Rice Price Market Integration and Supply Chain Management (SCM) in Indonesia

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***Abstract*— The purpose of this research is to analyze rice market integration and SCM among major cities in Indonesia. The data are the average monthly rice prices in 33 major cities from January 2014 to December 2017 taken from the Central Statistics Bureau of Indonesia. The research methods are non–time series analysis and time series analysis. The results from the non–time series analysis show that almost all rice prices have significant market integration, but a few cities do not. The time series analysis covers only a few of the cities included in the research; however, due to the requirement that the Error Correction Model (ECM) data must be stationary. The results from the time series analysis show that all cities analyzed have significant long-run integration, but in the short run, only a few cities have market integration. The results of this research can support government intervention in spreading the rice price in a few cities to other cities in Indonesia.**

Keywords *— rice prices, market integration; SCM; rice market in Indonesia; Error Correction Model, correlation analysis, agricultural economics*

1. Introduction

Rice is the leading staple food in Indonesia [1]. The rice market is vital to the economy in Indonesia. The rice market must be efficient in supporting community economics. Rice is a crucial commodity, and the Indonesian rice market is subject to extensive government intervention [2].

The intervention of the government in the rice market takes the form of rice price policy. This policy is a government effort to maintain food security [3-5]. The example of government intervention in the rice market is a trade barrier. Indonesian domestic rice prices are usually higher than international prices. In September 2017, the domestic rice prices in Indonesia were 54% more expensive compared to global rice prices from Thailand [6]. This means that if the government did not intervene in rice prices, the domestic rice prices would decrease because rice from the international market could enter the domestic market via rice imports. Lower rice prices would discourage Indonesian farmers from increasing production because it would not be profitable. This condition can threaten food security. To avoid this, the Indonesian government made Intervention Rule No. 93 in 2007 that placed tariff trade barriers to prevent the import of rice from the international market. This intervention can make the price of rice in the domestic market still higher because there is no competition from imported rice. This government intervention by tariff is not a good policy, but to maintain food security in Indonesia, and these tariff barriers must exist.

Another example of government intervention in the rice market is *Harga Pembelian Pemerintah* (HPP) or Government Price Purchase (GPP) program. The government purchases rice from farmers at a higher price if rice prices in the market are too low. The government also sells rice at lower prices if rice prices in the market are too high. This condition may harm the rice consumer.

The government must be careful about implementing rice price policy. If the government makes high rice prices its policy, it can stimulate an increase in paddy prices, namely, the prices of rice paddy when farmers sell their farm products [7]. indicated that rice prices have a significant influence on paddy prices. Increasing paddy prices can increase farm profit. The increase in farm profit can stimulate farm production. Farm output must be supported to ensure food security. This means food security must be supported by the high price policy.

Other effects of a high rice price policy are harm done to the rice consumer and a possible increase in the poverty rate [8-11]. The government, therefore, must be careful when implementing a high rice price policy. Food security needs a high rice price policy to stimulate domestic rice production, but at the same time, a high rice price policy can harm the consumer and increase poverty.

Government intervention by means of high rice price policy or low rice price policy depends on the situation. If the situation needs a high rice price policy to stimulate rice production, the government must intervene to increase rice prices. On the other side, if the situation needs a low rice price policy to reduce poverty, the government must provide an intervention with the low rice price policy. The dilemma is figuring out how effectively the intervention can impact rice prices.

Price intervention is useful if the rice price changes in the market that experienced the response are transmitted to another market. Market integration and economic development have a positive relationship. A well-functioning rice market is a precondition for economic development [2].

Market integration needs to be analyzed because it is a precondition for government intervention and policy. If the Indonesian market is not integrated, it is ineffective and costly to intervene in the rice market, but if the rice market is integrated, the government can use intervention to improve the rice market for an optimal rice price policy [12]. The law of one price (LOOP) is a measure of market integration [13]. The LOOP states that in competitive markets that are free of transportation costs and official barriers to trade, identical goods sold in different countries must sell for the same price when their prices are expressed in terms of the same currency [14].

According to [15], price transmission is a situation where the price of a product in one market can stimulate the price of the same product in another market. If one market has price transmission with another market and vice versa, this situation is defined as market integration [16]. The theory of market integration is the LOOP. According to [12], if a single price exists in several markets, the market is integrated. According to [17], the LOOP is a competitive spatial market equilibrium, which means that the price is in equilibrium. Many researchers, such as [17-20], have used the LOOP to analyze market integration. Market integration can be analyzed using simple bivariate correlation [2] for non–time series analysis and the Error Correction Model (ECM) for time series analysis. The ECM is used because this analysis can provide the short-run and long-run relationships between rice prices in several markets. [21-24] and many other researchers use the ECM to analyze market integration.

2. Methods

The data were gathered from *Badan Pusat Statistik* (the Central Bureau of Statistics in Indonesia) [25-32]. The data were average monthly rice prices for several brands of rice. The non-time series analysis was a simple bivariate correlation, which is one of several methods for analyzing market integration [2]. The time series analysis is the ECM because it is commonly used in market integration. The ECM method assumes that data are stationary. The Dickey-Fuller test was used for the stationary test.

3. Results

The research data were the monthly average rice prices in 33 major Indonesian cities between January 2014 and December 2017. The cities are listed in Table 1.

Table 1. Descriptive results in average monthly price per city in IDR/Kg

No.	City	Mean	Minimum	Maximum
1	Banda Aceh	10,114.58	8,942	10,794
2	Medan	10,188.38	9,412	10,879
3	Padang	12,364.65	10,928	13,591
4	Pekanbaru	11,813.38	8,585	12,908
5	Jambi	10,356.77	7,954	11,353
6	Palembang	9,804.52	8,847	11,152
7	Bengkulu	10,260.10	7,658	11,429
8	Bandar Lampung	9,846.90	5,000	11,144
9	Pangkal Pinang	10,704.50	9,136	11,817
10	Tanjung Pinang	12,688.15	10,801	14,299
11	Jakarta	12,092.38	10,273	13,104
12	Bandung	10,521.04	8,161	11,835
13	Semarang	10,071.90	8,953	10,804
14	Yogyakarta	10,111.13	9,151	11,459
15	Surabaya	10,501.58	8,020	11,524
16	Serang	9,097.29	7,940	10,359
17	Denpasar	10,448.92	9,011	11,838
18	Mataram	9,277.77	8,044	10,341
19	Kupang	10,491.38	9,306	11,550
20	Pontianak	11,992.58	10,488	12,689
21	Palangkaraya	13,521.27	10,941	14,905
22	Banjarmasin	11,995.65	7,302	13,159
23	Samarinda	11,114.25	10,084	11,725
24	Manado	10,336.31	8,750	11,634
25	Palu	9,558.06	8,178	11,297
26	Makassar	8,973.94	7,543	9,972
27	Kendari	9,766.40	8,169	11,208
28	Gorontalo	9,665.85	8,493	10,634
29	Mamuju	9,228.13	7,849	10,991
30	Ambon	11,445.23	7,001	12,248
31	Ternate	11,276.96	10,313	12,349
32	Manokwari	12,082.46	10,595	13,299
33	Jayapura	12,536.10	9,399	13,519

Table 1 shows the rice prices in 33 major cities in Indonesia. The data are measured in average monthly prices by IDR/Kg. The data ranges from January 2014 to December 2017.

The purpose of this research is to analyze rice market integration and SCM among major cities in Indonesia, which can be tested by correlation among cities. The correlation test of rice prices indicates the relationship between the prices of rice in all major cities in Indonesia. The result of the correlation test is shown in Table 2.

Table 2. The Result of Correlation Test

Description	Result	percent
Number of pairs significant correlation	1042	98.67
Number of pairs non-significant correlation	14	1.33
Number of pairs correlation*	1056	100

*) not included the self-pair correlation

The result shows that almost all rice prices are significantly correlated between cities, and only a few pairs of cities are not significantly correlated. They are Bandar Lampung-Banda Aceh, Bandar Lampung-Pangkal Pinang, Bandar Lampung-Tanjung Pinang, Bandar Lampung-Gorontalo, Bandar Lampung-Mamuju, Bandar Lampung-Ambon, and Bandar Lampung-Manokwari. The rice prices that are not correlated in other cities are only those of the city of Bandar Lampung. A subject for future research is determining why only Bandar Lampung prices are not correlated with other cities in Indonesia.

The next analysis is a cointegration analysis of the rice prices between the cities with an ECM analysis. Before ECM analysis can be applied, the data must be stationary. According to [33], the cointegration analysis must be supported by stationary data as non-stationary data produces spurious results [34]. The results of the stationary test can be seen in Table 3.

Table 3. Dickey-Fuller stationary test results for Indonesian cities

No.	Variable	t-statistic	Critical Value at 5%	Prob
1	Ambon	-2.079890	-2.926622	0.2534
2	Banda Aceh	-0.950692	-2.925169	0.7630
3	Bandar Lampung	-7.380026**	-2.926622	0.0000**
4	Bandung	-1.138701	-2.926622	0.6925
5	Banjarmasin	-3.005224*	-2.925169	0.0416*
6	Bengkulu	-2.722662	-2.925169	0.0778
7	Denpasar	-1.229653	-2.925169	0.6539
8	Gorontalo	-1.094037	-2.925169	0.7106
9	Jakarta	-2.284355	-2.925169	0.1811
10	Jambi	-1.538462	-2.925169	0.5053
11	Jayapura	-2.941024*	-2.925169	0.0482*
12	Kendari	-1.287184	-2.925169	0.6279
13	Kupang	-1.195713	-2.925169	0.6687
14	Makassar	-1.410607	-2.925169	0.5692
15	Mamuju	-0.875811	-2.925169	0.7873
16	Manado	-1.845311	-2.925169	0.3547
17	Manokwari	-1.378480	-2.925169	0.5848
18	Mataram	-2.291372	-2.925169	0.1789
19	Medan	-0.748713	-2.926622	0.8238
20	Padang	-1.855621	-2.926622	0.3498
21	Palangkaraya	-3.418221*	-2.926622	0.0153*
22	Palembang	-1.408797	-2.926622	0.5699
23	Palu	-1.715279	-2.926622	0.4172
24	Pangkal Pinang	-0.488143	-2.926622	0.8840
25	Pekanbaru	-2.048265	-2.926622	0.2660
26	Pontianak	-2.196425	-2.925169	0.2103
27	Samarinda	-1.563560	-2.931404	0.4922
28	Semarang	-2.078906	-2.925169	0.2538
29	Serang	-0.608812	-2.925169	0.8587
30	Surabaya	-2.368171	-2.925169	0.1560
31	Tanjung Pinang	-1.402901	-2.926622	0.5730
32	Ternate	-0.340948	-2.925169	0.9106
33	Yogyakarta	-0.995957	-2.926622	0.7473

**Highly Significant, *Significant

The stationary test used the Dickey-Fuller test with a level of significance at α=5%. The results of the stationary test in Table 3 show that the cities whose data prices passed the test are Bandar Lampung, Banjarmasin, Jayapura, and Palangkaraya. Because only these cities have stationary data, the analysis of ECM covers only these cities. The results of the ECM analysis are shown in Table 4.

Table 4. The Result of ECM Analysis

Relationship	Short Run Result	Long Run Result
Bandar Lampung-Banjarmasin	Non-significant	Significant
Bandar Lampung-Jayapura	Non-significant	Significant
Bandar Lampung-Palangkaraya	Non-significant	Significant
Banjarmasin-Bandar Lampung	Non-significant	Significant
Banjarmasin-Jayapura	Significant	Significant
Banjarmasin-Palangkaraya	Non-significant	Significant
Jayapura-Bandar Lampung	Significant	Significant
Jayapura-Banjarmasin	Non-significant	Significant
Jayapura-Palangkaraya	Non-significant	Significant
Palangkaraya-Bandar Lampung	Non-significant	Significant
Palangkaraya-Banjarmasin	Non-significant	Significant
Palangkaraya-Jayapura	Non-significant	Significant

Table 4 shows the results of the ECM analysis of the influence of rice prices in one city on rice prices in another city. Rice prices have significant short-run impacts only from Banjarmasin to Jayapura and from Jayapura to Bandar Lampung, but the long-run effect is significant in all the city pairs. Therefore, in the short run, the direct price transmission is only significant from Banjarmasin to Jayapura and from Jayapura to Banjarmasin, but in the long run, all the cities have significant impacts on each other in this analysis.

4. Discussion

This research found that almost all major Indonesian cities have significantly correlated rice prices in a non–time series analysis. This result provides evidence of the market integration of rice prices in these cities. For an analysis of short- and long-run integration, a time series analysis is needed. Time-series analyses need stationary data [34], but only Banjarmasin, Bandar Lampung, Jayapura, and Banjarmasin have stationary data. Therefore, only these cities can be analyzed. The research found that all cities have a significant long-run relationship. The significant short-run relationship applies only to Banjarmasin-Jayapura and Jayapura–Bandar Lampung. From these limited results, we concluded that most rice price markets in Indonesia are integrated.

The present research enriches the literature on rice markets. The research of [2] is a history of rice market integration and SCM from 1920–2006. The data were monthly prices from 11 major cities: Jakarta, Bandung, Semarang, Surabaya, Palembang, Padang, Medan, Pontianak, Makassar, Manado, and Banjarmasin. The research found that before 1940 the rice market was relatively integrated; from 1940–1970, the rice market was disintegrated, and from 1970–2006, the rice market returned to integrated.

[35] also examined rice market integration and SCM in Indonesia. The data were weekly rice prices from 1982–1993 of the entire rice market in Indonesia. The research found that the rice price between markets is weakly integrated. The research of [36] in Vietnam concluded that price controls could diminish the domestic adjustment costs of countering volatility in the world price and can support farmers' welfare. The research of [37] used the prices of 35 products in 45 cities in Indonesia and found that the prices converged to the LOOP if the LOOP of the market prices indicated that the products have market integration between cities. [38-39] found that trade liberalization of the rice market in Japan can threaten national food security, making Japan more dependent on food imports and more susceptible to risks in food security.

5. Conclusion

The rice markets among major Indonesian cities are almost completely integrated. The analysis of bivariate correlations with 1056 relationships among 33 major cities in Indonesia shows that 1042 relationships are significantly correlated, and only 14 relationships are not significantly correlated. More research is needed to determine why most cities have correlated rice prices and why other cities do not have correlated rice prices. The analysis of time series relationships with ECM applies only to the cities that passed the stationary data test: Bandar Lampung, Banjarmasin, Jayapura, and Palangkaraya. The analysis shows that the cities all have significant long-run relationships, but only two cities have significant short-run relationships. The cities that have short-run relationships are Banjarmasin-Jayapura and Jayapura–Bandar Lampung. The finding that most cities in Indonesia have significant rice-price relationships supports government policies such as Intervention Rule No. 93 and government purchase prices that intervene in rice prices. As evidenced by this research, such interventions in rice prices in a few cities can spread to other cities.

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