The paradox of dollar during global financial crisis (An application of ARIMA and ARCH models)

مفارقة الدولار خلال الأزمة المالية العالمية (إستعمال نماذج ARIMA وARCH)

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Abstract:

Does global financial crisis cause volatility of dollar exchange rate or not, a crucial question has been investigated by many scholars, where the appreciation of dollar make a paradox; Whether the crisis has an impact on the Dollar exchange rate The existing literature point out conflicting views in this regard. Therefore, This study aims to analyses the volatility of the Dollar exchange rate during 2008 financial crisis using various volatility models such as Autoregressive Integrated Moving Average Autoregressive Integrated Moving Average and Autoregressive Conditional Heteroskedasticity models During the period from (01- 01-2005to 01- 12 -2014); the results shows that there is a positive statistically significant effect of the crisis on volatility of dollar exchange rate

Keys words: **financial crisis; Dollar exchange rate; Volatility; ARIMA model; ARCH model.**

JEL classification codes: C1; G01; F31.

ملخص:

في إطار التداخل بين تأثير الأزمة المالية العالمية 2008 على سلوك الدولار وكذا عدم توافق النتائج في الدراسات التجريبية بحيث أن ارتفاع الدولار خلال الأزمة العالمية شكل مفارقة فيما إذا كان للأزمة المالية أثر على سعر الصرف الدولار، رأينا أهمية دراسة وتحليل هذه العلاقة؛ تهدف هذه الدراسة إلى تحليل تقلبات سعر الصرف الدولار خلال الأزمة المالية باستخدام عدة نماذج لدراسة التقلبات مثل نموذج الانحدار الذاتي المتكامل والمتوسط المتحرك ونموذج الانحدار الذاتي المشروط بعدم ثبات التباين خلال الفترة الممتدة من (01-01- 2005 إلى غاية 01-12-2014)؛ أشارت نتائج الدراسة إلى وجود تأثير إيجابي ذي دلالة إحصائية للأزمة على تقلبات سعر الصرف الدولار.

الكلمات المفتاحية: الأزمة المالية؛ سعر الصرف الدولار؛ تقلبات؛ نموذج الانحدار الذاتي المتكامل والمتوسط المتحرك؛ نموذج الانحدار الذاتي المشروط بعدم ثبات التباين.

تصنيف JEL: C1؛ G01؛ F31.

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1-Introduction

The 2008 financial crisis was the worst economic calamity since the Great Depression, The behavior of the dollar during the global crisis in 2008 raised the doubts of many researchers, in many ways, because they expected that a financial crisis centered on the U.S. would cause the dollar's exchange rate to fall, while the dollar appreciated at the height of the financial turmoil Where it became stronger in their effective terms than it has ever been since the early 2000s where The U.S current account deficit versus the rest of the world steadily widened Economic theory suggests that when foreign currency exchange rates are floating freely, current account deficits should be short-lived because exchange rates should adjust to rebalance trade. The currency exchange rates of countries with current account surpluses rise, making their exports less competitive and attracting imports, while those of countries with current account deficits fall, making their exports more competitive and discouraging imports

However, the opposite happened. Although the U.S. was the epicenter of the crisis and experienced rapid deterioration in key indicators, the dollar's exchange rate soared against all currencies, because the dollar was the world's premier reserve currency and the currency most used for international trade, international demand for dollars tended to keep the dollar's exchange rate too high for the U.S.'s current account deficit to ever close; this appreciation of dollar make a paradox foe economist Whether the crisis has an impact on the Dollar exchange rate or not.

The importance of this study is determining the impact of the 2008 global crisis on the exchange rate fluctuations of the dollar and resolving the paradox of the rising dollar in light of the crisis.

Research Questions:

The financial crisis of 2008 may have started in the US banking sector but it went on to unleash the deepest global recession since the Great Depression.

The year 2009 became the first on record where global GDP contracted in real terms and the lost growth resulting from the crisis and ensuing recession has been estimated at over $10 trillion, so the research study was based on this question:

How has 2008-09 financial crisis affect dollar exchange rate?

In order to answer this problem we will discuss the following main points in this paper:

- Conception framework of Dollar exchange rate since the 2008-09 crisis**;**
- the practical side of research.

Literature Review:

Despite the vast literature on global financial crisis, only few attempts have been made in recent literature to assess the impact of 2008 financial crisis on the dollar volatility.

(Naohiko & Yuji, 2011) in which the authors investigated when and how US dollar shortage problem evolved into the global financial crisis using cross-currency swap prices between three European currencies and USD during the financial, by employed the dynamic common (latent) factor model with regime-switching β, The results show that the dollar has entered in to the crisis regime soon after the onset of the subprime problem in August 2007.

(Gabriella, Antonio Carlo, & Massimo, 2016) in which the authors analyze Exchange Rate Volatility of the Euro/US dollar before, during and after the global financial crisis during the period 2003-2011 using EGARCH model, The findings indicate considerable volatility experienced over the sample period.

In another study by **(Zoe, 2010)** which analyze Global currency trends through the global financial crisis, the research indicate that the volatility and risk aversion in financial markets has prompted changes in the nature of foreign exchange market While the global crisis affected the dollar positively The US dollar remained the most commonly traded currency,

(Marion, 2010) The study aims to analyze unusual movements exchange rate during the global financial crisis of 2007–09 Due to the decline in a large number of countries that were not at the heart of the crisis against three major currencies: the US dollar, the Japanese yen, and the Swiss franc Compared to the Asian crisis1997 , The empirical findings concluded that the safe haven effects went against the typical pattern of crisis-related flows. and interest rate differentials explain more of the crisis-related exchange rate movements in 2008–09 than in the past , The study also indicated a significant impact on the US dollar exchange rate and a lower impact on the Swiss franc exchange rate.

(Marcel, 2009) also confirm that The global financial crisis caused an increase the dollar exchange rate against virtually all currencies globally, While the paper did not tested the hypothesis directly but The results suggest that negative US-specific macroeconomic shocks during the crisis have triggered a significant strengthening of the US dollar, rather than a weakening in half of 2008 and early 2009.

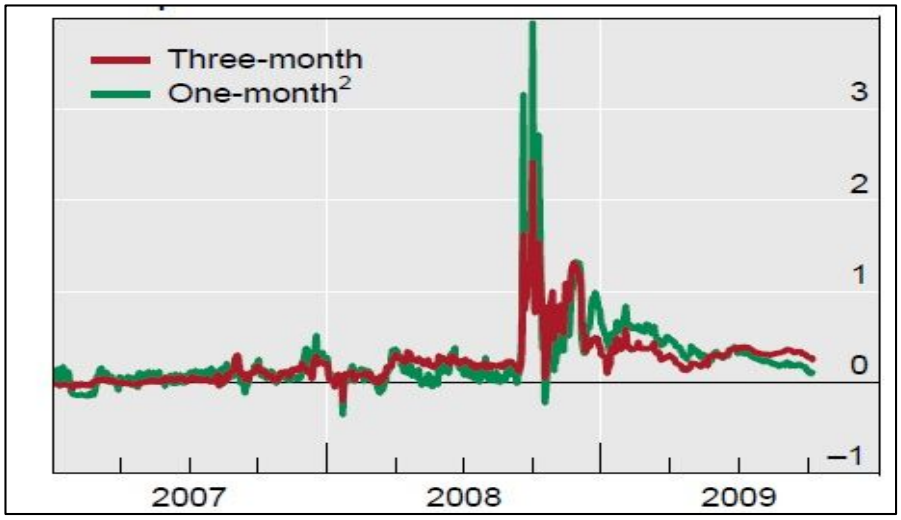
Our paper contributes to the literature by measuring the impact of the global financial crisis on the volatility of dollar exchange rate, where Our study is only an extension of previous studies using Quantitative methods Represented in ARIMA and ARCH model And Most used in financial models Because the need of investors is no longer confined only to predicting the expected returns, it has extended to include risk and uncertainty and measuring volatility of exchange rate, Also our study aims To solve the paradox of the unexpectedly appreciation of dollar exchange rate even though the U.S. was the epicenter of the crisis.

2- CONCEPTION FRAMEWORK OF THE EVOLUTION OF DOLLAR EXCHANGE RATE SINCE THE 2008-09 CRISIS:

The most obvious feature of the onset of a currency crisis, or the result a manifested in a sharp and large decline in exchange-rate for the affected countries (Faridul, 2019, p. 2).

The first decline of dollar was in 2007, as a result of the Federal Reserve Bank monetary policy response to the crisis, which promptly lowered its key interest rates because of a higher perception of the dollar, deterioration in US growth and inflation expectations (Federal Reserve Bank of New York, 2008), where starting from September 2007 a series of Fed Funds rate cuts, leading it from 5.25% to a range of -0.25% in December 2008 The depreciation of the dollar was thus not so much due to a lower appetite for dollar-denominated securities than a negative "return effect" on the US dollar.

Figure.1. Dollar swap yield premium



Source: BIS calculations

The dollar shortage reflected unbalanced growth in international banking, the European banks accumulated dollar assets well beyond their dollar deposits, and funded the difference in the interbank and other wholesale markets.

By contrast, US banks expanded their foreign claims modestly and ended up with comparatively little need for funding in European currencies this shortage, and high dollar yields in the market, contributed to a sharp appreciation of the currency (Robert & Patrick, p. 87).

While, in 2008 the dollar appreciated strongly in the second half of 2008, both against the euro and in effective terms.

The investors have not stopped buying securities denominated in dollars; they have certainly diverted US risky private securities, but have increased their purchases of government (Ricardo & Arvind, 2009, p. 2).

2 -1- The 2008-09 crisis measures used:

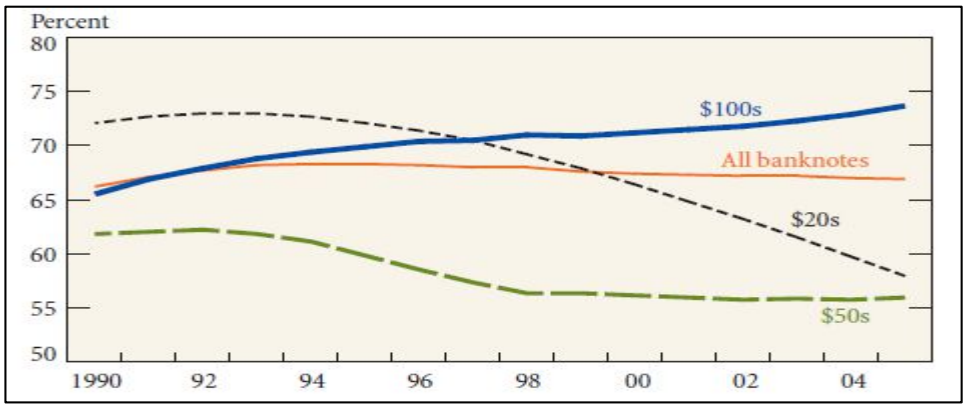
The crisis measures used are**:** (Jeffrey & George, pp. 12- 13)

- **Nominal local currency percentage change versus the US dollar from 15th September 2008 to 9th March 2009:** Though asset prices peaked and many measures of financial market risk started to rise prior to this date, financial market dislocations became particularly synchronized and abrupt after this date **.**
- ***Equity market returns* in domestic stock market benchmark indices over the same period as above, adjusted for the volatility of returns:** This method is preferred to simple percent returns, to account for the differing risk-return characteristics of each local stock market.
- **Percentage change in the level of real GDP from end-June 2008 to end-June 2009:** Though the NBER declared December 2007 as the start of the US recession, the global economy continued growing up to the second quarter of 2008 based on a number of high frequency variables
- **Percentage change in industrial production from end-June 2008 to end-June 2009:** The composition of GDP varies widely across economies, so industrial production is more consistent measure of the impact of the crisis across economies.
- **Recourse to IMF financing from July 2008 to November 2009:** This includes all countries that requested funds from the IMF under Stand-by Arrangements, the Poverty Reduction and Growth Facility and Exogenous Shock Facility.

2 -2- The Dollar as International Cash:

The dollar is a major form of cash currency around the world, The share of U.S. dollar banknotes estimated to be held outside the United States is substantial **(Goldberg, 2009, p. 2).**

Figure.2. U.S. Banknotes Held outside the United States



Source: Federal Reserve Bank of New York estimates (2006).

3- METHODS AND MATERIALS METHODS AND MATERIALS:

First the stationarity of the data will be checked using the ADF test (Augmented Dickey-Fuller test**)** The ADF test estimates the equation**:** (dickey & Fuller, 1981)

$$\nabla Y_t = \alpha_0 + y t_{t-1} + \sum_{i=2}^{p} \beta_i \nabla y_{t-i+1} + \varepsilon_t$$

The time series *yt* is stationary if for every *h* ϵ *Z*, the *yt+h* series has the same distribution as the *yt* series for any *t = 1, 2, …, n* (Enders, 1995).

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3-1- Autoregressive Integrated Moving Average Models (ARIMA (p, d, q)) Model:

ARIMA is one of the type of models in the Box-Jenkins methodology. Box-Jenkins (1976) approach on time-series analysis is a methodology where we try to find an ARIMA (p,d,q) model which best describes the stochastic process where the sample is derived. The ARIMA (p,d,q) can be expressed as:

$$\varphi_p(L)(1-L)^d(y_t-\mu) = \vartheta_q(L)e_t$$

Where:

$$\varphi_p(L) = 1 - \sum_{i=1}^{p} \varphi_i L^i$$

and

$$\vartheta(L) = 1 - \sum_{j=1}^{q} \vartheta_j L^j$$

p and q are polynomials in terms L of degree.

$\{ y_t \}$ is the time series, and is et the random error at time period t, with μ is the mean of the model, d is the order of the difference operator.

φ1, φ2,,,, φp and ϑ1, ϑ2,,,, ϑp are the parameters of autoregressive and moving average terms with order p and q respectively. L is the difference operator defined as :

$$\Delta y_t = y_t - y_{t-1}$$

3-2- Autoregressive Conditional Heteroskedasticity Models (ARCH models):

Engle (1982) developed the Autoregressive Conditional Heteroscedasticity (ARCH) model for testing the volatility of financial series. And most used in financial models because the need of investors is no longer

confined only to predicting the expected returns, it has extended to include risk and uncertainty, the basic ARCH model consists of two equations, a conditional mean equation and a conditional variance equation. Both equations should be estimated simultaneously given that variance is a mean equation. The mean equation estimate the conditional mean of the examined variable. The variance equation estimates this process as a typical autoregressive process. Both equations form a system that is estimated together with maximum likelihood method; So, ARCH model is an autoregressive process (AR) and can be written as follows: (CHAIDO, 2019)

$$\varepsilon_t = z_t - \sigma_t$$

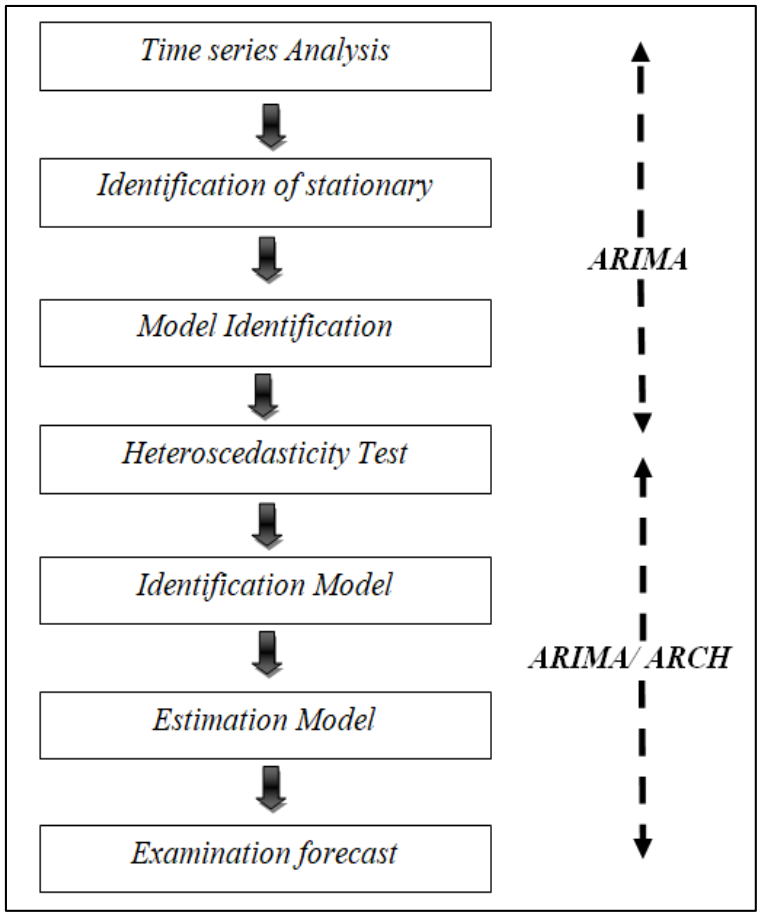
Where Zt is white noise

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2$$

Where ωt >0; αi ≥0 and i>0, ARCH test based on two hypothesis

H0: Homoscedasticity VS **H1**: Homoscedasticity

Figure.3. Flowchart of building ARIMA/ARCH process



Source: Authors' Construct.

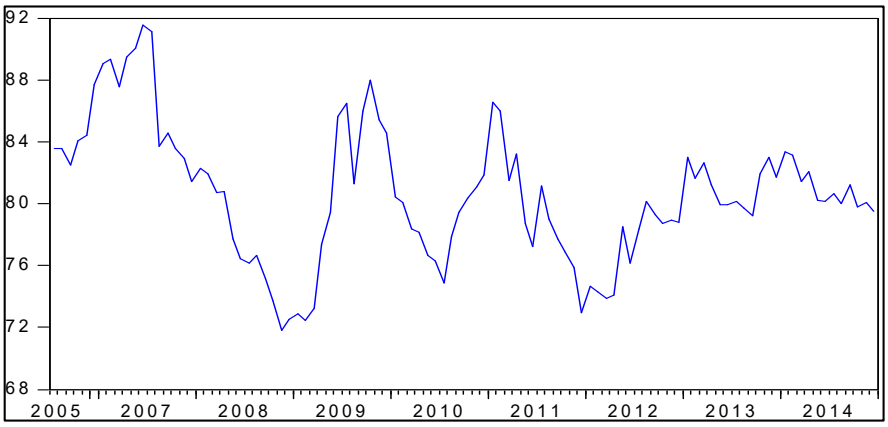
3-3- DATA:

The data which will be used in modelling volatility of exchange rate in this paper are the monthly of Dollar exchange rates.
The data span from 1st January 2005 to 12th December 2014 resulting in a total of 110 Observation.

4- STUDY RESULTS (ANALYSIS AND DISCUSSION):

One of the characteristics of exchange rate during financial crisis is the uncertainty that changes over time. In this regard, there is such a thing as "volatility clustering", It means that the volatility varies periodically, currency dynamics changes from slightly changing to more chaotic.This section describes the results of this research study, Data analysis and outputs of statistical tests which are used to analyze the data are discussed under this section.

Figure.4. Dollar exchange rates over the 01.01.2005 - 01.12.2014 time period



Source: Data Processed EVIEWS.10.

From figure 4 it can be seen that the data is non-stationary, but we will run the Augmented Dickey-Fuller test to make sure. Also, several fluctuations in the time series can be observed starting from 2007 before the global financial crisis and increasing trend of the time series as result The US dollar's appreciation in late 2008.

4-1- Stationarity unit root test:

In table 1 we have the output of the Augmented Dickey - Fuller test.

Table.1. Results of Augmented Dickey-Fuller unit root test

Null Hypothesis: SER02 has a unit root Exogenous: None Lag Length: 0 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.096921	0.7114
Test critical values:	1% level	-2.586550	
	5% level	-1.943824	
	10% level	-1.614767	
*MacKinnon (1996) one-sided p-values.			

Source: Data Processed EVIEWS.10.

From the table 1 we have the output of the Augmented Dickey - Fuller test. From it, it can be stated that our time series in level is non-stationary (it has a unit root) – the t-stats 0.71114 in absolute value is lower than the critical values 5%.

Table.2. Results of Augmented Dickey-Fuller unit root test at 1st difference

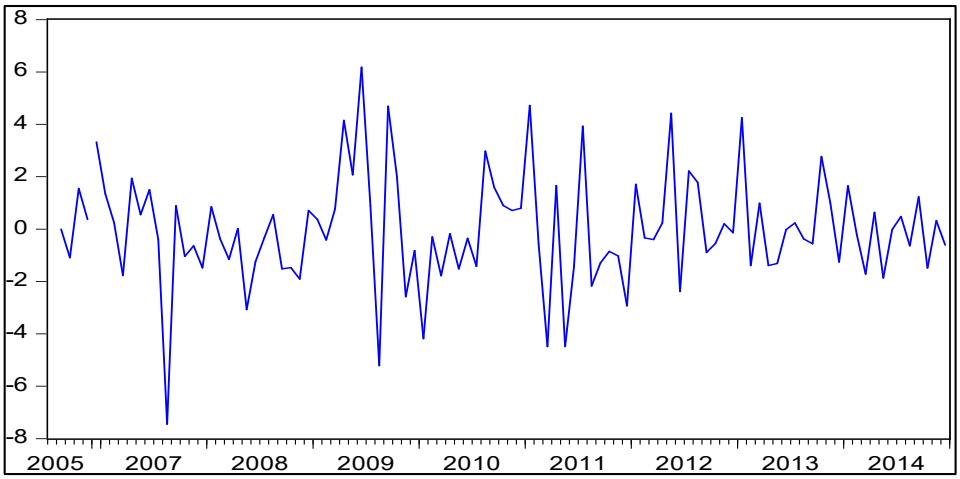
Null Hypothesis: D(DOLLAR) has a unit root Exogenous: None Lag Length: 0 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.45427	0.0000
Test critical values:	1% level	-2.588292	
	5% level	-1.944072	
	10% level	-1.614616	
*MacKinnon (1996) one-sided p-values.			

Source: Eviews.10 output.

From the table 2 it can be seen that the data is stationary in 1st difference. The 1st difference ($xt - xt{-}1$) is generally used in order to transform non-stationary data into stationary data.

the result illustrate that the absolute value of the ADF test (10.45427)is greater than the 1%, 5% and 10% critical values in absolute terms (2.588292 ,1.944072 and 1.614616) respectively it can be observed that in first difference the time series becomes stationary, so further in our analysis we will use the data in 1st difference.

Figure.6. Dollar exchange rates over the 01.01.2005 - 01.01.2014 time period in 1st difference

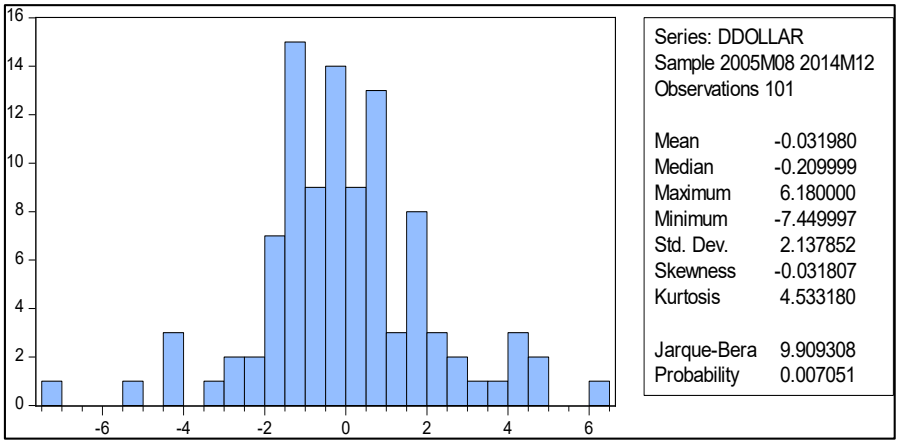


Source: Data Processed EVIEWS.1

4-2- Descriptive Statistics of Dollar exchange rates series:

In EViews.10 software, a descripting statistics on our data in order to observe the mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jaque-Bera, Probability, Sum, sum sq. dev. and the number of observations.

Figure n.5. Summary of Descriptive Statistics

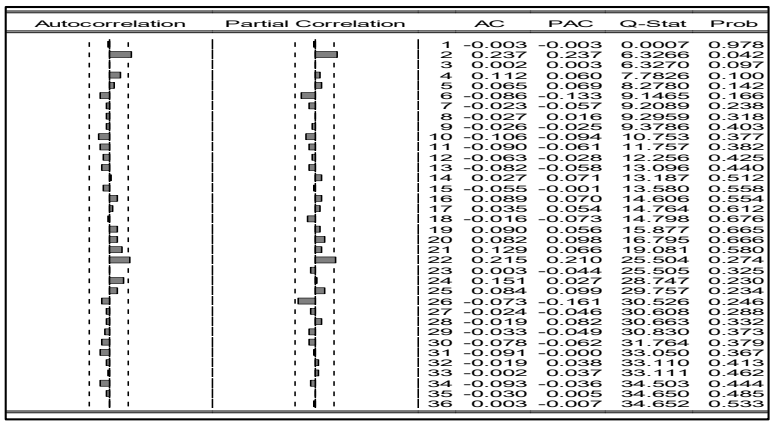


Source: Data Processed EVIEWS.10**.**

From the figure 5 shows that summary of descriptive statistics of the series, as we can see the Dollar exchange rates have a standard deviation of 2.137852 indicating that data fluctuation is extremely low, the skewness is (-0.031807) shows that the series is negatively skewed , Since the coefficient is less than 0 Indicates that he Dollar exchange rates series It is affected by negative shocks more than positive shocks, In terms of kurtosis (4.533180) it is more than 3 indicates that there are anomalies in the series . Both skewness and kurtosis of Dollar exchange rate show the departure from the normality P value of Jarque-Bera test indicates that dollar price series is not-normally distributed.

The ACF and PACF plot in Figure 7 shows no significant peaks, also all Q-statistics shows no significant ACF, this result confirm that the first difference of exchange rate series is stationary.

Figure.7. Correlogram of first difference of Dollar exchange rate series



	AC	PAC	Q-Stat	Prob
1	-0.003	-0.003	0.0007	0.978
2	0.237	0.237	6.3266	0.042
3	0.002	0.003	6.3270	0.097
4	0.112	0.060	7.7826	0.100
5	0.065	0.069	8.2780	0.142
6	-0.086	-0.133	9.1465	0.166
7	-0.023	-0.057	9.2089	0.238
8	-0.027	0.016	9.2959	0.318
9	-0.026	-0.025	9.3786	0.403
10	-0.106	-0.094	10.753	0.377
11	-0.090	-0.061	11.757	0.382
12	-0.063	-0.028	12.256	0.425
13	-0.082	-0.058	13.096	0.440
14	0.027	0.071	13.187	0.512
15	-0.055	-0.001	13.580	0.558
16	0.089	0.070	14.606	0.554
17	0.035	0.054	14.764	0.612
18	-0.016	-0.073	14.798	0.676
19	0.090	0.056	15.877	0.665
20	0.082	0.098	16.795	0.666
21	0.129	0.066	19.081	0.580
22	0.215	0.210	25.504	0.274
23	0.003	-0.044	25.505	0.325
24	0.151	0.027	28.747	0.230
25	0.084	0.099	29.757	0.234
26	-0.073	-0.161	30.526	0.246
27	-0.024	-0.046	30.608	0.288
28	-0.019	0.082	30.663	0.332
29	-0.033	-0.049	30.830	0.373
30	-0.078	-0.062	31.764	0.379
31	-0.091	-0.000	33.050	0.367
32	-0.019	0.038	33.110	0.413
33	-0.002	0.037	33.111	0.462
34	-0.093	-0.036	34.503	0.444
35	-0.030	0.005	34.650	0.485
36	0.003	-0.007	34.652	0.533

Source: Data Processed EVIEWS.10.

4-3- Exchange Rate Model Identification:

Since correlogram of Dollar exchange rate series does not give much help in identifying an appropriate model, thus numerous ARIMA models are suggested to fit exchange rate dollar series in the Sudan.

Table 2 bellow shows the suggested models and their corresponding AIC and BIC criteria numerous statistical criterion for assessing the goodness of fit to time series models have been introduced, **Akiakas (1987)** information criteria and **Schwartzs (1978)** Bayesian criteria are useful tools for comparing models with different parameters number, the model with smallest AIC or SBC is considered best. Several ARIMA (p,d,q) models have been suggested with the objective of identifying which of these models is adequate to fit buying exchange return series, the suggested ARIMA models and their corresponding AIC,SBC values are stated as follows:

Table.2. ARIMA (p,d,q).

Dollar	**AR(2)**	**MA(2)**	**AR(22)**	**MA(22)**	**AR(26)**	**MA(2)**
prob	0.0057*	0.0001*	0.7804	0.6311	0.3580	0.5731
AIC	4.363638		4.365967		4.376878	

Source: By Authors from Eviews.10 output**.**

A closer look to table 2 it can be seen that ARIMA (2,1,2) model have smallest value of AIC and BSC criteria. In this model it is assumed that the exchange rate data is subject to autoregressive of order2, differing 1, and moving average of order2.

In this paper, an autoregressive moving average ARMA (2,1,2) model for the conditional mean in the returns series is employed as an initial regression

Table.3. Parameter Estimation of an ARIMA (2,1,2)

Dependent Variable: DSER01
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 10/25/19 Time: 18:18
Sample: 2 110
Included observations: 109
Convergence achieved after 22 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.062350	0.218737	0.285045	0.7762
AR(2)	-0.721702	0.255538	-2.824248	0.0057
MA(2)	0.836172	0.207848	4.023002	0.0001
SIGMASQ	4.266396	0.443048	9.629642	0.0000

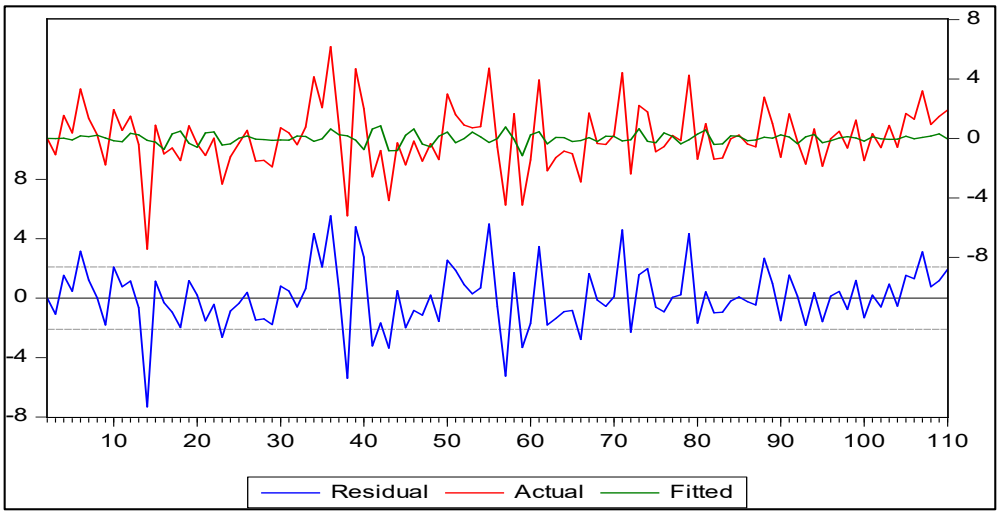
R-squared	0.028072	Mean dependent var	0.061193
Adjusted R-squared	0.000303	S.D. dependent var	2.104820
S.E. of regression	2.104501	Akaike info criterion	4.363638
Sum squared resid	465.0372	Schwarz criterion	4.462403
Log likelihood	-233.8182	Hannan-Quinn criter.	4.403690
F-statistic	1.010911	Durbin-Watson stat	2.038856
Prob(F-statistic)	0.391023		

Inverted AR Roots	-.00+.85i	-.00-.85i
Inverted MA Roots	-.00+.91i	-.00-.91i

Source: Data Processed EVIEWS.10**.**

Next we check the residuals of this model:

Figure n.8. Residuals of the model



Source: Data Processed EVIEWS.10.

Looking at the figure above, at the residuals plot, we can observe that there are long periods with low fluctuations and also long periods with high fluctuations, meaning that periods of low volatility tend to be followed by periods of low volatility for a prolonged period and periods of high volatility are followed by periods of high volatility for a prolonged period. We have clustering volatility.

4-4- ARCH test:

Next we will check the ARCH model we will run a heteroskedasticity test, we will check if it has an arch effect and if the residuals are normally distributed or not.

Table.5. Heteroskedasticity Test: ARCH

Heteroskedasticity Test: ARCH			
F-statistic	85.59793	Prob. F(1,97)	0.0000
Obs*R-squared	46.40904	Prob. Chi-Square(1)	0.0000

Source: Data Processed EVIEWS.10.

The test p-values from tables 5 (shown in the second column) are less than 5%, meaning that there is an ARCH effect.

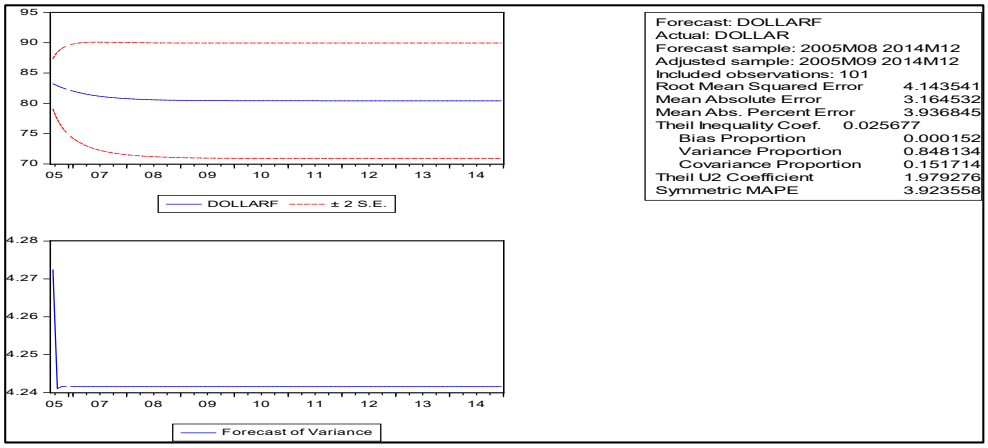
4-5- FORECASTING:

For the forecasting of ARIMA (2,1,2)- ARCH model on the dollar exchange rate, we use both the dynamic (n-step ahead forecasts) and static procedure. The dynamic procedure computes forecasting for periods after the

first sample period, using the former fitted values from the lags of dependent variable and ARMA terms. The static procedure uses actual values of the dependent variable.

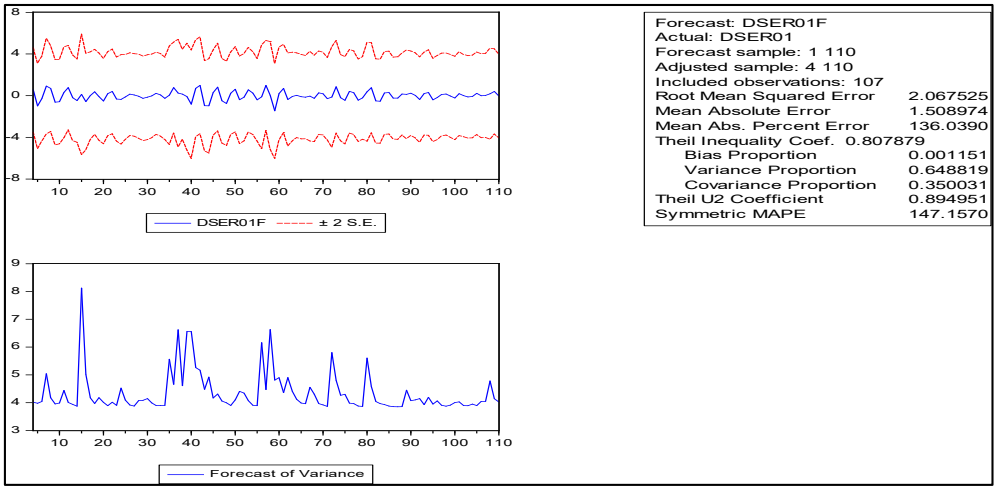
In the following diagram, we present the criteria for the evaluation of forecasting the US dollar exchange rate, using the dynamic and static forecast respectively.

Figure.9. Dynamic forecasting of dollar volatility and variance



Source: Data Processed EVIEWS.10**.**

Figure.10. Static forecasting of dollar volatility and variance



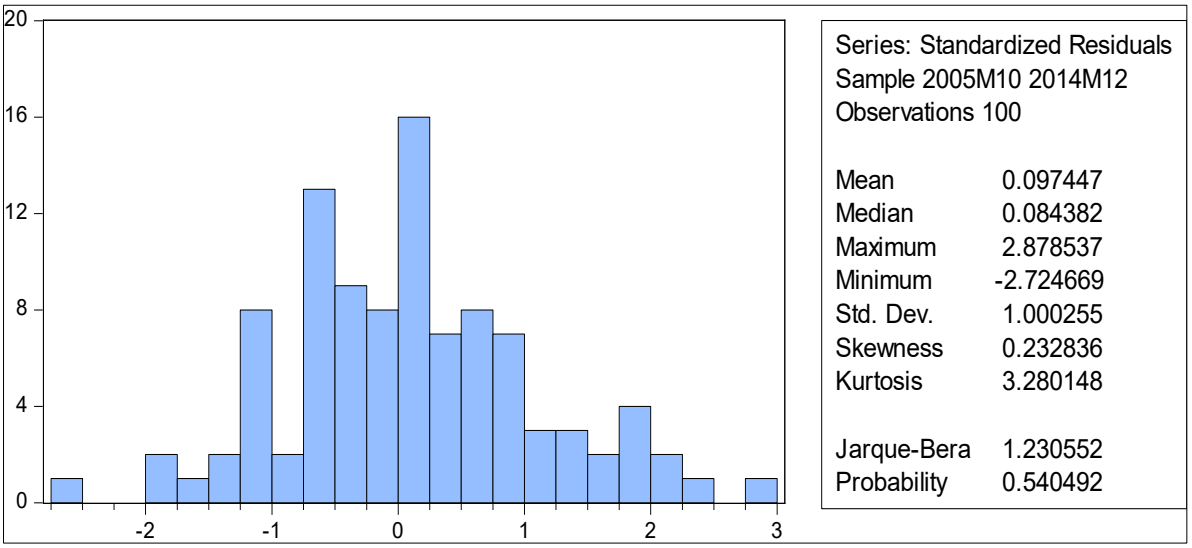
Source: Data Processed EVIEWS.10.

Figure 10 shows that fluctuations are concentrated in certain periods where variation is significant.

We conclude that large changes in the exchange rate are followed by other changes corresponding to them, which is known in the analysis of financial markets accumulated volatility in certain periods. As shown fluctuations are concentrated in certain periods where the variation is significant in 2008, followed by less volatile periods, and periods of recession or (wild) was the beginning of the crisis, we call these periods of frenzy

Which takes the image of the bear after 2008; therefore we conclude that large changes in the exchange rate followed by other changes (calm) against them, which is known in the analysis of financial markets accumulated fluctuations in certain periods.

Figure.11. Test of normality of errors



Source: Data Processed EVIEWS.10**.**

Skewness and kurtosis values of residuals shown in Figure above are closer to 0 and 3 respectively. P value of Jarque-Bera test (0.54) is greater than 0.05. Based on these results, it can be concluded that residuals are normally distributed with 5% level of significance.

8-Conclusion

Modelling the volatility of exchange rate series during financial market has become fertile field of empirical research in financial markets. This is simply because volatility is considered as an important concept in many economic and financial applications like asset pricing; risk management and portfolio allocation.

This article attempts to explore and measure the impact of financial crisis 2008- 09 on the volatility of dollar exchange rate, Due to the fact that exchange rate is regarded as a financial time series that may present volatility Given that there are ARCH effects on exchange rate US dollar exchange rate , we estimated ARIMA, ARCH(p),

the volatility of the dollar exchange rate have been modeled by using a Autoregressive Integrated Moving Average Models (ARIMA) and Autoregressive Conditional heteroskedasticity (ARCH) models time series over the 01- 01- 2005 to 01- 12- 2014, Using, First Box-Jenkins ARMA models were tried after ARCH test is applied to check whether there is an arch effect in Dollar exchange rate series and it strongly suggests the presence of ARCH effect in the series.

The empirical results show, the financial crisis 2008- 09 has a significant effect on the fluctuations of the dollar exchange rate, This indicates that the financial crisis had an impact on the volatility of the dollar exchange rate.

As future development of the paper, we recommend:

- Using family ARCH of models to measuring the volatility of dollar exchange rate;
- Extend the study period, Considering that the consequences of the global crisis are still onging today;
- This article can be extended by investigating the spillover effects between Dollar exchange rate volatilities and financial crisis in order to better reflect the reality of Exchange rate behavior.

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