Analysis of factors affecting retail prices of rice in North Sumatera

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Abstract. This study aims to determine the factors that affect the retail price of rice and its effect on retail rice prices in North Sumatra. The model useful to get the function of the retail price of rice by using annual data from 1986 to 2015. The results of the study we found that rice consumption per capita, quantity of rice import and Bulog rice stock have negative effect on retail price of rice, in contrast the international rice price and the rice production. Rice consumption per capita and quantity of rice import do not significantly affect retail price of rice, while the international rice price, Bulog rice stock and rice production significantly affect retail price of rice respectively at the alpha level of 5 and 1 percent. Rice production is the greatest influence on the formation of retail price of rice by the estimated coefficient of 1.040.

Keyword: retail prices of rice, rice consumption per capita, international rice price, Bulog rice stock, rice production

1. Introduction
Research on the price of rice at retailers that have been done with a different approach. Several studies were carried out using the economical approach such as ARIMA model [1], maximum likelihood estimation (MLE) [2], autoregressive model [3], Generalized Autoregressive Conditional Heteroskedasticity (GARCH) [4], cointegration and error correction models [5], Ordinary Least Square [6], error correction model (ECM) with short-run parameters represented by one-lagged autoregressive distributed lag (ADL) [7], and simultaneous equation [8]. Research the price of rice at retailers from the marketing approach by [9] in Cameroon, Uganda [10], Iran [11] and Taiwan [12], and examined asymmetric price transmission to examine the volatility of retail spreads in vertical markets [13]. The research on the retail price of rice is important because it is related to the purchase price of rice by consumers. If the retail price of rice increase, the government will intervention. Based on (14) concludes that rice prices are the only accurate indicator of the balance between supply and demand. This study aims to determine the factors that have influence to retail prices of rice

2. Methods
The the retail price of rice in the form of the function of the demand for rice, rice consumption per capita, producen price, the quantity of rice imports, international rice of prices, Bulog rice stock and rice production. The retail price of rice equations (1) used in this study is written as
\[ RPR = a + b_1 DR + b_2 RCC + b_3 RP + b_4 QRM + b_5 BRS + b_6 IRP + b_7 RP + \mu \]  
(1)

where RPR is retail price of rice, DR is demand for rice, RCC is rice consumption per capita, RP is rice production, QRM is quantity of rice import, BRS is Bulog rice stock, IRP is international rice of prices and RP is rice production. The model in equation (1) is useful to get the function of the retail price of rice by using annual data from 1986 to 2015.

Estimation of regression coefficients by the method of least squares (OLS) is shown to achieve good statistical and econometrics conditions. In an effort to achieve these objectives, methods of OLS will yield a good estimate if the underlying assumptions are met, including: test multicolinear, autocorrelation test, heteroscedasticity test, normality test error term [15,16].

3. Results and Discussion

In Figure 1. the graph a is explained that the rice production obtained from the conversion of rice into Grain Dry Grain (GKG), then converted again into rice using the conversion rate set by the National Logistics Agency of 86.02 percent. This means that if the conversion from GKP to MPD is 100 quintals, the resulting MPD is 86.02 quintals, with consideration of 100 of the converted weights reduced by two components, namely; deduction of weight due to drying of 10.71 percent and physical loss of 3.27 percent. While the conversion rate from GKG to rice is 62.74 percent. This figure estimates the rice that will be produced and shrinks due to milling.

In Figure 1. graph b, it is explained that the development of rice imports in North Sumatra fluctuated from year to year. The largest rice imports were carried out in 1996 and 1999, 513,837 tons and 644,637 tons respectively, 2001, which is 66,880 tons. Rice imports are carried out to meet the shortage of rice that will be distributed so that the stock in Bulog is maintained. In Figure 1 graph c is explained about the supply of rice to be made to Bulog rice. To maintain the rice needs and the stability of rice prices on the market, the government must maintain the amount of rice available through rice stocks in the BULOG. The rice stock available in the Bulog comes from local procurement, outside the region and imports from abroad. When the price of rice falls or lows, Bulog will buy rice and store it for distribution when prices increase through traders who have been approved by the National Logistics Agency or through market operations. And Figure 1 in the graph d is explained about changes in retail rice prices and rice prices at the producer level in North Sumatra, which in this graph shows a positive trend from 1986 to 2015. In Figure 1 in the graph d it can be seen that prices began to rise sharply since in 1998 and continued to increase until 2015.
Figure 1. (a) North Sumatra Rice Production, (b) North Sumatra Rice Imports, (c) North Sumatra Rice Stock in Bulog, (d) Rice Prices in North Sumatra

Table 1. describes the use of multiple regression equations in data processing showing the existence of symptoms of multicollinability in demand for rice and the producer price which the variance inflation factor (VIF) value > 10. On the hypothesis test also produced a very high F-count value of 240.136. The t-ratio value shows more variables that have no significant effect on the retail price of rice while the determination coefficient is very high at 98.7 percent. Furthermore, the variable is reduced the multicollinearity value as shown in equation (2). However, it can be seen that the coefficient of determination is still high is 92.4 percent while the results of the t test show more variables that have no real effect. This shows that there are still symptoms of multicollinearity, so this model cannot be used.
Table 1. Factors affecting the retail price of rice in North Sumatera uses multiple regression.

| Model                          | Unstandardized Coefficients | t   | Sig. | Collinearity Statistics |
|-------------------------------|----------------------------|-----|------|-------------------------|
|                               | B          | Std. Error |     | Tolerance | VIF |
| (Constant)                    | 1036,743   | 1194,378   | 0,868 | 0,018       | 55,33 |
| Demand                        | 2,297      | 0,494      | 4,647 | 0,000       | 0,018 | 55,33 |
| Rice consumption per capita   | -22,904    | 7,882      | -2,906 | 0,008      | 0,159 | 6,277 |
| Produce price                 | -0,312     | 0,443      | -0,705 | 0,488      | 0,013 | 76,08 |
| The quantity of rice import   | 1,213      | 0,803      | 1,510 | 0,145       | 0,601 | 1,664 |
| Bulog Stock                   | -0,581     | 1,608      | -0,361 | 0,721      | 0,495 | 2,019 |
| International Price           | 2,607      | 1,116      | 2,335 | 0,029       | 0,271 | 3,687 |
| Production                    | 0,783      | 0,464      | 1,688 | 0,106       | 0,146 | 6,841 |
| F-hitung                      |            |            |      |            | 240,136 |
| R²                            |            |            |      |            | 0,987 |

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The ln retail price of rice equations (2) used in this study is written as:

\[ \ln R_P = a + b_1 \ln RCC + b_2 \ln QRM + b_3 \ln BRS + b_4 \ln IRP + b_5 \ln R_P + \mu \] (2)

The result of equation (2) show that the VIF value of per capita consumption, rice imports, international rice prices, Bulog rice stock and smaller rice production of 10, it was concluded that there were no symptoms of multicollinearity. Apart from the VIF value, the multicollinearity test can also be seen from the t test value where more variables have significant effect in line with the not too high coefficient of determination (76.2 percent) and calculated F value (15,359) which are not too high but have a real effect.

Based on the results of autocorrelation testing using the Durbin-Watson test (D-W test) then through the calculation with SPSS Statistics 17.0 the D-W value was calculated at 1.066 for the equation of retail rice prices in North Sumatera. Referring to the Durbin-Watson Table at a confidence level of 90 percent, the dL value is 1.00 and dU is 1.93 for n = 30 and k = 6. From this result, the values of 4-dL = 3 and 4-dU = 2 are obtained. Because the DW value is smaller than the dL value and is greater than dU so that the data is in an uncertain area. Then it can be concluded that the autocorrelation symptoms in the data cannot be as certain.

Based on the result of F ratio is 2,103 at a 90 percent confidence level less than F tables, it can be concluded that there is no symptoms of heterohedasticity in the data. Based on the results of data processing the asymp value is obtained Sig. (2-tailed) is 0.780 greater than the 95 percent and 90 percent confidence level. So it can be concluded that the data is normally distributed. Because of the assumptions of ordinary least squares method is fulfilled, the result of the regression in Table 2 can be used to explain retail price of rice in North Sumatera. The determination coefficient obtained from the data processing results shown in table 2 is 0.762, meaning that 76.2 percent of the retail rice price can be explained by the rice consumption of per capita, the quantity of rice imports, the international rice rice.
prices, Bulog rice stock and rice production, while 23.8 percent is explained by other variables outside of the independent variables.

To determine the effect of independent variables simultaneously on the dependent variable (RPR) is done by F test. Based on the results of data processing, it was found that Fratio was 15.359 while Ftable at 90 percent confidence level was 2.103. Because it is calculated (15.359) > Ftable (2.103), it can be concluded that the rice consumption of per capita, the quantity of rice imports, international rice prices, Bulog rice stocks and rice production together have a significant effect on the retail price of rice in North Sumatra.

| Model                                  | Unstandardized Coefficients | t      | Sig.  |
|----------------------------------------|----------------------------|--------|-------|
| Constant                               | -2.996                     | 3.069  | -0.976|       |
| Ln rice consumption per capita         | -0.055                     | 0.299  | -0.183| 0.856 |
| Ln the quantity of rice import         | -0.053                     | 0.213  | -0.248| 0.806 |
| Ln International rice prices           | 0.811                      | 0.419  | 1.936 | 0.065 **|
| Ln Bulog rice stock                    | -0.378                     | 0.152  | -2.487| 0.020 *|
| Ln rice production                     | 1.040                      | 0.281  | 3.694 | 0.001 *|

R² = 0.762; F-hitung = 15.359; DW = 1.066

* significant at α = 0.01; ** α = 0.05

Based on the results of data processing in table 2, the ratio for each independent variable and t table at 90 percent confidence level is 1.711. From Table 2 show that rice consumption per capita variables has a negative sign but did not significantly influence the retail price of rice. The quantity of rice import has a negative sign but did not significantly influence the retail price of rice. Whereas, Bulog rice stock has a negative sign and significantly influence the retail price of rice. International rice prices and rice production has a positive sign and significantly influence the retail price of rice.

The result of the regression RPR obtaining as follows:

RPR = - 2.996 – 0.055 ln RCC – 0.053 ln QRM + 0.811 ln IRP – 0.378 ln BRS + 1.040 ln RP;
(3)

R² = 0.762; DW = 1.066

If there is an increase in rice consumption of per capita by one percent the retail price of rice will decrease by 0.055 percent. This coefficient shows the low level of retail price elasticity of rice consumption per capita (in elastic). If there is an increase in quantity of rice import by one percent the retail price of rice will decrease by 0.053 percent. This coefficient shows the low level of retail price elasticity of rice to quantity of rice import (in elastic).

If there is an increase in the international rice price by one percent the retail price of rice will increase by 0.811 percent. This coefficient shows the middle level of retail price elasticity of rice to international rice price (close elastic). If there is an increase in the Bulog rice stock by one percent the retail price of rice will decrease by 0.378 percent. This coefficient shows the low level of retail price elasticity of rice to Bulog rice stock (in elastic). If there is an increase in rice production by one percent the retail price of rice will increase by 1.040 percent. This coefficient shows the high level of retail price elasticity of rice to rice production (elastic).
4. Conclusion
The results of the study we found that rice consumption per capita, quantity of rice import and Bulog rice stock have negative effect on retail price of rice, in contrast the international rice price and the rice production. rice consumption per capita and quantity of rice import do not significantly affect retail price of rice, while the international rice price, Bulog rice stock and rice production significantly affect retail price of rice respectively at the alpha level of 5 and 1 percent. Rice production is a the greatest influence on the formation of retail price of rice by the estimated coefficient of 1.040.

References
[1] Abdus Sabur, S and Haque, Md. Ershadul, 1993. "An Analysis Of Rice Price In Mymensing Town Market: Pattern and Forecasting," Bangladesh Journal of Agricultural Economics, Bangladesh Agricultural University, vol. 0(2), pp 1-15
[2] Jahangir Alam M & Andrew M. McKenzie & Ismat Ara Begum & Jeroen Buysse & Eric J. Wailes & Guido Huylenbroeck, 2016. "Asymmetry Price Transmission in the Deregulated Rice Markets in Bangladesh: Asymmetric Error Correction Model," Agribusiness, John Wiley & Sons, Ltd., vol. 32(4), pp 498-511
[3] Korale Gedara P. M. , S. Ratnasiri , J. S. Bandara, 2016. "Does asymmetry in price transmission exist in the rice market in Sri Lanka?," Applied Economics, Taylor & Francis Journals, vol. 48(27), pp 2491-2505
[4] Muslim A, 2014. "Analyzing volatility of rice price in Indonesia using ARCH/GARCH model," Journal Articles, Universitas Islam Indonesia, Department of Economics, vol. 6(1), p 112.
[5] Yaya Keho, Camara, Aïssata S, 2012. "Vertical Price Transmission in Local Rice Markets in Côte d’Ivoire: Are Consumers Really Right?," Asian Journal of Agriculture and Rural Development, Asian Economic and Social Society (AESS), vol. 0(Number 04), pp 1-13
[6] Wawan H Fitrawati and Indra M 2016 Factors Affecting the Domestic Price of rice in indonesia journal of economics and policy 2016. 10 (1) pp 155-171
[7] Nuryanti Sri, D Budiman Hakim, H Siregar and M. Husein Sawit 2017 Political Economi Analysis of Indonesian Rice Marker . J. ISSAAS .23(2): 158 -168
[8] Sembiring SA and J Hutauruk 2018. Econometric Model of Rice Policy Based On Presidential Instruction. 4th International Conference on Operational Research (InteriOR) IOP Publishing. IOP Conf. Series: Materials Science and Engineering 300 (2018) 012028 doi:10.1088/1757-899X/300/1/012028
[9] M.J. Bime and Mai Bong JK, and Manu I., 2016. "Structure, conduct and Performace of the rice market in North-West region of Cameroon: a descriptive analysis.,” Russian Journal of Agricultural and Socio-Economic Sciences, vol. 59(11), pp 23-29
[10] Kikuchi Masao & Yusuke Haneishi & Kunihiro Tokida & Atsushi Maruyama & Godfrey Asea & Tatsushi Tsuboi, 2016. "The Structure of Indigenous Food Crop Markets in sub-Saharan Africa: The Rice Market in Uganda," Journal of Development Studies, Taylor & Francis Journals, vol. 52(5), pp 646-664
[11] Chizari, Amir Hossein & Sani, Masoud Fehresti & Kalashami, Mohammad Kavoosi, 2013. "Investigating Market Integration and Price Transmission of Different Rice Qualities in Iran," International Journal of Agricultural Management and Development (IJAMAD), Iranian Association of Agricultural Economics, vol. 0(4), pp 1-7
[12] Wang Kuan-Min and Yuan-Y Ming Lee, 2009. "A measure of marketing price transmission in the rice market of Taiwan," Zbornik radova Ekonomskog fakulteta u Rijeci/Proceedings of Rijeka Faculty of Economics, University of Rijeka, Faculty of Economics, vol. 27(2), pp 311-326.
[13] Jha R. and H. K. Nagarajan, 2002. "Wholesale spreads and the dynamics of retail price volatility in Indian rice markets," Applied Economics Letters, Taylor & Francis Journals, vol. 9(6), pp 387-390
[14] Rosner LP and Neil M 2008. A Note On Rice Production, Consumption And Import Data In Indonesia,” Bulletin of Indonesian Economic Studies, Taylor & Francis Journals, vol. 44(1), pp 81-92
[15] Lubis A D, Dian V. P 2012. Volatility of volume import of major food commodities in Indonesia. Economic Journal of Emerging Markets 4(2): 127-142
[16] Koutsoyiannis A 1977. Theory of Econometrics, Second Edition. The Macmillan Press Ltd. Great Britain

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