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CONTRIBUTORS OF MEAN AND VOLATILITY SHOCKS IN EAST EUROPEAN MARKETS

Noor ul Ain Yasin[1]; Moazzam Ali[2]; Ammara Riaz Chohan [3]

[1]MS Scholar CUST, Islamabad; [2]Asst. Prof. Allama Iqbal Open University, Islamabad;
[3]PhD Scholar, NUML, Islamabad

Corresponding Author: moazzamalitarar@gmail.com

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ABSTRACT

The study aims to explore the mean and volatility spillover from leading European market to the East European markets after the disintegration of Russia. The study also provides insight regarding shift in influence from old allies to new partners. The ARMA-GARCH -M model is used to analyze the connection between leading markets (UK, Germany, France, and Russia) and East European markets (Slovenia, Estonia, Lithuania, Czech Republic, Serbia, Ukraine, Croatia, Romania, Hungry and Poland). The findings of the study provide evidence about existence of significant mean and volatility spillover from leading European markets to Eastern Europe markets. Information transmission is more pronounced in Western European countries, e.g. UK, Germany, and France as compared to Russia. However, remnants of Russian influence in East European markets can still be traced.

Key Words: Mean and volatility spillover, GARCH-M, E-GARCH, Market integration.

INTRODUCTION

World war II resulted in the division of Europe in Eastern bloc and Western bloc. Eastern bloc consisted of socialist states of Central and Eastern Europe. Communist trained cadres took the power and initiated the agenda for social, political and economic transformation. These reforms helped in achieving technological and economic advancement but created dependence on the Soviet Union. The western analyst claimed that Eastern Bloc economies were less developed due to the non-existence of market-based mechanism. Union of Soviet Socialist Republics (USSR) dominated Eastern Europe for five decades in 20th century. However, by 1990, the history took a new direction in USSR thereby influencing the eastern bloc.

Several economic, social and political exigencies hastened the fall of the Soviet Union. It included the economic burden of the Afghanistan war, bureaucratic ineffectiveness, and expansion of authoritarianism. Together with it, the absence of democracy and freedom of speech further escalated the downfall. Gorbachev's decision to allow elections with a multi-party system began an abrupt process of democratization which eventually destabilized the communist control and led to the collapse of the Soviet Union. The disintegration of Soviet Union led to a complete change of political, economic and military alliances. Also, new states in Balkans and Central Asia were created. Market-based systems were adopted and there was a capital flow.

In the last fifteen years, the continent of Europe underwent dramatic economic, political and social changes. In 2004, ten countries from the previous eastern bloc joined the ranks of the European Union, which was followed by Romania and Bulgaria in 2007 and Croatia in 2013. Former eastern bloc and newly independent European countries started to trade with the dominant players of the European Union like UK, France, and Germany, which resulted in the cross-border capital flow. It ultimately resulted into the escalation of the influence of the West

European countries on the markets of Slovenia, Estonia, Lithuania, Czech Republic, Serbia, Ukraine, Croatia, Romania, Hungry and Poland.

Most of the studies of stock market integration are on developed or emerging markets. A few studies focused on Eastern Europe countries which were once a part of the Communist bloc. After the fall of the Soviet Union, this region, underwent big political and socioeconomic transformation. The changes must have an influence on the dynamics of the equity market, especially when the economic system of the region is in transformation. The shift in political as well as the economic condition is expected to affect equity market too.

Keeping in view the historical landscape, the present study analyses convergence between the East Europe and Western Europe including the Russian Federation. Moreover, the emphasis of this research is on the Eastern European states which joined EU in the post-communist period. Generally, these types of studies involve co-integration analysis, VAR Models and Quartile Regression, etc. While, this study utilizes ARMA-GARCH-M model to explain the mean and volatility spillover effect of the leading European markets on East European markets. Earlier studies emphasized on socio-economic convergence while financial convergence has received less attention. This study is of significance as it attempts to unveil another dimension of paradigm shift. In that perspective, this study is divided into five sections. The first section includes introduction. The second sections explains literature review while the third section shows data description and methodology. Fourth section describes the results of empirical analysis. Fifth section concludes the study and presents future directions.

Empirical Literature

Various studies have been conducted on the mean and volatility spillover by using different models to explain the mechanism of transmission of information across markets. Oikonomikou (2015) explores the market interaction among the Czech Republic, Poland, Ukraine, and Russia during the 2005-2014 by using multivariate asymmetric E-GARCH model. Results of the study reveal the presence of significant return and volatility spillover effect across markets. In crises period, the volatility transmission across markets is weak and these are found weakly integrated.

The study of Alkan and Cicek, (2020) sought to quantify the spillover between Turkish financial markets as well as look into the impact of global markets on Turkish financial markets. Between 2006 and 2018, a large mean spillover was observed from global markets to domestic stock and bond markets, from stock and exchange markets to the bond market, and from the dollar return to the stock market. This was determined by using the BEKK parameterization of the multivariate GARCH model. Ozer, Kamisli, and Kamisli (2016) examine the volatility spillover among German stock market and sixteen European stock markets by applying Breitung and Candelon (2006) frequency domain causality approach. Most of the result shows the bidirectional and unidirectional volatility spillover in different investment horizon (short, medium and long). Moreover, in long run unidirectional causality has found from stock market of Hungary towards the stock market of Germany. However, volatility spillover transmission is not found on Germany and Austria, Czech Republic, Croatia, Lithuania and Greece stock market returns.

Wang and Shih (2010) examine the volatility spillover effect from the worlds and regional markets to five equity markets of emerging Europe during 1996 to 2006 by using three stages, multi-factor model. The findings of the study reveal the presence of positive and significant volatility spillover. The intensity of spillover from the European region is found higher as compared to the world, but the direction of spillover is not found consistent. Drachal (2017) studies the markets of Central and Eastern Europe to investigate the leverage and volatility effect in emerging markets by using GARCH type models on data from 2005 to 2015. The findings are consistent with earlier research as volatility spillover effect is significant in most of the countries. The result shows negative risk-return tradeoff in most of the countries. Significant leverage effect is found in five countries. Russia is more exposed to political risk. In Serbia, positive shocks create more volatility. Similarly, Li and Majerowska (2006) find out the linkage among the emerging stock markets in Budapest, Warshaw, Frankfurt, and the US by using of GARCH-BEKK model. Time-varying conditional covariance shows limited relations between the

markets, Emerging markets are not strongly linked with developed markets.

Scheicher (2001) analyses the global and regional integration of stock markets of Hungry, Poland and the Czech Republic by using VAR with a multivariate GARCH model. The limited interaction has been found with both global and regional shocks. Volatility spillover is higher from regional stock markets. International markets are less correlated. Alikhanov's (2013) examines the volatility spillover from U.S and EU stock and commodity markets to national stock markets of eight European countries. The results of JGR-GARCH model indicate that European stock markets are affected by the volatility spillover from US global, EU-regional and world factor oil. Mean spillover effect is lower from EU stock markets although there is significant mean and volatility spillover effect from U.S stock market. Variance ratios are also used to find the magnitude of volatility spillover effect and results shows that US market creates more volatility spillover effect on stock returns of individual emerging countries. Moreover, dominating existence of US spillover is observed by investigating the spillover transmission of global and regional stock markets. Russian stock market is more affected by oil market shocks whereas Hungry, Poland and Ukraine stock markets are asymmetrically responded to the negative and positive shocks of the US stock market.

Li and Majerowska (2008) study the mean and volatility spillover effect from German and US markets to emerging markets of Europe (Warsaw and Budapest) by using multivariate asymmetric GARCH-BEKK model. Daily data is used for the time period from January 1998 to Dec 2005. The results show significant mean and volatility spillover effect among these markets. Moreover, the integration present in these markets is very weak and limited. Result also shows the bi-directional return spillover effect among DAX and WIG and from DAX and S&P 500 indices unidirectional volatility spillover has been observed. So, in terms of return and volatility spillover, two developing markets in Eastern and Central Europe are associated with the developed markets in U.S and Germany. The linkages among the emerging and developed markets are weak as estimated by time-varying conditional covariance and variance decomposition.

The increase in equity market association occurs due to regional integration and globalization. Baele (2005) investigate the unique period of financial, monetary and economic integration of Western Europe. The influence of markets of the US and European Union on 13 markets of Europe is examined to quantify the magnitude and time-varying nature of volatility spillover. The changes in shock sensitivities are tested through a regime switching model. The findings of the study indicate that in the period of 1980's and 1990's the intensity of spillover shocks is increased from EU and US, but EU spillovers are much increased as compared to the US. The EU shocks spillover is more intense due to equity market development, trade integration and low inflation contribution. The result also shows that the contagion effect is transferred from the U.S market to a number of local European equity markets during the period of high world market volatility.

The existence of interdependence between Eastern and Central European stock markets (WIG-20, PX-50, BUX) and Western European stock markets (CAC, DAX) is analyzed by Egert and Kocenda (2007) by using a broad range of econometric techniques on 5-minute tick intraday price data from 2003 to 2005. The study doesn't capture any co-integration relationship in long run, whereas short-run stock price return and volatility spillover are observed. Bi-directional Granger causality is also observed. Zhou, Zhang, and Zhang, (2012) measure the volatility spillover among the 11 world equity markets of Asia, Europe and North America using VAR framework. It is observed that during subprime mortgage crises US market has greater influence over other markets and only bad news affect the other markets. Shanghai stock market creates an impact on other markets volatility in time duration from February 2007 to July 2007. During global crises, Chinese market volatility is not affected.

The critical review of the literature suggests that information about financial markets is incorporated in prices and any change in one market causes changes in another market. Studies suggest that markets are interdependent upon each other. As evident from the review of extant literature, there is presence of volatility transmission among different countries regionally and globally. However, there is no conclusive evidence on the transmission of volatility across East European countries. While, this

spillover seems to be more pronounced where economic and political ties are strong. Similarly, global and regional influence is also present. As a consequence, this study aims to contribute to the literature by analyzing the regional volatility transmission of leading regional markets on East European markets after their independence from Communist Soviet Union. The mean and volatility spillovers, in turn, are indicators of the level of integration demonstrated by these countries on a regional basis. This provides the information about portfolio diversification opportunities within stock markets of Slovenia, Estonia, Lithuania, Czech Republic, Serbia, Ukraine, Croatia, Romania, Hungry and Poland to have a better cushion on the risk associated with investment in these markets.

Data Description

The current study aims to explore the impact of the developed European market and Russian markets on Eastern Europe markets after being part of the European Union. Eastern Europe markets include Slovenia, Estonia, Lithuania, Czech Republic, Serbia, Ukraine, Croatia, Romania, Hungry and Poland that join the European Union after Collapse of USSR (Soviet Union). This study uses the country-specific data because capital markets started operations at the different point in time. Country-specific data is used for analysis. Data has been taken according to countries stock market data availability. The details of Sample period are placed below on Table 3.1

Table 3.1 Details of Sample of Eastern European Countries

Serial No	Country	Index	Time period From (till 30th December 2022)
1.	Slovenia	LJSE	31st March 2010
2.	Estonia	OMXTGI	17th November 2008
3.	Lithuania	OMXVGI	17th November 2008
4.	Czech Republic	PSE	14th May 2001
5.	Serbia	BEL	3rd October 2005
6.	Ukraine	UX	8th January 2008
7.	Croatia	CROBEX	14th May 2001
8.	Romania	BET	14th May 2001
9.	Hungry	BUX	14th may 2001
10.	Poland	WIG	1st March 2001

The regional markets include that major player of Europe i.e. UK, Germany, France along with historical partner Russia. The details are as under:

Table 3.2 Details of Sample of developed European Countries

Serial No	Country	Index	Time period From (till 30th December 2022)
1.	UK	FTSE100	1st March 2001
2.	Germany	DAX	1st March 2001
3.	France	CAC40	1st March 2001
4.	Russia	RTS	1st March 2001

Return of each market is calculated by using daily stock market indices of each country

$R_t = \log (\mathbf{P}t/\mathbf{P}t\text{-}1)$

R_t = Return of the market at the end of day 't'

P_t = Closing price of the index at the end of the day't'

P_{t-1}= Closing price of the index at the end of 't-1'

Model Specification

The two-stage ARMA-GARCH-in-mean approach as specified by Liu and Pan (1997) has been used to examine the spillover from markets of UK, France, Germany and Russia Market to the East European markets including Slovenia, Estonia, Lithuania, Czech Republic, Serbia, Ukraine, Croatia, Romania, Hungry and Poland. In the first stage, the stock return series are modeled to capture the shocks as explained in the equation 1 and 2:

$$r_{k,t} = \alpha_0 + \alpha_1 r_{kt-1} + \alpha_2 \varepsilon_{k,t} + \alpha_3 \varepsilon_{k,t-1} + \varepsilon_{k,t}, \quad \varepsilon_{k,t} \sim N_{(0,vk,t)} \qquad (1)$$

$$\varepsilon_{k,t} = \alpha_0 + \alpha_2 \varepsilon^2_{k,t-1} + \alpha_1 \varepsilon_{k,t-1} \qquad (2)$$

Where $r_{k,t-1}$ is the daily return of leading market of the region i.e UK, France, Germany or Russia and $\varepsilon_{k,t}$ is the residual (or unexpected return) which is normally distributed with mean zero and time conditional variance $v_{k,t}$. The subscript k in each of the equation (1) and (2) refers to one of the leading European markets. The inclusion of ARMA (1, 1) structure in the model is designed to adjust for possible serial correlation in the data.

In the second stage, mean and volatility spillover effects across markets are estimated by obtaining the standardized residual and its square in the first stage and substituting them into the mean and volatility equations of other markets as follows:

$$r_{j,t} = \phi_0 + \phi_{j,1} r_{j,t-1} + \phi_{j,2} v_{j,t} + \phi_{j,3} \varepsilon_{j,t-1} + \lambda_J \varepsilon_{k,t} + \varepsilon_{j,t}, \varepsilon_{j,t} \sim N(0, v_{j,t}) \qquad (3)$$

$v_{j,t} = \alpha_{j,0} + \alpha_{j,2}\varepsilon^2_{j,t-1} + \alpha_{j,1}v_{j,1} + \gamma_j e^2_{k,t}$ (4)

Where $\varepsilon_{k,t}$ is the standardized residual series for the relevant index and captures the mean return spillover effect from the source market. In order to examine the volatility spillover, exogenous variable $e^2_{k,t}$, the square of the standardized residual series is included in the conditional volatility equation and is defined as $e_{k,t} = \varepsilon_{k,t}\sqrt{vk,t}$ .The subscript j in each of the equation (3) and (4) refers to one of Eastern Europe countries.

Data Analysis

The statistical behavior of the data is examined by using descriptive statistics of monthly returns and results of mean, standard deviation, Skewness, Kurtosis and Jarque-Bera Statistic are reported in table 5.1.

Table 5.1

Descriptive Statistics of Eastern Europe Markets

Country	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Croatia	0.01	1.01	-0.0251	30.3702	1.7 e 5	0.0000
Czech Rep	0.01	1.16	-0.6227	24.4476	1.1 e 5	0.0000
Estonia	0.04	0.91	1.0429	22.5854	4.7 e 4	0.0000
Hungary	0.03	1.27	-0.1212	14.0122	2.8 e 4	0.0000
Lithonia	0.04	0.80	0.0237	42.9490	1.9 e 5	0.0000
Poland	-0.18	11.73	-62.6584	3988.4270	2.7 e10	0.0000
Romania	0.04	1.27	-0.6598	17.2908	4.8 e4	0.0000
Serbia	-0.01	1.28	0.1380	18.6571	2.9 e 4	0.0000
Slovenia	-0.01	0.78	-0.5089	9.0933	3.8 e 3	0.0000
Ukraine	-0.04	1.85	-0.2135	15.3529	2.0 e3	0.0000

The monthly returns of the Estonian and Lithuanian markets are on the higher side with an average of 4% whereas the Polish market reports the highest loss of 18% per month. The risk of Polish is highest followed by Ukraine. Slovenian market is found stable with lowest standard deviation. Skewness indicates a distribution with an asymmetric tail extending toward more negative values. Kurtosis is positive that indicates a relatively peaked distribution in all markets. Jarque Bera tests provide that hypothesis of the normality of data is rejected.

Results for mean and volatility spillover from the Leading markets i.e.UK, Germany, France, and Russia to Eastern Europe markets which have been a part of Russian Bloc are reported below. Table 5.2 exhibits the results of important leading markets on Slovenia stock market.

Table 5.2

Mean and Volatility spillover from UK, Germany, France, and Russia to Slovenia by using GARCH-M Model

Data from 31st March 2010 to 30th Nov 2022

	UK	Slovenia	Germany	Slovenia	France	Slovenia	Russia	Slovenia
ϕ0	0.0000	0.0006	0.0000	0.0000	0.0000	-0.0001	-0.0009	0.0001
	(-0.0293)	(1.7870)	(-0.0428)	(-0.1155)	(-0.0670)	(-0.5687)	(-1.4907)	(0.4431)
ϕ1	1.0232	0.0642	1.7592	0.0761	0.9040	0.0719	-2.0870	0.0559
	(0.9183)	(3.2387)	(0.4678)	(3.4886)	(1.4229)	(3.3088)	(-1.5748)	(2.5201)
ϕ2	-0.1142	-11.7277	-3.3988	-1.2908	0.4995	0.2031	8.4814	-2.6918
	(-0.0074)	(-1.9888)	(-0.2007)	(-0.3304)	(0.0939)	(0.0517)	(2.1218)	(-0.7899)
λ1		0.1049		0.0705		0.0672		0.0349
		(6.2038)*		(4.3847)*		(4.0500)*		(2.6524)*

α0	0.0000 (7.9292)	0.0000 (6.6868)	0.0000 (6.5894)	0.0000 (26.4083)	0.0000 (6.9982)	0.0000 (30.3914)	0.0000 (8.7016)	0.0000 (24.9377)
α1	0.0805 (13.6022)	0.0904 (10.625)*	0.0560 (12.3754)	0.1827 (13.4277)*	0.0663 (13.4751)	0.1746 (13.7616)*	0.0493 (13.799)	0.1624 (10.6514)*
α2	0.8930 (114.735)	0.7796 (42.073)*	0.9291 (162.084)	0.1203 (5.8422)*	0.9135 (133.965)	0.1177 (7.2078)*	0.9347 (195.23)	0.0948 (5.4700)*
λ2		3.37E-06 (9.7836)*		2.22E-05 (12.3605)*		2.63E-05 (13.7560)*		2.48E-05 (15.6083)*

Note 1: The numbers in parenthesis below the coefficient estimates the Z statistics. In mean equation ϕ0 is constant, ϕ1 is R (-1), ϕ2 is GARCH term whereas λ1 is the second error term of effecting country which tells the mean spillover effect significance. In variance equation α_0 is constant α_1 is ARCH term, α_2 is GARCH term and λ2 is volatility term of effecting country which tells the volatility spillover significance. * (steric) shows significant mean and volatility spillover effect.

The objective of the study explores the link between the East European market with a market of past and present political alliance. Result reveals the presence of mean spillover from UK, Germany, France, and Russia to Slovenia. Similarly, volatility spillover is also observed from all markets. Volatility in regional market is significantly transmitted to Slovenian market. The mean and volatility transmission is highest from the UK followed by Germany France and Russia. Despite the disintegration of the Eastern European block, the influence of Russia in the market is still significant. The results further indicate that past price influence current volatility as ARCH term is significant; the persistence of volatility is also observed and GARCH term is found Significant. The sum of ARCH and GARCH term for the UK is 0.86 that indicates long Run persistence. However, in other cases, it is significantly lowered than 1. (Alkan, B., & Çiçek, S., 2020).

Table 5.3

Mean and Volatility spillover effect of UK, Germany, France, and Russia on Estonia Market by using GARCH-M Model

Data since 17th nov 2008 to 30 nov 2022								
	UK	**Estonia**	**Germany**	**Estonia**	**France**	**Estonia**	**Russia**	**Estonia**
ϕ0	-0.0002 (-0.6696)	0.0003 (2.0411)	0.0000 (0.0219)	0.0003 (1.8149)	-0.0001 (-0.2868)	0.0003 (1.8227)	-0.0004 (-0.8494)	0.0003 (1.7608)
ϕ1	0.1997 (0.2494)	0.0496 (3.2113)	0.5185 (0.2520)	0.0513 (3.6078)	0.4366 (0.6258)	0.0522 (3.4596)	-0.8996 (-1.3586)	0.0602 (4.1413)
ϕ2	7.2098 (0.9319)	1.2317 (0.4051)	2.0672 (0.2771)	1.7083 (0.5703)	2.9395 (0.6464)	1.7187 (0.5611)	5.2966 (2.0992)	1.3128 (0.4343)
λ1		0.1673 (14.4624)*		0.1400 (15.4537)*		0.1370 (15.1267)*		0.0787 (13.2958)*
α0	0.0000 (8.3809)	0.0000 (-7.0734)	0.0000 (6.6152)	0.0000 (-6.5208)	0.0000 (7.5838)	0.0000 (-5.6840)	0.0000 (10.9520)	0.0000 (-0.3754)
R α1	0.0646 (15.471)	0.0394 (30.7827)*	0.0474 (13.2085)	0.0305 (31.8105)*	0.0561 (15.1767)	0.0379 (31.5729)*	0.0405 (16.9626)	0.0294 (30.8104)*
α2	0.9188 (187.05)	0.9533 (753.50)*	0.9416 (220.71)	0.9653 (1219.70)*	0.9275 (192.23)	0.9559 (899.18)*	0.9484 (354.63)	0.9682 (1214.57)*

λ2	8.35E-07 (13.6272)*	5.43E-07 (11.4703)*	7.20E-07 (11.8323)*	2.14E-07 (5.2232)*

Table 5.3 reports the results of important leading markets on Estonia stock market. The results reveal the presence of mean and volatility spillover from developed leading markets of Europe to Estonia. Results show that the mean and volatility spillover is highest from the UK. Regardless of separation of Eastern European block, the influence of Russia in the market is still significant but its influence is less than other major players of European markets. ARCH term significance shows that past price behavior affect the current volatility and GARCH term indicate that there is the persistence of volatility found from leading markets to the Estonian market. The sum of ARCH and GARCH term for UK, France, and Russia is 0.98 and for Germany is 0.99 which indicates the long-run persistence of volatility. Results for both mean and volatility spillover coefficients are positive and statistically significant. (Alkan, et. al., 2020).

Table 5.4

Mean and Volatility spillover effect of UK, Germany, France, And Russia on Lithuania Market by using GARCH-M Model

Data since 17th nov 2008 to 30thnov 2022

	UK	**Lithuania**	**Germany**	**Lithuania**	**France**	**Lithuania**	**Russia**	**Lithuania**
ϕ0	-0.0002 (-0.6696)	0.0003 (2.7387)	0.0000 (0.0219)	0.0003 (2.7559)	-0.0001 (-0.2868)	0.0003 (2.8516)	-0.0004 (-0.8494)	0.0003 (2.6451)
ϕ1	0.1997 (0.2493)	0.0325 (2.0334)	0.5185 (0.2520)	0.0219 (1.2259)	0.4366 (0.6258)	0.0280 (1.6164)	-0.8996 (-1.3586)	0.0288 (1.6018)
ϕ2	7.2098 (0.9319)	0.0835 (0.0269)	2.0672 (0.2771)	-0.1206 (-0.0412)	2.9395 (0.6464)	-0.1868 (-0.0615)	5.2966 (2.0992)	-0.0538 (-0.0184)
λ1		0.1223 (13.8936)*		0.0952 (12.3493)*		0.0905 (12.9269)*		0.0549 (10.162)*
α0	0.0000 (8.3809)	-0.0000 (-10.4291)	0.0000 (6.6152)	-0.0000 (-15.2168)	0.0000 (7.5838)	-0.0000 (-17.0193)	0.0000 (10.9520)	0.0000 (0.7128)
α1	0.0646 (15.471)	0.0403 (28.161)*	0.0474 (13.208)	0.0590 (24.077)*	0.0561 (15.176)	0.0532 (26.245)*	0.0405 (16.962)	0.0624 (26.626)*
α2	0.9188 (187.05)	0.9573 (946.96)*	0.9416 (220.71)	0.9379 (602.15)*	0.9275 (192.23)	0.9431 (727.34)*	0.9484 (354.63)	0.9373 (615.69)*
λ2		5.62E-07 (15.0632)*		7.89E-07 (23.5213)*		8.23E-07 (22.5379)*		3.87E-07 (13.688)*

Table 5.4 represents the results of important leading markets on Lithuanian stock market. Mean and volatility spillover from leading markets of Europe that include UK, France, Germany, and Russia to Lithuania by using GARCH-M model is represented in table 4.4. The result shows the presence of mean and volatility spillover from the UK, Germany, France, and Russia to Lithuania. The economic shock transmission is highest from leading European markets as compared to historical Russia. While transmission of mean spillover effect is highest from UK market and volatility spillover shock transmission is highest from France as the coefficient of France is highest. In spite of independence of the Eastern European bloc, the influence of Russia in the market is still significant. The ARCH term (α1) of all

markets are significant which shows that past price behavior effect current volatility. Whereas GARCH term (α2) of variance equations is also significant which represent that there is a persistence of the volatility from UK, Germany, France, and Russia to Lithuania. The sum of ARCH and GARCH term for UK, France, Russia, and Germany is 0.99, which indicates the long run persistence. However, in all cases, it is significantly lowered than 1 (Alkan, et. al., 2020).

Table 5.5

Mean and Volatility spillover effect of UK, Germany, France, and Russia on Czech Republic Market by using GARCH-M Model

Data since14th may 2001 to 30 nov 2022

	UK	Czech Republic	Germany	Czech Republic	France	Czech Republic	Russia	Czech Republic
ϕ0	0.0000 (0.2644)	-0.0002 (-0.1684)	0.0004 (1.3800)	0.0004 (2.7904)	0.0001 (0.6525)	0.0005 (3.2633)	0.0013 (3.1764)	0.0006 (3.0700)
ϕ1	0.3195 (0.9381)	0.0700 (2.5653)	-0.1771 (-0.2922)	0.0282 (2.2726)	0.2963 (0.8098)	0.0241 (2.0418)	-0.7944 (-2.1901)	0.0233 (2.0002)
ϕ2	2.8181 (1.2134)	7.0476 (1.3985)	1.6231 (0.9952)	0.6480 (0.3321)	1.4317 (0.8438)	-0.6880 (-0.3129)	0.8979 (0.7667)	-1.1462 (-0.5003)
λ1		0.6342 (32.9873)*		0.3929 (46.2883)*		0.4373 (51.2840)*		0.2827 (46.0394)*
α0	0.0000 (9.12)	0.0001 (9.5107)	0.0000 (9.4326)	0.0000 (0.0239)	0.0000 (8.6760)	0.0000 (-0.770)	0.0000 (14.7599)	0.0000 (4.8329)
α1	0.0673 (21.469)	0.1500 (5.402)*	0.0567 (19.890)	0.0688 (17.164)*	0.0583 (21.408)	0.0593 (16.823)*	0.0550 (23.392)	0.0600 (15.682)*
α2	0.9255 (275.08)	0.6000 (13.81)*	0.9363 (296.340)	0.8781 (157.65)*	0.9353 (305.73)	0.9031 (187.23)*	0.9277 (293.91)	0.8863 (153.54)*
λ2		-1.69E-10 (-336.2525)*		4.31E-06 (17.3791)*		3.05E-06 (15.723)*		3.76E-06 (16.5536)*

Table 5.5 represents the results concerning mean and volatility spillover effect of important leading markets on the Czech Republic. The objective of the study explores the link between the East European market with its past and present political union. Result reveals the presence of mean spillover from UK, Germany, France, and Russia to the Czech Republic. The mean transmission is highest from the UK followed by other leading markets. Similarly, volatility spillover is also observed from all markets. Volatility in regional market is significantly transmitted to Czech Republic market. Volatility transmission is highest from Germany. Volatility spillover is negatively significant from the UK to the Czech Republic. Although the Eastern European block is separated, the influence of Russia in the market is still significant. The results further indicate that past price impact the current volatility as ARCH term is significant. The persistence of volatility is also observed shown by the significance of GARCH term. The sum of ARCH and GARCH term for the UK is 0.75, France is 0.96, Russia and Germany is 0.94. All models indicate the long run persistence (Oikonomikou,. 2015).

Table 5.6

Table 5.6
Mean and Volatility spillover effect of UK, Germany, France, and Russia on Serbia Market by using GARCH-M Model

Data from 3rd oct 2005 to 30th nov 2022

	UK	***Serbia***	***Germany***	***Serbia***	***France***	***Serbia***	***Russia***	***Serbia***
ϕ0	*0.0000*	*0.0004*	*0.0003*	*0.0004*	*0.0001*	*0.0004*	*0.0005*	*0.0004*
	(0.1003)	*(2.1488)*	*(0.5464)*	*(2.0357)*	*(0.3137)*	*(1.9987)*	*(1.0509)*	*(2.1931)*
ϕ1	*0.4769*	*0.2172*	*0.2941*	*0.2196*	*0.3609*	*0.2209*	*-0.0493*	*0.2216*
	(0.8987)	*(10.4618)*	*(0.2848)*	*(10.5765)*	*(0.9291)*	*(10.6518)*	*(-0.1758)*	*(10.6494)*
ϕ2	*2.6861*	*-2.5461*	*1.6847*	*-2.2601*	*1.8763*	*-2.2776*	*1.0168*	*-2.8165*
	(0.7313)	*(-1.3272)*	*(0.5323)*	*(-1.1577)*	*(0.8364)*	*(-1.1669)*	*(0.8404)*	*(-1.4305)*
λ1		*-0.0049*		*0.0385*		*0.0351*		*0.0239*
		(-0.3657)		*(3.3668)**		*(3.1988)**		*(3.0024)**
α0	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
	(6.6157)	*(3.6943)*	*(6.1710)*	*(5.3955)*	*(5.9933)*	*(4.5559)*	*(9.6062)*	*(4.2755)*
α1	*0.1240*	*0.2196*	*0.0973*	*0.2427*	*0.1057*	*0.2410*	*0.0864*	*0.2395*
	(12.583)	*(19.303)**	*(11.844)*	*(19.333)**	*(12.372)*	*(18.968)**	*(14.991)*	*(18.940)**
α2	*0.8596*	*0.7510*	*0.8871*	*0.7281*	*0.8780*	*0.7287*	*0.8880*	*0.7239*
	(83.586)	*(63.165)**	*(94.217)*	*(58.776)**	*(88.369)*	*(57.770)**	*(117.300)*	*(55.704)**
λ2		*3.65E-06*		*3.22E-06*		*3.50E-06*		*3.94E-06*
		*(8.1879)**		*(7.9781)**		*(7.9845)**		*(9.1290)**

represents the results of important leading markets on Serbia stock market. Here, it explores the market linkage of the East European market with a market of past and present political associations. Result reveals the presence of a mean spillover effect from the UK to Serbia which is negative and insignificant. While from Germany, France and Russia to Serbia is positive and significant. The mean transmission is highest from Germany followed by the UK, France, and Russia. Similarly, volatility spillover is also observed from all markets. Volatility in regional market is significantly transmitted to Serbia market, So Serbia market appears to be influenced by all major developed markets. Also, the volatility transmission is highest from Russia. This shows that Serbia has still influence of Russia because Serbia got independence in the later period of 2006. The results further indicate that past price influence current return as ARCH term is significant; the persistence of volatility is also observed through the significance of GARCH term. The sum of ARCH and GARCH term from UK, France, Russia, and Germany is 0.97 which shows the long run persistence of volatility as it is significantly lower than 1 (Oikonomikou,. 2015)

Table 5.7
Mean and Volatility spillover effect of UK, Germany, France, and Russia on Ukraine Market by using GARCH-M Model

Data since 8 Jan 2008 to 30 Nov 2022

	UK	Ukraine	Germany	Ukraine	France	Ukraine	Russia	Ukraine
ϕ0	-0.0000	-0.0001	0.0001	-0.0002	0.0000	-0.0003	0.0001	-0.0000
	(-0.1498)	(-0.1992)	(0.4327)	(-0.5156)	(-0.1634)	(-0.8327)	(0.1253)	(-0.1213)
ϕ1	0.5734	0.0950	0.2129	0.0930	0.2529	0.0920	0.9003	0.0965
	(0.8154)	(5.5742)	(0.1799)	(5.6106)	(0.4868)	(5.5530)	(1.1392)	(6.0184)
ϕ2	2.2454	0.6224	2.2781	0.9650	2.6828	1.4094	0.0072	0.4656
	(0.4805)	(0.4466)	(0.5299)	(0.6659)	(0.9100)	(0.9589)	(0.0058)	(0.3004)
λ1		0.5386		0.4408		0.4406		0.4395
		(25.3294)*		(23.5927)*		(24.1193)*		(31.4153)*
α0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(7.8377)	(4.4285)	(6.6714)	(4.2256)	(7.4059)	(5.9171)	(16.712)	(7.9810)
α1	0.0672	0.1454	0.0538	0.1260	0.0611	0.1317	0.0494	0.1513
	(16.940)	(20.387)*	(14.715)	(21.833)*	(16.030)	(20.797)*	(19.827)	(19.888)*
α2	0.9229	0.8124	0.9375	0.8317	0.9272	0.8214	0.9406	0.7806
	(210.05)	(102.12)*	(222.05)	(112.42)*	(198.73)	(105.13)*	(361.92)	(82.32)*
λ2		1.11E-05		1.02E-05		1.00E-05		1.35E-05
		(13.9643)*		(11.5742)*		(11.477)*		(12.923)*

Results from Table 5.7 represent the results of mean and volatility spillover from developed European markets to Ukraine. The purpose of the study is to find the connection between East European markets with present and past political association. There is significant mean and volatility spillover from leading markets of Europe to Ukraine. The mean spillover transmission is highest from the UK, whereas volatility spillover transmission is highest from Russia which is an effect of past political association with Russia. The influence of Russia is still present even though the disintegration of East European bloc from the Soviet Union. The significance of ARCH term indicates that past price behaviors affect the current volatility. Whereas, GARCH term shows the persistence of volatility in long run. Meanwhile, the sum of ARCH and GARCH term for the UK, France and Germany is 0.95 and for Russia is 0.93, which indicates the long run persistence (Drachal, K., 2017).

Table 5.8

Mean and Volatility spillover effect of UK, Germany, France, and Russia on Croatia Market by using GARCH-M Model

Data from 14th May 2001 to 30 Nov 2022

	UK	Croatia	Germany	Croatia	France	Croatia	Russia	Croatia
ϕ0	0.0000	0.0002	0.0004	0.0002	0.0001	0.0002	0.0013	0.0012
	(0.2644)	(1.8546)	(1.3800)	(1.5969)	(0.6525)	(1.5960)	(3.1764)	(1.9194)
ϕ1	0.3195	0.0601	-0.1771	0.0596	0.2963	0.0595	-0.7944	0.0399
	(0.9381)	(4.8566)	(-0.2922)	(4.7973)	(0.8098)	(4.7901)	(-2.1901)	(1.4754)
ϕ2	2.8181	-0.5458	1.6231	-0.2953	1.4317	-0.3612	0.8979	-4.3986
	(1.2134)	(-0.3145)	(0.9952)	(-0.1700)	(0.8438)	(-0.2102)	(0.7667)	(-1.4206)
λ1		0.1824		0.1342		0.1362		0.1636
		(22.4714)*		(24.6627)*		(22.0793)*		(18.3301)*
α0	0.0000	-0.0000	0.0000	-0.0000	0.0000	-0.0000	0.0000	0.0001
	(9.1238)	(-6.0608)	(9.4326)	(-4.8061)	(8.6760)	(-7.4888)	(14.7599)	(10.9320)
α1	0.0673	0.0497	0.0567	0.0505	0.0583	0.0535	0.0550	0.1494
	(21.4694)	(28.813)*	(19.8909)	(30.015)*	(21.4083)	(28.049)*	(23.3924)	(8.082)*
α2	0.9255	0.9495	0.9363	0.9488	0.9353	0.9459	0.9277	0.5968
	(275.0825)	(693.814)*	(296.340)	(679.776)*	(305.7365)	(623.666)*	(293.9106)	(16.542)*
λ2		7.10E-07		6.73E-07		7.91E-07		-1.41E-06
		(12.3677)*		(10.1849)*		(15.1880)*		(-29.4205)*

Mean and volatility spillover from leading European markets to Croatia market is presented in table 4.8, the main objective of this analysis is to inquire about the impact of its past and present political link with them. Results represent that there is significant mean and volatility spillover from leading markets to Croatia. Economic shocks from the UK are highest which affect the returns of Croatia. Whereas highest volatility spillover is observed from Russia but value of -29.42 indicates negative significance. Despite Croatian independence from Russia, the impact of Russia is still significant. The significance of ARCH term shows that past price behavior affects the current volatility of Croatia. Persistence of volatility is also observed through the significance of GARCH term. The sum of ARCH and GARCH term for UK, France, and Germany is 0.98 and for Russia is 0.74 that indicates the long run persistence. However, in all cases, it is significantly lowered than 1 (Drachal, K., 2017).

To conclude the results of table 4.8, coefficients of λ1 are positive and statistically significant. The mean and volatility spillover effects of all leading markets are also significant but the coefficient of λ2 shows inverse relationship from Russia to Croatia.

Table 5.9

Mean and Volatility spillover effect of UK, Germany, France, and Russia on Romania Market by using GARCH-M Model

Data since 14th may 2001 to 30th nov 2022

	UK	Romania	Germany	Romania	France	Romania	Russia	Romania
ϕ0	0.0000	0.0005	0.0004	0.0004	0.0001	0.0005	0.0013	0.0005
	(0.2644)	(2.6176)	(1.3799)	(2.4943)	(0.6525)	(2.6576)	(3.1764)	(2.5992)
ϕ1	0.3195	0.0789	-0.1771	0.0826	0.2963	0.0845	-0.7944	0.0740
	(0.9381)	(6.7024)	(-0.2921)	(6.8631)	(0.8097)	(7.0335)	(-2.1900)	(6.5135)
ϕ2	2.8181	1.7074	1.6231	2.1439	1.4317	1.9850	0.8979	1.7308
	(1.2133)	(1.0290)	(0.9951)	(1.3486)	(0.8438)	(1.2323)	(0.7667)	(1.0847)
λ1		0.2241		0.1512		0.1748		0.1258
		(20.0625)*		(16.6806)*		(18.6411)*		(20.3474)*
α0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(9.1238)	(6.4007)	(9.4325)	(5.9433)	(8.6760)	(5.0663)	(14.759)	(3.9209)
α1	0.0673	0.0874	0.0567	0.1024	0.0583	0.1048	0.0550	0.0817
	(21.469)	(30.345)*	(19.890)	(32.08)*	(21.4083)	(32.372)*	(23.392)	(36.149)*
α2	0.9255	0.8870	0.9363	0.8689	0.9353	0.8658	0.9277	0.9000
	(275.08)	(295.10)*	(296.34)	(249.65)*	(305.7365)	(254.00)*	(293.91)	(364.75)*
λ2		2.70E-06		3.18E-06		3.47E-06		2.21E-06
		(19.9028)*		(16.2065)*		(16.3679)*		(19.5822)*

Table 5.9 shows the mean and volatility spillover effect from developed leading market of Europe to Romania. This observes political alliance and market linkage after disintegration from the Soviet Union. The results show the significant mean spillover from leading markets of Europe to Romania. The Mean spillover transmission is highest from the UK. Volatility is also significantly transmitted to Romania from all developed markets. Volatility transmission is highest from France which means that France market affects the volatility of Romania market more than other markets. Both mean and volatility spillover coefficients are positive and statistically significant. The results further show that past price behavior influences current volatility as ARCH term is significant. GARCH term is also found significant which shows the persistence of volatility. The sum of ARCH (α1) and GARCH term (α2) for UK, France, and Germany is 0.97 and for Russia is 0.98, all Models indicates the long Run persistence but in all cases, it is significantly lowered than 1 (Drachal, K., 2017).

Table 5.10

Mean and Volatility spillover effect of UK, Germany, France, and Russia on Hungry Market by using GARCH-M Model

Data since 14th may 2001 to 30 nov 2022

	UK	Hungry	Germany	Hungry	France	Hungry	Russia	Hungry
ϕ0	0.0000	0.0007	0.0004	0.0005	0.0001	0.0006	0.0013	0.0006
	(0.2644)	(2.9850)	(1.3800)	(2.1444)	(0.6525)	(2.7506)	(3.1764)	(2.4066)
ϕ1	0.3195	0.0113	-0.1771	0.0105	0.2963	0.0083	-0.7944	0.0048
	(0.9381)	(1.0180)	(-0.2922)	(0.9379)	(0.8098)	(0.7581)	(-2.1901)	(0.4071)
ϕ2	2.8181	-1.2979	1.6231	0.6941	1.4317	-0.5209	0.8979	-0.5080
	(1.2134)	(-0.5703)	(0.9952)	(0.3288)	(0.8438)	(-0.2313)	(0.7667)	(-0.2375)
λ1		0.5549		0.4147		0.4596		0.2846
		(43.8119)*		(40.2674)*		(45.200)*		(41.7957)*
α0	0.0000	-0.0000	0.0000	-0.0000	0.0000	0.0000	0.0000	-0.0000
	(9.1238)	(-5.9423)	(9.4326)	(-5.3078)	(8.6760)	(-4.6977)	(14.7599)	(-0.0979)
α1	0.0673	0.0356	0.0567	0.0388	0.0583	0.0391	0.0550	0.0429
	(21.469)	(14.271)*	(19.890)	(15.097)*	(21.408)	(14.725)*	(23.392)	(15.499)*
α2	0.9255	0.9435	0.9363	0.9379	0.9353	0.9391	0.9277	0.9309
	(275.08)	(289.22)*	(296.34)	(280.38)*	(305.73)	(268.87)*	(293.91)	(251.92)*
λ2		3.29E-06		3.47E-06		3.29E-06		3.08E-06
		(16.760)*		(17.467)*		(15.527)*		(14.147)*

The objective of the study explores the market association of East European market with a market of past and present political linkage. Result in Table 5.10 shows that mean spillover is significant from the UK, Germany, France, and Russia to Hungry. The mean spillover transmission is highest from the UK followed by Germany France and Russia. Similarly, volatility spillover is also observed from all leading markets. The volatility of the regional market is significantly transmitted to Hungry market; volatility transmission is highest from the German market. The mean and volatility spillover effect is still significant for Russia despite Hungry independence from it. The results further indicate that past price influence current return as ARCH term is significant; the persistence of volatility is also observed as GARCH term is found significant. The sum of ARCH and GARCH term for UK, France, and Germany and Russia is 0.97, which shows the long-run persistence of volatility.

Results concluded that for both mean and volatility spillover, coefficients are positive and statistically significant. The ARCH term (α1) of all equations is significant which means that past price behavior effect current volatility. Whereas, GARCH term (α2) of variance equations is also significant, that means that there is a persistence of the volatility (Drachal, K., 2017).

Table 5.11
Mean spillover from UK, Germany, France Russia to Poland market by Regression Mean Equation

Data from 1st March 2001 to 30 nov 2022

UK to Poland	**Variables**	**C**	**RUK(-1)**	**EUK**	**RPD(-1)**
	Coefficient	-0.001373	0.15239	0.612718	-0.04358
	T Statistics	-0.735398	0.848275	4.0025*	-0.29302
	P value	0.4621	0.3963	0.0001*	0.7695
Germany to Poland	**Variables**	**C**	**RGR(-1)**	**EGR**	**RPD(-1)**
	Coefficient	-0.001818	0.048911	0.48203	-0.00043
	T Statistics	-0.973375	0.344518	3.967717*	-0.00291
	P value	0.3304	0.7305	0.0001*	0.9977
France to Poland	**Variables**	**C**	**RFR(-1)**	**EFR**	**RPD(-1)**
	Coefficient	-0.00139	-0.06843	0.47941	0.057887
	T Statistics	-0.759265	-0.466555	3.886935*	0.387615
	P value	0.4477	0.6408	0.0001*	0.6983
Russia to Poland	**Variables**	**C**	**RRU(-1)**	**ERU**	**RPD(-1)**
	Coefficient	-0.001574	0.000996	0.320779	-0.00904
	T Statistics	-0.861146	0.023025	3.516882*	-0.06995
	P value	0.3892	0.9816	0.0004*	0.9442

Note 2: RUK (-1) lagged return of UK, RGR (-1) Lagged return of Germany, RFR (-1) Lagged return of France. RRU (-1) Lagged return of Russia, E shows the error term of the related country (EUK, EGR, EFR, and ERU). RPD (-1) shows the lagged return of Poland market. * (steric) shows the significance of mean spillover.

Heteroscedasticity of Poland is insignificant which means that the Poland variance is constant and no volatility effect is present in Poland market so only mean spillover effect is observed by using simple regression analysis and GARCH model is not used, as heteroscedasticity does not exist in this market. In table 5.11 when specific market volatility is constant then no variation means nothing will explain it and only mean spillover is calculated by using regression analysis.

The results in table 5.11 show that there is mean spillover from leading regional markets to Poland. Economic Shocks comes from UK market effect the Poland market more than Germany, France, and Russia markets. Russian market economic shocks least affect the Poland market which means that Russian influence on Poland market is gradually diminishing.

CONCLUSION

The main purpose of this research is to explore the influence of leading European markets and Russia on the Eastern European markets. The East European markets include Slovenia, Estonia, Lithuania, Czech Republic, Serbia, Ukraine, Croatia, Romania, Hungry and Poland whereas the leading regional market includes UK, Germany, France, and Russia. The mean and volatility spillover effects have been studied to know whether these markets are still influenced by Russian market or European leaders like UK, Germany, and France have taken the lead. The two-stage ARMA GARCH-in-mean approach (GARCH-M), as proposed by Liu and Pan (1997) is used to find the international transmission by using daily data.

The results of this study represent that the mean and the volatility of Eastern European markets are influenced by both Russia and leading regional markets. The mean spillover effects from the leading European markets (UK, France, and Germany) and

Russia are significant for all Eastern European markets except the UK to Serbia, whereas the volatility spillover effects are also significant from leading markets to all Eastern European markets.

Moreover, it is evident that UK markets mean and volatility spillover has a greater influence upon the new economic regime of Eastern European markets after the collapse of Russia, given that the coefficients for most of the European countries are statistically positive and significant. Similarly, volatility spillover is also observed from all markets. Volatility in regional markets is significantly transmitted to all European markets, so they appear to be integrated with developed markets. Despite disintegration of the Eastern European bloc, the influence of Russia in the market is still significant but it is diminishing with the passage of time. Serbian market got independence in the later period of 2006 that's why the volatility spillover is highest from the Russian market to the Serbian market.

ARCH is insignificant for Poland which means that variance is constant and no volatility effect is present in Poland. However, mean spillover effect is observed from leading markets to Poland. This study is helpful for investors, economic policymakers, and academia. Investors should be vigilant about the behaviors of the markets because the spillover effect may affect their investment. Investors can formulate effective approaches against volatilities spillover from leading markets to newly emerged countries of Eastern Europe. Investors are able to manage effective portfolios in the selected countries to enhance their investment stock returns. The economic manager may devise policies to avoid contagious of spillover. Finally, the study concludes that when economic integration is switched off then financial integration can also be changed.

Limitations of the Study

This study limited on only ten East European stock markets (Slovenia, Estonia, Lithuania, Czech Republic, Serbia, Ukraine, Croatia, Romania, Hungry and Poland), Moreover, Other countries are not included which is also part of East Europe and get independence from Soviet Union i.e. Slovakia, Malta, Cyprus, Latvia and Georgia etc. are not included in our studies due to unavailability of data and limited time. In future large number of countries from other East European region may include for more accurate results. Country specific data is used according to availability of data due to limited time frame. In future researchers may conduct that research on more accurate data to get more precise results.

Recommendations of Study

This study is helpful for investors, economic policy makers and academia. Investors can formulate effective approaches against volatilities spillover from leading markets to newly emerged countries of Eastern Europe. Investors are able to manage effective portfolios in the selected countries of our study to enhance their investment stock returns. For economic policy makers, they help to understand about the information of returns and volatility spillover of East European stock markets so that they make policy easily to avoid contagious of spillover, So that new Policies may be formulated and implemented to manage the volatilities of stock markets. For academia purpose this study is also helpful to the researchers to have insight about the volatility spillover in East European countries stock market indices and extend literature in the field of this research domain.

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