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APPROCHING EUR/CHF EXCHANGE RATE VOLATILITY IN ALBANIAN MARKET

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A B S T R A C T

This paper explores the forecasting of EUR/CHF exchange rate volatility in short term period in Albanian market, being that Euro is the mostly used currency in financial and commercial transactions and furthermore together with Swiss franc are considered as safe currencies with a probabilistic volatility distribution statistically interesting. Precisely the latter, represents a continuous concern for the economic agents dealing with the above mentioned exchange risk, hence the measurement of its volatility helps them in the assessment and maintenance of capital needed for coverage purposes almost referring to trade balance trend toward Euro-Area and not as well as to the Eurobond issued. Under these circumstances, the financial time series dynamic models such as ARMA (1;1), ARCH (1) and GARCH (1;1) are used to estimate the EUR/CHF exchange rate volatility in short term period. The last one, which at 95% confidence level displays satisfactory statistical parameters in confront of the others in terms of normal residuals distribution is also used to forecast EUR/CHF exchange rate during 2015 in correspondence of moving average method based on latest 252 exchange rate values. In statistical terms the comparison of EUR/CHF exchange rate forecasted data through GARCH (1;1) model with the current ones demonstrated a good robustness of the latter at the confidence level taken into consideration. Therefore, the research in question suggests to the economic agents dealing with these kinds of transactions the implementation of GARCH models for the estimation and forecasting of EUR/CHF exchange rate volatility in the short term period, necessary for risk management purposes.

A R T I C L E I N F O

Keywords:
Dynamic models, exchange rate volatility forecasting, financial time series modelling.

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1. INTRODUCTION

The present research aims to identify the functional form of EUR/CHF exchange rate volatility in Albanian market, necessary to economic agents exposed to the above mentioned exchange risk not only for its forecasting needs in short term period but mainly for the assessment and maintenance of economic capital for coverage purposes. Namely, by considering EUR/CHF exchange rate and its variance statistical behavior (see Fig.1&2), leads to the understanding that precisely the last one makes the issue interesting in the market in question. What correspondently has also frequently contributed in the depreciation of domestic currency (Albanian Lek) against foreign currencies mainly used in the country. Referring to these kind of circumstances, worth mentioned that domestic currency has been significantly depreciated against foreign currencies due to: trade liberalization, implementation of flexible exchange rate regime and import volume growth as per primary services and goods necessity (in 1992); political/social issues followed consequently by the financial/economical instability (in 1997); the entrance of common currency of European Union (EURO) and the significant increase of imports and remittances in the country in this currency (in 2001-2002); the continuous depreciation of domestic currency against USD has maintained the same trend due to country's economic slowdown (during 2012-2014), at the end of January 2015 as per CHF overestimation against EUR in the financial markets while during the rest of year in question it marked a slight overestimation against both currencies in question.

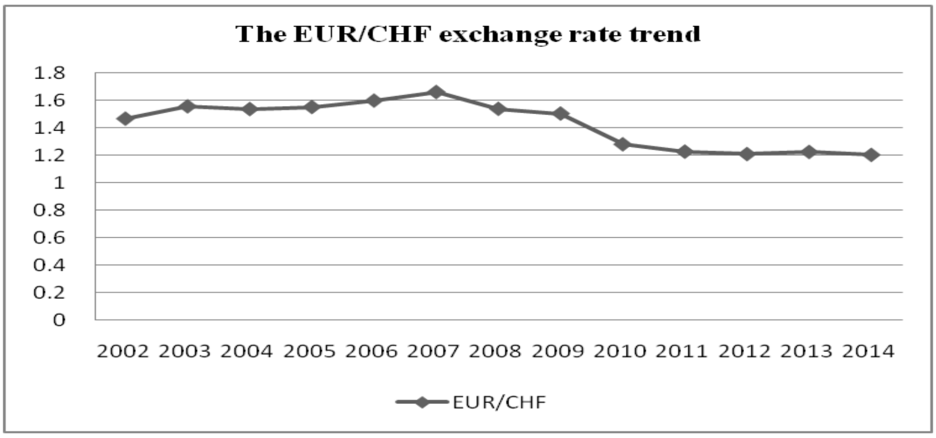

Figure 1: The EUR/CHF exchange rate trend (2002-2014)

Source: Bank of Albania data, author's elaboration.

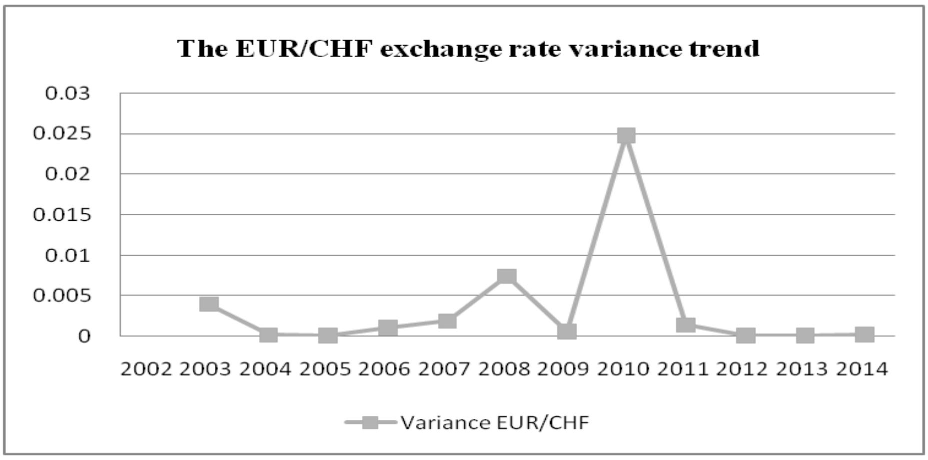

Figure 2: The EUR/CHF exchange rate variance trend (2002-2014)

Source: Bank of Albania data, author's elaboration.

Meanwhile is observed an increasing export trend toward Euro-Area and European Union especially to Italy year after year, but the value of these exports in 2014 felt about 52% of the total value. The same drop in exports is verified toward countries such as : France, UK, Germany, Spain, Switzerland, China. Contemporary they are increased in countries such as: Kosovo, Macedonia, Turkey, Greece, Austria and

Egypt and the transactions are performed in EUR, CHF and USD. From the other side imports have maintained a positive trend by generating a consistent gap in country's trade balance (see Fig.3).

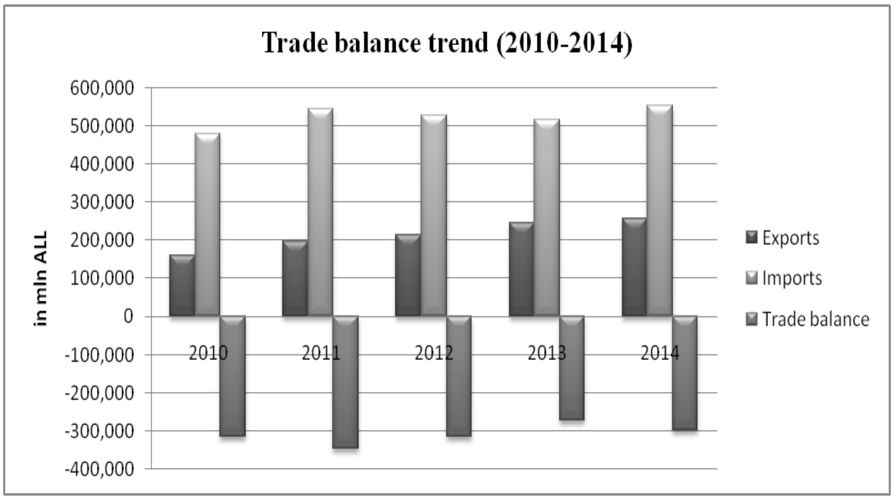

Figure 3: Trade balance trend (2010-2014)

Source: Bank of Albania data, author's elaboration.

Corespondently frequent oscilations are obtained regarding EUR/CHF exchange rates first order differencies which directly leads to the understanding of domestic currency depreciation/overestimation against both currencies by contributing in a certain way in the analysis in question and orienting the study into the financial time series dynamic models. Therefore the paper is developed through the raise of three hypotheses aiming to accurately explore the EUR/CHF exchange rate volatility charateristics in short term period in Albanian market helping by this way the economic agents in respective Value at Risk (VaR) calculation.

2. LITERATURE REVIEW

In general, the literature presents disputed empirical results regarding the impact of various factors on exchange rate volatility, but how is addressed the exchange rate volatility modeling issue on it? There are also many studies that deal with exchange rate volatility modeling, although most of them are focused mainly on finding the volatility sources for an appropriate market risk estimation and management according to Marrison (2002). And precisely for this reason they differ on the way how handle the exchange rate volatility issue. Especially the latter can be treated in two large groups. The first group pertains to the studies that use different standard deviation errors' modifications in autoregressive models while in the second one are classified the models that treat auto-correlated errors attitude with varying variance, the also called Autoregressive Conditional Heteroskedastic volatility models (ARCH). The latest was firstly developed from Engle (1982) and Bollerslev (1986) and further explored from Giot and Laurent (2001). As well as further modifications of ARCH approach can be found in Orlowski (2004). While, Belke and Setzer (2003) belong to the first group of researchers as they studied exchange rate volatility impact in labor market of Visegrad. From the other side Baum et al. (2004) by analyzing the impact of exchange rate volatility on bilateral exports volume applied a GARCH-type (Generalized Autoregressive Conditional Heteroskedastic volatility) model through which were made respective volatility measurements. Specifically, here for the exchange rate volatility modeling is used TARCH (an ARCH model with consistent autoregressive terms) model even it assumes that negative information distort the market as evidenced from Zakoian, (1994). And in fact, through TARCH models are analyzed the current developments in exchange rate volatility in Czech Republic, Poland, Hungary and Slovakia. The authors suggest it as they can't distinguish any difference between exchange rates and capital time series behavior. However, the literature shows another model which can be used in these cases and is a first order GARCH model. In addition other GARCH-type models were further developed from Sentana (1995) trying to detect also variance structural breaks (they demonstrate irregularities in financial time series related to heteroskedasticity problems in the data analyzed) and are usually present in financial time series on behalf of Bali and Guirguis (2007). Contemporary some simpler models like ARMA (which represents an autoregressive moving average process) are equally used to analyze and forecast exchange rate time series in compliance with Box et al. (2008) and Brooks (2002) proposed methodologies. Furthermore researchers, referring to time series characteristics initiated respective analysis from the best model (in statistical terms) that explains exchange rate volatility in order to forecast future values by keeping in mind the evidences of Brooks (1997) and Hsieh (1989) in this context. Also according to Engle (2001), Dowd (2002), Žiković (2008), Erdemlioglu, Laurent and Neely (2012) and Duffie and Pan, (1997) these models represent the best methodology in measuring exchange rate volatility or respective returns. By also giving the option of the largest loss expected calculation under a certain probability level during a given time period (depending on the exposure) for those entities that are exposed to a certain position and consequently are directly affected by exchange rate risk as confirmed from Marcucci (2005).

3. METHODOLOGY

Referring to EUR/CHF exchange rate financial time series (see Fig.4) can be evidenced its heteroskedastic distribution (see Fig.5) and consequently it technically reserves the right to be focus on the financial time series dynamic models for the estimation of EUR/CHF exchange rate volatility and further for its forecasting in short time period. Because these kind of models estimate the differential equations containing the stochastic component (which is missing due to leptokurtic functional form that the financial time series in question presents) and in this case are elaborated through gretl (1.9.8) version.

Another important element observed in the EUR/CHF exchange rate financial time series trend is the asymmetry of distribution which simultaneously confirms also the autocorrelation of respective data. Hence, by strictly referring to these characteristics, generally, two of the functional forms mostly used pertaining to the previously mentioned models are:

-autoregressive models (AR);

-moving average models (MA). And the Box-Jenkins (1970-1994) methodologies, combine these models in order to build the extended models ARMA (autoregressive moving average models).

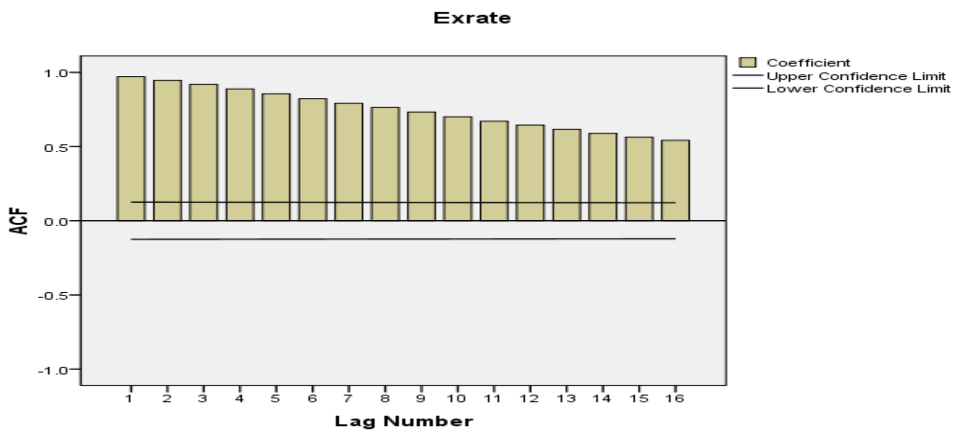

Figure 4:Lack of stochastic component in the EUR/CHF exchange rate trend during 2014

Source: Bank of Albania data, author's elaboration.

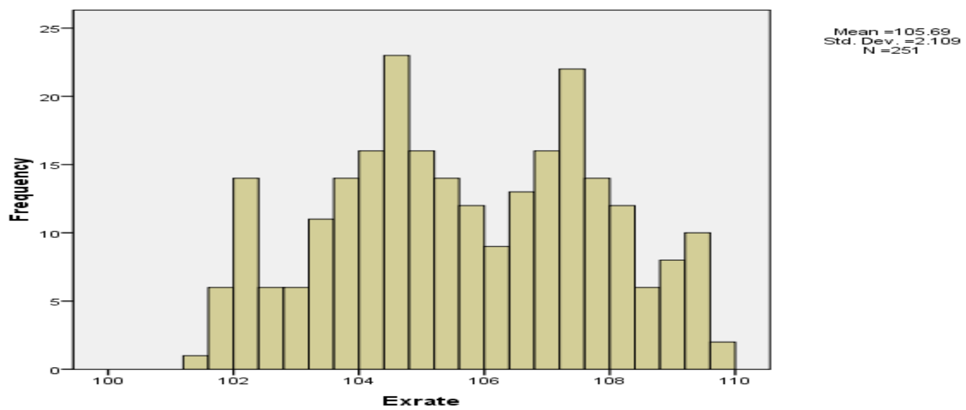

Figure 5: The EUR/CHF exchange rate frequency distribution during 2014

Source: Bank of Albania data, author's elaboration.

As they are used to describe the non-stationary of a financial time series, but in order to implement them in the time series in question, must be avoided its trend component and the last one is possible through the application of natural logarithm on EUR/CHF exchange rate financial time series first differences. The above transformation is used in order to verify the short memory of EUR/CHF exchange rate financial time series which simultaneously helps in a better understanding of respective behavior by implementing some simple financial time series models. Precisely for this purpose, is used the daily EUR/CHF financial time series for the entire year 2014.

3.1. The research hypothesis

H1-The ARMA (1;1) model can accurately estimate EUR/CHF exchange rate volatility in short term period;

H2-The ARCH (1;1) model can accurately estimate EUR/CHF exchange rate volatility in short term period;

H3-The GARCH (1;1) model can accurately estimate EUR/CHF exchange rate volatility in short term period in Albanian market.

4.1 THE ARMA MODEL

The autoregressive process (AR and MA) as can be understand for the name itself, explains the EUR/CHF exchange rate financial time series data and residuals in correspondence of its previous data through a linear autoregressive order and precisely this order determines the entire model order thus, in these cases the model data explain better than anyone else itselves. But as described in literature, must be estimated the persistence of these autocorrelations (as displayed in Fig.6) before applying it. As evidenced cat be confirmed the first order autocorrelation of EUR/CHF exchange rate data at 95% confidence level and the same situation persists to the residuals autocorrelation (refer to Fig.7&8). By this way, is deemed necessary to implement ARMA (1;1) models (refer to Table.1 data) for the forecasting of EUR/CHF exchange rate volatility even why the previous results don't confirm it. So, the **hypothesis H1 of the study is rejected**. And in order to prove the ARMA (1;1) model validity, it must be refer to respective residuals distribution and compare it within normal ones.

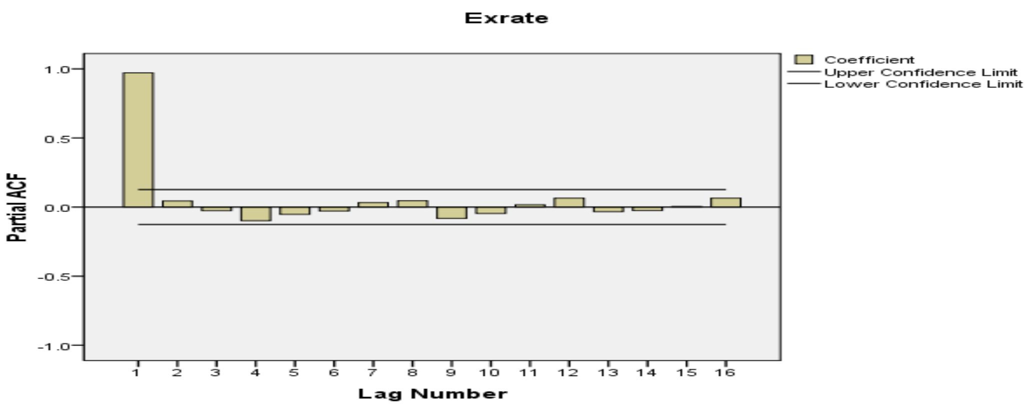

Figure 6: The EUR/CHF exchange rate data correlogram

Source: Bank of Albania data, author's elaboration.

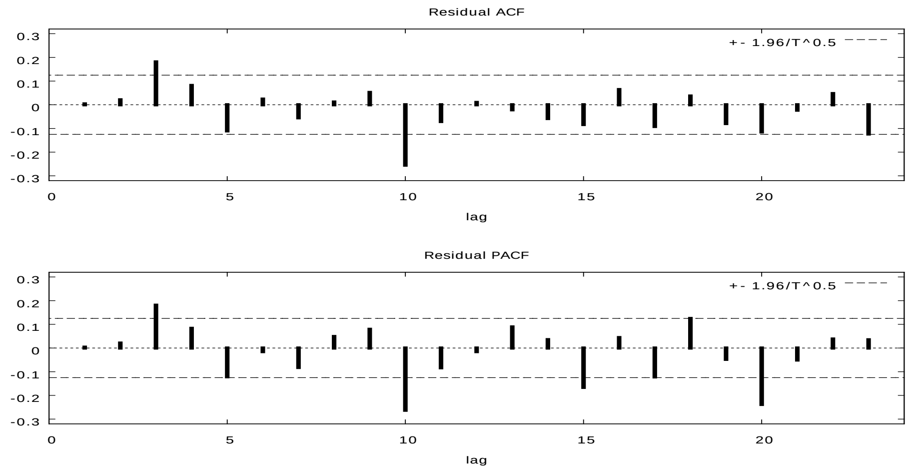

Figure 7: The ARMA (1;1) model residuals correlogram results

Source: Bank of Albania data, author's elaboration.

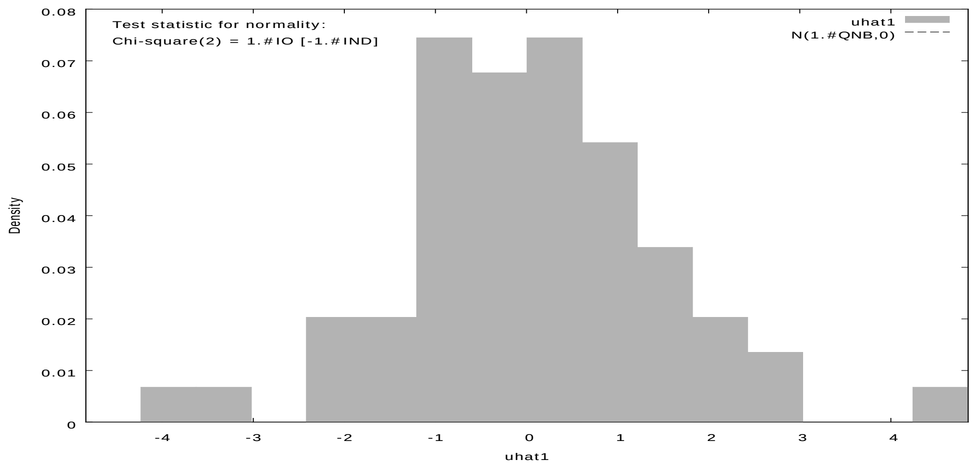

Figure 8: The ARMA (1;1) model residuals' normality test results

Source: Bank of Albania data, author's elaboration.

Table 1: ARIMA, using observations 2014/01/01-2014/12/31 (T = 251)

Estimated using Kalman filter (exact ML)
Dependent variable: EUR/CHF
Standard errors based on Hessian

	coefficient	std. error	z	p-value	
const	0.106745	0.192539	0.5544	0.5793	
phi_1	0.883882	0.0338065	26.15	1.11e-150	***
Phi_1	-0.441638	0.0599420	-7.368	1.74e-013	***
theta_1	-0.0242688	0.0706410	-0.3436	0.7312	

Mean dependent var	0.100528	S.D. dependent var	0.985289
Mean of innovations	0.000082	S.D. of innovations	0.531432
Log-likelihood	-194.6098	Akaike criterion	399.2195
Schwarz criterion	416.7462	Hannan-Quinn	406.2767

The results obtained by this way, demonstrate that the previously mentioned residuals aren't normally distributed and furthermore do not fit with the actual ones (see Fig.9). As far as can be understand, ARMA (1;1) model residuals' are significantly distributed in the extreme values. And this ascertains that other models should be explored in order to accurately estimate and forecast EUR/CHF exchange rate volatility in Albanian market.

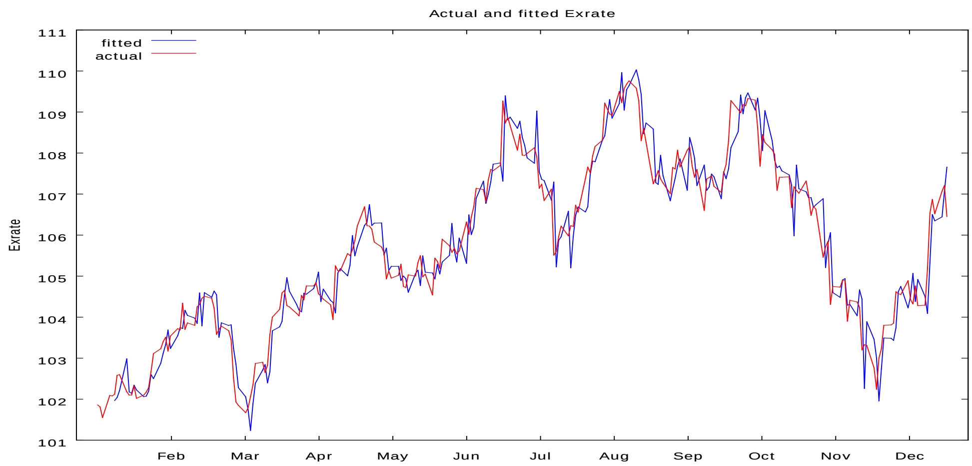

Figure 9: The ARMA (1;1) residuals' versus actual ones

Source: Bank of Albania data, author's elaboration.

4.2 THE ARCH MODEL

As previously mentioned is the phenomenon of heteroskedasticity manifested in EUR/CHF exchange rate financial time series data that negatively impacts on its behavior which is actually transformed in its primarily risk unit. In order to particularly include in the analysis this phenomenon, another model category must be explored, precisely it should be dealt with that category which is able to directly treat the heteroskedasticity of financial time series. In fact these ones have gained a special interest in the academic and applicative field. Namely, Engle (1982) paved the way to the detailed analysis that exists today over the models called ARCH (*Autoregressive Conditional Heteroskedasticity models).* Subsequently, it can be implemented ARCH (1) model by referring to H2 hypothesis of the study in order to estimate the EUR/CHF volatility in short term period (respective results are presented in Table.2). The results demonstrate that model coefficients are all statistically significant at 95% confidence level.

Table 2: ARCH, using observations 2014/01/01-2014/12/31 (T = 251)

Dependent variable: EUR/CHF
Standard errors based on Hessian

	coefficient	std. error	z	p-value	
const	105.342	0.220175	478.4	0.0000	***

alpha(0)	0.176721	0.0796777	2.218	0.0266	**
alpha(1)	0.983003	0.124065	7.923	2.31e-015	***

Mean dependent var	105.6884	S.D. dependent var	2.108586
Log-likelihood	-465.8988	Akaike criterion	939.7976
Schwarz criterion	953.8994	Hannan-Quinn	945.4725

While by referring to the specification test, the criterions of Akaike and Schwarz are significant and this leads to the understanding that ARCH (1) model can't accurately estimate EUR/CHF exchange rate volatility **by rejecting also the H2 hypothesis of the study**. Same results are obtained from residuals full and partial autocorrelation as well as from normality test (see Fig.10&11). All this from the other side reconfirms the presence of heteroskedasticity phenomenon in the financial time series in question. That's why additional dynamic financial time series models are explored in following.

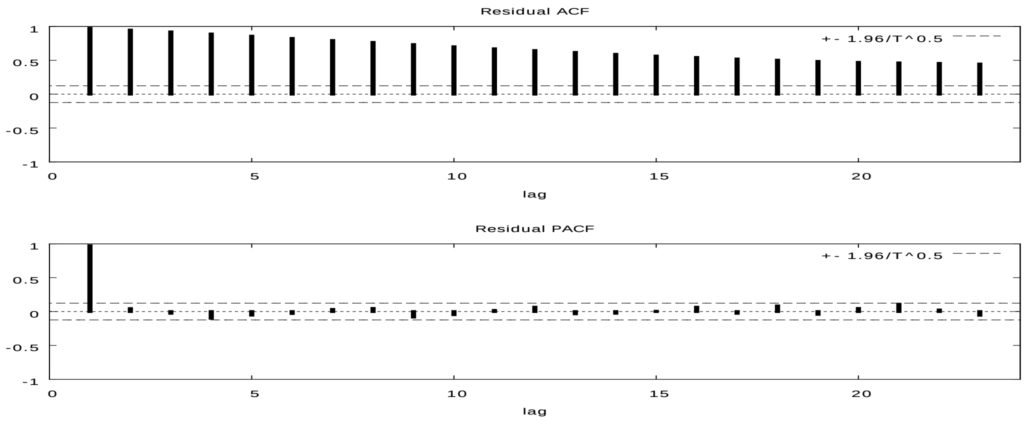

Figure 10: The ARCH(1) residuals full and partial autocorrelation data

Source: Bank of Albania data, author's elaboration.

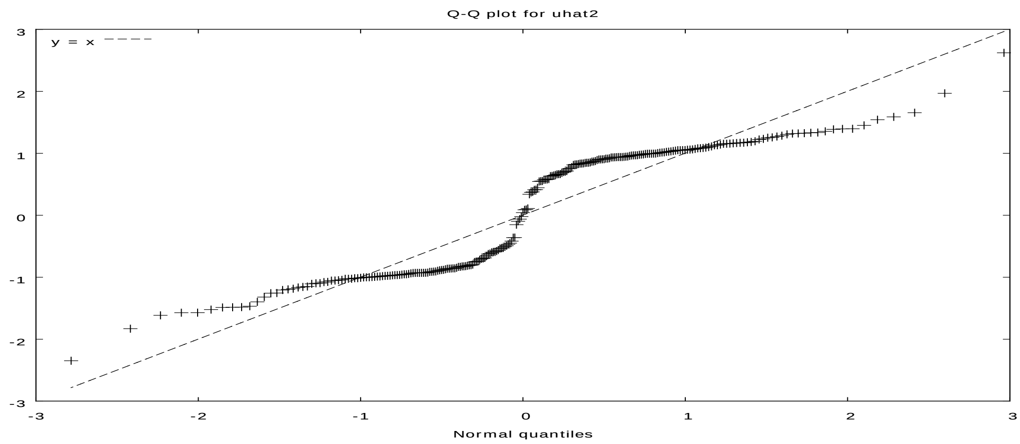

Figure 11:The ARCH(1) residuals quantiles distribution

Source: Bank of Albania data, author's elaboration.

4.3 THE GARCH MODEL

The latter empirical studies pertaining to heteroskedastic autoregressive conditional variance proposed from Bollerslev (1986), have significantly improved the ones proposed from Engle (1982). By this way, born and further developed GARCH (*Generalized Autoregressive Conditional Heteroskedasticity*) models. In this process, called GARCH of the (p; q) order the conditional variance doesn't represent only the autocorrelation function of squared EUR/CHF exchange rate financial time series variables (p-variables) but also to the respective squared residuals (q-variables).

Differently said, these kinds of models correspond to squared ARMA models. By this way, trying to estimate the validity of H3 hypothesis of the study is developed GARCH (1;1) model (see Table.3 data).

Table 3*:* GARCH, using observations 2014/01/01-2014/12/31 (T = 251)
Dependent variable: EUR/CHF
Standard errors based on Hessian

	Coefficient	*Std. Error*	*z*	*p-value*
alpha(0)	283.347	24457.1	0.0116	0.0076
alpha(1)	0.926364	9.01156	0.1028	0.04812
beta(1)	0.0483497	9.2615	0.0052	0.99583

Mean dependent var	105.6884	S.D. dependent var	2.108586
Log-likelihood	-1525.894	Akaike criterion	59.787
Schwarz criterion	73.889	Hannan-Quinn	3065.462

Two of latest coefficients are statistically significant at 95% confidence level, but the specification tests results aren't reduce in confront of ARCH (1) model. From the other side the residuals' normality distribution results conduct to an identical and consequently to a symmetrical data distribution by concluding in the H3 hypothesis acceptance.

4.3.1 The forecasting of EUR/CHF exchange rate volatility in short term period through GARCH(1;1) model

The estimations done regarding EUR/CHF exchange rate volatility through GARCH (1;1) model demonstrate that the last one can accurately do it, but in any case, beyond the statistical estimations in order to confirm the acceptance of H3 hypothesis of the study through the forecasting of financial time series in question in short term period.

More specifically, for this purpose is implemented the moving window method for the short time period forecasting of EUR/CHF exchange rate data (within a day period) for the entire year 2015 in correspondence of latest 252 exchange rate data pertaining to 2014 as presented in the Fig.12.

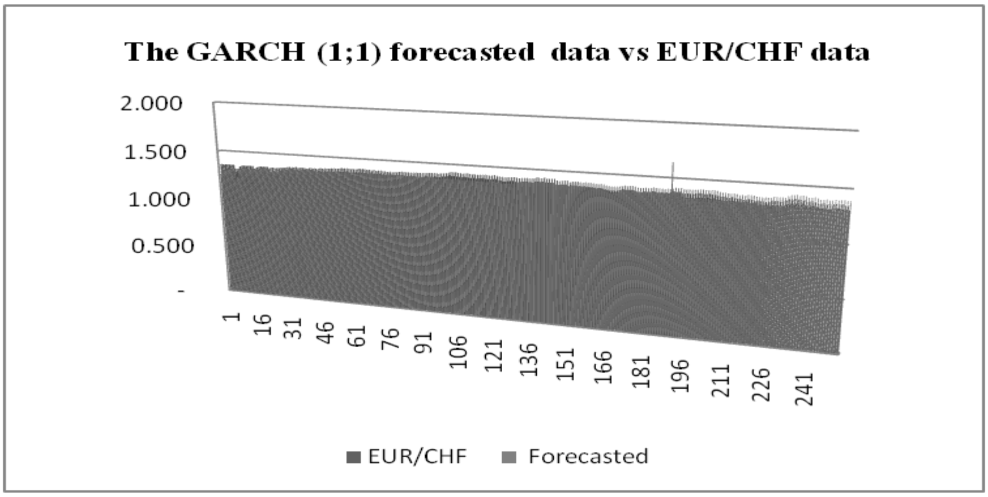

Figure 12:The USD/ALL exchange rate forecasted data through GARCH (1;1)
Source: Bank of Albania data, author’s elaboration.

5. CONCLUSIONS

The detailed analysis of EUR/CHF exchange rate volatility in Albanian market demonstrated that no one of simple models described and explored as above such as ARMA (1;1) and ARCH (1) weren’t capable to accurately estimate its volatility. Referring to statistical results the forecasted data have exceeded the minimal threshold 2 times and never the maximal one (see Fig.13). **So it can be concluded in the acceptation of H3 hypothesis of the study**.

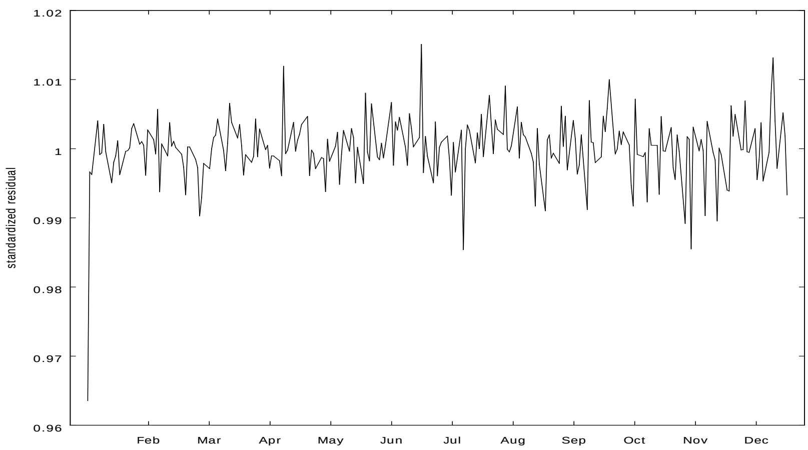

Figure 13: The distribution of USD/ALL exchange rate data without its trend component
Source: Bank of Albania data, author’s elaboration.

By this way, in order to analyze and better manage EUR/CHF exchange rate volatility the GARCH (1;1) model is used. Furthermore it can also be implemented for the EUR/CHF exchange rate returns forecasting and economic capital estimation for coverage purposes (refer to Fig.14).

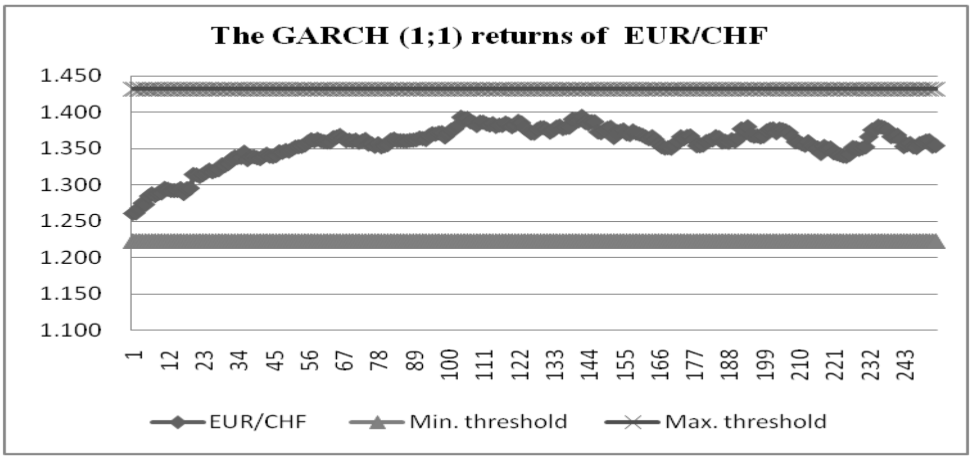

Figure 14:The EUR/CHF exchange rate return data estimated through GARCH (1;1)

Source: Bank of Albania data, author's elaboration.

Hence, depending on the circumstances the exploration of GARCH models from the rational economic agents operating in the country and exposed to the above mentioned fluctuations makes possible even respective Value at Risk calculation for a certain time period under a given confidence level what simultaneously positively contributes in the exchange risk management approach.

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