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What is Behind Extreme Negative Returns co-movement in the South Eastern European Stock Markets?

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Abstract

This paper examines co-movement of extreme returns in eight South Eastern European (SEE) stock markets during the period covering both the financial crisis from 2007-2009 and the COVID-19 health crisis. The analysis is based on coexceedances which represent the number of joint occurrences of extreme returns in a group of stock market indexes. To provide a valuable insight on how persistence, asset class, and volatility effects are related with the coexceedances, we utilize a multinomial logistic regression procedure. We find evidence in favour of the continuation hypothesis. However, the factors associated with the coexceedances differ between the SEE European Union (EU) members and the SEE EU accession countries. The EU members are more dependent on signals from major EU economies, while the accession countries are mainly impacted by regional signals. The implications of our analysis may help policy makers in understanding the nature of shock transmission in SEE stock markets.

Keywords: co-movement; contagion; stock markets; emerging markets; South Eastern Europe.

JEL classification: C25; F36; G15.

1. INTRODUCTION

The stock markets passed through two severe episodes of turmoil in the recent periods. First, the global financial crisis of 2007-09 created severe stock market crashes. During this crisis, the South Eastern European (SEE) stock markets experienced stronger fall in asset prices in comparison to the leading European markets. For example, in the period from April 2007 to April 2009, SEE stock markets experienced an average decrease of 70%, while in the same period the British and German stock markets fell by 39% and 45%. The SEE stock markets recovery was much weaker than those of the leading European Markets. The second crisis, which is still ongoing, is the COVID-19 pandemic. At the beginning of the pandemic

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the volatility skyrocketed upward in all markets around the world. Baker *et al.* (2020) argued that in the United States, volatility levels in the middle of March 2020 surpass those last seen in October 1987 and December 2008 and, before that, in late 1929 and the early 1930s.The shock quickly propagated to other less developed markets, among which are the SEE stock markets.

The contagious propagation of the extreme returns from one market to another is a well-posed problem in the international finance literature (for a comprehensive review of this topic we refer to Seth and Panda (2018). However, the mechanisms through which this process manifests itself depends on the markets in question. Motivated by this phenomenon, in this paper we study what is behind the extreme falls in SEE stock markets during these two crises. For this purpose, we implement the method proposed by (Bae *et al.*, 2003) and investigate the co-movements in the extreme returns between SEE stock markets, through the lenses of a multinomial logistic regression model. We test three possible explanations for the joint extreme negative stock market returns in SEE: (i) *persistence effects* -- Whether the extreme stock returns are followed by subsequent movements in the same direction?; (ii) *asset class effects* -- What is the explanatory power of the three asset class groups, namely interest rates, currency returns and stock returns?; and (iii) *volatility effects* -- What is the explanatory power of the volatilities in the asset class groups?

The initial study of this type for European Union (EU) was done by Christiansen and Ranaldo (2009), where the financial integration of the new EU member states' stock markets was examined through the lenses of the same multinomial logistic regression framework. For SEE two investigations of this type have been done. First, Dajcman (2014) examined the coexceedances between Croatian and 10 European stock markets during the period 2003 – 2012. Similarly, Baranová (2018) looked into the effect of coexceedances in the German stock market on five SEE EU accession countries and found significant contagious effect.

We build upon this literature and contribute to it in two ways. First, this is the first paper that isolates extreme negative co-movement in the SEE stock markets of the countries that are members of EU (Bulgaria, Croatia, Romania and Slovenia) from those that are accession countries (Bosnia and Herzegovina, North Macedonia, Montenegro and Serbia) and quantifies the potential contagious relationship between these two groups. We find that, in general, the SEE accession countries are not receiving signals from the leading EU stock markets, but from the more EU member country markets from the same region. One possible explanation for this observation is the strong presence of SEE EU member countries with financial institutions, commercial banks and investment funds in the finance industry structure of the accession countries. Second, to the best of our knowledge, this is the study with the longest period of observation for the extreme co-movement analysis between SEE stock markets. The period of observation is 2006-2020, covering different episodes of market distress, including the Global financial crisis and the current COVID-19 crisis. Hence, the results of this investigation may help policy makers to understand the nature of shock transmission in SEE stock markets. In addition, they may be useful to investment managers for international portfolio diversification.

The structure of the paper is as follows. Section 2 provides a comprehensive literature review on the stock market co-movements literature. We proceed in Section 3 with presenting the data. In Section 4 we explain the methodological framework of multinomial regression and explain the research hypotheses. Section 5 we describe the empirical results and discuss the implications created therein. In Section 6 we summarize our findings.

2. LITERATURE REVIEW

In recent years, stock market co-movements have received a lot of attention in international finance research because they offer simple explanations and pragmatic solutions for asset allocation and investment management issues. As a consequence, there is a growing body of literature that examines stock market co-movements in both developed and developing economies. The most recent studies of this phenomena in Central and Eastern Europe are Gjika and Horvath (2013); Horvath and Petrovski (2013); Harkmann (2014); Kiviaho *et al.* (2014); Reboredo *et al.* (2015); Stoica *et al.* (2015); Nitoi and Pochea (2016); Sensoy *et al.* (2016); Beck and Stanek (2019); Tilfani *et al.* (2020).

Despite an abundance of studies for CEE, investigations for the SEE markets have lagged behind. The majority of analyses for these markets are done on the basis of cointegration analysis, which is not enough to provide a valuable information on the co-movement's implications. For instance, the cointegration method was used in the following three studies. First, Kenourgios and Samitas (2011) examine long-run relationships among five Balkan emerging stock markets (Turkey, Romania, Bulgaria, Croatia, Serbia), the United States and three developed European markets (UK, Germany, Greece), during the period 2000 – 2009. Using conventional and regime-switching cointegration tests together with a Monte Carlo simulation, their results provide evidence in favor of a long-run cointegrating relationship between the Balkan emerging markets within the region and globally. Similarly, Guidi and Ugur (2014) investigate whether the SEE stock markets (Bulgaria, Croatia, Romania, Slovenia and Turkey) are integrated with their developed counterparts in Germany, the UK and the USA, over the period 2000 – 2013. Their results suggest the existence of a time-varying cointegration among the SEE markets and the developed counterparts, particularly during a sub-period of the financial crisis. Finally, Đukić and Đukić (2015) examine SEE stock markets interdependencies (Slovenia, Croatia, Serbia, Montenegro, Republic of Srpska, Macedonia and Bulgaria) over the period 2007-2011. They find that cointegration exists only between the stock market indexes of the Republic of Srpska and Serbia.

There are several studies which propose other methodologies for examining the SEE stock markets co-movements. For example, Gradojevic and Dobardzic (2013) employ a frequency domain approach to analyze the causal relationship between the returns of the main stock indexes of Croatia, Slovenia, Hungary and Germany on the return of the major Serbian stock exchange index. The results suggest a dominant effect of the Croatian and Slovenian stock exchange indexes on the Serbian stock index across a range of frequencies. In another study, Horvath and Petrovski (2013) employ multivariate GARCH models to examine the international stock market co-movements between Western Europe vis-à-vis Central (the Czech Republic, Hungary and Poland) and South Eastern Europe (Croatia, Macedonia and Serbia) in 2006 – 2011 period. The authors find that the degree of co-movements is much higher for Central Europe.

The study of Dajcman (2014) and Baranová (2018) are the only that have the same focus as the present paper. The first analysis examines the extreme returns co-movement and contagion between the Croatian and 10 European stock markets during the period 2003 – 2012. The author's findings suggest that DJI returns, EUROSTOXX50 conditional volatility, 10-year US Treasury note yields level, the USD-HRK exchange rate returns and the three-month EURIBOR level significantly impacted the probability of extreme returns co-movement in the pair-wise observed stock markets, where one is the Croatian market. In a similar vein, Baranová (2018) examined the effect of coexceedances in the German stock market on five countries which are actively seeking to become a part of EU (Montenegro, Serbia, Turkey, Bosnia and Macedonia) between 2006 and 2018 through a quantile regression approach. In this paper, it was suggested that there is a contagion from the German market to the studied SEE markets, i.e., the negative coexceedences in Germany are translated to SEE.

3. DATA DESCRIPTION

We focus on the extreme coexceedances in eight South and East Europe (SEE) stock markets Bulgaria (BGR), Bosnia and Herzegovina (BIH), Croatia (HRV), North Macedonia (MKD), Montenegro (MNE), Romania (ROU), Serbia (SRB) and Slovenia (SVN). We apply daily data of the leading stock market index for each country, which respectively is SOFIX, SASX10, CROBEX, MBI10, MONEX, BET, BELEXline and SBITOP. In addition, in the analysis we include the leading stock indexes from Germany (DEU), France (FRA), United Kingdom (GBR), Italy (ITA) and the United States (USA) for the purpose of investigating whether they are the major drivers of the extreme coexceedances in SEE. We use daily log returns calculated from the price indexes for the stock markets as measured in national currency. Christiansen and Ranaldo (2009) argue that the usage of national currencies returns is equivalent to currency hedged returns. The usage of common currency returns, on the other hand, biases the results and confounds the genuine stock performance with that of the exchange rates. In addition, because most markets are operating in the same time zone, the problem of non-overlapping trading hours does not arise and thus the data does not need any temporal adjustment. The data covers the period between February 2nd, 2006 and December 16th, 2020. The dates correspond to the first and last date for which there is data for every variable included in the analysis. This leads to a total of 3869 observations covering both bull and bear phases, high and low volatility and different market conditions. Most importantly, the observation period includes both the recent global financial crisis and the current COVID-19 crisis.

As a means to investigate the potential financial contagion, we divide the countries into four distinct groups. The first three groups consist of four countries, whereas the last one includes only one economy. The first two groups contain countries from SEE. The criterion for division between the SEE countries is the EU membership. The first group are EU accession countries from SEE: Bosnia and Herzegovina, Macedonia, Montenegro and Serbia. We denote this group with ACC. The second group, denoted as MBR, is represented by EU member countries from SEE: Slovenia, Romania, Bulgaria and Croatia. The third group represents the major EU economies according to nominal GDP in 2019. It consists of Germany, United Kingdom, France, and Italy, represented by the leading stock indexes: DAX, FTSE 100, CAC 40 and FTSE MIB, respectively. This group is labeled with MEU. Finally, the last group includes solely the United States, represented by Dow Jones U.S. Total Stock Market index. Tables no. A1 and A2 in the appendix present the descriptive statistics and correlation matrix for the daily log returns between all 13 considered countries. The data was gathered from the websites of the main stock markets of the SEE countries, and Google Finance for the leading indexes of the major EU economies USA and the explanatory variables described in the following.

3.1 Coexceedance variables

As pointed out, we focus on the occurrences of extreme returns and we treat extreme negative and extreme positive returns separately. The definition for an extreme return is taken from Bae *et al.* (2003): a negative extreme return (negative exceedance) is one that lies below the 5% percentile of the empirical return distribution. Similarly, a positive extreme return (positive exceedance) is a return that lies above the 95% percentile of the empirical return distribution. Here we will focus on describing the negative coexceedances variables, and we remark that the positive variables are defined analogously.

Following Christiansen and Ranaldo (2009) we construct a variable XN_t^{ACC} that counts the number of extreme negative returns among EU accession countries from SEE on a given day t. The variable takes on integer values between 0 and 2 and is our measure for the extreme coexceedances. It quantifies three possibilities: no extreme return in any of the countries from the group in the day ($XN_t^{ACC} = 0$), only one country with an extreme daily return in the group ($XN_t^{ACC} = 1$), and several countries with an extreme daily return ($XN_t^{ACC} = 2$). Identical negative coexceedance variables are constructed for the group of EU member countries from SEE (MBR) and for the group of major EU economies (MEU). We can summarize the negative coexceedance variables as:

- XN_t^{ACC}: number of negative coexceedances for EU accession countries from SEE on day t;
- XN_t^{MBR}: number of negative coexceedances for EU member countries from SEE on day t;
- XN_t^{MEU}: number of negative coexceedances for major EU economies on day t;

Summary statistics for the negative coexceedance variables are given in Table no. 1. The 3869 days in the sample period are divided into days in which there are no exceedances in any country (e.g., 3283 such days in ACC group for negative extreme returns), there is only one country exceedance (e.g., 451 such days in ACC group for negative extreme returns), and multiple country coexceedances (e.g., 135 such days in ACC group for negative extreme returns). The number of multiple coexceedances is higher in the group of major EU economies (MEU) in comparison to both SEE groups (ACC and MBR) even though the number of group members is the same (four countries). This reflects the higher level of interconnection of the MEU group in comparison with the SEE groups.

Table no. 1 – Summary statistics of negative coexceedance variables

	Number of Negative coexceedances		
	0	**1**	**2+**
ACC	3283 (84.8%)	451 (11.7%)	135 (3.5%)
MBR	3345 (86.5%)	372 (9.6%)	152 (3.9%)
MEU	3546 (91.6%)	123 (3.2%)	200 (5.2%)

3.2 Explanatory variables

In the empirical analysis, we include several explanatory variables that may have a potential effect on the observed extreme coexceedances. In the choice of variables, we follow the existing literature, and select to a large extent the same variables as Bae *et al.* (2003) and Christiansen and Ranaldo (2009). The frequency of every explanatory variable corresponds to the daily frequency of the coexceedance variables. The explanatory variables are:

- S_t^{USA}: concurrent return from the US stock market (log-returns from the Dow-Jones Industrial Average index).
- S_t^{MEU}: concurrent return from the major EU economies stock market (log-returns from equally weighted index constructed for the Germany, United Kingdom, France and Italy).
- S_t^{MBR}: concurrent return from the EU member countries from SEE stock market (log-returns from equally weighted index constructed for Slovenia, Romania, Bulgaria and Croatia).
- σ_t^{USA}: concurrent volatility for US stock market (square root of the conditional variance stemming from estimating the AR (1)-GARCH (1,1) model for the US stock return – S_t^{USA}).
- σ_t^{MEU}: concurrent volatility for major EU economies stock market (square root of the conditional variance stemming from estimating the AR (1)-GARCH (1,1) model for the major EU economies stock return – S_t^{MEU}).
- σ_t^{MBR}: concurrent volatility for EU member countries from SEE stock market (square root of the conditional variance stemming from estimating the AR (1)-GARCH (1,1) model for the EU member countries from SEE stock return – S_t^{EUS}).
- C_t: concurrent currency log return (exchange rate of EUR per USD).
- σ_t^{C}: concurrent volatility for currency return (square root of the conditional variance stemming from estimating the AR (1)-GARCH (1,1) model for the currency log return – C_t).
- R_t: concurrent interest rate (first differences of 1-month EURIBOR). Here we use the first difference, since the hypothesis for unit root of the level of interest rate series cannot be rejected.
- σ_t^{R}: concurrent volatility for currency return (square root of the conditional variance stemming from estimating the AR (1)-GARCH (1,1) model for the interest rate – R_t).

4. METHODOLOGICAL FRAMEWORK

In the first part of this section, we present the econometric technique of multinomial logistic regression that is convenient for modeling categorical observables such as the extreme coexceedances. In the second part, we describe our hypotheses.

4.1 Multinomial logistic regression

We use the multinomial logit method developed in Bae *et al.* (2003) for analyzing extreme co-movements between stock markets. This method offers a more efficient (in econometric terms) and consistent (in economic terms) way of analyzing co-movement between financial markets. In this case, the coexceedance measure is not biased in periods of high volatility, it is not restricted to model linear phenomena, and it is easy to compute across time and assets – see Baur and Schulze (2005); Dungey *et al.* (2005) and Markwat *et al.* (2009).

A multinomial logit model is appropriate for modeling coexceedance variables, represent discrete choice variables that, in our case, have only three categories (0, 1, and 2). We consider the no exceedance category as our base and model the marginal effects of changing from no exceedance to either only one exceedance or multiple coexceedances. Under this model, the probability of, for example, XN_t^{ACC} being in category i is given by:

$$P_i = \frac{exp(\beta_i^{'} x)}{\sum_{j=1}^{2} exp(\beta_j^{'} x)} \quad (1)$$

where $i \in \{1,2\}$; x is the vector of explanatory variables (including a constant term) and β_i is the vector of marginal effects for category i. The probability P_i of being in category i is given in the form of a softmax function f of the explanatory variables. For each covariate there is one coefficient associated with the marginal effect for each of the categories of the dependent variable (for example, β_{1j} for category 1 for x_j).

The explanation of the coefficients is straightforward: when β_{1j} is significant, then it can be argued that variable j has an effect on the probability of the occurrence of an exceedance; when β_{2j} is significant, then variable j potentially impacts the probability of the occurrence of a coexceedance. The significance of a given explanatory variable i.e., whether both coefficients for both categories are insignificant simultaneously ($\beta_{1j} = \beta_{2j} = 0$ for explanatory variable x_i) is checked with a χ^2-test of joint significance. To measure the performance of the model we additionally calculate the Cox and Snell's pseudo R^2 for each model.

4.2 Hypotheses and models

Persistence effects

The first hypothesis which we explore is regarding the persistence of extreme returns in the SEE stock markets. With this hypothesis, we investigate whether the negative or positive coexceedances in stock prices are followed with subsequent movements in the same direction (continuation) or in the opposite direction (reversal).

We utilize two specifications in order to test the persistence effects in SEE stock markets. The first specification tests whether the coexceedances in MBR stock markets are autoregressive and whether they are related to the coexceedances of the same type in MEU stock markets. In this case, for the negative coexceedance variable for the MBR group (XN_t^{MBR}), the explanatory variables are $XN_{t-1}^{MBR}$and XN_t^{MEU}. For XN_t^{MBR} the probability of having i negative coexceedances is:

$$P_i = f(\beta_{i0} + \beta_{i1} XN_{t-1}^{MBR} + \beta_{i2} XN_t^{MEU}) \quad (1)$$

In a similar manner, the second specification examines whether the coexceedances in ACC (EU accession countries from SEE group) stock markets are autoregressive and whether they are related to the coexceedances of the same type in MBR (EU member countries from SEE) and MEU (major EU economies group) stock markets. We believe that a transitory effect of the MBR to ACC stock markets is important for modeling the observed coexceedanes in the ACC group. Empirical evidence for this effect can be found in Gradojevic and Dobardzic (2013), where the authors find much stronger influence of the Croatian and Slovenian stock market indexes than the more developed German and Hungarian stock indexes on the dynamics of the Serbian stock index. Hence, for the negative coexceedance variable for the ACC group (XN_t^{ACC}), the explanatory variables are XN_{t-1}^{ACC}, XN_t^{MBR} and XN_t^{MEU} and the probability of having i negative coexceedances is:

$$P_i = f(\beta_{i0} + \beta_{i1} XN_{t-1}^{ACC} + \beta_{i2} XN_t^{MBR} + \beta_{i3} XN_t^{MEU}) \quad (3)$$

Asset class effects

The second hypothesis is focused on the potential asset class effects on the extreme returns in the SEE stock markets. With it, we explore whether currency rates and interest rates movements, as well as American and European stock markets developments, are relevant for explaining coexceedances in SEE stock markets.

As in the case of persistence effects, we use two forms in order to test the asset class effects in SEE stock markets. The first form tests whether the coexceedances in MBR (EU member countries from SEE group) stock markets or SEE (all countries from SEE) stock markets are related to different assets type returns. The explanatory variables are currency return (C_t), interest rate (R_t), major EU stock market return (S_t^{MEU}) and US stock market return (S_t^{USA}). Hence, for the negative coexceedance variable (XN_t^{MBR}) the probability of having i negative coexceedances can be written as:

$$P_i = f(\beta_{i0} + \beta_{i1}C_t + \beta_{i2}R_t + \beta_{i3}S_t^{MEU} + \beta_{i4}S_t^{USA}) \quad (4)$$

The second model specification includes ACC stock market negative coexceedances as a dependent variable and has an additional explanatory variable that describes the MBR stock market return (S_t^{MBR}). This allows us to capture regional transitory effects. For the negative coexceedance variable (XN_t^{ACC}) the probability of having i negative coexceedances is:

$$P_i = f(\beta_{i0} + \beta_{i1}C_t + \beta_{i2}R_t + \beta_{i3}S_t^{MEU} + \beta_{i4}S_t^{USA} + \beta_{i5}S_t^{MBR}) \quad (5)$$

Volatility effects

The last hypothesis examines the volatility effects on the extreme returns in the SEE stock markets. We use it to test whether coexceedances are more likely to occur in highly volatile environment overriding all asset classes. Here we also use two different model forms. The first form of the model tests whether the coexceedances in EU member countries from SEE group stock markets (MBR) are related to volatility of different assets type returns. The explanatory variables are volatility of currency return (σ_t^C), volatility of interest rate (σ_t^R), volatility of major EU stock market return (σ_t^{MEU}) and volatility of US stock market return (σ_t^{USA}). Thus, for the negative coexceedance variable (XN_t^{MBR}) the probability of having i negative coexceedances is:

$$P_i = f(\beta_{i0} + \beta_{i1}\sigma_t^C + \beta_{i2}\sigma_t^R + \beta_{i3}\sigma_t^{MEU} + \beta_{i4}\sigma_t^{USA}) \quad (6)$$

The second form of the hypothesis investigates the effect on ACC with an additional variable that captures the volatility of MBR stock market returns (σ_t^{MBR}), which is included for the purpose of capturing regional transitory effects. It follows that for the negative coexceedance variable (XN_t^{ACC}) the probability of having i negative coexceedances is:

$$P_i = f(\beta_{i0} + \beta_{i1}\sigma_t^C + \beta_{i2}\sigma_t^R + \beta_{i3}\sigma_t^{MEU} + \beta_{i4}\sigma_t^{USA} + \beta_{i5}\sigma_t^{MBR}) \quad (7)$$

5. EMPIRICAL RESULTS

In describing the results, we mainly focus on the implications created by the negative coexceedances. Tables no. 2-7 report the estimation results of the multinomial logit model for the two different dependent negative coexceedance variables. The left panel of each table presents the regression results where the dependent variable is the negative coexceedance variable for the EU members from SEE (XN_t^{MBR}). The right panel of the tables, correspondingly, gives the results from the regression analyses in which the dependent variable is the negative coexceedances for EU accession countries from SEE (XN_t^{ACC}). The first column shows the parameter estimates and the second gives their respective p-values. In the third column, the asterisk signs */**/*** indicate the significance of the individual parameter (β_{ij}) at a 10%/5%/1% level of significance. In the fourth column, we mark with &/&&/&&& the overall significance of the explanatory variable x_j at the 10%/5%/1% level of significance ($\beta_{1j} = \beta_{2j} = 0$).

Let us now present the results for each hypothesis test separately. We begin with Table no. 2 where we show the persistence effect results. We find evidence in favor of the continuation hypothesis since the lagged explanatory variable in both cases is significant and has a positive magnitude in the SEE markets, and hence we dispute the reversal hypothesis (subsequent movements in the opposite direction). This implies that the number of extreme negative returns in a day is positively related to the number of extreme negative returns in the previous day in both SEE groups (ACC and MBR).

In addition, we find that extreme negative returns in major EU economies' markets (MEU) have a significant and positive effect for both categories of coexceedances in the MBR group. This means that more extreme negative returns in major EU countries stock markets, lead to a higher likelihood of having (multiple) extreme negative returns on the EU member states from SEE stock markets (MBR). However, in the case of the accession countries from SEE (XN_t^{ACC}) the extreme negative returns in major EU economies' stock markets (MEU) are only significant for the two or more coexceedances category. Instead, the additional explanatory variable – negative coexceedances for EU member states from SEE (XN_t^{MBR}) is significant and positive for every category. This suggests that the negative extreme returns in the accession countries from SEE stock markets are impacted by any extreme negative movement in the region (MBR group), which is not the case for major EU economies (MEU group). The ACC group reacts only to strong bad signals (joint extreme negative returns in more than one country) from major EU economies stock markets, whereas it is more sensitive and reacts even in the case of isolated bad signals (only one country with extreme negative returns) from EU member states from SEE.

Table no. 2 – Multinomial regression results for persistence effects (negative coexceedances)

	Dependent variable: EU members from SEE (XN_t^{MBR})				**Dependent variable: Accession countries from SEE (XN_t^{ACC})**			
Const. (1)	-2.546	(0.000)	***	&&&	-2.435	(0.000)	***	&&&
Const. (2)	-4.212	(0.000)	***		-4.968	(0.000)	***	
XN_{t-1}^{ACC} (1)					1.038	(0.000)	***	&&&
XN_{t-1}^{ACC} (2)					1.997	(0.000)	***	
XN_{t-1}^{MBR} (1)	0.970	(0.000)	***	&&&				
XN_{t-1}^{MBR} (2)	1.527	(0.000)	***					
XN_t^{MBR} (1)					0.863	(0.000)	***	&&&
XN_t^{MBR} (2)					1.638	(0.000)	***	
XN_t^{MEU} (1)	0.731	(0.001)	***	&&&	0.121	(0.245)		&&&
XN_t^{MEU} (2)	1.544	(0.000)	***		0.481	(0.000)	***	
R-squared		11.3%				15.1%		

The results for the asset class effects are given in Table no. 3. For the EU member countries from SEE (MBR), the likelihood of observing negative coexceedances is related to the currency log return (C_t), interest rates (R_t) and major EU economies stock market return (S_t^{MEU}). The US stock market returns does not affect the extreme negative returns in the EU member countries from SEE (MBR). On the other hand, the likelihood of observing negative coexceedances in EU accession countries from SEE (XN_t^{ACC}) appears only connected with the EU member states from SEE stock returns (S_t^{MBR}), while the other assets class effects are insignificant. Larger returns are obviously associated with lower probabilities for extreme coexceedances. This implies that extreme negative returns in the EU accession countries from SEE are not influenced by the major EU stock markets and US stock market, but only from the developments in the stock markets of the countries in the region which are part of the EU (MBR).

When examining the volatility effects, we found existence of multicollinearity among the volatilities of US stock market return (σ_t^{USA}), major EU market stock market return (σ_t^{MEU}) and EU member countries from SEE stock market return (σ_t^{MBR}). In particular, in Table no. A3 in the appendix, which gives the correlation matrix of all included explanatory variables in the models, it can be seen that the correlations between the volatilities of the three above mentioned stock markets are higher than 0.85. To deal with this issue, we construct separate multinomial regression models for each of the volatility variables. Tables no. 4-6 display respectively the results of the volatility effects from major EU stock market return (σ_t^{MEU}), the US stock market return (σ_t^{USA}) and the EU member countries from SEE stock market return (σ_t^{MBR}).

Table no. 3 – Multinomial regression results for asset class effects (negative coexceedances)

	Dependent variable: EU members from SEE (XN_t^{MBR})				**Dependent variable: Accession countries from SEE (XN_t^{ACC})**			
Const. (1)	-2.252	(0.000)	***	&&&	-1.995	(0.000)	***	&&&
Const. (2)	-3.725	(0.000)	***		-3.629	(0.000)	***	
C_t(1)	0.062	(0.517)		&&&	0.027	(0.794)		
C_t(2)	0.538	(0.000)	***		-0.097	(0.526)		
R_t(1)	-16.598	(0.000)	***	&&&	-4.810	(0.179)		
R_t(2)	-13.461	(0.020)	**		-1.743	(0.781)		
S_t^{USA}(1)	-0.035	(0.517)			0.015	(0.797)		
S_t^{USA}(2)	0.049	(0.463)			-0.009	(0.894)		
S_t^{MEU}(1)	-0.302	(0.000)	***	&&&	-0.018	(0.803)		
S_t^{MEU}(2)	-0.897	(0.000)	***		-0.017	(0.860)		
S_t^{MBR}(1)					-0.277	(0.000)	***	&&&
S_t^{MBR}(2)					-1.175	(0.000)	***	
R squared		8.3%				5.8%		

From the tables we infer that an increase in the volatility of the interest rate and/or in the volatility of the currency increases the likelihood of observing negative coexceedances in EU member countries from SEE. Moreover, the marginal effects of the US and MEU markets volatility are significant and display positive relationship with the number of extreme coexceedances in both accession and member SEE countries. The accession countries extreme coexceedances are further positively related with the volatility of the SEE member countries.

Table no. 4 – Multinomial regression results for asset for volatility effects with only major EU stock market volatility (negative coexceedances)

	Dependent variable: EU members from SEE (XN_t^{MBR})				Dependent variable: Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-4.908	(0.000)	***	&&&	-5.248	(0.000)	***	&&&
Const. (2)	-8.907	(0.000)	***		-8.325	(0.000)	***	
$\sigma_t^C(1)$	0.882	(0.000)	***	&&&	0.781	(0.000)	***	&&&
$\sigma_t^C(2)$	1.337	(0.000)	***		1.291	(0.000)	***	
$\sigma_t^R(1)$	107.005	(0.000)	***	&&&	133.690	(0.000)	***	&&&
$\sigma_t^R(2)$	224.995	(0.003)	***		193.526	(0.000)	***	
$\sigma_t^{MEU}(1)$	0.182	(0.000)	***	&&&	0.099	(0.000)	***	&&&
$\sigma_t^{MEU}(2)$	0.086	(0.000)	***		0.191	(0.000)	***	
R squared		7.2%				6.7%		

Table no. 5 – Multinomial regression results for asset for volatility effects with only USA stock market volatility (negative coexceedances)

	Dependent variable: EU members from SEE (XN_t^{MBR})				Dependent variable: Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-4.848	(0.000)	***	&&&	-5.248	(0.000)	***	&&&
Const. (2)	-8.675	(0.000)	***		-8.325	(0.000)	***	
$\sigma_t^C(1)$	0.923	(0.000)	***	&&&	0.781	(0.000)	***	&&&
$\sigma_t^C(2)$	1.347	(0.000)	***		1.291	(0.000)	***	
$\sigma_t^R(1)$	106.186	(0.004)	***	&&&	133.690	(0.000)	***	&&&
$\sigma_t^R(2)$	219.527	(0.000)	***		193.526	(0.000)	***	
$\sigma_t^{USA}(1)$	0.058	(0.000)	***	&&&	0.099	(0.000)	***	&&&
$\sigma_t^{USA}(2)$	0.129	(0.000)	***		0.191	(0.000)	***	
R squared		6.8%				7.2%		

Table no. 6 – Multinomial regression results for asset for volatility effects with only MBR stock market volatility (negative coexceedances)

	Dependent variable: Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-5.086	(0.000)	***	&&&
Const. (2)	-8.086	(0.000)	***	
$\sigma_t^C(1)$	0.884	(0.000)	***	&&&
$\sigma_t^C(2)$	1.506	(0.000)	***	
$\sigma_t^R(1)$	127.269	(0.000)	***	&&&
$\sigma_t^R(2)$	185.889	(0.000)	***	
$\sigma_t^{MBR}(1)$	0.173	(0.000)	***	&&&
$\sigma_t^{MBR}(2)$	0.291	(0.000)	***	
R squared		6.9%		

Lastly, we estimate an encompassing model with all the explanatory variables analyzed above. Christiansen and Ranaldo (2009) argue that this encompassing model can be seen as a robustness check due to two main reasons: omitted variable bias and endogeneity. The omitted variable bias could arise because we conduct separate analysis for three hypotheses (persistence effects, asset class effects and volatility effects) and it is possible that in each model we omitted one or more independent variables that are correlated with at least one of the included independent variables. Similarly, the endogeneity issue could arise as a consequence of some of the independent variables being in fact interdependent with the coexceedance variable. Also, it is possible that we omit some potential factors that originate from SEE region. The encompassing model is a comprehensive check that considers the marginal effect of each individual explanatory variables while controlling for the possible effect of the others. We point out that, the only problem of estimating an encompassing model is that its results could be hampered by the presence of multicollinearity.

The results from the estimation of the model are given in Table no. 7. They suggest that the encompassing model is more parsimonious than the nested models of persistence, asset class, and volatility effects. In this model for the negative coexceedances in EU member countries from SEE (MBR) we observe that most of the variables that were significant in the nested persistence effects model, remain significant. Out of the volatilities, only the currency and interest rate volatilities remain significant.

Table no. 7 – Multinomial regression results for the encompassing model (negative coexceedances)

	Dependent variable: EU members from SEE (XN_t^{MBR})				**Dependent variable: Accession countries from SEE (XN_t^{ACC})**			
Const. (1)	-4.220	(0.000)	***	&&&	-4.259	(0.000)	***	&&&
Const. (2)	-9.330	(0.000)	***		-6.934	(0.000)	***	
$XN_{t-1}^{ACC}(1)$					0.903	(0.000)	***	&&&
XN_{t-1}^{ACC} (2)					1.828	(0.000)	***	
XN_{t-1}^{MBR} (1)	0.899	(0.000)	***	&&				
XN_{t-1}^{MBR} (2)	1.236	(0.000)	***					
XN_t^{MBR} (1)					0.873	(0.000)	***	&&&
XN_t^{MBR} (2)					0.960	(0.000)	***	
XN_t^{MEU} (1)	0.215	(0.111)			0.048	(0.723)		
XN_t^{MEU} (2)	0.091	(0.662)			0.165	(0.470)		
$C_t(1)$	0.083	(0.377)		&&&	-0.010	(0.912)		
$C_t(2)$	0.399	(0.005)	***		-0.148	(0.336)		
$R_t(1)$	-5.349	(0.150)			4.832	(0.123)		&&
$R_t(2)$	4.895	(0.076)	*		8.301	(0.022)	**	
$S_t^{USA}(1)$	-0.013	(0.796)			-0.009	(0.851)		
$S_t^{USA}(2)$	0.085	(0.189)			-0.042	(0.518)		
$S_t^{MEU}(1)$	-0.291	(0.000)	***	&&&	-0.035	(0.580)		
$S_t^{MEU}(2)$	-0.853	(0.000)	***		-0.026	(0.805)		
$S_t^{MBR}(1)$					0.119	(0.189)		&&&
$S_t^{MBR}(2)$					-0.420	(0.004)	***	
$\sigma_t^C(1)$	0.621	(0.003)	***	&&&	0.503	(0.010)	**	&&&
$\sigma_t^C(2)$	0.992	(0.000)	***		0.826	(0.007)	***	
$\sigma_t^R(1)$	68.431	(0.076)	***	&&&	78.215	(0.019)	**	&&
$\sigma_t^R(2)$	212.460	(0.000)	***		87.333	(0.159)		
$\sigma_t^{USA}(1)$	0.009	(0.831)			0.091	(0.024)	**	&&
$\sigma_t^{USA}(2)$	0.045	(0.353)			0.120	(0.020)	**	
$\sigma_t^{MEU}(1)$	0.045	(0.413)			-0.030	(0.595)		
$\sigma_t^{MEU}(2)$	0.102	(0.122)			-0.103	(0.206)		
$\sigma_t^{MBR}(1)$					-0.069	(0.236)		
$\sigma_t^{MBR}(2)$					0.048	(0.497)		
R squared		15.7%				16.7%		

The encompassing model for negative coexceedance variable for EU accession countries from SEE (XN_t^{ACC}) also supports the continuation hypothesis and the contagion effect from the MBR markets. In addition, XN_t^{MBR} remains a significant explanatory with a positive magnitude. Moreover, the MBR market return also remain significant, with negative marginal effects in both categories. Additionally, the US volatility remains significant for the ACC countries, though only on the 5% level. Overall, the encompassing models reaffirms the importance of the persistence effects and suggest that both asset class performance and volatilities affect the extreme coexceedances in SEE accession countries.

5.1 Comment for positive coexceedances

The estimation results of the multinomial logit model for the positive coexceedance variables are presented in Tables no. A5-A10 of the appendix. The positive coexceedance variables are defined analogously to negative coexceedance variables, where we arbitrarily use positive extreme return, or positive exceedance, as one that lies above the 95% percentile of the return distribution. Also, the model forms for these variables are constructed in the same fashion as those of the negative ones.

The continuation hypothesis (subsequent movements in the same direction) is confirmed also in the positive coexceedances. The number of extreme positive returns today is positively related to the number of extreme positive returns yesterday in both SEE groups (ACC and MBR). Differently from the results for the negative coexceedances, the extreme positive returns in major EU economies' markets (MEU) are not a significant explanatory variable in both the ACC and MBR cases. Nevertheless, the positive coexceedances in the accession countries remain significantly related with the positive coexceedances of EU member states group (MBR). This means that in EU accession group stock markets signals (both bad and good) come from the region.

The results of the asset class effects show that the likelihood of observing positive coexceedances in EU member countries from SEE (MBR) is only related to currency returns and major EU economies stock market returns. In addition, the interest returns may have an effect on the two or more coexceedances observation in the MBR markets. Similarly to persistence effects, the positive coexceedances of EU accession countries group (ACC) are linked only with EU member states from SEE stock returns (S_t^{MBR}), while there appear no links with US stock market return, major EU economies' stock market returns, currency or exchange rate return.

The results of the volatility effects point out that the likelihood of observing positive coexceedances in EU member countries from SEE (MBR) is positively related with the volatility of the currency return and the return of the interest rate. Moreover, it displays a positive relation with the volatility of the major EU economies stock markets and the US stock market return. The positive coexceedances of the EU accession countries follow a similar pattern and in addition are positively related with the volatility of MBR.

6. CONCLUSION

We applied the coexceedance methodology developed by Bae *et al.* (2003) and investigated the co-movements in the extreme returns in eight SEE stock markets in the period between 2006 and 2020, thus covering both the financial crisis of 2007 and the COVID-19 pandemic. Since the SEE countries differ qualitatively due to their EU status, we divided the SEE stock markets in two groups: SEE EU member countries and SEE EU accession countries. This allowed us to investigate the transmission mechanism from major EU economies' stock markets to EU member countries from SEE. Moreover, through this division we were able to study the transitory effect from EU member countries from SEE to accession countries from SEE region.

The negative coexceedance variable for the EU accession countries from SEE (ACC) was calculated as the count of the number of extreme returns (below 5% percentile) across the EU accession countries stock markets on a given day. The negative coexceedance variables for the following groups were constructed in the same analogous way: EU member countries from SEE (MBR), major EU economies (MEU) and the United States. Using the multivariate logit model, we tested the persistence, asset class and volatility effects on the likelihood of the coexceedances in SEE groups.

The empirical results discovered here are in line with those found in the literature, and in particular to the results of Christiansen and Ranaldo (2009). The authors discovered that there are strong persistence effects, and significant global linkages between the new EU countries stock markets and the stock markets in old EU countries in terms of returns, volatility, and coexceedances. In addition to the known literature, in this paper we found that the factors associated with the coexceedance variables differ between the EU member countries from SEE stock markets (MBR) and EU accession countries' stock markets from SEE (ACC). The negative coexceedances in EU member countries from SEE (MBR) stock markets are dependent on the extreme movements in the major EU economies' stock markets (MEU), while the EU accession countries from SEE stock markets (ACC) are mainly influenced by the EU member countries from SEE (MBR) stock markets developments.

This finding of the regional transmission of shocks in SEE region is a building block for the ongoing discussion of common regional regulation and further research of the SEE stock markets. Currently, there is only one trading platform that connects the Croatian, Macedonian and Bulgarian stock markets. It is the SEE-Link that is supported by the European Bank for Reconstruction and Development. However, the results of this paper shows that interdependence between SEE market and propagation of the shocks is much stronger and therefore it might need a more systematic approach than just one partial trading platform.

Definitely the propagation of extreme returns from one market to another is a complex phenomenon that is hampered by the presence of multiple interdependencies between the stock market dynamics. Such contagious interdependencies are usually represented as a complex network and are analyzed via the methods developed in network science (for a review of their application in international finance see Elliott *et al.*, 2014). Thus, we believe that a natural extension of our work would be to develop a network for the extreme coexceedances between the SEE stock markets and examine the lead-lag patterns in the region, as for example was done for currencies dynamics in Basnarkov *et al.* (2019, 2020).

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ANNEX

Table no. A1 – Descriptive statistics for the stock market returns

	BIH	MKD	MNE	SRB	HRV	BGR
Mean (%)	-0.018	0.015	-0.002	-0.011	-0.005	-0.018
Median (%)	0.000	0.000	0.000	0.000	0.000	0.000
Max. (%)	8.757	6.791	11.286	12.158	14.779	7.292
Min. (%)	-8.84	-10.283	-9.708	-10.861	-10.764	-11.360
5% percentile	-1.734	-1.494	-1.669	-1.648	-1.396	-1.490
95% percentile	1.696	1.604	1.693	1.588	1.399	1.521
Std. Dev. (%)	1.149	1.161	1.245	1.165	1.109	1.107
Skewness	0.080	-0.679	0.829	0.050	-0.491	-1.312
Kurtosis	12.561	16.616	16.317	20.953	26.910	18.706

	ROM	SVN	DEU	GBR	FRA	ITA
Mean (%)	0.004	-0.002	0.011	0.003	0.003	-0.013
Median (%)	0.004	0.000	0.050	0.004	0.024	0.012
Max. (%)	10.565	8.358	10.797	9.384	10.595	10.877
Min. (%)	-13.117	-9.383	-13.056	-11.512	-13.098	-18.541
5% percentile	-2.025	-1.510	-2.167	-1.829	-2.186	-2.560
95% percentile	2.032	1.528	2.036	1.712	2.061	2.320
Std. Dev. (%)	1.445	1.044	1.381	1.188	1.414	1.608
Skewness	-0.845	-0.721	-0.226	-0.384	-0.270	-0.672
Kurtosis	15.045	13.54	11.389	13.057	11.266	12.87

	MBR	MEU	USA
Mean (%)	-0.004	0.002	0.036
Median (%)	0.032	0.038	0.055
Max. (%)	8.378	10.027	10.775
Min. (%)	-8.998	-13.346	-13.165
5% percentile	-1.122	-2.046	-1.936
95% percentile	1.017	1.902	1.699
St. Dev. (%)	0.825	1.297	1.279
Skewness	-1.624	-0.448	-0.652
Kurtosis	27.147	12.182	16.468

Table no. A2 – Correlation matrix of the daily log returns of all stock market indexes

	BIH	MKD	MNE	SRB	HRV	BGR	ROM	SVN	DEU	GBR	FRA	ITA	MBR	MEU	USA
BIH	**1.00**	0.13	0.15	0.18	0.11	0.10	0.10	0.09	0.03	0.03	0.03	0.04	0.14	0.04	0.02
MKD	0.13	**1.00**	0.10	0.24	0.24	0.20	0.20	0.24	0.14	0.15	0.16	0.15	0.31	0.16	0.12
MNE	0.15	0.10	**1.00**	0.20	0.15	0.11	0.12	0.14	0.05	0.06	0.04	0.05	0.18	0.06	0.00
SRB	0.18	0.24	0.20	**1.00**	0.22	0.27	0.22	0.27	0.12	0.13	0.14	0.13	0.33	0.14	0.07
HRV	0.11	0.24	0.15	0.22	**1.00**	0.32	0.46	0.33	0.44	0.44	0.44	0.41	0.77	0.46	0.36
BGR	0.10	0.20	0.11	0.27	0.32	**1.00**	0.31	0.32	0.22	0.22	0.22	0.21	0.61	0.23	0.11
ROM	0.10	0.20	0.12	0.22	0.46	0.31	**1.00**	0.35	0.43	0.44	0.44	0.41	0.75	0.45	0.29
SVN	0.09	0.24	0.14	0.27	0.33	0.32	0.35	**1.00**	0.25	0.26	0.26	0.24	0.71	0.27	0.17
DEU	0.03	0.14	0.05	0.12	0.44	0.22	0.43	0.25	**1.00**	0.85	0.93	0.85	0.48	0.96	0.62
GBR	0.03	0.15	0.06	0.13	0.44	0.22	0.44	0.26	0.85	**1.00**	0.90	0.79	0.49	0.94	0.59
FRA	0.03	0.16	0.04	0.14	0.44	0.22	0.44	0.26	0.93	0.90	**1.00**	0.89	0.49	0.98	0.62
ITA	0.04	0.15	0.05	0.13	0.41	0.21	0.41	0.24	0.85	0.79	0.89	**1.00**	0.46	0.92	0.56
MBR	0.14	0.31	0.18	0.33	0.77	0.61	0.75	0.71	0.48	0.49	0.49	0.46	**1.00**	0.51	0.34
MEU	0.04	0.16	0.06	0.14	0.46	0.23	0.45	0.27	0.96	0.94	0.98	0.92	0.51	**1.00**	0.63
USA	0.02	0.12	0.00	0.07	0.36	0.11	0.29	0.17	0.62	0.59	0.62	0.56	0.34	0.63	**1.00**

Table no. A3 – Correlation matrix for the independent variables

	XN_t^{ACC}	XP_t^{ACC}	XN_t^{MBR}	XP_t^{MBR}	XN_t^{MEU}	XP_t^{MEU}	C_t	R_t	S_t^{USA}	S_t^{MEU}	S_t^{MBR}	σ_t^C	σ_t^R	σ_t^{USA}	σ_t^{MEU}	σ_t^{MBR}
XN_t^{ACC}	1.00															
XP_t^{ACC}	0.02	1.00														
XN_t^{MBR}	0.37	0.05	1.00													
XP_t^{MBR}	0.10	0.23	-0.05	1.00												
XN_t^{MEU}	0.19	0.01	0.33	-0.05	1.00											
XP_t^{MEU}	0.04	0.06	-0.01	0.22	-0.09	1.00										
C_t	0.04	-0.04	0.12	-0.10	0.14	-0.10	1.00									
R_t	-0.03	-0.04	-0.08	-0.09	-0.06	-0.05	-0.01	1.00								
S_t^{USA}	-0.10	0.01	-0.19	0.13	-0.41	0.35	-0.13	-0.01	1.00							
S_t^{MEU}	-0.14	0.04	-0.29	0.24	-0.62	0.56	-0.2	0.01	0.63	1.00						
S_t^{EUS}	-0.27	0.14	-0.61	0.48	-0.37	0.20	-0.18	0.00	0.34	0.51	1.00					
σ_t^C	0.23	0.14	0.24	0.21	0.16	0.18	0.02	-0.26	-0.02	-0.01	-0.07	1.00				
σ_t^R	0.12	0.10	0.14	0.09	0.06	0.05	0.00	-0.17	-0.02	-0.02	-0.04	0.16	1.00			
σ_t^{USA}	0.33	0.15	0.31	0.24	0.2	0.23	0.03	-0.19	0.00	-0.01	-0.12	0.42	0.16	1.00		
σ_t^{MEU}	0.30	0.14	0.30	0.23	0.21	0.27	0.03	-0.20	-0.01	0.00	-0.11	0.46	0.16	0.93	1.00	
σ_t^{EUS}	0.30	0.18	0.30	0.25	0.18	0.20	0.03	-0.17	-0.02	-0.01	-0.08	0.31	0.14	0.85	0.87	1.00

Table no. A4 – Summary statistics of positive coexceedance variables for each country group

	Number of Positive Coexceedances		
	0	**1**	**2+**
ACC	3245 (83.9%)	499 (12.9%)	125 (3.2%)
MBR	3267 (84.4%)	472 (12.2%)	130 (3.4%)
MEU	3524 (91.1%)	141 (3.6%)	204 (5.3%)

Table no. A5 – Multinomial regression results for persistence effects (positive coexceedances)

	Dependent variable: EU members from SEE (XP_t^{MBR})				Dependent variable: Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-2.295	(0.000)	***	&&&	-2.332	(0.000)	***	&&&
Const. (2)	-3.240	(0.000)	***		-4.486	(0.000)	***	
XP_{t-1}^{ACC} **(1)**					1.194	(0.000)	***	&&&
XP_{t-1}^{ACC} **(2)**					1.968	(0.000)	***	
XP_{t-1}^{MBR} **(1)**	0.443	(0.000)	***	&&&				
XP_{t-1}^{MBR} **(2)**	0.659	(0.000)	***					
XP_t^{MBR} **(1)**					0.690	(0.000)	***	&&&

	Dependent variable: EU members from SEE (XP_t^{MBR})			Dependent variable: Accession countries from SEE (XP_t^{ACC})		
XP_t^{MBR} (2)				1.163	(0.000)	***
XP_t^{MEU} (1)	0.004	(0.969)		-0.054	(0.601)	
XP_t^{MEU} (2)	-0.148	(0.437)		-0.005	(0.975)	
R squared		7.6%			11.6%	

Table no. A6 – Multinomial regression results for asset class effects (positive coexceedances)

	Dependent variable: EU members from SEE (XP_t^{MBR})				Dependent variable: Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-1.982	(0.000)	***	&&&	-1.888	(0.000)	***	&&&
Const. (2)	-3.793	(0.000)	***		-3.500	(0.000)	***	
C_t(1)	-0.176	(0.047)	**	&&	-0.045	(0.600)		
C_t(2)	-0.368	(0.014)	**		-0.258	(0.087)	*	
R_t(1)	-5.788	(0.186)		&&&	-5.995	(0.085)	*	
R_t(2)	-25.067	(0.000)	***		-7.778	(0.145)		
S_t^{USA}(1)	-0.001	(0.983)			0.000	(0.988)		
S_t^{USA}(2)	-0.134	(0.120)			-0.170	(0.067)	*	
S_t^{MEU}(1)	0.319	(0.000)	***	&&&	-0.042	(0.433)		
S_t^{MEU}(2)	0.923	(0.000)	***		-0.096	(0.335)		
S_t^{MBR}(1)					0. 302	(0.000)	***	&&&
S_t^{MBR}(2)					1.058	(0.000)	***	
R squared		6.5%				2.5%		

Table no. A7 – Multinomial regression results for asset for volatility effects with only EU stock market volatility (positive coexceedances)

	Dependent variable: EU members from SEE (XP_t^{MBR})				Dependent variable: Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-2.849	(0.000)	***	&&&	-4.578	(0.000)	***	&&&
Const. (2)	-8.381	(0.000)	***		-7.702	(0.000)	***	
σ_t^C(1)	0.874	(0.000)	***	&&&	0.528	(0.002)	***	&&&
σ_t^C(2)	1.424	(0.000)	***		0.955	(0.000)	***	
σ_t^R(1)	23.606	(0.493)		&&&	115.541	(0.000)	***	&&&
σ_t^R(2)	198.542	(0.000)	***		184.972	(0.000)	***	
σ_t^{MEU}(1)	0.059	(0.002)	***	&&&	0.055	(0.001)	***	&&&
σ_t^{MEU}(2)	0.136	(0.000)	***		0.084	(0.000)	***	
R squared		4.8%				2.6%		

Table no. A8 – Multinomial regression results for asset for volatility effects with only USA stock market volatility (positive coexceedances)

	Dependent variable: EU members from SEE (XP_t^{MBR})				Dependent variable: Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-2.852	(0.000)	***	&&&	-4.493	(0.000)	***	&&&
Const. (2)	-8.188	(0.000)	***		-7.590	(0.000)	***	
σ_t^C(1)	0.927	(0.000)	***	&&&	0.511	(0.003)	***	&&&
σ_t^C(2)	1.399	(0.000)	***		0.951	(0.000)	***	
σ_t^R(1)	25.087	(0.460)		&&&	112.735	(0.000)	***	&&&
σ_t^R(2)	192.998	(0.000)	***		181.903	(0.000)	***	
σ_t^{USA}(1)	0.036	(0.016)	**	&&&	0.046	(0.000)	***	&&&
σ_t^{USA} (2)	0.103	(0.000)	***		0.063	(0.000)	***	
R squared		4.9%				2.7%		

Table no. A9 – Multinomial regression results for asset for volatility effects with only MBR stock market volatility (positive coexceedances)

	Dependent variable: Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-4.415	(0.000)	***	&&&
Const. (2)	-7.486	(0.000)	***	
$\sigma_t^C(1)$	0.534	(0.000)	***	&&&
$\sigma_t^C(2)$	0.957	(0.001)	***	
$\sigma_t^R(1)$	108.525	(0.000)	***	&&&
$\sigma_t^R(2)$	175.755	(0.000)	***	
$\sigma_t^{MBR}(1)$	0.117	(0.000)	***	&&&
$\sigma_t^{MBR}(2)$	0.165	(0.000)	***	
R squared		3.1%		

Table no. A10 – Multinomial regression results for the encompassing model (positive coexceedances)

	Dependent variable: EU members from SEE (XP_t^{MBR})				Dependent variable: Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-2.899	(0.000)	***	&&&	-4.131	(0.000)	***	&&&
Const. (2)	-7.921	(0.000)	***		-7.298	(0.000)	***	
XP_{t-1}^{ACC} (1)					1.147	(0.000)	***	&&&
XP_{t-1}^{ACC} (2)					1.897	(0.000)	***	
XP_{t-1}^{MBR} (1)	0.798	(0.000)	***	&&&				
XP_{t-1}^{MBR} (2)	1.211	(0.000)	***					
XP_t^{MBR} (1)					0.465	(0.000)	***	&&&
XP_t^{MBR} (2)					0.414	(0.048)	**	
XP_t^{MEU} (1)	-0.265	(0.037)	**	&&	-0.107	(0.423)		
XP_t^{MEU} (2)	0.006	(0.976)			0.034	(0.890)		
$C_t(1)$	-0.179	(0.040)	**	&&	-0.041	(0.632)		
$C_t(2)$	-0.357	(0.013)	**		-0.165	(0.288)		
$R_t(1)$	0.810	(0.748)			0.652	(0.791)		
$R_t(2)$	-6.618	(0.172)			0.476	(0.897)		
$S_t^{USA}(1)$	-0.012	(0.811)	***		-0.004	(0.926)		
$S_t^{USA}(2)$	-0.146	(0.059)	***		-0.134	(0.096)	*	
$S_t^{MEU}(1)$	0.419	(0.000)	***	&&	-0.028	(0.641)		
$S_t^{MEU}(2)$	0.897	(0.000)	***		-0.105	(0.345)		
$S_t^{MBR}(1)$					0.155	(0.060)	*	&&&
$S_t^{MBR}(2)$					0.673	(0.000)	***	
$\sigma_t^C(1)$	0.785	(0.000)	***	&&	0.373	(0.052)	*	&&
$\sigma_t^C(2)$	1.023	(0.000)	***		0.694	(0.024)	**	
$\sigma_t^R(1)$	17.919	(0.593)		&&&	82.141	(0.017)	**	&&
$\sigma_t^R(2)$	155.367	(0.001)	***		130.645	(0.016)	**	
$\sigma_t^{USA}(1)$	-0.006	(0.874)		&&&	0.017	(0.648)		
$\sigma_t^{USA}(2)$	0.150	(0.003)	***		0.019	(0.753)		
$\sigma_t^{MEU}(1)$	0.066	(0.189)			-0.051	(0.343)		
$\sigma_t^{MEU}(2)$	-0.111	(0.141)			-0.140	(0.146)		
$\sigma_t^{MBR}(1)$					0.119	(0.054)	*	&&&
$\sigma_t^{MBR}(2)$					0.241	(0.004)	***	
R squared		12.3%				12.8%		