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by

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ABSTRACT

This study was conducted to explore the varying volatility of world rice price for the period 1961 to 2008 using monthly data. The paper provides estimates of two GARCH models, namely, GARCH and EGARCH which were used to capture the stochastic variation and asymmetries in the world rice price. The results indicate that EGARCH model gives better estimate of the volatility of world rice price. Furthermore the EGARCH model was able to describe the asymmetric volatility in the world price of rice. It was further discovered that the positive shocks (good news) is more dominant than the negative shock (bad news).

Keywords: *Asymmetry, conditional heteroscedasticity, volatility,world rice price.*

JEL code: C52, E31

1.0 INTRODUCTION

The world price of rice in 2008 reached its highest record last May but declined in August in the same year. Rising prices and a growing fear of scarcity have prompted some of the world's largest rice producers to announce drastic limits on the amount of rice they export. The price of rice, a staple in the diets of nearly half the world's population, has almost doubled on international markets in the last three months. That has pinched the budgets of millions of poor Asians and raised fears of civil unrest. This has fed the insecurity of rice-importing nations, already increasingly desperate to secure rice supplies. Several factors are contributing to the steep rice in prices. Rising affluence in India and China has increased demand. At the same time, drought and other bad weather have reduced output in Australia and elsewhere. Zhuang and Abbott (2007) claim that China has the market power in this commodity whereby rice–wheat system is an important cropping system grown in 13.5 million hectares in the Indo–Gangetic plains of South Asia and 9.0–13.5 million hectares in China.

For decades Vietnam struggled to feed itself but is now the second-largest exporter of rice after Thailand (United Nations, 2008). Last year, it sold 4.5 million tonnes to foreign buyers, so it is no wonder that the government's decision to reduce rice

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exports by 22 percent sent countries, such as the Philippines, scrambling to secure stocks. Though Vietnam have the luxury of vast rice surplus, fear have been cropping in due to domestic problems, namely, inflation, an unusually long winter, pests, shrinking land for rice cultivation, as well as increasingly frequent and damaging typhoons. Thesee internal factors are raising concerns in local government and a source of major problems for policy makers in Vietnam. The volatility in the price of rice is quite damaging and is being closely watched in most parts of the word. Demos (2008) mentioned that most banks in the United States have stopped lending to farmers and agricultural companies because of volatility in grain prices. The fear was further strengthened by Dawe (2008) who reiterate that the policy makers in Indonesia remain reluctant to use the world rice market to achieve domestic food security for at least two reasons.

Firstly there is a concern that trade policies of other countries create a heavily distorted world market price. (2) Fear of world market price volatility. In another study, regarding Korea, Ho et al. (2008) explain that infrastructure investment from the late seventeenth century promoted development and prosperity, but declining investment, dysfunctional institution, bad weather, and a population crash pushed the economy towards subsistence in the nineteenth. Decline resulted in rice monoculture, inflation, and price volatility even before imperialism's impact.

Tripathy (2008) conclude that price volatility is the feature of the Indian primary commodities market, which has been proved so, irrespective of the commodities and futures trading and ban periods in India. He further add that declining food production, rising food grain prices (agflation), absence of parity price across different markets, excessive dependency on import of food grains, inability of government to ensure minimum buffer stock, inactive minimum support price for farmers, and futures trading ban are major concerns in the primary commodity markets of India.

The volatility of the price of rice especially, and grains generally, has been the interest of studies, and a concern for policy makers as explained by Dana et al. (2006) in their study on Malawi and Zambia on the South African Exchange (SAFEX) whereby they used simulation methods to examine the results of hedging maize food security imports into Malawi and Zambia. Some economist claimed that futures trading drives up prices and thus, inflation is also shooting up to all time high all over the world. But an efficient and well-organized commodities futures market is generally acknowledged to be helpful in price discovery for sellers. It offsets the transaction in commodities without impacting the physical goods until the futures contract expires. Thus, a futures market encourages competition by attracting traders who hedge their bets and minimize risks on the basis of their own market information and price judgment. As a result, the commodity market attracts participation of hedgers who have a long-term perspective of the market, and traders, or arbitragers who hold an immediate view of the market.

Another quite important and valid argument is of that 'food for fuel' reasoning with the emergence of biodiesel fuel whose main component is ethanol which is mainly produced from sugarcane, wheat and other grains. These developments have pushed up the demand and subsequently the price of food.

The purpose of this study is to identify the volatility of rice price (if any) and to identify the best model to explain volatility the best. This paper is organized as follow, whereby in the next section, we discuss the method and sources of data used in analysis. The third section will be on the results and the discussion.

2.0 DATA AND METHODOLOGY

Two models from the GARCH family were considered for this study, GARCH, and EGARCH. Monthly data of export price (US$/t free on board) of Thai rice 5% broken, January, 1961 to April, 2008 from International Rice Research Institute (IRRI) on-line were used in this study.

Generalized Autoregressive Conditional Heteroscedastic (GARCH (p, q)) Model

The GARCH model of Bollerslev (1986) allows for the conditional variance to depend upon past information and therefore vary over time. It allows for a more flexible lag structure than the ARCH model of Engle (1982). In the GARCH model the conditional variance is predicted by past forecast errors and past variances. GARCH model addresses the issues of heteroscedasticity and volatility clustering frequently found in financial time series by specifying the conditional variance to be linearly dependent on the past behavior of the squared residuals and a moving average of past conditional variance Formally, the model can be expressed as follows:

$$Y_t = x_t P + \mu_t \tag{1}$$

$$\mu_t \,|\, F_{t-1} \sim n(0, s_t^2) \tag{2}$$

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-1}^2 \tag{3}$$

whereby the conditional information set at time $t\text{-}1$ is denoted F_{t-1}. In this study Y_t is equal to the change in $log(P_t)$, the log of the price of rice. X_t is a $1´k$ vector of lagged endogenous variables included in the information set. P is a $k´1$ vector of unknown parameters.

GARCH (1, 1) model is given in equation 4

$$\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (4)$$

$\alpha > 0$, $\beta > 0$, and $\alpha + \beta = 1$

Exponential Generalized Autoregressive Conditional Heteroscedastic (EGARCH)

The EGARCH model of Nelson (1991), has no restrictions on parameters whereas the GARCH model imposes nonnegative constraints on the parameters α and β. s_t^2 is an asymmetric function of past errors as defined by equations (1), (2), and (5):

$$\ln(\sigma_t^2) = \alpha_0 + \sum_{I=1}^{p} \alpha_i g(z_{t-i}) + \sum_{j=1}^{q} \beta_i \ln \sigma_{t-j}^2 \quad (5)$$

where $g(z_t) = uz_t + b[|z_t| - E|z_t|]$ and $z_t = e_t/s_t$. Equation 4 is similar to an unrestricted ARMA(p,q) model for the log of s_t^2. If $a_i u < 0$, the variance will rise (fall) when e_{t-1} is negative (positive). If z_t is assumed to be *i.i.d* normal, e_t is variance stationary provided all the roots of the autoregressive polynomial $(B) = 1$ lie outside the unit circle. EGARCH model has several advantages over the symmetrical GARCH model. In EGARCH model, there is no need of putting restrictions on the parameter. By modeling the logarithm of conditional variance, EGARCH always produces a positive conditional variance independently of the sign of the estimated parameter.

Equation 6 represents the EGARCH (1, 1)

$$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \gamma \left[\frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} \right] + \alpha \left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} \right] \quad (6)$$

The asymmetric effect of past shocks is captured by the γ coefficient, which is usually negative, implying positive shocks generate less volatility than negative shocks of the same magnitude. This feature permits the capture of the sign effect by allowing positive and negative innovations to have different effects on the volatility. If $\gamma = 0$, positive and negative shocks have the same effect on volatility. The size effect is captured by and is expected to be positive. Shocks are measured relative to its standard deviations. The use of absolute shocks and logs in this parameterization allows us to capture the size effect, in that it increases the impact of large shocks on the next period conditional variance.

3.0 RESULTS AND DICUSSION

As illustrated by Table 1, the augmented Dickey-Fuller test (Dickey and Fuller,

1981) statistics shows that the price of rice is stationary after first differencing (*I* (1)). Table 2shows the result of the descriptive statistics, and it can be observed that, Δprice of rice is skewed positively. AIC and SBC criteria was used to chose the better model (EGARCH or GARCH). IGARCH was not done since α + β was approaching 1.

The resulting equation can be written as below.

For GARCH (as per equation 5):

$$\sigma_{\mathrm{t}}^2 = 0.0005 ** + 0.1610 ** u_{t-1}^2 + 0.6351 ** \sigma_{\mathrm{t-1}}^2$$

For EGARCH (as per equation 6):

$$\ln(\sigma_t^2) = -1.2007 ** + 0.8341 ** \ln(\sigma_{t-1}^2) + 0.2404 ** \left[\frac{u_{\mathrm{t-1}}}{\sqrt{\sigma_{\mathrm{t-1}}^2}}\right] + 0.1641 ** \left[\frac{|u_{\mathrm{t-1}}|}{\sqrt{\sigma_{\mathrm{t-1}}^2}}\right]$$

Note: ** denotes significant at 1%
(Please refer to Table 3 and Table 4 for full results of the estimation for GARCH and EGARCH)

Both the AIC and SBC criteria suggest that EGARCH is the better model to describe the volatility in the world price of rice. EGARCH is also seen as the better model since it can describe the dynamic time-varying asymmetric volatility in the world price of rice. It also can be seen from the result, that the positive shocks plays a more prominent effect on the volatility, which can be observed from the positive γ.

A simple interpretation would be positive policies, good weather and all others that can be termed as good news, is more dominant than bad weather, disasters and all those termed as bad news. It can also be observed from Figure 1 (conditional variance) that the peak of the standard variance was recorded for the year 1968 and 1994. The turbulence periods are two, 1973-1975, and 1995-1998.The leverage effect that can normally be found on financial markets is not in existence here, this might be due to that commodity markets are more prone to volatility when the price goes up and when the price goes down as what can be observed in the financial markets.

There have been numerous studies examining the volatility of the price of rice lately and as pointed out by Tripathy (2008) on his study which concluded, for the case of India, that price volatility is the feature of the Indian primary commodities market, which has been proved so, irrespective of the commodities and futures trading and ban periods. Results of Dana et al. (2006) show that hedging using either futures or options can spread import costs over time, thereby reducing variability, and also possibly generating lower average costs. These benefits are increased if hedging only takes place when local prices are at less than import parity and also if the hedge is levered. However, problems will remain so long as intra-regional transport costs remain high. A point reiterated by Demos (2008) who mentioned that most banks in the United States have stopped lending to farmers and agricultural companies because of volatility in grain prices.

4.0 CONCLUSION

We examine the varying volatility of Thai rice price for the period 1961 to 2008 using monthly data. For purpose of comparison, this paper provides estimates of two models, namely, GARCH and EGARCH, which were used to capture the stochastic variation and asymmetries in the world rice price. The results indicate that

i) The price of Thai rice is quite volatile during three sub-periods, namely 1967-1969, 1974-1976 and 1994-1997. Conditional volatility in the Thai rice price are clustered and persistent.
ii) Furthermore the EGARCH model was able to describe the asymmetric volatility in the Thai price of rice.
iii) It was further discovered that the positive shocks (good news) is more dominant than the negative shock (bad news).
iv) EGARCH model gives better estimate of the volatility of Thai rice price.
v) there is no evidence of a leverage effect in the Thai rice price, in fact the positive shocks are more dominant than the negative shocks

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Table 1: Results of the Unit Root Tests

	ADF Test	
	Level	First Difference
Variables	Constant, Trend	Constant, Trend
Price of Rice	-1.980341	-12.99300*

Note: * denotes significant at 5% significance level.The lag length was arbitrarily selected using SIC.

Table 2: Descriptive Statistics

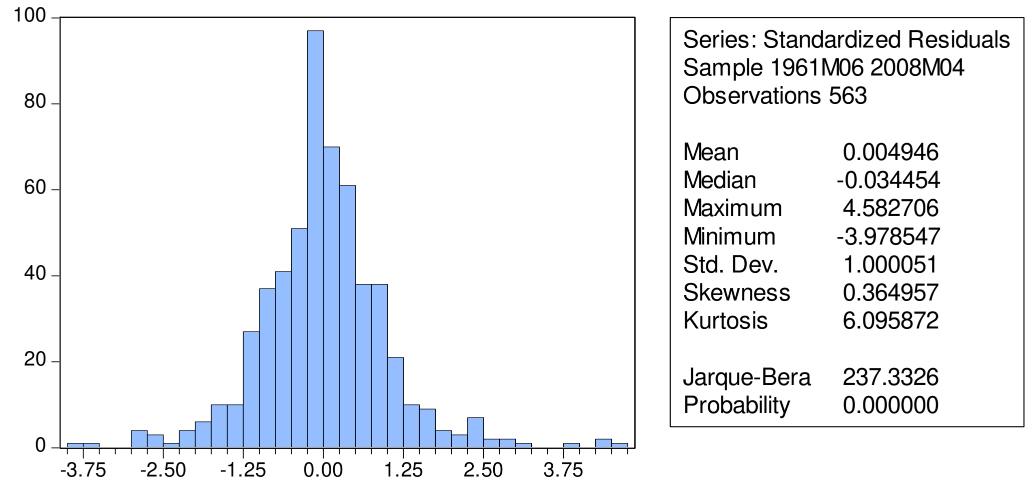

Figure 1 Conditional Variance

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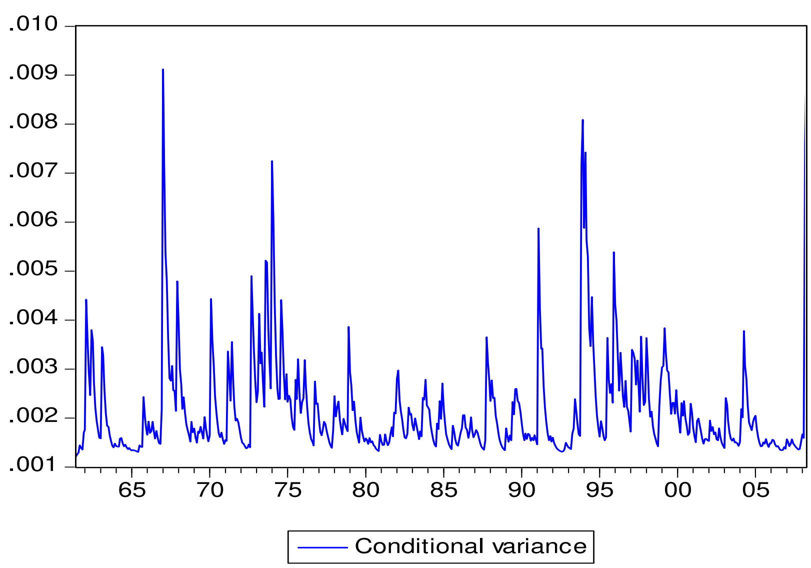

Table 3 Garch and E-Garch comparison

	GARCH (1,1)	EGARCH (1,1)
ω	0.0005	-1.2007
	(0.0001)	(0.2293)
α	0.1610	0.8341
	(0.0329)	(0.0338)
β	0.6351	0.2404
	(0.0646)	(0.0515)
γ		0.1641
		(0.0314)
R^2	0.2119	0.2119
Adjusted R^2	0.2049	0.2034
F-statistic	29.9569	24.9025
Mean Dependent Var	0.0034	0.0034
S.D. Dependent Var	0.0532	0.0532
Akaike Info Criterion	-3.3349	-3.3525
Schwarz Criterion	-3.3010	-3.3063

Note:, EGARCH seems to be the better model due to the smaller value based on the Shwartz and Akaike info criterion