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Proceeding

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Strengthening Indonesian Agribusiness: Rural Development and Global Market Linkages

IPB International Convention Center, Bogor - Indonesia,
25 - 26 April 2016

Editors :
Amzul Rifin
Meine Pieter van Dijk
Diederik P. de Boer
Huub Mudde
Johan van Rooyen
Siti Jahroh

Organized by
Department of Agribusiness, Faculty of Economics and Management, Bogor Agricultural University - Indonesia
in collaboration with
NICHE NUFFIC Programme - The Netherlands

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PROCEEDING

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FOREWORD

With deep satisfaction I was writing this foreword to the Proceedings of International Conference with the theme of **Strengthening Indonesian Agribusiness: Rural Development and Global Market Linkages** held in IPB International Convention Center, Bogor Agricultural University, Indonesia, on 25 -26 April 2016. This conference marked the end of the NICHE Project which started in 2011.

Diverse papers and discussion represent the thinking and experiences of mixed and various scholars of their particular interest and fields. Of valuable was the presence of prominent scholars who brought their newest findings out of their research works. Their contributions helped to make the conference as outstanding as it has been.

Special thanks are due to the invited speakers Prof. Meine Pieter van Dijk (Maastricht School of Management (MSM) Netherlands), Dr. Daniel Sherrard (Earth University, Costarica), Dr. Nunung Kusnadi (Agribusiness Department, Bogor Agricultural University), Oliver Olson, MBA (Director Global Education Programs at Maastricht School of Management), Huub Mudde, M.Sc (Agricultural Counselor, Embassy of the Kingdom of the Netherlands), Prof. Johan van Rooyen (Agricultural economics at Stellenbosch Univeristy, South Africa), Ir. Wildan Mustofa, MM (Hikmah Farm, Pangalengan West Java), Joshua Bray, M.Sc (Sydney University, Australia) and Dr. Nerlita M. Manalili (Managing director NEXUS Agribusiness Solutions, Philippines and SEARCA Consultant Agribusiness). We would like also to thank the editor of the proceeding, Dr. Amzul Rifin, Prof. Meine Pieter van Dijk, Diederik P. de Boer, PhD, Huub Mudde, M.Sc, Prof. Johan van Rooyen, Siti Jahroh. Phd, Triana Gita Dewi, M.Sc, M. Rizqy Mubarok, M.Si, and Hamid Jamaludin, SE for the layout of the proceeding.

It is my hope that this proceeding will contribute to the development of agriculture and rural development in the world and in Indonesia especially.

Dr. Dwi Rachmina
Head of
Department of Agribusiness
Faculty of Economics and Management
Bogor Agricultural University

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VERTICAL MARKET INTEGRATION PERFORMANCE OF INDONESIAN RICE MARKET CHAIN

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ABSTRACT

The purpose of this study was to assess vertical market integration performance of Indonesian rice market chain through price volatility and price transmission among producer, ricemiller, wholesaler and retailer, with respect to the imposement of rice price stabilization policy in Indonesia. This study used monthly series data of national rice prices of January 2000-May 2012. The standard deviation of return was applied to calculate the price volatility and then Johansen Maximum Likelihood Error Correction Model was applied to estimate the long-term balance, short-term dynamics and parameter of ECM at once in a single stage. The results of this study showed that the extent of price volatilities decreased along market chain from producer to retailer. Producer faced the highest price volatility at 24.9 percent, then ricemiller and wholesaler face had lower price volatility than producer but still high at 18.3 percent and 18.1 percent, respectively. Whereas retailer faced stable price at 8.7 percent. The price transmission analysis concluded that the rice market chain in Indonesia was segmented. The rice prices were not transmitted completely from producer to consumer and vice versa. Only two markets were integrated, namely price relationships between producer-ricemiller and between wholesaler-retailer. While the price relationships between producer-wholesaler, producer-retailer, ricemiller-wholesaler and ricemiller-retailer were not integrated.

Keywords: *Vertical market integration, price transmission, error correction model, price volatility, rice market chain*

INTRODUCTION

Rice price has important role for Indonesia with respect to poverty, economic growth and food security. The level of rice price is the most important determinant of poverty at household level in the short-run. The Indonesian household spent about 10 percent of their income and the poor households spent about 20-25 percent of their total income to buy rice. Indonesian people consumption for rice per capita is the 3rd highest in the world, it is about 139.1 kg/year/person. The unaffordable and unstable rice price bring Indonesian rice market to face the disaster for the poor, the poor always bears the brunt of bad economics and this condition inhibits the poverty allevation (Timmer, 2004).

In addition, rice commodity has strategic roles both economically, socially and politically. In january 2012, the national inflation was about 0.76 percent with rice as the main factor by contribution about 0.18 percent (BPS, 2012). The inflation of rice price will trigger the other goods prices. High prices of food will trigger a riot of society and disrupt the stabilization of politics, even it could drop the government power. This situation has occured in Indonesia, when 1998 multicrisis hit this country.

In the last decade from 2000 until 2012, there were two crises of food and financial in world market. The first crisis took place in 2007/2008 and the second in 2010/2011. Before, food prices increased slowly and steadily, but in the begining of 2007 food prices took off and reached its peak in the mid of 2008 (FAO, 2011). In this period, staple food prices spiked significantly in world market, maize price increased by 74 percent, wheat price increased by 124 percent and rice price increased by 224 percent (World Bank, 2008). Further, after mid 2008 food prices declined but then increased again in 2010 and reached its recorded peak in February 2011 (FAO Global Food Monitor, 2011).

The food crisis in 2007/2008 affected the economic growth of many developing countries which active as exporter and importer in the world rice market. The economic growth of these countries were dropped to negative rate, for example, in 2008 the economic growth of Singapore at -8.9 percent, Thailand at -7.11 percent, Malaysia at -6.2 percent and the Philippines still had positive economic growth with declining growth rate (World Bank in Tambunan, 2010).

In contrast, Indonesia had a positive economic growth at 6.2 percent, though then it declined into 5.2 percent in the last quarter of 2009. Many of studies concluded that the food crisis in 2007/2008 did not affect Indonesian economy, especially in the rice market. The high rice price in world market was not transmitted into the rice price in Indonesia (Timmer, 2008; BAPPENAS, 2009; Keats et al., 2010; Tambunan, 2010; Dawe, 2011).

The rice production which performed well in 2007, can provide enough stock and injection of rice supply to domestic market. In addition the Government of Indonesia also controlled on quantities traded internationally with trade restriction (Dawe, 2011). One of government efforts to prevent the rice selling abroad in order to maintain its stock was by announcing a ban policy on rice export early in 2008, before the peak of rice harvest time (Timmer, 2008). Bulog as a state enterprise, whose role to stabilize the rice price, managed well the excess supply from production and maintain rice supply to meet demand in the rice market. Therefore, the rice price was stable with normal inflation in Indonesia (BAPPENAS, 2009). See Annex 1.

The resilience of Indonesian economy in the rice price crisis 2008 has benefited domestic consumer with stable rice price. But how does this stable price in retailer market impact the other market institutions in the rice market chain? Do the rice prices in retail market transmit to the wholesale price, the rice miller price and producer price? We can measure price transmission in the market chain to see how the market chain's performance and market efficiency during the period of price stabilization policy. The price transmission occurs when the price changes in one market of any given commodity similarly reflected at other market in different location (spatially) or other level in the market chain (vertically), yet transaction costs and marketing margin are assumed not counted. The extent of price transmission is important because the magnitude of price transmission will affect the extent of adjustment by market institutions in the market chain to stabilize price movements. In addition, the prevailing price obtained by each level influences the welfare for them (Timmer, 2008).

The rice price volatility in each level of market chain is also important to see, because volatility of rice price might dampen the potential benefit of higher price for the actor in the market chain by increasing the uncertainty and distorting the economic planning (von Braun, 2008). In the short run, the price volatility increases risk and vulnerability for producer, rice miller, wholesaler and retailer in the market chain due to mystifying market signals and overcomplicated decision making process (IFAD, 2010 in UK Hunger Alliance, 2011).

This study aimed to find out how the vertical market integration performance of Indonesia rice market chain, especially the price volatility and the extent of market integration and price transmission. The research questions of this study are:

1. How volatile were paddy and rice prices in each level of Indonesian rice market?
2. How were the rice price transmission between producer, rice mill, wholesaler and retailer in indonesian rice market chain?
3. What are the policy implications from this study for the Government of Indonesia?

METHODS

DATA AND SAMPLE COLLECTION

The study used monthly data of rice prices in producer level, ricemill level, wholesaler level and retailer level from January 2000 until May 2012. These data were secondary data, collected from relevant institutions in Indonesia. They were Bulog (Logistic Department of Indonesia), Central Bureau Statistics of Indonesia (BPS), Directorate General of Processing, Marketing of Agricultural Products The Ministry of Agriculture and PT Food Station Tjipinang Jaya.

DATA PROCESSING AND ANALYSIS

This study analyzed the price volatility by determining the standard deviation of return of each level in the market chain and price transmission analysis by linear price transmission and asymetric price transmission. The steps on this analysis were Unit Root Test, determination of lag (ordo) optimum, Cointegration Test, estimation of VECM and Impulse Response Function (IRF). The processing data used Microsoft Excel and Jmulti software.

VOLATILITY ANALYSIS

The price volatility shows how much the price dispersion (price volatility) from their mean (Kotze, 2005). This study used standard deviation of return to find out the price volatility of time series data. If the volatility is greater, it can be concluded that the price series have a tendency to fluctuate with the mean. The equation to estimate the standard deviation of return is:

$$u_1 = \ln (P_t) - \ln (P_{t-1}) = \ln (P_t/P_{t-1})$$

Note:
u_1 = standard deviation of return;
P_t = current price; P_{t-1} = past price

This study analyzed the volatility of each level in the market chain those were producer price, rice miller price, wholesaler price and the retailer price. We compared the price volatilities among them and see if the volatilities showed the impact of market interventions. In addition we compared the volatilities of rice price between before crisis in 2000-2006 and during crisis in 2007-2011. We used F-test to test the significance of difference between before and after crisis. The hypotheses are:

H_0: $\sigma_1^2 \leq \sigma_2^2$ (the variances before and during crisis are similar)
H_1: $\sigma_1^2 > \sigma_2^2$ (the variance before crisis are higher than during crisis)

We compared the F-value to the F-table and we rejected Hypothesis null if F-value obtained was bigger than F-table. We got F-value from simple formula F-value = s_1^2/s_2^2. The results of this comparison showed us whether there were any differences of price volatilities before and during crisis period. The critical value for F-table $_{(95\%, 85,64)}$ was 1.4824. df 85 was the number of series before crisis, N_1 = 85 and df 64 was the number of series after crisis, N_2 = 64.

PRICE TRANSMISSION ANALYSIS

The analysis in price transmission started from investigating the stationary of series data by unit root test then continued to cointegration test and error correction model (ECM) analysis.

Testing for Unit Roots

First step to process price transmission analysis was to examine the stationary of the data series through unit roots test. Stationary of each series data is needed to prevent the spurious regression in model. We wanted to confirm whether the series data were stationary in I (1) or not referred to unit root test.

$$X_t = \gamma X_{t-1} + \varepsilon_t$$

With hypothesis H0: γ =1 and H1: γ<1, but since γ has nonstandard distribution, we could not use the standard t-test. Then the model developed to be Augmented Dickey Fuller. Unit root test can be analyzed by using Augmented Dickey Fuller test (ADF). The specification of Augmented Dickey Fuller model is below:

$$X_t - X_{t-1} = \gamma X_{t-1} - X_{t-1} + \varepsilon_t$$
$$\Delta X_t = (\gamma\text{-}1)\, X_{t-1} + \varepsilon_t$$
$$\Delta X_t = (\gamma\text{-}1)\, X_{t-1} + \sum \Delta X_{t-j} + \varepsilon_t$$

The hypothesis of this test is:
H_0: γ = 1 (data has a unit root or data is not stationary)
H_1: $\gamma \neq 1$ (data does not have a unit root or data is stationary)

The test criterion was: we rejected Ho if t-value was bigger than t-table. Critical values were: 10 percent = -1.62 ; 5 percent = -1.94; and 1 percent = -2.56. In this study we assessed the stationary of producer, rice miller, wholesaler and retailer both in level and differenced form. We also assessed the stationary of error from the relationship of producer-rice miller, producer-wholesaler, producer-retailer, rice miller-wholesaler, rice miller-retailer and wholesaler-retailer. We wanted to confirm that the relationships among them were valid and cointegrated.

Determination of Lag (Ordo) Optimum

The determination of optimal lag for the regressed variable in the equation was purposed to avoid the possibility of residual autocorrelation in the series of rice price. We used Schwarz Bayes Criterion to choose the appropriate lag length. Schwarz Bayesian Criterion has shorter lag length than Akaike Information Criterion, which frequently used. We supposed Schwarz Bayesian Criterion was more appropriate for this study due to the rice production cycle in Indonesia is three times a year. So we supposed the dynamics short-run of price transmission were happened within no more than 4 months.

Cointegration Test

Cointegration test between two series of data analyzes the tendency toward a common behavior in the long run, even in the short-run they behave in different way. The aim of cointegration test was to analyze the existence of cointegrating vector in the model. We can test the cointegration by verifying the order of variables and its error then used the Johansen Trace test. In the first test we have to verify whether P_x and P_y are I (1) and the error is I (0) from $P_y = \alpha + \beta P_x + \varepsilon_t$. If these are confirmed, these mean that P_x and P_y are cointegrated. This study also used Johansen Trace Test to determine the existence of cointegrating vector in the model. There are two hypothesis tested namely:

1) Rank test 0
   H_0: There is no cointegrating vector
   H_1: There is one cointegrating vector
2) Rank test 1
   H_0: There is one cointegrating vector
   H_1: There are two cointegrating vectors

We reject H_0 if eigenvalue (LR) is bigger than level of significant or P-value less than critical value (α). We tested the existence of cointegrating vector of models: producer-rice miller, producer-wholesaler, producer-retailer, rice miller-wholesaler, rice miller-retailer and wholesaler-retailer.

Error Correction Models

The characteristics of the dynamic relationship can be explained by error correction model (ECM). This study used Johansen Maximum Likelihood Model to estimate the dynamics in the long-run equilibrium, the dynamics in the short-run and equation of the ECM simultaneously by one step. The specification of Error Correction Model is:

$$\Delta PX_t = a + \underbrace{\sum \beta_i \Delta PX_{t-i} + \sum \beta_i \Delta PY_{t-i}}_{A} + \underbrace{\alpha_1}_{B} [\underbrace{PX_{t-1} - \theta_1 PY_{t-i} + c}_{C}]$$

Note:
A = dynamics short-run
B = error correction parameter
C = long-run equilibrium

Error correction model explains the short-run adjustment of prices toward the long-run equilibrium (Conforti, 2004). The long-run equilibrium indicates as a measure of the degree of price transmission of one price to the other, whilst the short-run adjustment indicates the speed of price transmission contemporaneously (Prakash, 1999 in Conforti, 2004).

The specifications of Error Correction Models in this study are:

1. Producer Price-Rice miller Price

$$\Delta MP_t = \beta_{11}\Delta MP_{t-i} + \beta_{12}\Delta PP_{t-i} + \alpha_1[MP_{t-1} - \theta_1 PP_{t-i} + c]$$
$$\Delta PP_t = \beta_{21}\Delta MP_{t-i} + \beta_{22}\Delta PP_{t-i} + \alpha_2[MP_{t-i} - \theta_1 PP_{t-i} + c]$$

2. Producer Price-Wholesaler Price

$$\Delta WP_t = \beta_{31}\Delta WP_{t-i} + \beta_{32}\Delta PP_{t-i} + \alpha_3[WP_{t-i} - \theta_2 PP_{t-i} + c]$$
$$\Delta PP_t = \beta_{41}\Delta WP_{t-i} + \beta_{42}\Delta PP_{t-i} + \alpha_4[WP_{t-i} - \theta_2 PP_{t-i} + c]$$

3. Producer Price –Retailer Price

$$\Delta RP_t = \beta_{51}\Delta RP_{t-i} + \beta_{52}\Delta PP_{t-i} + \alpha_5[RP_{t-i} - \theta_3 PP_{t-i} + c]$$
$$\Delta PP_t = \beta_{61}\Delta RP_{t-i} + \beta_{62}\Delta PP_{t-i} + \alpha_6[RP_{t-i} - \theta_3 PP_{t-i} + c]$$

4. Rice miller Price –Wholesaler Price

$\Delta WP_t = \beta_{71}\Delta WP_{t-i}+\beta_{72}\Delta MP_{t-i}+\alpha_7[WP_{t-i}-\theta_4 MP_{t-i}+c]$
$\Delta MP_t = \beta_{81}\Delta WP_{t-i}+\beta_{82}\Delta MP_{t-i}+\alpha_8[WP_{t-i}-\theta_4 MP_{t-i}+c]$

5. Rice miller Price –Retailer Price

$\Delta RP_t = \beta_{91}\Delta RP_{t-i}+\beta_{92}\Delta MP_{t-i}+\alpha_9[RP_{t-i}-\theta_5 MP_{t-i}+c]$
$\Delta MP_t = \beta_{101}\Delta RP_{t-i}+\beta_{102}\Delta MP_{t-i}+\alpha_{10}[RP_{t-i}-\theta_5 MP_{t-i}+c]$

6. Wholesaler Price –Retailer Price

$\Delta RP_t = \beta_{111}\Delta RP_{t-i}+\beta_{112}\Delta WP_{t-i}+\alpha_{11}[RP_{t-i}-\theta_6 WP_{t-i}+c]$
$\Delta WP_t = \beta_{121}\Delta RP_{t-i}+\beta_{122}\Delta WP_{t-i}+\alpha_{12}[RP_{t-i}-\theta_6 WP_{t-i}+c]$

Note:
c = constanta
α = coefficient of error correction model
β = coefficient of dynamic short-run
θ = slope of long-run equilibrium
PP = Producer price (Rp/kg)
MP = Rice miller price (Rp/kg)
WP = Wholesaler price (Rp/kg)
RP = Retailer price (Rp/kg)

RESULTS AND DISCUSSIONS

PRICE VOLATILITY

The standard deviation of return in the table below shows that the volatilities in each level are different. Producer price had the highest volatility of 24,90 percent. Whilst, ricemiller price and wholesaler price had lower volatilities of 18,30 percent and 18,10 percent, respectively. Retailer price had the lowest volatility of 0,87 percent. This result shows that the magnitude of the volatilities from upstream to downstream decreased. Farmers in upstream faced very high volatility of farmgate price, while consumers received stable price. Overall, This unbalance condition was not good for farmer.

High volatility in producer price was reasonable due to the price gap of seasonal prices (See Annex 2). The first crop produces the main harvest in March. It produces about 60-65 percent of total national production of rice in a year. While the second crop in August produces about 25-30 percent and the third crop in December produces about 5-15 percent of total national production of rice in a year (Ellis, 1993 in Sari, 2010).

The rice price in producer level in the harvest time is low due to the abundant of rice supply. Vice versa in non-harvest time when the supply is in shortage, the rice price is high. However, the government's intrument to purchase the excess of supply in harvest time can not dampen the volatility of seasonal rice price effect fully. Bulog only purchases the rice production with Government Purchasing Prices which meets the criteria as stated in the Precidential Instruction. This intrument does not absorb all excess demand of rice production.

The volatilities of ricemiller price and wholesaler price were lower than those of producer price, because rice miller and wholesaler have the ability to holding the stock despite the short time and can wait for better price to release stock. This advantage was due to access to market information owned by rice miller and wholesaler. While retailer price had small volatility at 8,70 percent. It means the rice price faced by consumer was relatively stable. Government intervention through market operation to inject the rice supply into the market was successful. Stable rice price in the market was also supported by rice import policy, eventhough rice import was very small at 3,6 percent of rice supply per year on average in 2000-2012 (BPS, 2012). But the market expectation of import could decline the domestic rice price.

This study also compared the rice price volatilities between before crisis in 2000-2006 period and within crisis in 2007-2008 period. We used F-test to test the significancy of differences. We wanted to confirm the expectation that the

Table 1. The Price Volatilities of Producer, Ricemiller, Wholesaler and Retailer

Variable	PP		MP		WP		RP	
Period	SD	Change (%)	SD	Change (%)	SD	Change (%)	SD	Change (%)
2000-2012	0.249	-	0.183	-	0.181	-	0.087	-
2000-2006	0.279	-	0.165	-	0.188	-	0.089	-
2007-2012	0.207	-25.96*	0.205	24.19	0.173	-8.34	0.084	-5.43

Note : asterix sign indicates reject Ho: there is no difference between two variances, at 95% level of significant

Table 2. Unit Root Test Result

Variables	t-statistic	Error of Model	t-statistic
Producer (PP)		**PP-MP**	
Level (2)	2.1271	u1 in level (0)	-6.9459***
Differences (1)	-11.7015***	**PP-WP**	
Ricemiller (MP)		u2 in level (0)	-4.2549***
Level (10)	5.8841	**PP-RP**	
Differences (1)	-12.2466***	u3 in level (2)	-2.9671***
Wholesaler (WP)		**MP-WP**	
Level (0)	1.7797	u4 in level (0)	-3.8677***
Differences (0)	-10.1124***	**MP-RP**	
Retailer (RP)		u5 in level (2)	-2.4995**
Level (2)	4.6505	**WP-RP**	
Differences (1)	-7.7232***	u6 in level (0)	-3.8611***

Notes: the number in parentheses indicates the lag length. One (*), two (**)and three (***) asterisks indicate rejection of unit root at 10%, 5% and 1% level of significance, respectively. Critical values for 10% = -1.62; 5% = -1.94; and 1% = -2.56. Reference: Davidson, R. and MacKinnon, J. (1993),"Estimation and Inference in Econometrics" p 708, table 20.1,Oxford University Press, London.

price volatility within crisis period was less than before due to the government intervention to control the price in this period (H1: $\sigma^2_1 > \sigma^2_2$).

The result shows that only producer price had significantly lower price volatility than before. Whilst, the volatility change of ricemiller price, wholesaler price and retailer price were not significantly different. It means there was no shock in the crisis period on rice prices in Indonesian market. The rice prices were relatively stable like before crisis.

MARKET INTEGRATION

Uni Root Test Result

First step was to examine the stationarity of the data using Augmented Dickey Fuller (ADF) test. We confirmed whether the data were stationary in I(1). We used Schwarz Bayes Criterium to choose the appropriate lag length. The Table 2 shows the result of the stationary test. On the level for all variables, there are insufficient evidences to reject the null hypothesis of non-stationarity. While on the differenced series, there are strong evidences to reject the null hypothesis on non-stationary. This indicates that all price series were I(1).

Beside the stationary test for price data, we also had to confirm the error of the models through test on I (0) which was intended to avoid the spurious regression of the model. Table 2 shows that there are strong evidences to reject the null hypothesis of non stationarity for the errors on level for all models. These mean that all errors were stationary in I(0). Therefore, we concluded that all variables used in analysis were valid

COINTEGRATION AND VECM RESULT

1. Producer-Ricemiller

There is strong evidence that producer price and ricemiller price were cointegrated. The Johansen Trace test rejected the null hypothesis of no cointegration, but failed to reject the null hypothesis of one cointegrating vector. Cointegration indicated that producer price and ricemiller price were integrated. See Annex 3.

Long-run equilibrium:

$$MP_{t-1} = 12.738 + 1.025\ PP_{t-1}{}^{***} + u_{t-1}$$
$$(1.848) \quad (-6.719)$$

The Johansen test result shows the adjustment parameter, the short-run dynamics and the long-run equilibrium. The error correction as the adjustment parameter shows that it adjusted 51.3 percent of the divergence from the long-run equilibrium being corrected each month. The producer price adjusted the changes in ricemiller price after 2 months. In the short run there was no significant differenced lag, but the price changes was shown to be transmitted in the

Table 3. Result of Cointegration Test by *Johansen Trace Test*

Model	r_0	LR	P-value		Relationship
PP-MP	0	29.71	0.0014	***	PP and MP are cointegrated
3 lag	1	6.36	0.1704	-	
PP-WP	0	16.95	0.1358	-	PP and WP are not cointegrated
3 lag	1	4.68	0.3317	-	
PP-RP	0	28.76	0.0020	***	PP and RP are cointegrated
3 lag	1	7.59	0.1006	-	
MP-WP	0	17.00	0.1340	-	MP and WP are not cointegrated
3 lag	1	5.86	0.2093	-	
MP-RP	0	28.29	0.0025	***	MP and RP are cointegrated
3 lag	1	6.52	0.1593	-	
WP-RP	0	29.64	0.0014	***	WP and RP are cointegrated
2 lag	1	7.58	0.0159	-	
Level of Significant					
r_0	**90%**	**95%**	**99%**		* = Reject H_0 at 10% level of significant
0	17.98	20.16	24.69		** = Reject H_0 at 5% level of significant
1	7.60	9.14	12.53		*** = Reject H_0 at 1% level of significant

short run. Long-run equilibrium will be achieved when ricemiller price is 1,025 times producer price.

2. **Producer-Wholesaler**

There is no sufficient evidence that producer price and wholesaler price were cointegrated. The Johansen Trace test which could not reject the null hypothesis of no cointegration vector indicated that producer price and ricemiller price were not integrated.

3. **Producer-Retailer**

There is strong evidence that producer price and retailer price were cointegrated. The Johansen Trace test rejected the null hypothesis of no cointegration, but failed to reject the null hypothesis of one cointegrating vector. See Annex 4.

Long-run Equilibrium :

$$RP_{t-1} = -4{,}179.049 - 4.564\ PP_{t-1}{}^{**} + u_{t-1}$$

(-0.933) (2.011)

Producer price and retailer price were cointegrated statistically, but the long-run equilibrium was implausible as it was not accordance with the theory and unrealistic to be interpreted economically. Therefore, we cannot acknowledge that the producer price and retailer price were integrated.

4. **Ricemiller-Wholesaler**

There was no sufficient evidence that ricemiller price and wholesaler price were cointegrated. The Johansen Trace test could not reject the null hypothesis of no cointegration vector. This indicated that ricemiller price and wholesaler were not integrated.

5. **Ricemiller-Retailer**

There was strong evidence that ricemiller price and retailer price were cointegrated. The Johansen Trace test rejected the null hypothesis of no cointegration, but failed to reject the null hypothesis of one cointegrating vector. See Annex 5.

Long-run Equilibrium :

$$RP_{t-1} = -8{,}308.793 + 9.241\ MP_{t-1}{}^{***} + u_{t-1}$$

(-1.215) (2.700)

Rice miller price and retailer price are contegrated statistically, but the long-run equilibrium is implausible because it is not accordance with the fact. The retailer price is not as big as 9.24 rice miller price. Therefore we cannot acknowledge that the rice miller price and retailer price are cointegrated.

6. **Wholesaler-Retailer**

There was strong evidence that wholesaler price and retailer price were cointegrated. The

Johansen Trace test rejected the null hypothesis of no cointegration and failed to reject the null hypothesis of one cointegrating vector. See Annex 6.

Long-run Equilibrium :

$$RP_{t-1} = 1{,}391.230 + 1.220\ WP_{t-1}^{***} + u_{t-1}$$
$$(1.848) \qquad (-6.719)$$

Cointegration indicated that wholesaler price and retailer price were integrated.

DISCUSSION

The results of this study are interesting. There are some results appropriate with the initial hypothesis, but there are also some unexpected results. Table 4 shows the summary of the vertical market integration relationships in Indonesian rice market chain.

Table 4 depicts that the rice market chain in Indonesia was segmented. The price changes from retailer market were not transmitted to producer market completely in the market chain and vice versa from producer to consumer. There were only two cointegrated relationships between producer and rice miller and between wholesaler and retailer. Both producer-rice miller and wholesaler-retailer had direct interaction each other.

In addition, there were two price determinations in the rice market chain in production point and consumer point (two poles of price determination). Both of them were found to have strong influence for price determination in the other stages. Therefore, it is like there were two markets which have their own price, whereas there were flows of goods between them or in other words the market chain was segmented.

The other relationships in the market chain confirm that the market chain was segmented. The relationship between rice miller and wholesaler in the mid of rice market chain was not integrated. It is like a broken bridge connecting producer and consumer. The three relationships which crossed this bridge were also not connected. We can see that producer price was not integrated with wholesaler price, as well as rice miller price and retailer price. This finding is plausible which also confirms the previous result.

The factors which determined the price transmission and market integration were not explained by models, but we can analyze this situation by referring to the policy which was imposed in the rice market chain.

Price determination in the farm market was strongly influenced by seasonal rice production. The high production in the first harvest and low production in the second and the third harvest created a high volatility of producer price. The domestic purchasing by Bulog can dampen the high volatility slightly. Rice miller price will be influenced by producer price with lower price volatility than producer price. But then rice miller price was not transmitted to wholesaler price. Wholesaler price was more influenced by rice price equilibrium in retailer market. Wholesaler blocked the seasonal price effects transmitted to retailer price or consumer market. They had strong ability to store rice in stocks then manage the supply into the market to provide stable supply to retailer market in addition, Market Operation by Bulog strongly influences the price determination when rice price rises highly.

Table 4. The summarize of Vertical Market Integration Performance of Indonesia Rice Market Chain

Model	Produsen	Penggilingan	Grosir	Ritel
1	● ←——→	●		
2	○ ←-------	⊘ -------→	○	
3	○ ←-------	⊘ -------	-------	-------→ ○
4		○ ←----- ⊘	-----→ ○	
5		○ ←-----	⊘ -----	-----→ ○
6			● ←———	———→ ●

The Bulog injection supplies into rice market significantly maintain stable supply into rice market. Therefore, when rice demand is constant and rice supply in the market is maintained to be stable, the equilibrium price in consumer rice market is relatively stable. Consumer relatively faces stable price along the year.

Price stabilization policy by Bulog benefits consumer with stable prices along the year. But the negative side of this policy is when rice price increases in the consumer rice market there is no transfer of benefit from consumer to backward linkages, especially farmer as producer. Price stabilization policy is deemed to be too pro-consumer and neglects farmer interest. Farmers do not get the benefit from consumer market and face high volatility of rice price. Price stabilization should be benefiting all institutions in the market chain. Therefore there should be improvement strategy of price policy.

The price stabilization policy which is imposed to market chain stresses the price stability in the consumer market. Government treats the rice supply to be stable only in consumer market. Government should treat rice supply to be stable as well as in the production market. The shift of rice price stabilization from consumer market to production market is needed. The root problem is in the production, in which the unstable rice production occurs along the year because the rice cropping pattern follows the season pattern, high production in rainy season and low production in dry season. There are no arrangements on cropping patterns, so farmers grow paddy together simultaneously during the rainy season in the most of rice production area in Indonesia. While in dry season, not all farmers grow paddy due to limitation of water. There are limited technology applied by farmers to grow paddy in dry season which can produce rice as good as in the rainy season and can be applied massively.

In addition, as the typical smallholder farmers in the developing countries, farmers do not have strong power to store the rice production in harvest time. They always sell their rice production immediately in harvest time due to immediate cash needs. They cannot control rice production supply into market as well as to control the rice price. Strengthening farmers' institution is also needed to do. When rice production can be controlled and can provide stable supply into market, government does not need to do price stabilization in the consumer market. Let the price follow the market mechanism to determine price equilibrium. Competitive market is more efficient than controlled market. Furthermore, government can save the budget efficiently.

CONCLUSIONS AND RECOMMENDATIONS

1. The extents of price volatility in Indonesia vertical rice market chain decreased from upstream to downstream. Producer price in upstream had the highest price volatility at 24,90 percent and rice miller price also wholesaler price had lower price volatilities than producer price but still at high value of 18,30 percent and 18,10 percent, respectively. Whereas retailer price had stable price at 8,70 percent. This study also confirmed that rice price volatility before and during the crisis was not significantly different.
2. The rice price was not transmitted completely along the supply chain from producer to consumer, vice-versa. So the Indonesian rice market chain was not integrated vertically. There were only two cointegration relationships between producer-rice miller and wholesaler-retailer. We found that there were two poles of price determination in Indonesian rice market chain, in the up-stream market which were more influenced by seasonal harvesting price and in the downstream market which were more influenced by consumer market demand. Meanwhile, there were no cointegrations between producer-wholesaler, producer-retailer, rice miller-wholesaler and rice miller-retailer. The factors which may influence these relationships were seasonal price effects, market power to manage supply, trade barriers, direct or indirect interaction related to

product flow effects on price determination, transaction costs, transparency of market information and price stabilization policies.

3. The policy implication which can be recommended from this study is to shift the price stabilization policy from consumer market to production market as the critical problem is the unstable rice supply along the year from farmer due to seasonal reason in production market. Rice price stabilization in consumer market is costly and it will not solve the problem for the long-run. Moreover, there are some problems which may cause the unstable rice supply along the year, namely rice cropping management which follows the season, limited technology to balance the production in dry season and farmers having weak market power to hold the excess production and manage their production. Government should solve the source of these problems and then encourage market competitive along market chain since competitive market leads to market efficiency.

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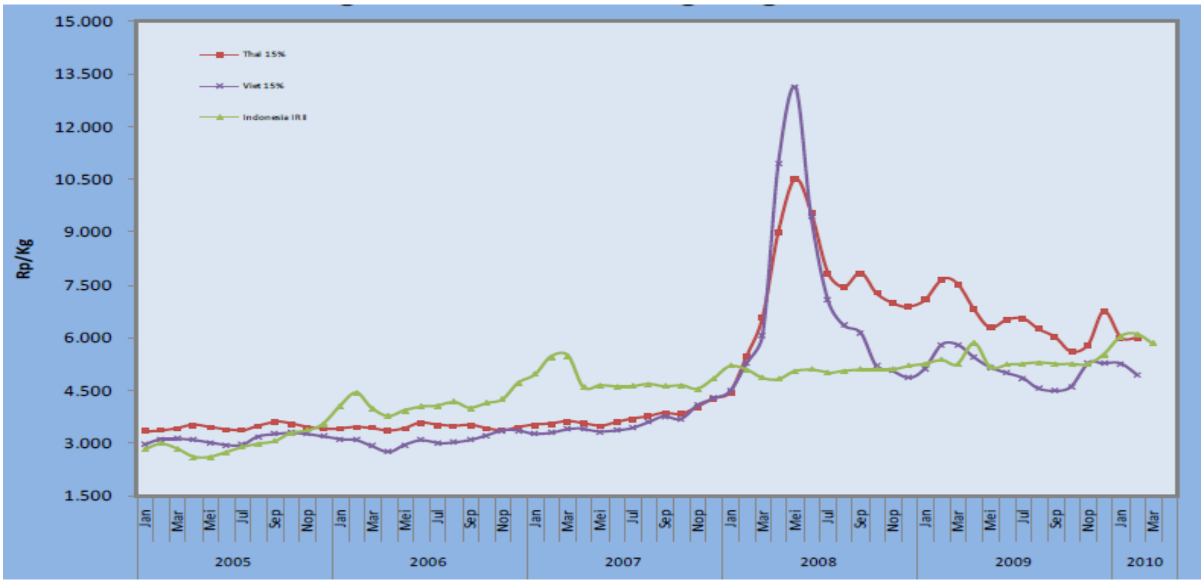
Annex 1. Comparison of Rice Prices between Indonesia, Thailand and Vietnam in 2005-2010



Source : Bulog RI, 2011

Annex 2. Seasonal Paddy Crop Calendar

First crop												
Second crop												
Third crop												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Planting Mid-season Harvest

Source : Ministry of Agriculture, Indonesia 2012 in FAS USDA, 2012

Annex 3. Error Correction Model for Producer-Rice Miller

Dependent variable	ΔMP t		ΔPP t	
Independent variable	**parameter**	**t-value**	**parameter**	**t-value**
ECM t-1	0,051	0,198	0,513*	1,859
ΔMP t-1	0,368	1,277	0,446	1,453
ΔPP t-1	-0,044	-0,156	-0,150	-0,505
ΔMP t-2	-0,422	-1,550	-0,386	-1,333
ΔPP t-2	-0,062	-0,237	-0,083	-0,298
ΔMP t-3	-0,001	-0,006	0,002	0,010
ΔPP t-3	0,158	0,687	0,163	0,666
Long-run Equilibrium : **MPt-1 = 12,738 + 1,025 PPt-1***+ ut-1** **(0,704) (-123,479)**				
LM-Type Test For Autocorrelation, p-value : 0.0000 Tests For Nonnormality, p-value : 0.0000 Multivariate ARCH-LM Test, p-value(chi^2) : 0.0000				

Notes : One (*), two (**) and three (***) asterisks indicate rejection Ho : β = 0 at 10%, 5% and 1% level of significance, respectively. Critical values for 10% = 1,645; 5% = 1,96; and 1% = 2,576.

Annex 4. Error Correction Model for Producer-Retailer

Dependent variable	ΔRP t		ΔPP t	
Independent variable	**parameter**	**t-value**	**Parameter**	**t-value**
ECM t-1	0,005***	5,018	0,003**	2,453
ΔRP t-1	0,388***	3,884	0,330***	3,000
ΔPP t-1	0,217**	2,393	-0,034	-0,341
ΔRP t-2	-0,374***	-3,565	-0,473***	-4,094
ΔPP t-2	-0,022	-0,257	-0,269***	-2,853
ΔRP t-3	-0,144	-1,512	-0,058	-0,556
ΔPP t-3	0,245***	2,715	0,178*	1,791
Long-run Equilibrium : **RPt-1 = -4179,049 - 4,564 PPt-1**+ ut-1** **(-0,933) (2,011)**				
LM-Type Test For Autocorrelation, p-value : 0.0141 Tests For Nonnormality, p-value : 0.0000 Multivariate ARCH-LM Test, Ho : p-value(chi^2) : 0.0059				

Notes : One (*), two (**) and three (***) asterisks indicate rejection Ho : β = 0 at 10%, 5% and 1% level of significance, respectively. Critical values for 10% = 1,645; 5% = 1,96; and 1% = 2,576.

Annex 5. Error Correction Model for rice Miller-Retailer

Dependent variable	ΔRP t		ΔMP t	
Independent variable	**parameter**	**t-value**	**parameter**	**t-value**
ECM t-1	0,003***	5,202	0,002***	2,656
ΔRP t-1	0,338***	3,356	0,280***	2,731
ΔMP t-1	0,332***	3,330	0,126	1,245
ΔRP t-2	-0,383***	-3,657	-0,412***	-3,863
ΔMP t-2	-0,071	-0,775	-0,367***	-3,959
ΔRP t-3	-0,182*	-1,905	-0,129	-1,323
ΔMP t-3	0,378***	3,708	0,306***	2,951
Long-run Equilibrium : $\mathbf{RP_{t-1} = -8308{,}793 + 9{,}241\ MP_{t-1}^{***} + u_{t-1}}$ **(-1,215) (2,700)**				
LM-Type Test For Autocorrelation, p-value : 0.4037 Tests For Nonnormality, p-value : 0.0000 Multivariate ARCH-LM Test, p-value(chi^2) : 0.0010				

Notes : One (*), two (**) and three (***) asterisks indicate rejection Ho : β = 0 at 10%, 5% and 1% level of significance, respectively. Critical values for 10% = 1,645; 5% = 1,96; and 1% = 2,576.

Annex 6. Error Correction Model for Wholesaler-Retailer

Dependent variable	ΔRP t		ΔWP t	
Independent variable	**parameter**	**t-value**	**parameter**	**t-value**
ECM t-1	0,038***	4,861	0,044***	3,135
ΔRP t-1	0,411***	4,366	0,350**	2,051
ΔWP t-1	0,142***	2,760	0,098	1,056
ΔRP t-2	-0,347***	-3,969	-0,505***	-3,185
ΔWP t-2	0,014	0,266	-0,101	-1,062
Long-run Equilibrium : $\mathbf{RP_{t-1} = 1.391{,}230 + 1{,}220\ WP_{t-1}^{***} + u_{t-1}}$ **(1,848) (-6,719)**				
LM-Type Test For Autocorrelation, p-value : 0.5012 Tests For Nonnormality, p-value : 0.0000 Multivariate ARCH-LM Test, p-value(chi^2) : 0.0484				

Notes : One (*), two (**) and three (***) asterisks indicate rejection Ho : β = 0 at 10%, 5% and 1% level of significance, respectively. Critical values for 10% = 1,645; 5% = 1,96; and 1% = 2,576.

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