Integration of Rice Prices at Producer, Wholesaler, and Urban and Rural Consumer Markets with Paddy Prices at the Farm Gate

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ABSTRACT
In this study, we analyzed the integration of rice prices at the producer, wholesaler, and urban and rural consumer markets with paddy prices at the farm gate, which has important implications for rice pricing policy. A high price policy can lead to high paddy prices, and thereby increase the profits of paddy farms. Although this policy can generally ensure food security, it may have the effect of decreasing rice consumption. A high-price rice policy can, nevertheless, be beneficial if rice prices are sufficiently well integrated with paddy prices, which can simultaneously enhance paddy farm profits and ensure domestic food security. For the purposes of this study, we examined monthly price data obtained from the Central Bureau of Statistics of Indonesia for the period from January 2013 to December 2016. Using this data, we applied an error correction model (ECM) to integrate the rice prices at the producer, wholesaler, and urban and rural consumer markets with paddy prices at the farm gate. The results showed that producer, wholesaler, and rural consumer market rice prices were significantly integrated with paddy prices at the farm gate. Moreover, if necessary, the government can intervene in these markets to stabilize paddy prices to maintain food security.

Keywords: rice price; paddy price; food security; government policy

INTRODUCTION
Increasing the price of paddy rice can encourage farmers to increase production, as this enhances farm profitability (Yu & Fan, 2011), and increasing paddy production is one element of the rice policy in Indonesia (Robinson, et al., 1997). In order to maintain food security in Indonesia, it is important that farmers are guaranteed sufficiently high prices for their products in order to stimulate production (Timmer, 2002), and, indeed, many studies have concluded that high rice prices can significantly increase the supply of rice (Farooq, Young, Russell, & Iqbal, 2001); (Seck, Tollens, Marco, Diagne, & Bamba, 2010); (Zohir, Shahabuddin, & Hossain, 2002).

Given that paddies are the primary source of rice, it is logical that the price of paddy rice is determined by traded rice prices. If the price of rice continues to increase, merchants will find it desirable to sell more rice in order to obtain profits, which in turn increases the demand for paddy rice, and thereby leads to an increase in the price of paddy rice. Rice is influenced by the
demand for paddy if increases in paddy prices lead to improvements in rice prices. Thus, rice and paddy prices can stimulate each other. In this study, we consider the transmission channel from rice to paddy prices.

The concept of increasing the price of one product to stimulate a price increase in another product is referred to as price transmission, which can be either symmetric or asymmetric. Symmetric price transmission indicates the situation whereby increasing the price of one product can stimulate an increase in the price of another product and vice versa, whereas asymmetric price transmission implies that raising the price of one product does not promote an increase in the price of another product (Meyer & Cramon-Taubadel, 2002). The law of one price (LOP) is a theory relating to the price transmission from one product to another (Conforti, 2004), and defines market integration. Researchers first used the LOP to analyze spatial price transmission, in which the price of a product in one location affects that of the same product in another market location. Goodwin (Goodwin, 2006) modified this theory for application to the study of vertical price transmission, which encompasses the linkages between farms, wholesale markets, and retail markets. Many studies have subsequently used LOP to assess vertical price transmission, including those of Ahn and Lee (Ahn & Lee, 2015), Asche et al. (Asche, Jaffry, & Hartman, 2007), and Cramon-Taubadel et al. (Cramon-Taubadel, Loy, & Meyer, 2006).

The LOP is a measure of market integration, indicating that if a single price exists in several markets, these markets are considered to be integrated (Yang, Bessler, & Leatham, 2000). To assess market integration, researchers can use error correction models (ECM), because such analysis can provide evidence of long-term relationships. Many studies have demonstrated that the LOP is valid in the context of market integration, including those of Mohanty et al. (Mohanty, Meyers, & Smith, 1999), Muwanga and Snyder (Muwanga & Snyder, 1997), Katrakilidis (Katrakilidis, 2008), Elberg (Elberg, 2015), Baquedano and Liefert (Baquedano & Liefert, 2014), Ravallion (Ravallion, 1985), Sekhar (Sekhar, 2012), Zhou and Koemle (Zhou & Koemle, 2015), and Xu et al. (Xu, Dong, LI, & LI, 2011). In the rice market, price integration is supported by many studies, such as those of Emokaro and Ayantoyinbo (Emokaro & Ayantoyinbo, 2014), and Ohen and Abang (Ohen & Abang, 2011).

Although evidence of the existence of price transmission from rice to paddy is essential to support a high rice price policy in Indonesia, price transmission is only one of the many factors that potentially influence such a policy. However, a high rice price policy represents a significant burden for the Indonesian population, particularly those in poverty.

Although many factors can influence price transmission, including market forces, transport and transaction costs, the scale of production, homogeneity, and differentiation of products, exchange rates, and domestic policies (Conforti, 2004), the aim of the present study was not to identify such factors but to establish the existence of price transmission from rice to paddy prices. Such a finding would be essential to support the rice pricing policy in Indonesia.

Agricultural pricing policy involves a high level of government intervention (Tsakok, 1990). The mechanism of agricultural pricing policy can be used to extract and transfer agricultural surpluses, and a range of agricultural pricing policies have been examined using macroeconomic (exchange rates and interest rates), trade (exports and imports), and sectoral indicators. A simple example of agricultural pricing policy is that related to rice imports. If a government makes it easy to import rice, the domestic price of rice may decrease. Although such a policy is beneficial for consumers, it may harm producers because it provides a

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disincentive for increasing paddy production. In this regard, the current rice pricing policy approach adopted in Indonesia is to stimulate productivity growth through the imposition of high tariffs on imported rice (Timmer, 2004). These policies are implemented by drafting rules to impose high import tariffs on rice, such as the Ministry of Finance Rule No. 93 in 2007 (Menteri Keuangan, 2016). In 2013, Indonesia imported no rice (Kementerian Pertanian, 2015), even though the price of domestic rice in Indonesia was 64.88% higher than that of imported rice (Kementerian Perdagangan, 2015). If the government does not regulate rice imports, the price of rice in Indonesia could decline, and those in poverty would be able to buy more rice.

A high price rice policy could be supported by evidence wherein high rice prices can be transmitted to high paddy prices. Evidence of this transmission is relevant because many people in Indonesia have suffered as a result of the high rice price policy. Rice is an important staple food in Indonesia (Bulog, 2015), and thus a high rice pricing policy causes hardship for most Indonesians, particularly those in poverty. Those who live under conditions of poverty spend 70% of their income on rice (Zeigler, 2005), and it has been estimated that increasing rice prices in Indonesia by 10% would increase poverty by 4%, whereas a 30% increase would increase poverty by 14% (Peiffer, 2013). Warr and Yusuf (Warr & Yusuf, 2013) and McCulloch (McCulloch, 2008) concluded that an increase in the price of rice would lead to a rise in both urban and rural poverty, and even increase the level of poverty among small rice farmers. Although in the present study, we do not assess the impact of rice prices on poverty, we do to some extent explain that most of the impoverished population have made sacrifices as a consequence the high rice pricing policy. Thus, it is important to understand whether paddy prices will remain high if rice prices are high. Given that the high rice price policy is supported by the existence of price integration between rice and paddies, if there is no price integration, a high rice price policy will not be beneficial because it means that those in poverty will suffer without an increase in paddy production and food security.

To ensure that rice prices can have an impact on paddy prices, it is necessary to analyze the transmission from rice to paddy prices. Accordingly, in this study, we aimed to provide evidence in support of the high rice price policy. Although such a policy inevitably represents a potential burden to rice consumers, this can be considered a necessary cost if paddy farmers are to earn profits, which in the long run will be conducive to the maintenance of food security in Indonesia. Hence, the question we sought to answer in this study is whether there is a price transmission from rice to paddy rice.

**METHODS**

In the analyses performed in this study, we used paddy prices at the farm gate as the dependent variable, with rice prices at the local producer, wholesaler, and urban and rural consumer markets being used as independent variables. In these analyses, we applied an error correction model (ECM), in which the dependent variable \( Y \) represents data for paddy prices at the farm gate, and the independent variables \( X_1, X_2, X_3, \) and \( X_4 \) represent rice prices at local producer, wholesaler, urban consumer, and rural consumer markets, respectively. All the data represent a change in price between time \( t \) and \( t-1 \), which is necessary for determining stationary data.

The analytic model employed in this study involves several steps. The first step was a descriptive analysis to derive descriptive statistics (average, maximum, minimum, and standard deviation) for rice and paddy prices. The second step was a visual analysis of these prices to determine price fluctuations. The third step involved an analysis of stationary data. If the results indicated stationary data, we then continued to the fourth step, an analysis of...
cointegration, which was used to assess the long-term relationships of the variables. Any significant long-term relationship found was analyzed using the ECM to determine the effect on short-term and long-term paddy prices. These analyses were performed using the eviews software program.

DATA

Data Source
The data used in the aforementioned analyses were derived from the Badan Pusat Statistik (Central Bureau of Statistics) of Indonesia. Paddy price data were the monthly averages of paddy prices at the farm gate after the draining harvest, known in Indonesia as Gabah Kering Panen. We considered price data covering the period from January 2013 and December 2016 taken from the BPS website (BPS, 2016a). The rice prices at local producer markets were the monthly average prices of medium-quality rice at rice mill stores, which were taken from the BPS website (BPS, 2016b). Rice prices at wholesaler markets were the monthly average prices of medium-quality rice at a wholesale store, which were also taken from the BPS website (BPS, 2017). The prices of rice in urban consumer markets were the monthly average prices of IR, a brand of rice sold in Jakarta. We selected this brand because it is the first listed and most popular rice brand sold in Jakarta, the latter of which was selected as it is the capital of Indonesia. These data were taken from publications on the BPS website at 6-month intervals (BPS, 2013a); (BPS, 2013b); (BPS, 2014a); (BPS, 2015a); (BPS, 2015b); (BPS, 2016d); (BPS, 2016e). The prices of rice at rural consumer markets were the monthly average rice prices of rural markets in Indonesia, which were taken from annual publications on the BPS website (BPS, 2013c); (BPS, 2014c); (BPS, 2015c); (BPS, 2016f).

RESULTS

Descriptive Statistics
Descriptive statistics of the data used in this study are presented in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Constant monthly rice and paddy prices (IDR/kg) 2013–2016</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy price at the farm gate</td>
<td>3535.336</td>
<td>4335.631</td>
<td>3881.446</td>
<td>233.5940</td>
</tr>
<tr>
<td>Rice price at producer markets</td>
<td>7042.018</td>
<td>8326.926</td>
<td>7449.362</td>
<td>301.6466</td>
</tr>
<tr>
<td>Rice price at wholesalers</td>
<td>8476.472</td>
<td>9720.292</td>
<td>9013.014</td>
<td>386.1790</td>
</tr>
<tr>
<td>Rice price at urban consumer markets</td>
<td>9307.449</td>
<td>10603.45</td>
<td>9843.428</td>
<td>399.1952</td>
</tr>
<tr>
<td>Rice price at rural consumer markets</td>
<td>7983.542</td>
<td>8554.099</td>
<td>8207.528</td>
<td>142.3741</td>
</tr>
</tbody>
</table>

The table shows constant rice and paddy prices. The constant price was based on the price in January 2013. Thereafter, the price was adjusted based on inflation in Indonesia, as per the BPS data (BPS, 2016). The prices quoted in this study are presented in units of rupiahs (IDR) per kilogram. The average rice price at local producer markets has nearly doubled because paddy price has decreased by 65% (Erwindodo & Pribadi, 2004), and traders must earn a marginal profit. The price of rice sold at rural consumer markets is lower than that at wholesale markets in the city because the channel marketing of rice often comes directly from the rice producer markets. In contrast, the price of rice sold at urban consumer markets is the highest among all the markets because of the long rice marketing channel in Indonesia.
Price Fluctuation Patterns
The patterns of fluctuation in paddy prices at the farm gate and rice prices in producer, wholesaler, and urban and rural consumer markets are shown in Figure 1. These price fluctuations show a similar pattern, indicating price integration.

![Figure 1. Fluctuation in rice and paddy prices.](image)

Stationary Results
The initial analysis considered price integration using paddy prices at the farm gate as the Y (dependent) variable, and rice prices at producer markets as the X1 (independent) variable. The primary analysis indicated a stationary pattern for each variable based on the augmented Dickey-Fuller test, the results of which are presented in Table 2.

<table>
<thead>
<tr>
<th>Variable</th>
<th>t-statistic</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>-5.967073</td>
<td>0.0000</td>
</tr>
<tr>
<td>X1</td>
<td>-4.567770</td>
<td>0.0006</td>
</tr>
<tr>
<td>X2</td>
<td>-4.648217</td>
<td>0.0005</td>
</tr>
<tr>
<td>X3</td>
<td>-5.446859</td>
<td>0.0000</td>
</tr>
<tr>
<td>X4</td>
<td>-4.437941</td>
<td>0.0009</td>
</tr>
</tbody>
</table>

If α < 0.05, the variable is significant. The results of this test indicate that all variables in this analysis were stationary, and thus the stationary test was passed.

Optimum Lag and Cointegration Analysis
To determine the optimum lag, we used the likelihood ratio (LR), the final prediction error (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SC), and the Hannan–Quinn information criterion (HQ). The optimum lags for these criteria are shown in Table 3.
The optimum lag test was used to determine how many lags to use in the next analysis. The optimum lag for this analysis was four because this value was best supported based on a number of criteria, namely, the LR, FPE, and AIC. Subsequent to the stationary and optimum lag tests, we conducted cointegration analysis, the results of which are shown in Table 4.

The table shows that the null hypothesis of no cointegration is rejected, which indicates that all variables in this model are cointegrated. Thus, the model can be considered to have cointegration.

**ECM Analysis**

Next, we used ECM analysis to determine the influence of rice prices on paddy prices in the short and long terms. The initial ECM analysis assessed the influence of rice prices at producer markets on paddy prices at the farm gate, the results of which are shown in Table 5.

The results of this analysis indicate that the model is significant, which means the variables have a highly significant effect on prices at the farm gate over both short and long terms.

We next analyzed the influence of rice prices at wholesale markets on paddy prices at the farm gate, the results of which are shown in Table 6.
Table 6. The influence of rice prices at wholesale markets on paddy prices at the farm gate

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.445736</td>
<td>21.68462</td>
<td>0.020555</td>
<td>0.9837</td>
</tr>
<tr>
<td>Δ Rice prices at wholesale markets **</td>
<td>1.245804</td>
<td>0.215422</td>
<td>5.783073</td>
<td>0.0000</td>
</tr>
<tr>
<td>**U2(0-1) **</td>
<td>-0.972854</td>
<td>0.159299</td>
<td>-6.107094</td>
<td>0.0000</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.505103</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob (F-statistic) **</td>
<td>0.000000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at α = 0.05
** Significant at α = 0.01

The table shows that, in this model, rice prices at wholesale markets and **U2(0-1)** are significant at the 0.01 probability level, which indicates that rice prices at wholesale markets have a highly significant effect on paddy prices.

In the subsequent analysis, we examined the influence of rice prices at urban consumer markets on paddy prices at the farm gate, the results of which are shown in Table 7.

Table 7. The influence of rice prices at urban consumer markets on paddy prices at the farm gate

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.278920</td>
<td>26.111201</td>
<td>0.087275</td>
<td>0.9309</td>
</tr>
<tr>
<td>Δ Rice prices at urban consumer markets *</td>
<td>0.027317</td>
<td>0.147335</td>
<td>0.185406</td>
<td>0.8538</td>
</tr>
<tr>
<td>**U3(0-1) **</td>
<td>-0.697256</td>
<td>0.164128</td>
<td>-4.248240</td>
<td>0.0001</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.282381</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob (F-statistic) **</td>
<td>0.000300</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at α = 0.05
** Significant at α = 0.01

The table shows that, in this model, the prices of rice at urban consumer markets have a significant long-term effect on the price of paddy rice, whereas, over the short term, the effect is non-significant, which contrasts with the findings for rice prices at producer and wholesaler market. These finding accordingly indicate that there are certain characteristics of urban rice markets that differ from those of producer and wholesale markets, which warrant further investigation in future studies. In the final ECM-based analysis, we examined the influence of rice prices at rural consumer markets on paddy prices at the farm gate, the results of which are shown in Table 8.

Table 8. The influence of rice prices at rural consumer markets on paddy prices at the farm gate

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.578152</td>
<td>23.05280</td>
<td>0.068458</td>
<td>0.9457</td>
</tr>
<tr>
<td>Δ Rice prices at rural consumer markets **</td>
<td>1.222569</td>
<td>0.302087</td>
<td>4.047071</td>
<td>0.0002</td>
</tr>
<tr>
<td>**U4(0-1) **</td>
<td>-0.849994</td>
<td>0.148270</td>
<td>-5.732760</td>
<td>0.0000</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.440539</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob (F-statistic) **</td>
<td>0.000001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at α=0.05
** Significant at α=0.01
Table 8 shows that the price of rice in the rural consumer market has a significant bearing on paddy prices at the farm gate over both the short and long terms. In Table 9, we present a summary of our ECM analyses of the influence of rice prices at the producer, wholesaler, and urban and rural markets on paddy prices at the farm gate.

Table 9. A summary of the results of ECM analyses

<table>
<thead>
<tr>
<th>Variable</th>
<th>Short term</th>
<th>Long-term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Rice prices at producer markets</td>
<td>significant</td>
<td>significant</td>
</tr>
<tr>
<td>Δ Rice prices at wholesaler markets</td>
<td>significant</td>
<td>significant</td>
</tr>
<tr>
<td>Δ Rice prices at urban consumer markets</td>
<td>not significant</td>
<td>significant</td>
</tr>
<tr>
<td>Δ Rice prices at rural consumer markets</td>
<td>significant</td>
<td>significant</td>
</tr>
</tbody>
</table>

From Table 9, it can be seen that, in the short term, the prices of rice at the producer, wholesaler, and rural markets have a significant influence on the price of paddy rice at the farm gate, whereas the effect of rice prices at urban markets are not significant. Over the long term, however, the prices of rice at all markets have a significant influence on paddy prices at the farm gate.

DISCUSSION

The results of our ECM analyses show that the price of rice at producer markets has a significant influence on paddy price at the farm gate over both the short and long terms. This finding indicates that the government can intervene to change rice prices at producer markets to increase paddy prices at the farm gate. The government institution with such intervention powers is the “Badan Urusan Logistik (Bulog)” or Agency for Logistics Affairs, the aims of which are maintenance of the underlying price of paddy, rice price stabilization, distribution of rice to the poor, and food stock management (Bulog, 2015).

Intervention by the Bulog to change rice prices at producer markets can be a useful measure, given that producer market rice prices have a significant influence on paddy prices at the farm gate. Bulog can achieve this effect by purchasing rice at producer markets to drive up rice prices.

Similar to the influence of rice prices at producer markets, wholesaler market rice prices have a significant impact on stimulating paddy prices at the farm gate. The government can intervene in this market through changes in rice pricing policy and can also impose high tariff barriers to curb imports from international rice markets (Tsakok, 1990). Although this policy is not applicable to the global market, it is necessary to protect rice prices on the domestic market. Lower rice prices on the international rice market can lead to decreasing rice prices at wholesale markets, which in turn can be integrated with paddy prices at the farm gate. The resulting decrease in paddy prices could result in a reduction in rice production, which in the long term could threaten food security in Indonesia.

Over the short term, we found that urban market rice prices are not significantly integrated with paddy prices at the farm gate. In this case, however, government intervention would not be necessary, although such intervention may be warranted over the long term.

Rural market rice prices provide a significant stimulus to paddy prices at the farm gate, and in this regard, the Bulog can intervene by purchasing rice. In Indonesia, there is a high level (14.7%) of rural poverty (BPS, 2017). Among the rural poor, food accounts for 70% of
household expenditure (Zeigler, 2005), and consequently a high rice price policy would represent a considerable burden on poor people in rural communities. Under this circumstance, the Bulog can distribute rice to the rural poor, in line with its mission to minimize the detrimental impacts of high rice prices on rural society.

**CONCLUSION**

In Indonesia, high paddy prices at the farm gate are necessary to maintain food security. The price of rice traded on the producer, wholesaler, and rural consumer markets provide a significant stimulus for paddy prices at the farm gate over both short and long terms. In contrast, urban consumer market rice prices are not significantly integrated with farm gate paddy prices over the short term. In order to prevent a decrease in paddy rice prices, the government can, when necessary, intervene to adjust rice pricing at the levels of producer, wholesaler, and rural consumer markets. Such price intervention can stimulate an increase in paddy prices at the farm gate, thereby contributing to enhanced food security in Indonesia.

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