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RESEARCH ARTICLE

SUGGESTED STATISTICAL MODEL FOR FORECASTING EGYPTIAN POUND EXCHANGE RATE BY USING 'CARCH' MODELS

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ABSTRACT
In this research statistical model was built for Egyptian pound versus U.S Dollar by using CRACH models to specify the volatility in conditional variance in order to reach best model which help in studying and analyzing more stationary time series and sudden changes in exchange rate so as to use them in accurate future forecasts. Because such models take into consideration the volatility in exchange rates we will use them in forecasting the deviations in Egyptian pound, we studied the impact of type of random error upon the accuracy of statistical model. We compared among different Types of GARCH models when the random term normally distributed and hence we reach the best model for representation the data and at the same time capable to forecast the random volatility of Egyptian pound. After analyzing the data of the study it is appeared that MGARCH (2.2) is the best model as this model capable of forecasting the values of conditional standard deviation. The ability of the model in comparing the actual versus the fitted is confirmed.

INTRODUCTION

The important factor is the country's growth rate is the appropriate estimate of exchange rate. Exchange rate is defined as foreign currency exchange which refers to domestic currency with respect to forging currency. Where the domestic exchange rate effects the economic performance, many researches refers to the difficulty of forecasting the realistic exchange rate (Applah & Adetvnde, 2011, 76).

The US dollar is considered as basic currency in the world, which affects the international Monetary System and international money institutions, moreover the degree of international liquidity, because most countries linked their national currencies to U.S dollar as the basket of industrial countries currencies, whereas the dollar has biggest weight. According to the position of US dollar as pricing currency to almost international commercial exchanges, hence the national currency increases and decreases according to commercial, financial & political factors. The economic state of the country will be more dangerous when the currency depreciates without hope to appreciate as a result of swings in US dollar prices. So in this research we study the volatile exchange rate and its impact on Egyptian economy.

In 1940 the equivalent of one Egyptian pound was 4 US dollars, depreciated to 2.875 in 1950, and since 1962 the US dollar has been considered as the basis on which the pound valuated. The exchange rate was stable for a long time against the dollar and changing against other currencies valuated on the basis of the dollar. Parallel rates were used at crises periods up to 1979. The main reason of depreciation of the Egyptian pound was the adjustment policy in collaboration with the IMF until the stabilization of the pound against the dollar at 3.47 pound per one dollar (Central Bank 1999). The Central Bank tried to control the situation by injecting big amounts of dollars which resulted in the reduction of the money reserve. The Central Bank endured the difference between the official rate of 3.4 and the black market rate of 3.48. Despite these efforts the pound was depreciating to reach 7 pounds to a dollar in 2003 i.e. 100%. The government interfered by introducing the liberalization of the exchange rate in 2003 to curb the inflation the result was the stabilized rate of the 6 pound in 2012. The pound depreciated to 6.6 in 2013 and 7.6 in 2014.

Research Methodology

Previous studies

The Centre of Information and Decision Support (2006) studied the "Determination of Egyptian Pound against Foreign Currencies" focusing on various exchange regimes, and the most important factors in the short and long run. They used the Probit model to test the probability of adopting certain regime. The best model is the revolving devaluation augment with certain procedures, and considered as the best regime in emerging economies.

Ammar (2003) studied the "Effects of Misalignment of the Real Exchange Rate from Its Equilibrium on Growth Rate" besides exchange rate policies in Egypt.

The study of The Centre of Information and Decision Support (2005) about the "Effects of Exchange Rate Changes on the Prices of Essential Food Commodities in Egypt" aiming at testing these effects since the liberalization of the exchange rate.

The Centre of Information and Decision Support (2004) studied the "The Effects of Exchange Pass-through on Inflation Rate in Egypt". The study started analyzing the development of the exchange rate to determine the correlation between exchange rate and price level, then calculated the percentage change in prices according to the change in the exchange rate, autoregression was used to quantify this effect.

The National Planning Institute (1990) studied "Effects of Exchange Rate Changes on Agricultural Sector and its Economic Implications" aiming at estimating foreign component in the cost of agricultural production according to exchange rate during the study period. The study included the definition of exchange rates applied on commercial activities geared to agricultural inputs and crops. It estimated the expected effects on the prices of agricultural crops, wages, trends of local consumption of food commodities in the past and future.

Muna Bargaa (1984) studied the Effects of Monetary and Credit Policy on Egyptian Pound Exchange Rate considering the characteristics of foreign exchange market in Egypt and policy of foreign currency in the seventies, and the borrowing and lending from the external world.

on current remittances, on Egyptian balance of payments, and presented the development of banks and money supply in the seventies, and explained the relation between credit and monetary balance in Egypt.

The study entitled "Development of Foreign Exchange Market in Egypt: Forecast and Analysis of Demand for US Dollar" by the Centre of Information and Decision Support (2003) considered the development of Egyptian exchange rate against US dollar, its daily and monthly predictions in terms of influence factors. The study analyzed the demand structure for US dollar such as imports and deposits in dollars purporting to determine the causes of depreciation of the exchange rate.

The Centre of Information and Decision Support (2003) "The Influence of Liberalization of the Exchange Rate on the Egyptian Economy" aiming at analyzing the effects of the exchange rate liberalization, the policy package ought to be adopted to assure its success, and the minimization of negative effects. The study recommended the stabilization of the exchange rate by raising interest rate on deposits in local currency; attain transparency in the market, and the importance of making inflation market as a pivotal element in the monetary policy requires the independence of central bank and banking system reform.

The Centre of Information and Decision Support (2003) studied "Forecasting the Egyptian Exchange Rate" by the Centre of Information and Decision Support (2003) discussing the stages of development of the Egyptian exchange rate during the nineties aiming at tracking the causes liberalization policy announced by the government in 2003. The study presented the direct effects of the policy on major economic aggregates and financial institutions as commercial banks and foreign exchange companies.

Mahmoud Abdalhay (1992) considered the factors that determine the exchange rate in Egypt and third world and the important factors for the Egyptian economy in his study entitled "The problem of the Exchange Rate in the Egyptian Economy". The study looked at volatility of the exchange rate, effects of interest rate, and the role of loans and investments in currency depreciation, international policies, the influence of major currencies on the thinking and behavior of policy makers and business men.

Sabir Salih (2010) mentioned in his study entitled "Optimal level of International Monetary Reserves in terms of Free Exchange Rate: Application on Egypt" that the liquid and semi liquid reserves of Egypt are used in filling the deficits of the balance of payments, and stabilizing the exchange rate. No doubt the increase of monetary reserve over the optimal level leads to the squandering of benefits that can be gained by investing these reserves. The determination of the optimal level is a problem of the State and should seek accurate stick yard for this purpose.

Nawal Aljarrah and Nada Alhakkak (2013) applied hybrid models on the daily time series of the Ira qi exchange rate of which are Exponential Smoothing (ES), Artificial Neural Network Analysis (ANN), and model composed of ARMA & ANN, ES & ANN, ARMA and multiple regression in their study entitled "The Use of Hybrid Methods in Forecasting the Iraqi Exchange Rate against US Dollar". ANN&ARMA model was selected as the best one according MSE.

Pncelli (2012) employed ANN and ARCH & GARCH for forecasting Euro against US Dollar in his study "Forecasting Exchange Rate: Comparative Analysis. He reached the conclusion that ARCH & GARCH are better than ANN in forecasting the Euro against the dollar.

Engle (1982) proposed autoregressive conditional heteroscedasticity ARCH by using random variables to explain conditional heteroscedasticity in his study entitled "Inflation Rate in United Kingdom". In this framework other works have been introduced by Weiness (1982, 1984), Milhodog (1984), Bollerseleve (1986) Engle (1987), Bue & Higgins (1982), and Fresteret (194).

Importance of the Research

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) is one of the important statistical methods that offer most accurate forecasts. We introduce in this research the

GARCH family to describe volatility in order to obtain the best models that helps in studying and analyzing non-stationary time series and abrupt changes in the exchange rate and then their usage in forecasting. The research also stems its importance from increased interest in studying Egyptian exchange rate, specifically after recent fluctuations which puzzled economic analysts and experts.

Research Objectives

This research tends to construct statistical model to forecast Egyptian exchange rate via GARCH family and selects the most appropriate one.

Research Problem

The analysis of time series via models entails existence of certain conditions concerning random error the most important of which is the homoscedasticity. Most of time series especially financial ones are characterized by uncertainty, varying means, and heteroscedasticity. The exchange rate is considered as financial time series exposed to the same problems as the rest of the series so it is inappropriate to use Box-Jenkins approach instead we opt to use GARCH models.

Research Limits

This research is concerned only with the Egyptian exchange rate against US dollar. The research will analyze two types of data, daily and weekly for the exchange rate.

It is possible to model economic phenomena using linear time series models for forecasting , but they fail to chase the dynamism of financial time series since linearity hypothesis entails time elements ought to be once in addition to the fact that model constancy assumed by ARMA does not take into account non-corresponding values.

While AR(q) interprets current values in terms of previous ones and so is unable to utilize existing information fully. ARIMA models are not based genuine theory it just predicts the future depending only on historical data. To use ARIMA model the expected value of error term must be zero i.e. $E(\varepsilon_t) = 0$ and their variance is constant over time $E(\varepsilon_t^2) = \sigma^2$and independent $(\varepsilon_t, \varepsilon_s) = 0\, for\ t, s \neq 0$ it very difficult to attain these conditions from analytical point of view and hence we must seek another method. The development of time series models was pioneered by Kaldor (1940) and Goodwin (1955) using non-linear applied on financial and monetary time series characterized by non-stationarity. Weiner (1958) developed relative correspondence, followed by another correspondence based on non-linear ARMA, duality models, system changing models, Engle (1982) autoregressive conditional heteroscedasticity (ARCH), and the generalization of ARCH models by Bollersleve i.e. (GARCH).

Autoregression Conditional Heteroscedasticity Models:

This model explains series volatility taking into account that the conditional heteroscedasticity is affected to a great extent by squared values of the pervious residuals$y_{t-1}^2, y_{t-2}^2, \cdots, y_{t-p}^2$. Engle (1982) explained the importance of the conditional variance instead of unconditional variance in improving forecasts values since condition variance stays constant over time and at the same time translates the relation between the current and previous residuals. The mathematical model introduced by Engle was:

$r_t = \mu + y_t \quad (1)$

$y_t = \sigma_t \varepsilon_t \qquad (2)$

Where σ_t represents standard deviations of the time series y_t, and white noise $\varepsilon_t \cong giid(0,1)$

$\sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 + \cdots + \alpha_p y_{t-p}^2 \quad (3)$

Where $\alpha_0 \geq 0, i = 1,2, \cdots p, \alpha_i > 0$ r_t represents returns series, μ is the mean of return series

At $p = 1$ the ARCH model can be written as follows (Abdalla 2008):

$y_t = \sigma_t \varepsilon_t$

$\sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 \quad (4)$

ARCH(p) characteristics depends on the special case, the unconditional variance is defined as follows (Liu 2006):

$$\sigma_t^2 = \alpha_0 + \alpha_1\sigma_{t-1}^2 = \frac{\alpha_0}{(1-\alpha_1)}; 0 \le \alpha_1 \le 1 \quad (5)$$

The fourth moment is:

$$m_4 = E\left(\frac{y_t^4}{F_{t-1}}\right) = \frac{3\alpha_0^2(1+\alpha_1)}{(1-\alpha_1)(1-3\alpha_1^2)} \quad 0 \le \alpha_0^2 \le \frac{1}{3} (6)$$

$$k = \frac{m_4}{\sigma_y^2} = \frac{3\alpha_0^2(1+\alpha_1)}{(1-\alpha_1)(1-3\alpha_1^2)} \times \frac{(1-\alpha_1)^2}{\alpha_0^2} = 3\frac{1-\alpha_1^2}{1-3\alpha_1^2} > 3 (7)$$

The kurtosis coefficient of the ARCH(p) is greater than 3 and the tail distribution is heavier than normal distribution since its coefficient is 3.

Generalized Autoregression Heteroscedasticity GARCH(p,q)

In 1986 Bollersleve introduced a model that describes accurately the process of heteroscedasticity in the time series which requires the estimation of many coefficients, and can add autoregressive term to the ARCH model to become GARCH(p,q) which contains constant term (α_0) the lagged squared residuals, and lagged variances.

$$r_t = \mu + y_t \quad (8)$$

$$y_t = \sigma_t\varepsilon_t \; ; \; \varepsilon_t \cong iid(0,1) \qquad (9)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 + \cdots + \alpha_p\alpha_1 y_{t-1}^2 + \beta_1\sigma_{t-1}^2 + \cdots + \beta_p\sigma_{t-p}^2 \quad (10)$$

Rewriting equation (10)

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p}\alpha_i y_{t-1}^2 + \sum_{j=1}^{q}\beta_j\sigma_{t-1}^2 \; ; \; \sum_{i=1}^{p}\alpha_i + \sum_{j=1}^{q}\beta_j < 1 \, (11)$$

$$\beta_j \ge 0, j = 1, \cdots, q, \alpha_i \ge 0, i = 1, \cdots, p, \alpha_0 > 0$$

At $q = p = 1$ the mathematical model of GARCH(1,1) becomes:

$$y_t = \sigma_t\varepsilon_t \; ; \; \varepsilon_t \cong iid(0,1) \qquad (12.1)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 + \beta_1\sigma_{t-1}^2 \qquad (12.2)$$

Unconditional variance of GARCH(1,1) becomes (Liu 2006):

$$E(x_t^2) = \frac{\alpha_0}{1-(\alpha_1-\beta_1)} \; (13)$$

$$k = \frac{m_4}{\sigma_y^2} = \frac{3[1-(\alpha_1+\beta_1)^2]}{1-(\alpha_1+\beta_1)^2 - 2\alpha_1^2} > 3 \qquad (14)$$

The kurtosis coefficient of the ARCH(p) is greater than 3 and the tail distribution is heavier than normal distribution since its coefficient is 3.

Estimation of (GARCH) Parameters

The Maximum Likelihood Method (MLM) was used to estimate GARCH model parameters. The Likelihood function was determined by the random error of the model. If , for example, the probability distribution is the standardizes normal, then the likelihood function could be expressed as follows:

$$L\left({r_t}/{\underline{x}}\right) = -\frac{N}{2}\log(2\pi) - \frac{1}{2}\sum_{t=1}^{N}\log\sigma_t^2 - \frac{1}{2}\sum_{t=}^{N}{\varepsilon_t^2}/{\sigma_t^2} \quad (15)$$

Where:

$\underline{x} = (\mu, \alpha_0, \alpha_1, \beta_1)$ is the parameters vector to be estimated when GARCH model is of the 1st order as showed by the 12th equation.

But, if the distribution of the error is the student's distribution, the function could be expressed a follows:

$$L\left({}^{r_t}/_{\underline{x}}\right)=\sum_{t=1}^{N}\log\left(\frac{\Gamma(\nu+1)/2}{\Gamma(\nu-2)\Gamma(\nu/2)}\right)\frac{1}{2}\log\sigma_t^2-\left(\frac{\nu+1}{2}\right)\log\left[1+\frac{\varepsilon_t^2}{\nu-2}\right]$$

Where:

$\underline{x}=(\mu,\alpha_0,\alpha_1,\beta_1,\nu)$ is the vector of the parameters of GARCH model of the 1st order to be estimated. Since GARCH models are non-lamer, the iteration method will be used to estimate the model parameters.

(3) Empirical Study

Daily time series of Egyptian pound exchange rate against American dollar for the period extended from 12.02.09 to 19.05.15 was used to formulate the statistical model. This series is, thus, consisted of 1815 observations. The model formulated would be used to identify the functions of Egyptian pound exchange rate against American dollar. The data of the series was obtained from the daily publications of Egyptian Central Bank, and the historical date electronic site Inveating.com.USD EGP.

The following table gives some descriptive statistics of the data of the time series:

Table (1) reflect the descriptive statistics of Egyptian pound versus US dollar

indicator	Last price	Open price	High price	Low price
Mean	6.319736	6.318185	6.328905	6.308258
Median	6.045500	6.044900	6.055000	6.037500
Maximum	7.659500	7.654300	7.683800	7.650100
Minimum	5.403600	5.403600	5.426200	5.381200
Std. Dev.	0.653198	0.653235	0.648811	0.657841
Skewness	0.406954	0.407599	0.416475	0.395670
Kurtosis	1.812401	1.813628	1.817992	1.801676
Jarque-Bera	156.7583	156.6971	158.1282	155.9538
Probability	0.000000	0.000000	0.000000	0.000000
Sum	11470.32	11467.51	11486.96	11449.49
Sum Sq. Dev.	773.9761	774.0616	763.6133	785.0177
Observations	1815	1815	1815	1815

Table (1) shows some statistical indicators of Egyptian pound during the span of the study. These indicators were calculated for four levels: closing (lead) price, opening (first) price, maximum price, and minimum price. The results of the table showed that the price mean of the four levels were almost the same. The greatest one was the mean the maximum price, and the least was the minimum price. The table also showed that the median price of the maximum one was the greatest followed by the closing price, while minimum price median was the least.

Regarding the standard deviation, the table revealed that the greatest standard deviation was the one of the minimum price, and the least one was the standard deviation of the maximum price. With respect to skewness coefficient, the results of the table show that minimum price had the least coefficient, and maximum price had the greatest one. Furthermore, the four levels were positively skewed. This indicates that the probability distributions of the four levels of price were non-normal, and skewed to the right. The table also knows that the kurtosis coefficients of the four levels were less than 3. This implies that exchange rate probability distributions were kurtosised, and that minimum price was the most kurtosis, and maximum price was the lese.

Gerk Perril test was used to test the normality of the distribution . As shown by table the P-values for the four levels of prices were zero. Thus, the null hypothesis is rejected in favor of the alternative hypothesis, i.e, The distributions were non-normal.

Hence, we could conclude, according to the statistical indicators discussed above, that exchange rate is characterized by non-normality, and variation at the four levels, with minimum price being the most, followed by the closed price, and maximum price being the least. Thus, it is suggested to depend upon generalized restricted autocorrelation regressing to analyzed and study the different levels of exchange rate. In this study, ARCH and GARCH non-linear model will be formulated using the closing (last) price as follows:

Steps of formulating ARCH and GARCH non-linear model for closing price:

The steps to be followed to formulate ARCH and GARCH models as in (Abdulla, 2008) are:

(i) Diagnosis.
(ii) Test of ARCH and GARCH effect.
(iii) Estimation of the model, and
(iv) Check out of the appropriateness of the model.

(I) Diagnosis: In this step we shall plot the original data to know whether the series stationary or not

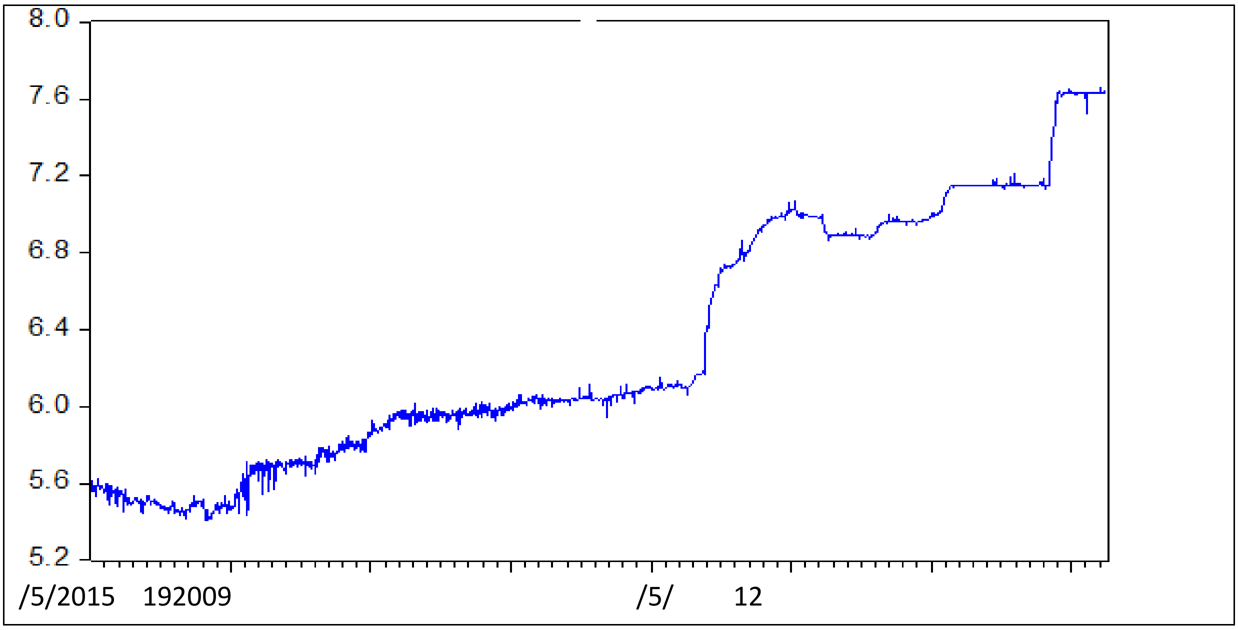


Figure (1)

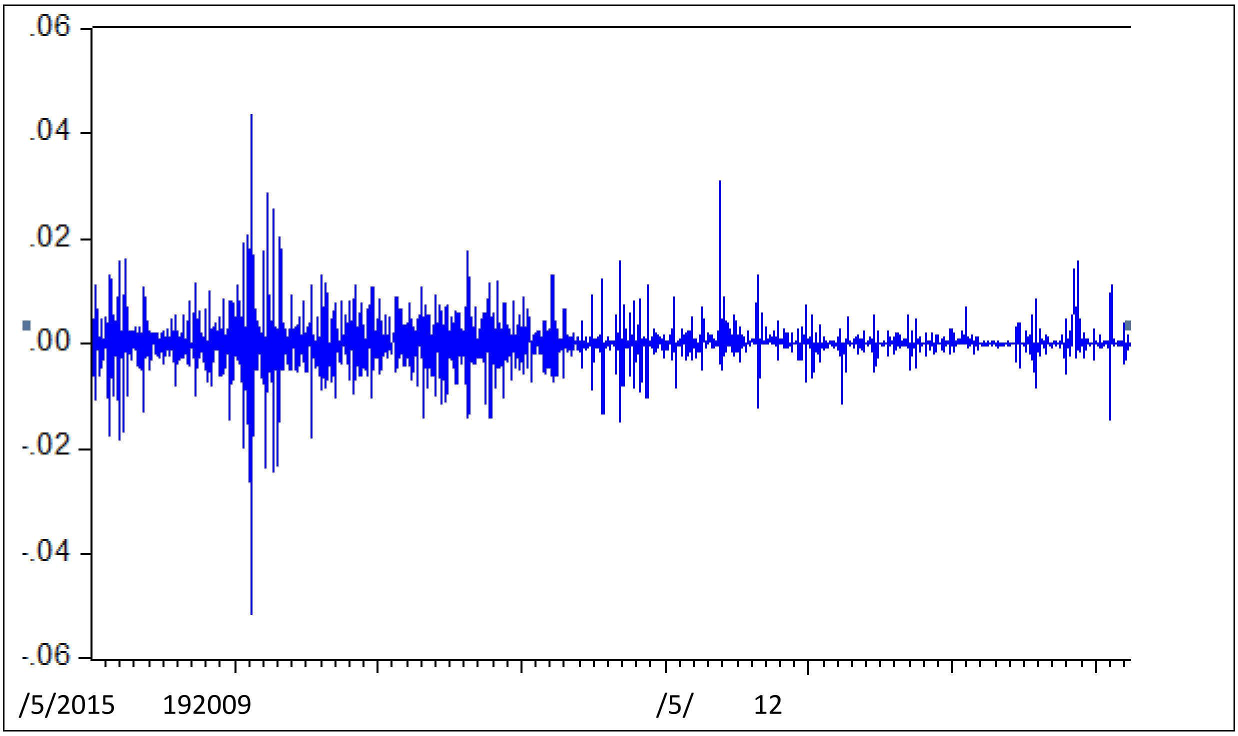
The observed date of the time series was plotted to test the statuary of the series. The plotted exchange rate time series for the specified period (Fig 1) shows an increasing trend. This is seem clear from table 1, where the minimum value was 5.403600 and the maximum value was 7.659500 with a mean of 6.319736. It was noted, also from the figure that the series was not stationary. Nevertheless, it could be made stationary- called return series- using the following equation:-

[Heij, Boer, Franses, Kloek & van Dijk, 2004, 297]

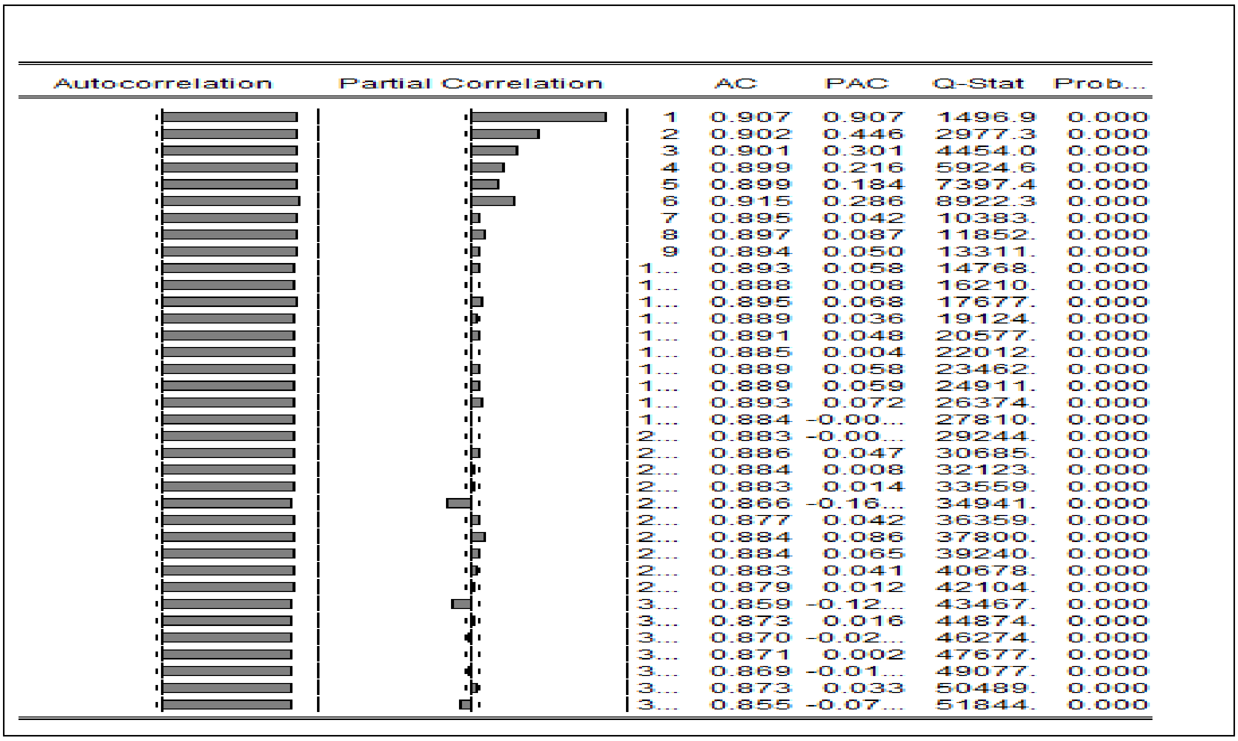
$$x_t = \log(y_t) - \log(y_{t-1}) = \log\left(1 + \frac{y_t - y_{t-1}}{y_{t-1}}\right) \cong \frac{y_t - y_{t-1}}{y_{t-1}} \qquad (17)$$

Assuming exchange rate as stocks, and it is preferable, thus, to depend upon return series in the analysis in order to arrive at the appropriate model of predication.

The plotting of the return series produced a stationary series as shown by fig. 2.



Furthermore, fig. 3 of autocorrelation, and fig 4 of partial autocorrelation of exchange rate time series showed that the series was not stationary.



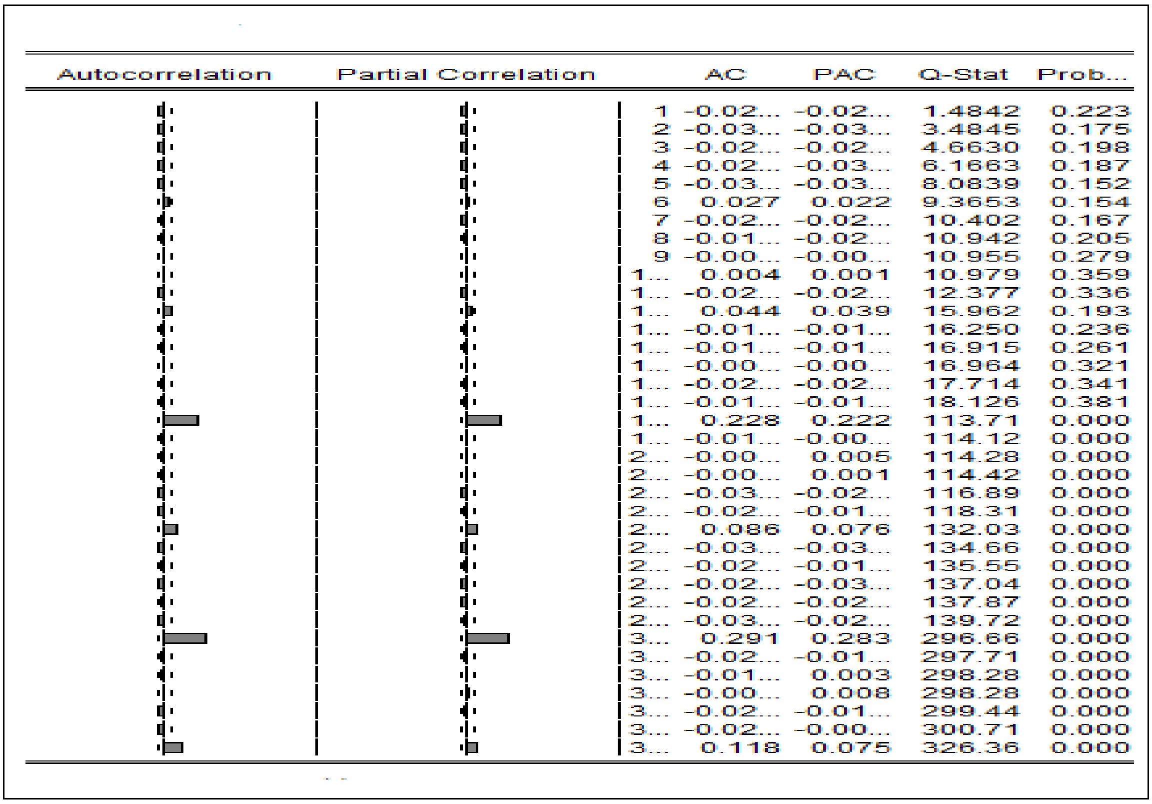
	AC	PAC	Q-Stat	Prob...
1	0.907	0.907	1496.9	0.000
2	0.902	0.446	2977.3	0.000
3	0.901	0.301	4454.0	0.000
4	0.899	0.216	5924.6	0.000
5	0.899	0.184	7397.4	0.000
6	0.915	0.286	8922.3	0.000
7	0.895	0.042	10383.	0.000
8	0.897	0.087	11852.	0.000
9	0.894	0.050	13311.	0.000
1...	0.893	0.058	14768.	0.000
1...	0.888	0.008	16210.	0.000
1...	0.895	0.068	17677.	0.000
1...	0.889	0.036	19124.	0.000
1...	0.891	0.048	20577.	0.000
1...	0.885	0.004	22012.	0.000
1...	0.889	0.058	23462.	0.000
1...	0.889	0.059	24911.	0.000
1...	0.893	0.072	26374.	0.000
1...	0.884	-0.00...	27810.	0.000
2...	0.883	-0.00...	29244.	0.000
2...	0.886	0.047	30685.	0.000
2...	0.884	0.008	32123.	0.000
2...	0.883	0.014	33559.	0.000
2...	0.866	-0.16...	34941.	0.000
2...	0.877	0.042	36359.	0.000
2...	0.884	0.086	37800.	0.000
2...	0.884	0.065	39240.	0.000
2...	0.883	0.041	40678.	0.000
2...	0.879	0.012	42104.	0.000
3...	0.859	-0.12...	43467.	0.000
3...	0.873	0.016	44874.	0.000
3...	0.870	-0.02...	46274.	0.000
3...	0.871	0.002	47677.	0.000
3...	0.869	-0.01...	49077.	0.000
3...	0.873	0.033	50489.	0.000
3...	0.855	-0.07...	51844.	0.000

Fig(3) values of auto correlation & partial auto correlation of residual series

To assure whether the time series of the exchange rate is stationary or non-stationary, an Augmented Dickey- Fuller (ADF) test is carried out using the statistical package E-view 8. The following table showed the results of the test.

test	Original data series	
	t-Statistic	p-value
ADF	0.682346	0.9918

Table (3)



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob...
		1	-0.02...	-0.02...	1.4842	0.223
		2	-0.03...	-0.03...	3.4845	0.175
		3	-0.02...	-0.02...	4.6630	0.198
		4	-0.02...	-0.03...	6.1663	0.187
		5	-0.03...	-0.03...	8.0839	0.152
		6	0.027	0.022	9.3653	0.154
		7	-0.02...	-0.02...	10.402	0.167
		8	-0.01...	-0.02...	10.942	0.205
		9	-0.00...	-0.00...	10.955	0.279
		1...	0.004	0.001	10.979	0.359
		1...	-0.02...	-0.02...	12.377	0.336
		1...	0.044	0.039	15.962	0.193
		1...	-0.01...	-0.01...	16.250	0.236
		1...	-0.01...	-0.01...	16.915	0.261
		1...	-0.00...	-0.00...	16.964	0.321
		1...	-0.02...	-0.02...	17.714	0.341
		1...	-0.01...	-0.01...	18.126	0.381
		1...	0.228	0.222	113.71	0.000
		1...	-0.01...	-0.00...	114.12	0.000
		2...	-0.00...	0.005	114.28	0.000
		2...	-0.00...	0.001	114.42	0.000
		2...	-0.03...	-0.02...	116.89	0.000
		2...	-0.02...	-0.01...	118.31	0.000
		2...	0.086	0.076	132.03	0.000
		2...	-0.03...	-0.03...	134.66	0.000
		2...	-0.02...	-0.01...	135.55	0.000
		2...	-0.02...	-0.03...	137.04	0.000
		2...	-0.02...	-0.02...	137.87	0.000
		2...	-0.03...	-0.02...	139.72	0.000
		3...	0.291	0.283	296.66	0.000
		3...	-0.02...	-0.01...	297.71	0.000
		3...	-0.01...	0.003	298.28	0.000
		3...	-0.00...	0.008	298.28	0.000
		3...	-0.02...	-0.01...	299.44	0.000
		3...	-0.02...	-0.00...	300.71	0.000
		3...	0.118	0.075	326.36	0.000

Fig(4) values of auto correlation & partial auto correlation of square residual series

It is clear from the results of (ADF) – test that the test was not significant, indicating that the exchange rate time series was not stationary. The test was carried out once again using the return series, i.e, after taking the 1st difference of the logarithm of the observed series so as to make the series stationary. The results of the test is given in the following table :

test	Original data series	
	t-Statistic	p-value
ADF	-5.895362	0.00

Table (4)

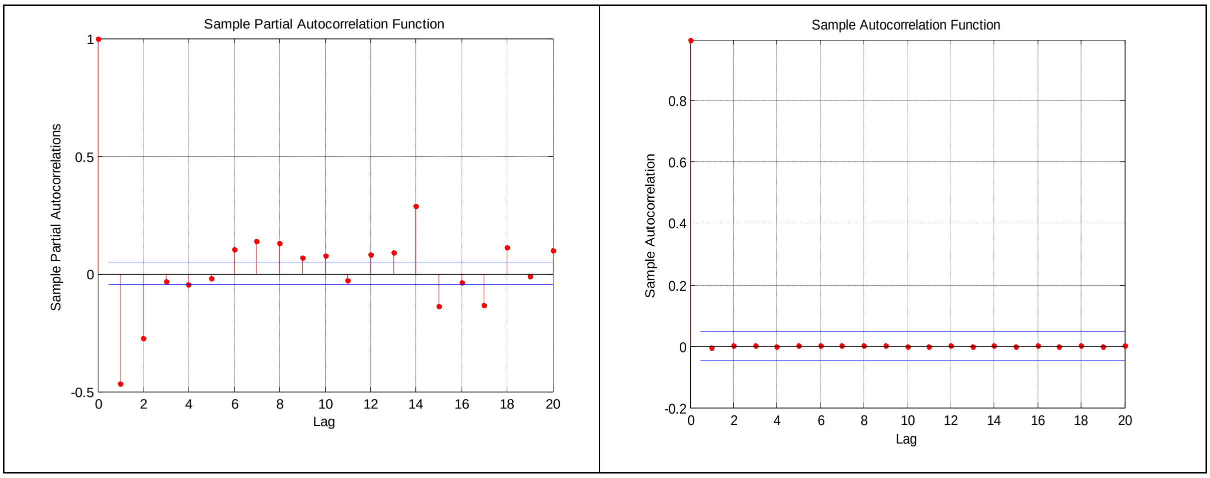
As table (4) showed, the test is significant indicating that the series had become stationary we conclude, thus, that the formula used – as specified by equation (17)- to transform the series is appropriate, and could be used to estimate the appropriate model of GARCH models.

Test of ARCH and GARCH effect:

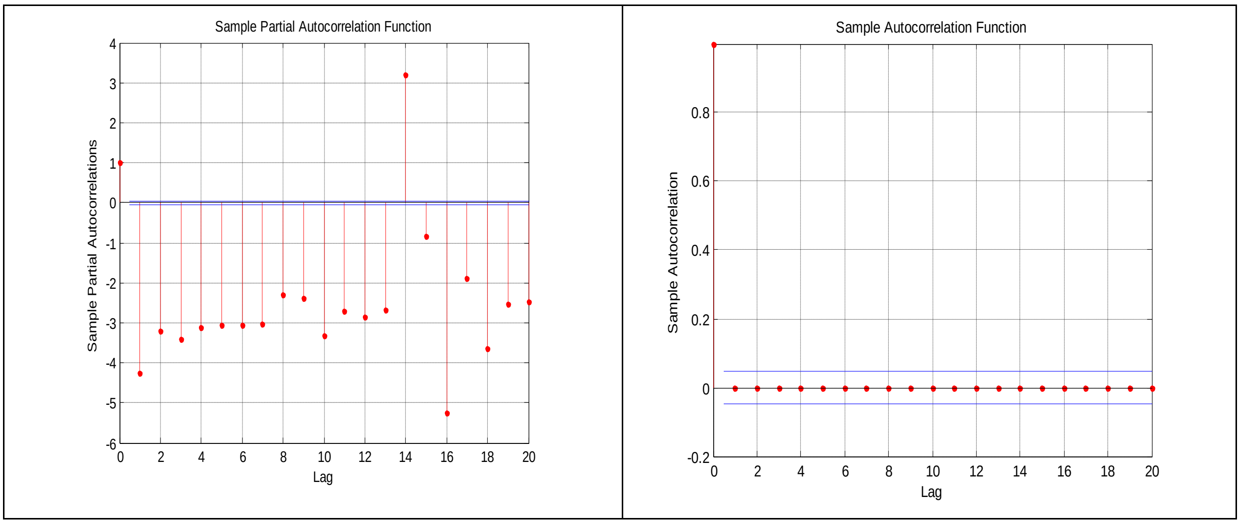
The test of ARCH and GARCH effect is carried out through two stages:

1st, calculation, and plotting of autocorrelation function, partial autocorrelation function, and squares of return series as shown in fig (5) and fig (6).

A serial correlation in the return series (differences) was detected from fig (4), where most co-efficient of auto correlation of the time series of residuals failed outside the zero- limits, i.e. the values were for from zero. This could be attributed to the effects of inequality of variances of the errors. It is found, as shown by fig (5), that the series of return (differences) was also suffering from the effective valance inequality, and linear dependency, since most of residual series co-efficient failed outside zero- limits.



Fig(5) values of auto correlation & partial auto correlation of differences series



Fig(4) values of auto correlation & partial auto correlation of square of differences series

(II) Estimation: We are going – in this part of the study, to estimate parameters of a number of models which will be investigated in a attempts to arrive at the best model to represent exchange rate data. The study will deepened upon many models. The random error of these models is normally distributed , Then, these models would be differentiating according to the value of AIC test. The best model would be the one which has the minimum AIC test value. The following table gives the results of AIC test:

Table (5) estimates of models parameters

parameters / models	α_0	α_1	α_2	β_1	β_2	AIC
GARCH (1 ,0)	8.41E-06	0.747434				-8.380258
GARCH (2 ,0)	4.71E-06	0.749200	0.426208			-8.527206
GARCH (1 ,1)	.04E-06	0.386752		0.644161		-8.581679
GARH(0,1)	3.47E-09			.998152		-8.338755
GARCH (1 ,2)	1.19E-06	0.458142		0.148695	0.415956	-8.599900
GARCH (2 ,1)	2.30E-08	0.543035	-0.523355	0.980385		-8.642515
GARCH (2 ,2)	1.33E-08	0.551611	-0.541895	.137515	-.147395	-8.656367

It is clear from the results of AIC test that GARCH (2,2) model according to AIC –test, criteria. None the less, the predication power test of the model showed that the model was not able to predict the future values. Thus three cases of GARCH (2,2) model were tested uoing ARCH (Marquradt) test. These cases are:

(i) ARCH (Marquardt) standard deviation, ARCH (Marquardt) valance, and ARCH (Marquardt) log (variable). The ARCH (Marquardt) test gave the ability of the three models. The differentiation between the three models would, thus, be according to AIC test criteria as shown in the following table:

Table (6) estimates of models parameters in case of (Marqurdt ARCH)

parameters / models	μ	α_0	α_1	α_2	β_1	β_2	AIC
GARH(2,2) ARCH (Marquardt) std. Dev.	0.074371	51E-08	531585	0.520572	520572	-0.170956	-8.660249
GARCH (2 ,2) ARCH (Marquardt) Variance	-8.660249	47E-08	543194	0.531969	35917	-0.147223	-8.657967
GARCH (2 ,2) ARCH (Marquardt) Log(var)	-1.74E-05	39E-08	544455	0.533371	38338	-0.149498	-8.664143

It is clear from the results of table ( ) above, and according to the criteria of AIC test that GARCH (2,2) ARCH (Marquardt) log (variable) is the most appropriate model.

(4) Check out of the Appropriateness of the Model:

After the choice of GARCH (2,2) ARCH (Marquardt) log (variable) as the best model to according to AIC criteria to represent the data, the appropriateness of the estimated model of the Egyptian pound exchange rate date was checked out using Lung-Box test. The test is applied on lag(1) to lag (35) as shown in fig (7), and table (7).

Table (7) test of selected model significance

Date: 09/30/15 Time: 13:41
Sample: 1 1830
Included observations: 1814

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob...
		1	0.009	0.009	0.1489	0.700
		2	-0.01...	-0.01...	0.4357	0.804
		3	-0.00...	-0.00...	0.5254	0.913
		4	-0.01...	-0.01...	1.1076	0.893
		5	0.008	0.009	1.2377	0.941
		6	0.057	0.057	7.2108	0.302
		7	0.001	0.000	7.2130	0.407
		8	-0.00...	-0.00...	7.3321	0.501
		9	0.054	0.055	12.582	0.182
		1...	-0.02...	-0.01...	13.280	0.208
		1...	-0.01...	-0.01...	13.637	0.254
		1...	0.031	0.028	15.376	0.221
		1...	0.025	0.026	16.493	0.224
		1...	-0.02...	-0.02...	17.193	0.246
		1...	-0.02...	-0.02...	17.915	0.267
		1...	-0.01...	-0.01...	18.586	0.291
		1...	-0.00...	-0.00...	18.636	0.350
		1...	0.030	0.022	20.273	0.318
		1...	-0.01...	-0.01...	20.480	0.366
		2...	-0.02...	-0.02...	21.916	0.345
		2...	-0.01...	-0.01...	22.285	0.383
		2...	-0.01...	-0.01...	22.579	0.426
		2...	-0.01...	-0.00...	22.756	0.475
		2...	0.035	0.033	25.056	0.403
		2...	-0.01...	-0.01...	25.335	0.444
		2...	-0.01...	-0.01...	26.031	0.461
		2...	-0.01...	-0.01...	26.521	0.490
		2...	-0.02...	-0.01...	27.256	0.504
		2...	-0.00...	-0.00...	27.383	0.551
		3...	0.061	0.055	34.266	0.270
		3...	0.006	0.005	34.338	0.311
		3...	-0.03...	-0.02...	35.955	0.288
		3...	-0.01...	-0.01...	36.623	0.304
		3...	-0.02...	-0.02...	37.887	0.296
		3...	-0.00...	-0.00...	37.934	0.337
		3...	0.037	0.026	40.446	0.280

*Probabilities may not be valid for this equation specification.

Heteroskedasticity Test: ARCH

F-statistic	0.218733	Prob. F(2,1809)	0.8036
Obs*R-squared	0.438085	Prob. Chi-Square(2)	0.8033

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 09/30/15 Time: 13:46
Sample (adjusted): 4 1815
Included observations: 1812 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.993573	0.102155	9.726132	0.0000
WGT_RESID^2(-1)	0.009166	0.023510	0.389888	0.6967
WGT_RESID^2(-2)	-0.012643	0.023510	-0.537774	0.5908

R-squared	0.000242	Mean dependent var	0.990117
Adjusted R-squared	-0.000864	S.D. dependent var	4.116399
S.E. of regression	4.118176	Akaike info criterion	5.670352
Sum squared resid	30679.51	Schwarz criterion	5.679462
Log likelihood	-5134.339	Hannan-Quinn criter.	5.673714
F-statistic	0.218733	Durbin-Watson stat	2.000118
Prob(F-statistic)	0.803558		

The results indicated that the null hypothesis which hypothesized in equality of the valances could not be rejected . This means that the variance equation used for the data been analyzed was appropriate.

(5)Predication:

The main objective of the study and analysis of the time series using GARCH models was predication when the restrictive valance of the model is stationary, in order to get the best possible results. This was done through the best chosen model to represent Egyptian pound exchange rate against American dollar data. The model predicted the value of restricted standard deviation for 15 successive days using the variance equation after fitting the model. Comparison is then made between the predicted values of the variance equation and the observed values of the restricted deviations of the return series. Table (8) and fig (8) below should the observed and predicted values of the deviations.

Fig(8) the deviations of forecast values from actual values of return series

year	Original conditional standard deviations value	Forecasting value	year	Original conditional standard deviations value	Forecasting value
1750	0	0.00016	1791	0	0.00016
1751	0	0.00016	1792	0	0.00016
1752	0.000524	0.00016	1793	-0.00031	0.00016
1753	-0.00024	0.00016	1794	1.31E-05	1.60E-04
1754	-0.00029	0.00016	1795	0.000747	0.00016
1755	0	0.00016	1796	-0.00045	0.00016
1756	0	0.00016	1797	0	0.00016
1757	-0.00031	0.00016	1798	-0.00031	0.00016
1758	-0.00079	0.00016	1799	0.000315	0.00016
1759	0.001468	0.00016	1800	0	0.00016
1760	-0.00068	0.00016	1801	0.003859	0.00016
1761	0.000315	0.00016	1802	-0.00386	0.00016
1762	-0.00031	0.00016	1803	0	0.00016
1763	0.000315	0.00016	1804	-0.00031	0.00016
1764	1.31E-05	1.60E-04	1805	0.000315	0.00016
1765	-0.00051	0.00016	1806	-0.00024	0.00016
1766	0.000498	0.00016	1807	0.00152	0.00016
1767	0	0.00016	1808	-0.00128	0.00016
1768	0	0.00016	1809	0	0.00016
1769	0	0.00016	1810	-0.00031	0.00016
1770	0.000144	0.00016	1811	0	0.00016
1771	0.000694	0.00016	1812	-0.00028	0.00016
1772	-0.00084	0.00016	1813	0.000459	0.00016
1773	-0.00031	0.00016	1814	0.000131	0.00016
1774	0.000315	0.00016	1815	3.93E-05	1.60E-04
1775	-0.00031	0.00016	1816		0.00016
1776	-0.01433	0.00016	1817		0.00016
1777	0.003187	0.00016	1818		0.00016
1778	0.011455	0.00016	1819		0.00016
1779	0	0.00016	1820		0.00016
1780	0	0.00016	1821		0.00016
1781	0	0.00016	1822		0.00016
1782	-0.00022	0.00016	1823		0.00016
1783	-0.00047	0.00016	1824		0.00016
1784	0.000891	0.00016	1825		0.00016
1785	-0.0002	0.00016	1826		0.00016
1786	0	0.00016	1827		0.00016
1787	0	0.00016	1828		0.00016

1788	0	0.00016	1829		0.00016
1789	-0.00038	0.00016	1830		0.00016
1790	0.00038	0.00016			

Table (9) actual and forecast values for conditional deviations of return series

Results and Recommendations:

1. the exchange rate is volatile and non-normal whereas the low price, opening prices, closing prices and high prices have this characteristic respectively
2. propose the use of GARCH model to study levels of exchange rate.
3. the study reviled that the daily time series of the Egyptian exchange rate against the dollar is non-stationary and can be transformed to stationary depending on return series.
4. the exchange rate are considered as stock so it is preferred to depend on the return series.
5. the best model to analyze the pound against the dollar are MGARCH which is capable of forecasting.
6. the study recommends make more studies on exchange rate to identify its determinants and factors that are affected by it via advanced statistical models to deter its volatility.

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