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What is behind extreme negative returns co-movement in the South Eastern European stock markets?

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Summary
This paper examines co-movement of extreme negative returns in the South Eastern European (SEE) stock markets during the period covering the recent financial crisis and sovereign debt crisis. The analysis is based on negative co-exceedances - joint occurrences of negative extreme returns in different countries stock markets. To provide a valuable insight on how persistence, asset class, volatility and liquidity effects are related with negative co-exceedances in SEE markets we utilize a multinomial logistic regression procedure. We find evidence in favor of the continuation hypothesis in SEE stock markets. However, the factors associated with the co-exceedances differ between the SEE EU member countries and SEE EU accession countries. The EU member countries are more dependent on the signals from major EU economies, while the accession countries are mainly influenced by the signals from the region.

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

JEL classification: C25, F36, G15.

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1. Introduction

The recent Global financial crisis created a severe financial turmoil. 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%. Also, the SEE stock markets recovery was much weaker than those of the leading European Markets.

The goal of this paper is to study what is behind the extreme falls in SEE stock markets. We implement the method proposed by Bae et al. (2003) to investigate the co-movements in the extreme returns between SEE stock markets, which is based on the multinomial logistic model. We test the four 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 explanation power of the three asset class groups, namely interest rates, currency returns and stock returns?; (iii) *volatility effects* -- What is the explanation power of the volatilities in the asset class groups?; and (iv) *liquidity effects* -- Whether the joint extreme negative stock market returns in SEE are caused by the liquidity dry-ups of these markets?

The results of this study may help policy makers to understand the nature of shock transmission in SEE stock markets. Similarly, they may be useful to investment managers for international portfolio diversification.

The structure of the remaining part of the paper is as follows. Section 1 gives a literature survey. In Section 2 we present the data and in Section 3 we explain the methodological framework. Section 4 contains the empirical results, and Section 5 concludes.

2. Literature review

Stock market co-movements receive a lot of attention in international finance since they have important practical implications for asset allocation and investment management. There is an increasing body of literature that examines stock market co-movements in Central and Eastern Europe (CEE), where the most recent papers are: Gijka and Horvath (2013), Kiviaho et al. (2014), Harkmann (2014), Stoica and Mehdian (2015), Reboredo et al. (2015), Sensoy et al. (2016), and Nitoi and Pochea (2016). However, the stock markets co-movements in SEE remain largely unexplored.

The most common method employed for co-movement analysis in the SEE stock markets is cointegration. This method is used in the following three papers. 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. Guidi and Ugur (2014), investigates 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. Using a dynamic cointegration analysis, their results suggest the existence of a time-varying cointegration among the SEE markets and the developed counterparts, particularly during sub-period of the financial crisis. 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 indices of Republic of Srpska and Serbia.

Gradojevic and Dobardzic (2012) employ a frequency domain approach to analyze the causal relationship between the returns on main indexes of Croatia, Slovenia, Hungary and Germany on the return of the major Serbian stock exchange index. The results suggest a somewhat dominant effect of the Croatian and Slovenian stock exchange indexes on Serbian stock index across a range of frequencies.

Horvath and Petrovski (2013) employ multivariate GARCH models to examine the international stock market co-movements between Western Europe vis-àvis Central (the Czech Republic, Hungary and Poland) and South Eastern Europe (Croatia, Macedonia and Serbia) in 2006–2011 period. The results indicate that the degree of co-movements is much higher for Central Europe.

Dajčman (2014) is the only study that has the same focus as the present paper. It examines the extreme returns co-movement and contagion between the Croatian and 10 European stock markets during the period 2003 – 2012. The author found 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.

3. Data description

We focus on eight South and East Europe (SEE) stock markets: Bosnia and Herzegovina, Macedonia, Montenegro, Serbia, Slovenia, Romania, Bulgaria and Croatia. Greece is excluded from the analysis since it is a Eurozone member. Furthermore, the period under consideration is severely affected by Greece's banking and sovereign debt crisis with their immediate implications for the stock market.

We apply the daily data from DataStream stock index for various countries. Only in the cases of Bosnia and Herzegovina, Macedonia, Montenegro and Serbia, we use the relevant index from the local stock market (SASX10, MBI10, MONEX20 and BELEXline), because the DataStream stock index is not available.

We use daily log returns calculated from the price indexes for the stock markets measured in the national currency. Christiansen and Ranaldo (2009) argue that usage of the national currencies returns are equivalent to currency hedged returns, while usage of common currency returns would bias the results and confound the genuine stock performance with that of the exchange rates. Also, because most markets are operating in the same time zone, the problem of non-overlapping trading hours does not arise. The data covers the period from October 5, 2005 to June 25, 2014. This leads to a total of 2276 observations covering both bull and bear phases, high and low volatility and different market conditions.

We consider three groups of countries, each consisting of four countries. The first two groups contains 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 2012. It is consists of: Germany, United Kingdom, France, and Italy. This group is labeled with MEU. Tables A1 and A2 in the appendix present the descriptive statistics and correlation matrix for the daily log returns of all 12 considered countries.

3.1. Coexceedance variables

As pointed out, we focus on 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) pioneer paper: a negative extreme return (negative exceedance) is one that lies below the 5% percentile of the return distribution. Similarly, a positive extreme return (positive exceedance) is a return that lies above the 95% percentile of the return distribution.

Following Christiansen & Ranaldo (2009) we construct a variable that counts the number of extreme negative returns among EU accession countries from SEE on a given day. The variable, denoted XN_t^{ACC}, takes on integer values between 0 and 2 and is our measure of coexceedances. It quantifies three possibilities: no extreme return in any of the counties from the group ($XN_t^{ACC} = 0$), only one country with an extreme return in the group ($XN_t^{ACC} = 1$), and several countries with an extreme return ($XN_t^{ACC} = 2$). A similar 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 use the following notation for the negative coexceedance variables:

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

Summary statistics for the negative coexceedance variables are given in Table 1. The 2276 days in the sample period are divided into days in which there are no exceedances in any country (e.g. 1927 such days in ACC group for negative extreme returns), there is only one country exceedance (e.g. 266 such days in ACC group for negative extreme returns), and multiple country coexceedances (e.g. 83 such days in ACC group for negative extreme returns). The number of multiple country coexceedances is higher in the group of major EU economies (MEU) in comparison to both SEE groups (ACC and

MBR) with the same number of group members (four countries), which reflect the higher level of interconnection of the MEU group in comparison with the SEE groups.

Table 1: Summary statistics of negative coexceedance variables

	Number of Coexceedances		
	0	1	2+
Negative Coexceedances in ACC	1927 (84.7%)	266 (11.7%)	83 (3.6%)
Negative Coexceedances in MBR	1965 (86.3%)	218 (9.6%)	93 (4.1%)
Negative Coexceedances in MEU	2092 (91.9%)	59 (2.6%)	125 (5.5%)

The table shows the distribution of the negative coexceedance variables.

3.2. Explanatory variables

In the empirical analysis, we also use additional explanatory variables. These variables estimate the impact of different stock markets and economic fundamentals on the coexceedance variable in various multinomial logit models. 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). Besides these variables we also use turnover by volume of the stock markets as the proxy of liquidity, since illiquidity in the SEE markets may be driving the probability of extreme returns. The frequency of all the explanatory variables corresponds with the daily frequency of the coexceedance variables. Altogether, the explanatory variables are:

- S_t^{USA}: concurrent return from the US stock market (log-returns from DataStream 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).[2]
- 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).
- TV_t^{USA}: turnover by volume of the US stock market (log of DataStream's US turnover by volume)
- TV_t^{MEU}: turnover by volume of the major EU economies stock market (log of average turnover by volume of Germany, United Kingdom, France and Italy).
- TV_t^{MBR}: turnover by volume of the major EU economies stock market (log of average turnover by volume of Slovenia, Romania, Bulgaria and Croatia).

4. Methodological framework

In the first part of this section, we present the econometric technique of multinomial logistic regression. In the second part, we describe the models used for hypothesis testing.

4.1. Multinomial logistic regression

We use the Bae et al. (2003) method of multinomial logit model to analyze extreme comovements between stock markets. This method offers a more efficient (in econometric terms) and consistent (in economic terms) way of analyzing comovement between financial markets, because 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, which as discussed above are 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:

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

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[2] Here we use the first difference, since the hypothesis for unit root of the level of interest rate series can not be rejected.

where $i \in \{1,2\}$; x is the vector of explanatory variables (including constant) and β_i is the vector of coefficients for category i. The probability of being in category i is given as a function of explanatory variables $P_i = function(\beta_i^{'}x)$. There is one coefficient for each covariate for each of the categories (for example, β_{1j} for category 1 for x_j).

The explanation of the coefficients is straightforward: when β_{1j} is significant, then variable j has a positive effect upon the probability of the occurrence of an exceedance; when β_{2j} is significant, then variable j has a significant effect upon 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 χ^2-test. The joint significance of all the explanatory variable is again determined by the χ^2-test, where we compare the estimated model with a baseline model that only has the constant term as an explanatory variable. To measure the performance of the model we additionally calculate the Cox and Snell's pseudoR^2 for various models.

4.2. Hypotheses and models

Persistence effects

The first hypothesis is about the persistence of the extreme returns in the SEE stock markets. Here, we explore whether negative and positive coexceedances in stock prices are followed by 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. Therefore, 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:

$$P_i = function(\beta_{i0} + \beta_{i1}XN_{t-1}^{MBR} + \beta_{i2}XN_t^{MEU}). \quad (2)$$

The second specification tests 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 in modeling of the coexceedanes of ACC. Empirical evidence for this effect can be found in Gradojevic and Dobardzic (2012), where the authors find much stronger influence of the Croatian and Slovenian stock market indexes than the 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}. For XN_t^{ACC} the probability of having i negative coexceedances is:

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

Asset class effects

The second hypothesis is about the asset class effects on the extreme returns in the SEE stock markets. We explore whether currency rates and interest rates movements, as well as American and European stock markets developments, are relevant for explaining coexccedances 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}). So, for the negative coexceedance variable (XN_t^{MBR}) the probability of having i negative coexceedances reads:

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

The second form of the model is designed for ACC stock markets have an additional variable that describes the MBR stock market return (S_t^{MBR}). This allows us to capture regional transitory effects. So, for the negative coexceedance variable (XN_t^{ACC}) the probability of having i negative coexceedances is:

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

Volatility effects

The third hypothesis examines the volatility effects on the extreme returns in the SEE stock markets. We explore whether coexceedanes are more likely to occur in highly volatile environment overriding all asset classes. We use two different model forms in order to test the asset class effects in SEE stock markets. The first form of the model test whether the negative 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:

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

As for the previous hypotheses, here also the second form of the model investigates the effect on ACC with an additional variable that captures the volatility of MBR stock market returns (σ_t^{MBR}), in order to capture the regional transitory effect. Therefore, for the negative coexceedance variable (XN_t^{ACC}) the probability of having i negative coexceedances is:

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

Liquidity effects
With the fourth hypothesis we test the liquidity effects on the extreme returns in the SEE stock markets. Here, we use the same model specification for both groups. The explanatory variables are the following one-day lagged variables: turnover in EU member countries from SEE group stock markets (TV_{t-1}^{MBR}), turnover in major EU economies stock markets (TV_{t-1}^{MEU}) and turnover in US stock market (TV_{t-1}^{USA}). Hence, for the negative coexceedance variable in EU member countries from SEE group stock markets (XN_t^{MBR}) the probability of having i negative coexceedances is:

$$P_i = function(\beta_{i0} + \beta_{i1}TV_{t-1}^{MBR} + \beta_{i2}TV_{t-1}^{MEU} + \beta_{i4}TV_{t-1}^{USA}). \quad (8)$$

The ACC group (EU accession countries from SEE) only has a different dependent variable: XN_t^{ACC}.

5. Empirical results

We mainly focus on the implications created by the negative coexceedances. Tables 2-7 report the estimation results of the multinomial logit model for the two different negative coexceedance variables. The left-most part of the table concerns the situation where the negative coexceedance variable for the EU members from SEE (XN_t^{MBR}) is the dependent variable, and in the second part the negative coexceedances for EU accession countries from SEE (XN_t^{ACC}) is the dependent variable. The first two columns show the parameter estimates and their p-values in parentheses. In the third column, the asterisk signs */**/*** indicate the significance of the individual parameter (β_{ij}), respectively, at a 10%/5%/1% level of significance. In the fourth column, we mark with &/&&/&&& when the explanatory variable x_j is overall significant at the 10%/5%/1% level of significance ($\beta_{1j} = \beta_{2j} = 0$).

Table 2 reports the persistence effect results. We find evidence in favor of the continuation hypothesis since the lagged explanatory variable in both cases is significant (subsequent movements in the same direction) in the SEE markets rather than reversal hypothesis (subsequent movements in the opposite direction). It implies that the number of extreme negative returns today is positively related to the number of extreme negative returns yesterday in both SEE groups (ACC and MBR).

In addition, we find that the extreme negative returns in major EU economies' markets (MEU) has a significant and positive effect only 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, the extreme negative returns in major EU economies' stock markets (MEU) are not significant in the case of negative coexceedances for accession countries from SEE (XN_t^{ACC}). In this case, the additional explanatory variable – negative coexceedances for EU member states from SEE (XN_t^{MBR}) is significant and positive. This implies that the extreme negative influence of major EU countries' stock markets on the extreme negative returns of the accession countries is not direct, but goes through the EU member states from SEE stock markets. In other words, in accession group stock markets (ACC) bad signals come from the region (MBR) and not from major EU economies (MEU).

Table 2: Persistence effects (negative coexceedances)

	EU members from SEE (XN_t^{MBR})				Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-2.431	(0.000)	***	&&&	-2.361	(0.000)	***	&&&
Const.(2)	-4.094	(0.000)	***		-4.465	(0.000)	***	
XN_{t-1}^{ACC} (1)					0.907	(0.000)	***	&&&
XN_{t-1}^{ACC} (2)					1.694	(0.000)	***	
XN_{t-1}^{MBR} (1)	0.756	(0.000)	***	&&&				
XN_{t-1}^{MBR} (2)	1.074	(0.000)	***					
XN_t^{MBR} (1)					0.747	(0.000)	***	&&&
XN_t^{MBR} (2)					1.349	(0.000)	***	
XN_t^{MEU} (1)	0.444	(0.001)	***	&&&	0.040	(0.766)		
XN_t^{MEU} (2)	1.563	(0.000)	***		0.111	(0.560)		
Pseudo R squared	16.9%				19.5%			
Chi-square	251.3***				304.2***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

The results for the asset class effects are given in Table 3. For the EU member countries from SEE (MBR), the likelihood of observing negative coexceedances is related to interest rates (R_t) and major EU economies stock market return (S_t^{MEU}). On the other hand, the likelihood of observing negative coexceedances in EU accession countries from SEE (XN_t^{ACC}) appears only connected with EU member states from SEE stock returns (S_t^{MBR}), while the other assets class effects are insignificant. This link has negative effects upon the likelihood. In both cases, the currency return (C_t) is not significant.

Regarding volatility effects, we find existence of multicolinearity 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}). Table A3 in the appendix, which gives the correlation matrix of all included explanatory variables in the models, shows that the correlations among the volatilities of the three above mentioned stock markets are higher than 0.8. Therefore, we include in the models only one of these variables at a time. In Tables 4-5, we report the results of the volatility effects from major EU market stock market return (σ_t^{MEU}) and EU member countries from SEE stock market return (σ_t^{MBR}).

Table 3: Asset class effects (negative coexceedances)

	EU members from SEE (XN_t^{MBR})				Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-2.259	(0.000)	***	&&&	-2.015	(0.000)	***	&&&
Const.(2)	-3.826	(0.000)	***		-3.545	(0.000)	***	
$C_t(1)$	0.090	(0.448)			-0.081	(0.462)		
$C_t(2)$	0.276	(0.134)			-0.178	(0.338)		
$R_t(1)$	-24.641	(0.000)	***	&&&	-8.155	(0.084)	*	
$R_t(2)$	16.147	(0.021)	**		-3.633	(0.635)		
$S_t^{USA}(1)$	-0.031	(0.638)			-0.001	(0.992)		
$S_t^{USA}(2)$	0.061	(0.462)			0.092	(0.278)		
$S_t^{MEU}(1)$	-0.218	(0.007)	***	&&&	-0.039	(0.607)		
$S_t^{MEU}(2)$	-1.058	(0.000)	***		-0.104	(0.380)		
$S_t^{MBR}(1)$					-0.314	(0.000)	***	&&&
$S_t^{MBR}(2)$					-0.862	(0.000)	***	
Pseudo R squared	15.8%				8.6%			
Chi-square	233.4***				128.5***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

In particular, Table 4 shows the results for volatility effects with only included volatility of major EU stock market return (σ_t^{MEU}) from stock markets volatilities. The volatility of the major EU stock market return (σ_t^{MEU}) seems not to be relevant for explaining negative coexccedence variables in the two cases. The effects of the other possible volatility variables are the ones presented in Table 4.

Table 4: Volatility effects with only σ_t^{MEU} effects from stock markets volatilities (negative coexceedances)

	EU members from SEE (XN_t^{MBR})				Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-3.783	(0.000)	***	&&&	-3.163	(0.000)	***	&&&
Const.(2)	-5.804	(0.000)	***		-4.769	(0.000)	***	
$\sigma_t^C(1)$	0.963	(0.013)	**	&&	0.689	(0.060)	*	
$\sigma_t^C(2)$	0.860	(0.120)			-0.447	(0.493)		
$\sigma_t^R(1)$	2.339	(0.816)		&&	1.992	(0.827)		
$\sigma_t^R(2)$	31.860	(0.003)	***		13.324	(0.300)		
$\sigma_t^{MEU}(1)$	0.805	(0.000)	***	&&&	0.628	(0.000)	***	&&&
$\sigma_t^{MEU}(2)$	1.355	(0.000)	***		1.355	(0.000)	***	
Pseudo R squared	14.5%				8.6%			
Chi-square	214.2***				128.5***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

Table 5 gives the results for volatility effects only for EU accession countries from SEE (ACC), whereas as an explanatory variable from stock markets is included only the volatility of EU member countries' stock market return (σ_t^{MBR}). The volatility of the EU member countries' stock market return (σ_t^{MBR}) is significant and positive. This means that the increase in volatility in EU member countries' stock market return (σ_t^{MBR}) leads to an increase of the likelihood of observing negative coexceedances in EU accession countries' stock markets (XN_t^{ACC}). Again, the effects of the other volatility variables resemble the one shown in Table 5.

Table 5: Volatility effects for Accession countries from SEE with only σ_t^{MBR} effects from stock markets volatilities (negative coexceedances)

	Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-3.058	(0.000)	***	&&&
Const.(2)	-4.523	(0.000)	***	
$\sigma_t^C(1)$	0.502	(0.147)		
$\sigma_t^C(2)$	-0.279	(0.651)		
$\sigma_t^R(1)$	-3.677	(0.698)		
$\sigma_t^R(2)$	10.245	(0.439)		
$\sigma_t^{MBR}(1)$	0.809	(0.000)	***	&&&
$\sigma_t^{MBR}(2)$	1.287	(0.000)	***	
Pseudo R squared	10.7%			
Chi-square	161.9***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

Table 6 gives the results for the effects of liquidity. For the EU members from SEE we find that there is a significant positive effect from its own liquidity and from the liquidity in the USA stock market. The effect of the liquidity of the major EU countries is negative, though insignificant. Contrastingly, for the accession countries from SEE the liquidity of every market has a positive magnitude, but it is significant only for MEU and USA. The positive signs of the significant coefficients are rather counterintuitive since one should expect that more liquidity will lead to lesser likelihoods for extreme negative coexceedances, Dey (2005). We believe that a more detailed analysis of the relationship between coexceedances and liquidity is needed before assessing the implications of these findings.

Table 6: Liquidity effects (negative coexceedances)

	EU members from SEE (XN_t^{MBR})				Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-25.990	(0.000)	***	&&&	-32.973	(0.000)	***	&&&
Const.(2)	-91.625	(0.000)	***		-79.705	(0.000)	***	
$TV_{t-1}^{MBR}(1)$	0.165	(0.056)	*	&&&	0.049	(0.538)		
$TV_{t-1}^{MBR}(2)$	0.449	(0.001)	***		0.172	(0.243)		
$TV_{t-1}^{MEU}(1)$	-0.161	(0.427)			0.568	(0.002)	***	&&&
$TV_{t-1}^{MEU}(2)$	-0.165	(0.625)			1.001	(0.002)	***	
$TV_t^{USA}(1)$	1.322	(0.000)	***	&&&	1.178	(0.000)	***	&&&
$TV_{t-1}^{USA}(2)$	4.626	(0.000)	***		3.189	(0.000)	***	
Pseudo R squared	9.0%				8.6%			
Chi-square	124.6***				123.4***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

At the end, we estimate an encompassing model with all the explanatory variables analyzed above. The results are given in Table 7. In this specification we include only the volatility of US stock market returns from the volatilities of stock markets in the model. Christiansen & 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 four hypotheses (persistence effects, asset class effects, volatility effects and liquidity 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. To account for this, the encompassing model is a comprehensive check that considers all variables at once with. We point out that we are aware that this approach could encounter the problem of multicolinearity. However, the correlation matrix among all explanatory variables suggests that this might not be the case (Table A3 in the appendix).

The encompassing model is more parsimonious than the nested models of persistence, asset class, volatility and liquidity effects. In this model for the negative coexceedances in EU member countries from SEE (MBR) we observe that the same variables that were significant in the nested persistence effects model, are also significant. However, the effect of major EU economies' stock market return (S_t^{MEU}) and volatilities of US stock market return (σ_t^{USA}) is insignificant. The model for negative coexceedance variable for EU accession countries from SEE (XN_t^{ACC}) indicates as influential its own lagged value (XN_{t-1}^{ACC}), major EU stock market return (S_t^{MEU}) and EU member countries from SEE stock markets (S_t^{MBR}), while it points coexceedances in major EU group (XN_t^{MEU}) and EU member countries from SEE group (XN_t^{MBR}), as well as volatilities of US stock market return (σ_t^{USA}), as insignificant. The results for the liquidity effect remain unchanged. Overall, the encompassing models confirms the importance of the persistence effects and suggest that asset class effects have more influence on extreme negative coexceedances on the SEE stock markets in comparison to the vollatility effects.

The insignificance of intercept dummy variables in all four models implies that the likelihood of coexccedances in EU member states or accession countries is not changed after January 2007, which is not supportive for closer connection between SEE and EU stock markets through the integration process. However, we must highlight the recent financial crisis as a very important factor, which has opposite influence than integration process of the likelihood of coexceedances in SEE stock markets.

The empirical results are in the same line with those found in Christiansen and Ranaldo (2009). The authors of this paper analysed the stock markets in the new EU member countries, including 3 SEE countries, for the period 2000-2007. They found strong persistence effects, and that there are significant global linkages of the new EU countries stock markets with stock markets in old EU countries in terms of returns, volatility, and coexceedances. However, they also found that the relevance of many of the factors changed after the EU enlargement in May 2004. This fact is not found in the present study, as is expected with the new EU enlargement in January 2007.

5.1. Comment for positive coexceedances

The estimation results of the multinomial logit model for the positive coexceedance variables are presented in the tables in Tables 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). Regarding extreme positive returns in major EU economies' markets (MEU) as an explanatory variable, as expected, we found that they are significant and positive in EU member states group (MBR). However, the positive coexceedances of EU accession group (ACC) are not influenced by positive coexceedances from major EU economies group (MEU). They are influenced only by a positive coexceedances of EU member states group (MBR). This is the same as in the case of negative coexceedances. It means that in EU accession group stock markets (ACC) signals (bad or good) come from the region.

Table 7: Encompassing model (negative coexceedances)

	EU members from SEE (XN_t^{MBR})				Accession countries from SEE (XN_t^{ACC})			
Const. (1)	-24.711	(0.000)	***	&&&	-32.217	(0.000)	***	&&&
Const.(2)	-71.042	(0.000)	***		-57.283	(0.000)	***	
XN_{t-1}^{ACC}(1)					0.718	(0.000)	***	&&&
XN_{t-1}^{ACC} (2)					1.640	(0.000)	***	
XN_{t-1}^{MBR} (1)	0.376	(0.008)	***	&&				
XN_{t-1}^{MBR} (2)	0.288	(0.165)						
XN_t^{MBR} (1)					0.400	(0.020)	**	&&&
XN_t^{MBR} (2)					0.710	(0.007)	***	
XN_t^{MEU} (1)	-0.095	(0.602)			-0.198	(0.261)		
XN_t^{MEU} (2)	0.438	(0.083)	*		-0.257	(0.363)		
C_t(1)	0.079	(0.487)			-0.017	(0.872)		
C_t(2)	0.285	(0.106)			0.150	(0.449)		
R_t(1)	-4.495	(0.428)			3.638	(0.486)		
R_t(2)	7.115	(0.339)			4.316	(0.567)		
S_t^{USA}(1)	0.050	(0.444)			0.061	(0.289)		&&
S_t^{USA}(2)	0.139	(0.080)	*		0.204	(0.009)	***	
S_t^{MEU}(1)	-0.269	(0.003)	***	&&&	-0.090	(0.280)		
S_t^{MEU}(2)	-0.571	(0.000)	***		-0.157	(0.235)		
S_t^{MBR}(1)					-0.060	(0.475)		
S_t^{MBR}(2)					-0.153	(0.253)		
σ_t^C(1)	1.455	(0.002)	***	&&&	1.899	(0.000)	***	&&&
σ_t^C(2)	3.437	(0.000)	***		1.877	(0.038)	**	
σ_t^R(1)	-4.365	(0.696)			-11.866	(0.257)		
σ_t^R(2)	25.747	(0.052)	*		-16.251	(0.363)		
σ_t^{MEU}(1)	0.603	(0.001)	***	&&&	0.209	(0.216)		&
σ_t^{MEU}(2)	0.831	(0.001)	***		0.561	(0.032)	**	
TV_{t-1}^{MBR}(1)	0.180	(0.050)	**	&&	0.028	(0.743)		
TV_{t-1}^{MBR}(2)	0.412	(0.022)	**		-0.056	(0.786)		
TV_{t-1}^{MEU}(1)	0.206	(0.394)			0.975	(0.000)	***	&&&
TV_{t-1}^{MEU}(2)	1.054	(0.042)	**		1.988	(0.000)	***	
TV_t^{USA}(1)	0.860	(0.026)	**	&&&	0.738	(0.031)	**	&&
TV_{t-1}^{USA}(2)	2.336	(0.001)	***		1.159	(0.076)	*	
Pseudo R squared	28.7%				25.8%			
Chi-square	426.3***				394.6***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

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. 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 are 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 of EU accession countries from SEE (ACC) is related with volatility of interest rate, volatility of US stock market return and volatility of EU member states from SEE (MBR) stock market. The positive coexcedances of EU member states from SEE (MBR) stock market seems not related with the observed volatilities.

Finally, the discoveries regarding the liquidity effects, point out that there might be markets whose increase in liquidity leads to an increase in the likelihood of positive coexceedances. Additionally, there might be markets whose increase in liquidity leads to a decrease in the likelihood of positive coexceedances.

6. Conclusion

We applied the coexceedance methodology of Bae et al. (2003) and investigated the co-movements in the negative extreme returns between SEE stock markets. We divided the SEE stock markets in two groups based on the countries EU membership in order to allow for transmission mechanism from major EU economies' stock markets to EU member countries from SEE, and in addition, 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) counts the number of extreme returns (below 10% percentile) across the EU accession countries 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 all SEE countries (SEE). Using the multivariate logit model, we tested the persistence, asset class and volatility effects on the likelihood of the coexceedances in SEE groups.

We found strong persistence effects in coexceedances, which is evidence in favor of the continuation hypothesis rather than reversal hypothesis in SEE stock markets. However, 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 from 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.

References

Bae, Kee-Hong, G. Andrew Karolyi, and Reneé M. Stulz. 2003. "A New Approach to Measuring Financial Contagion." *The Review of Financial Studies, 16*(3): 718-763.

Baur, Dirk, and Niels Schulze. 2005. "Coexceedances in Financial Markets – A Quantile Regression Analysis on Contagion." *Emerging Markets Review, 6*(1): 21-43.

Christiansen, Charlotte and Angelo Ranaldo. 2009. "Extreme Coexceedances in New EU Member States Stock Markets." *Journal of Banking and Finance*, 33(6): 1048-1057.

Dajčman, Silvo. 2014. “Was there a contagion between major European and Croatian stock markets? An analysis of coexceedances.” *Economic Research-Ekonomska Istraživanja*, 27(1): 155-168.

Dey, Malay K. 2005. “Turnover and return in global stock markets.” *Emerging Markets Review,* 6(1), 45-67.

Dungey, Mardi, Renee Fry, Brenda Gonzalez and Vance L. Martin. 2005. ”Empirical Modelling of Contagion: A Review of Methodologies.” *Quantitative Finance, 5*(1): 9-24.

Đukić, Đorđe and Mališa Đukić. 2015. “Interdependencies of Markets in Southeastern Europe and Buyback of Shares on Shallow Capital Markets: The Application of Cointegration and Causality Tests.” *Panoeconomicus*, 62(4): 469-491.

Gijka, Dritan and Roman Horvath. 2013. ”Stock market comovements in Central Europe: Evidence from the asymmetric DCC model”. *Economic Modelling*, 33: 55-64.

Gradojevic, Nikola, and Eldin Dobardzic. 2012. "Causality between Regional Stock Markets: A Frequency Domain Approach." *Panoeconomicus*, 60(5): 633-647.

Guidi, Francesco and Mehmet Ugur. 2014. ”An analysis of South-Eastern European stock markets: Evidence on cointegration and portfolio diversification benefits”. *Journal of International Financial Markets*, *Institutions and Money*, 30: 119-136.

Harkmann, Kersti. 2014. ”Stock Market Contagion from Western Europe to Central and Eastern Europe During the Crisis Years 2008-2012”. *Eastern European Economics*, 52(3): 55-65.

Horvath, Roman and Dragan Petrovski. 2013. ”International Stock market integration: Central and South Eastern Europe compared.” *Economic Systems,* 37(1): 81-91.

Markwat, Thijs, Erik Kole and Dick van Dijk. 2009. ”Contagion as a Domino Effect in Global Stock Markets.” *Journal of Banking and Finance,* 33(11): 1996-2012.

Kenourgios, Dimitris and Aristeidis Samitas. 2011. ”Equity market integration in emerging Balkan markets.” *Research in International Business and Finance, 25*(3): 296-307.

Kiviaho, Jarno, Jussi Nikkinen, Vanja Piljak, and Timo Rothovius. 2014. ”The Co-movement Dynamics of European Frontier Stock Markets”. *European Financial Management*, 20(3): 574-595.

Nitoi, Mihai, Maria Miruna Pochea. 2016. ”Testing financial markets convergence in Central and Eastern Europe: A non-linear single factor model”. *Economic Systems*, 40(2): 323-334.

Reboredo, Juan C., Aviral Kumar Tiwari and Claudiu Tiberiu Albulescu. 2015. ” Do sovereign rating announcements have an impact on regional stock market co-movements? The case of Central and Eastern Europe”. *Economic Systems*, 40(4): 552-567.

Sensoy, Ahmet, Veysel Eraslanb and Mutahhar Erturk. 2016. ” An analysis of dependence between Central and Eastern European stock markets”. *Economic Systems*, 39(3): 474-490.

Stoica, Ovidiu, Mark J. Perry and Seyed Mehdian. 2015. ”An Empirical Analysis of the Diffusion of Information Accross Stock Markets of Central and Eastern Europe”. *Prague Economic Papers*, 24(2): 192-210.

Appendix

Table A1: Descriptive statistics

	BIH	MKD	MON	SRB
Mean (%)	-0.084	0.012	-0.020	-0.025
Median (%)	0.000	0.000	0.000	0.000
Max. (%)	7.566	11.286	6.661	12.158
Min. (%)	-41.365	-9.708	-10.283	-10.861
5% percentile	-1.757	-1.947	-2.343	-1.990
95% percentile	1.682	1.945	2.377	2.029
Std. Dev. (%)	1.379	1.602	1.346	1.403
Skewness	-11.777	0.744	-0.417	0.151
Kurtosis	356.464	11.761	11.641	16.453

	HRV	BGR	ROM	SVN
Mean (%)	-0.007	-0.016	-0.007	-0.014
Median (%)	0.000	0.000	0.000	0.000
Max. (%)	14.779	10.399	11.825	8.170
Min. (%)	-10.764	-11.278	-13.955	-8.333
5% percentile	-1.764	-2.301	-2.749	-1.554
95% percentile	1.696	2.155	2.514	1.543
Std. Dev. (%)	1.297	1.464	1.782	1.079
Skewness	-0.005	-0.399	-0.619	-0.539
Kurtosis	19.728	11.561	11.120	11.648

	DEU	GBR	FRA	ITA
Mean (%)	0.016	0.011	0.004	-0.015
Median (%)	0.084	0.016	0.031	0.014
Max. (%)	16.046	8.861	9.920	10.482
Min. (%)	-7.801	-8.714	-8.429	-8.636
5% percentile	-2.030	-1.977	-2.181	-2.403
95% percentile	1.754	1.788	1.867	2.149
St. Dev. (%)	1.278	1.245	1.328	1.460
Skewness	0.540	-0.190	-0.009	-0.082
Kurtosis	18.991	10.159	9.345	8.006

	USA	MEU	MBR
Mean (%)	0.023	0.004	-0.009
Median (%)	0.061	0.041	0.024
Max. (%)	10.902	8.984	10.253
Min. (%)	-9.409	-8.150	-10.092
5% percentile	-2.054	-2.017	-1.582
95% percentile	1.747	1.754	1.447
St. Dev. (%)	1.325	1.244	1.085
Skewness	-0.368	-0.165	-0.542
Kurtosis	13.178	9.440	17.414

The tables report the descriptive statistics for the daily log returns (in %) of the considered stock markets for the sample period from October 5, 2005 to June 25, 2014 (2276 observations).

Correlation matrix of the daily log returns of all stock markets and indexes

	BIH	MKD	MON	SRB	HRV	BGR	ROM	SVN	DEU	GBR	FRA	ITA	MBR	MEU	USA
BIH	1.00	0.14	0.10	0.16	0.05	0.08	0.07	0.07	0.00	0.00	0.01	0.01	-0.01	0.00	0.08
MKD	0.14	1.00	0.10	0.23	0.16	0.08	0.14	0.15	0.06	0.08	0.07	0.08	0.03	0.08	0.18
MON	0.10	0.10	1.00	0.26	0.21	0.10	0.20	0.22	0.09	0.12	0.15	0.14	0.06	0.14	0.24
SRB	0.16	0.23	0.26	1.00	0.24	0.22	0.26	0.29	0.12	0.16	0.16	0.16	0.07	0.17	0.32
HRV	0.05	0.16	0.21	0.24	1.00	0.22	0.48	0.37	0.43	0.47	0.47	0.45	0.35	0.49	0.84
BGR	0.08	0.08	0.10	0.22	0.22	1.00	0.26	0.24	0.12	0.17	0.15	0.15	0.06	0.16	0.54
ROM	0.07	0.14	0.20	0.26	0.48	0.26	1.00	0.42	0.37	0.45	0.44	0.43	0.24	0.46	0.80
SVN	0.07	0.15	0.22	0.29	0.37	0.24	0.42	1.00	0.22	0.27	0.29	0.27	0.16	0.29	0.49
DEU	0.00	0.06	0.09	0.12	0.43	0.12	0.37	0.22	1.00	0.79	0.84	0.78	0.70	0.86	0.45
GBR	0.00	0.08	0.12	0.16	0.47	0.17	0.45	0.27	0.79	1.00	0.92	0.85	0.60	0.97	0.52
FRA	0.01	0.07	0.15	0.16	0.47	0.15	0.44	0.29	0.84	0.92	1.00	0.92	0.62	0.97	0.51
ITA	0.01	0.08	0.14	0.16	0.45	0.15	0.43	0.27	0.78	0.85	0.92	1.00	0.57	0.93	0.49
MBR	-0.01	0.03	0.06	0.07	0.35	0.06	0.24	0.16	0.70	0.60	0.62	0.57	1.00	0.63	0.33
MEU	0.00	0.08	0.14	0.17	0.49	0.16	0.46	0.29	0.86	0.97	0.97	0.93	0.63	1.00	0.53
USA	0.08	0.18	0.24	0.32	0.84	0.54	0.80	0.49	0.45	0.52	0.51	0.49	0.33	0.53	1.00

Table A3: Correlation matrix of the all 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}	TV_t^{USA}	TV_t^{MEU}	TV_t^{MBR}
XN_t^{ACC}	1.00																		
XP_t^{ACC}	-0.02	1.00																	
XN_t^{EUS}	0.34	0.01	1.00																
XP_t^{EUS}	0.04	0.18	-0.07	1.00															
XN_t^{MEU}	0.19	0.02	0.37	-0.03	1.00														
XP_t^{MEU}	0.04	0.03	-0.02	0.25	-0.08	1.00													
C_t	0.04	-0.05	0.14	-0.11	0.24	-0.18	1.00												
R_t	-0.04	-0.03	-0.12	-0.17	-0.09	-0.11	-0.01	1.00											
S_t^{USA}	-0.07	0.01	-0.18	0.15	-0.41	0.39	-0.21	-0.06	1.00										
S_t^{MEU}	-0.15	0.03	-0.31	0.24	-0.62	0.55	-0.36	-0.01	0.64	1.00									
S_t^{EUS}	-0.25	0.12	-0.60	0.49	-0.39	0.22	-0.24	-0.01	0.32	0.54	1.00								
σ_t^{C}	0.16	0.05	0.24	0.21	0.17	0.20	0.02	-0.41	-0.02	-0.02	-0.07	1.00							
σ_t^{R}	0.11	0.00	0.17	0.06	0.08	0.06	0.04	-0.14	-0.04	-0.04	-0.07	0.15	1.00						
σ_t^{USA}	0.31	0.10	0.37	0.27	0.27	0.28	0.02	-0.45	-0.02	-0.03	-0.13	0.67	0.32	1.00					
σ_t^{MEU}	0.28	0.07	0.36	0.24	0.27	0.30	0.03	-0.39	-0.02	-0.01	-0.12	0.62	0.31	0.94	1.00				
σ_t^{EUS}	0.32	0.19	0.39	0.31	0.24	0.24	0.02	-0.38	-0.03	-0.02	-0.09	0.52	0.33	0.83	0.83	1.00			
TV_t^{USA}	0.19	-0.02	0.22	0.06	0.16	0.09	0.01	0.03	-0.03	-0.05	-0.14	-0.08	0.10	0.24	0.26	0.22	1.00		
TV_t^{MEU}	0.15	0.17	0.09	0.06	0.00	-0.03	-0.01	0.21	-0.02	-0.01	-0.01	-0.34	0.21	-0.04	-0.02	0.14	0.34	1.00	
TV_t^{MBR}	-0.03	0.01	-0.02	-0.02	-0.03	-0.04	0.00	0.06	0.00	0.01	0.00	-0.08	0.01	-0.08	-0.09	-0.02	-0.11	0.16	1.00

Summary statistics of positive coexceedance variables

	Number of Coexceedances		
	0	1	2+
Positive Coexceedances in ACC	1898 (83.4%)	316 (13.9%)	62 (2.7%)
Positive Coexceedances in MBR	1918 (84.3%)	282 (12.4%)	76 (3.3%)
Positive Coexceedances in MEU	2073 (91.1%)	84 (3.7%)	119 (5.2%)

The table shows the distribution of the positive coexceedance variables.

Table A5: Persistence effects (positive coexceedances)

	EU members from SEE (XP_t^{MBR})				**Accession countries from SEE (XP_t^{ACC})**			
Const. (1)	-2.192	(0.000)	***	&&&	-2.195	(0.000)	***	&&&
Const.(2)	-3.979	(0.000)	***		-4.655	(0.000)	***	
XP_{t-1}^{ACC} (1)					1.199	(0.000)	***	&&&
XP_{t-1}^{ACC} (2)					2.080	(0.000)	***	
XP_{t-1}^{MBR} (1)	0.720	(0.000)	***	&&&				
XP_{t-1}^{MBR} (2)	1.135	(0.000)	***					
XP_t^{MBR} (1)					0.530	(0.000)	***	&&&
XP_t^{MBR} (2)					1.121	(0.000)	***	
XP_t^{MEU} (1)	0.590	(0.000)	***	&&&	-0.129	(0.350)		
XP_t^{MEU} (2)	1.180	(0.000)	***		-0.222	(0.393)		
Pseudo R squared	10.3%				15.6%			
Chi-square	156.1***				242.3***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

Table A6: Asset class effects (positive coexceedances)

	EU members from SEE (XP_t^{MBR})				Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-2.044	(0.000)	***	&&&	-1.801	(0.000)	***	&&&
Const.(2)	-3.712	(0.000)	***		-3.630	(0.000)	***	
$C_t(1)$	-0.193	(0.072)	*		-0.082	(0.432)		
$C_t(2)$	0.098	(0.614)			-0.302	(0.131)		
$R_t(1)$	-31.849	(0.000)	***	&&&	-2.194	(0.637)		
$R_t(2)$	-33.094	(0.000)	***		-6.484	(0.455)		
$S_t^{USA}(1)$	-0.038	(0.538)			0.009	(0.878)		
$S_t^{USA}(2)$	-0.036	(0.737)			-0.214	(0.089)	*	
$S_t^{MEU}(1)$	0.392	(0.000)	***	&&&	-0.035	(0.632)		
$S_t^{MEU}(2)$	0.887	(0.000)	***		-0.133	(0.393)		
$S_t^{MBR}(1)$					0.167	(0.018)	**	&&&
$S_t^{MBR}(2)$					0.666	(0.000)	***	
Pseudo R squared	12.1%				2.9%			
Chi-square	183.8***				43.3***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

Table A7: Volatility effects with only σ_t^{MEU} effects from stock markets volatilities (positive coexceedances)

	EU members from SEE (XP_t^{MBR})				Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-3.088	(0.000)	***	&&&	-2.166	(0.000)	***	&&&
Const.(2)	-5.548	(0.000)	***		-4.018	(0.000)	***	
$\sigma_t^C(1)$	1.170	(0.001)	***	&&&	0.443	(0.218)		
$\sigma_t^C(2)$	0.769	(0.002)	***		-0.068	(0.928)		
$\sigma_t^R(1)$	-2.867	(0.756)			-4.142	(0.647)		
$\sigma_t^R(2)$	-7.081	(0.672)			-12.577	(0.535)		
$\sigma_t^{MEU}(1)$	0.402	(0.004)	***	&&&	0.123	(0.382)		&&
$\sigma_t^{MEU}(2)$	0.916	(0.000)	***		0.624	(0.011)	**	
Pseudo R squared	7.5%				0.9%			
Chi-square	112.9***				13.8**			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

Table A8: Volatility effects for Accession countries from SEE with only σ_t^{INT} effects from stock markets volatilities (positive coexceedances)

	Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-2.039	(0.000)	***	&&&
Const.(2)	-3.368	(0.000)	***	
$\sigma_t^C(1)$	-0.353	(0.309)		&
$\sigma_t^C(2)$	-1.529	(0.056)	*	
$\sigma_t^R(1)$	-19.000	(0.062)	*	&&&
$\sigma_t^R(2)$	-62.595	(0.035)	**	
$\sigma_t^{MBR}(1)$	0.648	(0.000)	***	&&&
$\sigma_t^{MBR}(2)$	1.304	(0.000)	***	
Pseudo R squared	5.1%			
Chi-square	76.2***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

Table A9: Liquidity effects (positive coexceedances)

	EU members from SEE (XP_t^{MBR})				Accession countries from SEE (XP_t^{ACC})			
Const. (1)	2.358	(0.631)		&&&	1.870	(0.689)		
Const.(2)	-36.746	(0.000)	***		-5.490	(0.590)		
$TV_{t-1}^{MBR}(1)$	0.065	(0.371)			-0.008	(0.908)		
$TV_{t-1}^{MBR}(2)$	0.274	(0.035)	**		0.125	(0.346)		
$TV_{t-1}^{MEU}(1)$	0.084	(0.621)			1.023	(0.000)	***	&&&
$TV_{t-1}^{MEU}(2)$	0.144	(0.662)			0.801	(0.021)	**	
$TV_t^{USA}(1)$	-0.327	(0.243)		&&&	-1.019	(0.000)	***	&&&
$TV_{t-1}^{USA}(2)$	1.538	(0.004)	***		-0.602	(0.292)		
Pseudo R squared	1.5%				4.3%			
Chi-square	20.8***				61.858***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).

Table A10: Encompassing model (positive coexceedances)

	EU members from SEE (XP_t^{MBR})				Accession countries from SEE (XP_t^{ACC})			
Const. (1)	-2.871	(0.615)		&&&	-1.559	(0.773)		
Const.(2)	-43.417	(0.000)	***		2.911	(0.804)		
XP_{t-1}^{ACC} (1)					1.084	(0.000)	***	&&&
XP_{t-1}^{ACC} (2)					1.978	(0.000)	***	
XP_{t-1}^{MBR} (1)	0.580	(0.000)	***	&&&				
XP_{t-1}^{MBR} (2)	0.747	(0.000)	***					
XP_t^{MBR} (1)					0.386	(0.013)	**	&&&
XP_t^{MBR} (2)					0.943	(0.001)	***	
XP_t^{MEU} (1)	0.013	(0.936)			-0.095	(0.598)		
XP_t^{MEU} (2)	-0.094	(0.717)			0.205	(0.561)		
C_t(1)	-0.191	(0.072)	*		-0.083	(0.426)		
C_t(2)	0.011	(0.951)			-0.267	(0.222)		
R_t(1)	-19.513	(0.000)	***	&&&	-0.872	(0.871)		
R_t(2)	3.705	(0.682)			-6.559	(0.585)		
S_t^{USA}(1)	-0.073	(0.229)			-0.025	(0.673)		&&
S_t^{USA}(2)	-0.061	(0.481)			-0.292	(0.020)	**	
S_t^{MEU}(1)	0.401	(0.000)	***	&&&	-0.005	(0.952)		
S_t^{MEU}(2)	0.744	(0.000)	***		-0.103	(0.578)		
S_t^{MBR}(1)					0.006	(0.936)		
S_t^{MBR}(2)					0.157	(0.314)		
σ_t^C(1)	1.007	(0.021)	**	&&&	1.175	(0.006)	***	&&
σ_t^C(2)	3.296	(0.000)	***		-0.569	(0.569)		
σ_t^R(1)	-11.628	(0.290)			-19.192	(0.094)	*	&
σ_t^R(2)	-18.088	(0.374)			-48.041	(0.191)		
σ_t^{MEU}(1)	0.240	(0.153)			0.017	(0.920)		
σ_t^{MEU}(2)	0.413	(0.111)			0.373	(0.298)		
TV_{t-1}^{MBR}(1)	0.090	(0.239)		&	-0.012	(0.863)		
TV_{t-1}^{MBR}(2)	0.324	(0.029)	**		0.144	(0.374)		
TV_{t-1}^{MEU}(1)	0.451	(0.023)	**	&&	1.134	(0.000)	***	&&&
TV_{t-1}^{MEU}(2)	1.029	(0.027)	**		0.576	(0.201)		
TV_t^{USA}(1)	-0.411	(0.193)			-0.972	(0.001)	***	&&&
TV_{t-1}^{USA}(2)	0.995	(0.140)			-0.933	(0.158)		
Pseudo R squared	19.3%				19.3%			
Chi-square	291.3***				291.3***			

The table reports estimates from multinomial logit model for the two different coexceedance variables: the negative coexceedance variable for the EU members from SEE (first part of the table), and the negative coexceedance variable for the EU accession countries from SEE (second part of the table).