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SOURCES OF VOLATILITY IN STOCK AND CURRENCY MARKETS: A Panel Data Analysis of European Countries

Muhammad JAMIL*

Abstract

Volatility in financial markets is a highly explored area of research for the last few decades. Possible reasons for high concentration on the markets are its unexplained and unexplored sources. The present study aims to check certain macroeconomic variables as determinants of financial markets (stock market and exchange rate) volatility. It also aims to analyse the contribution of the volatility of one financial market to the volatility of another financial market before and after the financial crises. The analysis is conducted using two types of data sets from 27 European countries. The study employed A.R. (k)-EGARCH (p, q) models to measure financial markets volatility. The study finds no significant interlink effects among volatilities of stock market returns and volatility of exchange rate returns after the financial crises. However, the increase in volatility in one market caused an increase in the other market's volatility before the financial crises. Further, results also revealed that macroeconomic variables affect volatilities in these markets differently before and after the financial crises. The study recommends that the macroeconomic policies for stability in these markets cannot coincide as they differ in their impacts in different markets.

Keywords: Stock Market, Forex Market, Governance, Volatility Spillover, AR (k)-EGARCH (p, q).
JEL Classification: C58, G32, G41.

I. Introduction

One of the central unsolved problems in research on financial markets remains the disagreements regarding the financial markets' sources of volatility. Because volatility in the exchange rate and stock market returns has larger implications for the monetary and fiscal policies, a large number of studies have paid special attention to investigate the sources of fluctuations in these markets. After the introduction of the Euro, European economies are characterised by the changing and creating of institutions and fundamental changes in the role of the state. Hence, their macroeco-

* Professor, Ghulam Ishaq Khan Memorial Chair, Kashmir Institute of Economics, The University of Azad Jammu and Kashmir, Muzaffarabad, Pakistan.

nomic sources of volatility may differ from that of other regions. Along with this, volatility behaviour may vary in these countries before and after the financial crises. The present study aims to bridge these research gaps.

Overall, fluctuations in one market are related to the fluctuations in another market. Mishra, et al. (2010) indicated that volatility in one market leads to instability in the other related markets due to financial liberalisation and globalisation of the world markets. Understanding these volatility spillovers among financial markets helps economic and financial decision-makers. In a perfectly inter-dependent and integrated financial market, explicit linkages always exist in the volatility. Due to these explicit inter-market linkages, the exchange rate has become more responsive to innovations in the stock market and uncertainty in the commodity market [Yang and Doong (2004)].

This paper provides an empirical investigation of the links between stock market volatility and exchange rate volatility. The paper also tries to highlight and evaluate various economic variables as contributors to the volatility in these markets. Our exploration is motivated by the existence of differences in empirical studies regarding the sources of financial markets volatility. Moreover, the study aims to provide a strong literature background along with empirical findings concerning these issues. In addition, and crucially, our empirical approach exploits the group differences and cross-country variations to uncover links that would otherwise be lost in simple time series analysis. Hypothetically, the main questions that this study aims at answering include:

- Does volatility in one type of the financial market returns (stock market/exchange rate market) cause changes in the volatility of another type of financial market returns (exchange rate market/stock market)?
- Which macroeconomic variables contribute to the volatility of financial market returns (stock market returns/exchange rate market returns)?
- Are the effects of macroeconomic and financial variables on volatilities in these markets differ pre- and post-financial crises?

The information set available through this study can be of great importance for market players, managers and policymakers, investors. The policymakers can benefit from the results of this study by understanding the behavior of the two markets to efficiently formulate and implement effective policies for financial and economic stability. Moreover, investors and other market players can utilise the information set to manage their international and local portfolio risk policies. Additionally, the study results can help managers stabilise earnings through their exposure to exchange rate risk. Overall, the intended study is a unique work in the volatility spillover context that jointly analyses the mechanism of volatility transmission between two major financial markets. In this aspect, the present study contributes to the literature generally with reference to volatility spillover, specifically in the context of shocks to either market that may be transmitted quickly to one another or the domestic economy through various contagious channels. Also, the empirical evidence of the strong relationship between the two markets is instructive for portfolio reallocation and domestic policymaking [Sensoy and Sobaci (2014) and Leung, et al. (2017)].

The paper's remainder is organised as follows: A detailed review of literature concerning the link between the financial markets volatility and the economic variables is presented in Section II. The methodological issues are presented in Section III, construction of the necessary variables is described in the Section IV. The results are presented in Section V whereas the last Section VI concludes the study with a summary and considerable remarks.

II. Literature Review

A number of factors contribute to the fluctuations of the exchange rate returns and the stock market returns. In one way or another, some past studies have attempted to evaluate the research questions highlighted in the previous section. In a Conference organised by Bank for International Settlements in 1996, 21 papers and presentations explored the issues related to measurement and financial market volatility [BIS (1996)]. Conference covers all the aspects, for example, volatility in the stock market, volatility in the exchange rate and their linkage with the inflation and monetary policy. However, a comprehensive theoretical consensus on the interaction and sources of stock market returns volatility and exchange rate returns volatility still lacks. This section will first present theoretical and empirical links between the volatility of exchange rate returns and stock market volatility. Then the sources of the stock market volatility and exchange rate volatility will be presented in detail.

1. Spillover Effects of Financial Markets

In past literature, the researchers examined the issue of volatility transmission from various perspectives. However, irrespective of the existence of huge literature on the linkages and interactions between the exchange rates and stock prices, only a limited body of research has attempted to analyse the possible linkage and interaction between volatility in exchange rate return and volatility in stock market return. Much of the available empirical evidence on stock markets' linkages and exchange rates is concentrated on the first moments. Kanas (2000) is one of the first studies, who have analysed volatility spillovers from stock market returns to exchange rate change in the USA, U.K., Japan, Germany, France, and Canada. Through the analysis based on Exponential Generalised Autoregressive Conditional Heteroscedasticity (EGARCH), the author finds that volatility spillovers from the stock market return to exchange rate changes for all countries except for Germany whereas the volatility spillovers from exchange rate changes to stock returns were found to be insignificant for all countries.

Later, Kanas (2002) also finds evidence that stock market volatility is a significant determinant of the exchange rate volatility for the United States, United Kingdom, and Japan. Using multivariate EGARCH model for the G-7 countries, Yang and Doong (2004) find that information flows between the two markets. They also find that the two markets are integrated and that the movement of stock prices will affect future exchange rate movements whereas the changes in exchange rates do not cause a significant direct impact on the future changes in the stock prices. The study concludes that stock markets play a relatively more important role in comparison to the foreign exchange markets in the first and second-moment interactions and spillovers. It is similar to Kim's (2003) findings and Sichoongwe (2016), which report a significant and negative relationship between these two variables.

In a similar vein, the flow and stock-oriented types of models, in the past literature, are proposed to explain the interaction between stock market volatility and exchange rate volatility. According to Choi, et al. (2008), flow models explain the effects of exchange rate movements on the international competitiveness of the firms and the balance of the trade position. Similarly, changes in the stock market share prices affect aggregate demand through wealth and liquidity effects. A reduction in stock prices decreases the wealth of local investors and further decreases liquidity in the economy. The interest rate decreases due to a reduction in the liquidity, which in turn induces capital outflows and in turn, cause currency depreciation. Choi et al. (2008) using EGARCH model on daily data from January 1990 to December 2004, report unidirectional volatility spillover from New Zealand stock market returns to the exchange rate changes. Caporale, et al. (2014) examine the linkages between stock market prices and exchange rates in six advanced economies, finding evidence of unidirectional Granger causality from stock returns to exchange rate changes in the U.S. and U.K., from exchange rate changes to stock returns in Canada, and bi-directional causality in the Euro area and Switzerland.

Another type of model is the stock-oriented model in which the relationship between the stock market and the exchange rate is explained through a country's capital accounts. Adjasi, et al. (2008) report a negative relationship between the exchange rate volatility and the stock market returns. They also find a positive relationship between inflation and stock market returns, i.e. an increase in consumer prices will lead to a rise in stock market volatility. Adjasi and Biekpe (2005) checked the relationship between stock market returns and exchange rate movements for seven African countries. The cointegration tests used in the study show a decrease in the stock market return due to an increase in the exchange rate depreciation in the long-run for some of the countries. While an increase in the stock market return in the short-run is due to an increase in exchange rate depreciation has been observed.

On the other hand, since both stock prices and exchange rates may be inclined by a number of common factors, these 'stock-oriented' exchange rate models suggest that there is no linkage between exchange rates and stock prices [Gavin (1989)]. Likewise, Mishra (2004) reports that no Granger causality exists between the exchange rate and the stock market returns. Pan, et al. (2007) using data for Malaysia find no cointegration between the exchange rate and the Malaysian stock market returns in the long-run. However, their pair wise causality tests indicate an unconditional causality from the stock market's exchange rate in the short-run.

Wu (2005) examines volatility spillovers between stock prices and exchange rates for Indonesia, Japan, Philippines, Singapore, South Korea, Taiwan, and Thailand for 1997-2000. The author divides the sample into two periods, i.e., crises and recovery. A bi-directional relationship between the volatility of stock returns and exchange rate changes is reported during the recovery period for all the countries except for South Korea. The author also finds that volatility spillovers increase in the recovery period. Qayyum and Kemal (2006), using a bivariate EGARCH model, show a strong relationship between the volatility of the foreign exchange market and stock market returns volatility. They find that the returns of the stock market are sensitive to the returns of the exchange rate as well as the volatility of exchange market whereas the returns in the foreign exchange market are mean reverting, i.e., they are affected by the volatility of stock market returns.

Morales (2008a) investigates the nature of volatility spillovers between stock returns and a number of exchange rates in six Latin American countries and one European economy using data from 1998 to 2006. The results show that stock returns' volatility affects the volatility of exchange rates but find no evidence of volatility transmission in the opposite direction. In the same lane, Morales (2008b) analyses the issue for three different regions of Europe, and reports no evidence of co-movement between these two variables in long- or short-run.

Kalu (2014) also reports the existence of the bi-directional volatility spillover among stock and currency markets of selected Asian countries using the multivariate GARCH model. Similar results are postulated by Jebran and Iqbal (2016) for selected Asian countries using the EGARCH model. Andrikopoulos, et al. (2014) explore the structure of the volatility transmission mechanism between stock and currency markets for the euro area economies with systemic fiscal problems, presenting evidence for the existence of bi-directional, asymmetric volatility spillovers between currency and stock markets. Moving further, Tian and Hamori (2016) report that the dynamics of volatility spillovers between financial markets vary tremendously over time. Finally, Morales-Zumaquero and Sosvilla-Rivero (2018) analyse the intra- and inter-spillovers between foreign exchange and stock markets for the seven economies (Australia, Canada, Japan Switzerland, U.K, USA, and the Euro area). The study employs data from January 1, 1990 to December 31, 2015. According to the study's findings, the stock markets play a dominant role in the transmission of the long- and short-run volatility in all samples except for the period after the global financial crisis, where the foreign exchange markets remain the main long-run volatility triggers.

Despite all these studies trying to put clear evidence on interlinks between stock market volatility and volatility in exchange rates, the relationship are not clear. Other than this, none of the study tries to explore the linkage for European countries to the best of my knowledge. Hence, the present study tries to provide empirical evidence on the linkage between stock market volatility and exchange rate volatility using European countries' data. The study also explores the link between volatility in these markets before and after the financial crisis.

2. Macroeconomic Sources of Volatility in Stock Market Returns

The theoretical models indicate that stock returns' volatility depends not only on the asset-specific fundamentals but also on non-diversifiable risk factors driven by macroeconomic aggregates. There are number of macroeconomic variables that can affect stock market volatility. Overall, the general failure to link real macroeconomic variables to financial markets volatility holds for stock returns. A number of the studies describe the relationship between stock market returns and macroeconomic variables but only a handful of them have tried to link real economic variables as main contributors to stock market volatility in the late 1990s.

The empirical evidence of the information in macroeconomic variables to predict the stock market volatility has been growing. Officer (1973) shows that volatility of money, aggregate stock volatility, and industrial production increased during the period of depression. The study also finds that stock volatility was at similar levels before and after the depression. Schwert (1989), in a classic paper under the title 'why does stock market volatility change over time' based on monthly data from 1857-1987, tries to link macroeconomic volatility with stock market volatility. However, the study does not find much evidence in the analysis and concludes that stock market volatility does not closely relate to other economic variables' volatility. Davis and Kutan (2003) also reports that the variability of inflation and output growth rate has weak predictive power for conditional stock market volatility. Similarly, Calvet, et al. (2006) approves the hypothesis that the volatility in macroeconomic variables does not explain little about the volatility of stock market returns.

On the contrary, several studies report various macroeconomic variables as the primary contributors to the stock market volatility. Liljeblom and Stenius (1997) using Finnish data finds that the conditional stock market volatility changes between one-sixth and more than two-thirds because of the conditional macroeconomic volatility, i.e., inflation, industrial production, and money supply. Similarly, Errunza and Hogan (1998) find a significant influence of monetary and real macroeconomic volatility on stock market volatility for the seven largest European countries.

In a similar fashion, Beltratti and Morana (2006) find causality in both directions, although the direction of causality remains stronger from macroeconomic to stock market volatility. Engle and Rangel (2008) use Spline-GARCH model for equity markets of 50 countries for up to 50 years of daily data to determine the macroeconomic determinants of volatility. The researchers successfully find that the volatility in macroeconomic factors such as GDP growth, inflation, and short term interest rate are important explanatory variables to increase volatility. They also find consistent evidence that the growth rate of output and high inflation are positive determinants of financial markets volatility.

Furthermore, Engle, et al. (2013) use versatile class of component volatility models combining the insights of spline-GARCH and MIDAS filters to analyse the impacts of inflation and growth rate of industrial production on stock market volatility. They find a significant impact of these variables on volatility in short as well as long-run. They also find for the full sample that the long-run components typically account for roughly half of the predicted volatility. They further find that, at a daily level, inflation and industrial production growth account for between 10 per cent and 35 per cent of one day ahead volatility prediction.

In the same vein, Saryal (2007) using GARCH models on Turkey and Canada's monthly data checks the contribution of inflation to stock market volatility. The author finds that inflation has high predictive power for stock market volatility in Turkey, whereas it remains weaker though significant in Canada's case. Among the recent papers, Diebold and Yilmaz (2012), using data for forty countries with 20 years and seventy countries with 10 years find a clear link between macroeconomic fundamentals and stock market volatility. Rahman, et al. (2009) analyse macroeconomic determinants of the Malaysian stock market, indicating that the Malaysian stock market is sensitive to macroeconomic variables. The authors claim that the stock market has stronger dynamic interaction with reserves and industrial production index based on the variance decomposition analysis.

One of the main findings of the past literature is that the business cycle stage affects the stock market volatility. Going more into the detail, stock market volatility is higher in recessions. This hypothesis is supported by Hamilton and Lin (1996); later, Gerlach, et al. (2006) using long data series investigate the behaviour of the volatility of returns in the bond and stock markets for a sample of eight countries. They show that the volatility is high in periods of economic and political turbulence. Moving further, Valentina, et al. (2013) presents a model that tries to link volatility in stock market returns with business cycles. The authors report that business cycle factor is needed to explain the fluctuations of volatility in stock market returns along with unobserved factors. The study also reports industrial production growth as the major cause of fluctuations in stock market returns.

Moreover, Nikmanesh and Noor (2016) study the relationship between the stock market volatility and the volatility of macroeconomic variables in Indonesia and Malaysia. The study uses data of the stock market and macroeconomic variables from 1998 till 2013. The results indicate that trade openness and macroeconomic volatility explain 75 per cent of Indonesia's stock market volatility and 81 per cent of Malaysia's stock market volatility.

In the past, the researchers have sought to analyse the relative importance of economy-wide factors, industry-specific factors, and firm-specific factors on a stock return's volatility. A number of studies have tried to provide sources (inflation, GDP, industrial production, interest rate, political instability, interwar periods, regulations of stock markets, and liberalisation) of the stock market's volatility based on various indicators. In the European region, researchers have tried to explore the link for individual countries, but none of the studies has tried to explore the contributions of macroeconomic fundamentals to the volatility of stock market returns for the panel of the European countries. The present study identifying macroeconomic variables that contribute significantly to variations in the stock market returns of 27 European countries.

3. Macroeconomic Sources of Volatility in Exchange Rate's Returns

Linking variations of the exchange rate to real macroeconomic variables is not a new idea. The literature on the determinants of volatility in exchange rate return identifies a number of variables as prime contributors to exchange rate volatility. According to Edwards and Savastano (1999), the real equilibrium exchange rate, in the long-run, is determined by a set of foreign and domestic real variables called fundamentals. The list includes government spending, terms of trade, a country's openness to international trade, foreign capital inflows, net foreign assets, and sectorial productivity differentials (the Balassa-Samuelson effect).[1]

Interestingly, empirical literature provides evidence in both directions. Flood and Rose (1999) show no macro-fundamentals that can explain the dramatic volatility of the exchange rate. On the other hand, Devereux and Lane (2003) identify such variables including bilateral trade as a share of GDP, the standard deviation of the bilateral growth rate differentials, log of the products of two countries GDP, size of the domestic financial sector, and bilateral external debt play a significant role in determining the bilateral volatility of the exchange rate. Canales-Kriljenko and Habermeier (1999) using data of 85 developing and transition economies find inflation, real GDP growth, trade openness, and fiscal deficit in the percentage of GDP as the most important macroeconomic determinants of nominal exchange rate volatility.

In the European region, Stancik (2007) analyse the key factors contributing to the volatility of exchange rate using daily data from January 1, 1999 to December 31, 2004 for the countries of Czech Republic, Hungary, Latvia, Poland, Slovakia, and Slovenia. The study concludes that openness has a negative effect on exchange rate volatility, and the extent of this effect varies substantially across countries. Hau (2000 or 2002) and Obstfeld and Rogoff (2000) also successfully link exchange rate volatility with trade openness negatively indicating that more-open economies exhibit less volatile real exchange rates.

[1] A differential in productivity growth between the countries leads to differentials in inflation rates is called Balassa-Samuelson effect after Balassa (1964).

Mpofu (2016) use the model developed by Obstfeld and Rogoff (2000) and Hau (2002) to explore the determinants of exchange rate volatility for South Africa. The study employs the monthly data for 1986-2013. The study finds that commodity prices, the volatility of output, foreign reserves and money supply significantly affect the exchange rate volatility. Kilicarslan (2018) by using the data for Turkey from 1974 to 2016 identifies that an increase in the domestic investment, money supply and trade openness increases the exchange rate volatility whereas an increase in the foreign direct investment, GDP and government expenditures reduces the volatility.

Due to existing gap and controversies in the past literature about the contributions of fundamental macroeconomic variables, the study highlight some of the prime contributors to exchange rate volatility.

4. Financial Crisis and Sources of Financial Market's Volatility

The researchers and practitioners' focus on inter-linkages between the financial markets increased after the financial crises of 2008. The studies mainly investigated the spillover effects between the stock markets across the countries. Most of the studies considered the U.S. stock market as the benchmark for other domestic stock markets. Volatility spillovers across markets is analysed by an extensive body of past literature as well [Diebold and Yilmaz (2009), Diebold and Yilmaz (2014), Antonakakis and Badinger (2016)]. Although these studies analyse the volatility spillovers across countries, they do not compare the interdependence of financial markets volatilities before and after the financial crises. The present study also estimates these inter-linkages and estimates the sources of stock market volatility and volatility in exchange rate returns.

Hence, compared to the previous studies based on the determinants of financial markets volatility, the approach of the study has the following advantages: (1) the study analyses the determinants of stock market volatility as well as exchange rate volatility in the European countries; (2) rather than using simple standard deviation as the measure of volatility, the study uses extensive A.R. (k)-EGARCH (p,q) model to capture the volatility of stock market returns and the volatility of exchange rates returns; (3) the study try to determine economic sources of stock market volatility and exchange rate volatility in the European countries using the techniques of panel data; (4) the study focus on the three economic variables (i) inflation, (ii) industrial production growth, and (iii) growth rate of trade in this regard; and (5) the study investigate and compare the sources of financial markets volatility before and after the financial crises.

III. Methodology

To calculate volatility, following the methodology of Kanas (2000), for stock market returns and exchange rate returns calculated at the first differences of the natural logarithms, i.e.,

$$SMR_{it} = log\ (SMI_{it}) - log\ (SMI_{it-1}) \tag{1}$$

$$ERR_{it} = log\ (ER_{it}) - log\ (ER_{it-1}) \tag{2}$$

where SMR_{it} and ERR_{it} are the stock market return and the exchange rate return of country 'i' in period 't' respectively whereas SMI and ER represent the stock market index and the exchange rates.

Many extensions to the model have been introduced since the introduction of ARCH-GARCH models by Engle (1982) and Bollerslev (1986) for the measurement of volatility. The study employ AR (k)-EGARCH(p,q) for the measurement of volatility in stock market returns and exchange rate returns for each of the European country in the analysis. The significant evidence as provided by various researchers and summarised by Hamilton (1994) supports the use of Exponential GARCH models. The log form of the conditional variance is one of the nicest features of the EGARCH models, there by guaranteeing that the variance is positive without any parametric restriction. Nelson (1991), who developed the EGARCH model, indicates that the model demonstrates the existence of asymmetry in volatility with respect to the direction of growth.

Similar to Wang (2010), AR(k)-EGARCH(p, q) model for measuring the volatility in the stock market return and the exchange rate returns is used in the present study. The model allows for time variation in both the conditional mean and conditional variance. The model can be expressed as follows:

$$SMR_t = \alpha_0 + \textstyle\sum_{i=1}^{k}\ \alpha_i\, SMR_{t-i} + u_t \tag{3}$$

$$u_t = \varepsilon_t\, h_t^{1/2} \qquad \text{where} \qquad \varepsilon_t/\psi_{t-1} \sim N(0,\ h)$$

$$log\ (h_t) = \omega + \textstyle\sum_{i=1}^{p} \gamma_i\, log\ (h_{t-i}) + \sum_{j=1}^{q}\ \rho_j \left| \dfrac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m\, \dfrac{u_{t-m}}{\sqrt{h_{t-m}}} \tag{4}$$

where SMR_t represents the stock market return, α_0 represents the mean exchange rate return, conditional on information set at time $t\text{-}1(\psi_{t-1})$. The logarithm of the conditional variance (h_t) on the right-hand side imply that the leverage effect is exponential, rather than quadratic, and that the forecasts of the conditional variance are guaranteed to be non negative without imposing any restriction on the coefficients. The presence of leverage effects can be tested through the hypothesis $\theta_m = 0$. On the other hand, the impact is asymmetric if $\theta_m \neq 0$.

Furthermore, the sources of financial markets are explored in four dimensions: firstly, the relationship between the volatility in one financial market to volatility in another financial market is explored; secondly, the impacts of the macroeconomic variables on the volatility of the financial markets are estimated; thirdly, the impact of the size of the financial variables on the volatility of financial markets is estimated; and fourthly, the impacts of macroeconomic and financial variables before and after the financial crises in the volatilities of these markets. Based on the methodology of Stancik (2007), the following equation is estimated using various models of panel data to determine variables that can affect volatility in financial markets.

$$SMV_{it} = a_1 + \delta_1 REERV_{it} + \beta_1 X_{it} + \varepsilon_{it} \tag{5}$$

$$REERV_{it} = a_2 + \delta_2 SMR_{it} + \beta_2 X_{it} + \varepsilon_{it} \tag{6}$$

where, SMR_{it} and $REERV_{it}$ represent the volatility of stock market returns and the volatility of exchange rate returns of country '*i*' in period '*t*'respectively, a_1 and a_2 are constants' β_1 and β_2 are vectors of coefficients, X_{it} represents the vector of macroeconomic and financial variables and ε_{it} is a random disturbance term. Here δ_1 is the measure the spillover effect of $REERV_{it}$ on SMV_{it} whereas δ_2 measures the spillover effect of SMV_{it} on $REERV_{it}$.

IV. Data and Sources

The study employs two different data sets. At the first step, monthly data spanning the first month of 2002 to the last month of 2008 for the 27 European countries. The countries for the analysis include Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. The study restricts the time period of the analysis till 2008, i.e., prior to global financial crises.

The data of stock market indices, market capitalisations and trading values of the selected countries are taken from various issues of Global Stock Markets Fact book, published by Standard and Poor's. However, the Fact book is available only till 2012, which does not provide enough data to estimate the relationship post-global financial crises. Thus, the analysis has been restricted. Moreover, the data for the real effective exchange rate is taken from International Financial Statistics. The growth rate of industrial production index (GIP), the growth rate of trade (GTRA), the logarithmic value of consumer price index (LCPI), and growth rate of total reserves (GTR) as the possible macroeconomic determinants of volatility in the financial markets has been used.

At the second step, to investigate the effects of volatility in stock market returns (exchange rate returns) on volatility in exchange rate returns (stock market returns) before and after the financial crisis, the data from 1996 to 2017 is employed. The data for all the variables (financial and macroeconomic) is extracted from World Development Indicators. The monthly data of real effective exchange rate from International Financial Statistics is used to calculate the exchange rate volatility.

V. Results

1. *Descriptive Analysis of Volatility in Financial Markets:*

The AR (k)-EGARCH (p, q) models are employed to evaluate volatility in the stock market returns and the exchange rate returns for the 27 countries.[2] The descriptive statistics for the panel of the macroeconomic variables, i.e., financial markets variables, and the volatility of financial markets returns are presented in Table 1.

TABLE 1

Descriptive Statistics

Variable	Obs.	Mean	STD	Min.	Max.
GIP	2158	0.0016	0.1116	-0.7307	0.6847
GTRA	2217	0.0103	0.1098	-0.5542	0.4701
LCPI	2268	4.6101	0.0783	4.1986	4.9374
GTR	2241	0.0015	0.1104	-2.0673	0.7791
LMC	2016	4.8835	0.9657	2.6911	6.6327
LTV	2016	3.4408	1.4356	0.0000	5.8800
SMV	2112	1.0033	0.0070	1.0000	1.2307
REERV	2207	1.0047	0.0258	1.0000	1.2553

Source: Author's Estimation.
Note: GIP: The growth rate of industrial production index, GTRA: The growth rate of trade, LCPI: Logarithm of the consumer price index, GTR: The growth rate of total reserves, LMC: Logarithm of market capitalisation, LTV: Logarithm of trading value, SMV: Stock market volatility, REERV: Real effective exchange rate volatility.

From the Table 1, it can be observed that on average, the volatility in the real effective exchange rate is higher than the volatility in stock market returns. Similarly, the variation in real effective exchange rates' volatility is also observed to be higher than the variation of the volatility in the stock market returns. For the initial inter-relationship between the financial and macroeconomic variables, correlation coefficients are checked. The correlation coefficients between the volatility of financial variables and potential explanatory variables are presented in Table 2.

The coefficients of correlations indicate that the trade is positively linked with industrial production growth, whereas inflation, total reserves and market capitalisation are negatively linked. The correlation between the volatility of stock market returns and the growth rate of industrial production is negative, whereas the correlation between the volatility of real effective exchange rate and the growth rate of the in-

[2] Detailed specification of AR(k)-EGARCH(p,q) model for each country is presented in Appendix A-I and Appendix A-II.

dustrial production is positive. Other than industrial production's growth rate, all other macroeconomic and financial variables are negatively linked with real effective exchange rate volatility. A detailed analysis with the help of panel regressions is presented in the next subsection.

TABLE 2

Correlation Coefficients between Financial and Macroeconomic Variables

	GIP	GTRA	LCPI	GTR	LMC	LTV	SMV
GIP							
GTRA	0.7098						
LCPI	-0.0317	-0.0889					
GTR	-0.0001	0.0471	-0.0319				
LMC	-0.015	-0.0249	0.1118	-0.0758			
LTV	0.0022	-0.0073	0.0463	-0.0656	0.9663		
SMV	-0.0238	-0.1058	0.1916	-0.0043	-0.1678	-0.1677	
REERV	0.0008	-0.0011	-0.0449	-0.0675	-0.1927	-0.206	-0.0315

Source: Author's Estimation.
Note: GTRA: The growth rate of trade, LCPI: Logarithm of the consumer price index, GTR: Growth rate of total reserves, LMC: Logarithm of market capitalisation, LTV: Logarithm of trading value, SMV: Stock market volatility, and REERV: Real effective exchange rate volatility.

2. *Sources of Volatility in Financial Markets*

Based on the above-mentioned methodology and data, the estimation is carried out in two steps. In the first step, for each country, the volatility of stock market returns and exchange rate returns are calculated using the GARCH type models. In the second step, these volatility measures are used in the panel regression along with other macroeconomic variables to find the spillover and the macroeconomic determinants of volatility in the financial markets.

Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) using the monthly data for the 24 European countries are estimated. Three countries (Cyprus, Luxembourg, and Malta) are dropped from the analysis due to the unavailability of financial indicators' data. The selection of the appropriate model is done with the help of tests like Chow-test, which compares the efficiency of Pooled-OLS to the fixed effect models, Breusch-Pagan LM test that checks if country-specific intercepts are different from each other (comparing random effect model with Pooled-OLS), and Hausman specification test that compares the fixed-effect models with random effect models. The results of the regression analysis are presented in Table 3.

TABLE 3

Macroeconomic Sources of Financial Markets Volatility

Independent Variable	Dependent Variable							
	SMV				REERV			
	FE	RE	FE	RE	FE	RE	FE	RE
REERV	-0.0158	-0.0168	-0.0055	-0.0153				
	(-1.24)	(-2.20)**	(-.42)	(-1.94)*				
SMV					-0.0508	-0.054	-0.0169	-0.0198
					(-1.24)	(-1.32)	(-0.42)	(-0.49)
GIP	0.0052	0.006	0.0062	0.0062	0.002	0.002	0.0023	0.0023
	(2.65)***	(3.03)***	(3.10)***	(3.12)***	-0.58	-0.56	-0.66	-0.65
GTRA	-0.0087	-0.0104	-0.0097	-0.0103	-0.0024	-0.0024	-0.0035	-0.0033
	(-4.37)***	(-5.16)***	(-4.81)***	(-5.12)***	(-.68)	(-.66)	(-.97)	(-.92)
LCPI	0.0384	0.0198	0.0218	0.0178	-0.0115	-0.0101	-0.0251	-0.0237
	(13.27)***	(9.77)***	(9.42)***	(8.86)***	(-2.12)**	(-1.92)*	(-6.10)***	(-5.79)***
GTR	0.0002	0.0006	0.0001	0.0005	0.0067	0.0066	0.0069	0.0066
	-0.61	(3.18)***	-0.21	(2.30)**	(11.39)***	(11.22)***	(11.55)***	(11.24)***
LMC	-0.0098	-0.0022			-0.0047	-0.0052		
	(-10.71)***	(-8.22)***			(-2.79)***	(-3.24)***		
LTV			-0.0027	-0.0012			0.0012	0.0007
			(-5.36)***	(-6.75)***			-0.17	-0.43
C	0.8884	0.9336	0.9169	0.9366	1.0703	1.0709	1.0704	1.0708
	(53.38)***	(76.45)***	(54.79)***	(75.16)***	(26.58)***	(26.38)***	(26.55)***	(26.31)***
Obs.	1942	1942	1942	1942	1942	1942	1942	1942
Countries	24	24	24	24	24	24	24	24
F-test(a)	38.51	177.17	23.36	154.44	25.56	150.67	24.5	139.89
P-Value	0	0	0	0	0	0	0	0

Model Specification Test				
Random Effects Model Vs Common Effects Model				
B.P. test	25.02	20.98	47958.02	47399.21
P-Value	0.0000	0.0000	0.0000	0.0000
Fixed Effects Model vs Common Effects Model				
F (Chow test)	6.02	2.93	344.71	340.73
P-Value	0.0000	0.0000	0.0000	0.0000
Fixed EffectsModel vs Random Effects Model				
Hausman Test	72.65	21.42	4.31	9.63
P-Value	0.0000	0.0015	0.6349	0.1411

Source: Author's Estimation.

(a) F.E.:Estimation with Fixed Effect model; RE:Estimation with random effect model; B.P.:Breusch and Pagan.

(b) SMV:Volatility in stock market returns, REERV:Real effective exchange rate volatility, GIP:Growth rate of industrial production index, GTRA:Growth rate of trade, LCPI:Logarithm of consumer price index, GTR:Growth rate of total reserves, LMC:Logarithm of market capitalisation, LTV:Logarithm of trading value, C:Constant

(c) ***,**,*significant at: 1 per cent, 5 per cent, and 10 per cent level of significance, respectively.

The significance of F-statistics (a) indicates that the overall models are a good fit, and independent variables explain significant variation in the dependent variable. Further, F (Chow-test) compares the FEMs against the CEMs indicates that the FEMs are preferred over the CEMs. Likewise, Breusch and Pagan's results that compare the REMs against the CEMs indicate that the REMs are preferred over the CEMs. However, the Hausman-test that tests the significance of the FEMs against the REMs gives mixed results. For the regressions in which the stock market volatility is used as a dependent variable, the FEMs are preferred over the REMs. On the contrary, for the regressions where the volatility of real effective exchange rates is used as a dependent variable, the REMs are preferred over the FEMs.

The determinants of the volatility in the stock market returns indicate that increased volatility in the currency market has a negative but insignificant effect on the volatility in the European countries' stock market returns. This result is similar to Kanas (2000) and Yang and Doong (2004), which also report no effect on the stock market's exchange rate volatility. Among other financial determinants, the market's size measured through market capitalisation and trading value has a negative yet significant effect on the volatility of the stock market returns. Again, the results make the sense that the higher the size and activity in the market, the more reduction in the volatility of stock market returns. Further, among the macroeconomic variables, inflation and industrial production contribute towards the volatility whereas an increase in the trade reduces the volatility in the stock market returns. On the other hand, an increase in the reserves has no impact on the stock market's volatility.

Looking at the results for the determinants of the volatility in the exchange rate, it can be seen that the stock market volatility has a negative but insignificant effect. These results in the combination of results for volatility in stock market returns indicate no spillover effect across the two markets. However, the size of the stock market has a negative effect on the volatility of the exchange rate. Unlike the results of the determinants of the volatility in the stock market, inflation has significantly negative whereas the reserves have a significantly positive effect on the volatility in the exchange rate. Moreover, the industrial production and the trade have insignificant effects on the exchange rate volatility.

The results for the macroeconomic sources of volatility before and after the financial crises are presented in Table 4. The decomposition of data into the periods of before and after the financial crises indicates more or less the same effects of macroeconomic variables on these volatilities. However, after the financial crises, the coefficients for these volatility variables are insignificant, indicating that the volatility in one market does not affect the volatility in the other. Moreover, an increase in the growth rate of GDP, an increase in governance, an increase in inflation, and an increase in investment decrease the volatility of these markets before the financial crises. These variables differently affect the volatilities in the stock market and the exchange rate after the financial crises. For example, an increase in trade openness causes an increase in the volatility of the exchange rate returns, whereas it decreases the volatility of the stock market returns after the financial crises.

TABLE 4

Macroeconomic Sources of Financial Markets Volatility before and after the Financial Crises

Independent Variable	Dependent Variable					
	SMV			REERV		
	Model Used for estimation					
	FEM	FEM	FEM	CEM	FEM	REM
	Time Period of Analysis					
	1996-2006	2009-2017	1996-2017	1996-2006	2009-2017	1996-2017
REERV	0.8888	1.43	1.0287			
	(2.28)**	-1.6	(3.09)***			
SMV				0.0153	0.0093	0.0207
				(1.71)*	-1.6	(3.77)***
GGDPPC	-0.0622	-0.5361	-0.3415	-0.071	0.028	-0.0163
	(-0.2849)	(-3.01)***	(-2.57)**	(-2.10)**	(1.91)*	(-0.99)
TO	0.0064	-0.068	-0.0491	0.0065	0.0046	0.0066
	-0.3447	(-5.19)***	(-5.05)***	(2.16)**	(4.21)***	(5.05)***
GDPD	-0.224	-0.4581	-0.2843	-0.0236	0.026	-0.0191
	(-3.52) ***	(-3.49)***	(-5.93)***	(-3.20)***	(2.40)**	(-4.90)***
INV	-0.3261	0.1589	-0.2168	-0.0909	-0.0154	-0.0531
	(-2.59)**	-0.97	(-2.37)**	(-4.56)***	(-1.16)	(-4.60)***
LPOP	-0.0028	-1.7456	-1.1075	0.0789	0.1827	0.1332
	(-.01)	(-3.21)***	(-3.04)***	-0.84	(4.22)***	(2.69)***
AGOV	-0.104	-0.1422	-0.0855	-0.0289	0.0079	-0.0101
	(-1.67)*	(-2.78)***	(-2.33)**	(-3.24)***	(1.90)**	(-2.26)**
NLC	0.0397	-0.0338	-0.0217	-0.001	0.0044	0.0005
	-1.52	(-1.33)	(-1.34)	(-0.24)	(2.13)**	-0.21
LLR	-0.0565	0.0697	0.0212	-0.005	-0.0028	-0.005
	(-3.22) ***	(5.56)***	(2.31)**	(-1.72)*	(-2.57)**	(-4.07)***
BZS	0.1169	-0.1056	-0.0168	-0.0081	-0.0268	-0.0127
	-1.55	(-1.36)	(-0.33)	(-0.64)	(-4.45)***	(-1.89)*
C	55.53	108.6	80.87	5.64	-5.2393	1.9881
	(4.89)***	(6.35)***	(10.84)***	(3.01)***	(-3.53)***	(1.88)*
Obs.	253	207	506	253	207	506
Countries	23	23	23	23	23	23
F-test(a)	13.22	20.38	17.52	11.66	6.79	14.09
P-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

(Continue .....)

TABLE 4 *(Continued)*

Macroeconomic Sources of Financial Markets Volatility before and after the Financial Crises

Independent Variable	Dependent Variable					
	SMV			REERV		
	Model Used for estimation					
	FEM	FEM	FEM	CEM	FEM	REM
	Time Period of Analysis					
	1996-2006	2009-2017	1996-2017	1996-2006	2009-2017	1996-2017
	Model Specification Test					
	Random Effect Model Vs Common Effect Model					
Breusch-Pagan test	189.98	21.78	243.5	0.0001	43.28	7.7
P-Value	0.0000	0.0000	0.0000	0.9958	0.0000	0.0055
	Fixed Effect Model vs Common Effect Model					
Period F	11.38	3.73	11.07	1.19	6.78	2.27
P-Value	0.0000	0.0005	0.0000	0.2959	0.0000	0.0012
	Fixed Effect Model vs Random Effect Model					
Hausman Test	113.82		34.05	11.94		11.84
P-Value	0.0000		0.0000	0.2892		0.2959

Source: Author's Estimation.

(a) FEM: Estimations based on Fixed Effect model, REM: Estimations based on Random Effect Model.

(b) SMV: Volatility in stock market returns, REERV: Real effective exchange rate volatility, GGDPPC: The growth rate of GDP per capita, TO Trade openness (trade to GDP ratio), GDPD: GDP deflator, INV: Investment (Gross fixed capital formation to GDP ratio), LPOP: Logarithm of the total population between age 15 and 60, AGOV: Average of governance indicators, NLC: Number of listed companies per 1000000 people, LLR: Liquidity liability ratio, BZS: Bank Z-Score, C-Constant.

(c) ***, **, *significant at: 1 per cent, 5 per cent, and 10 per cent level of significance, respectively.

Through comparison of determinants of the volatility in the stock market and forex market, it can be stated that most of the macroeconomic variables contribute significantly to the stock market volatility. In contrast, not much evidence is found in the case of the exchange rate volatility. Precisely, an increase in industrial production and inflation's growth rate leads to higher stock market volatility. On the other hand, an increase in the growth rate of industrial production has an insignificant effect on volatility in the exchange rate, while an increase in inflation decreases the volatility in the exchange rate. In addition, weak evidence of an increase in the variation of the stock market returns through an increase in the total reserves is also found. Moreover, an increase in the market capitalisation helps reduce volatility in the stock market returns and the volatility in the exchange rate.

However, the decomposed analysis before and after the financial crises indicates that the macroeconomic variables contribute in a similar way to the volatility in both markets. Both growth rate of GDP and inflation help decreasing volatilities in these markets before and after the financial crises. Moreover, the volatility in one market causes an increase in the volatility of the other market before the financial crises. After the financial crises, the volatilities in the two markets are independent. Overall, the study results indicate that the determinants of volatility are changing over time and are very much dependent on the time period of analysis.

VI. Conclusion and Recommendations

The academic literature indicates that the dynamic relationship between the volatility in the stock market returns and the volatility in the exchange rate has attracted the attention of financiers, economists, policymakers and practitioners because both of the markets play an important role in portfolio decisions. After introducing the common currency in the European region, the member countries face the same exchange rate of Euro with other currencies. However, the real effective exchange rate differs across all the countries. Due to the European Monetary Union and improved financial system, the volatility in the exchange rate should be less than the prior times and the stock markets in the region should be more stable. However, the determinants of volatility in these markets might differ before and after the financial crises.

The main finding of the study is that the volatility of one financial market does not contribute to the volatility of another financial market for the European countries after the financial crises. It might happen because the players in one market are different from that of the other [Kim (2003)]. The study also finds that the impacts of the macroeconomic variables on the volatility in these markets are different in the pre-and post-financial crises eras. Further, the results also indicate that the direction of the relationship between the macroeconomic variables and the volatilities in the financial markets changed before and after the financial crises. It further finds that good governance, trade openness, and the economy's growth rate are the key indicators to decrease the volatility in the stock market returns. On the other hand, domestic investment, liquid liability ratio, and increased competition among the banks are the major sources of decrease in the volatility of the exchange rate returns after the financial crises.

Hence, to make their turns in the stock markets less volatile, the Securities and Exchange Commission's in these countries should intervene to further improve the governance in these markets. Moreover, the currency union in the region should enhance coordination so that the management could be done at one central point. Further, the study recommends that the macroeconomic policies for stability in these markets cannot coincide as they differ in their impacts in different markets.

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APPENDIX A

Table A-1

Specification of *A.R. (k)-EGARCH (p,q)* of Exchange rate returns of European Countries

$R_t = \alpha_0 + \sum^{k}_{i=1} \alpha_i R_{t-i} + \varepsilon_t h^{1/2}_t$ $\qquad \varepsilon_t/\psi_{t-1} \sim N(0,h),$ $\qquad \log(h_t) = \omega + \sum^{p}_{i=1} \gamma_i \log(h_{t-i}) + \sum^{q}_{j=1} \rho j \left|\frac{u_{t-j}}{\sqrt{h_{t-j}}}\right| + \sum^{r}_{m=1} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}}$

Coefficient	AUS	BEL	BUL	CYP	CZE	DEN	EST	FIN	FRA	GER	GRE	HUN	IRE	ITA
							Mean Equation							
α_0	.0010**	.0009***	.0030***	.0025***	.0029***	.0015***	-.0043*	.0022***	.0019***	.0018*	.0008***	.0054***	.0039***	.0016**
α_1			.215**		-.270***	.250***	.385***	.544***			.266***	.367***		
α_2		-0.117					-.357***		0.079		-.166***	-.219***		.164***
α_3	-.256*		-.101*							-0.106			-.048***	
α_4					-.047**									
							Variance Equation							
ω	-18.138***	-19.579***	-15.252***	-21.473***	-11.326***	-.859*	-24.143***	-1.074**	-17.357***	-4.067**	-17.784***	-12.902***	-18.950***	-19.484***
ρ_1	.454*	.713***	1.051***	.723***	1.623***	.653**	-0.38	0.252	.455**	.282*	1.361***	.686**	.355***	.693**
ρ_2						-.650**								
θ_1	-.320*	-.379***	-0.057	-.504**	-.418***	.679***	0.155	1.040***	-.558***	-.327**	-.572**	.451***	-.325**	-0.339
γ_1	-.718***	-.808***	.207***	-.544**	.723***	.914***	-1.409***	.896***	-.663***	.602***	-.623***	-.539***	-.960***	-.900***
γ_2			-.816***	-.645***	-.965***		-.770***							
A.R.-EGARCH (p, q)	AR(3)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,2)	AR(0)-EGARCH (1,2)	AR(4)-EGARCH (1,2)	AR(1)-EGARCH (2,1)	AR(2)-EGARCH (1,2)	AR(1)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(2)-EGARCH (1,1)

(Continue)

Table A-1 *(Continued)*

Specification of *A.R. (k)-EGARCH (p,q)* of Exchange rate returns of European Countries

Coefficient	LAT	LIT	LUX	MAL	NET	POL	POR	ROM	SLK	SLO	SPA	SWE	UKI
Mean Equation													
α_0	-.0054**	-0.0015	.0014**	-.0030***	.0017***	-0.0002	.0015***	-.0097***	.0045***	-.0378***	.0020***	0.0005	-.0016*
α_1		.460***		-.015***		.230***		.130**	0.034	-.114*	.121*		.257**
α_2					-0.022		-.279**	-0.094		.007***			
α_3		-0.011		.026***		.169*					-.264***		
α_4	.321***		-0.064			-.190***							
Variance Equation													
ω	-4.358**	-21.711***	-5.976***	-3.628***	-19.670***	-7.128***	-11.046***	-17.085***	-29.151***	-.979***	-20.392***	-3.79	-.629***
ρ_1	.686*	-0.467	0.423	-2.624***	.577***	-1.305***	.801***	1.533***	.388***	-2.083***	.733**	0.125	-.318***
ρ_2								1.617***		-.609***			
θ_1	.329*	0.169	-.337*	.870***	-.439**	-.649***	-0.285	-.331***	0.007	-2.107***	-.310**	-.439**	-.356***
γ_1	.504*	-1.063***	.480***	-.056***	-.884***	0.266	0.025	-.936***	-1.462***	.021***	-.817***	.577**	.897***
γ_2		-.799***		.260***		-.328*			-.817***				
AR-EGARCH (p,q)	AR(4)-EGARCH (1,1)	AR(3)-EGARCH (1,2)	AR(4)-EGARCH (1,1)	AR(3)-EGARCH (1,2)	AR(2)-EGARCH (1,1)	AR(4)-EGARCH (1,2)	AR(2)-EGARCH (1,1)	AR(2)-EGARCH (2,1)	AR(1)-EGARCH (1,2)	AR(2)-EGARCH (2,1)	AR(3)-EGARCH (1,1)	AR(0)-EGARCH (1,1)	AR(1)-EGARCH (1,1)

a) AUS-Austria, BEL-Belgium, BUL-Bulgaria, CYP-Cyprus, Czech-Republic-CZE, Denmark-DEN, Estonia-EST, FIN-Finland, FRA-France, GER-Germany, Greece-GRE, Hungary-HUN, IRE-Ireland, ITA-Italy, LAT-Latvia, LIT-Lithuania, LUX-Luxembourg, MAL-Malta, NET-Netherlands, POL-Poland, POR-Portugal, ROM-Romania, SLK-Slovak-Republic, SLO-Slovenia, SPA-Spain, SWE-Sweden, UKI-United Kingdom.

b) ***,**,*significant at: 1 per cent, 5 per cent, and 10 per cent level of significance, respectively.

Table A-2

Specification of *A.R. (k)-EGARCH (p,q)* of Stock Market returns of European Countries

$R_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h^{1/2}_t$ $\varepsilon_t / \psi_{t-1} \sim N(0,h)$, $\log(h_t) = \omega + \sum_{i=1}^{p} \gamma_i \log(h_{t-i}) + \sum_{j=1}^{q} \rho j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}}$

Coefficient	AUS	BEL	BUL	CYP	CZE	DEN	EST	FIN	FRA	GER	GRE	HUN	IRE	ITA
Mean Equation														
α_0	.0215***	-0.0001	.0259**	.0195*	.0222**	.0159**	.0164*	-.0070***	0.0027	.0177***	0.0112	.0423***	.0271***	0.0014
α_1	.351***		.259**		0.181			.539***	.223***	.178***	.332**		.519***	.192*
α_2		.357***		.214**		-0.036	0.044	-.420***				-.198**	.204***	
α_3			.296**					.114*			-.255***	-.223***		
α_4	-.351***													
Variance Equation														
ω	-1.062***	-.320***	-2.792*	-4.598***	-8.876***	-0.616	-2.329*	-.637***	-.696***	-2.399***	-0.501	-1.840***	-6.895***	-.326***
ρ_1	0.091	-.189***	0.348	.478***	.470***	0.059	.760***	-.530***	-.559***	-.682***	.412**	-0.237	.570**	-.186***
ρ_2			.817*							.927***	-.615***	1.543***	2.254***	
θ_1	-.295***	-.440***	0.1	-.470***	-.401**	-.315***	-0.063	-.519***	-.583***	-.675***	-.256***	.630***	.978***	-.317***
γ_1	1.693***	.911***	.623**	0.145	-.518**	.901***	.641***	.790***	.405***	.633***	.879***	.829***	0.116	.916***
γ_2	-.852***								.406***					
A.R.-EGARCH (p,q)	AR(4)-EGARCH (1,2)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (2,1)	AR(2)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(1)-EGARCH (1,2)	AR(1)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(2)-EGARCH (2,1)	AR(1)-EGARCH (1,1)

(Continue)

Table A-2 *(Continued)*

Specification of *A.R. (k)-EGARCH (p,q)* of Stock Market returns of European Countries

Coefficient	LAT	LIT	LUX	MAL	NET	POL	POR	ROM	SLK	SLO	SPA	SWE	UKI
							Mean Equation						
α_0	.0096**	.0223**	.0195*		.0049***	.0230**	0.01	0.0147	.0222**	0.0045	.0036***	0.0026	-.0046***
α_1						-0.17	.359***	.284**	0.019	.264***		0.064	.326***
α_2		0.205	.214**		0.011		-0.063			.238**	.140**		
α_3	.179***												
α_4													
							Variance Equation						
ω	-10.842***	-0.014	-4.598***		-.699***	-6.252***	-5.400***	.016***	-1.313	-3.197**	-.417*	-.563**	-1.411***
ρ_1	.700***	.153**	.478***		-.555***	0.328	.603**	-.183**	.505*	0.179	-.419**	-.456*	-0.11
ρ_2	1.001***									.553*			-.736***
θ_1	-.349***	-.085**	-.470***		-.527***	-.413**	-.677***	.482*	-0.038	-.507***	-.385***	-.386***	-.454***
γ_1	-0.091	1.013***	0.145		.809***	.486**	.478***	-0.132	.800***	.545***	.867***	.827***	.668***
γ_2	-.631***					-.671***	-.313*						
A.R.-EGARCH (p,q)	AR(1)-EGARCH (1,1)	AR(3)-EGARCH (2,2)	AR(2)-EGARCH (1,1)		AR(2)-EGARCH (1,1)	AR(1)-EGARCH (1,2)	AR(2)-EGARCH (1,2)	AR(1)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(2)-EGARCH (2,1)	AR(2)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(1)-EGARCH (2,1)

a) AUS-Austria, BEL-Belgium, BUL-Bulgaria, CYP-Cyprus, Czech-Republic-CZE, Denmark-DEN, Estonia-EST, FIN-Finland, FRA-France, GER-Germany, Greece-GRE, Hungary-HUN, IRE-Ireland, ITA-Italy, LAT-Latvia, LIT-Lithuania, LUX-Luxembourg, MAL-Malta, NET-Netherlands, POL-Poland, POR-Portugal, ROM-Romania, SLK-Slovak-Republic, SLO-Slovenia, SPA-Spain, SWE-Sweden, UKI-United Kingdom.

b) ***, **, *significant at: 1 per cent, 5 per cent, and 10 per cent level of significance, respectively.