Assessing the Impact of Exchange Rate Volatility on Agricultural Exports: Case of Desiccated Coconut Industry in Sri Lanka

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ABSTRACT

The purpose of this study was to assess the impact of Exchange Rate Volatility (ERV) on agricultural exports in Sri Lanka. The Desiccated Coconut (DC) exports to Egypt, United Arab Emirates (U.A.E) and Saudi Arabia from 1992 to 2008 was considered as the case. The monthly data on DC exports and Real Exchange Rates (RER) were collected from the Databases managed by the Coconut Development Authority, the Central Bank of Sri Lanka, the Ceylon Shipping Corporation and the Department of Census and Statistics. The Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model was used to estimate the ERV using the *EViews* (Version 3.0) software. To determine the behaviour of the effect of ERV on the DC export, a Multiple Regression Analysis containing seven explanatory variables was carried out. The results revealed that the DC export from Sri Lanka to major destinations were negatively related with ERV and significant for Egypt and Saudi Arabia. The analysis highlights the importance of having a complementary role of markets and other regulatory bodies to manage the volatility risk associated with DC exports.

Keywords: Agricultural exports, Desiccated coconut industry in Sri Lanka, EGARCH model, Exchange rate volatility

INTRODUCTION

Exchange rate – "the price of a currency in terms of another currency" is one of the most important variables in determining the economic environment for trade sectors. It affects trade by determining the relationship of international and domestic prices. Fluctuations in the Real (inflation-adjusted) Exchange Rate (RER), result in the

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rising or lowering of the prices of goods in local currency terms around the world. The movement of exchange rates not only makes the exports / imports costlier or cheaper, the unpredictable movement of which is responsible for the level of risk or uncertainty to trade. Exchange Rate Volatility (ERV) is used to measure the day-to-day change of exchange rate with respect to the importing and exporting country and the high volatility in exchange rates makes the financial environment for international transactions riskier (Bajpai and Mohanty, 2008). According to McKenzie and Michael (1999), ERV plays an important role on international trade flows, as different markets respond differently to the volatility of exchange rate.

In general, exchange rate movements are particularly important for the agriculture sector than other sectors, because agricultural trades are quite significantly and negatively affected by high frequency exchange rate volatility that does not seem to impact other sectors significantly (Wang and Barrett, 2007 - 2008). But, ERV is not always a dominant factor in agricultural trades. Due to the macro economical changes in the world, ERV has become a very important factor which determines agricultural trades not only in developing economies but for advanced economies also.

Exchange rate movements are particularly important for the agriculture sector in Sri Lanka, as agricultural exports account for a major portion of agricultural production, (i.e. 20% of the total exports of the country) (Central Bank of Sri Lanka, 2007). However, in a situation where both the exchange rate and export earnings from agricultural exports in Sri Lanka increase overtime; however, with substantial short term fluctuations, it is not clear the real impact of the former on the performance of the latter (Figure 1). In fact, there may be situations at which export earnings increase by monetary terms without significant change to the physical quantities.

The main purpose of this study is, therefore, to assess the impact of exchange rate volatility occurred during the period of 1992 to 2008 on the volume of agricultural exports in Sri Lanka, where the desiccated coconut export was used as the case.

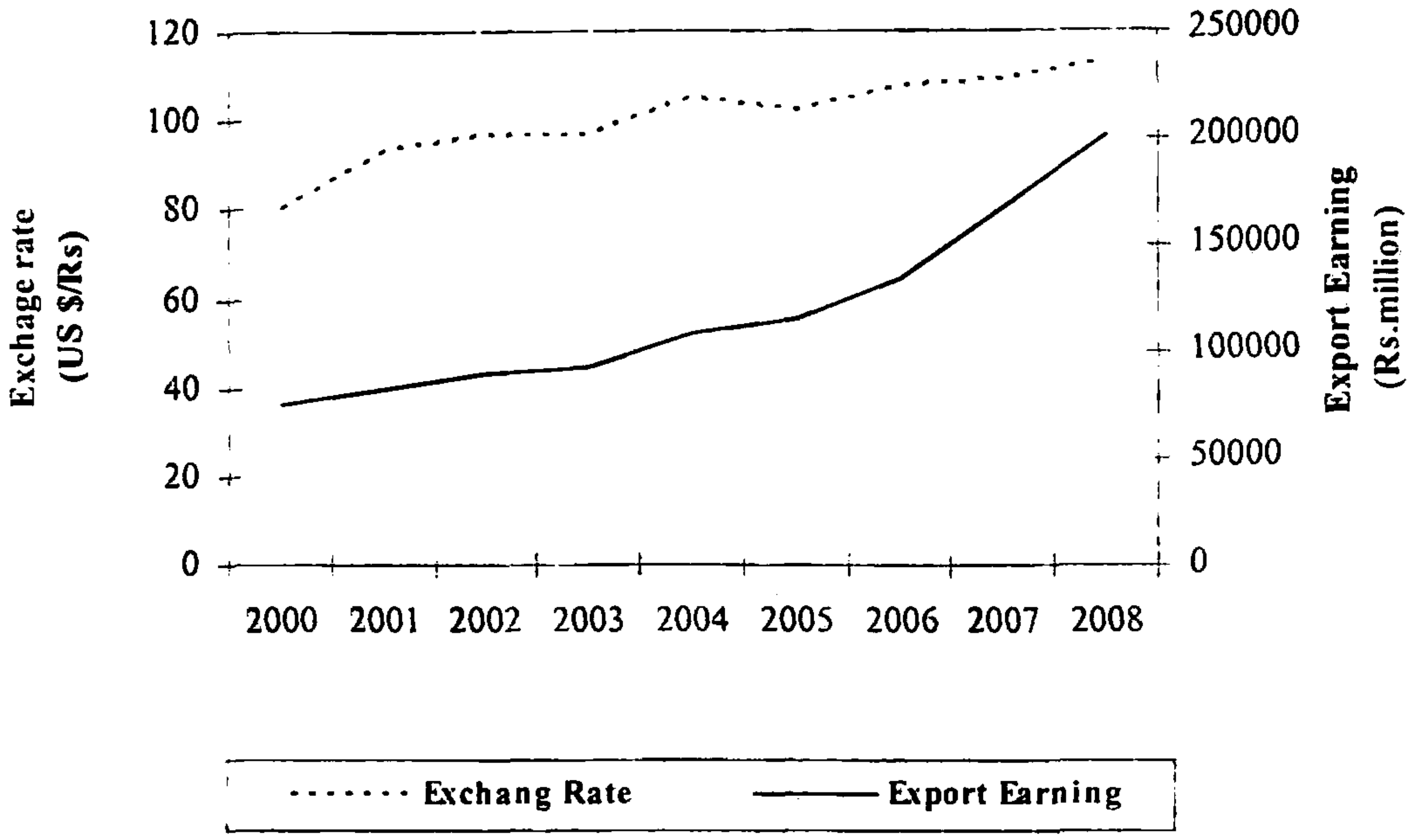


Figure 1: Fluctuation in exchange rate and agricultural exports in Sri Lanka

This study utilized in particular the three major destinations of DC in Sri Lanka for the analysis, including: (1) Egypt; (2) United Arabia Emirates (U.A.E.), and (3) Saudi Arabia (Figure 2).

Among the coconut kernel based products, Desiccated Coconut (DC) is one of the major products exported to many destinations in the world, including APCC (Asian Pacific Coconut Community) countries, Pacific, Africa, Europe, America and other countries. The export performance of DC showed a substantial growth in foreign exchange earnings in Sri Lanka, for example in the year 2007 the export earnings was US$ 53,633 (in thousands) and it has increased significantly up to US$ 64,397 (in thousands) in 2008 (Coconut Development Authority, 2008).

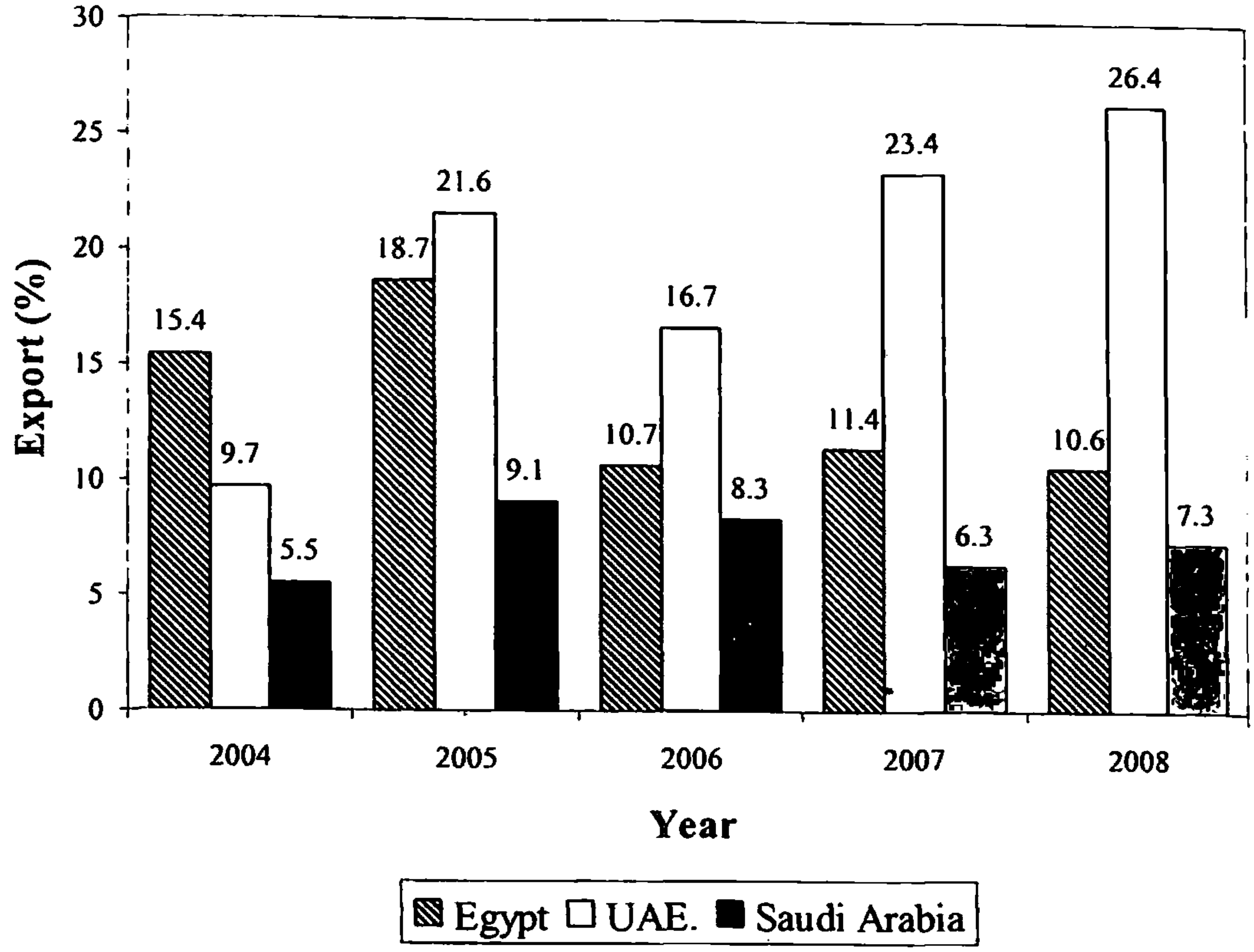


Figure 2: Contribution for total DC export in Sri Lanka

METHODOLOGY

The Economic Framework

Structural time series

Firstly, the Structural Time Series Technique (Harvey, 1989, 1990; Koopmen *et al.*, 2000) was used to explore the performance of DC sector in Sri Lanka with regard to volume of export for the period of 1992 to 2008, and is specified below.

Given: $Exp_{i,t}$ = Exports to country *i*; $\mu_{i,t}$ = Trend component; $\psi_{i,t}$ = Cyclical component; $\gamma_{i,t}$ = Seasonal component; $X_{i,t}$ = Vector of all the explanatory variables; B = Coefficient of vector; $\mu_{i,t-1}$ = Level of trend component; $\beta_{i,t-1}$ = Slope of trend component and the stochastic components are $\varepsilon_{i,t}$, $\eta_{i,t}$, $\xi_{i,t}$, $\kappa_{i,t}$, $\begin{bmatrix} \nu_{i,t} \\ * \\ \nu_{i,t} \end{bmatrix}, \begin{bmatrix} \tau_{i,t} \\ * \\ \tau_{i,t} \end{bmatrix}$, it can be specified as follows:

$$\mathrm{Exp}_{i,t} = \mu_{i,t} + \psi_{i,t} + \gamma_{i,t} + X_{i,t}B + \varepsilon_{i,t} \tag{1}$$

$$\mu_{i,t} = \mu_{i,t-1} + \beta_{i,t-1} + \eta_{i,t} \tag{2}$$

$$\beta_{i,t} = \beta_{i,t-1} + \xi_{i,t} \tag{3}$$

$$\begin{bmatrix} \psi_{i,t} \\ \psi^{*}_{i,t} \end{bmatrix} = \rho_1 \begin{bmatrix} \cos\lambda_1 & \sin\lambda_1 \\ -\sin\lambda_1 & \cos\lambda_1 \end{bmatrix} \begin{bmatrix} \psi_{i,t-1} \\ \psi^{*}_{i,t-1} \end{bmatrix} + \begin{bmatrix} \nu_{i,t} \\ * \\ \nu_{i,t} \end{bmatrix} \tag{4}$$

$$\begin{bmatrix} \hbar_{i,t} \\ \hbar^{*}_{i,t} \end{bmatrix} = \rho_2 \begin{bmatrix} \cos\lambda_2 & \sin\lambda_2 \\ -\sin\lambda_2 & \cos\lambda_2 \end{bmatrix} \begin{bmatrix} \hbar_{i,t-1} \\ \lambda_{i,t-1} \end{bmatrix} + \begin{bmatrix} \tau_{i,t} \\ * \\ \tau_{i,t} \end{bmatrix} \tag{5}$$

$$\gamma_{i,t} = -\sum_{j=1}^{s-1} \gamma_{i,t} - j + \kappa_{i,t} \tag{6}$$

In the above specification, λ_1 and λ_2 represent the damping factor and the frequency while ρ_1 and $\rho_2 \in [0, 1]$. The error component in the equation 1-6 were assumed to follow a normal distribution with mean zero and variances are, irregular exports (σ^2_ε), trend (σ^2_η), slope (σ^2_ξ), cyclical (σ^2_υ, σ^2_τ) and seasonal (σ^2_κ) components (Bajpai and Mohanty, 2008).

Exponential Gegeralized Autoregressive Conditional Heteroskedasticity Model

Linear models are unable to explain a number of important features common to much financial data, including volatility, leptokurtic, and leverage effect. That is because the assumption of homoskedasticity (or constant variance) is not appropriate when using financial data, and at such instances, it is preferable to examine the patterns that allow the variance to depend upon the history (Floros, 2008; Bova, 2009).

It is often observed that downward movements in the market are followed by higher volatilities than upward movements of the same magnitude. To account this asymmetric phenomenon, Engle *et al.* (1993) describe an asymmetric News Impact Curve with the following shape:

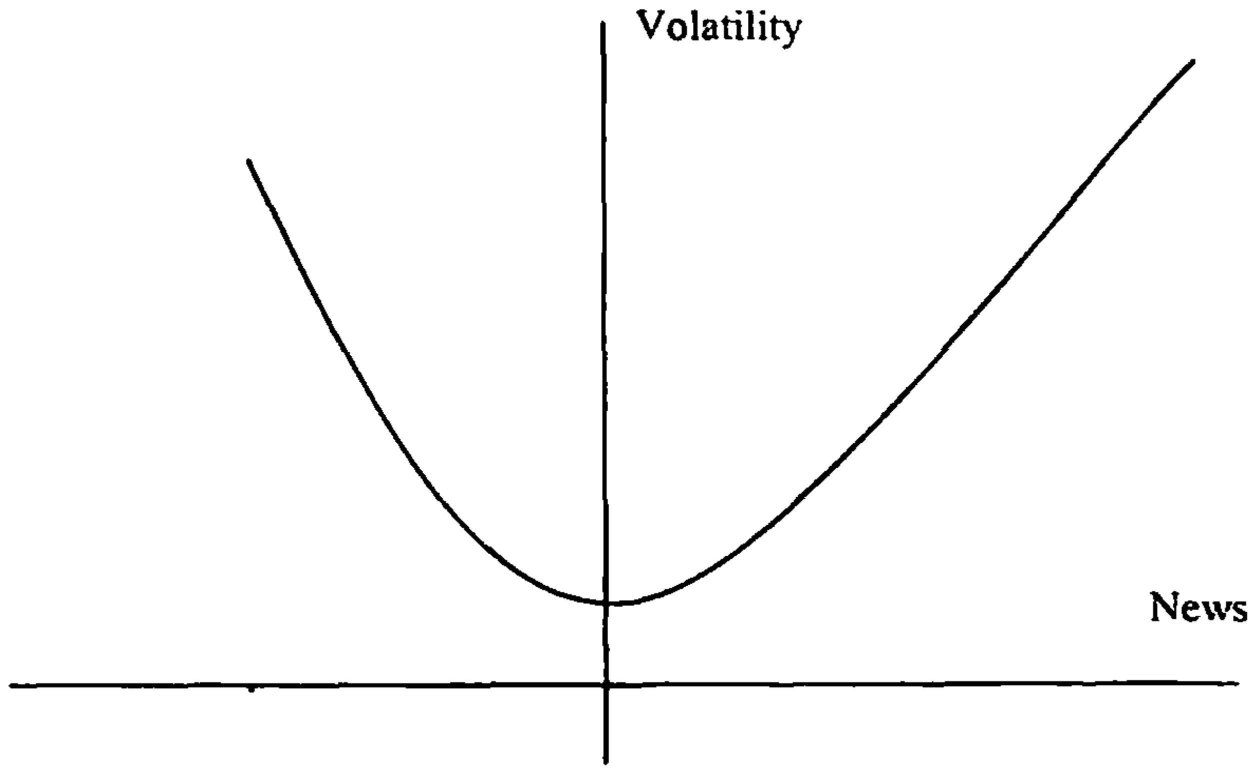


Figure 3: News impact curve

Keeping this in view, the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model (Nelson, 1991), which implies that the logarithmic of conditional variance is exponential has been used in this study to examine the behaviour of exchange rate volatility and to obtain the conditional variances. The model is specified as follows:

$$\log\left(\sigma_t^{\,2}\right) = \omega + \beta \log\left(\sigma_{t-1}^{\,2}\right) + \alpha \left|\varepsilon_{t-1} / \sigma_{t-1}\right| + \gamma \varepsilon_{t-1} / \sigma_{t-1} \qquad (7)$$

In the above model, "good news" = ($\varepsilon_t > 0$); "bad news" = ($\varepsilon_t < 0$); σ_t^2 = Conditional variance; σ_{t-1}^2 = Last period forecast variance; ω = Mean; α = ARCH parameter; β =

EGARCH coefficient; ε = Error component; σ = Standard deviation and γ = Coefficient (Measure of leverage effect).

Export Demand for DC in Sri Lanka

Thirdly, demand estimation was carried out to examine the "nature" of the effect of ERV on DC export using conditional variances obtained from EGARCH analysis for ERV and the specification of which is given below.

$$X_{i,t} = \int \begin{pmatrix} Exp_{i,t-1}, Exp_{i,t-2}, Exp_{i,t-3}, \\ GDP_{i,t}, P^{SL}{}_{i,t}, R_{i,t}, V_{i,t} \end{pmatrix} \qquad (8)$$

Where; $X_{i,t}$ = Vector of all the explanatory variables of country i (MT); $Exp_{i,t-1}$, $Exp_{i,t-2}$, $Exp_{i,t-3}$ = Lag exports of country i (MT); $GDP_{i,t}$ = Gross Domestic Products (GDP) of country i (Billions); P^{SL} = Price of the product at country i's port or (CIF) price (U.S. \$'000 / MT); $R_{i,t}$ = Real exchange rate of country i's currency with respect to the Sri Lankan rupees and $V_{i,t}$ = Exchange rate volatility of country i's currency

Data Collection and Analysis

The monthly data on DC exports and RER covering the period of January 1992 to December 2008 was used. The database maintained by the Coconut Development Authority (CDA), the Central Bank of Sri Lanka, the Ceylon Shipping Corporation, the Department of Census and Statistics and the International Monitory Fund (IMF) were utilized to obtain the necessary information.

The RER was used to estimate EGARCH coefficients and conditional variances. The model EGARCH was used for that and analyzed by using *EViews* (Version 3.0) software. A Multiple Linear Regression (MLR) analysis was carried out together with seven explanatory variables explained earlier to determine the "nature" of the effect of ERV in RER on DC exports in Sri Lanka using conditional variances obtained from EGARCH for ERV. The relationship obtained for export was investigated using SPSS (Version 16).

RESULTS AND DISCUSSION

Descriptive Statistics of DC Importing Countries

The general characteristics in both export and RER were obtained to examine the behaviour of two series (Export and RER) for three major destinations (Table 1).

Both export and RER series are non normal for all the three countries since the probability of Jarque Bera test turns out to be very low indicating, that the null hypothesis of normality is rejecting. The value of kurtosis is high for all cases indicating that the distribution is peaked relative to normal and two series are leptokurtic. According to the value of skewness, two series were positively skewed with large right tails for all the cases.

Table 1: Distribution of exports and RER

Character	Export			RER		
	Egypt	**U.A.E.**	**Saudi Arabia**	**Egypt**	**U.A.E**	**Saudi Arabia**
Mean	426.45	481.79	155.87	1.97	2.35	2.31
Std. Dev.	321.75	458.85	136.74	1.11	1.40	1.38
Skewness	1.02	1.72	0.84	1.45	1.53	1.34
Kurtosis	4.05	6.10	2.92	4.54	5.70	4.91
Jarque – Bera	44.25	181.58	26.61	87.88	141.69	91.70
Probability	0.00	0.00	0.00	0.00	0.00	0.00

Note: Jarque - Bera test is a test statistic for testing normality; Std. Dev = Standard Deviation

To determine the presence of Autoregressive Conditional Heteroskedasticitic (ARCH) residual in two series, the squared residuals were obtained for all countries. Exports to all destinations indicated volatility clustering throughout the sample period. Especially the exports to Saudi Arabia showed a high volatility. Similarly RER indicates the presence of high volatility clustering around 1995, 1997, 1999, 2000 and 2003 (Figure 4).

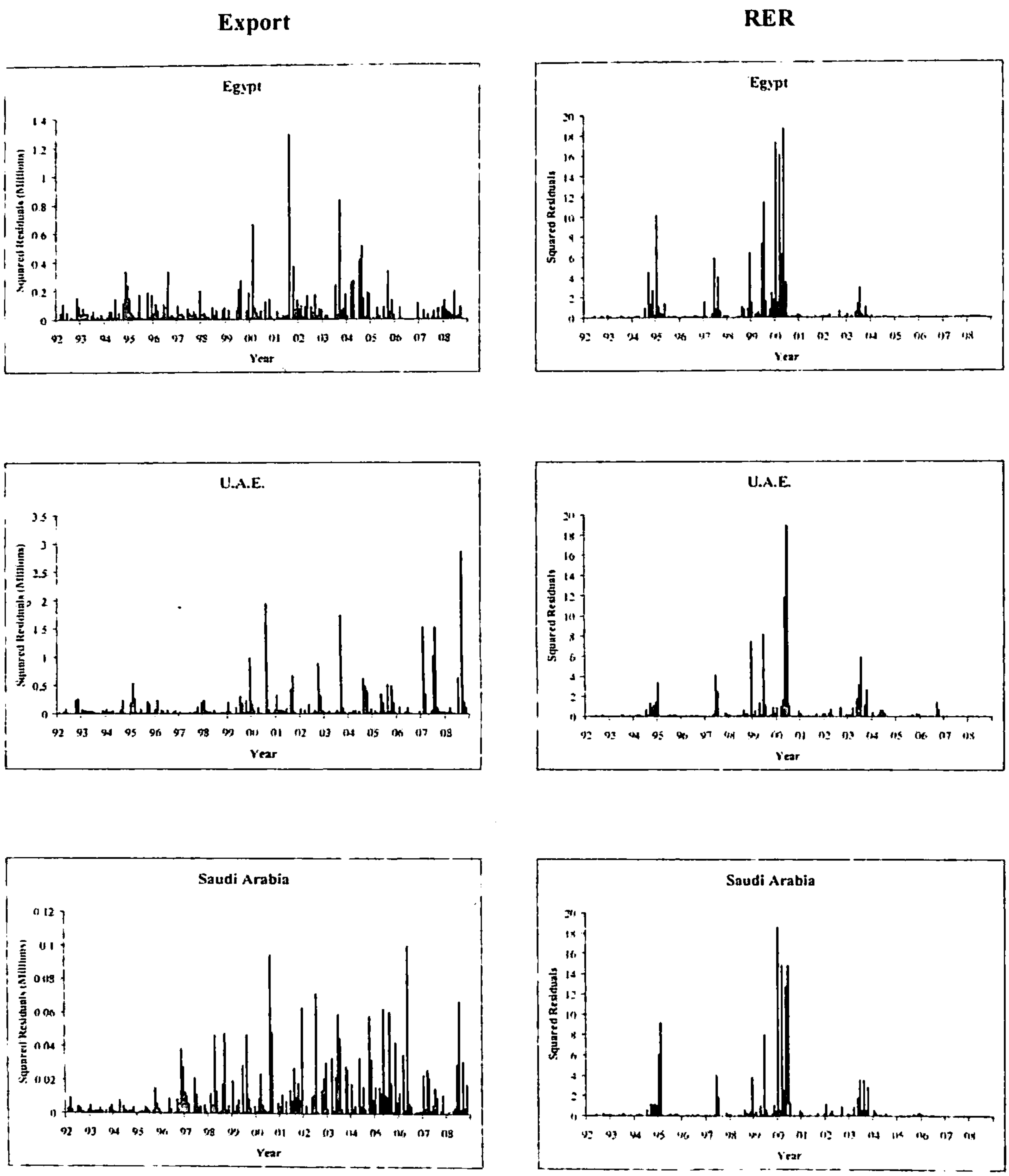
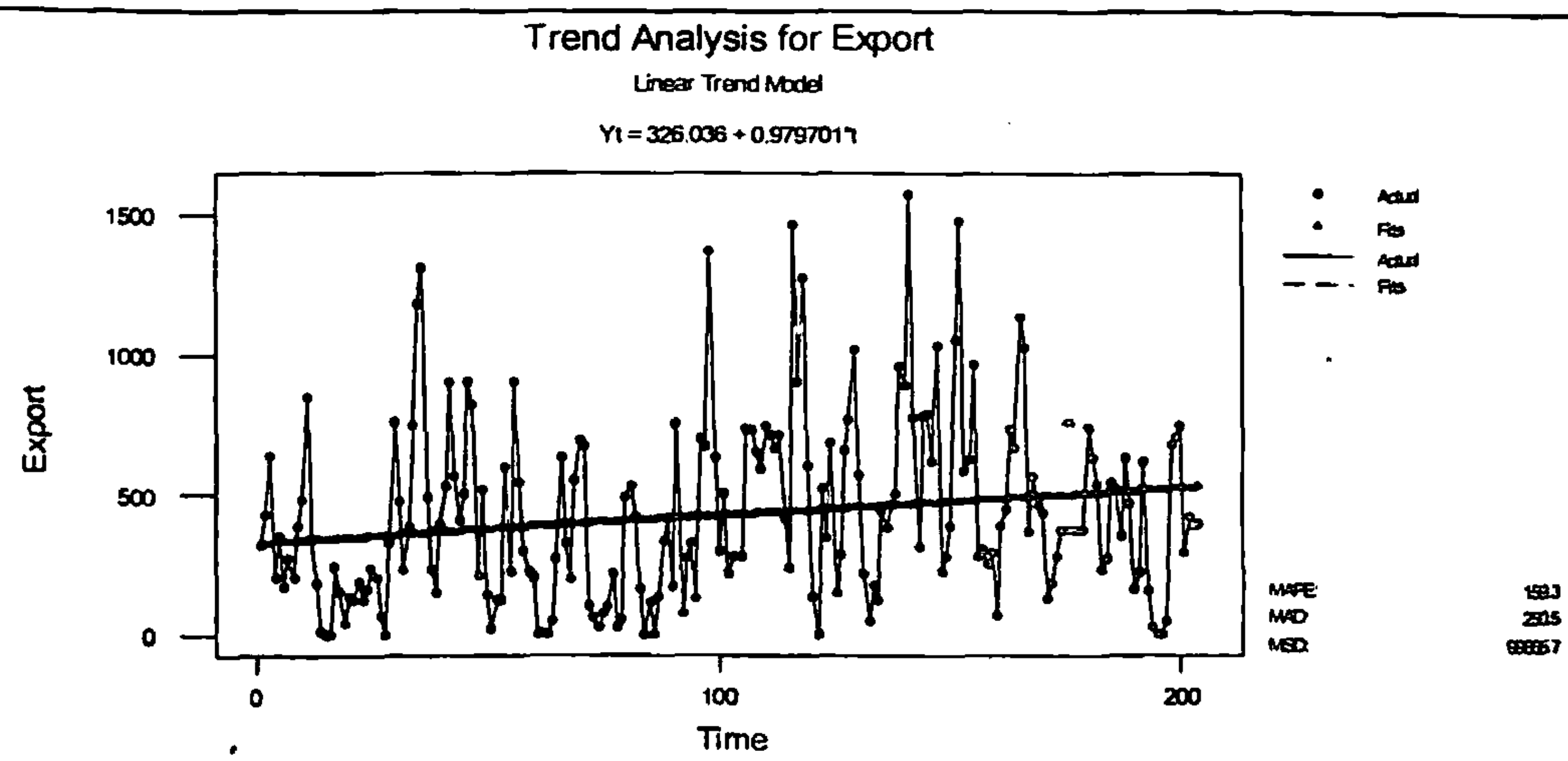


Figure 4: Volatility clustering in export and RER

Outcome of the Structural Time Series

The DC export from 1992 to 2008 shows a positive trend for all cases. The highest trend for DC was observed from Saudi Arabia and then from UAE. Although trends were positive, R squared values between the linear model of export and time were relatively low. This may be due to the presence of more irregular variations in three export series (Figure 5).



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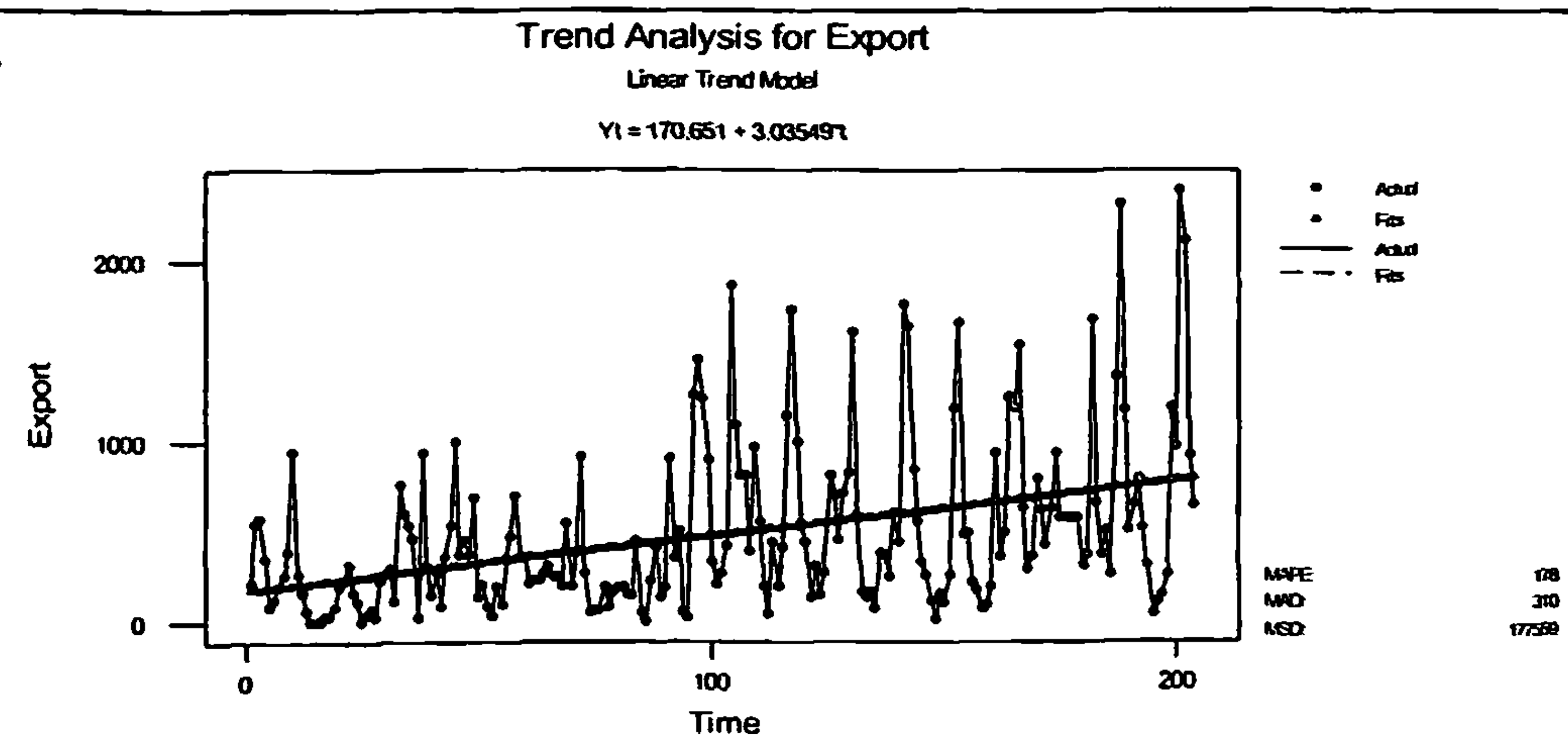

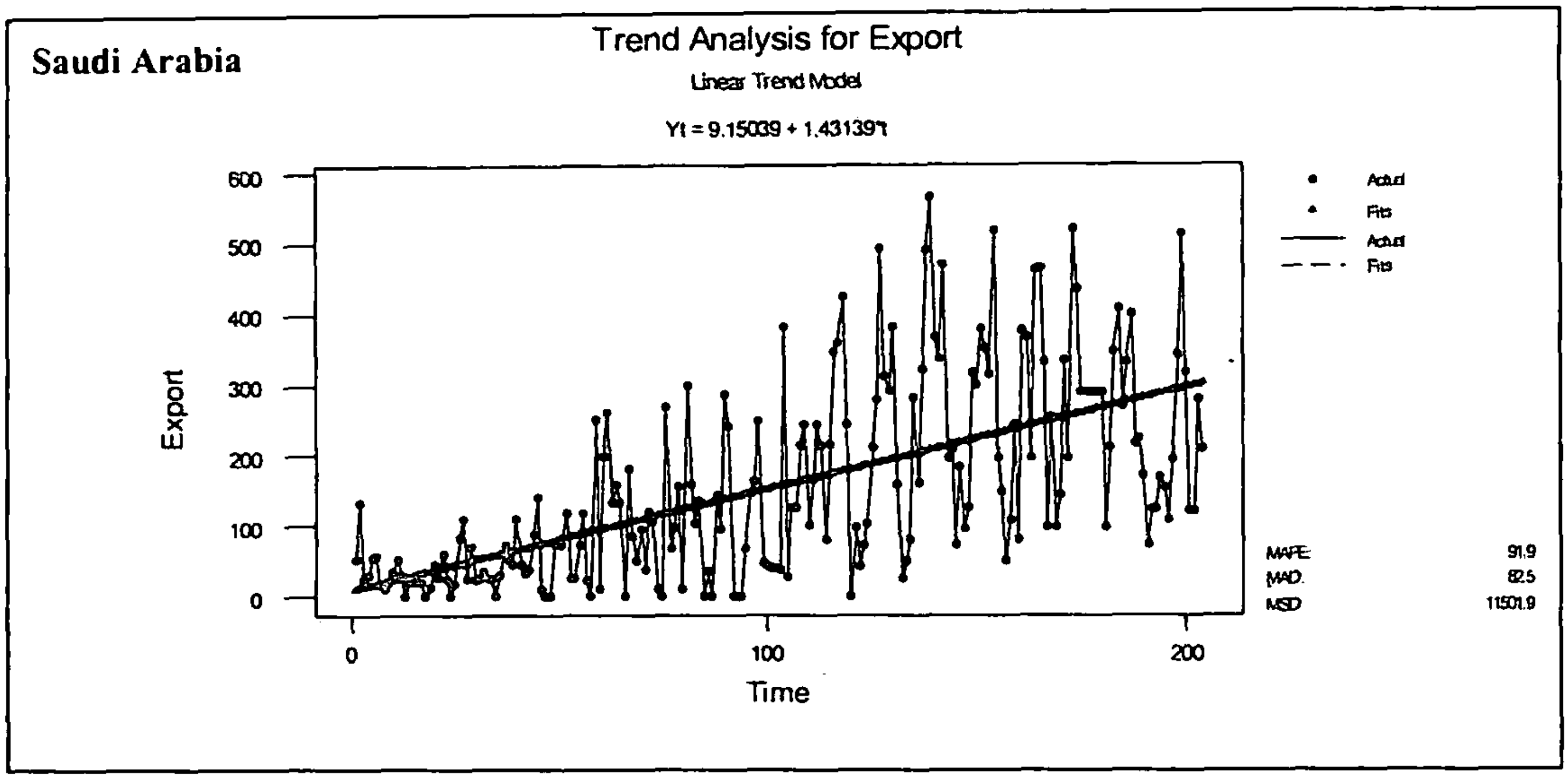

Figure 5: Trend of DC exportation

According to the seasonal indices extracted from exported volumes, Egypt, UAE and Saudi Arabia indicated high seasonal variations respectively in the month of October, September and August (Table 2)

Table 2: Seasonal indices for DC exports (1992 to 2008)

Month	Index Value		
	Egypt	U.A.E.	Saudi Arabia
January	0.8746	0.6354	0.4978
February	0.5003	0.5605	0.8159
March	0.4435	0.4437	0.9923
April	0.5162	0.4145	0.8576
May	0.9902	0.7777	1.1514
June	1.0784	0.5161	1.1394
July	1.0818	0.9877	1.1296
August	1.3918	1.5177	1.4222
September	1.4695	2.0385	1.0954
October	1.5410	1.6725	1.3043
November	0.9753	1.3590	0.7675
December	1.1367	1.0761	0.8260

Outcome of EGARCH model

The results revealed that the coefficient obtained from EGARCH analysis was positive in all cases and significant at $\rho = 0.05$ (Table 3). It indicates that there is a positive impact from past variances to existing volatility.

Table 3: The outcome of EGARCH model

Character	**Egypt**	**U.A.E.**	**Saudi Arabia**
Coefficient (β)	0.8933	0.9195	0.9028
P value	0.000*	0.000*	0.000*

Note: * = Significance at 0.05 level

Outcome of the Multiple Linear Regression Analysis

ERV was negatively related with exports in all cases while significant only for Egypt and Saudi Arabia at 0.1 significant level (Table 4). As a result, when ERV increases, export tends to decrease.

Table 4: Estimate of coefficients of the explanatory variables explaining DC exports in Sri Lanka

Variable	**Egypt**	**U.A.E.**	**Saudi Arabia**
$GDP_{i,t}$	0.153*	0.253*	0.354*
P^{SL}	-0.195*	-0.045	-0.118**
$V_{i,t}$	-0.142**	-0.040	-0.099**
$Exp_{i,t-1}$	0.477*	0.557*	0.411*
$Exp_{i,t-2}$	-0.017	-0.134	0.045
$Exp_{i,t-3}$	-0.086	-0.082	-0.022
$R_{i,t}$	0.165*	0.047	0.071
R^2 (Adj)	0.321	0.354	0.465

Note: * = Significance at 0.05 level
** = Significance at 0.10 level

GDP of every country was positively related with export and significant at 0.05 significant level, indicating that when GDP increases, DC importing quantity also increases. The relationship of the CIF price with export was negative for all the countries while significant only for Egypt and Saudi Arabia at 0.05 significant level. Thus, DC exports in Sri Lanka decreases when the domestic price of DC rises above international price. The one month lag of exports was significant for all countries at 0.05 significant level, while the second month and third month lag of exports were not significant for any country. It indicates that, only one month lag of exports has a large impact on DC export. The DC export was positively affected by RER, but it was only significant for Egypt. As a result of the increase in RER can change export in to positive direction and *vice versa*.

CONCLUSIONS

The main purpose of this study was to identify the impact of ERV on agricultural exports in Sri Lanka using the DC export as the case. The EGARCH model was used to capture the volatility in RER and six variables with ERV were used to determine the nature of effect of ERV on the DC exports.

The results revealed that the DC exports from 1992 to 2008 have positive trends for Egypt, U.A.E. and Saudi Arabia with high seasonal variations in October, September and August respectively. It can also be seen volatility in exchange rates in three major DC importing countries and it has a negative impact on the DC trade in Sri Lanka. Therefore, there is a potential need to manage ERV risk in the DC trade in Sri Lanka. Thus, the markets and other regulatory bodies may take appropriate hedging actions and other risk management tools (e.g. future contracts, fixed exchange rate systems and new dynamic agricultural policies) to manage this volatility risk.

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