2015). Impact of Futures Trading on Volatility of spot market-A case of Guar Seed. *Journal of Agricultural Finance Review*, 75 (3), 416–431.

Sharma, P. (2010). *Impact Analysis of Commodity Futures on Spot Prices, and Risk Management in Essential Commodities*. NIAM Research Report. Rajasthan (IN): CCS National Institute of Agricultural Marketing (Ministry of Agriculture, Govt. of India).

Sharma, P. (2016). *Impact Analysis of Commodity Futures on Spot Prices, and Risk Management in Essential Commodities*. In NIAM Research Report. Rajasthan (IN): CCS National Institute of Agricultural Marketing, Govt. of India (IN): Ministry of Agriculture.

Srinivasan, T.N and Wallack, J. (2003*). Export performance and the real effective exchange rate*. in Anne O Krueger and Sajjid Z Chinoy (eds), Reforming India's External, Financial, and Fiscal Policies. Stanford (US): Stanford University Press.

Wexler, A. (2015). Arabica Coffee Rises as Traders Worry About Brazil Rains; Coffee Was Top-Performing Commodity in 2014. *Wall Street Journal* (Online). New York [7 January 2015].

Wibowo, B. (2017). Hedging Ratio Measurement Methods and Hedging Effectiveness in Jakarta Futures Exchanges. *Jurnal Ekonomi Pembangunan*, 18 (1), 118–130.