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Modeling Juri Stock Market Volatility : an Asymmetric Garch Models Approach

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ABSTRACT

The aim of this paper is to examine JURI (Japan, U.K, Romania, India) stock markets volatility using an asymmetric GARCH models approach. JURI stock markets form an apparently atypical conglomerate, but with a very high investment potential. Empirical analysis includes GARCH (1, 1), EGARCH (1, 1) and GJR GARCH models. The study provides additional empirical evidence regarding investment opportunities and risk management based on international portofolio diversification.

Keywords : volatility, asymmetric GARCH models, international portofolio diversification

INTRODUCTION

This research paper presents an alternative perspective for the purpose of financial investment in accordance with the selected country development, degree of stock market volatility, leverage effect and informational impact on stock market. Empirical analysis includes GARCH (1, 1), EGARCH (1, 1) and GJR GARCH family models. The acronym JURI includes the following stock markets : Japan, U.K, Romania, India. Beyond the original selection mode, this quartet seemingly antagonistic is based on non-random criteria. Essentially, JURI stock markets are distinguished by a geographic symmetry ie two couples Europe-Asia. Moreover, Japan and UK are both developed markets, while India and Romania are emerging markets, but in different categories, namely secondary emerging and frontier. Nevertheless, economic, historical, political, social, demographic and cultural criteria generate a strong area of investment influence. In this respect, the relations between India and Japan have traditionally been very strong, extremely long and multilateral. Moreover, India and UK relation is characterized by strong ties of quite recent history, including intensified trade and investment international linkages. The relationship between U.K and Japan has profound implications especially in recent terms of globalization, strategic partnerships and financial liberalization. On the other hand, Romania is a country of great contrasts, ie a multifaceted miniature of the other three countries, so as similarities, but especially as differences. The financial benefits provided by international portofolio diversification are very attractive in the context of JURI stock markets.

APPLIED METHODOLOGY

Empirical research provided by this article focuses on the application of GARCH class models in order to highlight the leverage effect and estimation of time series for JURI stock markets. ARCH (1, 1) model presented by Engle (1982), this is kind of first model which represents Autoregressive conditional heteroskedasticity and bases on conditional variance of error term at beginning of time represented by (t) and which is always expected to be positive always, depends on realized value of squared error terms in pervious time periods. This model can be explored as:

$$h_t = \alpha_0 + \sum_{t=1}^{q} \alpha_j u_{t-i}^2$$

The previous model is an ARCH (q) where (q) refers to order of lagged squared returns which is included in model and ARCH (1) model is as $h_t = \alpha_0 + \alpha_1 u_{t-1}^2$ here, (ht) refers to conditional variance which we have discussed above. During the formulation process, we need coefficients for positive conditional variance to form equation for GARCH (1,1) as :

$$h_t = \omega + \alpha_1 u_{t-1}^2 + \beta_1 h_{t-1}$$

GARCH (1, 1) was introduced by Engle (1982) further it is extended by Bollerslev (1986) and again by Nelson (1991). This is most popular Generalized autoregressive conditional heteroskedasticity (GARCH) model, and calculates weighted average of constant (ω), yesterday's forecast of closing indices (α_{1ut-1}^2) and represents ARCH term, and yesterday's squared error (β_1 h_{t-1}) and this represents GARCH term. Despite the fact is most popular model GARCH (1, 1) has also limited by finding out leverage effect which is also called asymmetric effect in time series of JURI stock markets. Nelson (1991) has provides Exponential GARCH or EGARCH model which assures confidence for positivity of conditional variance. It covers the asymmetric impact. The specimen of EGARCH model can be explored as;

$$\text{Log } h_t = \omega + \beta_1 \log h_{t-1} + \alpha_1[\theta V_{t-1} + \gamma\{|V_{t-1}| - E|V_{t-1}|\}]$$

This model guarantees positive variance because of h_t= exp (R.H.S.) > 0 always and θV_{t-1} covers asymmetric effect. Nevertheless this model is also limited to tell about effects of good news and bad news. Glosten, Jagannathan and Renkle (1993) have developed GJR-GARCH model which estimates effects of good news and bad news from JURI markets stock indices. This model also covers asymmetric or leverage effect confidently. GJR-GARCH can be express as :

$$h_t = \omega + \alpha_1 u_{t-1}^2 + \beta_1 h_{t-1} + \theta I_{t-1} u_{t-1}^2$$

Here I_{t-1} = 1 if u_{t-1} < 0 and I_{t-1} = 0 or otherwise and if θ > 0, we say that there is a leverage effect. This model also represents effect of good news or bad news on volatility. If (u_{t-1} > 0), that has an effect of α_1 u_{t-1}^2 on the variance and represents effect of good news on volatility, while bad news effects (u_{t-1} < 0) has an effect of (α_1+θ) u_{t-1}^2 on the variance. Table-1 represents descriptive statistics for JURI stock markets.

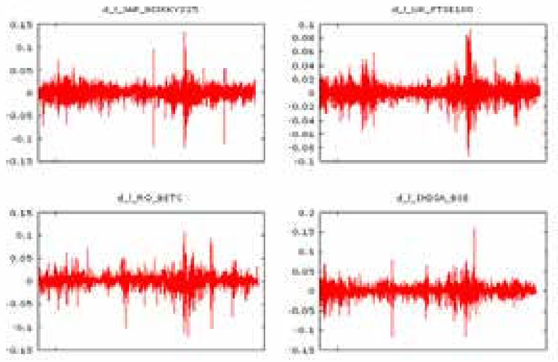
TABLE – 1 DESCRIPTIVE STATISTICS

Variance	JAPAN-NIKKEI225	UK-FTSE100	ROMANIA-BET C	INDIA BSE SENSEX
Mean	-0.000163905	-1.81006e-005	0.000553437	0.00040404I
Median	0.000000	0.000243769	0.000689376	0.000689376
Min	-0.121110	-0.0926557	-0.121184	-0.121184
Max	0.132346	0.0938434	0.108906	0.108906
Std.Dev	0.0159058	0.0129011	0.0155045	0.0165159
Skewness	-0.392697	-0.122574	0.613461	-0.183377
Kurtosis	7.39581	5.77388	7.76780	6.33765
Unit Root – ADF Test statistics: 10% (0.119), 5% (0.148), 1% (0.218)				
Test statistics	0.102916	0.0511196	0.16078	0.149939

Source: Author's computation using stock indices

Focused observation of table-1 identifies that mean for developed markets (Japan and UK) represents negative value. It suggests that central tendency of returns is either underperforming or represents loss on past investment. Table 1 also included results obtained from Augmented Dickey Fuller test (ADF) which test for unit root in series and preventing ARCH presence. Test statistics provides stationary of data and proves no unit root problems, which allows ARCH effect to the JURI market indices at level of 0.01 now, it allows processing GARCH modeling for all sample markets. A detailed result of ADF test is graphically presented in Fig 1. represents log-return series which has no unit root problems and allows ARCH effect.

Figure 1 Log returns series of JURI indices



Source: Author's computation using stock indices

Above figure represents large series of stock indices data from JURI stock markets. Secondly, we failed to notify years and this makes difficult to read above figures. All sketches which diverted to upside in graph that suggests positive volatility and otherwise. Most interesting part of this paper, it includes three basic kinds of types of markets out of four. The series return covers comparatively developed market (Japan, UK), secondary emerging market (India), and frontier emerging market (Romania). It suggests the degree of volatility at different kind of markets for the same period of time. We noticed that secondary emerging market and emerging markets reacts more to reflect non-conditional volatility compared to developed markets. All time series of JURI markets verified significant at level of 1% in Augmented Dickey Fuller test (ADF) and it includes no unit root problems, which allows implement GARCH modeling to estimate JURI markets. All models follow Generalized Error Distribution (GED) error instead of normal distribution.

The outcomes of GARCH (1, 1), Exponential GARCH and GJR-GARCH are specified in table 2. With exception of GJR-GARCH model in the case of Romania-BET-C, all models fitted in rest sample countries. We start to understand results starting with GARCH (1, 1). It involves ARCH term and GARCH term and thus, we can formulate ($\alpha_1 + \beta_1$) for JURI markets.

GARCH (1, 1) model;

Japan (NIKKEI225) = (α_1) +(β_1) = 0.0959045 + 0.87700 = 0.9729045

UK (FTSE100) = (α_1) +(β_1) = 0.101592 + 0.8913 60 = 0.992952

Romania (BET-C) = (α_1) +(β_1) = 0.222399+ 0.761619 = 0.984018

India (BSE-SENSEX) = (α_1) +(β_1) = 0.121162 + 0.862926 = 0.984088

Mean and Variance of GARCH (1, 1) model for NIKKEY225 from Jan 00' to Jan 13'

It is apparent that GARCH (1, 1) outcomes (α_1) +(β_1) is less that (1) that suggests that all models perfectly fitted in model. What all we learn here is outcomes of (α_1) + (β_1) which near to (1) is secures first preference for investment, hence, UK (FTSE100) (0.992952) is priories compare to Japan (NIKKEI225) (0.9729045) in case of developed countries. There is very less difference in outcomes of secondary emerging market India (BSE) (0.984088) and frontier emerging market (Romania) (BET-C) (0.984018). Nevertheless we can see impact of global financial crisis on all kinds of markets. Investors can priories market either according to criteria for security and volatility with considering overall outcomes of descriptive statistics. To estimate leverage effect it was employed Exponential GARCH or EGARCH as the following model formulation for Japan (NIKKEI225) markets. The model is formulated with specimen formula which is prescribed in methodology.

Exponential GARCH model (GED distribution)

Japan (NIKKEI225)= Log h_t = 0.000137937 (ω) + 0.959787(β_1) log h_{t-1} + 0.205054 (α_1) [θV_{t-1} + 0.324972 (γ){$|V_{t-1}|$ - E$|V_{t-1}|$}]

Mean and Variance of EGARCH model for NIKKEI225 from Jan 00' to Jan 13'

The above equation represents outcomes of four parameters, namely, ω,β, α and γ. Here we can see that 0.205054 (α) parameter represents a magnitude effect or the symmetric effect of the model, this is also called GARCH effect. Further, 0.324972 (γ) parameter measures asymmetry or the leverage effect, and the most important parameter of the model which makes EGARCH model allowed for testing asymmetries. A focused observation of above execution gives idea that (γ) represents positive value (non-zero), it suggests that Japan market has asymmetric effect or leverage effect. Nevertheless other sample markets have also non-zero value for (γ) which confirms existence of leverage effect in all sample markets. However, we have not made partition in series. An asymmetric series suggests that bad news has more effect on volatility (negative news) compared to good news (positive news). Therefore the results of diagnostics tests proved that all sample JURI series models are correctly specified (see table 2).

GJR-GARCH model (GED distribution)

Japan (NIKKEI225) h_t = 0.000120387 (mean)(ω) +0.00000776536 (ω)+ 0.0875539 (α_1)u_{t-1}^2 + 0.324972 (γ) + 0.868170 (β_1) h_{t-1}

Mean and Variance of GJR-GARCH model for NIKKEI225 from Jan 00' to Jan 13'

Previous model suggests that for Japanese stock market the impact of good news has a magnitude of 0.0875539, while the impact of bad news has a magnitude of 0.0875539-0.324972 = -237418.

TABLE - 2 GARCH CLASS MODEL ESTIMATIONS

Indices	Variable	GARCH (1, 1)	EGARCH	GJR-GARCH
Japan-NIKKEI225	Mean Equ.	0.000350832 (0.0107)	0.000137937 (0.0195)	0.000120387 (0.0079)
	Omega	6.56394e-06 (1.59e-05)	0.500617 (4.27e-011)	7.76536e-06 (6.11e-07)
	Alpha	0.0959045 (5.81e-015)	0.205054 (2.27e-020)	0.0873539 (6.51e-014)
	Gamma	-	0.0778621 (2.51e-08)	0.324972 (3.25e-08)
	Beta	0.877800 (0.0000)	0.959787 (0.0000)	0.868178 (0.0000)
UK-FTSE100	Mean Equ.	0.000467623 (0.0015)	7.87262e-05 (0.0608)	0.000103348 (0.0494)
	Omega	1.33583e-06 (0.0004)	0.225802 (1.19e-015)	1.60442e-06 (4.70e-07)
	Alpha	0.101592 (1.57e-017)	0.105123 (1.14e-013)	0.0391691 (0.0002)
	Gamma	-	0.131482 (4.95e-036)	0.998029 (5.63e-05)
	Beta	0.891360 (0.0000)	0.984672 (0.0000)	0.900674 (0.0000)
Romana-BETC	Mean Equ.	0.000735443 (9.09e-06)	0.000740275 (4.87e-06)	0.000749987 (3.15e-05)
	Omega	7.78651e-06 (0.0001)	0.758003 (3.55e-010)	8.21911e-06 (9.36e-05)
	Alpha	0.222399 (5.49e-013)	0.383392 (3.42e-023)	0.224572 (6.83e-013)
	Gamma	-	0.0264265 (0.0461)	0.0422302 (0.2112)*
	Beta	0.761619 (7.12e-128)	0.945975 (0.0000)	0.756023 (3.90e-121)
India BSE	Mean Equ.	0.00118407 (7.36e-09)	0.000867982 (4.78e-05)	0.000934390 (6.56e-06)
	Omega	4.78690e-06 (3.58e-05)	0.486168 (5.20e-013)	6.70300e-06 (6.56e-07)
	Alpha	0.121162 (5.54e-17)	0.235628 (5.37e-025)	0.105237 (5.13e-014)
	Gamma	-	0.0922831 (3.09e-011)	0.334732 (5.60e-08)
	Beta	0.862926 (0.0000)	0.964479 (0.0000)	0.854379 (0.0000)

Source: Author's computation using stock indices

CONCLUSIONS

The volatility of JURI stock markets have been investigated and modeled using symmetric model GARCH (1, 1) and two nonlinear asymmetric models, Exponential GARCH (1,1) and GJR-GARCH (1,1). Skewness also measures degree and direction of asymmetry effect or called abnormal distribution which has left long tail or negative skewness. It also reflected by kurtosis which measures clustering distribution of stock market indices. Empirical analysis suggested the existence of asymmetric effect on all JURI markets and news impact curve by GJR-GARCH model. Descriptive statistics shows that all markets has negative skewness or leptokurtosis effects with left tail and high kurtosis (7.76) BET-C than normal level of (3). GARCH (1, 1) modeled well for JURI stock markets and it ranks UK from developed markets compared to Japan market and India and Romania stand alone for secondary emerging market and frontier market. We failed to employ GJR-GARCH model on BET-C thus, we do not have news impact formulation for Romania stock market as an exceptional case, while GJR modeled well for rest sample markets. Results suggest that JURI markets have higher impact of bad news with higher magnitude than good news. In addition, EGARCH model clearly revealed the estimation of leverage effects which was significant for all sample markets. The results of all GARCH

REFERENCES

[1] Bollerslev, T., (1986), "Generalized autoregressive conditional heteroskedasticity", Journal Economic., 31: pp. 307-327. | [2] Dickey, D.A., W.A. Fuller, (1979), "Distribution of the estimators for autoregressive time series with a unit root", J. Am. Stat. Assoc., 74: 427-431 | [3] Elsheikh M.A., S. Zakaria., (2011) "Modeling stock market volatility using GARCH models evidence from Sudan", International journal of business and social science, vol.2 no.23. | [4] Engle, R. (1982), "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of UK Inflation", Econometrica, Vol. 50, 987-1008. |