Spatial Market Integration of Red Chilies in Indonesia

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ABSTRACT— Red chili is a horticultural commodity that has strategic and economic value. Red chili production is concentrated in certain areas. In addition, the difference in harvest time and its perishable characteristics add to the uncertainty of the amount of supply that can meet the demand for red chili. When there is an imbalance in supply and consumption, it causes parts of Indonesia to experience excess and shortage of red chili which then has an impact on price differences. Price differences lead to inter-provincial trade, thus encouraging market integration. The purpose of this study was to analyze the spatial market integration of red chili producers in Indonesia. The data utilized Agricultural Producer Price Statistics Foodcrops, Horticulture and Smallholder Estate Crops Subsectors from 2008 until 2020. The integration of the red chili commodity market in Indonesia is carried out using the Error Correction Model (ECM). The results indicate that chilies market in Indonesia was spatially integrated. The price information was transmitted along the other regions. The speed of convergence of chilies prices to equilibrium varies. The provinces in Java island has high magnitude of adjustment coefficient.

KEYWORDS: Red chili, Error Correction Model (ECM), price, spatial integration.

1. INTRODUCTION

The high level of consumption of food commodities in the vegetable group can be attributed to the culinary culture of the Indonesian people who use red chili as their basic seasoning. In 2019 it was noted that the average consumption of these commodities in each province reached 13 thousand tons per year [18]. Red chili is one of the commodities included in the volatile food group. The price of red chili tends to fluctuate according to season [15]. Chili prices will be low during the main harvest period and increase dramatically in the period before the next harvest. One way to reduce price fluctuations is to sell products from areas experiencing surplus (producing areas) to deficit areas (consumers). Indonesia's red chili production centers are still concentrated in Java and Sumatra island, while red chili consumers are spread throughout Indonesia. Therefore, the distribution of red chili to consumption centers will affect prices at the consumer level [12].

Efficient marketing of agricultural commodities will benefit producers and consumers because surplus production in one place can be channeled to other places that experience a deficit with reasonable trading costs [1]. Spatial market integration refers to price movements in spatially separated markets or the degree to which supply and demand shocks that arise in one market are transmitted to other markets in geographically different locations. Market integration also provides information on price fluctuations in one area and its impact on other areas, especially at the producer level.

Market integration is a concept where prices in spatially separated markets or at different levels of the market chain are linked by supply and demand mechanisms [3]. The establishment of market integration in an area is aimed at making the allocation of resources more efficient, encouraging competition, and increasing economies of scale in production and distribution between these regions [20]. Market integration is one indicator of marketing efficiency, especially price efficiency. Market integration in different locations refers to the existence of a long-term relationship between prices.

Markets are spatially integrated if there is trading activity between them. An efficiently integrated market system will have a positive relationship between prices in different market areas. If trade occurs in two different regions and the price in the importing area is proportional to the price in the exporting area plus the required costs, then the two markets can be said to be integrated [16]. In addition, the market is integrated when changes at one market level are channeled or transferred to other markets. Markets are not integrated in remote locations or over time. This shows that market inefficiency occurs as a result of market concentration, causing price distortions in the market. Market integration occurs when there is adequate market information and this information is transmitted quickly from one market

to another. Therefore, fluctuations in price changes that occur in one market can be immediately caught by other markets. This can then be used as a signal in producer decision making. Market integration analysis is one indicator to determine marketing efficiency.

The existence of differences in the price of red chili in various provinces encourages inter-provincial trade to meet the shortage of red chili supply, especially those carried out by deficit provinces. On the other hand, the surplus province seeks to be able to sell its red chili supply to other provinces so that prices within the province do not fall further. This inter-provincial red chili trade is also an effort to keep the price of red chili relatively stable. The red chili trade between regions indicates the integration of spatial markets in Indonesia. This research analyzed the market integration for chilies within an island and between the island, because Indonesia is an archipelago state. This research on the spatial market integration of red chili at the producer level is important in order to be able to respond the changes in red chili prices quickly and accurately. The results obtained are expected to be input to the government in managing the distribution of red chili in Indonesia.

Research on the market integration of chili commodities has been carried out in Indonesia. [5] investigated the integration of regional vegetable markets in Indonesia using a cointegration approach and the [16] model to identify whether market integration exists between four production areas in Sumatra, Java, and the central market in Jakarta (PIKJ). The vegetables studied included shallots, red chilies, potatoes, cabbage and tomatoes. The result of this research is that there is no market integration for all these commodities. In addition, there is no difference in market integration performance between the highest and lowest production areas. Research on the market integration of chili commodities has also been carried out in Indonesia. [10] investigated the integration of the producer-level chili commodity market in Indonesia using Engle-Granger cointegration and Error Correction Model (ECM). The results of the cointegration test between 23 producer markets show that chili markets that are separated between provinces tend to be integrated in the long run. In addition, short-term changes in chili prices in one producer market also appear to have an immediate impact on chili prices in other markets. [12] conducted research on the integration of the red chili market with the Johansen cointegration approach using the Vector Error Correction Model (VECM). Research shows that there is a long-term relationship between prices at the farmer, wholesaler, and consumer levels. However, the degree of vertical market integration is not strong enough. Producer prices and wholesale prices affect consumer prices, there is a one-way causal relationship. Fuel prices have the biggest influence on the formation of red chili prices at the consumer level. Spatially, Medan is the reference market (price leader) for chili prices in Indonesia.

This study has similarities with [10], which examines the integration of the chili commodity market at the producer level. The difference is that this study uses the Engle-Granger cointegration approach, while this study uses the Johansen cointegration approach. In addition, there are differences in the time and number of provinces analyzed. Meanwhile, when compared with the research of [12], this study has a difference because it examines vertical market integration using the Vector Error Correction Model (VECM). This study examines the horizontal integration of the market, at the producer level.

2. METHODS

This study use the monthly average producer price of red chili by province obtained from Statistics Indonesia. The data utilized Agricultural Producer Price Statistics Foodcrops, Horticulture and Smallholder Estate Crops Subsectors from 2008 until 2020. The analyzed provinces cover all provinces in Indonesia, except DKI Jakarta and North Kalimantan (Table 1). DKI Jakarta province does not produce red chili. In addition, data for North Kalimantan province is only available from 2020.

Table 1. Provinces and islands in Indonesia

Island	Province
Sumatera	Aceh, North Sumatera, West Sumatera, South Sumatera, Riau, Riau Islands, Jambi, Bangka Belitung, Bengkulu, Lampung.
Java	West Java, Banten, Central Java, D.I. Yogyakarta, East Java.
Bali and Nusa Tenggara	Bali, West Nusa Tenggara, East Nusa Tenggara.
Kalimantan	West Kalimantan, Central Kalimantan, East Kalimantan, South Kalimantan.
Sulawesi	West Sulawesi, Central Sulawesi, East Sulawesi, Southeast Sulawesi, North Sulawesi, Gorontalo.
Maluku and Papua	Maluku, North Maluku, Papua, Papua West

The integration of the red chili commodity market in Indonesia is carried out using the Error Correction Model (ECM). The steps taken are:

Stationarity Test

Data Time series data (time sets) are generally not stationary in the level form, while various econometric methods used for time series data are based on stationary assumptions. If a time series data is not stationary, then the application of statistical analysis testing on the data will be inappropriate and can give spurious results [9]. The stationarity test in this study used the Augmented Dickey Fuller (ADF) unit root test. The equation is written as follows:

$$\Delta P_t^i = a_0 + \gamma P_{t-1}^i + \sum_{i=2}^{p} a_i \Delta P_{t-1}^i + \varepsilon_t \quad (1)$$

Where Δ= First-order difference, P_t^i= Red chili producer price in province i at time t , i = red chili producer market analyzed in this study t = Time period γ, a_0 , a_i = coefficient, ε_t = Error

Cointegration Test

Johansen cointegration test is used to analyze the spatial market integration of red chili producer level. Cointegration is a long-term relationship that occurs between two or more data series that are non-stationary at the level (I(1)), where the linear function of the long-term relationship is stationary (I(0)). Cointegration testing using Johansen's method allows testing of significant cointegration vectors through a trace test. The trace test is a likelihood ratio test to find out the cointegration vector r with the equation:

$$\partial_{trace} = -T \sum \ln(1 - \partial_i) \quad (2)$$

T is the number of observations and ∂_{trace} is the eigenvalue. If the statistical value obtained from the test is less than the Johansen critical value, then H_0 cannot be rejected. If H_0: r = 0 is not rejected, it can be concluded that there is no cointegration vector. On the other hand if H_0: r = 0 can be rejected, it means that there is one cointegration vector.

Granger Causality Test

The Granger causality test is used to analyze the direction of causation between two time series price producer level. It estimated as follows:

$$Y_t = a_1 + \sum_{i=1}^{n} \beta_i X_{i-1} + \sum_{i=1}^{n} \gamma_i Y_{t-1} + \varepsilon_{1t} \quad (3)$$

$$X_t = a_2 + \sum_{i=1}^{n} \theta_i X_{i-1} + \sum_{i=1}^{n} \delta_i Y_{t-1} + \varepsilon_{2t} \quad (4)$$

Where ε_{1t} are white Gaussian random errors. Given two market A and B and Price in market A *(Y)* and Price in market B *(X)*, if *Y* for market A in equation (4) is not significant and *X* for market B in equation (3) is significant it means there is a unidirectional causation running from market B to market A. It means that if market B and A were integrated, shocks that alter price in market B are transmitted to

market A by altering price in market A. Bi-directional causational relationships exist when both prices in market A and market B are significant in the two equations. There is no causation between the two pair market if the two prices are both not significant.

Error Correction Model (ECM)

The Error Correction Model (ECM) is used to assess the short-term dynamics of the relationship between two prices in separate markets. First, we will estimate the long-term model and remove the residue. Then the Error Correction Model (ECM) can be estimated as follows:

$$\widehat{\Delta P_t^i} = \alpha_0 + \propto_1 \Delta P_{t-1}^j + \propto_2 \widehat{u_{t-1}} + \varepsilon_t \quad (5)$$

$$\widehat{u_{t-1}} = P_t^i - \beta_0 - \beta_1 P_{t-1}^j - \beta_2 \quad (6)$$

Where $\propto_1$ is a short-term effect and $\propto_2$ shows the speed of error correction (speed adjustment).

3. RESULTS

Stationarity of the data in this study was carried out by unit root test using the Augmented Dickey Fuller (ADF) test. Data that does not have a unit root move randomly or the data has a random walk nature so that it was stationary data. Data that is not stationary will be heteroscedastic or have autocorrelation [9]. In addition, non-stationary time series data can also produce spurious regression, that a condition where two or more variables have a causal relationship but there is no theory or logic underlying a direct causal relationship between the two or more variables. Therefore, non-stationary data must be stationary first.

Stationarity test shows that at level I(0), there are 30 of 33 market price data for red chili producers are not stationary at the 5% confidence level. This is indicated by the probability value below 0.05. The non-fulfillment of the assumption of stationarity at the level or I(0) causes all variables to be tested by testing the degree of integration or first difference. The results of the unit root test on the first difference, all variables used in this study were stationary. So it can be concluded that all variables have the same degree of integration, namely I(1) so that the cointegration analysis can be continued. After knowing the stationarity of each variable. The next step is conducting cointegration testing to see the long-term balance that occurs between the two prices. The method used is the Johansen cointegration test. Johansen's cointegration test is based on the unrestristed p-dimensional VAR lag order k model. Determination of the optimal lag based on the assessment criteria on the largest Likelihood Ratio (LR) or on Akaike Information Criterion (AIC), Schwarz Criterion (SC), Final Prediction Error (FPE), or Hannan Quinn (HQ) with the smallest value.

Johansen cointegration test results between markets for red chili producers in Indonesia using trace test statistics. The trace statistic (TS) value which is greater than the critical value indicates the cointegration level. Cointegration analysis in this study was conducted with 298 pairs of red chili producer markets. The results of Johansen's cointegration test can see whether or not there is spatial integration of red chili in Indonesia. Cointegration test is divided into the relationship pairs of price within the island and the relationship between islands (Table 2).

Among 298 pairs province with trade cointegration of chili in Indonesia, only 69 pairwise have long-run relationship. There is 12 pairwise integrated market awithin islands and 47 pairwise between islands. This confirms that the market are not fully cointegrated even within the regions where transaction cost are assumed to be low as compared to inter-region market [3]. In general, western Indonesia dominates the integration relationship compared with provinces in eastern Indonesia.This finding is consistent with study conducted by [21] regarding the long-term relationship between the price of beef in Indonesia. The eastern region is less prioritized than Indonesia's western region [13].

For the pairwise within island, Sumatera has 7 integrated pairwise, then Java with 3 integrated pairwise, Kalimantan and Sulawesi have only one integrated pairwise. Provinces which are the main production centers of red chili in Indonesia, such as West Java, Central Java, and DI Yogyakarta, have more integrated relations than other provinces. Table 1 shows that the province of West Java, as the largest producer of red chili in Indonesia, has the highest trade integration and distribution relationships, which are 10 producer markets covering East Java, Bali, Aceh, Bangka Belitung, West Kalimantan, Central

Kalimantan, East Kalimantan, Central Sulawesi, Southeast Sulawesi, North Maluku. Meanwhile, North Sumatra, as the second largest red chili producer in Indonesia, only has an integrated relationship with the markets of Banten, Central Java, DI Yogyakarta.

Table 2. The relationship between the market integration of red chili producers in Indonesia

Province	Integrated with Province	
	Within Island	**Between Island**
Aceh	Riau, Bangka Belitung	Banten.
North Sumatera	-	Banten, Central Java, DI Yogyakarta.
West Sumatera	Bangka Belitung, Aceh	Banten, Central Java
Jambi	Bengkulu	West Nusa Tenggara
South Sumatera	Bangka Belitung	-
Bengkulu	-	Bali
Bangka Belitung	Bengkulu	Banten, Bali
Riau Islands	-	East Nusa Tenggara
West Java	East Java	Bali, Aceh, Bangka Belitung, West Kalimantan, Central Kalimantan, East Kalimantan, Central Sulawesi, Southeast Sulawesi, North Maluku.
Central Java	Banten	Bali, Aceh, Jambi, Bengkulu, Bangka Belitung, West Kalimantan, East Kalimantan, North Sulawesi, Central Sulawesi, Southeast Sulawesi, North Maluku, Papua.
D.I. Yogyakarta	Banten	Bali, Aceh, Bangka Belitung, West Kalimantan, East Kalimantan, North Sulawesi, Central Sulawesi, Southeast Sulawesi, West Sulawesi, North Maluku, West Papua, Papua.
East Java	-	Bali, Bangka Belitung, North Maluku, Papua.
West Kalimantan	South Kalimantan	Gorontalo, North Sulawesi
Central Kalimantan	-	Banten.
Central Sulawesi	-	Papua
Southeast Sulawesi	Sulawesi West	Banten
West Sulawesi	-	Banten.
North Maluku	-	West Papua, Papua.
Papua West	-	Banten.

Based on the Granger causality test, the red chili producer market in Indonesia has three types of relationship, namely one-way relationship (31.54%), two-way relationship (6.38%) and no relationship/direction (62.06%). The Riau Islands province only affects prices in the producer market within the island of Sumatra, namely in the provinces of Aceh, North Sumatra, West Sumatra, South Sumatra, Bangka Belitung, Bengkulu, Lampung. As the largest red chili producing province, prices in West Java province affect prices in Banten, Central Java, D.I. Yogyakarta, West Nusa Tenggara. This happened because West Java in addition to distributing red chili production, also brought in red chili stocks from other regions, thus affecting producer prices in the region. The results of the Granger Causality estimation between chilies producer markets that have a one-way relationship can be seen in Table 3.

The province that has the most two-way relations with other provinces is Bali. The province of Bali has a two-way relationship with the provinces of North Sumatra, Riau, Bengkulu, West Java, Central Java, DI Yogyakarta, East Java and Banten. This is because the price of chili producers in the province of Bali influences each other with other regions. Meanwhile, the province of West Java as the largest producer only has a two-way relationship with the provinces of Bali and South Sulawesi. Two-way relationship between chili producer market can be seen at Table 4.

Table 3. One-way relationship between red chili producer markets in Indonesia

Province	Direction	Province	
		Within Island	Between Island
Aceh	→	West Sumatera	Central Java
North Sumatera	→	West Sumatera	Java Central, D.I. Yogyakarta
West Sumatera	→	-	East Java, West Nusa Tenggara.
Riau	→	Aceh, North Sumatera, West Sumatera	Bali, West Nusa Tenggara.
Jambi	→	-	Bali
South Sumatera	→	Aceh, West Sumatera, Lampung.	Central Java
Lampung	→	-	Bali, Nusa Southeast West.
Bangka Belitung	→	West Sumatera, Bengkulu, Lampung.	-
Riau Islands	→	Aceh, North Sumatera, West Sumatera, South Sumatera, Bangka Belitung, Bengkulu, Lampung	-
West Java	→	-	Banten, Central Java, D.I. Yogyakarta, West Nusa Tenggara
East Java	→	-	North Sulawesi
Banten	→	D.I. Yogyakarta	Aceh, North Sumatera, West Sumatera, Jambi, Bengkulu, East Kalimantan, West Sulawesi
West Nusa Tenggara	→	-	Jambi, Bengkulu
East Nusa Tenggara	→	Bali	Kepulauan Riau, Jambi
West Kalimantan	→	Kalimantan South, Kalimantan East	DI Yogyakarta, Gorontalo,
Central Kalimantan	→	Kalimantan East, Southeast, West Sulawesi	Banten, East Java, Sulawesi
South Kalimantan	→	-	D.I. Yogyakarta, West Sulawesi, Central Sulawesi
East Kalimantan	→	-	Central Java, Central Sulawesi
North Sulawesi	→	West Sulawesi	West Kalimantan, South Kalimantan
Central Sulawesi	→	Southeast Sulawesi, West Sulawesi	-
South Sulawesi	→	West Sulawesi	Central Kalimantan, Central Java, D.I. Yogyakarta, East Java, West Papua, Maluku
Southeast Sulawesi	→	West Sulawesi	Central Java, DI Yogyakarta
Gorontalo	→	West Sulawesi, Central Sulawesi	-
North Maluku	→	West Papua, Papua	West Java, Banten, Central Java, DI Yogyakarta, East Java, Southeast Sulawesi, West Sulawesi, Central Sulawesi
Papua	→	West Papua	West Java, Central Java , D.I Yogyakarta, East Java, Central Sulawesi

Table 4. Two-way relationship between red chili producer markets

Province	Direction	Province	
		Within Island	Between Island
Aceh	↔	North Sumatera	
North Sumatera	↔		Bali
Riau	↔		Bali
Jambi	↔	Riau Islands	
South Sumatera	↔	Bengkulu	
Bengkulu	↔		Bali
West Java	↔		Bali
West Java	↔		South Sulawesi
Central Java	↔	East Java	
Central Java	↔		Bali
Central Java	↔		West Nusa Tenggara
Central Java	↔		Central Sulawesi
D.I. Yogyakarta	↔		Bali
East Java	↔		Bengkulu
East Java	↔		Bali
Banten	↔	Central Java	
Banten	↔		Bali
Bali	↔		Aceh
South Sulawesi	↔		North Maluku

The model that includes adjustments to correct short-run imbalances towards long-run equilibrium is called the Error Correction Model. According to [9] the existence of cointegration between producer markets shows a long-run equilibrium relationship between the two variables. Even if there is a long-run balance in the short run, the two may not strike a balance. This means that in the short term what economic actors want (desired) is not necessarily the same as what actually happens. The difference between what is desired and what is actually happening requires an adjustment. Table 5 presents the short-term dynamics (speed adjustment).

The estimated Error Correction Model valid if it has a significant coefficient and has the correct (negative) sign. Positive sign indicates that those series diverge from equilibrium, hence, negative coefficient converges to equilibrium in the short run. In addition, the coefficient of ECM measures the ability of prices to incorporate shocks or price news available in the market [17]. Based on the analysis of the ECT coefficients, it shows that the speed adjustment from the slowest to the fastest is between -0.057 (West Kalimantan and Gorontalo) and -0.266 (Southeast Sulawesi with DI Yogyakarta). The negative sign of the ECT coefficient means that the price movement is in the opposite direction of its deviation towards long-term equilibrium. It shows a stable system that bounces back to the equilibrium in the log run [4].

The value of speed of adjustment in the provinces in one island is the largest between the provinces of Banten and Yoyakarta (-0.1772) while the smallest value is between the provinces of North Maluku and Papua (-0.0952). In provinces with different islands, the smallest speed adjustment value was found between the provinces of West Kalimantan and Gorontalo (-0.0566), while the largest value was found in Southeast Sulawesi and DI Yogyakarta (-0.2664).

In relation to the provinces of West Java and Bali, an adjustment coefficient of -0.1030 shows that when shocks occur in the West Java producer, the chili prices at Bali producer revert to equilibrium steadily at speed of 10.3% per month. The system reverts to equilibrium quickly, as it takes 8 months for the system to fully equilibrate. This is, however not long for the market to respond to price shocks from West Java.

Table 5. Speed of adjustment market integration in Indonesia

Province	Province			
	Within Island	**Speed of Adjustment**	**Between Island**	**Speed of Adjustment**
Aceh	West Sumatera	-0.1412***	Central Java	-0.1409***
North Sumatera			Central Java	-0.1157***
			DI Yogyakarta	-0.1672***
Bengkulu			Bali	-0.0661**
Bangka Belitung	Bengkulu	-0.1200***		
Bali			Bengkulu	-0.0992***
			West Java	-0.1381***
			Central Java	-0.1206***
			DI Yogyakarta	-0.1269***
			West Java	-0.1343***
West Java			Bali	-0.1028***
Banten	Central Java	-0.1178***		
	DI Yogyakarta	-0.1772***		
Central Java			Bali	-0.0843**
	Banten	-0.0976***		
DI Yogyakarta			Bali	-0.0904**
East Java			Bali	-0.0984***
West Kalimantan	South Kalimantan	-0.1002***	DI Yogyakarta	-0.1136***
			Gorontalo	-0.0566*
Central Kalimantan			Banten	-0.1210***
East Kalimantan			Central Java	-0.2204***
Southeast Sulawesi	West Sulawesi	-0.1357***	Central Java	-0.1942***
			DI Yogyakarta	-0.2664***
North Maluku			West Java	-0.1213***
			Central Java	-0.1062***
			DI Yogyakarta	-0.1157***
			West Java	-0.1126***
			Banten	-0.1035***
	West Papua	-0.1105***		
	Papua	-0.0952***		
Papua			Central Java	-0.1356***
			DI Yogyakarta	-0.1576***
			East Java	-0.1561***

Note: significance ***p<0.01, **<0.005,*<0.1

4. DISCUSSION

Based on the trace statistic, 23.15 percent (69 market pairs) are integrated in the long term and 76.85 percent (229 market pairs) are segmented (not integrated). This shows that there is no comprehensive integration in the long term between red chili producer markets in Indonesia. This absence of spatial integration indicates that price changes in one producer market are not reflected as a price change in geographically different producer markets [19]. Furthermore, this segmented market will lead to inefficient allocation of resources [14]. Segmented markets can carry inaccurate information so that it can distort producer market decisions and contribute to inefficient product movements. Market that is not integrated will cause high price fluctuations.

There is no long-term integration between red chili producer markets in Indonesia due to the weak flow of information in the market so that the information transmitted is imperfect [12]. The absence of integration between markets for red chili producers in the long term shows that the red chili market in Indonesia leads to an imperfect competition market. In general, the market structure for agricultural commodities is oligopsony, where producers will get lower prices because the market information obtained is imperfect [2]. This limited market information causes producers to be unable to adjust their offers to get more favorable prices [8]. According to [6] the better road conditions as one of the transportation infrastructure will further increase market integration because it will reduce the transportation cost of trade or the flow of goods between these markets. It shows that producers located in the same island are not necessarily integrated.

After performing the cointegration test, the analysis continued by applying the causal approach. The causality test used in this study is the Granger Causality test. This causality analysis aims to determine the response of price changes in one market to other markets. The response to this change can run in one direction from one market to another, two ways from both markets or not mutually responsive between the two markets analyzed. The Granger causality test in this study was conducted on 298 combinations of producer markets. If two or more series are cointegrated, then this causality test provides information on whether a series causes variations in another series (unidirection) or affects each other (two directions) because cointegration has limited information. The market will be said to be dominant (leading) in price formation if price changes that occur in that market will be transmitted to other markets.

Long-term integrated producer markets do not always have a causal relationship and vice versa. The absence of causality between markets can be caused by poor distribution systems and the existence of market power so that market mechanisms do not work well [11] and [7]. This imperfect market mechanism shows that the red chili market at the producer level is inefficient. This efficiency issue is important because it can increase the welfare of producers and encourage innovation. This inefficient market causes high price fluctuations at producer level red chili in Indonesia.

Central Java province, which is also a red chili production center, affects prices for East Java, Bali, West Nusa Southeast and Central Sulawesi. Therefore, if the government is to make a policy to control the price of chilies, the market that must be the main concern is the market leading price leaders, namely West Java, Central Java and East Java.

In the short term, producer markets that act as price leaders such as Aceh, North Sumatra, Bali, Banten, Central Java, North Sulawesi, North Maluku and Papua also affect changes in the market prices of other red chili producers. Producer prices in Bali affect five other markets namely Bengkulu, West Java, Central Java, DI Yogyakarta and East Java. West Java is the fastest to respond to changes in producer prices in the province of Bali, which takes 7 months. The province that took the longest to respond was Bengkulu, which was 10 months.

Producer markets that have a long-term integration relationship with other markets do not necessarily have a short-term relationship between the two. Based on the ECM analysis, there are 36 pairs of integrated red chili producer markets in the short term. While the number of markets for integrated red chili producers in the long term is 69 pairs. The red chili producer market in Indonesia is more integrated in the long term. Producer markets that are integrated in the short run are not necessarily integrated in the long run. For example, the producer market in Aceh has a short-term relationship with West Sumatra and Central Java, but in the long-term there is no integration.

The province of Bali has long and short term integration with four main centers of red chili in Indonesia, namely West Java, Central Java, DI Yogyakarta and East Java. This means that the province of Bali has efficient trade relations with the four main chili centers. Bali's relationship with the four production centers is also two-way, which means they influence each other. Papua is also a province that has long-term and short-term relations with the production center provinces of Central Java, DI Yogyakarta and East Java, but the relationship is one-way. This means that the province of Papua affects producer prices in the three production centers.

5. CONCLUSION

The purpose of this study was to examine whether there is spatially market integration of chilies in Indonesia. The cointegration test shows that there is a long run relationship among market price in 69 pairs provinces. The short run integration was also found based on correlation test. These findings indicate that chilies market in Indonesia was spatially integrated. In addition, the ECM shows that the province of cillies producer market in Java, such of Java West, Java Central, Yogyakarta and Java East was affected by the other regions. The price information was transmitted along the other regions. The speed of convergence of chilies prices to equilibrium was found varies, where the provinces in Java island has high magnitude of adjustment coefficient.

This study recommends the goverment to policies which providing infrastructure not only in Java Island to avoid market exploitation and spread price information along provinces in Indonesia. This will make efficiency of the marketing system in agricultural commodities and reduce market distortions. Further research along this may consider to examine vertical integration on markets across provinces in Indonesia. It will provide general overview about current condition of chilies in Indonesia.

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