IV METHODS

4.1 Data and Collecting Method

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

4.2 Data Processing and Analysis Method

This study analyzes the price volatility by determine the standard deviation of return of each level in the market chain and the price transmission analysis by Error Correction Model. The steps on this analysis are Unit Root Test, Cointegration Test, and estimation of Error Correction Model. The processing data will use excel and Jmulti software.

4.2.1 Volatility Analysis

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

\[ u_1 = \ln (P_t) - \ln (P_{t-1}) = \ln \left( \frac{P_t}{P_{t-1}} \right) \]

Note:
\[ u_1 \] = the standard deviation of return; \( P_t \) = current price; \( P_{t-1} \) = past price

This study analyze the price volatilities of four market institutions in the market chain, they are producer price, rice miller price, wholesaler price, and retailer price. We compare the price volatilities among them and see if the
volatilities show the impact of market interventions. In addition we will compare
the volatilities of rice price between before crisis period in 2000-2006 and during
crisis period in 2007-2011. We use 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 crisis and during crisis are similar)

\[ H_1: \sigma_1^2 > \sigma_2^2 \] (the variance before crisis is higher than during crisis)

We compare the F-value to the F-table; we reject Hypothesis null if F-value
is bigger than F-table. We get the F-value from the simple formula, \( F = \frac{s_1^2}{s_2^2} \). The results of this comparison will show us whether there is any
differences of price volatility between before crisis period and during crisis
periods. The critical value for F-table (95%, 85, 64) is 1.4824. Note: df 85 is the number
of series before crisis (\( N_1 = 85 \)) and df 64 is the number of series after crisis (\( N_2 = 64 \)).

4.2.2 Price Transmission Analysis

The analysis of price transmission starts by investigating the stationary of
series data by unit root test, then continue to the cointegration test and the Error
Correction Model (ECM) analysis.

a. Testing for Unit Roots

First step to process price transmission analysis is that we have to examine
the stationary of the data series through unit roots test. The stationary of each
series data is needed to prevent the spurious regression in the model. We want to
confirm whether the series data are stationary in the same order or not. The data
will be valid to use if the variables in the model are in the same order.

\[ X_t = \gamma X_{t-1} + \epsilon_t \] .......................... (3)

With hypothesis H0: \( \gamma = 1 \) and H1: \( \gamma < 1 \), but since \( \gamma \) has non standard distribution,
we cannot use the standard t-test. Then the model developed to be the Augmented
Dickey Fuller. The unit root test can be analyzed by using Augmented Dickey Fuller test (ADF). The specification of Augmented Dickey Fuller model is:

\[ X_t - X_{t-1} = \gamma X_{t-1} - X_{t-1} + \varepsilon_t \]  \hspace{2cm} (4)

\[ \Delta X_t = (\gamma - 1) X_{t-1} + \varepsilon_t \]  \hspace{2cm} (5)

\[ \Delta X_t = (\gamma - 1) X_{t-1} + \sum \Delta X_{t-j} + \varepsilon_t \]  \hspace{2cm} (6)

The hypotheses of this test are:

- \( H_0: \gamma = 1 \) (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 is: we reject \( H_0 \) if t-value is bigger than t-table. The critical values for 10% = -1.62; 5% = -1.94; and 1% = -2.56. In this study we assess the stationary of producer price, rice miller price, wholesaler price, and retailer price in the level I(0) and in the differenced form I(1). We also assess the stationary of the errors from the models of producer price-rice miller price, producer price-wholesaler price, producer price-retailer price, rice miller price-wholesaler price, rice miller price-retailer price, and wholesaler price-retailer price. We also want to confirm that the relationships among them are valid and cointegrated.

b. Determination of the Optimum Lag

Determination of the optimal lag for the regressed variable in the equation is purposed to avoid the possibility of residual autocorrelation in the series of rice price. We use 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 is 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 are happened within no more than 4 months.
c. **Cointegration test**

Cointegration test between two series data analyzed the tendency toward one common behavior in the long run, even in the short-run they behave in the different way. The aim of cointegration test is to analyze the existence of cointegrating vector in the model. We can test the cointegration through verify the order of variables and its error and the Johansen Trace test. In the first test we have to verify whether $P_x$ and $P_y$ are stationary in the same order and the error stationary in the level from $P_y = \alpha + \beta P_x + \epsilon_t$. If these are confirmed, it means that $P_x$ and $P_y$ are cointegrated. This study also uses Johansen Trace Test to determine the existence of cointegrating vector in the model. There are two hypothesis tested here:

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 the level of significant or $P$-value less than critical value ($\alpha$). We test the existence of cointegrating vector in the models of: producer price-rice miller price, producer price-wholesaler price, producer price-retailer price, rice miller price-wholesaler price, rice miller price-retailer price, and wholesaler price-retailer price.

d. **Error Correction Models**

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

$$\Delta P_X = a + \sum \beta_i \Delta P_X + \sum \beta_i \Delta P_Y + \alpha_1 [P_X - \theta_1 P_Y + c] \quad \text{......... (7)}$$
A = the dynamics short-run
B = the error correction parameter
C = the long-run equilibrium

The 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
\[ \Delta MP_t = \beta_{11} \Delta MP_{t-1} + \beta_{12} \Delta PP_{t-1} + \alpha_1 [MP_{t-1} - \theta_1 PP_{t-1} + c] \]  .......... (8)

2) Producer Price-Wholesaler Price
\[ \Delta WP_t = \beta_{21} \Delta WP_{t-1} + \beta_{22} \Delta PP_{t-1} + \alpha_2 [MP_{t-1} - \theta_1 PP_{t-1} + c] \]  .......... (9)

3) Producer Price –Retailer Price
\[ \Delta RP_t = \beta_{31} \Delta RP_{t-1} + \beta_{32} \Delta PP_{t-1} + \alpha_3 [WP_{t-1} - \theta_2 PP_{t-1} + c] \]  .......... (10)

4) Rice miller Price –Wholesaler Price
\[ \Delta WP_t = \beta_{41} \Delta WP_{t-1} + \beta_{42} \Delta PP_{t-1} + \alpha_4 [WP_{t-1} - \theta_2 PP_{t-1} + c] \]  .......... (11)

5) Rice miller Price –Retailer Price
\[ \Delta MP_t = \beta_{51} \Delta MP_{t-1} + \beta_{52} \Delta PP_{t-1} + \alpha_5 [MP_{t-1} - \theta_3 PP_{t-1} + c] \]  .......... (12)

6) Wholesaler Price –Retailer Price
\[ \Delta RP_t = \beta_{61} \Delta RP_{t-1} + \beta_{62} \Delta PP_{t-1} + \alpha_6 [WP_{t-1} - \theta_3 PP_{t-1} + c] \]  .......... (13)

7) Rice miller Price–Wholesaler Price
\[ \Delta MP_t = \beta_{71} \Delta WP_{t-1} + \beta_{72} \Delta MP_{t-1} + \alpha_7 [WP_{t-1} - \theta_4 MP_{t-1} + c] \]  .......... (14)

8) Wholesaler Price–Retailer Price
\[ \Delta RP_t = \beta_{81} \Delta RP_{t-1} + \beta_{82} \Delta WP_{t-1} + \alpha_8 [RP_{t-1} - \theta_5 WP_{t-1} + c] \]  .......... (15)

9) Rice miller Price–Retailer Price
\[ \Delta MP_t = \beta_{91} \Delta RP_{t-1} + \beta_{92} \Delta MP_{t-1} + \alpha_9 [RP_{t-1} - \theta_5 MP_{t-1} + c] \]  .......... (16)

10) Wholesaler Price–Retailer Price
\[ \Delta RP_t = \beta_{101} \Delta RP_{t-1} + \beta_{102} \Delta WP_{t-1} + \alpha_{10} [RP_{t-1} - \theta_6 WP_{t-1} + c] \]  .......... (17)

11) Rice miller Price–Retailer Price
\[ \Delta MP_t = \beta_{111} \Delta RP_{t-1} + \beta_{112} \Delta WP_{t-1} + \alpha_{11} [RP_{t-1} - \theta_6 WP_{t-1} + c] \]  .......... (18)

12) Wholesaler Price–Retailer Price
\[ \Delta WP_t = \beta_{121} \Delta RP_{t-1} + \beta_{122} \Delta WP_{t-1} + \alpha_{12} [RP_{t-1} - \theta_6 WP_{t-1} + c] \]  .......... (19)
Note:

- **PP** = Producer price (IDR/kg)
- **MP** = Rice miller price (IDR/kg)
- **WP** = Wholesaler price (IDR/kg)
- **RP** = Retailer price (IDR/kg)
- \( \alpha \) = the coefficient of Error Correction Model
- \( \beta \) = the coefficient of dynamic short-run
- \( \theta \) = the slope of long-run equilibrium
- \( c \) = the constant