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The Integration of Rice Market in Indonesia as an Archipelago Country (Vector Error Correction Model Analysis)

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Abstract— **Indonesia is the third-largest rice producer in the world after China and India. Indonesia has different rice distribution patterns with continental countries such as China and India as archipelagic countries. The rice distribution pattern in Indonesia is still problematic, as seen from the high price disparity between producer and consumer level and regions. A considerable price disparity reflects an inefficient market, as prices are not transmitted perfectly between regions within a single region. This study aimed to analyze the integration of the Indonesian rice market, which considered scattered locations geographically separated by the ocean. Market mechanisms that assume the spontaneous movement of goods or services due to price differences cannot fully occur due to physical and infrastructure constraints. This research used the Vector Autoregression method, which is specified as Vector Error Correction Model. The results show that the Indonesian rice market is not fully integrated. In the long run, there is still an independent rice market. It is indicating a low level of efficiency of the rice market. The geographic condition of the Indonesia archipelago causes perfect market integration to be difficult to achieve. Improvement of the infrastructure in transportation and communication will make the flow of rice more efficient from surplus to deficit area. The market is segmented into several points in some areas based on the island. This means that controlling the rice market can not be concentrated at one point, but control must be done at the determinants market spread across every island in Indonesia.**

Keywords— **Distribution patterns; price disparity; price transmission; market integration.**

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I. INTRODUCTION

Indonesia is the third-largest rice producer in the world after China and India. In 2015, China, India, and Indonesia produced 208.24 million tons, 156.62 million tons, and 75.55 million tons of paddy, respectively [1]. Rice production centers in Indonesia are concentrated in Java Island and some areas in Sumatra and Sulawesi islands, whereas the consumption areas are spread throughout Indonesia. There are three rice production centers in Java island, i.e., East Java, West Java, and Central Java Provinces. The three production centers each have an average production of over 10 million tons per year. Paddy production in Java island reached 50.95 percent of the total national rice production. Outside Java Island, the highest rice production is in South Sulawesi Province, followed by North Sumatera Province and South Sumatera Province [2]. The uneven distribution of production centers requires a well-planned distribution activity to distribute rice equally throughout Indonesia [3].

As an archipelagic territory, Indonesia has different rice distribution patterns with mainland countries such as China and India, the two largest rice-producing countries. The shape of the Indonesian territory can also affect the performance of its rice market as this requires a smooth distribution among regions. Poor transports and communications infrastructures will increase transaction costs so that the market will not work efficiently [4]. The inelastic characteristics of rice supply and demand and the time gap between production and consumption make the smooth distribution of rice have an important role in ensuring the availability of rice throughout the year [5].

The current pattern of rice distribution in Indonesia is still problematic, as can be seen from the high price disparity between producer and consumer [2]. In addition, rice price disparities occur between regions in Indonesia. Despite being in the same archipelago of Sumatra island and some areas of Java island, the average retail price of rice in some major cities in these regions shows considerable differences, as shown in Figure 1. The standard deviations are indicated by the error bars in the figure also reflect various fluctuations of prices. The higher the average price, the higher the standard deviation, which means the price fluctuates.

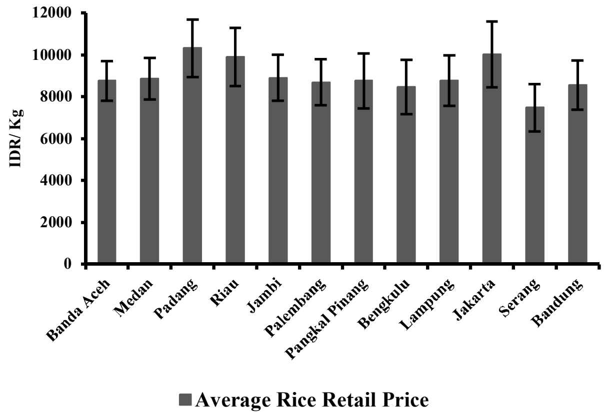

Fig. 1 Average Rice Retail Price of Some Big Cities in Indonesia, the Year of 2010 – 2015

The average data on retail prices in several major cities in Indonesia from 2010 to 2015 showed that the highest average prices are in Padang that exceeded the average price in Jakarta. In comparison, the lowest average price was in Serang Banten. A considerable price disparity reflects an inefficient market, as prices are not transmitted perfectly between regions within a single region. One way to understand market efficiency is to understand the relative strength of a market and the mechanism of price transmission from one market to another through the study of market integration [6]. Agricultural and food products, including rice, are considered relatively homogeneous. Regional price differences show distortions that are not caused by differences in quality but may be due to market forces, inefficiencies, and policy distortions [7].

The more efficient a market, the faster price adjustment to market equilibrium. Understanding the efficiency level or integration of the rice market is beneficial for implementing price policies by the government. The implementation will be effective if the rice market is integrated. Stable rice prices in one area can have implications on the stability of rice prices in the others. Stable and logical rice prices for producers and consumers will have multiple effects, which provides more income security and productive incentives to farmers and at the same time maintains the consumer's purchasing power [8], [9]. On the contrary, an unintegrated rice market means no inter-market price transmission, which causes inefficiency of resource allocation and a decrease in economic prosperity [10].

In general, this study's novelty is finding the important concept of island economics in the Indonesian rice market. This study tries to explain the performance of the national rice market, which includes distance separation due to the geographical condition of Indonesia in the form of an archipelago (physical barrier problems). The efficiency of the Indonesian rice market will be different from countries with mainland regions such as China and India as the biggest rice-producing countries. The analysis in this study is not directed to seek perfect integration throughout Indonesia, but rather to integration within sub-regions, so that policy implications are also per region. An understanding of the Indonesian rice market condition, which is in the form of an archipelago, is expected to become a reference for the government to determine the right policies regarding rice price and distribution patterns in Indonesia. Finally, it can be beneficial for farmers, traders, and consumers of rice.

This study aimed to analyze the integration of the Indonesian rice market, which considered scattered locations geographically separated by the ocean. Market mechanisms that assume the spontaneous movement of goods or services due to price differences cannot fully occur due to physical and infrastructure constraints, so that a one-price policy nationally in Indonesia is ineffective. There are always variations in prices between regions. Analysis of market integration will explain the physical relationship or flow of goods between regions in Indonesia.

II. Materials and Methods

This is quantitative research with an empirical method using statistical analysis tools and econometric in time series model classification [11]. A spatial equilibrium model is explained using excess supply and excess demand curves on two trading areas [12]. Secondary data used were monthly consumer rice prices from January 2000 to December 2015 (time series data). The year 2000 is the beginning year because the price data before the 2000 period was considered unstable due to the economic and disaster crisis of El-Nino, La-Nina in 1998-1999. Price movements in that years are feared cannot accurately explain the price transmission between regions.

The consumers' average rice price in Indonesia was divided into two categories: surplus and deficit areas. This was done to see the market behavior, rice distribution, and the relation between them. The average rice price at the consumer level is the price in the capital city of the province. Samples representing surplus areas were six rice production centers i.e., East Java (Surabaya), West Java (Bandung), Central Java (Semarang), South Sulawesi (Makassar), North Sumatra (Medan) and South Sumatra (Palembang). Samples representing deficit areas were taken from four provinces representing four major islands in Indonesia with the category of small rice production, namely Riau Province (Pekanbaru), DKI Jakarta (Jakarta), East Kalimantan (Samarinda), and Southeast Sulawesi (Kendari).

Data were collected from the Central Bureau of Statistics and Cipinang Market. This research used Vector Autoregression (VAR) approach introduced by Sims 1980 [13]. The advantages of this method are it can be used for data from various periods, the results obtained are not spurious, can determine the extent of integration, the direction of price transformation, and the market leader or isolated market participants. This test can prove price correlation in the short and long term between markets in a region. Figure 2 shows the research method flow chart of rice market integration in Indonesia.

In general, economic data is not stationary, so that the first step is to test and make the data stationary. The stationarity of data was evaluated by unit root test described by Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests [13]. If the stationary test indicated that the data series of a variable was not stationary, first difference ($\Delta Y_{t-1} = Y_t - Y_{t-1}$) must be analysed by drawing the differentiation of the endogenous variable so that the data become stationary under the condition I (1).

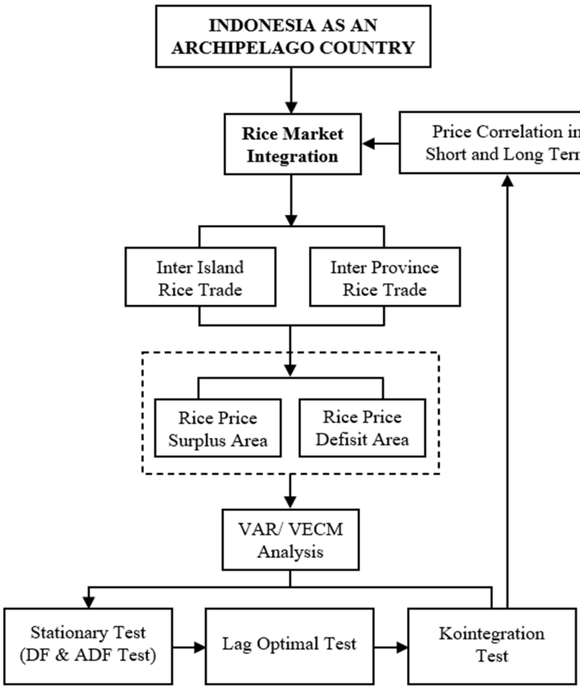

Fig. 2 Research Method Flow Chart of Rice Market Integration in Indonesia

If the first level was not stationary as well, the second level difference was analyzed, and so on until a stationary condition was obtained. This process resulted in the level or order of integration of the variables. The stationary of time series data was determined using Augmented Dicky-Fuller (ADF) test, which can be expressed in the following equation:

$$\Delta P_t = \alpha_0 + \alpha_1 T + \delta P_{t-1} + \sum_{i=1}^{k} \beta_i \Delta P_{t-1} + \varepsilon_t \qquad (1)$$

description:

Δ	= Operator first level difference
P_t	= Variables of rice price
T	= Time trend
$\alpha_0, \alpha_1, \delta, \beta_i$	= Coefficient
k	= Number of lags
ε_t	= Error equation

The next step was comparing the statistical value with the critical values 95 and 99 percent. If the statistical value was greater than the critical value, then the data were categorized as stationary I (0), but if it was smaller, it was not stationary. The time-series data that were not stationary at the level but stationary in data difference and cointegrated shows a long-term relationship between variables, so the analysis was done with Vector Error Correction Model (VECM).

The optimal lag test was performed to find out how many lags were appropriate for the model. An optimal variable lag length is needed to capture the effect of each variable on the optimal variable in the VAR system [14]. The determination of the optimal lag length used of the following information criteria: (1) Akaike Information Criterion (AIC), (2) Schwarrz Information Criterion (SC), (3) Hannan-Quinn Criterion (HQ), (4) Likelihood Ratio (LR), dan (5) Final Prediction Error (FPE). The optimal lag length test is useful to avoid the possibility of residual autocorrelation in the data series of the VAR system. When using only one of the criteria in determining the lag length, the optimal lag length occurs if the above criterion values have the smallest absolute value.

The assumption that must be fulfilled in the VAR method is that all independent variables must be stationary (mean, variance, and covariance is constant). In addition, the residue is white noise that has a zero average, constant variance, and independent. If the data is not stationary, a cointegration test is required, where if the non-stationer data are cointegrated, the linear combination between the variables in the system will be stationary so that a stable long-term equation system can be obtained [15]. This stage was done to find out whether the model used is a different level VAR if there is no cointegration and VECM when there is cointegration [14].

Analysis of rice market integration used VAR model that was specified into Vector Error Correction Model (VECM). VAR/ VECM is a system of equations that shows each variable as a linear function of the constant and the lag value of the variable itself, and the lag value of the other variables present in the system. The statistical hypothesis for rice market integration analysis is:

H_0 : Statistically, there are no interrelations between rice market integration variables in Indonesia.

H_1 : Statistically, there are interrelations between rice market integration variables in Indonesia.

The general equations of the VAR model of horizontally rice market integration in Indonesia are written as follows:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \dots + \alpha_p Y_{t-p} + \varepsilon_t \quad (2)$$

description:

Y_t	= Dependent variable vector, rice price of a province t period (IDR/kg)
$Y_{t-1,2,\dots,p}$	= Independent variable vector, rice price *lag* of a province t period (IDR/kg)
α_0	= Intercept vectors
$\alpha_{1,2,\dots,p}$	= Parameter matrix
p	= Lag length
ε_t	= Residual vector ($\varepsilon_{1.t}, \varepsilon_{2.t}, \dots, \varepsilon_{n.t}$) sized n x 1

The presence or absence of cointegration was based on the likelihood ratio test. If the calculated value was greater than the critical value, we accepted the cointegration of many variables and vice versa. If the calculated value was less than the critical value, then there was no cointegration. The calculated likelihood ratio test value is calculated based on the following formula:

$$\lambda_t(r) = -T \sum_{i=r+1}^{p} \log(1 - \lambda i) \qquad (3)$$

The calculation used the alternative likelihood ratio statistic test known as maximum eigenvalue statistic, can be calculated from trace statistic which is stated as follows:

$$\lambda_{\max}(r) = -T(1 - \lambda_{i+1}) = Q_t - Q_{t+1} \qquad (4)$$

description:

T	= Number of time observation
λ	= Estimate of eigenvalue (the root of the alleged feature) generated from the matrix estimation *a*
r	= Rank, which indicates the number of cointegration vectors

III. Results and Discussion

A. Spatial Integration Analysis of Indonesian Rice Market

The level of market efficiency can be measured with the concept of market integration, which reflects how a market works [4]. The interrelationship of rice trade among location/ regions horizontally is a spatial market integration seen through price equilibrium in each market in each sample province. Data analysis used ten provinces representing the rice market in Indonesia. The stationarity test of the data in this study was conducted with a root unit test based on Augmented Dickey-Fuller (ADF) test. The test results show that the data used in this study is not stationary at the level but stationary at the first different level. The stationary data describes the movement of each variable within a certain period. The stationary variable can be interpreted that there is no trend in the movement of data [14]. Analysis can be continued in the next step of testing to determine the optimal lag length.

The optimal lag test is useful to eliminate autocorrelation problems in the VAR system. Based on the Schwarrz Information Criterion (SC) and Hannan-Quinn Criterion (HQ) information criteria, the Indonesian rice market spatial integration model in this study uses lag 1 as the optimal lag to be used in the analysis. The use of lag 1 means that from the economic side, all variables of rice price exist in the models affecting each other in the current period, but those variables are interrelated in one period or one month before. The value of the lag of a variable can affect other variables because it takes time for a variable to respond to the movement of other variables.

Two variables that are not stationary before being deference but stationary at the first different level are likely to occur cointegration, which means there is a long-term relationship between them [16]. The existence of cointegration relation in a system of equations indicates that there is an Error Correction Model in the system, which describes the existence of short-term dynamics consistently with long-term relationships. There are two pieces of information from the cointegration test results: the deterministic trend assumptions and the number of cointegration relationships. In this study, the selection of assumptions is adjusted based on the AIC information criteria that are *linear intercept no trend.*

Based on the trace test and the max-eigenvalue test on the model, there are four cointegrations. This model shows that from 10 variables analyzed. There are only four linear equations in the long run. Since there are only four Vector Autoregression or linear combinations on the rice market, it can be said that the long-term integration is not perfect. The horizontal linkage of Indonesia's rice market has not been fully connected to each other. In the long run, there are still independent or isolated rice markets not affected by others. Cointegration that occurs in the model is a statistical implication of the long-term relationship between economic variables. This long-term relationship means that the variables move together over time.

The Error Correction Term (ECT) coefficients in the VECM are a measure of the speed of adjustment to the Long Run equilibrium relationship (LR) between markets [15]. The speed of adjustment is shown by the absolute value of the ECT, the greater coefficient indicating the speed of adjustment to the LR equilibrium and vice versa. The disruption of previous period price changes on some markets in the model can be interpreted as a Short Run (SR) adjustment, while the market is in LR balance with other markets [17].

The cointegration equation shows the relationship of LR equilibrium between rice prices in the ten sample provinces. Table 1 shows the long-term Cointegration Equation (CE) of the rice market horizontally. There is a relationship of LR balance between all rice markets in Indonesia except West Java rice market.

TABLE I
The Long-Term Co-Integration Equation of Horizontal Rice Market

Error Correction:	**D(East Java)**	**D(West Java)**	**D(Central Java)**	**D(South Sulawesi)**	**D(North Sumatra)**	**D(South Sumatra)**	**D(Riau)**	**D(DKI Jakarta)**	**D(East Kalimantan)**	**D(SoutheastSulawesi)**
CointEq1	-0.0554	-0.0292	0.2376	-0.0970	0.1533	0.1228	0.4702	0.5021	0.0714	-0.1243
	[-0.7748]	[-0.3419]	[2.5552]**	[-0.8485]	[2.9459]**	[1.5369]	[3.3656]**	[4.7199] **	[1.1453]	[-1.3530]
CointEq2	-0.0152	-0.0233	0.1151	0.0203	0.0210	0.0368	0.0562	0.5554	0.0798	0.0984
	[-0.3483]	[-0.4468]	[2.0244]**	[0.2905]	[0.6599]	[0.7539]	[0.6579]	[8.5359] **	[2.0949] **	[1.7514] *
CointEq3	-0.0582	-0.0045	-0.3725	0.5327	-0.0624	-0.1766	-0.3112	-0.2205	0.0763	0.2279
	[-0.6710]	[-0.0440]	[-3.3054]**	[3.8449]**	[-0.9902]	[-1.8247]*	[-1.8380]*	[-1.7109]*	[1.0105]	[2.0471] **
CointEq4	0.0954	0.0378	0.1390	-0.3371	-0.0734	0.0454	-0.2688	0.0529	-0.0778	-0.0064
	[2.1214]**	[0.7043]	[2.3809]**	[-4.6945]**	[-2.2456]**	[0.9048]	[-3.0636]**	[0.7926]	[-1.9878]**	[-0.1109]

Description: D = The first differentiation operator; [] t-count
** Real at 5% confidence level; * Real at 10% confidence level

The ECT coefficients describe the rate of adjustment per period to the LR equilibrium. In the rice market of ten sample provinces in Indonesia, ECT coefficient values are smaller than one. The cointegration relationship between variables is given below:

- The first cointegration equation is a long-term equilibrium relationship between rice prices of Central Java, North Sumatra, Riau, and DKI Jakarta.
- The second cointegration equation is a long-term equilibrium relationship between rice prices of Central Java, DKI Jakarta, East Kalimantan, and Southeast Sulawesi.
- The third cointegration equation is a long-term equilibrium relationship between rice prices of Central Java, South Sulawesi, South Sumatra, Riau, DKI Jakarta, and Southeast Sulawesi.
- The fourth cointegration equation is a long-term equilibrium relationship between rice prices of East Java, Central Java, South Sulawesi, North Sumatra, Riau, and East Kalimantan.

Table 2 shows the coefficients of the VECM Model of the spatial integration equation of the Indonesian rice market. The error correction coefficient in lag 1 illustrates the magnitude of adjustment due to SR price changes in the previous month's price period on the current price change (independent variable). Statistically, the short-run relationship between variables is given below:

- East Java's rice price is influenced by lag 1 of rice prices of South Sulawesi, North Sumatera, and South Sumatra.
- West Java's rice price is influenced by lag 1 of rice prices of North Sumatra, South Sumatra.
- Central Java's rice price is influenced by the lag 1 rice prices of East Java, West Java, North Sumatra.
- South Sulawesi's rice price is influenced by lag 1 of rice price of South Sulawesi, South Sumatra, East Kalimantan.
- North Sumatra's rice price is influenced by lag 1 of rice prices of North Sumatra, East Kalimantan, Southeast Sulawesi.
- South Sumatra's rice price is influenced by lag 1 of rice prices of South Sumatra, East Java, East Kalimantan.
- Riau's rice price is influenced by lag 1 of rice prices of Riau, South Sulawesi, DKI Jakarta.
- Jakarta's rice price is influenced by lag 1 of rice prices of DKI Jakarta, North Sumatra, Riau.
- East Kalimantan's rice price is influenced by lag 1 of rice prices of East Kalimantan, South Sumatra, Southeast Sulawesi.
- Southeast Sulawesi's rice price is influenced by lag 1 of rice prices of Southeast Sulawesi, South Sulawesi, South Sumatra.

TABLE II
VECM COEFFICIENT VALUE EQUATION SPATIAL INTEGRATION OF INDONESIAN RICE MARKET

Error Correction:	D (East Java)	D (West Java)	D (Central Java)	D (South Sulawesi)	D (North Sumatra)	D (South Sumatra)	D(Riau)	D (DKI Jakarta)	D (East Kalimantan)	D (Southeast Sulawesi)
D (East Java (-1))	0.2665	0.2325	0.4116	0.0074	0.0534	0.2733	0.3506	-0.2421	0.1560	-0.1390
	[2.0602]**	[1.5041]	[2.4492]**	[0.0362]	[0.5681]	[1.8929]*	[1.3886]	[-1.2594]	[1.3852]	[-0.8373]
D (West Java (-1))	-0.0109	-0.1721	-0.2903	0.0061	-0.0544	-0.1268	-0.0332	0.0199	0.0441	0.2027
	[-0.1104]	[-1.4538]	[-2.2551]**	[0.0390]	[-0.7551]	[-1.1468]	[-0.1719]	[0.1354]	[0.5120]	[1.5940]
D (Central Java (-1))	-0.1657	-0.0269	-0.1598	-0.1970	0.0269	-0.0558	0.2103	0.1449	-0.1151	-0.1100
	[-1.6171]	[-0.2203]	[-1.2005]	[-1.2040]	[0.3613]	[-0.4883]	[1.0516]	[0.9519]	[-1.2901]	[-0.8363]
D (South Sulawesi (-1))	-0.1063	-0.0290	-0.0744	-0.4091	0.0148	-0.0115	0.1766	-0.0577	0.0084	0.1391
	[-2.4087]**	[-0.5505]	[-1.2979]	[-5.8030]**	[0.4638]	[-0.2339]	[2.0501]**	[-0.8807]	[0.2187]	[2.4566]**
D (North Sumatra (-1))	0.2851	0.2581	0.4841	0.2367	0.2643	0.0216	0.1771	0.6420	0.0859	-0.1773
	[2.4256]**	[1.8383]*	[3.1708]**	[1.2612]	[3.0927]**	[0.1651]	[0.7723]	[3.6763]**	[0.8397]	[-1.1755]
D (South Sumatra (-1))	0.2898	0.4121	0.1903	0.3097	0.0399	0.2634	-0.1687	0.1977	0.2157	0.3054
	[3.0855]**	[3.6722]**	[1.5603]	[2.0644]**	[0.5851]	[2.5136]**	[-0.9207]	[1.4169]	[2.6383]**	[2.5331]**
D (Riau (-1))	-0.0255	-0.0691	-0.0767	-0.0965	0.0011	0.0444	0.2444	-0.4306	-0.0126	-0.0288
	[-0.6480]	[-1.4691]	[-1.5005]	[-1.5346]	[0.0400]	[1.0103]	[3.1792]**	[-7.3576]**	[-0.3694]	[-0.5714]
D (DKI Jakarta(-1))	-0.0108	-0.0310	0.0591	0.0233	-0.0523	-0.0409	-0.3332	-0.1383	0.0326	0.0725
	[-0.2379]	[-0.5685]	[0.9973]	[0.3198]	[-1.5744]	[-0.8038]	[-3.7372]**	[-2.0381]**	[0.8203]	[1.2371]
D (East Kalimantan(-1))	-0.0260	0.0323	-0.0879	0.3222	0.1130	-0.1968	0.0627	0.1468	-0.1533	-0.0617
	[-0.2865]	[0.2973]	[-0.7448]	[2.2190]**	[1.7099]*	[-1.9397]**	[0.3535]	[1.0871]	[-1.9364]**	[-0.5290]
D (Southeast Sulawesi(-1))	-0.0182	-0.1127	-0.0240	-0.1521	-0.1534	-0.0389	-0.0429	-0.0389	0.0964	0.2066
	[-0.3074]	[-1.5868]	[-0.3119]	[-1.6014]	[-3.5480]**	[-0.5868]	[-0.3696]	[-0.4411]	[1.8618]**	[2.7068]**
R-squared	**0.2224**	**0.2183**	**0.2833**	**0.4309**	**0.3096**	**0.1888**	**0.3569**	**0.5528**	**0.2956**	**0.2620**
F-statistic	**3.5771**	**3.4908**	**4.9419**	**9.4665**	**5.6060**	**2.9101**	**6.9384**	**1.5452**	**5.2464**	**4.4383**

Description: D = The first differentiation operator; [] t-count
** Real at 5% confidence level; * Real at 10% confidence level

B. *Rice Market Integration in Indonesia*

Market integration is a concept whereby market participants in different areas are driven by supply and demand conditions. This condition is indicated by the rapid transboundary movement of goods, services, and factors of production in a region. In a perfectly homogeneous market of goods and services, the intensity of market integration within an area is measured through the level of price convergence within the region [18]. Market integration involves physical relationships or the flow of goods between regions that trade. In the rice market, to know the flow of goods, the distribution of rice between regions must be known.

A survey on rice distribution map in Indonesia shows that almost all provinces which are samples of rice producers get raw material in the form of unhusked paddy grain ready to be milling from within their respective provinces [2]. Most rice production is distributed in the province and the rest to others, which are close to and classified as deficit areas (Figure 3). Provincial production centers distribute their rice production into their territory, and the rest is distributed to non-central areas and other production centers. While the non-production areas only distribute their rice production for consumption needs in their own territory, even rice from production centers enters into non-central areas to meet their consumption needs.

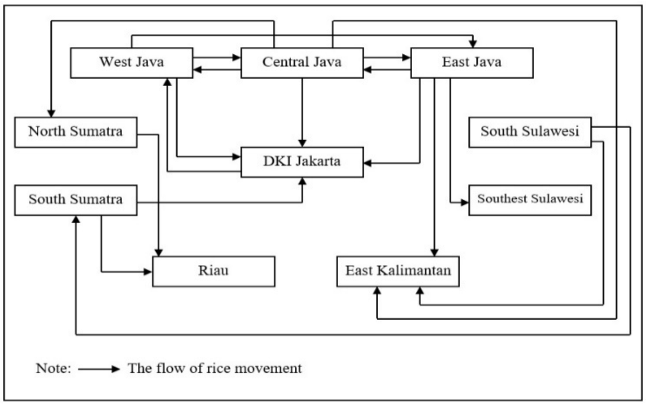

Fig. 3 Distribution Map of Rice Inter Province in Indonesia

There are short-term and long-term relationships between rice markets in East Java, West Java, Central Java, South Sulawesi, North Sumatra, South Sumatra, Riau, DKI Jakarta, Southeast Sulawesi, and East Kalimantan, although not all markets are connected. There is a strong relationship of the rice market between East Java and Central Java, South Sulawesi and South Sumatra, East Kalimantan and Southeast Sulawesi. This is because statistically, these markets are connected in the short and long term (Figure 4). The absence of statistical linkages between markets means that price movements are not the same across regions. This could be due to the small volume of traded goods that do not affect the market balance. More long-term relationships that occur than short-term relationships can be attributed to Indonesia's archipelago geographical conditions, causing differences in the rate of adjustment to price changes related to the location of the area and the condition of its infrastructure.

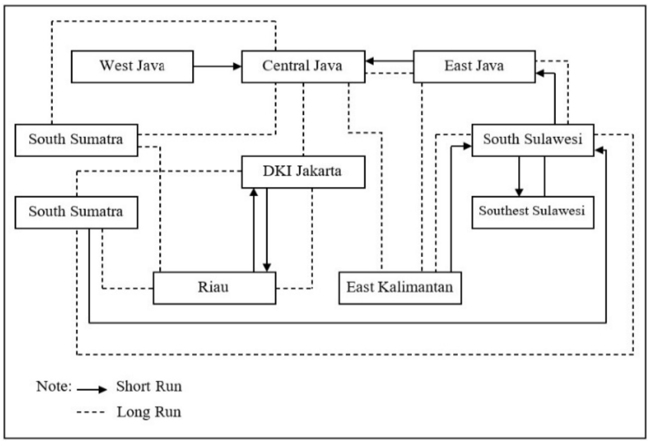

Fig. 4 Integration of Rice Market in Indonesia

The interesting finding from the analysis result is based on rice distribution map in West Java where this province has trade relation with the rice market of Central Java and DKI Jakarta. But the analysis shows that in the short term, the price of West Java rice is only related to the price of rice in Central Java. Both in the short and long term, the price of West Java rice is not related to the price of DKI Jakarta rice. This means that the movement of rice price in the West Java rice market is not the same as price movement in DKI Jakarta. The sizable flow of goods in and out between the West Java and DKI Jakarta rice market raises the suspicion that there are factors that cause West java was not statistically linked with DKI Jakarta.

Some of these factors are differences in production centers and the quality of traded rice. Almost all rice from West Java that goes to DKI Jakarta is rice from production centers in Pantura, namely Karawang and Cirebon, with medium quality. Meanwhile, rice in the rice market in Bandung is mostly rice from Priangan production center with premium quality [19]. This is why the rice market analysis of DKI Jakarta is not connected with the West Java rice market because the price data used in the analysis is the retail price of rice data in big cities that are Jakarta and Bandung. The results of this analysis are in line with the results of others [19], which concluded that the price of rice in Bandung is not related to production centers in the Pantura region.

The cointegration equation shows that the West Java Rice market has no relation to the four cointegrations that occur in the Indonesian rice market. The West Java rice market is independent in the long term because it is not connected with the rice market in other regions. The population can cause it in West Java province is the largest population in Indonesia, where the preferences or tastes of different consumers, so the West Java rice market has its uniqueness. Different conditions with the West Java rice market, where the Central Java rice market is seen to have a long-term relationship in all cointegration that occurs. This indicates the importance of the Central Java rice market in the relationship of Indonesian rice market cointegration. In the long term, changes in the rice market in Central Java will affect the rice market in Indonesia.

The discussion on spatial integration of the Indonesian rice market shows the relation of goods flows between regions or provinces in Indonesia. Areas with high production even tend to sell excess rice to other areas around it. While the province with lower rice production tends to be a deficit, it will fulfill its rice needs by obtaining rice from production center areas around its territory. The rice traded in the deficit area is mostly imported from other regions. Almost all traded goods are already in the form of rice. DKI Jakarta, as one of the rice trading centers in Indonesia, supplies and distributes rice from and to various areas in Java and inter-island.

Several previous studies have found results that rice markets in some parts of Indonesia have not been fully integrated; the Indonesian rice market is still segmented. This indicates that the rice market in the region is included in the market structure of imperfect competition. As a consequence, the market is influenced by market forces that cause the price of rice to becoming unstable [6], [20]–[23].

To Indonesia as an archipelagic country, the efficiency of the rice market does not mean that the market must be perfectly integrated into one country. The Indonesian rice market is segmented into several regions based on the island. The form of an archipelago requires more attention to transportation and communication to achieve national integration in all fields [24]. Improvement of the infrastructure in transportation and communication will make the flow of rice more efficient from surplus to deficit area.

Interisland rice trade is one of the commodity market mechanisms that occur naturally in response to the uneven distribution of rice production between regions. Inequality distribution of rice production between regions is one of the causes of the imbalance in rice prices between regions. It is one strategy to reduce rice price fluctuations by equalizing inter-island trade through more even distribution of products between regions [25].

In general, from the analysis of the spatial integration model of the Indonesian rice market, it can be said that there is a horizontal correlation between rice trade inter-region. Spatial rice market integration has occurred in the short and long term in the incomplete integrated rice market. This can be seen from the relationship between variables or markets where not all markets are connected. Even in the long run, there is still an independent rice market. The coefficient values of models which are smaller than one indicates a weak level of integration, meaning that the level of efficiency of the Indonesian rice market is still low. The geographic condition of the Indonesia archipelago causes perfect market integration to be difficult to achieve. The rice market will be segmented into several regions due to differences in location and infrastructure conditions of each region in adjusting to price changes.

Although the integration of the Indonesian rice market is imperfect, reflecting the low level of market efficiency, it can be concluded from the results of the analysis that there are regions or central points that are determinants or market rulers. This means that controlling the rice market in Indonesia does not require controlling the entire rice market spreading throughout Indonesia and can not also be concentrated at one point, but control must be done at the determinants market spread across every island in Indonesia. This is done because of the different rice market behavior in each location. There are six locations or central points, namely: North Sumatra and South Sumatra with rice trade flow in the western part of Indonesia; DKI Jakarta and Central Java with rice trade flow in the central and west part of Indonesia; East Java with rice trade flows in central and eastern Indonesia, and South Sulawesi with rice trade flows in eastern Indonesia.

IV. Conclusion

This paper proposes a novel concept of island economics in the Indonesian rice market, which is inefficient based on the imperfect analysis of market integration. This means that rice prices between regions have not fully moved in the same direction and magnitude. Indonesia's archipelago geographical conditions make it difficult to achieve the perfect integration of the rice market. Horizontal market integration is segmented into several points in some areas. The implementation of rice policies will be efficient if policies are developed and implemented based on specific commodities for the location or province of the determinants of market authorities. The efficient determination of the rice market will impact the market efficiency of rice in other areas that are linked or integrated. This study is limited to analyze the inter-island and inter-provincial rice trade with secondary data from BPS. Future studies are expected to map the flow of goods from the main ports on each island used for the inter-island rice trade and imports.

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