Agricultural Socio-Economics Journal
Volume 22, Number 2 (2022): 95-102

P-ISSN: 1421-1425
E-ISSN: 2252-6757

DEVELOPMENT OF PRICES AND MARKET INTEGRATION OF RED CHILLIES (Capsicum annuum L.) IN MALANG REGENCY, MALANG CITY, AND SURABAYA CITY

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Abstract: Red chilli (Capsicum annumm L.) is a commodity with high price fluctuations. Market participants use red chilli price fluctuations to manipulate price information and cause information asymmetry. So that, the price information is not transmitted properly and indicates the market is not integrated. This study aims to describe price developments and analyze the integration of the red chilli market in Malang Regency, Malang City, and Surabaya City. The analytical method used is descriptive statistics, Johansen cointegration, and Vector Error Correction Model (VECM). The results showed that the price of red chilli fluctuated. Red chilli price fluctuations occur because production is seasonal, causing the distribution of chillies to be uneven every month. Therefore, efforts are needed to regulate cropping patterns so that the supply of chilli is always available. The results of market integration show that all variables are cointegrated in the long run and not integrated into the short run. This indicates that price information is transmitted imperfectly. Therefore, it is necessary to improve the information system so that all market participants can access market information.

Keywords: *Johansen Cointegration, Price, Production, Red Chilli, VECM*

http://dx.doi.org/10.21776/ub.agrise.2022.022.2.3

Received 5 October 2021
Accepted 26 April 2022
Available online 30 April 2022

INTRODUCTION

Red chilli (Capsicum annumm L.) is a commodity with economic value. Demand for red chilli in the domestic market in 2019 increased by 30% from the previous year (Badan Pusat Statistik, 2019). The increase in red chilli"s consumption needs to be balanced with the availability of red chilli. East Java Province is one of Indonesia's centres of red chilli production, which supplies 8.61% of the total national red chilli production (Badan Pusat Statistik, 2020). However, red chilli production is concentrated in certain areas, such as Malang Regency, which supplies 29.57% of chilli needs in East Java Province (Department of Agriculture and Food Security of East Java Province).

The centralization of chilli production and the production pattern that tends to be the same in certain months causes the supply to be unevenly distributed every month (Irawan, 2016). This causes the price of red chilli to fluctuate so that price changes occur very quickly. Price fluctuations that occur will open up opportunities for market participants who have the power to manipulate price information and that leads to untransmitted prices among market participants (Elvina et al., 2018). This condition causes the market not to be integrated, which impacts inefficiency in marketing (Eliyatiningsih & Mayasari, 2019).

Information asymmetry can be prevented by the availability of accurate and continuous information that can be accessed by all market participants so that market participants can respond quickly in case of price changes (Nuraeni et al., 2015). Properly available information is one indicator of the achievement of an integrated marketing system. The market is integrated if there are price movements/changes in one of the markets and the price information is transmitted to other markets with the same magnitude of change. This is in line

CITATION: Ridayati, Sujarwo, Fahriyah., (2022). DEVELOPMENT OF PRICES AND MARKET INTEGRATION OF RED CHILLIES (Capsicum annuum L.) IN MALANG REGENCY, MALANG CITY, AND SURABAYA CITY, Agricultural Socio-Economics Journal, 22(2), 95-102 DOI: http://dx.doi.org/10.21776/ub.agrise.2022.022.2.3

with the opinion of Barrett & Li (2002) that market integration shows the extent to which prices in different markets move together. Unintegrated markets can distort producers' production decisions and reflect inefficient markets due to unfair and equitable distribution of profits.

Price movements in each region indicate a fluctuating red chilli price with an increasing trend. The average price of red chilli/kg in Malang Regency is around Rp. 21.721 to Rp. 29.804. The average price of red chilli/kg in Malang City is around Rp. 23.398 to Rp. 32.046. While the average price of red chilli/kg in the city of Surabaya is around Rp. 24.132 to Rp. 32.496 (Siskaperbapo, 2021). This condition shows that the amount of changes in the price of red chilli in one market is not followed by changes in prices in other markets with the same magnitude. The field phenomenon also shows that market participants do not fully have market information. Market participants who have more information have more bargaining power in determining prices. This indicates that price information has not been properly transmitted to all market participants, which means that the transmission of red chilli prices in Malang Regency, Malang City, and Surabaya City is still low.

Information related to price developments and market integration is needed to provide an overview of price developments and market efficiency of red chilli in Malang Regency, Malang City, and Surabaya City in East Java Province. This research can also provide information about price fluctuations in one area and their impact on other areas. It can be used as an anticipatory measure to prevent the spread of price fluctuations. The aims of this study are (1) to describe the development of red chilli prices in Malang Regency, Malang City, and Surabaya City in East Java Province. (2) to analyze the market integration of red chilli in Malang Regency, Malang City, and Surabaya City in East Java Province.

RESEARCH METHODS

The research location was purposively in Malang Regency as a red chilli production centre in East Java Province and Surabaya City and Malang City as a red chilli consumption area in East Java Province. The secondary data used is weekly time series data on red chilli prices at the consumer level in the markets of Malang Regency, Malang City, and Surabaya City use production data in 2016 - 2020, as well as red chilli production data in Malang Regency use production data in 2016 - 2020. Red chilli price data at the consumer level was obtained from Sistem Informasi Ketersediaan dan Perkembangan Harga Bahan Pokok (SISKAPERBAPO) website managed by the Industry and Trade Office of East Java, and red chilli production data were obtained from Department of Agriculture and Food Security of East Java Province.

The analysis used to determine the development of prices is descriptive statistics and uses the coefficient of variation. The coefficient of variation is mathematically formulated by:

$$CV = \frac{\text{standard deviation}}{\text{average}}\ x\ 100\% \qquad (1)$$

The price is stable, if the value of the Coefficient of Variation (CV) the price is in the range of 5-9%, and if it is more than 9%, then the price fluctuates.

The analytical method used to analyze market integration is the Vector Autoregression (VAR)/Vector Error Correction Model (VECM) approach. The stages of analysis used are:

a . Stationarity Test

A stationarity test needs to be done because time series data generally have various problems. One of the problems is autocorrelation which causes the data to be non-stationary. Non-stationary data causes the estimated model to be less good (Ekananda, 2016). The stationarity test used in this study is the Augmented Dickey-Fuller (ADF) test. The stationarity test is carried out at a level I(0). If the data is not stationary, the test continues at the first difference I(1). The Augmented Dickey-Fuller (ADF) unit root test formulation can be written as follows:

$$\Delta P_t = \alpha_0 + \gamma P_{t-1} + \beta_1 \sum_{j=1}^{n} \Delta P_{t-1} + \varepsilon_t \qquad (2)$$

Where :

P_t : variable consumer price of red chilli in each market at period t (Rp/kg)

P_{t-1} : variable consumer prices of red chilli in each market at the previous period (Rp/kg)

ΔP_t : $P_t - P_{t-1}$

ΔP_{t-1} : $P_{t-1} - P_{(t-1)-1}$

n : number of lags

α_0 : intercept

β_1, γ : Coefficient parameter

ε_t : error term

Hypothesis testing:

$H_0: \gamma = 0$ (time series data is not stationary)

$H_1: \gamma < 0$ (time series data is stationary)

Rules of testing:

1. If $ADF_{statistic} > ADF_{critis}$, then reject H_0 and accept H_1, means that time series data does not contain unit root (stationary data)
2. If $ADF_{statistic} \leq ADF_{critis}$, then accept H_0 and reject H_1, means that time series data contain unit root (non-stationary data)

b. Optimal Lag Determination

The determination of the lag length is done because the independent variable used is the lag of the dependent variable. Determination of the lag length is crucial because it can affect the results of

estimation which can be biased and inaccurate and is useful for eliminating autocorrelation problems in the VAR system (Ekananda, 2016). Several criteria for determining the optimal lag length are Schwartz Information Criteria (SIC), Akaike Information Criteria (AIC), Likelihood Ratio (LR), Hanna-Quinn Criteria (HQ), and Final Prediction Error (FPE). If the information criteria obtained show only one interval candidate, then that candidate is the optimal one. If there is more than one candidate, the lag selection can be based on the shortest lag or the most selected criteria. Determination of the optimal lag length in this study using the Akaike Information Criteria (AIC).

c. Cointegration Test

A cointegration test is carried out if the price variable in the study is not stationary at level I(0) but is stationary during differentiation. A cointegration test was conducted to determine the long-term relationship between variables. This research uses the Johansen cointegration test. The Johansen cointegration test is a special test for the VAR model, differentiated data (Ekananda, 2016).

Testing Hypothesis:
H_0 : LR value < critical value 5% (not cointegrated)
H_1 : LR value > critical value 5% (cointegrated)

Rules testing:
1. If value trace statistic (TS) and maximum eigenvalue (ME) > t- statistic value, then the null hypothesis is rejected, meaning that there is a long-term relationship.
2. If value trace statistic (TS) and maximum eigenvalue (ME) < t- statistic value, then the null hypothesis is accepted, meaning that there is no long-term relationship.

d. Vector Autoregression (VAR)/Vector Error Correction Model (VECM)

Variables that are not stationary at the level and stationary at the same level of differentiation can be continued with VAR analysis in the form of differences (VARD) or Vector Error Correction Model (VECM). VARD is used when the data is not stationary, and there is no cointegration. While VECM is used when the data is not stationary at the level, the variable is cointegrated in the long run (Ekananda, 2016). VECM is used to analyze the correction of variables due to imbalances in several variables to adjust for long-term balance or short-term test dynamics (Kustiari et al., 2018). The VECM equation model can be written as follows:

$$\Delta MLGRP_t = \alpha + A_1 MLGRP_{t-1} + \cdots + A_p MLGRP_{t-p} + \beta_1 MLGCP_{t-1} + \cdots + \beta_q MLGCP_{t-q} + \gamma_1 SBYCP_{t-1} + \cdots + \gamma_r SBYCP_{t-r} + \varepsilon_t \quad (3)$$

$$\Delta MLGCP_t = \alpha + A_1 MLGRP_{t-1} + \cdots + A_p MLGRP_{t-p} + \beta_1 MLGCP_{t-1} + \cdots + \beta_q MLGCP_{t-q} + \gamma_1 SBYCP_{t-1} + \cdots + \gamma_r SBYCP_{t-r} + \varepsilon_t \quad (4)$$

$$\Delta SBYCP_t = \alpha + A_1 MLGRP_{t-1} + \cdots + A_p MLGRP_{t-p} + \beta_1 MLGCP_{t-1} + \cdots + \beta_q MLGCP_{t-q} + \gamma_1 SBYCP_{t-1} + \cdots + \gamma_r SBYCP_{t-r} + \varepsilon_t \quad (5)$$

Where
$MLGRP$: The price of red chilli at the consumer level in the Malang Regency market at period t (time) (Rp/kg).
$MLGCP_t$: The price of red chilli at the consumer level in the Malang City market at period t (time) (Rp/kg).
$SBYCP_t$: The price of red chilli at the consumer level in the Surabaya City market at period t (time) (Rp/kg).
$MLGRP_{t-p}$: The price of red chilli at the consumer level in the Malang Regency market at the previous period (t-p) (Rp/kg).
$MLGCP_{t-q}$: The price of red chilli at the consumer level in the Malang City market in the previous period (t- q)(Rp/kg).
$SBYCP_{t-r}$: The price of red chilli at the consumer level in the Surabaya City market at the previous period (t- r)(Rp/kg).
$\Delta MLGRP_t$: $(MLGRP_t - MLGRP_{t-1})$, changes in the price of red chilli in the Malang Regency market on the dependent variable at period t (Rp/kg).
$\Delta MLGCP_t$: $(MLGCP_t - MLGCP_{t-1})$, changes in the price of red chilli in the Malang City market on the dependent variable at period t (Rp/kg).
$\Delta SBYCP_t$: $(SBYCP_t - SBYCP_{t-1})$, changes in the price of red chilli in the Surabaya City market on the dependent variable at period t (Rp/kg).
α, A, β, Y : short-term coefficient.
ε_t : error term.

RESULTS AND DISCUSSION

The price of red chilli at the consumer level at the 2016-2020 period, in the markets of Malang Regency, Malang City, and Surabaya City, shows a movement pattern that tends to be the same, which the fluctuating price of red chilli with an increasing trend (Figure 1). The red chilli price increases at the beginning of the year, namely from January to March, and at the end of November to December. Meanwhile, the decline in red chilli prices occurred in the middle of the year, from May to September These results are in line with Nauly (2016) that the price of chilli has fluctuated within six years, where the lowest price occurred in July-August.

The red chilli production pattern generally has two planting seasons, the high planting season from December to January and the low planting season from April to May. During the high planting season,

the production pattern can be harvested from April to May, and the planting season is low harvested in July-August (Farid & Subekti, 2012). This production pattern causes the red chilli price to increase at the beginning and the end of the year. The prices are decreasing in the middle of the year. An increase in the supply of chilli during the harvest season resulted in a decline in prices. The results of the development of red chilli prices from 2016 to 2020 are presented in Figure 1 as follows.

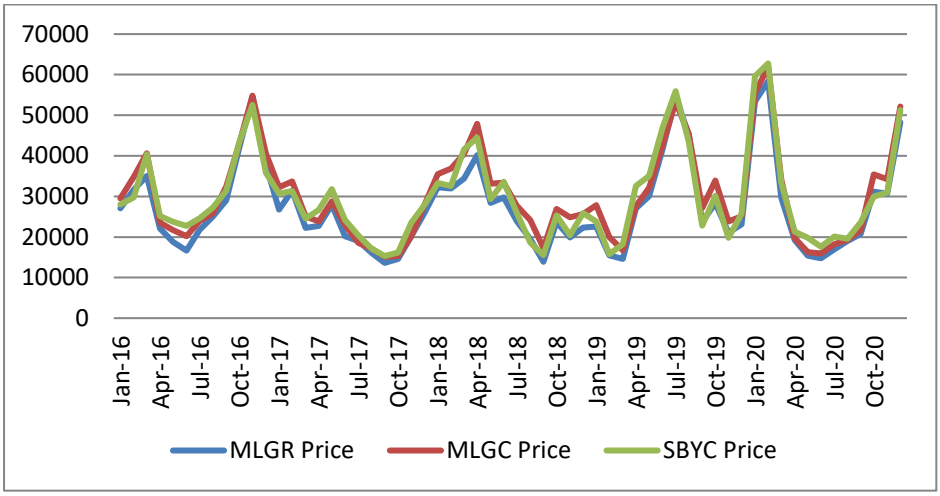

Figure 1. Red chilli prices at the consumer level in the Malang Regency, Malang City, and Surabaya City markets for the 2016-2020 period.
Source: Secondary Data, 2021 (processed).
Where:
MLGR : Malang Regency
MLGC : Malang City
SBYC : Surabaya City

Red chilli price fluctuations can be shown by calculating the Coefficient of Variation (CV) in each region. Based on the Coefficient of Variation (CV) results, the price of red chilli in Malang Regency, Malang City, and Surabaya City shows a high CV value because it is above the criteria of the Ministry of Trade, which ranges from 5-9%. This condition indicates that the price of red chilli in the area is unstable or fluctuating. The high value of the coefficient of variation in the price of red chilli is caused by the unstable production of red chilli every year.

The fluctuation of red chilli production is indicated by the CV value above 9%, which ranges from 17.03 to 46.52%. Meanwhile, red chilli consumption tends to be stable, with a CV value of consumption below 9% (PDSP, East Java, 2021). Based on the study results, fluctuations in the price of red chilli are caused by the production of red chilli, which is volatile every year, while consumption tends to be stable. The results of the analysis of the coefficient of variation in price and red chilli production are presented in Table 1 as follows.

Table 1. Results of Coefficient of Price Variation and Production of Red Chilli in the Malang Regency, Malang City, and Surabaya City markets for the 2016-2020 period.

Year	Price Coefficient Variation			Production Coefficient Variation
	Malang Regency CV (%)	Malang City CV (%)	Surabaya City CV (%)	Production CV (%)
2016	36,22	32,31	28,77	17,03
2017	25,43	27,12	24,32	22,73
2018	27,85	26,88	30,39	22,26
2019	42,02	34,66	40,50	46,52
2020	51,85	51,48	50,15	41,08

Source: Secondary Data, 2021 (processed).

The coefficient of price variation also showed that the market in Malang Regency as a production centre tends to be higher than the market in Malang City and Surabaya City as a consumption area. This result is consistent with research conducted by Susanawati et al. (2017) and Kustiari (2017) that the CV value of consumer prices moves more stable than wholesale prices and producer prices. The difference in the value of the coefficient of variation

shows differences in the ability to reduce price fluctuations and the ability of regions to bring in supplies (Arnanto et al., 2014). The Coefficient of Variation (CV) value of prices in consumer areas is lower than in production centres. It Indicates the ability of consumer areas to predict the need for red chilli every time and seek supply from other production centre areas including outside East Java Province, to meet chilli needs in the area.

The results of the market integration analysis with the VAR/VECM method approach are as follows:

a. Stationarity Test

Based on the results of the stationarity test using the Augmented Dickey-Fuller test on the price of red chilli at the consumer level, in the markets of Malang Regency, Malang City, and Surabaya City shows that the price variable is not stationary at the level. The value of ADF statistic is less than ADF critical (ADF statistic < ADF critics) and all variables are not significant at level 5 % indicating that all variables have unit-roots. Parameter estimation results of non-stationary data lead to spurious or false regression. Therefore, the ADF test was continued on the first difference.

The results of ADF analysis on the first difference show that the three variables are stationary because the value ADF statistic > ADF critics and all variables are significant at the 5% confidence level in the first difference. Based on the stationarity test, it can be concluded that all the variables used are stationary in the same order, namely order I(1), so that the estimation results of the model are free from false regressions. The results of the Augmented Dickey-Fuller (ADF) test analysis are presented in Table 2 as follows.

Table 2. ADF test results at the level and first difference.

	ADF-level			ADF-first difference		
Market	Critical Value 5%	t-stat	Prob	Critical Value 5%	t-stat	Prob
Malang Regency	-1.942059	0.093017	0.7114	-1.942059	-11.59114	0.0000**
Malang City	-1.942064	0.181609	0.7382	-1.942064	-7.940005	0.0000**
Surabaya City	-1.942059	0.075576	0.7059	-1.942074	-7.618573	0.0000**

Source: Secondary Data, 2021 (processed).
Note: *= significant at 1%, **= significant at 5%, ***= significant at 10%.

b. Lag Optimal Determination

The results of the optimal lag test using the Akaike Information Criteria (AIC) obtained lag three as the optimal lag in the VAR model. The use of lag three as the optimal lag indicates that all variables in the model influence each other in the current period and the price variables that are interrelated in the previous three periods. The optimal lag test results are presented in Table 3 as follows.

Table 3. Results of Optimal Lag Test.

Lag	LR	FPE	AIC	SC	HQ
0	NA	8.40e-07	-5.475816	-5.434387	-5.459156
1	192.8487	4.21e-07	-6.168025	-6.002309*	-6.101382*
2	19.55032	4.17e-07	-6.176187	-5.886185	-6.059563
3	26.38362*	4.02e-07*	-6.212965*	-5.798676	-6.046358

Source: Secondary Data, 2021 (processed).

c. Johansen Cointegration Test

The results of the Johansen cointegration test based on trace statistic value and maximum eigenvalue shows that the value of trace statistic and maximum eigenvalue of red chilli prices in Malang Regency, Malang City, and Surabaya City> critical value of 5% and probability value < 5%. These results indicate that the red chilli market has a relationship or balance long-term.

These results are in line with Ahmed & Singla (2017) and Katrakilidis (2008), Mishra & Kumar (2013), where all markets are well-cointegrated, indicating that these markets have a long-term relationship.

Two markets are spatially integrated if a trade takes place continuously between the regions. Malang Regency, Malang City, and Surabaya City are connected through the red chilli trade. This condition indicates that the red chilli market has a long-term balance. So that price changes in one market will be transmitted to other markets. The integration of the market in the long term is due to the distance that is not too far away, where the further the distance, the lower the integration (Kumar & Mishra, 2017). In each short-term period, all variables tend to adjust to each other to achieve long-term equilibrium, so the Vector Error Correction Model (VECM) test is then carried out.

Table 4. Results Johansen Cointegration Test

Cointegration	Trace			Max-Eigenvalue		
	Trace Statistic	*Critical value* 5%	Prob**	Max-Eigen Stat	*Critical value* 5%	Prob**
None *	89.58782	35.19275	0.0000	46.30819	22.29962	0.0000
At most 1 *	43.27963	20.26184	0.0000	32.79901	15.89210	0.0001
At most 2 *	10.48063	9.164546	0.0280	10.48063	9.164546	0.0280

Source: Secondary Data, 2021 (processed).

d. Vector Error Correction Model (VECM) Test

The Vector Error Correction Model (VECM) test was carried out after the red chilli price variable in the markets of Malang Regency, Malang City, and Surabaya City was cointegrated in the long term at the same order level, namely first difference. The results of the VECM analysis of red chilli prices in Malang Regency as the dependent variable with Malang City, and Surabaya City, were significant at the 5% level, with a t-statistic value of -2,92624 > t-table 1,9695. The ECT_1 coefficient of Malang Regency is -0.378546, indicating that the variable speed to adjust prices to reach long-term equilibrium is 2,6 weeks. Price changes in Malang Regency were only affected by the City of Surabaya in the previous week. An increase 1% of red chilli prices in the city of Surabaya in the previous week will cause an increase in the price of red chilli in Malang at this time by 0.60%.

The results of the VECM analysis of red chilli prices in Malang City as the dependent variable with Malang Regency and Surabaya City, significant at the 5% level with a t-statistic value of -3.09004 > t-table 1.9695. The ECT2 coefficient value in Malang City is -0.259308, explaining that the variable speed to adjust prices to reach equilibrium is 3.8 weeks. Price changes in Malang City were only affected by Surabaya City in the previous week. An increase 1% of red chilli prices in the city of Surabaya in the previous week will cause an increase in the price of red chilli in the city of Malang at this time by 0.49%. Meanwhile, the results of the VECM price of red chilli in Surabaya City as the dependent variable with Malang Regency and Malang City are not significant at the 5% level because of the t-statistic value < t-table.

Overall, the results of the VECM analysis of the red chilli market in Malang Regency, Malang City, and Surabaya City are not integrated into the short term. These results are in line with Mishra & Kumar (2013) that almost all markets are integrated into the long term and not integrated into the short term. The non-integration of the market in the short term shows that price information between the two consumer markets is slow (Asmara & Ardhiani, 2013). The market is not integrated into the short term due to the unavailability of adequate information in the research area, the lack of dissemination of available information, and transportation conditions, where these factors cause traders not to immediately respond to price changes in other markets (Kumar & Mishra, 2017). This statement is following the field phenomenon where some market participants only know market information. The price information is obtained from other market participants who carry out the trade.

Market participants who have more information, such as the quantity of red chilli available in each market, will have bargaining power in determining prices. The lack of available information causes market participants to be slow in responding to price changes. It shows the information is not transmitted perfectly. Information that is not transmitted perfectly will distort production decisions. When there is a price increase and information is not transmitted perfectly, the surplus market cannot distribute the excess supply to the deficit market, which increases the price of red chilli. Therefore, for the red chilli market in East Java Province to be efficient, it is necessary to improve a better market information system and disseminate market information on time about product prices, demand, and supply. So that producers, traders, and consumers make the correct production and marketing decisions.

Information related to the price of red chilli has been made on the SISKAPERBAPO Website (Sistem Informasi dan Perkembangan Harga Bahan Pokok) by the Industry and Trade Agency of East Java which can be accessed by everyone. However, some market participants do not yet know about this website, so an active role from market information service officers is needed to disseminate market information to market participants. This is because not all market participants know and access market information. In addition, further information is needed regarding the number of requests and the quantity of availability of each market in East Java Province on the SISKAPERBAPO website.

Table 5. Results Vector Error Correction Model (VECM)

Error Correction	Dependent Variable		
	D(DLNMLGR)	D(DLNMLGC)	D(DLNSBYC)
ECT_1	-0.378546	0.181718	0.021730
	[-2.92624]*	[1.57336]	[0.13832]
ECT_2	0.161178	-0.259308	0.095329
	[1.71482]	[-3.09004]*	[0.83512]
D(DLNMLGR(-1))	-0.188710	-0.084740	-0.186863
	[-1.45673]	[-0.73267]	[-1.18774]
D(DLNMLGR(-2))	-0.113734	-0.100638	-0.026193
	[-1.05846]	[-1.04901]	[-0.20072]
D(DLNMLGC(-1))	0.051694	0.078418	-0.067910
	[0.45505]	[0.77317]	[-0.49223]
D(DLNMLGC(-2))	0.045294	0.032047	-0.001057
	[0.45877]	[0.36356]	[-0.00881]
D(DLNSBYC(-1))	0.605135	0.497653	0.532336
	[5.76019]*	[5.30576]*	[4.17239]*
D(DLNSBYC(-2))	-0.014779	-0.075982	-0.043732
	[-0.14497]	[-0.83481]	[-0.35322]
R-squared	0.402031	0.384913	0.122709

Source: Secondary Data, 2021 (processed).

CONCLUSION

Based on the results of the research conducted, the following conclusions can be drawn:

The results of the analysis of the development of red chilli prices in Malang Regency, Malang City, and Surabaya City in East Java Province from 2016 to 2020 show the fluctuating price of red chilli with an increasing trend. The red chilli price increase occurred at the beginning and the end of the year. In contrast, the price decline occurred in the middle of the year due to the harvest season. This fluctuation is due to the pattern of red chilli production in certain seasons. So that production during on season cannot meet the needs of red chilli during the offseason. The high fluctuation of red chilli can be shown by the coefficient of price variation that ranges between 24.32 - 51.85% above Kementerian Perdagangan criteria of 9%. Therefore, efforts are needed from the government to regulate the red chilli planting season out of season (off-season), so that the availability of red chilli can continuously meet the needs of red chilli.

The integration of the red chilli market shows that markets in Malang Regency, Malang City, and Surabaya City are integrated into the long term but not integrated into the short term. The market is not integrated into the short term because market information related to the demand and availability of red chilli in each market is not fully accessible to all market participants. Information regarding the price of red chilli is available on the SISKAPERBAPO website, managed by the Industry and Trade Office of East Java, and can be accessed by everyone. However, there is no information on the website regarding the amount of demand and quantity of availability of each market in East Java Province in a sustainable manner. Therefore, it is necessary to improve the market information system and market information service officers' active role in disseminating information to market participants.

ACKNOWLEDGEMENTS

The author would like to thank all those who have supported this research. To Industry and Trade Office of East Java, the Department of Agriculture and Food Security of East Java Province who is willing to provide data to support this research. We would also like to thank the Editors of the Agrise Journal for taking the time to review and provide constructive suggestions before publication.

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