Rice Market Integration In Indonesia: A Cointegration Analysis

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ABSTRAK

Tulisan ini mencoba melihat integrasi pasar beras dengan menggunakan uji kointegrasi (*cointegration test*). Pendugaan kointegrasi pada *bivariate* sistem dilakukan dengan memperlakukan setiap peubah sebagai peubah *endogenous* dan *exogenous* secara bergantian (dua arah). Pada analisis ini digunakan model Engle dan Granger yang disebut *Cointegrating Regression Durbin Watson (CRDW)* dan *Augmented Dickey Fuller (ADF)*. Selanjutnya analisis sebab-akibat Granger diterapkan pada pasar-pasar yang berkointegrasi untuk menentukan pasar sentral dan pasar regional. Hasil pengujian *stationarity* menunjukkan bahwa pada umumnya harga beras *stationar* pada order 1, sedangkan hasil uji kointegrasi memperlihatkan bahwa tidak semua pasar yang letaknya berdekatan berintegrasi satu sama lain. Dari 56 kombinasi hanya terdapat 26 kombinasi pasar yang berkointegrasi. Data harga beras yang digunakan adalah harga perdagangan besar dari tahun 1979 - 1995. Hasil pengujian ini menunjukkan bahwa kebijakan kontrol harga yang dilaksanakan oleh BULOG tidak dapat mencegah terjadinya segmentasi pasar.
Kata kunci : Integrasi, Kointegration, Integrasi pasar, Stasionaritas

ABSTRACT

This article analyzes integration of rice markets using cointegration test. The cointegration bivariate system were estimated in both directions. Cointegration analysis based on the Engle and Granger model, namely CRDW and ADF, is applied. Granger (cause) analysis applied to cointegrated markets, to find central and regional markets. Test results show that most of rice prices are stationary of order 1. It is concluded that there seems to be long run relationships between markets which are relatively close to each other. Percentage of cointegrated market for rice is 46 percent out of 56 combinations. This high cointegration mainly due to marketing system of rice which is strongly controlled by the government. Hence rice price is subject to a controlled trade regime and floor/ceiling price. Rice prices is represented by monthly wholesale price. The periode covered in this study is 1979-1995. It was concluded that BULOG'S Policies in controlling rice market to avoid market segmented did not work as expected.
Key Words : Integration, Cointegration, Market integration, Stationarity

INTRODUCTION

Rice plays an important role in food procurement system. Rice production is concentrated in Java, Sumatera and Sulawesi islands. There is a distinct production peak occuring betwen January and March. The main objective of the government's agricultural policy is food security by maintaining rice price stability. Price policy for essential food, mainly rice is arranged by Bulog, the National Logistics Agency. Bulog has the sole

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authority to import rice and is also responsible for a national buffer stock to stabilize inter-seasonal rice price fluctuations. The Bulog sets an annual floor price for producers and a ceiling price for consumers. Up to date, Bulog was very successful at stabilizing rice prices through its procurement and distribution of rice.

Although Bulog does not have a monopoly of the domestic market, it retains a significant role in rice storage and marketing. Hence, it is expected that price differences between any two regions trading rice with each other will just equal to transfer costs. In the case of rice, eventhough the markets are controlled, there is a possibility that they are not cointegrated. A large number of studies on agricultural commodities have found that the law of one price, denotes that price across countries can differ by no more than the cost of commodity arbitrage, does not hold even in perfect competitive markets. Such studies are among other carried out by Suryana (1986), Hutabarat (1988) and Simatupang and Situmorang (1988).

The objective of this study is to assess the integration of rice market. Considering that most economic variables are affected by trends generated by some global dynamics, such as inflation and exchange rate. The specific objectives of the paper including: (1) to study the extend of market integration and segmentation and (2) to examine the relationships between prices in separated markets and (3) to indicate the central and regional markets. A central market is a market causing all other markets unidirectionally, or it is not caused by any other markets, while a regional market is a market that is caused by other markets.

METHODOLOGY

Source of Data

Data used in the analysis are monthly rice wholesale prices for various years at regional markets. All of the data are obtained from the Central Bureau of Statistics. The data used are times series covering 1979-1995 period. However, some regions have less data covered, hence the periods of analysis varies among regions according to the data availability. Given limited data, it is not possible to monitor prices in all existing markets. This study select several markets of major producing and consuming regions.

Theoretical Background

A series is said to be stationary if it has finite variance, the mean value of the series and its correlation function is time invariant. The stationar time series are called stationary I(O), denoting "stationar of order zero". If the series need to be differentiated n times to become stationary it is said to be "stationar of order n", denoted as I(n). A stationary series tends to constantly return to its mean value and fluctuation around this mean has a broad constant amplitude. Accordingly, a shock has only a temporary effect. Whereas a non-stationary series have a mean varying over time and an infinitive variance. Most of economic time series data are non stationary processes (Johansen and Juselius, 1990). Nonstationarity causes econometrics problems since the estimated parameters become unstable and meaningless (Ardeni, 1989). To find out whether or not these series move together in the long run we can employ cointegration test. The cointegrated regression will then produce a consistent estimate of parameters.

In this study, the cointegration test was utilized to test the relationship among markets. The cointegration market analysis has obvious importance to formulate trade empirical model in general and to measure a market integration level in particular. However, the test result could not determine anything about the strength of market integration (Golleti and Babbu,1994). Markets which are integrated may be amenable for aggregate analysis and price in a particular market can be used as reference price to another market. This allows us to assume that the marketing system is efficient and the price formation system is unique. Most studies in the country have relied upon computing bivariate correlation coefficients market price time series and Ravallion model, only a small number of studies utilized vector autoregressive model.

As mentioned by Simatupang and Situmorang (1988) simple regression approach do not allow us to find the dominant market or price maker. While Ravallion model approach relatively more powerfull compare to that of simple regression approach, since Ravallion model could indicate the strength of market relationships. The vector autoregressive approach is applied by Simatupang and Situmorang (1988) to analyze integration of rubber markets in Indonesia and Singapore.

The acceptance of cointegration between two markets ensures causality in at least one direction. The analysis is performed by applying causality approach. Based on the Granger representation theory if two series are cointegration of order (1,1) they can be represented by a specific error correction mechanism. Error correction refers to the fact that markets are usually not in equilibrium and that some of the disequilibriums in one period are corrected in the next period. Test of causality suggested by Granger consists of regressing a dependent variable on its lag variable then an independent variable lag vector is added to the regression.

Test Procedure

The procedure is commenced by transforming both the dependent and independent variables using *ln* allows non-linear relationships can be handled by ordinary least squares.

The stationarity test analyze the presence of nonstationarity on a univariate time series, utilizing the Dickey-Fuller test. While the test for cointegration are applied to multiple time series, to test whether the series move together in the long run. Before proceeding to test for cointegration, it is necessary to know the order of stationarity of the variable. A linear combination of two series with the same order could form a series with a lower order. To be specific, consider the functional form below:

$$Y_t = \mu + \rho Y_{t-1} + \varepsilon_t \quad (1)$$

Basically, the above model is a simple autoregressive AR(1) model, where Y denotes univariate time series, and ε is a random error with an expected value of zero and a constant-finite variance. The coefficient ρ measures the persistence degree of deviation of Y from μ.

The test of stationarity is carried out by testing the null hypothesis that $|\rho| = 1$ in the following model,

$$\Delta Y_t = \mu + \rho Y_t + \sum_{t=1} \beta\ i \Delta Y_t \qquad (2)$$

The test utilized lag orders selected by the minimum value of Akaike's final prediction error (FPE). If t-statistic is less than critical value then the null hypothesis is accepted, the series is said to be nonstationary. The variance of Y_t approach infinity as time increases and the mean of Y_t, μ, is not defined (Dickey *et al.*, 1987). If the null hypothesis cannot be rejected one must go on to test whether the series is stationar of the higher order. In contrast, when t-statistic is greater than the critical value, the null hypothesis is rejected and the series is said to be stationary and the variance of Y_t is finite.

The test for stationarity do not used Student's t table. As it has been shown by Fuller (1976), when univariate time series is nonstationary the ρ is not distributed according to the Student's t statistic anymore. The distribution of ρ, however, follows the Fuller's t-like statistic (Dickey & Fuller, 1981).

The cointegration test between the series is applied after knowing the order of the series. There is a number of tests for cointegration which could be employed. Among others are proposed by Johansen, Stock Watson and Engle-Granger. The first two persons utilizing Maximum Likelihood approach while the latest using Residual-based approach. Engle-Granger proposed test statistics for testing of non-co-integration against the alternative of cointegration, including Co-integrating Regression Durbin Watson (CRDW), Dickey Fuller (DF), Augmented Dickey Fuller (ADF), the restricted vector autoregression test (RVAR), the augmented RVAR (ARVAR), the unrestricted VAR (UVAR),and the augmented UVAR (AUVAR) adding up to seven cointegration tests. The latter four tests are highly applicable to higher-order testing.

The CRDW method is a quick and rough approximation of the cointegration relation, and is conducted by obtaining the DW statistics on the residuals of the OLS estimation of equation for each of the different pairs of series combination . However, CRDW has been proven to be "unstable" and depends on the specification of the regression equation used in the test. If DW statistics of cointegrating regression is low and below one this indicates an autocorrelations in the residual. If this is the case, the Augmented Dickey-Fuller (ADF) test has to be used instead of Dickey-Fuller (DF) test. The ADF test has an advantage, it could accommodate higher-order autoregressive moving average processes in the residual term. In this study four lagged variables were included in the model to avoid autocorrelation. Moreover, the Augmented Dickey-Fuller has essentially the same critical value for finite sample experiments and theoretically has as good as observed power properties in most comparisons, therefore, it is a recommended approach (Engle and Granger, 1987). Statistically the cointegrating regression would take the following form:

$$Y_t = \alpha + \beta X_t + \varepsilon_t \qquad (3)$$

where Y and X are two monthly wholesale price in market y and market x, and is magnitude of divergence between the prices (residual series). The null hypothesis of no cointegration is rejected if significantly different from zero. The ADF test is performed by running the following regression:

$$\Delta \xi_t = \varphi \xi_{t-1} + \sum_{t=1}^{4} \theta_i \Delta \xi_{t-i} + \varepsilon_t \qquad (4)$$

The ADF test statistic used is the *t*-statistic of -. The t-statistic will be compared to the critical value obtained from Granger and Engle (1987).

Cointegration test followed by a causality test to address the strength and the direction of the (Granger) causality. The two cointegrated variables will have an error correction presentation of the following form

$$\Delta Y_t = \alpha_1 + \alpha_2 Y_{t-1} + \alpha_3 X_{t-1} + \Sigma \partial_i (\Delta Y_{t-i}) + \Sigma \delta_i \Delta x_{t-i} + \varepsilon_t \qquad (5)$$

$$\Delta X_t = \beta_1 + \beta_2 X_{t-1} + \beta_3 Y_{t-1} + \Sigma \Phi_i (\Delta X_{t-i}) + \Sigma \lambda_i \Delta Y_{t-i} + \varepsilon_t \qquad (6)$$

where X_t and Y_t are the prices. The selection of the lag structure of the estimated equation was based on the values of the Schwartz Bayesian Information Criterion (SBIC) test. First autoregressive equation states that the change in price in Y market is a function of the variable (Y_{t-1}), several lags change in the price in market Y, and a stochastic error term ($_t$). The direction of causality can be determined by assessing the significance of the terms lagged X_t and several lags change of X, in equation 5 and the terms lagged Y_t and several lags change of Y in equation 6.

If the inclusion of these terms in the respective equations significantly improves the explanatory power of the equations, we could state that Granger causality exists, the independent variable is said to cause dependent variable.

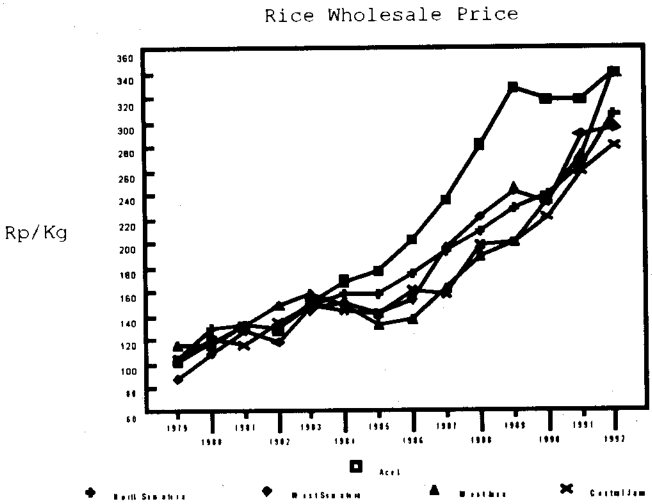
The standard F test that can be applied to test causal direction is

$$F(P,df) = \frac{(SSE_{reduced} - SSE_{complete})/P}{SSE_{complete}/df}$$

Where $SSE_{complete}$ is the error sum of squares of complete model, regression with all terms included, that is equation 1. While $SSE_{reduced}$ the error sum of squares of reduced model. The reduced model would be $X_t = \alpha_1 + \alpha_2 X_{t-1} + \Sigma^n{}_1 \gamma X_{t-i} + e_t$, Δ P different in the number of parameters, complete versus reduced model, df the degree of freedom, complete model.

RESULTS AND DISCUSSION

Macroeconomic variables like inflation and exchange rate trends would equally affect price throughout the country. However, these trends may supersede price variations, in other words the rice price increase may be due to overall price levels within the economy as well as a structural change in rice supply and demand. For instance Figure 1 shows that some rice price series are drifting together roughly at the same rate but some do not. In Aceh and North Sumatera for example, price changes in these regions do not take place at the same speed and may even diverge from one place to another leading to a low cointegration. The rice price behavior is less wild, this would seem to confirm that the government of Indonesia, Bulog in this case, has been doing a good job in shielding the domestic market from fluxes, and distributing rice to consumers.



The Dickey-Fuller unit root/stationary test result supported the presence of a unit root in every time series in this study, indicating a nonstationary in each of the price series. Eventhough the results of the Engle-Granger did not change with the variable chosen as the dependent variable, the test was performed with each variable on the right-hand side. Hence cointegrating bivariate systems were estimated in both directions to find the cointegrating parameters. The study used both actual (not showing in the table) and logarithmic form of prices but did not show significant differences.

Given eight rice markets, there were 56 different possible pairwise comparisons. The two cointegration tests were conducted for each pair of markets.

Not as expected some markets which were relatively close to each other did not show cointegration. In all, empirical results suggested that cointegration of the rice markets was limited. The number of cointegrated rice markets was only 26 out of 56 different pairwise combinations.

The cointegration test results showed that most of the commodity prices in different markets appeared to be non-stationary and not cointegrated, showing a Law of One Price (LOP), did not exist. This might be caused by collecting data method. Before 1983, prices data were collected from 76 cities. Five type of questionairs were used, one for each subsector (food crops, fishery, livestock, industrial crops, and forestry). After 1983, data were compiled from 126 big cities and only utilized one type of questionair for all commodities in each subsectors. In addition, data were not taken from certain sample/respondence. Other convincing reasons were the price of commodities are not the actual price but averaged price. As mentioned by Johansen and Juselius (1990), unsatisfactory result may be due to poor market information, data defect, and prices in one place is not fully transmitted to other places.

The test results for series of rice price for the sample period 1979-1995 were reported in Table 1. Result of stationary tests indicated that there was no strong evidence that higher order of serial correlation existed in the price series. Therefore, further testing using other tests suggested by Engle and Granger (1987) were not necessary and di not alter the results of the study.

As seen in Table 1, the regression estimates of the *t*-statistics for the coefficients were all below the critical ADF values. None of the tests is able to reject the nonstationary hypothesis and they are all insignificant at the 10 percent level. The null hypothesis was, however, rejected when the tests applied to the first differences of the series (step two). From the results of all tests it was apparent that all prices do not seem to contain a deterministic trend. There was strong evidence for the presence of a stationarity for all prices in the first differences. Thus, all rice prices were integrated of order I (1).

The next step was to test cointegration of the series by testing the stationarity of the residuals of the cointegrating regression. The number of lags was used and determined by the need to avoid autocorrelated errors. In this work, four time lags were used. The test need was repeated for each set of equations. There were 56 combinations, since 8 markets analyzed in this study. This study employed two of the cointegration test available, namely, the CRDW and ADF. The CRDW test was chosen because it was easy and appropriate to be used to the bivariate time series, while ADF test was used since the DW statistics of cointegrating regression was low and below one.

The estimated bivariate co-integrating regression of rice prices and relevant statistics are presented in Table 2. Using results of the ADF test, the maintained hypothesis of non-cointegration could not be rejected for the 54 percent of Indonesian rice markets in the study or twenty four out of fifty six cointegration tests support cointegration. Not as expected, most of estimated cointegrating parameters were statistically insignificant.

Eventhough, all rice markets were each integrated of order 1, not all cointegrating regression produced stationary or integrated error terms. This indicated that the series were to drift apart without bound (Taylor and Tonks, 1989). In this case, there was no long run linear relationships between the two series of rice price, implying that a fixed differential between these price pairs need to be explored.

Some markets which are close one to another showed cointegration, among others were between North Sumatera and West Sumatera, and between West Java and Central Java. As expected North Sumatera and West Sumatera price are cointegrated, in contrast North Sumatera and Aceh were not integrated.

In most cases the cointegrating parameter () are close to one in numerical value. Thus, estimates of the cointegration parameters provide informal support for spatial integration in the regional rice markets.

For the cointegrating regression estimated with North Sumatera as the endogenous variable and each of the provincial market as exogenous, the high cointegrating parameter of 0.96 was obtained between North Sumatera and West Sumatera. This was reasonable since North Sumatera close to West Sumatera. High cointegration parameter between North Sumatera and Central Java, which far from each other, was contradicted to the expectations.

The West Java market was primarily cointegrated with the Central Java and North Sumatera markets. The West Sumatera market cointegrated with most markets in the study. Central Java cointegration with many markets in Java and Sumatera islands, except with East Java.

The evidence from Table 2 shows that there were many markets did not support cointegration between provincial markets. This limitation did not allow to conclude that the whole markets in the study were integrated within a unique price system. Traders did not use the same area of reference to take their decisions. They did necessary give attention to price development in other regions. Price differentials did not only reflect transportation and transaction costs.

Test for causation in the Granger sense were undertaken on cointegrated pairs of variables, however this study applied the test on 56 combinations of prices. The dependent variable was regressed on three lags of dependent variables and three lags of the independent (causal) variables. The results of the test are presented in Table 3.

Test result on Bali and East Java indicated that there was an integration between the two provinces. However, none of the market was to take the price leader position. Price was dictated by both markets through competitive market mechanism. This study indicated that price changes in West Sumatera led price changes in North Sumatera, West Kalimantan, East Java, and Central Java. This result was consistent with cointegration among these markets. Therefore, West Sumatera was considered as central market, whereas the others were regional markets.

The overall results of cointegration were not consistent with expectations. The strongest cointegration for the markets which were relatively close to each other are expected and cointegration diminishes as the distance between an individual market increased. Cointegration parameters were generally negative and statistically insignificant at conventional level, suggesting that any deviations from the long-run equilibrium observed between markets were permanent and the effects of a shock would always affect the prices.

CONCLUSIONS

The cointegration tests must be supplemented by information on market characteristics to bring forward a sufficient conditions for market aggregation. The cointegration test indicated that the transmission of price signal among the markets in various regions of the country were not well performed. The geography and physical structure of Indonesia played an important role in the integration of their markets. The results dissemination may contribute to develop a common base information for all economic agents involved in food crop subsector within the country.

In general, the result across all markets was that the degree of price cointegration between two separated market was not always influenced by the distance between the markets. Similar result also found by Goodwin and Schoeder (1991). Several markets separated by long distances, for example Aceh and Bali, have higher level of cointegration than that of markets did in close proximity. Markets which were considered as central markets were West Java and West Sumatera. Prices in these markets induced rice prices in other markets. In contrary, rice prices in West Java and West Sumatera were never affected by prices in other markets.

Table 1. Unit Root (Stationarity) Test Result of Rice Price on Individual Series $\Delta Y_t=\alpha+\rho Y_{t-1}+\beta\Sigma\Delta Y_{t-i}+\varepsilon_t$

RICE CBS Wholesale	Unit root test					
	T=1			T=4		
	ρ	t	N	ρ	t	N
Testing for order 0						
Aceh	-0.0014	-0.124	198	-0.002	-0.163	195
N. Sum	-0.0012	-0.086	198	-0.0007	-0.062	195
W. Sum	-0.0019	-0.091	198	-0.0023	-0.196	195
W. Java	-0.0007	-0.096	198	-0.0018	-0.167	195
C. Java	-0.0027	-0.067	198	-0.0005	-0.024	195
E. Java	-0.0023	-0.214	162	-0.0026	-0.197	159
Bali	-0.0015	-0.202	198	-0.0025	-0.214	195
W. Kal	-0.0065	-0.138	198	-0.0013	-0.112	195
Testing for order 1						
Aceh	0.984	9.774	196	0.971	7.907	193
N. Sum	1.007	9.966	196	0.995	7.971	193
W. Sum	0.963	9.639	196	0.984	8.062	193
W. Java	0.965	9.552	196	0.975	7.920	193
C. Java	1.008	9.992	196	1.005	8.052	193
E. Java	0.991	8.851	160	0.972	7.068	157
Bali	1.018	9.991	196	1.026	8.151	193
W. Kal	1.001	9.927	196	0.994	7.986	193

Notes: Critical value provided by Fuller (1976) for;
100 obs : 2.89 (5%) and 2.58 (10%);
50 obs : 2.93 (5%) and 2.60 (10%).

Table 2. Cointegration Tests Result on Rice Wholesale Price, $Yt=\alpha+\beta Xt+\varepsilon t$

Yt	Xt'	β	't'	DW	ADF
Aceh	N. Sum	1.0103	221.7	0.213	-1.980
Aceh	W. Sum	0.9785	255.1	0.279	-2.856
Aceh	W. Java	0.9323	136.9	0.099	-2.081
Aceh	C. Java	1.0076	175.1	0.117	-2.253
Aceh	E. Java	0.9673	231.3	0.258	-2.887
Aceh	Bali	0.9888	227.2	0.252	-2.785
Aceh	W. Kal	1.0009	281.0	0.340	-3.371**
N.Sum	Aceh	0.9857	221.7	0.213	-1.932
N.Sum	W. Sum	0.9666	268.3	0.430	-4.142***
N.Sum	W. Java	0.9236	207.6	0.284	-3.11*
N.Sum	C. Java	0.9974	320.1	0.498	-4.64***
N.Sum	E. Java	0.9652	208.9	0.247	-2.19
N.Sum	Bali	0.9769	247.3	0.398	-4.242***
N.Sum	W. Kal	0.9874	198.4	0.174	-2.221
W.Sum	Aceh	1.0188	255.1	0.278	-2.841
W.Sum	W. Sum	1.0317	268.3	0.429	-4.176***
W.Sum	W. Java	0.9535	182.7	0.186	-2.795
W.Sum	C. Java	1.0295	228.6	0.245	-3.299**
W.Sum	E. Java	0.9927	236.1	0.258	-4.465***
W.Sum	Bali	1.0095	264.7	0.391	-4.882***
W.Sum	W. Kal	1.0209	242.4	0.289	-3.897***
W. Java	Aceh	1.0613	136.9	0.095	-2.081
W. Java	N. Sum	1.0777	207.6	0.281	-3.144*
W. Java	W. Sum	1.0425	182.7	0.184	-2.799
W. Java	W. Java	1.0768	258.1	0.355	-3.196*
W. Java	C. Java	1.0476	188.6	0.153	-2.199
W. Java	E. Java	1.0541	189.5	0.198	-2.995*
W. Java	W. Kal	1.0638	138.7	0.108	-2.344
C. Java	Aceh	0.9861	175.2	0.117	-2.221
C. Java	N. Sum	1.0006	320.1	0.498	-4.641***
C. Java	W. Sum	0.9676	228.6	0.246	-3.255**
C. Java	W. Java	0.9258	258.1	0.359	-3.171**
C. Java	C. Java	0.9674	204.7	0.140	-1.975
C. Java	E. Java	0.9784	235.9	0.250	-3.564**
C. Java	W. Kal	0.9883	175.2	0.113	-2.545
E. Java	Aceh	1.0306	231.3	0.255	-2.845
E. Java	N. Sum	1.0322	208.9	0.245	-2.221
E. Java	W. Sum	1.0044	236.2	0.257	-3.425**
E. Java	W. Java	0.9502	188.6	0.154	-2.189
E. Java	C. Java	1.0297	204.7	0.138	-1.991
E. Java	E. Java	1.0152	276.2	0.333	-2.823
E. Java	W. Kal	1.0408	328.6	0.460	-4.085***
Bali	Aceh	1.0074	227.2	0.251	-2.797
Bali	N. Sum	1.0203	247.4	0.397	-4.282***
Bali	W. Sum	0.9878	264.7	0.391	-4.893***
Bali	W. Java	0.9434	189.5	0.200	-3.022*
Bali	C. Java	1.0185	235.9	0.249	-3.624**
Bali	E. Java	0.9829	276.2	0.335	-2.854
Bali	W. Kal	1.0099	240.4	0.253	-2.812
W.Kal	Aceh	0.9965	281.0	0.340	-3.364**
W.Kal	N. Sum	1.0076	198.4	0.174	-2.241
W.Kal	W. Sum	0.9762	242.4	0.289	-3.898***
W.Kal	W. Java	0.9304	138.7	0.111	-2.319
W.Kal	C. Java	1.0053	175.2	0.113	-2.578
W.Kal	E. Java	0.9593	328.6	0.463	-4.091***
W.Kal	Bali	0.9868	240.3	0.253	-2.777

Notes: Critical Values from Engle and Granger :
100 obs : 3.73 (1%);
3.17 (5%); 2.91 (10%)50 obs: 4.12 (1%);
3.29 (5%); 2.90 (10%).

Table 3. Granger-Causality Results Among Selected Markets for Rice, January 1979-December 1995

To	From							
	Aceh	N.Sum	W.Sum	W.Java	C.Java	E.Java	Bali	W.Kal
Aceh	0	0.3162	1.4175	0.8243	0.1956	0.8052	0.2243	0.3396
N. Sum	0.2568	0	2.9304	2.4378	1.4162	1.9413	1.4748	1.4206
W. Sum	1.0245	2.1358	0	0.6389	1.1623	2.3355	0.9689	1.3362
W. Java	0.4609	0.9348	1.0558	0	1.5489	1.5089	1.2259	0.7067
C. Java	0.1449	1.5346	2.4028	2.7985	0	2.0351	1.0599	1.0872
E. Java	0.3353	2.4956	3.7785	3.0234	2.7648	0	3.7423	2.7111
Bali	0.3704	1.3438	2.0241	1.8667	0.6928	2.7673	0	1.0819
W. Kal	0.1855	1.3462	2.3807	1.5831	1.0588	2.3394	1.3864	0

Notes : F (4,188) Critical Value :
0,1%=4,62;1%=3.32;
2.5%=2.79;
5%=2.37.

REFERENCES

Ardeni, P. G. 1989. Does The Law of One Price Really Hold for Commodity Prices?. American Journal of Agricultural Economics. p:661-669.

Dickey, D. A., Dennis W. J. and Daniel L. T. 91 or 87. A Primary On Cointegration with an Application to Money and Income. Federal Reserve Bank of ST. Louis.

Engle, R. F., and C. W. J. Granger. 1987. Co-Integration and Error Correction: Representation, Estimation, and Testing. Econometrica 55:251-276.

Goletti, F. and Babu, S. 1994. Market Liberalization and Integration of Maize Market in Malawi. Agricultural Economics 11:311-324.

Hutabarat, B. 1988. Analisis Keterpaduan Pasar Gula Pasir di Jawa. Jurnal Agro Ekonomi 7:1-11.

Johansen, S. and K. Juselius. 1990. Maximum Likelihood Estimation and Inference on Cointegration-with Application to the Demand for Money. Oxford Bulletin of Economics and Statistics. pp. 169-210.

Simatupang, P dan J. Situmorang. 1988. Integrasi Pasar dan Keterkaitan Harga Karet Indonesia dengan Singapura. Jurnal Agro Ekonomi 7:12-29.

Suryana, A. 1986. Integrasi Pasar:Suatu Analisa Pada Pasar Internasional Minyak Nabati. Jurnal Agro Ekonomi 5:1-9.

Taylor, M.P. and Tonks. 1989. The Internationalisation of Stock Markets and The Abolition of UK Exchange Control. The Review of Economics and Statistics, 71:332-336.

Fuller, W. Introduction to Statistical Time Series. New York : John Wiley & Sons. 1976.

Dickey, D. A., and W. A., Fuller. The Likelihood Ratio Statistics for Autoregressive Time Series With a Unit Root Econometrica 49 (1981).

Doodwin, B. K., and Ted, C. Schroeder. Countegration Tests and Spatrial Price Linkages in Regional Cattle Markets. America Agricultural Economics Association (1991) : 452-475.