# The Influence of Fluctuations in International Rice Prices, Exchange Rate, and World Oil Prices on Rice Prices in Indonesia

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**Abstract.** The increase that will have an impact on controlling economic development is influenced by changes in the global market for rice, oil and financial instruments. This study aims to provide an overview of how changes in global rice prices, world oil prices, and exchange rates have an impact on rice prices in Indonesia. In the case of the shock of the rice price variable in Indonesia, it can be seen how the global rice price reacts, the rupiah exchange rate, and other factors. This shows the extent to which changes in the prices of rice, rupiah and crude oil are all related. The secondary time series data used ranged from 1980 to 2019. Using the VAR form, the relationship between the variables of world rice prices, rupiah exchange rates, and world oil prices was investigated. In contrast to international oil prices and global rice prices, the exchange rate has a positive and quite large impact on rice prices. On the other hand, the findings of the Forecast Error Variance Decompotition show that local rice prices are strongly influenced by the exchange rate compared to world oil prices. This is due to exchange rate fluctuations causing a significant decline in rice prices compared to world oil prices and world rice prices. With respect to global rice prices.

**Keywords:** World Oil, World Rice, Exchange Rate, Rice Price, VAR.

## 1   Introduction

World oil, finance, and world rice prices will all change, and these changes will inevitably have an impact on the domestic economy. The management of economic growth will be influenced by the uncertain nature of world rice, rice and oil prices, as well as world financial conditions. In addition, changes that occur will have an impact on increasing domestic commodity prices. More inflation will result from rising prices. The current inflationary pressure will push the interest rate hike (BI) initiated by Bank Indonesia.

A similar sentiment was echoed by Riyadh MI [1] stating that if inflation is not controlled, people's purchasing power will decline, casting doubt on the judgment of economic activists. Finally, residents find it difficult to make judgments about Production, consumption, and investment all of which slow down the economic growth of a region. The increase in rice prices in recent years in Indonesia is evidence of the severity of the riots that occur more frequently and unexpectedly. Changes in trade regulations, minimum wages, and regulations for fixing prices for fuel oil (BBM), which also indirectly affect production prices and distribution of agricultural commodities, have an impact on rice price shocks. Other external factors that influence them include currency values and commodity prices on world markets [2].
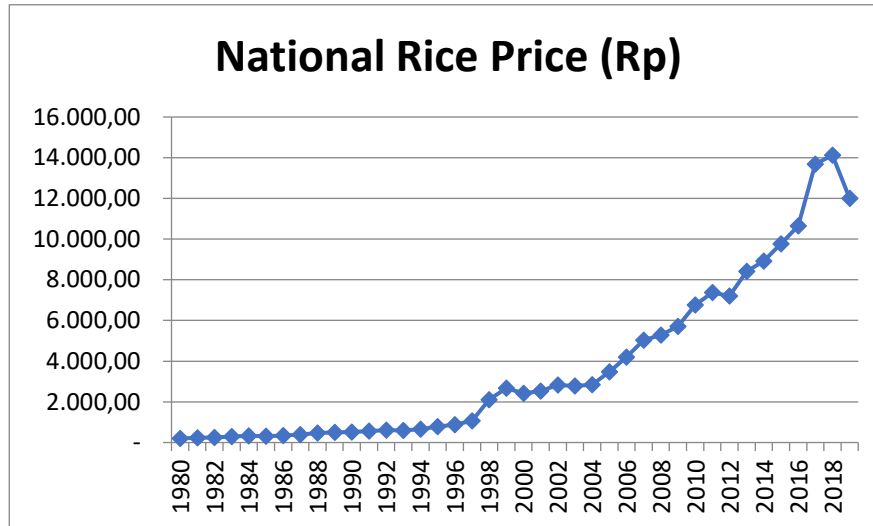
**Fig 1**. National Rice Price (Rp)

For the fulfillment of individual human rights are protected by. The 1945 Constitution of the Republic of Indonesia is based on Law (UU) Number 18 of 2012 concerning Food. Therefore, meeting the food needs of a nation is very important.

Food security and food value are closely related concepts. The food security strategy, according to Ariani [3], focuses on three main areas: Individuals. Food distribution or accessibility (physical and financial aspects), production, supply, and income; and (3) consumption (nutritional value and quality). As a result, food availability is evaluated from various angles. The importance of food and the idea of food security are closely related. According to Ariani [3], the plan for food availability, which includes production, supply, and income; distribution or accessibility, which addresses the physical and financial aspects; and consumption, which includes nutritional quality, safety, and coverage, are the three main areas emphasized in individual food security. Food is readily available not only from a financial point of view but also from an economic point of view because it is quite cheap in terms of people's purchasing power.

Food price volatility has long been an annual issue. Rising food prices in Indonesia are a major contributor to inflation. Variations in rice prices—both uncontrolled and controlled—are a single phenomenon. The reason is, when oil prices fell in February-March 2015, given the decline in global food costs, Indonesian food prices actually by 17%. Other important products including corn, chilies, poultry and meat all saw price increases. Food costs may go up due to other variables as well. This is the exchange rate in relation to other currencies, specifically the dollar (USD). To meet its food needs, Indonesia is still very dependent on imports.

**Research Purposes**

1.    Do world oil price fluctuations affect rice prices in Indonesia?

2. Has the price of rice in Indonesia changed due to changes in the rupiah exchange rate?
3. Does the world rice price affect the rice price in Indonesia?

## 2  Literature Review

Price, in essence, is the main signal that influences how economic actors allocate their resources. In other words, price movements in a perfectly competitive market (PPS) can be used as a signal to determine prices for both producers and consumers. Prices are believed to provide an overview of the market and indicate how much of a particular commodity is bought and sold. Thus, prices are very important for the development of price stabilization policies, increasing food production, and making price forecasts. Because rice is a staple food. One of the main challenges in international trade in agricultural goods is how local agricultural commodity markets react to changes in global prices. Prices of some goods fluctuate from season to season, especially those related to agriculture and animal husbandry. The final response of producers to prices is one of the factors that contribute to variation [17]. Prices of agricultural goods sometimes undergo significant short-term changes. The price may soar to a very high level at one point, but the next time it will see a terrible collapse. The inelasticity of supply and demand for agricultural goods can lead to price volatility. When supply or demand fluctuates, this feature results in very large fluctuations in the price level. Changes in supply and fluctuations in demand are two factors that can cause agricultural prices to fluctuate [18]. The economy of a country that participates a lot in international trade is said to have an open economy. Although closed, the economy does not recognize the reality of global trade. The majority of countries in the world have an open economies. Engaging in international trade will increase the competitiveness of domestic production and market share, which will improve the country's economy. Both export and import are considered international trade activities.

For Wiranto [4], the retail price of commodities—the main components of which are rice, soybeans, and sugar—is influenced by the exchange rate and gross domestic product. Only retail prices of primary food commodities like soybeans were significantly affected by inflation; rice and sugar, which are the main components of the diet, were less affected. Rice and soybeans are perishable goods. On the other hand, rice and sugar are noted to have a high risk of exchange rate volatility. In line with that, Ayu [5], emphasized that the increase in transportation costs for import and export operations could have an impact on the price of Indonesian rice. Furthermore, it can be seen that the prices of all rice commodities in Indonesia are influenced by changes in international rice commodity prices. The opposite happened to Pertiwi [6]. The results of the investigation showed that both small producers and large consumers were affected by fluctuations in rice prices. A similar situation applies to Seno [7]. Long-term changes in oil prices can have an impact on domestic and international rice and wheat prices and an indirect effect on domestic wheat prices. Crude oil prices may have a direct impact on local rice prices. Assistance in fuel costs can reduce fluctuations in rice commodity prices against world oil prices. Furthermore, according to this study, because Indonesia imports these products in large quantities to meet local demand, domestic rice, soybean, and wheat prices are vulnerable to changes in commodity prices in global markets. Based on the findings of the study, the Indonesian government should consider the use of fuel assistance for rice farmers to reduce the impact of changes in world crude oil prices. To reduce the need for imports of these products, the government is also required to increase the production capacity of rice and soybeans and reduce the use of domestic wheat. Fluctuations in world oil prices, the rupiah exchange rate, and

rice prices in the long term will have an impact on rice prices, which in turn will have an impact on domestic rice prices.
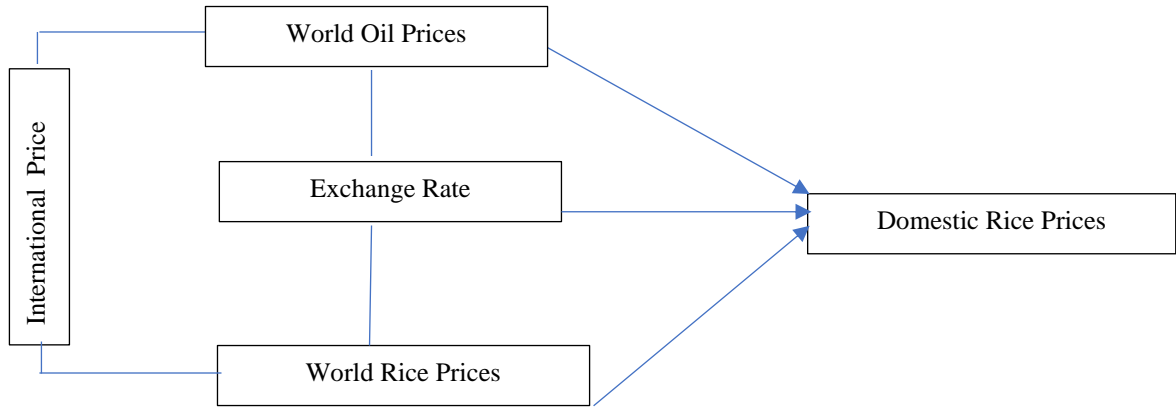


**Fig 2**. Conceptual Framework

## 3    Methods of Research

Time series data with a time span of 1980 to 2019 is the type of data used. The World Development Indicator (WDI), the Ministry of Agriculture, the Central Statistics Agency (BPS), Bank Indonesia (BI), International Financial Statistics (IFS), and other relevant national and international organizations are data sources. It leverages annual data from Global Financial Data on global commodity prices (GFD). It also uses commodity price information from the World Bank, IMF, and UNCTAD for comparison and verification. The software used is E-views.

Version 10. A Data Stationarity Test The Dickey-Fuller test can be improved by including trends and intercepts. By comparing the statistic with the McKinnon Critical Value, the conditions for accepting the hypothesis are the same as for the DF test. Enders [23] states that the equation for the Augmented Dickey Fuller Test looks like this:

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \epsilon_t$$

.................................................(1)

Enders (2004) suggests choosing a VAR model with the least Schwartz Bayesian and Akaike Information Criterion (AIC) (SBC) values. This is how AIC came about.

$$AIC(p) = T \log \left| \sum \right| + 2N$$

...........................................................(2)

**Models of VAR**

All independent variables must be stationary (mean, variance, and covariance must be constant) and all residuals must include white noise, which has zero mean, constant variance,

and interdependent covariance. In the general approximation model, the VAR form can be expressed mathematically as follows:

$$X_t = A_0 + \sum_{i=1}^{k} A_i X_{t-1} + \mu_t \text{ ......................................................................(3)}$$

Here is the equation model:

$$PBRD = \alpha_{11} + \alpha_{12}PBRD_{t-1} + \alpha_{13}FLUC\ OIL_{t-1} + \alpha_{14}FLUC\ ER_{t-1} +$$
$$\alpha_{15}PBRW_{t-1} +$$
$$\vartheta_{1t}\text{...........................................................................................................(4)}$$

**Structural Vector Autoregressive (SVAR) Models**

The model used to examine fluctuations in world rice prices against fluctuations in domestic rice prices which can have a direct impact on world oil and fuel prices, the exchange rate can be stated as follows:

$$\begin{bmatrix} a_{11}\ a_{12}\ a_{13}\ a_{14} \\ a_{21}\ a_{22}\ a_{23}\ a_{24} \\ a_{31}\ a_{32}\ a_{33}\ a_{34} \\ a_{41}\ a_{42}\ a_{43}\ a_{44} \end{bmatrix} \begin{bmatrix} PBRD_t \\ FLUC\ OIL_t \\ FLUC\ ER_t \\ PBRW_t \end{bmatrix} = \begin{bmatrix} b_{11}\ b_{12}\ b_{13}\ b_{14} \\ b_{21}\ b_{22}\ b_{23}\ b_{24} \\ b_{31}\ b_{32}\ b_{33}\ b_{34} \\ b_{41}\ b_{42}\ b_{43}\ b_{44} \end{bmatrix} \begin{bmatrix} PBRD_{t-1} \\ FLUC\ OIL_{t-1} \\ FLUC\ ER_{t-1} \\ PBRW_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{PBRDt} \\ \varepsilon_{FLUC\ OILt} \\ \varepsilon_{FLUC\ ERt} \\ \varepsilon_{PBRWt} \end{bmatrix}$$

$$\text{...............................................................................................................(5)}$$

To determine the dynamic reaction of each variable—world oil price, Rupiah exchange rate, and world rice price—the Impulse Response Function is used. In addition, the impulse response function seeks to isolate shocks to be more precise, implying that only certain types of shocks can have an impact on economic variables. While the exact shock cannot be determined, the overall shock can. To find out the magnitude (in percent) of the variations in the world oil price model, the Rupiah exchange rate, and the world rice price, which are affected by shocks for each variable, the Forcast Error Variance Decomposition is used in this study. Since achieving price stability and its effects on the economy are linked, it is important to know how important each shock is when trying to explain the variables of world oil prices, Rupiah exchange rates, and global rice prices

## 4 Result and Discussion

Data Stationary The main problem with time series analysis is that the non-stationarity of the spurious regression data will be caused by the non-stationary variables. which would give skewed regression findings and useless (meaningless) conclusions. So that the data does not move, the first step that must be done is to evaluate and process it.

**Table 1**. Unit Root Test (Level)

| Variable | ADF Value | McKinon critic Value | | | Description |
|---|---|---|---|---|---|
| | | 1 % | 5% | 10% | |
| LPBRD | -0.801455 | -3.6104 | -2.9389 | -2.6079 | Non-Stationary |
| LFluc Oil | -0,886034 | -3,6104 | -2,9389 | -2,6079 | Non-Stationary |
| LER | -1,692494 | -3,6104 | -2,9389 | -2,6079 | Non-Stationary |
| DPBRW | -1.627146 | -3.6104 | -2.9389 | -2.6079 | Non-Stationary |

From the results of Table 1, it can be seen that the data on rice prices (LPBRD), world oil prices (LFluc Oil), exchange rates (LER), and world rice prices (LPBRW) are not stationary at an alpha value of 1%, 5%, and 10%. The first difference should be a unit root test because the data for the other five variables is not stationary.

**Table 2**. Unit Root Test (First Difference)

| Variable | ADF Value | McKinon Critic Value | | | Description |
|---|---|---|---|---|---|
| | | 1 % | 5% | 10% | |
| DLPRBD | -4.857690 | -3.6210 | -2.9434 | -2.6102 | **Stationer at level 5%** |
| DLFluc Oil | -5,67891 | -3,6155 | -2,9411 | -2,6090 | **Stationer at level 5%** |
| DLER | -5,20434 | -3,6155 | -2,9411 | -2,6090 | **Stationer at level 5%** |
| DLPBRW | -5.374302 | -3.6155 | -2.9411 | -2.6090 | **Stationer at level 5%** |

## 4.1 Test for Optimal Lag

Akaike Information Criteria (AIC) or Schwart Criteria (SC) are used to determine the ideal amount of lag to be applied to the analyzed variables. At lag 1, the smallest or minimum is found (one). Table 3 shows this.

**Table 3**. Selection of a VAR. Length of System Lag

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 1 | 65.12678 | NA | 7.70e-07* | -2.729265* | -2.025479* | -2.483625* |
| 2 | 79.94777 | 23.05488 | 8.44e-07 | -2.663765 | -1.256193 | -2.172485 |
| 3 | 85.04485 | 6.796103 | 1.67e-06 | -2.058047 | 0.053311 | -1.321127 |

## 4.2 Vector Autoregressive Models

As a consequence of setting the ideal lag, a VAR estimation model with a lag of one is generated; the estimation results are as follows:

$$D(LPBRD) = 0.3181*D(LPBRD(-1)) - 0.0024*D(LFLUC\_OIL(-1)) + 0.4206*D(LER(-1)) + 0.0041*D(LPBRW(-1))$$

The exchange rate of 0.42 percent is the main factor affecting the price of domestic rice, meaning that if the rupiah weakens, the price of domestic rice will increase by 0.42 percent. The development of local product prices is directly affected by changes in exchange rates, although

world rice and oil prices are not directly affected. Domestic rice prices are somewhat influenced by other countries in the world. In other words, if rice and oil prices rise globally, domestic rice prices will increase by 0.0024 percent and 0.0041 percent, respectively. The main drivers of rising food costs, according to Ayu [5], are supply and demand concerns rather than higher oil prices. According to Nazlioglu [9], this does not indicate that there is a conflict between South African agricultural commodity prices and world oil prices. According to statistical analysis, the 95 percent confidence level is significantly influenced by Kurster's on rice prices (3.26). This is in line with Abbott et al. [10]; Baffes & Dennis [11]; Dillon & Barrett [12]; Harris et al. [13]; Nazlioglu & Soytas [14]; and Nugraheni [15], which state that the exchange rate is one of the key variables affecting changes in food commodity prices and has no significant impact on world oil prices (-0.02) and global rice prices (0.02). with domestic rice prices. Similarly, the F test shows that there is no relationship at the 95% confidence level. There is a significant relationship between local rice prices and world rice prices, world oil prices, rupiah exchange rates, or world rice prices (1.86). The cost of the state's ability to pay for oil subsidies is high or is increasing due to the global energy crisis, which is causing world oil prices to rise. Domestic vehicle fuel and avtur may need to be adjusted if the increase is significant. As a result, rising gasoline prices can help boost the domestic economy and lower transportation spending. Jong Wanich and Park [16] claim that because food accounts for a significant portion of consumption in developing countries, the increase in food costs has a considerable effect on total consumer prices. That's not the situation. This needs to be considered because the government usually intervenes to increase domestic rice prices in the near future by opening market operations. Meanwhile, only 7% of domestic rice prices can be explained by the coefficient of determination ($r^2$) of rice prices, world oil prices, rupiah exchange rates, and world rice prices.

**Table 4.** VAR model's effect on domestic rice prices of global oil prices, exchange rates, and global rice prices.

| Commodity | Rice | |
|---|---|---|
| | Coefficient | t-statistic |
| Rice price | 0.3181 | [ 2.210] |
| World Oil | -0.0024 | [-0.02] |
| Exchange Rate | 0.4206 | [3.26] |
| World Rice Price | 0.0041 | [0.03] |
| R-squared | 0.14 | |
| Adjusted R-Squared | 0.07 | |
| F-Statistic | | 1.86 |

## 4.3 Impulse Response Function

Analysis The purpose of the impulse response function is to track the dynamic behavior of a variable in the event of a particular shock to that variable. 5.4.1. Price of Domestic Rice While international oil prices, rupiah exchange rates, and world rice prices will remain unchanged, domestic rice prices will rise by 12.55% in the first year, pushing prices up in the second year. Domestic rice prices rise 7.28 percent, while the value of the rupiah rise 5.99 percent. In the third year, world rice prices rose by 0.0762 percent, while world oil prices fell by 1.54 percent.

In the fourth year and above, global rice prices fell 2.98 percent, while global oil prices rise 0.53 percent. Bank Indonesia must take steps to manage the 3.74 percent exchange rate in order to keep up with the high rate of price growth.

**Table 5**. Effect of Cholesky's (d.f. adjusted) one S.D Domestic Rice Price D(LPJGD) Innovation

| Period | D(LPBRD) | D(LFLUC_OIL) | D(LER) | D(LPBRW) |
|--------|----------|--------------|--------|----------|
| 1 | 0.125508 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.072896 | -0.015457 | 0.059960 | 0.000762 |
| 3 | 0.032046 | 0.005350 | 0.037422 | -0.029854 |
| 4 | 0.025203 | 0.003258 | 0.013017 | -0.020484 |
| 5 | 0.019966 | -0.001467 | 0.011159 | -0.007734 |
| 6 | 0.012163 | -0.000445 | 0.009848 | -0.006049 |
| 7 | 0.007677 | 0.000424 | 0.005766 | -0.005290 |
| 8 | 0.005503 | 6.50E-05 | 0.003477 | -0.003201 |
| 9 | 0.003760 | -8.49E-05 | 0.002579 | -0.001932 |
| 10 | 0.002443 | 9.04E-06 | 0.001787 | -0.001406 |
| 11 | 0.001640 | 2.52E-05 | 0.001140 | -0.000978 |
| 12 | 0.001121 | -2.39E-07 | 0.000763 | -0.000629 |

Cholesky Ordering: D(LPBRD) D(LFLUC_OIL) D(LER) D(LPBRW)

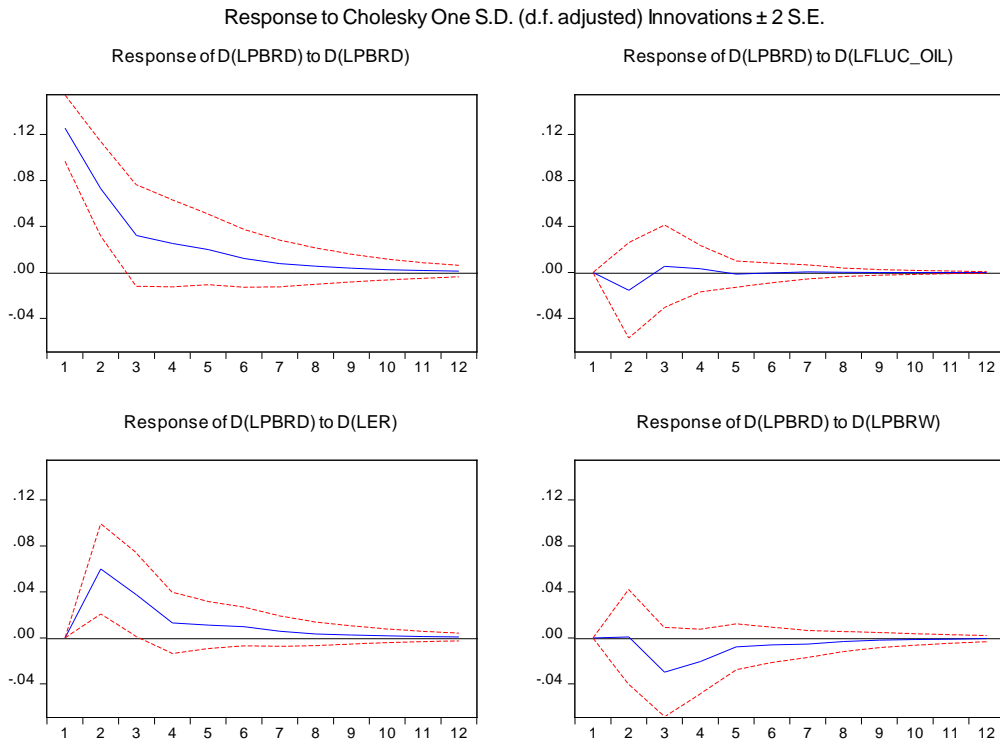Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.



**Fig 3**. Response to Cholesky One S.D.

## 4.4  Forecast Error Variance Decomposition

Variance of Forecast Error Decomposition is expected to explain the relative impact of each shock on the international exchange rate and the domestic exchange rate of the country

**Domestic Rice Prices**

With world oil prices (D(lfluc oil)) accounting for only 0.95 percent of changes in rice prices, Table 6 shows that fluctuations in local rice prices are primarily influenced by shocks (100%), as a function of the following factors: Other factors come into play. parts in the second year. The difference between the exchange rate and the international rice price is about 0.0023% (D) (ler). The impact of the rice price shock on it in the 12th year was still quite significant, amounting to 76.51 percent, but gradually reduced. However, shocks accounted for only 0.91 percent of global oil price fluctuations, 17.80 percent of Rupiah exchange rate fluctuations, and 4.75 percent of global rice prices. This means that a significant factor in the increase in domestic rice prices is the rupiah exchange rate.

**Table 6**. Decomposes Variations in World Oil Prices, Exchange Rates, and World Rice Prices in Relation to Fluctuations in Domestic Rice Prices

| Period | S.E. | D(LPBRD) | D(LFLUC_OIL) | D(LER) | D(LPBRW) |
|--------|------|----------|--------------|--------|----------|
| 1 | 0.125508 | 100.0000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.157800 | 84.59992 | 0.959470 | 14.43828 | 0.002331 |
| 3 | 0.168071 | 78.21066 | 0.947114 | 17.68496 | 3.157269 |
| 4 | 0.171706 | 77.08937 | 0.943452 | 17.51897 | 4.448206 |
| 5 | 0.173401 | 76.91500 | 0.932253 | 17.59217 | 4.560568 |
| 6 | 0.174212 | 76.68854 | 0.924250 | 17.74841 | 4.638799 |
| 7 | 0.174557 | 76.57907 | 0.921190 | 17.78741 | 4.712326 |
| 8 | 0.174707 | 76.54625 | 0.919615 | 17.79635 | 4.737778 |
| 9 | 0.174777 | 76.53108 | 0.918900 | 17.80384 | 4.746187 |
| 10 | 0.174809 | 76.52271 | 0.918566 | 17.80780 | 4.750929 |
| 11 | 0.174823 | 76.51912 | 0.918419 | 17.80917 | 4.753292 |
| 12 | 0.174830 | 76.51763 | 0.918352 | 17.80977 | 4.754240 |

Cholesky Ordering: D(LPBRD) D(LFLUC_OIL) D(LER) D(LPBRW)
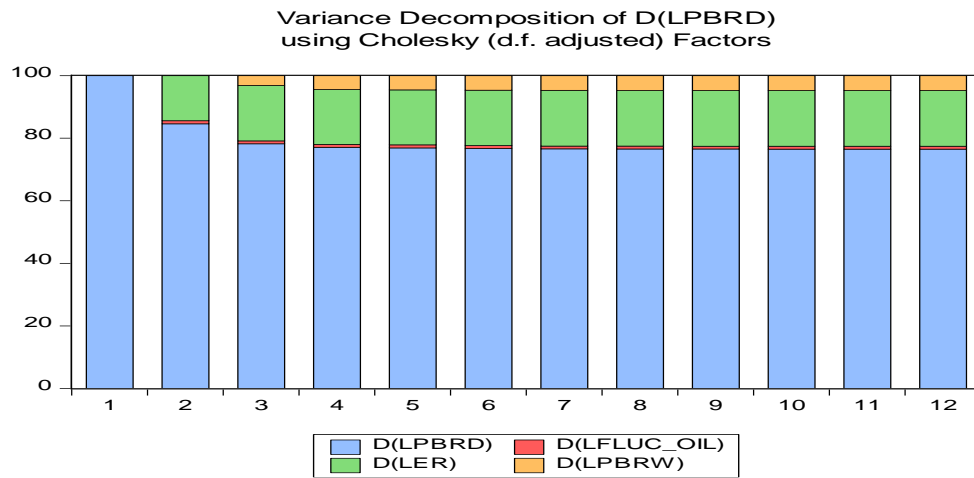


Fig 4. The Impact of Global Oil Prices, Exchange Rates, and Global Rice Prices on Domestic Rice Prices.

## 5    Conclusion

1.   Based on the equations of the VAR model, it can be shown that although local rice prices are strongly influenced by world rice and oil prices, the value of the rupiah has no real impact.

2. The findings of the impulse response analysis lead to the conclusion that domestic rice prices will skyrocket as a reaction to depreciation caused by changes in the value of the rupiah. To prevent the development of capital inflows that have the potential to increase the rupiah exchange rate, BI must improve the performance of the SBI interest rate in order to maintain the current level.
3. Based on the results of forecast error variance decomposition, the domestic rice price (D(LPBRD)) was more influenced by the shock to itself, which reached 100%, while the exchange rate (D(LER)) reached 14.43%. The world rice price (D (LPBRW) is worth 0.0023 percent and the world oil price (D (LFLUC OIL) is 0.95 percent. On the other hand, rice prices can be controlled relatively through increasing agricultural production and productivity, so it is expected to be able to improve farmers' welfare, increase national rice security, and increase availability by building rice stocks and reserves in each district as part of the direct control program.

# 6 Policy Implication

It is estimated that the Ministry of Trade will cooperate with the provincial government, city districts, the rice task force, and BULOG using the same database to predict rice prices. Actions that can be taken include: 1) determining the adequacy of basic needs in the region; 2) carrying out direct monitoring of the people's market and contemporary retail; and 3) observing the availability of supply and the stability of the prices of basic commodities in the market. The SBI interest rate is a monetary policy tool to achieve rupiah exchange rate stability in accordance with the findings of the study of the impulse response function and forecast error variance decomposition. As a result, Bank Indonesia may use the SBI Interest Rate tool, as it has done in the past, to carry out its inflation objectives. limit the occurrence of capital outflows and compete with the rupiah. Governments are advised to concentrate on the most pressing issues, particularly global warming, which is estimated to be deep and broad in scope at the economic level, to deal with significant shocks to international prices such as world oil prices, exchange rates, and world food prices. Therefore, efforts to improve food security must receive high attention. If the government wants price stability with supportive increases, then Bank Indonesia's monetary policy must: 1) maintain a constant focus on the inflation target, such as knowing how to calculate inflation accurately to ensure that the target is met; 2) implement policies consistently and transparently to increase public confidence in the chosen course of action; and improve coordination of monetary and fiscal policies to maximize the effectiveness of results.

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