The Implementation of New Technology on Indonesia’s Rice Import: Based on Presidential Instruction for Rice Policy

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Abstract
There are many Presidential Instruction (Inpres) for Rice Policy in the period 2005-2008. Based on Inpres, ones of the policy instrument to achieve the objectives of rice policy are to make use the new technologies. The objective of this research is to analyze the new technologies effects on Indonisia’s rice import. The research used time series data based on the Presidential Instruction, March 2005-September 2009. This research used simultaneous equation model, consisting of sixth structural equation and forth identity equation. The model of simultaneous equation is over identified, and model was estimated using 2SLS (Two Stage Least Squares). The result showed that: (1) using new technologies increase paddy yield and paddy production. The increase in the paddy production hence increased rice production. The increase rice production led to increase total rice for seed and shrinkage although it is increase, rice production also increases, (2) the increase of rice production led to increase total society’s rice supply. The increase of total society’s rice supply led to a decrease in the total Indonesia’s rice import. While the total Indonesia’s rice import has a positive correlation on the total rice stock for Bulog distribution and not significant, moreover, the decrease of the total Indonesia’s rice import led to decrease on the total rice stock for Bulog distribution, and (3) based on presidential instruction, we review new rice technologies that have been develop by research institute, specifically a new variety, to improved paddy yield and paddy production.

Keywords: presidential instruction, rice policy, technology, paddy yield, rice import.

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INTRODUCTION
Discussions about presidential instruction for rice policy is a new issue. The earliest research on presidential instruction for rice policy was based on survey rice farmers by Sembiring et al (2010), in addition, based on monthly time series data by Sembiring (2011) and Sembiring et al (2012). Finally, recently improved studies about presidential instruction for rice policy by Sembiring (2013, 2015).

The scope of this paper is limited the new technologies that are mentioned on presidential instruction for rice policy. There were many paper reported about the impact of technologies on rice production. The most recently studies to estimate the impact of new technologies and the consequence of improved technology such as Yorobe Jr et al (2016), that estimated the yield and income effect of GSR rice varieties in the Philippines, Rada (2016) noted that productivity growth due to improving farm structure or management skill are combined with new-varietal adoption.
Yamano et al (2016), review 25 evaluation studies on new rice technologies used by smallholder rice farmers from many aspect. The previous studies to analyze the impact of new technologies, such as, Panuju et al (2013) noted that the role of seed inventions in Indonesia to improve paddy production and productivity, Estudillo et al (2001) noted that modern varieties (MVs) of rice with direct-seeding to increase cropping intensity and the average rice yield rose from 4.3 to 5.1 ton per ha.

Nevertheless, no previous investigations has analyzed the economic effects of new technologies based on government regulations, specifically to analyze new rice technologies on rice import. Based on nine studies to analyze government policy on rice subsidy that estimated rice import, Sembiring (2011) found that there are 14 variables that affect rice imports, such as: import rice price rice, retail rice price, exchange rate, interest rate, income per capita, GDP, aggregate supply, domestic rice production, domestic demand for rice, national rice final stocks, population, time trend and lag import but there is not studies describe on the effect of technology on rice imports.

TECHNOLOGY IN THE PRESIDENTIAL INSTRUCTION FOR RICE POLICY

Article 1 on Presidential Instruction (Instruksi) No. 9/2002 for rice policy does not explicitly mention technology for increasing the productivity of rice and rice production. Unlike the Inpres No. 2/2005, which explicitly mentions that the technology of post harvest of grain/rice is needed to improve quality and to reduce production loss.

The objectives of agricultural policy interventions can be diverse and numerous and the task of policy is then to select the best instruments to achieve the selected targets (Ellis, 1992). According to Sembiring (2014), there are many objectives of presidential instruction for rice policy. The most important objective rice policy in period 2001-2005 are to increase farmer’s income and rural economic development, while in period 2007-2012 are to increase farmer’s income and rural economic development, improving food security, and economic stabilization.

Whereas, the most important instrument policy in period 2002-2012 is rice import.

Based on Inpres No. 2/2005 and No. 13/2005, there was no difference in the application of technology in both Inpres, while based on Inpres No. 3/2007, the application of the technology is more specific than Inpres No. 13/2005. In Article 1, 2 and 3 of the Inpres No. 3/2007 mentioned the importance of the application of technology, namely certified seeds of high-yielding rice, balanced fertilizer in paddy, and technology of rice post-harvest. Based on Inpres No. 3/2007, No. 1/2008 and No. 8/2008, there was no difference in the application of technology to achieve rice policy objective. The objective of this research is to analyze the effect of new technologies on Indonesia’s rice import.

DATA AND ANALYSIS

The research used time series data, March 2005- September 2009. This research used simultaneous equation model, consist of sixth structural equation and forth identity equation. The specification of the simultaneous equation model in this research are as follows:

1. Paddy harvested Area

   \[ \text{LAPT}_t = a_0 + a_1 \text{HGKP}_t + a_2 \text{LAPT}_{t-1} + u_1 \]  

   Equation (1) shows that harvested area of paddy (LAPT) is determined by price of dried harvest paddy and harvested area of paddy (LAPT \_t-1) the previous year. The relationship between price of dried harvest paddy and lag harvested area of paddy with harvested area of paddy is expected to be positive.

2. Yield of Paddy

   \[ \text{YPI}\text{T}_t = b_0 + b_1 \text{T}_t + b_2 \text{YPI}\text{T}_{t-1} + u_2 \]  

   The yield of paddy (YPI\text{T}) is determined by the price of paddy (P\text{T}) and the previous year's yield of paddy (YPI\text{T} \_t-1) with a time trend (T) and lagged YPI\text{T} (YPI\text{T} \_t-1) expected to be positive.
Equation (2) shows that yield of paddy (YPIT) is determined by trend technology and yield of paddy (YPIT t-1) the previous year. The relationship between trend technology and lag yield of paddy with yield of paddy is expected to be positive.

3. **Price Dried Harvest Paddy**

\[ HGKP_t = c_0 + c_1 \text{HPGP}_t + c_2 \text{KAGP}_t + c_3 \text{STOB}_t + c_4 \text{HGKP}_{t-1} + u_3 \]  \hspace{1cm} (3)

Equation (3) shows that price of dried harvest paddy (HGKP) is determined by government purchase price of dried harvest paddy (HPGP) and water content of dried harvest paddy (KAGP), Bulog Rice Stock for distribution (STOB) and price of dried harvest paddy (HGKP t-1) the previous year. The relationship between government purchase price of dried harvest paddy and lag of price of dried harvest paddy with price of dried harvest paddy is expected to be positive while the relationship between water content of dried harvest paddy and Bulog Rice for distribution is expected to be negative.

4. **Water Content of Dried Harvest Paddy**

\[ \text{KAGP}_t = d_0 + d_1 \text{CHIT}_t + d_2 \text{KAGP}_{t-1} + u_4 \]  \hspace{1cm} (4)

Equation (4) shows that water content of dried harvest paddy (KAGP) is determined by rainfall and water content of dried harvest paddy (KAGP t-1) the previous year. The relationship between rainfall and lag content of dried harvest paddy with water content of dried harvest paddy is expected to be positive.

5. **Total Indonesia’s Rice Import**

\[ \text{QMBT}_t = e_0 + e_1 \text{QCBD}_t + e_2 \text{QMBT}_{t-1} + u_5 \]  \hspace{1cm} (5)

Equation (5) shows that total Indonesia’s rice imports (QMBT) is determined by total society’s rice supply (QCBD) and total Indonesia’s rice import (QMBT t-1) the previous year. The relationship between total society’s rice supply with total Indonesia’s rice import is expected to be negative while lag total Indonesia’s rice import is expected to be positive.

6. **Total Rice Stock for Bulog Distribution**

\[ \text{STOB}_t = f_0 + f_1 \text{QMBT}_t + f_2 \text{STOB}_{t-1} + u_6 \]  \hspace{1cm} (6)

Equation (6) shows that total rice stock for Bulog distribution (STOB) is determined by total Indonesia’s rice import (QMBT) and total rice stock for Bulog distribution (STOB t-1) the previous year. The relationship between total rice import and lag total rice stock for Bulog distribution is expected to be positive.

7. **Total Paddy Production**

\[ \text{QPIT} = \text{LAPT} \times \text{YPIT} \]  \hspace{1cm} (7)

Identity equation (7) shows that total paddy production (QPIT) is determined by multiplied harvested area of paddy (LAPT) and yield of paddy (YPIT).

8. **Total Rice Production**

\[ \text{QBIT} = \text{FK} \times \text{QPIT} \]  \hspace{1cm} (8)

Identity equation (8) shows that total rice production (QBIT) is determined by multiplied total paddy production (QPIT) and conversion factor (FK) which is 0.63.

9. **Total Rice for seed and Shrinkage**

\[ \text{QBLD} = \text{FP} \times \text{QBIT} \]  \hspace{1cm} (9)
Identity equation (9) shows that total rice for seed and shrinkage (QBLD) is determined by multiplied total rice production (QBIT) and conversion factor (FP) which is 0,10.

10. Total Society’s Rice Supply

\[ \text{QCBD} = \text{QBIT} - \text{QBLD} \] ................................................................. (10)

Identity equation (10) shows that the total society’s rice supply (QCBD) is determined by difference total rice production (QBIT) and the total of rice for seed and shrinkage.

Based on data, we have many stages to analyze simultaneous equation model: (1) to determined order condition for identifications, (2) to determine parameter estimates of each structural equation, (3) to find standard error and t values, the coefficient of determination $R^2$, F values, (4) to find Durbin-h statistics, and (5) to estimate the short run and long run elasticity (Koutsoyiannis, 1977; Intriligator, 1980; Pindick and Rubinfield, 1991)

RESULT AND DISCUSSION

The model of simultaneous equation was over identified, and the model were estimated using 2SLS (Two Stage Least Squares). The tables 1 shows that the highest coefficient of multiple determination ($R^2$) value was obtained in the structural equation of price of dried harvest paddy (HGKP) with a value of 0,94943 which means 94,93 percent of the total variation of price dried harvest paddy explained by the government purchases price of dried paddy, water content of dried harvest paddy, total Rice stock for Bulog Distribution and lag of price of dried harvest paddy.

The lowest $R^2$ value was obtained in the structural equation total Indonesia’s rice import (QMBT) with a value of 0,04678 which means 4,67 percent of the total Indonesia’s rice import explained by the total rice supplies of society and lag of total Indonesia’s rice import. There are fifth structural equation that the value of the F-statistic is higher than the level of significance $\alpha =5\%$ which means that the variation of the explanatory variables together in each structural behavioral equations explain well the variation in the current endogenous variable, except in the structural equation the total Indonesia’s rice imports (QMBT) with a value 1,25. Based on table 1, result of the Durbin-Watson (DW) statistic values ranging from 1,635-2,081. Fifth equation do not exhibit autocorrelation while ones equation exhibit positive autocorrelation.

Besides that, the signs and magnitude of the parameter estimates of each structural behavioral conforms to the principles of economic theory even though there are some parameter estimates that are not statistically significant. Consequences of simultaneous equation, there is a joint dependence between endogenous variables and explanatory variables, and their relationship cannot be described with a single equations, but with a system of simultaneous equations (Koutsoyiannis, 1977).

Based on simultaneous equations, using technology (T) increase paddy yield (YPIT) and paddy production while paddy production (QPIT) is multiplied harvested area of paddy and paddy yield. Furthermore, the increase of the government purchases price of dried harvest paddy (HPGP) led to increase the price of dried harvest paddy (HGKP), in addition, the increasing of the price of dried harvest paddy tend to increasing harvested area of paddy and consequently, paddy production tend to increase too. The technology has a positive correlation on paddy yield and significant, but not responsive, both in short run and long run, with short and long run elasticity, 0,158 and 0,546, respectively which means, a 1 percent increase in technology (new technologies), holding all other parameter constant would increase the paddy yield by 0,158 percent in short run and 0,546 percent in long run.
Table 1: Estimate Structural Equation using time series data

<table>
<thead>
<tr>
<th>No SQ</th>
<th>Equation/Variable</th>
<th>PE</th>
<th>SE</th>
<th>TV</th>
<th>ESR</th>
<th>ELR</th>
<th>FV</th>
<th>RS</th>
<th>D-W</th>
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<td>433,715</td>
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<td></td>
<td>11,55*</td>
<td>0,31182</td>
<td>1,668</td>
<td>2,148#</td>
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<td></td>
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<td>YPIT</td>
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<tr>
<td>3</td>
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<td>1,688</td>
<td>1,933#</td>
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<td>Intercept</td>
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<td></td>
<td>HPG</td>
<td>0,16836</td>
<td>0,081</td>
<td>2,06(B)</td>
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<td>0,847</td>
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<td>KAGP</td>
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<td>21,656</td>
<td>-6,01(B)</td>
<td>-1,083</td>
<td>-6,537</td>
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<td>0,177</td>
<td>-0,15</td>
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<td>-0,015</td>
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<td>LHGKP</td>
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<td>1,755</td>
<td>2,273#</td>
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<td>1,24(D)</td>
<td>0,013</td>
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<tr>
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<td>0,04678</td>
<td>2,081</td>
<td>3,485##</td>
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<td>QCBD</td>
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<td>0,001</td>
<td>-0,83</td>
<td>-0,067</td>
<td>-0,083</td>
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<td>STOB</td>
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<td>2,0429</td>
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<td>0,27</td>
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<td>LSTOB</td>
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</table>

Note: PE = parameter estimate; SE = standard error; TV = T-value; ESR = short run elasticity; ELR = Long run elasticity; FV = F value; RS = R-squares; DW = Durbin-Watson value; h = Value in parentheses A,B,C and D denote variables significance at 1%, 5%, 10% and 15% levels; * significant at 5%; # = no autocorrelation; ## = positive autocorrelation

The consequences of paddy yield tend to increase cause paddy production tend to increase. The study revealed that increase in the paddy production hence increased rice production (QBIT). The increase rice production led to increase total rice for seed and shrinkage (QBLD), although it is increase, rice production also increase. The increase of rice production led to increase total society’s rice supply.

The increase of total society’s rice supply (QCBD) led to a decrease in the total Indonesia’s rice import. It is observed in the simultaneous equation that the total society’s rice supply influence Indonesia’s rice import. The total society’s rice supply has a negative correlation on the total Indonesia’s rice import and not significant, and not responsive, both in short run and long run, with short and long run elasticity, -0,067 and -0,083 respectively, which means, a 1 percent increase in total society’s rice supply, holding all other parameter constant would decrease the Indonesia’s rice import by 0,067 percent in short run and 0,083 percent in
long run. While the total Indonesia’s rice import has a positive correlation on the total rice stock for Bulog distribution (STOB) and not significant.

The increase of total Indonesia’s rice import led to increase the total rice stock for Bulog, where as the increase the total rice stock tend to decrease price of dried harvest paddy (HGKP). Because of the relationship between the total Indonesia’s rice import on the total rice stock for Bulog distribution is positive, moreover, the decrease of the total Indonesia’s rice import led to decrease on the total rice stock for Bulog distribution.

The relationship between rainfall (CHIT) with water content of dried harvest paddy (KAGP) has a positive correlations and significant, it means that the increase of rainfall led to increase water content of dried harvest paddy. Where as, the consequences of water content of dried harvest paddy tend to increase cause price of dried harvest paddy tend to decrease.

Based on presidential instruction, we review new rice technologies that have been develop by research institute, specifically a new varieties, to improved paddy yield and paddy production. As a result, the total Indonesia’s rice import tend to decrease. According to Panuju, DR, Kei M, Bambang HT (2013), the role of seed inventions in Indonesia to improve paddy production and productivity. The objective of this research is to analyze the effect of new technologies on the other hand it is also limited to technologies that are already used by farmers, as mentioned earlier, based on presidential instruction there are many type of technologies, namely certified seeds of high-yielding rice, balanced fertilizer in paddy, and technology of rice post-harvest.

CONCLUSION
Using new technologies increase paddy yield and paddy production. The increase in the paddy production hence increased rice production. The increase rice production led to increase total rice for seed and shrinkage although it is increase, rice production also increase. The increase of rice production led to increase total society’s rice supply. The increase of total society’s rice supply led to a decrease in the total Indonesia’s rice import.

While the total Indonesia’s rice import has a positive correlation on the total rice stock for Bulog distribution and not significant, moreover, the decrease of the total Indonesia’s rice import led to decrease on the total rice stock for Bulog distribution.

Based on presidential instruction, we review new rice technologies that have been develop by research institute, specifically a new varieties, to improved paddy yield and paddy production. According to based presidential instruction for rice policy, the present study also need the specific technologies to simultaneous equation model and simulations result.

REFERENCES


