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| RESEARCH ARTICLE

Rice Market Spatial Integration during Covid-19 in Indonesia

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| ABSTRACT
Restrictive policies during the Covid-19 pandemic have significantly disrupted the distribution of trade between regions in Indonesia. The availability of production and affordability of prices is essential to always pay attention to during the Covid-19 period, especially for rice commodities, whose role is very strategic. Rice price stabilization will be more effective and efficient in an integrated market. This study aims to analyze the disparity of rice prices before and during Covid-19 and the spatial integration of the rice market in Indonesia. The data used is the daily price of rice at the consumer level from August 1, 2018, to August 31, 2021. The analysis area consists of 12 reference provinces, and the rest are assumed to be followers. The method used in this research is Johansen Cointegration, Causality, and Vector Error Correction Model (VECM). The results showed that the inter-provincial rice marketing system in Indonesia in terms of price efficiency had already occurred. This can be seen from the results of the study, which show that the disparity in rice prices is not significant even during the Covid-19 period, and price transmission has been well integrated throughout the province in the long term. Meanwhile, in the short term, the deficit reference provinces, namely Jakarta and Papua, are more integrated with other provinces than surplus provinces. This allows rice supply from the surplus market to be very important in determining the price of rice in the two provinces. The adjustment rate to the average equilibrium price is 0.0086% per day, so the total adjustment time is three months and 26 days. Meanwhile, when Covid-19 occurred, the average adjustment rate was 0.00078% per day, so the total adjustment time was prolonged during Covid-19 by 1282 days or three years and six months. The results also show that East Java, West Java, Central Java, South Sulawesi, Riau, Papua, and DKI Jakarta are reference markets that can determine prices in other provinces while other provinces become follower markets.

| KEYWORDS

Consumer Market, Covid-19, Rice, Spatial Integration, VECM

| ARTICLE INFORMATION

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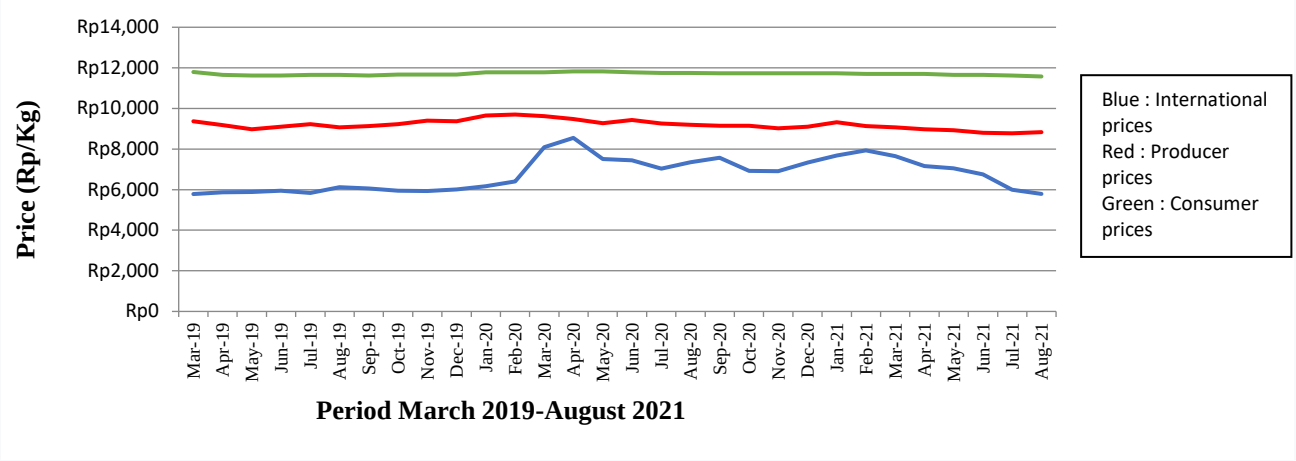
1. Introduction

The spread of the Covid-19 pandemic has had a significant impact on all trade activities, including the agricultural sector, one of which is rice, which is the leading staple food in Indonesia. According to FAO (2020), the Covid-19 pandemic has directly affected the food system. The impact will be seen in the supply and demand of food and indirectly through a decrease in purchasing power, capacity to produce, and distribution of food ingredients. Firdaus (2021) The COVID-19 pandemic has disrupted certain food supplies due to restrictions on various production and distribution activities. These limitations triggered Indonesia's inflation which continued to increase during the COVID-19 pandemic through fluctuations in strategic food prices. Bank Indonesia (2021) recorded inflation of 0.28 percent (mm) based on data in November 2020, the Consumer Price Index (CPI) was higher than in October when inflation was recorded at 0.07 percent and higher than the previous year at 0.14 percent.

Figure 1. International Rice Prices, Prices Producer, and Consumer Prices 2018-2021



Source: (Mundi Index 2021; PIHPS 2021)

The shock of fluctuations in the price of Indonesian rice and world rice can be seen in Figure 1. World rice prices tended to fluctuate more than domestic rice prices both at the consumer and producer levels when the Covid-19 pandemic began in December 2020. The extreme fluctuations in world rice prices occurred as a result of the obstruction of global trade flows, some of which implemented protective policies. The existence of protection policies in several countries causes the distribution of supply chains, one of which is rice, not going well and will cause a chain reaction, especially in countries that still depend on the fulfillment of their rice consumption from imports. Trademap (2020) Thailand, the third largest exporting country in the world, has shown a downward trend in the volume of rice exports to the world by up to 42.21% in the January-February 2020 period.

Based on information obtained from the National PIHPS in Figure 2, information is also obtained that the movement of producer and consumer rice prices for the period March 2019 to August 2021 tends to be stable. The price of producer rice ranges from Rp. 8,775 to Rp. 9,700, and the price of consumer rice ranges from Rp. 11,575 to Rp. 11,825. Saliem et al. (2020) Food commodity prices at the consumer level mostly tend to increase due to supply constraints in the market as a result of distribution disruptions which impact the PSBB policy during the Covid-19 pandemic.

Meanwhile, prices at the producer level have decreased due to declining demand from restaurants, hotels, and households affected by Covid-19. Plus, if it coincides with the time of the main harvest, it makes the price of food commodities at the farmer level even lower. Even though there have been changes in rice prices at both the producer and consumer levels due to the Covid-19 pandemic, these changes are still relatively stable and reasonable compared to international prices, which have extreme fluctuations. This indicates that the government's intervention to maintain rice prices during the Covid-19 pandemic has been effective. Effective government intervention during Covid-19 was also confirmed by research conducted by Asrin (2022) that the price of rice producers and consumers during the Covid-19 pandemic was stable and did not affect each other so that changes in rice prices that occurred to producers were not transmitted on the price of rice at the consumer level.

Another factor that caused rice prices to stabilize during Covid-19 was that almost every year, Indonesia had a surplus of rice. Even though rice production is higher than consumption, Indonesia imports rice yearly to maintain rice price stability and keep rice stocks safe and secure. In fact, in the last two years, Indonesia's imports have decreased significantly from 2.17 million tons in 2018 to 981 thousand tons in 2020. This indicates that the dependence of domestic rice on imported rice has decreased. Thus, even though the price of rice on the world market fluctuates, it does not have a significant impact on domestic rice prices.

This condition is inversely proportional to geographical (spatial) views. The average household consumption in Indonesia can be met by domestic rice production, with a surplus of 49.83 percent. However, as many as 17 provinces have been unable to meet all household needs by relying on production within the province. It is known from the production volume that it is in deficit compared to consumption needs. Of the 17 provinces with deficit production, 9 of them experienced a deficit of more than 50 percent, so these provinces needed to import rice from suppliers outside the province. The province is Riau Province, Kep. Bangka Belitung, Kep. Riau, DKI Jakarta, North Kalimantan, Maluku, North Maluku, West Papua, and Papua. In general, the island of Java, which includes West Java, Central Java, and East Java, is a surplus area and is the main centre of rice production, contributing a percentage of 56 percent (Central Bureau of Statistics, 2021). This proves that the flow of rice trade between regions is still strong, especially from the island of Java as a centre for rice production. This trade flow will lead to the formation of a linkage between regional

markets into an integrated trading system. If the market is spatially integrated, then price changes will be transformed into other markets. This causes price increases in one market to spread price volatility in integrated markets. In an integrated market, the dominant market can be a reference market. Reference markets can influence price formation in other markets and set national prices in the long run. Therefore, government policies related to price stability will get the desired results if the policies are aimed at that market so that they do not expand and become turmoil at the national level.

Spatial rice market integration also plays an essential function in maintaining economic performance in the regions, especially in uncertain conditions such as Covid-19. On the other hand, in conditions like this, controlling the need for food in sufficient quantity, quality is maintained, and affordable prices are significant. Integrated market conditions are still considered to optimize trade performance between regions despite the pandemic (Nasir et al., 2021). Therefore, research on the spatial integration of the rice market, especially during the Covid-19 pandemic, needs to be analyzed further so that it can respond to changes in rice prices quickly and accurately. This research is expected to provide policy recommendations on strategies to secure the supply and stability of commodity rice prices when the COVID-19 outbreak occurs again. In the end, it will be a valuable guideline for local governments to improve the community development of local resources in each region.

2. Methodology

Type of data used in this study is daily data on rice prices at the retail level with medium rice types sourced from the Strategic Food Price Information Center (PIHPS). The time series data used in this study are for 1126 days, starting from August 1, 2018, to August 31, 2021. Data from August 1, 2018, to March 2, 2020, represents the period before Covid-19, while the period during Covid-19 is shown by data from March 3, 2020 – August 31, 2021. Daily data is used because it tends to have more significant price dynamics and detailed information than data over a more extended period. Cross section data to be analyzed are 12 reference provinces consisting of six surplus provinces that sell to other provinces and six deficit provinces that purchase from other provinces. The determination of the twelve provinces is seen from the amount of production, consumption, and trade flows. The surplus provinces are West Java, East Java, Central Java, South Sulawesi, South Sumatra, and Lampung. While the deficit provinces are DKI Jakarta, Riau, Papua, East Nusa Tenggara, Riau Islands, and North Sumatra. Meanwhile, other regions are assumed to be follower provinces. The test of this research uses the Error Correction Model (ECM), which consists of a unit root test, determination of optimum lag, cointegration test, and ECM vector estimation (VECM). Eviews 10 software is used for data processing.

2.1 Unit Root Test

When the analysis is performed on non-stationary data, it produces spurious regression results, and the conclusions drawn are less meaningful (Enders 1995; Thomas 1997). Therefore, the first step is to test and make the data stationary. One method that can be used to test the stationary of the data is the Augmented Dickey-Fuller (ADF) method.

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \mu_t$$

Where Yt is the first difference from Yt, assuming the time series data before differentiation is not stationary, stationarity testing is still carried out on the initial data before differentiation. The hypothesis is static data if statistical ADF > critical ADF, then reject H0. While the data is not stationary, if the ADF statistic < ADF critical, then reject H0.

2.1.1 Determination of Optimum Lag

Determination of the optimal lag length is essential in forming the VAR model because the endogenous variables in the equation system will be used as exogenous variables and are needed to capture the influence of each variable on other variables in the VAR system, the possibility of residual autocorrelation. Determination of optimal lag can use several information criteria as follows: (1) Akaike Information Criterion (AIC), (2) Schwarz Information Criterion (SC), (3) Hannan-Quinn Information Criterion (HQ), (4) Likelihood Ratio (LR), and (5) Final Prediction Error (FPE).

The optimal lag length occurs if the values of the criteria above have the smallest absolute values, except for the LR criteria using the largest if only one of the criteria is used. Meanwhile, if you use several criteria, you must use additional criteria, namely adjusted R2 for the VAR system. The optimal lag length occurs when the adjusted R2 value is the highest. Three hundred ninety-six market pairs formed from 12 selected provinces have optimum lag values ranging from 1 to 9. This means that the price of rice in exogenous variables (the following provinces) can currently be influenced by rice prices from endogenous variables (reference provinces) for 1 to 9 days in Indonesia. Advance. The lag is considered small according to the model and is good; the slight lag can also avoid the possibility of multicollinearity.

Cointegration Test 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 analysis shows that prices of homogeneous products in different markets move together in a long-run relationship even though they may move apart in the

short-run (Enders 1995). 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 with the Causality Test.

This test is used to see whether a variable is treated as an exogenous or endogenous variable. The causality test was conducted to determine whether there was a two-way, one-way relationship between the variables or no relationship. The causality test in this study will use the Granger causality test.

2.1.1.1 Vector Error Correction Model

VECM estimation uses a restricted VAR model due to the existence of data that is not stationary but has the possibility of being cointegrated. After knowing the existence of cointegration, it is recommended to enter the cointegration equation into the model used so that the VECM contains the speed of adjustment from short to long term. The VAR/VECM model in spatial integration used in this study is as follows:

$$\Delta \hat{P}_t^i = \alpha_0 + \alpha_1 \Delta P_{t-1}^j + \alpha_2 \hat{u}_{t-1} + \varepsilon_t$$
$$\hat{u}_{t-1} = \Delta \hat{P}_t^i - \alpha_0 - \alpha_1 \Delta P_{t-1}^j - \alpha_2$$

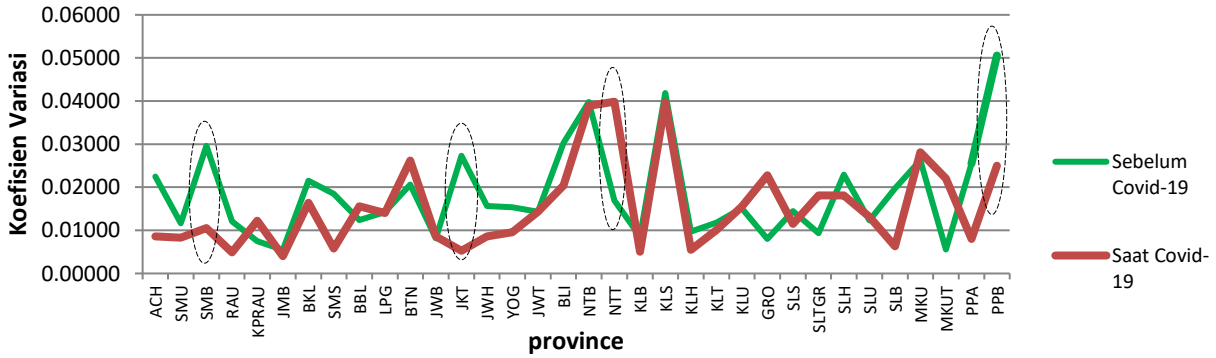
Where α1 is the short-term effect and 2 indicates the error correction speed (speed adjustment). The critical parameter is two because it describes the dynamics of the system and describes the rate at which the variable adjusts to balance. Analyzing the dynamics of the adjustment (speed adjustment) allows for studying the speed of price transmission. For example, how many days, weeks, or months it takes for prices to be paired from one location to another? Policymakers need to plan food distribution and price stabilization. Sometimes the speed of this price response is related to the efficiency of the market system. They need not imply that the system is functioning correctly. It is, therefore, essential to consider the speed of adjustment as only one dimension of integration. Two markets, A and B, which have high-speed adjustments, show that both markets have good integration (Jojo et al., 2021).

3. Results and Discussion

3.1 Rice Price Disparity in Indonesia

The magnitude of fluctuations in food prices can be described by the coefficient of variation. Figure 2 shows the coefficient of rice variation before and during Covid-19. The decrease in the coefficient of variation occurred in 23 provinces with a percentage of 67.65 percent. At the same time, the remaining 32.35 percent experienced an increase. The Covid-19 pandemic has resulted in fluctuations in rice, especially in deficit provinces. This is because the province still supplies most rice from other provinces. Significant fluctuations occurred in the provinces of West Sumatra, Jakarta, East Nusa Tenggara, and West Papua. East Nusa Tenggara Province has the highest increase in value with CV before covid of 0.0196, increasing to 0.0399 during Covid-19.

Meanwhile, the highest CV decline was in West Papua, with a CV value before Covid of 0.0250 to 0.0506. Nevertheless, the price disparity between regions in Indonesia is still relatively stable, with an average of 0.018 before Covid and 0.015 during Covid, so the difference in decline before and during Covid-19 is 0.003 percent per day. In line with research conducted by (Anugrah et al. 2020), there was a relaxation of several restrictive policies for the rice distribution process, and supply remained smooth even though the volume of purchases and absorption from several destination markets was still limited, and the circulation took longer to sell.



Source: PIHPS 2021 (processed)

Figure 2. Coefficient of Variation of Rice Prices Before and During Covid-19 period August 2018- August 2021

3.1.1 Spatial Integration of the Rice Market in Indonesia

3.1.1. Testing Unit Roots

Stationarity test results in Table 1 show that there are 30 out of 34 rice price data which is not stationary at the level or I(0) at the 1% significance level. The Augmented Dickey-Fuller (ADF) t-statistic value is greater than the McKinnon critical value. The non-fulfilment of the assumption of stationarity at level or I(0) causes all variables to be tested by testing the degree of integration or first difference. A variable is said to be stationary at the first difference if the ADF Test value is less than the McKinnon critical value.

The results of the unit root test on the first difference, all variables used in this study were stationary. The stationarity of all variables can be seen from the ADF value, which is smaller than the McKinnon critical value at the 1% confidence level. 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.

Table 1 Unit root test for rice prices at the Retail level in Indonesia

Province	Level		1st First Difference	
	Nilai ADF	Information	Nilai ADF	Information
Aceh (ACH)	-2.1339	Not Stationary	-13.9031***	Stationary
Sumatra Utara (SMU)	-2.1019	Not Stationary	-24.3315***	Stationary
Sumatra Barat (SMB)	-3.0648**	Stationary		
Riau (RAU)	-4.4654	Not Stationary	-29.7119***	Stationary
Kepulauan Riau (KPRAU)	-1.3951	Not Stationary	-12.9367***	Stationary
Jambi (JMB)	-1.2035	Not Stationary	-22.8030***	Stationary
Bengkulu (BKL)	-2.3384	Not Stationary	-25.5355***	Stationary
Sumatra Selatan (SMS)	-2.0979	Not Stationary	-24.9987***	Stationary
Bangka Belitung (BBL)	-1.9188	Not Stationary	-20.5782***	Stationary
Lampung (LPG)	-1.9426	Not Stationary	-18.6200***	Stationary
Banten (BTN)	-0.935	Not Stationary	-14.2941***	Stationary
Jawa Barat (JWB)	-1.5356	Not Stationary	-18.5473***	Stationary
Jakarta (JKT)	-2.4344	Not Stationary	-47.9507***	Stationary
Jawa Tengah (JWH)	-1.5262	Not Stationary	-24.3476***	Stationary
Yogyakarta (YOG)	-1.4355	Not Stationary	-16.6874***	Stationary
Jawa Timur (JWT)	-0.711	Not Stationary	-36.619***	Stationary
Bali (BLI)	-4.9475***	Stationary		
Nusa Tenggara Barat (NTB)	-2.2514	Not Stationary	-22.2133***	Stationary
Nusa Tenggara Timut (NTT)	-1.1764	Not Stationary	-13.7493***	Stationary
Kalimantan Barat (KLB)	-2.3373	Not Stationary	-13.3382***	Stationary
Kalaimantan Selatan (KLS)	-0.8040	Not Stationary	-20.0701***	Stationary
Kalimantan Tengah (KLH)	-1.3797	Not Stationary	-22.3113***	Stationary
Kalimantan Timur (KLT)	-3.3071	Not Stationary	-21.117***	Stationary
Kalimanatan Utara (KLU)	-4.4956***	Stasioner		
Gorontalo (GRO)	-2.2312	Not Stationary	-20.8050***	Stationary
Sulawesi Selatan (SLS)	-3.1627	Not Stationary	-25.9135***	Stationary
Sulawesi Tenggara (SLGR)	-2.1343	Not Stationary	-16.6470***	Stationary
Sulawesi Tengah (SLH)	-1.9290	Not Stationary	-23.9407***	Stationary
Sulawesi Utara (SLU)	-2.5296	Not Stationary	-37.6006***	Stationary
Sulawesi Barat (SLB)	-2.9805**	Stationary	-31.5804***	Stationary
Maluku (MKU)	-1.0928	Not Stationary	-24.7354***	Stationary
Maluku Utara (MKUT)	-0.9314	Not Stationary	-21.8788***	Stationary
Papua (PPA)	-0.9314	Not Stationary	-21.8788***	Stationary
Papua Barat (PPB)	-3.8621*	Stationary	-21.2183***	Stationary

Source : PIHPS 2021 (processed)
Description: *** indicates significance at a 1% level of significance
** shows significance at a 5% significance level
* shows significance at the 10% level of significance
The value of the t-table (α=1%) is 2.5803432

3.1.1.1.2 Cointegration Test

The results of the cointegration test show that all reference provinces have a cointegration relationship of 100% with the destination province, which means there are 396 combinations of integration relationships. This means the null hypothesis, which states that there is no cointegration, is rejected. The alternative hypothesis, which states that there is cointegration, is not rejected, so it can be said that all variables have a significant long-term relationship. Medium rice prices have a long-term equilibrium relationship, and there is strong cohesiveness between consumer-level medium rice markets, so prices in one market can be used to predict prices in other markets. According to (Hidayanto 2014), the greater the trace statistic value, the higher the cointegration level. The market cointegration with the highest trace statistic value is the surplus provinces, namely East Java (JWT), West Java (JWB), and South Sulawesi (SLS), and the deficit provinces, namely Jakarta (JKT) and Riau (RAU). While the eastern part of Indonesia tends to have low cointegration with the central regions, as shown in Figure 2.

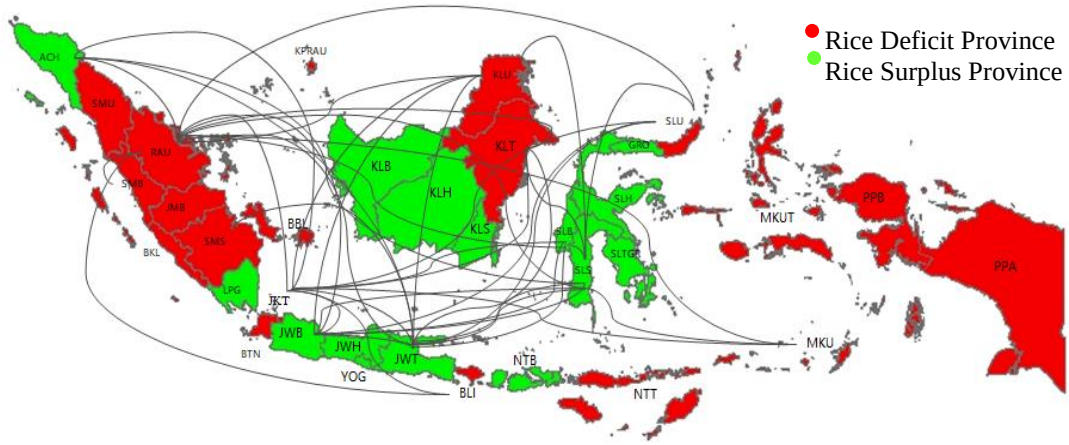


Figure 2. The results of the cointegration test of the rice market with the highest Trace Statistics value (processed)

3.1.2 Long-term dynamics of the rice market in Indonesia

Long-term integration can be seen in Table 2. All market pairs, both surplus reference market and deficit reference market are integrated with all destination markets. This result is inversely proportional to the research that has been done previously by Arnanto et al. (2014) using reference areas, namely West Java (JWB), East Java (JWT), Central Java (JWH), South Sulawesi (SLS), South Sumatra (SMS), Lampung (LPG) and DKI Jakarta (JKT). The results of his research show that provinces on the island of Sumatra and Java can accept price changes from the reference area. Meanwhile, the islands of Kalimantan, Sulawesi, and Papua are not well integrated. Price changes in the reference area are not appropriately transmitted by the islands. Hidayanto (2014) also shows that the long-term integration of the rice market at the inter-provincial retail level is only 38.46%. The integration of rice in all market pairs indicates that rice distribution has run efficiently in the long term. Prices at the retail or consumer level have been well transmitted to the provinces of surplus and deficit rice.

The impact of the Covid-19 pandemic has affected the dynamics of the national food situation. The impact of restrictions on mobility through PSBB (Large-Scale Social Restrictions) and other health protocols encourages community activities to fulfill basic food needs to be limited. The implementation of PSBB is an obstacle to supply chain activities for primary and strategic food commodities (Anugrah et al., 2020). In the rice deficit area, the lack of supply will increase rice prices. In contrast, in the surplus area, there will be a significant decline in prices due to increased production that is not accompanied by good distribution throughout Indonesia.

Table 2. Long-term spatial integration of rice market in Indonesia

Reference province	Integration of all provinces	Integration of the Covid-19 Pandemic

	Long Term	Percent (%)	Long Term	Percent (%)
Jawa Barat (JWB)	33	100	19	57
Jawa Timur (JWT)	33	100	20	60
Jawa Tengah (JWH)	33	100	29	87
Sulawesi Selatan (SLS)	33	100	22	66
Sumatera Selatan (SMS)	33	100	18	54
Lampung (LPG)	33	100	19	57
Jakarta (JKT)	33	100	33	100
Riau (RAU)	33	100	16	48
Papua (PPA)	33	100	14	42
Nusa Tenggara Barat (NTB)	33	100	17	51
Kepulauan Riau (KPRAU)	33	100	15	45
Sumatera Utara (SMU)	33	100	11	33
Total	396	100	233	58,83

Source: Result of analysis processing Researchers, 2022

Overall when Covid-19 occurs in the long term, 223 market pairs are integrated between the reference market to the destination, or 56.31%. This number is less than the previous 396 market pairs (100%). This indicates that the spread of Covid-19 will reduce the integration of the rice market in the long term. It is known that the provinces most significantly affected in the long term when Covid-19 occurs are Jakarta (JKT) and Central Java (JWH). In the deficit province, namely Jakarta (JKT), price changes due to the Covid-19 pandemic in Jakarta province will be transmitted to 33 other provinces in the long term.

Meanwhile, in the Central Java surplus province (JWH), when a price change occurs during Covid-19, it will be transmitted to 29 other follower market pairs in the long term. The other five provinces, namely East Kalimantan (KLT), Gorontalo (GRO), Southeast Sulawesi (SLTGR), Central Sulawesi (SLH), and West Papua (PPB), did not have a significant impact on price changes in Central Java (JWH). The results of Table 2 show that provinces integrated during the Covid-19 deficit, namely Jakarta (JKT), tended to be more able to influence price changes in other provinces than the surplus province of Central Java (JWH). This is due to the strong influence of demand in the province of Jakarta (JKT). The transmission of surprise price increases in Central Java (JWH) to destination markets tends to be slow.

In contrast, price shocks in Jakarta (JKT) are transmitted quickly to destination provinces. In addition, in line with research conducted by Suryana et al. (2014) in the province of Jakarta (JKT), there is a PIBC (Cipinang Rice Main Market) where the market is a barometer of the national rice trade. Sinaga (2020) The price of PIBC significantly affects the retail price of Indonesian medium rice. The PIBC price shock was fantastically responded to by retail prices. However, the retail price shock was not responded to by the PIBC price.

3.1.3 Short-Term Dynamics of the Rice Market in Indonesia

The ECM model contains an error correction term (ECT) coefficient, which is a speed adjustment to measure how quickly the response variable is adjusted to return to a long-term equilibrium condition after a shock occurs in the variable. Free. The value of this ECT coefficient must be less than 1, negative and significant. The higher the speed adjustment in an ECM model, the faster a response variable will adjust to its long-term equilibrium condition.

Table 3. Speed Adjustment in the Short Term every Day

Highest ECT			Lowest ECT		
Market	Coefficient	Per Day	Market	Coefficient	Per Day
JWB-JWH	-0.01648***	61	JWB-PPB	-0.000096	10384
JWT-JWH	-0.02165***	46	JWT-KLU	-0.000100	10000
JWH-JWT	-0.02450***	41	JWH-KLU	0.000215	4651
SLS-KLT	-0.02038***	49	SLS-JKT	-0.000729	1373
SMS-RAU	-0.02711***	37	SMS-PPB	-0.000438	2283
LPG-JWB	-0.01198***	83	LPG-PPA	-0.00043***	2320
JKT-JWH	-0.02544***	39	JKT-KLS	-0.003127	320
RAU-SMS	-0.01216***	82	RAU-MIKU	-0.00019	5263
PPA-SLS	-0.05259***	19	PPA-PPB	-0.004059	246
NTT-LPG	-0.00808***	124	NTT-MKU	-0.000547	1828
KPRAU-RAU	-0.00773***	129	KPRAU-KLU	0.000157	6369

SMU-JMB	-0.02174***	46	SMU-NTT	-0.000474	2110

Source: The results of the researchers' analysis processing, 2022

The results of the analysis of the short-term dynamics, the Error Correction Term (ECT) coefficient or speed adjustment, are presented in Table 3. It is known that the higher the ECT value, the faster the adjustment. To long term will get faster. It can be seen that the provinces that have the highest ECT are mostly provinces that are close enough to allow the transmission of prices to dash. This means that price changes in the reference market will be transmitted quickly to the destination market. On the other hand, the province with the lowest ECT value is the one that has a relatively long distance, so price transmission can run slowly. This means that price changes in the reference market will be slowly transmitted to the destination province. This is in line with research conducted by (Goletti et al. 1995; Varela et al., 2013; Nasir et al. 2021). The farther the distance between markets, the higher the transportation cost and hinder the flow of goods or trade between these markets. All the highest ECT market pairs have trade flows and significant value integrated with the short term. Except for the provinces of East Nusa Tenggara and Lampung, where both do not trade, prices in NTT can be transmitted to Lampung quickly. Likewise, the lowest ECT market pair between Lampung and Papua does not trade but shows a significant value. This indicates that the integration of the rice market is quite good even though there is a long-distance relationship between regions and there is no buying or selling trade relationship. This statement is also confirmed by the Papua province pair as a reference which is, on average significant in the short term.

The speed of adjustment of the province of Papua to all provinces with an average of 0.03472% per day, so the total adjustment time reaches 28 days. This indicates that even though it is a rice deficit and the area is farthest from the rice production centre, it can still be integrated and can balance rice prices with other provinces quickly. Meanwhile, other provinces with the lowest ECT besides LPG-PPA tend to be insignificant and do not trade, so the speed of rice price adjustment is plodding between provinces.

Table 3. also shows the highest Speed Adjustment by the Province of Papua (PPA), which is integrated with South Sulawesi (SLS) with an ECT coefficient value of 0.0526. This means that rice price deviations in Papua Province (PPA) against the long-term balance caused by the rice price shock in South Sulawesi Province (SLS) will be corrected by 5.26% percent daily or with a speed of adjustment toward the long-term 19 days. Meanwhile, Speed Adjustment is the lowest among the pairs of West Java (JWB) and West Papua (PPB) provinces, with an ECT coefficient of 0.000096 percent. This means that the deviation of rice prices in West Java (JWB) against the long-term balance caused by the shock of rice prices in the province of West Papua (PPB) will be corrected by 0.009 percent per day. The low (slow) Speed Adjustment is because the market pairs, namely West Java (JWB) and West Papua (PPB), do not integrate, and there is no trade flow.

Table 4. Number of Provinces that can be significantly influenced by the reference market in the short term

Template / Island	JWB	JWT	JWH	SLS	SMS	LPG	JKT	RAU	PPA	NTT	KPRAU	SMU
Sumatera	5	3	3	7	3	4	8	5	10	6	6	4
Jawa	4	3	1	5	2	4	5	3	6	5	4	2
Bali Nusa	2	2	0	1	0	2	1	0	3	1	3	0
Kalimantan	0	2	1	4	1	3	4	2	4	2	1	1
Sulawesi	3	3	2	2	4	4	6	2	6	5	3	3
Maluku Papua	0	0	0	1	0	2	4	0	2	1	1	0
Total Provinsi	14	13	7	20	10	19	28	12	31	20	18	10

Source: Results of research analysis processing, 2022

Table 4. Shows the number of provinces that can significantly influence the destination market in the Short Term, divided into six islands in Indonesia. Based on the VECM analysis, there are 233 (58.83%) pairs of rice markets that are integrated in the short term, which is smaller than the integrated rice consumer market in the long term of 396 (100%). The consumer market is integrated in the long term but not necessarily in the short term. Although all provinces are integrated into the long term, after testing in the short term, deficit provinces tend to be more able to transmit prices to all provinces than surplus provinces; this can be seen from the whole provinces integrated with the reference market when a price change, either an increase or a decrease, the price will be appropriately transmitted to areas experiencing a rice deficit. This indicates that the supply of rice in deficit provinces tends to accept prices from surplus provinces that carry out trade. This finding is in line with the fact that some of the deficit provinces bring most of their supplies from outside the province, especially Papua (PPA) and Jakarta (JKT). East Java (JWT), West Java (JWB), and Central Java (JWH) are rice surplus areas that are expected to be well integrated with other regions in Indonesia. However, in the short-term test of Table 4. it can be seen that East Java (JWT) and Central Java (JWH) are not well integrated with other regions. The results of this study are in line with the results conducted by (Arnanto et al. 2014).

In the reference province, the surplus during the spread of the Covid-19 pandemic can still be integrated into other provinces but with a smaller percentage of 27 percent. In comparison, 73 percent is not integrated. The surplus province with the most prices integrated with other markets during Covid-19 was Central Java (JWH), with 21 provinces. The two-way influence when the Covid-19 province is in surplus occurs in the JWB-JWH, JWH-JWT, JWH-SLS, SMS-JWT, and JWB-SMS pairs. The most significant deficit province integrated in the short term when Covid-19 occurred was the province of Jakarta. In the province of Jakarta, when Covid-19 took place, as much as 10 percent of rice prices could be transmitted to other markets. In contrast, the remaining 90 percent were not transmitted. Two-way influence only occurs in the pair Jakarta (JKT) - Riau Islands (KPRAU).

The results show that when the spread of the Covid-19 pandemic in the short term is most affected, namely the province with a surplus of rice (30%) while the deficit is only 10%. This is because there are restrictions so that prices in surplus provinces will tend to decrease, especially during the harvest season. Overall, when the spread of Covid-19 in the short term did not have a significant impact on the rice market in Indonesia. This shows that the rice market in Indonesia can be said to be efficient even during Covid-19. However, it is possible that if the spread of this virus lasts for a long time, it will shock prices between regions. It can be seen from the previous long-term test, which showed a decrease in market integration by 100 percent before Covid-19 and 58.83 percent during the spread of Covid-19.
Policy implications

Based on the results of the integration test and the Granger causality of the rice market in Indonesia, it was found that the provinces of Riau (RAU), Jakarta (JKT), Papua (PPA), South Sulawesi (SLS), West Java (JWB), and Central Java (JWH) could be integrated into most provinces in Indonesia compared to other reference provinces. All reference provinces are integrated in the long term. Meanwhile, in the short term, provinces with a deficit rice supply tend to be integrated into the long and short term. Therefore, if the government wants to restore stability in rice prices, the policy taken will be inappropriate if it is applied only to rice surplus provinces. Policies to quickly stabilize rice prices need to be directed at provinces that are centres of consumption rather than production centres such as Jakarta, Riau, and Papua. Thus, rice price stability can be obtained more quickly and spread well.

On the other hand, the government can implement policies with long-term goals for rice production, such as in the provinces of West Java, East Java, and South Sulawesi. Furthermore, the policies taken are expected to meet the needs of rice producers and consumers in Indonesia. Overall, it can be concluded that the policy implications of controlling rice prices with the primary consideration of focusing on the market that are the price leaders, namely the six provinces, will be transmitted in harmony to other provinces so that they are more effective and efficient in restraining price fluctuations so that they do not spread to other provinces. The types of policies taken depend on the policy's objectives, whether they aim to stabilize prices in a short time (more quickly affect) or have long-term goals.

4. Conclusion

Overall, the inter-provincial rice marketing system in Indonesia from the perspective of price efficiency has already taken place. It can be seen in the results of the study, which show that the disparity in rice prices is not significant even during Covid-19, and the price transmission has been well integrated throughout the province in the long term. This is because rice is a staple food, so price stabilization is very much considered by the government even when there are price shocks such as Covid-19, where the government makes a policy not to limit access to food distribution, especially rice. Meanwhile, in the short term, the deficit reference province is more integrated with other provinces than the surplus province. This shows that most deficit provinces still fulfil their rice supply from surplus provinces, so the price formed is primarily determined by the surplus rice provinces. The deficit provinces are Jakarta and Papua. The adjustment rate to the average equilibrium price is 0.0086% per day, so the total adjustment time is three months and 26 days. The causality results also show that East Java, West Java, South Sulawesi, Riau, Jakarta, and Papua are the leading price leaders. At the same time, other provinces are followers (following).

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