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Analysis on the Variation of Retail Price of Commercial Rice in the Philippines

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Abstract:

This purpose of this study is to identify the factors that affect the variation of retail price of commercial rice in the Philippines using multiple linear regression analysis. The data collected is from July 2010 to December 2016 on a monthly basis, with a total of 78 observations. The independent variables used in this paper are the farmgate prices of palay, wholesale prices of commercial rice, price of dealers' fertilizer, commercial rice stock inventory, rice imports, exchange rate and purchasing power of peso (PPP) in rice. Of these, only the variables farmgate prices of palay and PPP are found significant at 0.01 level of significance after executing Prais-Winsten Transformation.

Key words: retail price, rice, commercial rice, multiple linear regression, economics

INTRODUCTION

Despite the plan to make Philippines an industrialized economy by 2000, primarily it is still an agricultural country. Most of the citizens live in rural areas support themselves through farming.

Farming, fisheries, livestock, and forestry makes up the agricultural sector.

The most pressing concerns is the conversion of agricultural land which is intended for farming transformed into a golf courses, housing units, condominiums, and developed as business ventures. The share of irrigated crop land in the Philippines in the mid-1990 has an average of about 19.5 percent. This sector has not received sufficient funding like creation of efficient irrigation system.[1]

It is believed that agricultural land area affects the price of crops because of low production.

Based on the 2015 Family Income and Expenditure Survey of the Philippine Statistics Authority, families spent greatly in food than in non-food items, like clothing and footwear, household durables, etc. Families' food expenditure was estimated at 41.9 percent of the total expenditure for all income classes. [2]

Food is a necessity, not only to Filipino households but also to everyone. The common denominator to each Filipino households is the inclusion of rice in every meal, from breakfast through lunch to dinner. Rice is a staple food to every Filipinos. That is why changes the retail price of rice affects mainly the consumers.

1.1 Objective of the Study

This paper intends to present trend of retail price of commercial rice and to determine the factors that affect the variability of the price.

The selected independent variables for this study are farmgate prices of palay, wholesale prices of commercial rice, price of dealer's fertilizer, rice stock inventory, exchange rate (peso-dollar), purchasing power of peso (PPP) for rice commodity measured at 2006 constant prices and rice imports.

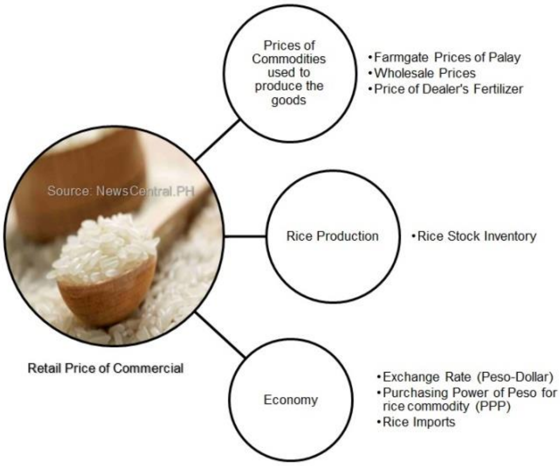


Figure 1. Research Paradigm

1.2 Statement of the Problem

1.1.1 What is the trend of the retail price of rice in the Philippines from July 2010 to December 2016?

1.1.2 What is the movement of the following independent variables:

a. famgate price of palay and
b. PPP for rice

1.1.3 Among the independent variables, which of these affect the average retail price of rice in the country from July 2010 to December 2016?

1.1.4 How do these variables affect the changes in the retail price in the country?

1.3 Scope and Limitation

There are four types of commercial rice in the market: a) rice, special; b) rice, premium; c) regular-milled and d) well-milled rice. The retail prices for these types of rice are not the same. Regular-milled rice is the cheapest among the four, followed by premium rice and well-milled rice while the special rice is the most expensive.

There are no specific data for each independent variables on these four types of rice. Thus, the retail prices of rice presented on this paper are the average retail prices of the four.

The study covers the retail price of rice in the Philippines from July 2010 to December 2016. The data are in current prices.

The main objective of this paper is to identify the factors, not to forecast or predict the retail price of commercial rice in the country.

The result will not imply a cause-and-effect relationship among the dependent and significant independent variable(s).

REVIEW OF RELATED STUDIES

Rice is one of the most important food crop in the world. It is the main food across Asia and it can grow and live in wet environments were other crops cannot last.[3] Asian country has been plenty of rain. Heavy rains cause problems to farmers. Certain nutrients like nitrogen, potassium, sulfur and boron leached out from soil. Rain can interrupt planting. Planters must watch out for waterlogging and oxygen depletion in the soil during rainfall seasons. [4]

Four types of farm are considered to affect the rice production. These are fully irrigated, partially irrigated, lowland rainfed, and upland rainfed. These highly affect the rice productivity through economic and institutional factors. Economic variables were particular with the amount of input used with the amount of fixed asset in the production, while institutional factors were dedicated on the relationship with the government and the amount loan available to farmer members. [5]

Economic activities have an impact to the prices of the commodities. The factors that have been contributing to the changes in the market prices of rice were the developing country GDP, export rice, and Dollar-Euro exchange rate.[6]

Dr. Aqeel-ur-Rehman reflected even there are many findings on how to improved existing skills to be more productive for agriculture thru machinery there are issues that have substantial effect which occur like speedy deviations of weather and the source of water. [7]

A study conducted in order to grow crops especially rice, stuffs need to prioritize are irrigation, acceptance of crossbreed substance of seed, machinery and training on rice production should be considered.[8]

The increasing price of rice affects the household varying on their status and locations. Poor families living in urban areas, as well as farmers, were mostly affected. [9]

A sudden upward movement of fuel and fertilizer expenses lead to an increase of the retail price of rice. It was also noted that the legislations of nations have place a great impact like the decisions of the government not to allow export, out of fear that there is the possibility of scarcity may happen. Thus, countries prepare a sudden program to guarantee that they will endure in case of shortage. [10]

Philippine Statistics Authority (PSA) released latest report of rice inventory in the country declined by 20.35 percent from 3.36 million metric tons (MMT) to 2.68 MMT. Availability of stocks per household would not be higher than 45 days, while in warehouses for commercial would be around 30 days. The government will assess whether there is a need to import to increase local stocks. Mostly the inventory or the availability of the stocks defines the price of the crops.[11]

Purchasing power said to have effects in all aspects pertaining to economic rate, from purchasing of goods, stock prices, import, export and investment. An excessive inflation may occur when peso purchasing decreases, costs of living will remain high which includes the rising of commodity and services.[12] The tangible increase of goods and services is due to the upward increase in the unit value of money. Indications show that for every unit of dollar goes up, purchasing power of money decline. [13]

Purchasing power of one peso last December 2016 was 67 centavos, which make it the lowest purchasing power since 2008. This explains that one peso can buy you three pieces of candy in 2008 but now, that one peso in your pocket can only buy you two pieces of candy. These changes in the value of our money are big deal for millions of rank- and-file workers.[14]

METHODOLOGY

3.1 Statistical Tool

Stata 12 was used to generate the results of this study. Stata is good at handling and running datasets, as this does not force to produce a result that is not valid.

3.2 Statistical Treatment

Multiple Linear Regression (MLR) analysis was employed in this study identify the factors that affect the retail prices of rice.

MLR is a study of how the dependent variable y is related to the independent variables, x. The analysis requires a continuous dependent variable. The basic general MLR model is as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \varepsilon$$ [15]

In order to fit a model, there are assumptions needed to take into considerations:

a. Linearity

The model should be "linear in the parameters", meaning no parameter should appear as an exponent or is multiplied or divided to another parameter. It should also be "linear in the independent variable". The relationship between the dependent and the independent variable is linear that it appears in the first power only.[16]

The relationship between the two variables can be determined through Pearson Product-Moment Correlation Coefficient. This measures the correlation to determine the linear relationship of two variables. The formula for computing the correlation coefficient of the ungrouped data is as follows:

$$r_{xy} = \frac{N\sum XY-(\sum X)(\sum Y)}{\sqrt{[N\sum X^2-(\sum X)^2][N\sum Y^2-(\sum Y)^2}} \qquad [17]$$

This assumption can be detected in Stata by employing the pairwise correlation *pwcorr.*

b. There should be no multicollinearity among the independent variables.

It is common for the independent variables to be collinear. Problem only arises when these variables are highly correlated. This is also known as multicollinearity.

Multicollinearity among the independent variables can be detected through Variance-Inflation Factor (VIF), which is defined as:

$$VIF = \frac{1}{1-{R_k}^2} \qquad [18]$$

where R_k^2 is the coefficient of multiple determination

VIF shows how the variance of an estimator is inflated by the presence of multicollinearity.

c. The error variance should be constant.

Homoscedasticity is when the variance of the error terms are constant. Homoscedasticity can be detected through *estat* *hettest* command. This command produces a Breusch-Pagan. The test statistic for the Breusch-Pagan test is

$$bp = \frac{1}{v}(\boldsymbol{u} - \bar{u}i)'Z(Z'Z)^{-1}Z'(\boldsymbol{u} - \bar{u}i)$$

where $\boldsymbol{u} = (e_1^2, e_2^2, \ldots, e_n^2)$,
$\boldsymbol{i}$ is a $n \times 1$ vector of ones, and

$$v = \frac{1}{n}\sum_{i=1}^{n}\left(e_i^2 - \frac{e'e}{n}\right)^2 \qquad [19]$$

This is a modified version of the Breusch-Pagan test, which is less sensitive to the assumption of normality than the original test.

The null hypothesis is that the error terms have constant variance. If the p-value produced is less than or equal to 0.05, then we reject the null hypothesis.

If the error terms are heteroscedastic, a transformation must be employed to either the dependent or independent or both.

d. The distribution of error terms $e_1, e_2, e_3, \ldots e_n$ should be normal.

To achieve normality, Shapiro Wilk test *swilk* can be used. If the result p-value is less than or equal to the level of significance, then the error terms are (approximately) normal.

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_i\right)^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where x_i are the ordered random sample values
a_i are constants generated from the covariances, variances and means of the sample size n from a normally distributed sample

When non-normality arises, it is improper to delete the observations that make the error terms deviate from normality, unless it the observation was a result from error.[16]

e. The error terms should be independent.

To test the independence of the error terms, a Durbin-Watson test statistic *estat dwatson* can be used. Durbin-Watson test assumes the first-order autoregressive error models, with the values of the independent variable(s) fixed.

$$D = \frac{\sum_{t=2}^{t=n}(e_t - e_{t-1})^2}{\sum_{t=1}^{t=n} e_i{}^2}$$

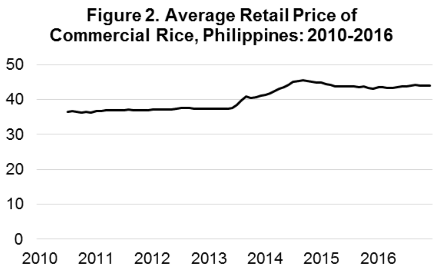
where n is the number of observations.

Serial correlation exists mostly on Economics, as an event in one period can influence events in subsequent periods. One way of fixing this problem is adding an independent variable. Remember that omission of important variables affects the results of the study. When this fails, a Prais-Winsten transformation, using Cochran-Orcutt procedure, use to approximate errors in linear regression model and evaluate constraints. Errors use to follow first estimate in autoregressive process. [20]

Prais-Winsten can be run in Stata using the prais $y\ x_1\ x_2 \ldots x_n$, *corc* command.

RESULTS AND DISCUSSIONS

4.1 How is the movement of the average retail price of commercial rice from July 2010 to December 2016?



The figure shows the retail price of rice per kilo remain stable with around PhP 35 to 40 from 2010 to 2013. Visible movement sudden arises before the end of 2013. This continued to have an upward movement until it reach a peak of PhP 45 before 2014 ended, which is considered the highest retail price in the country from 2010 to 2016.

4.2 What is the movement of the following independent variables:

a. Farmgate Price of Palay

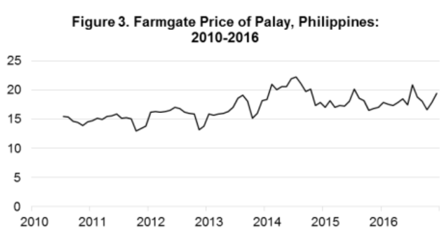
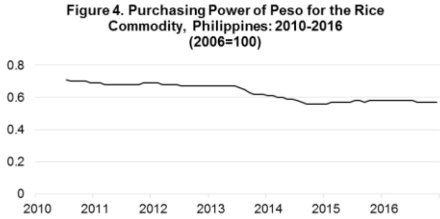


Figure 3 illustration for farmgate price of Palay from 2010 to 2016 was fluctuating. The prices continuously changed but just within the range of PhP 10 to 25. There were no abrupt changes seen in the prices.

The price of Palay was highest in middle of 2015 while had its lowest before the 2011 ended.

b. PPP for rice



The figure from 2010 to 2016 expresses the continuous decline of the PPP. This implies that the value of our Peso decreases.

The lowest value reached was around 0.50 in 2014. Meaning, if the retail price of rice in 2006 was PhP25, its price in 2014 would be around PhP 50.

4.3 Among the independent variables, which of these affect the average retail price of rice in the country?

Number of obs	=	78
F(2, 75)	=	20013.11
Prob > F	=	0.0000
R-squared	=	0.9981
Adj R-squared	=	0.9981
Root MSE	=	0.00698

Log(Retail Price of Commercial Rice)	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
Log(PPP for rice)	-0.9119848	0.0246303	-37.03	0.000	-0.9610509	-0.8629187
Farmgate Price	0.0034979	0.0007163	4.88	0.000	0.0020709	0.004925
C	3.212626	0.123461	260.21	0.000	3.188031	3.23722

The result shows the final and reduced model after running Prais-Winsten transformation.

The model is significant. It shows that the there is a significant relationship among the dependent and the independent variables at 0.01 level of significance *(Prob > F).*

The variables found to be significant in this study are farmgate prices of palay and PPP in affecting the retail price of rice.

The adjusted R-squared (Coefficient of Determination, r^2) is 0.9981. This explains that the variation in the retail price of rice is reduced by 99.8 percent when PPP for rice and farmgate price of palay are considered.

4.4 How do these variables affect the changes in the retail price in the country?

The statistical model for retail price is:

$$ln(y_i) = 3.212626 - 0.9119848ln(x_1) + 0.0034979x_2 + e_{t-1}$$

where y_i is the average retail price of commercial rice
x_1 is the PPP for rice
x_2 is the farmgate price of palay
e is the error term

The model demonstrates how the PPP and farmgate price of palay affect the retail price of rice.

When the PPP, or as the value of Peso increases by 10.0 percent, the retail price of commercial rice decreases by nine percent (1.10^0.9119848) if the PPP is held constant.

Moreover, for every one unit increase in the farmgate price of palay, there is a corresponding 0.3 percent ($e^{0.0034979}$) increase in the retail price of rice when the other variable is held constant.

CONCLUSIONS AND RECOMMENDATION

5.1 Conclusion

Researches used multiple linear regression analysis to identify the trend of retail price of rice. Based on data gathered there are two independent variables found significant to the retail price of rice namely farmgate price of palay and purchasing power of peso (PPP) these variables affect the retail price of commercial rice weather increases or decreases.

5.1.1 The average retail price of rice is increasing

The retail price of rice was increasing from July 2010 to December 2016. High prices of commodities are one of the major problems of the country that some of the poor Filipino consumers suffer while making the merchants richer.

However, inflation is a good thing to the society. Inflation implies the capability of the consumers to buy a certain product. People often think that a negative inflation rate is good as this makes the commodities affordable but little did they know that this will create an economic downfall.[20]

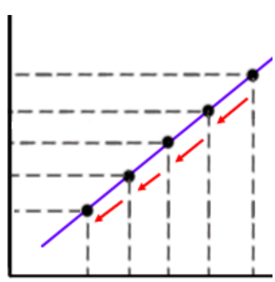
5.1.2 The prices of palay go together with the rice

Bear in mind that rice is from palay. As a result, for every amount increase in the farmgate price of palay shows a significant increase of change in the retail price of commercial rice, and vice versa. The farmgate price of palay and retail price of rice have a positive linear relationship.

However, the selling price of palay is slightly lower than the retail price of rice. This creates an argument that while the middle men gain more thus the farmers remain poor.

Figure 5. Relationship of the Retail Price of Rice and Farmgate Price of Palay

Retail Price of Rice

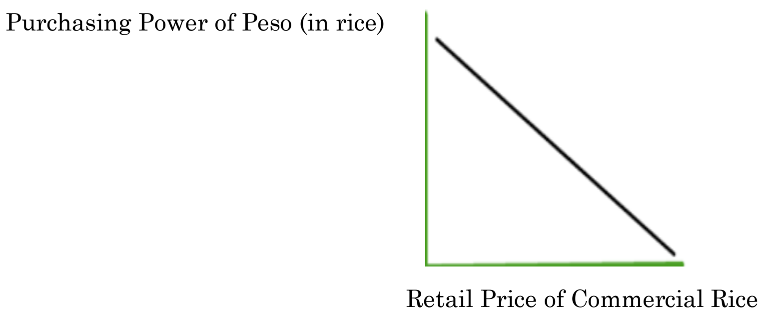


Farmgate Price of Palay

5.1.3 As the value of Purchasing Power of Peso increases, the retail prices decreases

As PPP increases, the retail prices decreases. It denotes that if Philippine Peso strengthen or get a value higher in exchange to dollar, there would be a momentous decrease in retail price and vice versa.

Figure 6. Relationship of the Retail Price and Purchasing Power of Peso for Rice



Purchasing power loss, or gain, describes an increase or decrease in how much consumers can buy with a given amount of money. Consumers lose purchasing power when prices increase, and gain purchasing power when prices decrease. [11]

5.2 Recommendation

It is important that the retail price of rice is deflated, or is presented in a base year. The prices used in this study are all affected by inflation, meaning the prices may look bloated that it is impossible to identify if the retail price of rice is really increasing or almost the same throughout the period.

Variables included and not included in this study affect the results. Therefore, it is important to add more variables, like season and rice production.

Some variables in this study are neglected because of nonlinearity. The next researchers should consider running a nonlinear regression analysis to include these variables as these may also effect the retail price of rice.

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Appendix A – Dataset

Date	stockinventory	farmgate	wholesale	ppp	fertilizer	exchangerate	imports	rice
Jul-10	424	15.48	30.18	0.71	871.08	46.32	2.10E+08	36.43
Aug-10	480	15.34	30.18	0.7	850.74	45.18	1.30E+08	36.71
Sep-10	381	14.68	29.9	0.7	849.49	44.31	543140	36.51
Oct-10	484	14.46	29.51	0.7	867.44	43.44	1.80E+06	36.31
Nov-10	693	13.91	29.36	0.7	876.93	43.49	1.40E+06	36.44
Dec-10	699	14.5	29.58	0.69	907.33	43.95	137863	36.33
Jan-11	551	14.73	30.06	0.69	940.14	44.17	81	36.72
Feb-11	543	15.13	30.35	0.69	962.11	43.7	3.30E+06	36.81
Mar-11	455	14.98	30.38	0.68	968.84	43.52	383850	36.91
Apr-11	616	15.45	30.53	0.68	973.19	43.24	6.50E+07	36.98
May-11	699	15.56	30.66	0.68	976.81	43.13	1.80E+08	37.05
Jun-11	737	15.93	30.7	0.68	1003.96	43.37	2.00E+08	36.91
Jul-11	687	15.2	30.72	0.68	1048.06	42.81	1.50E+08	36.91
Aug-11	597	15.26	30.8	0.68	1059.65	42.42	6.80E+07	37.08
Sep-11	484	15.03	30.76	0.68	1070.26	43.03	3.40E+07	37.05
Oct-11	645	12.97	30.65	0.68	1095.84	43.45	4.60E+06	36.94
Nov-11	713	13.45	30.78	0.69	1107.67	43.27	2.70E+06	36.98
Dec-11	711	13.85	30.98	0.69	1118.29	43.65	2.30E+06	37.05
Jan-12	604	16.23	31.15	0.69	1122.86	43.62	3.10E+07	37.07
Feb-12	607	16.29	31.14	0.69	1116.38	42.66	3.30E+07	37.09
Mar-12	423	16.23	31.27	0.68	1105.4	42.86	3.80E+07	37.2
Apr-12	531	16.32	31.32	0.68	1101.29	42.7	7.30E+07	37.18
May-12	800	16.49	31.41	0.68	1114.97	42.85	6.60E+07	37.22
Jun-12	750	17.01	31.54	0.68	1121.59	42.78	1.70E+08	37.37
Jul-12	562	16.82	31.81	0.67	1120.32	41.91	2.50E+08	37.55
Aug-12	487	16.18	31.9	0.67	1117.05	42.05	1.00E+08	37.62
Sep-12	392	15.96	31.64	0.67	1110.28	41.75	9.70E+07	37.57
Oct-12	560	15.88	31.33	0.67	1104.54	41.45	1.30E+08	37.38
Nov-12	783	13.2	31.32	0.67	1101.41	41.12	3.50E+07	37.42
Dec-12	691	13.82	31.3	0.67	1097.11	41.01	2.80E+07	37.28
Jan-13	622	15.92	31.29	0.67	1087.69	40.73	1.10E+06	37.3
Feb-13	556	15.68	31.27	0.67	1081.17	40.67	3.00E+06	37.36
Mar-13	512	15.93	31.25	0.67	1075.35	40.71	264995	37.4
Apr-13	673	15.95	31.21	0.67	1071.68	41.14	2.60E+06	37.4
May-13	800	16.3	31.31	0.67	1068.53	41.3	8.00E+07	37.46
Jun-13	716	17.06	31.76	0.67	1061.75	42.91	7.80E+07	37.7
Jul-13	685	18.56	33.04	0.66	1053.52	43.36	6.20E+07	38.48
Aug-13	585	19.13	34.46	0.65	1041.09	43.86	6.30E+07	39.78
Sep-13	499	18.12	35.5	0.63	1024.71	43.83	3.80E+07	41.01
Oct-13	477	15.14	34.85	0.62	1012.72	43.18	3.00E+07	40.53
Nov-13	637	16	34.91	0.62	998.15	43.55	1.00E+07	40.63
Dec-13	755	18.18	35.47	0.62	997.56	44.1	3.60E+07	41.09
Jan-14	583	18.44	35.79	0.61	996.73	44.93	1.40E+08	41.32
Feb-14	474	20.96	36.31	0.61	995.41	44.9	5.80E+07	41.73
Mar-14	376	20.09	37.2	0.6	995.2	44.79	5.20E+07	42.55
Apr-14	475	20.56	37.58	0.6	996.38	44.64	4.00E+06	43.06
May-14	727	20.58	38.03	0.59	997.38	43.92	5.00E+07	43.57
Jun-14	817	21.87	38.69	0.59	993.42	43.82	1.20E+08	44.2
Jul-14	689	22.25	39.8	0.58	989.72	43.47	1.00E+08	45.14
Aug-14	579	21.07	39.58	0.57	983.7	43.77	1.90E+08	45.36
Sep-14	439	19.73	39.28	0.56	978.75	44.08	9.20E+07	45.47
Oct-14	522	20.16	38.64	0.56	977.2	44.8	7.70E+07	45.29
Nov-14	903	17.33	38.15	0.56	975.81	44.95	1.20E+08	45.16
Dec-14	978	17.91	38.4	0.56	974.91	44.69	8.60E+07	44.9
Jan-15	812	17.04	37.22	0.56	971.24	44.6	6.70E+07	44.84
Feb-15	770	18.22	36.61	0.57	964.95	44.22	6.00E+07	44.56

Mar-15	745	17.07	36.32	0.57	960.8	44.45	1.60E+08	44.3
Apr-15	801	17.35	36.46	0.57	960.74	44.41	1.80E+08	43.88
May-15	1066	17.25	36.39	0.57	958.89	44.61	7.30E+07	43.87
Jun-15	1109	18.04	36.06	0.57	958.56	44.98	2.00E+07	43.75
Jul-15	841	20.17	36.12	0.58	956.22	45.26	1.90E+08	43.81
Aug-15	717	18.57	36.27	0.58	955.53	46.14	5.70E+07	43.84
Sep-15	582	18.16	36.04	0.57	955.02	46.75	7.90E+06	43.56
Oct-15	666	16.47	35.83	0.58	950.73	46.36	1.80E+08	43.72
Nov-15	882	16.83	36.9	0.58	948.01	47.01	2.60E+08	43.4
Dec-15	976	17.05	35.36	0.58	948.99	47.23	2.90E+08	43.2
Jan-16	965	17.88	35.12	0.58	945.04	47.51	1.30E+08	43.57
Feb-16	942	17.55	35.25	0.58	939.06	47.64	6.20E+07	43.51
Mar-16	706	17.39	35.17	0.58	932.07	46.72	6.20E+07	43.45
Apr-16	1006	17.84	35.33	0.58	925.23	46.28	3.10E+07	43.42
May-16	1042	18.45	35.39	0.58	919.38	46.8	918947	43.5
Jun-16	995	17.45	36.26	0.58	913.99	46.46	562673	43.78
Jul-16	839	20.86	36.04	0.58	902.66	47.06	253766	43.78
Aug-16	622	18.83	36.27	0.57	890.42	46.68	862378	44.04
Sep-16	522	18.09	36.4	0.57	881.92	47.43	3.80E+07	44.16
Oct-16	788	16.6	35.86	0.57	875.24	48.35	8.80E+07	44.01
Nov-16	1079	17.82	35.46	0.57	871.08	49.16	8.60E+06	44.06
Dec-16	1097	19.42	36.6	0.57	873.84	49.82	2.80E+07	44.03

Appendix B – Testing of the Assumptions and Fitting of the Model

A. Pairwise Correlation

	Retail Price of Rice	Rice Stock Inventory	Farmgate Price of Palay	Wholesale	PPP	Price of Dealer's Fertilizer	Exchange Rate (Peso-USD)	Rice Imports
Retail Price of Rice	1.0000							
Rice Stock Inventory	0.4737* 0.0000	1.0000						
Farmgate Price of Palay	0.7551* 0.0000	0.1802 0.0000	1.0000					
Wholesale	0.9643* 0.0000	0.3513* 0.0000	0.8320* 0.0000	1.0000				
Purchasing Power of Peso (in rice)	-0.9908* 0.0000	-0.5073* 0.0000	-0.7014* 0.0000	-0.9423* 0.0000	1.0000			
Price of Dealer's Fertilizer	-0.4790* 0.0000	-0.2611 0.0000	-0.2467 0.0000	-0.3411* 0.0000	0.4592* 0.0000	1.0000		
Exchange Rate (Peso-USD)	0.6637* 0.0000	0.4670* 0.0000	0.4028* 0.0000	0.5274* 0.0000	-0.6574* 0.0000	-0.7600* 0.0000	1.0000	
Rice Imports	0.1613 0.1584	0.0965 0.4005	0.1637 0.1522	0.1806 0.1135	-0.1524 0.1829	0.0061 0.9576	0.0939 0.4134	1.0000

B. Full Model

Source	SS	df	MS
Model	867.233087	6	144.538848
Residual	5.1993831	71	.073230748
Total	872.43247	77	11.3302918

Number of obs	=	78
F(6, 71)	=	1973.75
Prob > F	=	0.0000
R-squared	=	0.9940
Adj R-squared	=	0.9935
Root MSE	=	0.27061

Rice	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
stockinventory	.0002548	.0002184	1.17	0.247	-.0001807	.0006902
Farmgate	.00981	.0295634	0.33	0.741	-.0491377	.0687576
Wholesale	.3909295	.0484086	8.08	0.000	.2944056	.4874535
PPP	-39.05474	2.659444	-14.69	0.000	-44.35752	-33.75196
Fertilizer	-.0021754	.0006164	-3.53	0.001	-.0034044	-.0009463
ExchangeRate	.0578672	.0293621	1.97	0.053	-.0006793	.1164136
_constant	51.07994	3.715177	13.75	0.000	43.67209	58.48779

1. Multicollinearity Test

Variable	VIF	1/VIF
Wholesale	22.42	0.044599
PPP	20.09	0.049780
Farmgate	4.01	0.249493
Exchangerate	3.67	0.272501
Fertilizer	2.50	0.400337
Stockinventory	1.74	0.574381
Mean VIF	9.07	

C. First Reduced Model

Source	SS	df	MS
Model	862.457291	5	172.491458
Residual	9.97517943	72	0.138544159
Total	872.43247	77	11.3302918

Number of obs	=	78
F(5, 72)	=	1245.03
Prob > F	=	0.0000
R-squared	=	0.9886
Adj R-squared	=	0.9886
Root MSE	=	0.37222

Rice	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
stockinventory	-0.0002965	0.0002854	-1.04	0.302	-0.0008653	0.0002724
Farmgate	0.1679576	0.0304621	5.51	0.000	0.1072324	0.2286827
PPP	-58.50393	1.551489	-37.71	0.000	-61.59677	-55.41109
Fertilizer	-0.0015905	0.0008419	-1.89	0.063	-0.0032688	0.0000879
ExchangeRate	0.0118543	0.0396187	0.30	0.766	-0.0671242	0.0908327
_constant	75.70318	2.919618	25.93	0.000	69.88302	81.52333

D. Final Reduced Model

Source	SS	df	MS
Model	862.307428	3	287.435809
Residual	10.1250425	74	0.136824899
Total	872.43247	77	11.3302918

Number of obs	=	78
F(3, 74)	=	2100.76
Prob > F	=	0.00000
R-squared	=	0.9884
Adj R-squared	=	0.9879
Root MSE	=	0.3699

Rice	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
Farmgate	0.1771581	.0289148	6.13	0.000	0.1195441	0.2347722
Fertilizer	-0.0017651	0.000605	-2.92	0.005	-0.0029706	-0.0005596
PPP	-57.88181	1.267481	-45.67	0.000	-60.40732	-55.3563
_constant	75.64987	1.146587	65.98	0.000	73.36524	77.93449

E. Final Reduced Model of the Transformed Variables

Source	SS	df	MS			
Model	0.527166571	3	0.17572219	F(3, 74)	=	2651.54
Residual	0.004904107	74	0.000066272	Prob > F	=	0.0000
Total	0.532070678	77	0.006910009	R-squared	=	0.9908
				Adj R-squared	=	0.9904
				Root MSE	=	0.00814

Number of obs = 78

logRice	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
Farmgate	0.0047217	0.0006331	7.46	0.000	0.0034601	0.0059832
logFertilizer	-0.0274685	0.0131699	-2.09	0.040	-0.0537102	-0.0012269
logPPP	-0.8990791	0.017379	-51.73	0.000	-0.9337075	-0.8644507
_constant	3.38718	0.0930672	36.39	0.000	3.20174	3.572621

1. Normality test

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	Z	Prob > Z
e	78	0.97402	1.747	1.220	0.11115

2. Homoscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of logrice

chi2(1) = 0.18
Prob > chi2 = 0.6733

3. Test of Independence

Durbin-Watson d-statistic (4, 78) = .9802862

Lags (p)	F	df	Prob > F
1	22.356	(1,73)	0.0000

H0: no serial correlation

a. Prais-Winsten Transformation

Iteration 0: rho = 0.0000
Iteration 1: rho = 0.4919
Iteration 2: rho = 0.5344
Iteration 3: rho = 0.5410
Iteration 4: rho = 0.5421
Iteration 5: rho = 0.5423
Iteration 6: rho = 0.5424
Iteration 7: rho = 0.5424
Iteration 8: rho = 0.5424
Iteration 9: rho = 0.5424

Cochrane-Orcutt AR(1) regression -- iterated estimates

Source	SS	df	MS			
Model	0.107714924	3	0.035904975	F(3, 73)	=	761.49
Residual	0.003442031	73	0.000047151	Prob > F	=	0.0000
Total	0.111156955	76	0.001462592	R-squared	=	0.9690
				Adj R-squared	=	0.9678
				Root MSE	=	0.00687

Number of obs = 77

logRice	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
Farmgate	0.003541	.0007021	5.04	0.000	.0021417	.0049403
logFertilizer	-.0091797	.0256868	-0.36	0.722	-.0603734	.042014
logPPP	-.9236804	.0281363	-32.83	0.000	-.9797561	-.8676048
_constant	3.26901	.1837032	17.80	0.000	2.90289	3.63513
rho	0.542374					

Durbin-Watson statistic (original) 0.980286

Durbin-Watson statistic (transformed) 2.092767

F. Final Model

Source	SS	df	MS			
				Number of obs	=	78
Model	0.52687828	2	0.26343914	F(2, 75)	=	3805.17
Residual	0.005192398	75	0.000069232	Prob > F	=	0.0000
Total	0.532070678	77	0.006910009	R-squared	=	0.9902
				Adj R-squared	=	0.9900
				Root MSE	=	0.00832

logRice	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
Farmgate	0.004539	0.0006409	7.08	0.000	0.0032623	0.0058158
logPPP	-0.9141628	0.0161519	-56.60	0.000	-0.946339	-0.8819866
_constant	3.193723	0.0077993	409.49	0.000	3.178186	3.20926

1. Normality test

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	Z	Prob > Z
e	78	0.96708	2.213	1.738	0.04111

2. Homoscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of logrice

chi2(1) = 1.90

Prob > chi2 = 0.1678

3. Test of Independence

Durbin-Watson d-statistic (3, 78) = .9206595

Lags (p)	F	df	Prob > F
1	25.018	(1,74)	0.0000

H0: no serial correlation

a. Prais-Winsten Transformation

Iteration 0: rho = 0.0000
Iteration 1: rho = 0.5075
Iteration 2: rho = 0.5589
Iteration 3: rho = 0.5726
Iteration 4: rho = 0.5769
Iteration 5: rho = 0.5784
Iteration 6: rho = 0.5789
Iteration 7: rho = 0.5791
Iteration 8: rho = 0.5791
Iteration 9: rho = 0.5791
Iteration 10: rho = 0.5791
Iteration 11: rho = 0.5791
Iteration 12: rho = 0.5791

Prais-Winsten AR(1) regression – iterated estimates

Source	SS	df	MS
Model	1.95232776	2	0.976163878
Residual	0.003658217	75	0.000048776
Total	1.95598597	77	0.025402415

Number of obs	=	78
F(2, 75)	=	20013.11
Prob > F	=	0.0000
R-squared	=	0.9981
Adj R-squared	=	0.9981
Root MSE	=	0.00698

LogRice	Coef.	Std. Err.	t	P > |t|	[95% Confidence Interval]	
LogPPP	-0.9119848	0.0246303	-37.03	0.000	-0.9610509	-0.8629187
Farmgate	0.0034979	0.0007163	4.88	0.000	0.0020709	0.004925
C	3.212626	0.123461	260.21	0.000	3.188031	3.23722
rho	0.5791443					

Durbin-Watson statistic (original) 0.920659
Durbin-Watson statistic (transformed) 2.050661