

**DOCTORAL SCHOOL OF FINANCE AND BANKING
BUCHAREST UNIVERSITY OF ECONOMIC STUDIES**

Mean-Volatility Spillover Effects on European Bond Markets

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DESCRIBING DATA

- Price return government bond indices calculated by Merrill Lynch for nine **European countries**: Austria, Belgium, Czech Republic, France, Germany, Italy, Poland, Romania, Spain
- Bonds denominated in EUR
- **Daily log-returns** are calculated for a period of almost 6 years: from **January 2009 to May 2014**

Presence of Volatility Clustering

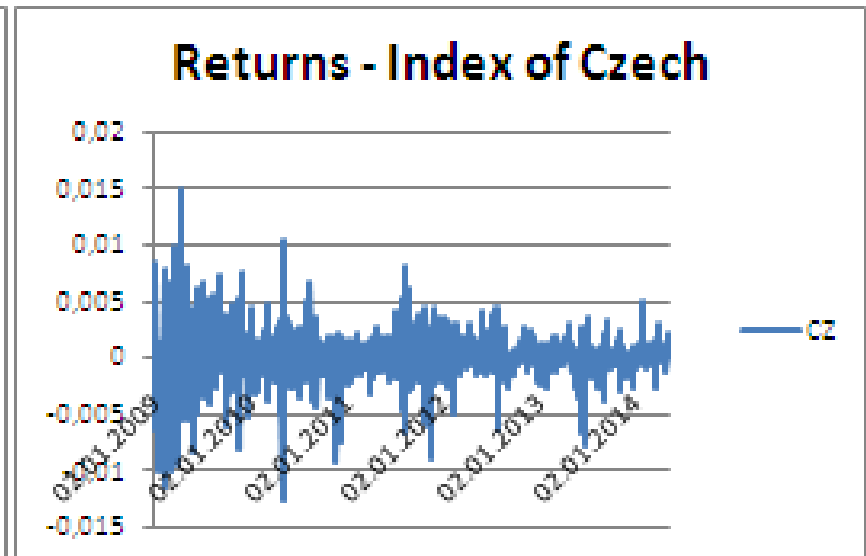
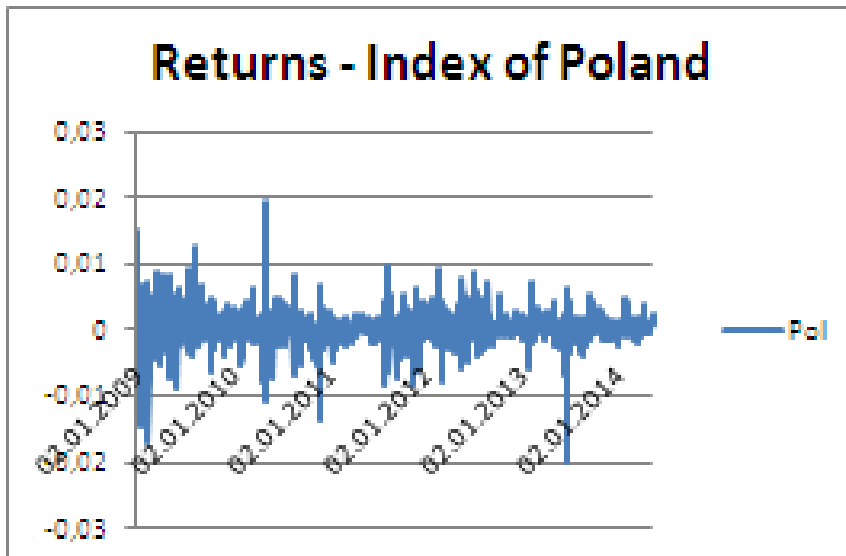
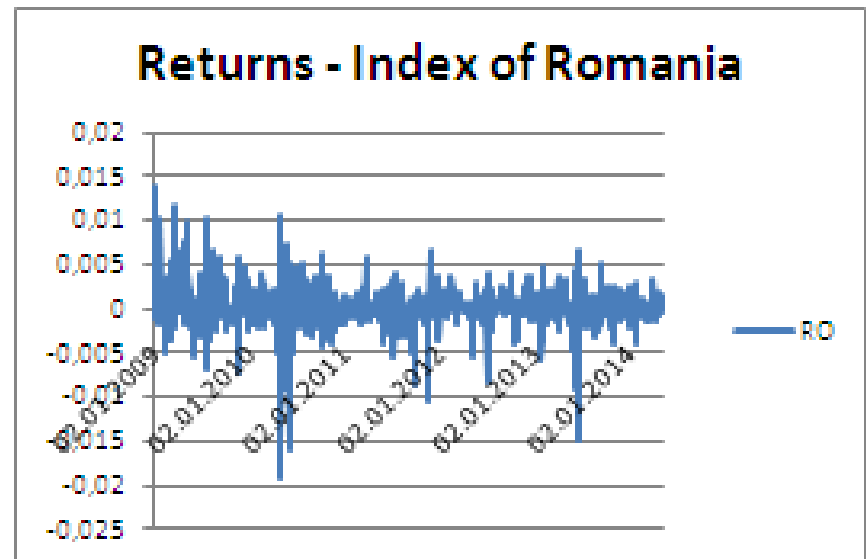
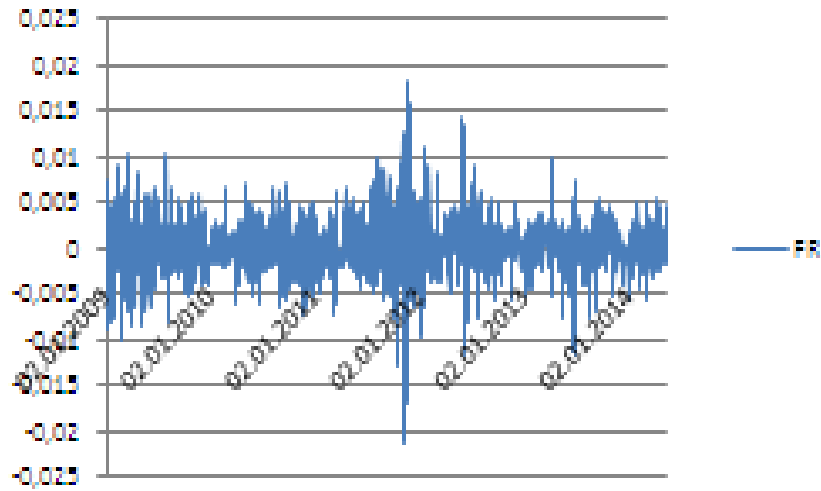
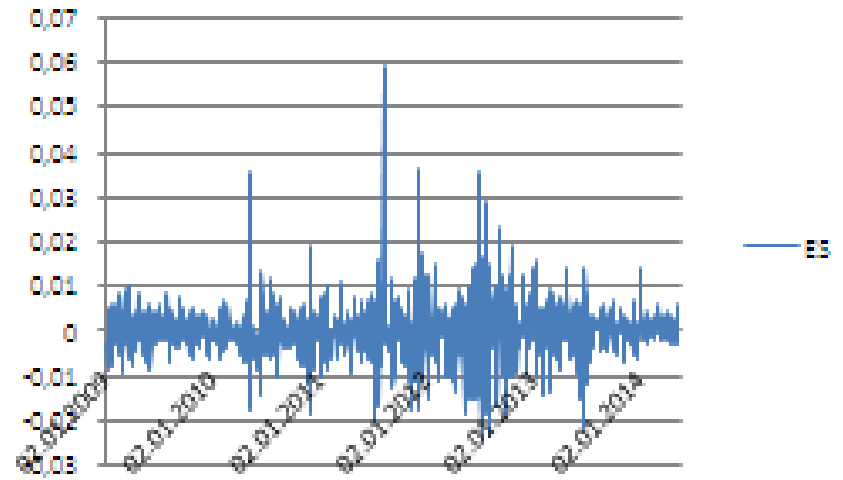


Figure 1 – Returns of Romania, Poland and Czech Republic

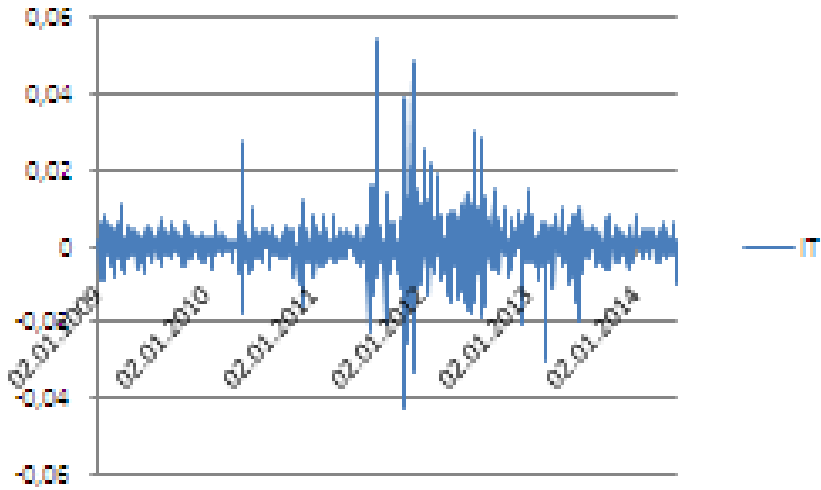
Returns - Index of France



Returns - Index of Spain



Returns - Index of Italy



Returns - Index of Belgium

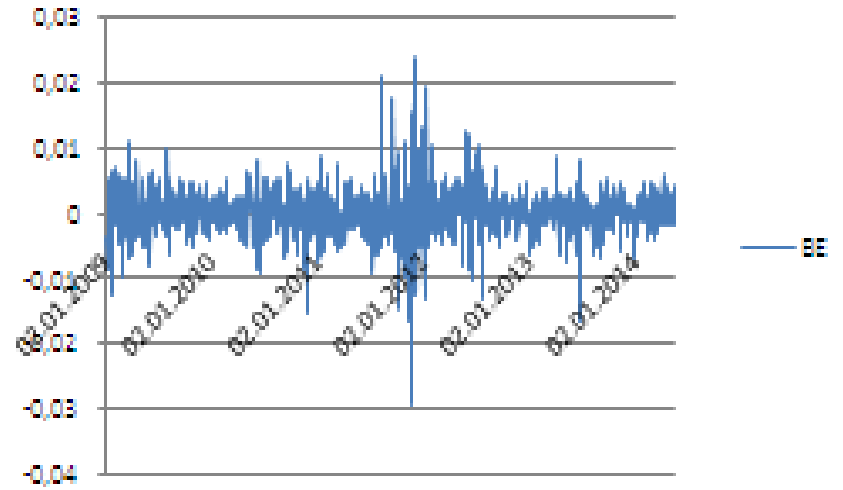


Figure 2 – Returns of France, Spain, Italy and Belgium

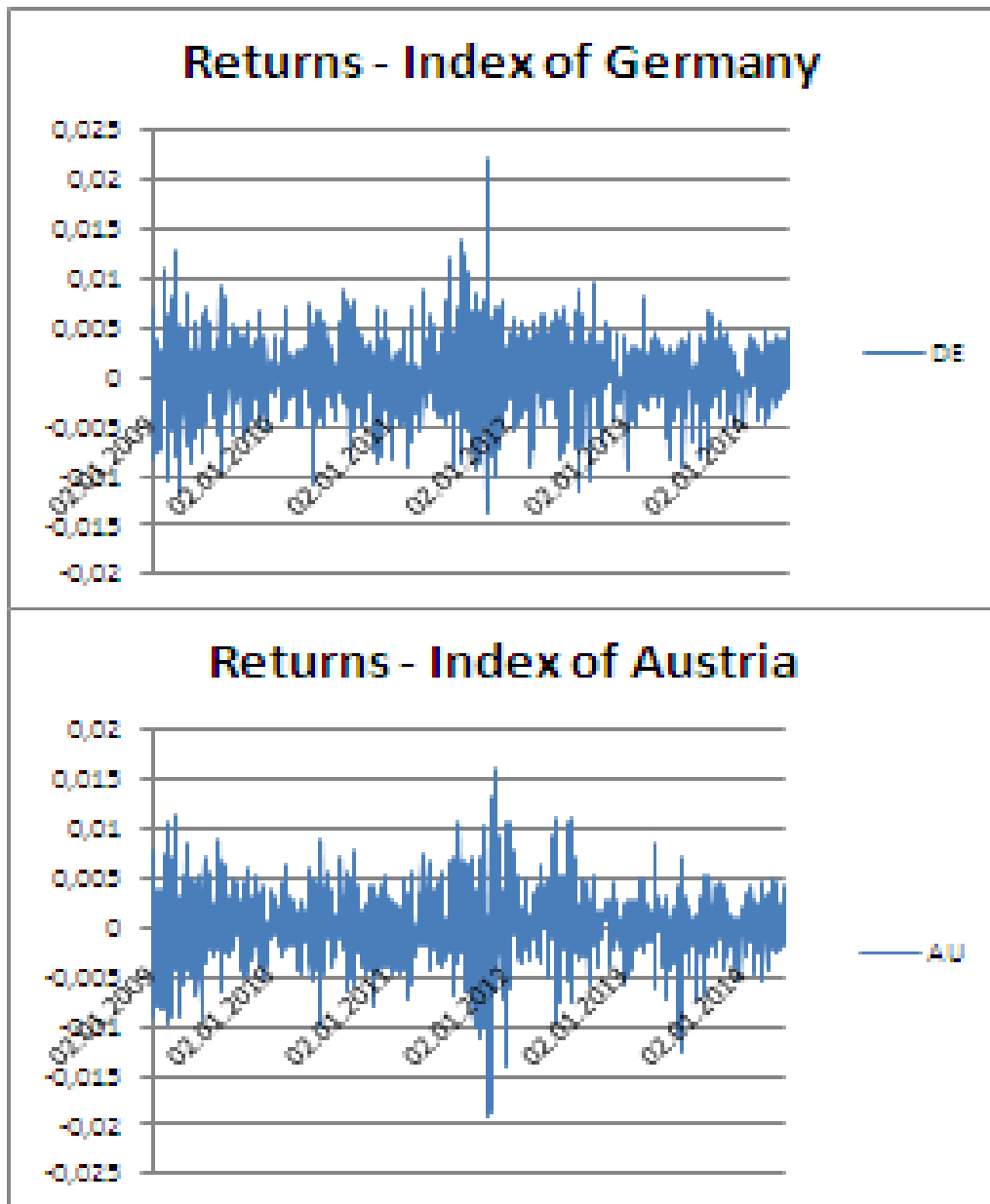


Figure 3 – Returns of Germany and Austria

DESCRIPTIVE STATISTICS

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Austria	0.00012	0.0034	-0.245	6.126	584.582	0.000
Belgium	0.00013	0.0039	-0.015	10.598	3373.095	0.000
Czech	0.00011	0.0022	-0.052	10.411	3209.354	0.000
France	0.00011	0.0033	-0.043	6.539	732.025	0.000
Germany	0.00011	0.0036	0.076	4.596	150.131	0.000
Italy	0.00011	0.0057	0.812	19.796	16633.25	0.000
Poland	0.00034	0.0027	-0.483	12.082	4872.767	0.000
Romania	0.00021	0.0021	-0.896	17.597	12634.70	0.000
Spain	8.13E-0	0.0059	1.184	14.907	8609.742	0.000

Table 1 - Descriptive Statistics

EXAMINING THE DATA: PRESENCE OF HETEROSKEDASTICITY

	F-Statistic	Probability
Romania	47.7499	0.000
Poland	67.8049	0.000
Czech	112.867	0.000
Austria	42.5493	0.000
Belgium	192.285	0.000
France	24.9276	0.000
Germany	27.0687	0.000
Italy	43.2758	0.000
Spain	19.2597	0.000

The returns are regressed against a constant.

The ARCH test is conducting.

Table 2 – ARCH Test Results

METHODOLOGY

1. Estimate the mean and volatility using an ARMA-GARCH(1,1) process.
2. The model is extended in order to include the returns of foreign markets in the mean equation and the squared residuals of foreign markets, derived from the GARCH model applied to returns of foreign markets, in the variance equation

$$R_{it} = \alpha_i + \theta R_{i,t-1} + \sum_{i \neq j} \theta_{ij} R_{j,t-1} + \epsilon_{it} - \beta \epsilon_{i,t-1}$$

$$h_{it} = a_i + b_i h_{i,t-1} + c_i \epsilon_{i,t-1}^2 + \sum_{i \neq j} \lambda_j \epsilon_{j,t-1}^2$$

STEP 1: RESULTS – CASE OF ROMANIA

Mean Equation

Variable	Coefficient	Prob.
R_RO(-1)	0.168894	0.0000
MA(2)	0.065480	0.0344

Variance equation

Variable	Coefficient	Prob.
C	1.68E-07	0.0000
RESID(-1)^2	0.183031	0.0000
GARCH(-1)	0.758728	0.0000

Table 3 – Mean and Variance Equations
ARMA(1,2)-GARCH(1,1)

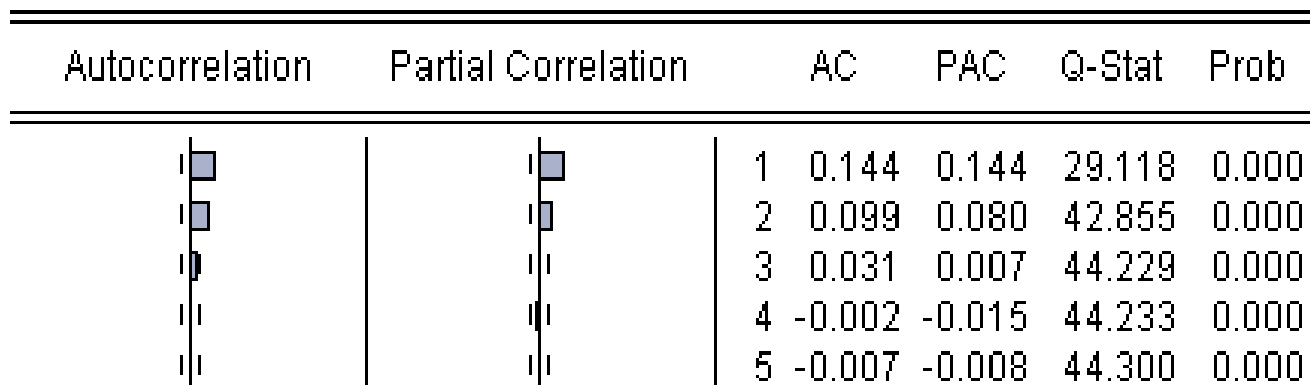


Figure 4 – Correlogram of returns

STEP 1: RESULTS

- Poland: ARMA(1,2)-GARCH(1,1)
- Czech: AR(3)-GARCH(1,1)
- Austria: MA(1)-GARCH(1,1)
- Belgium: AR(1)-GARCH(1,1)
- France: AR(1)-GARCH(1,1)
- Germany: AR(2)-GARCH(1,1)
- Italy: ARMA(1,2)-GARCH(1,1)
- Spain: ARMA(1,1)-GARCH(1,1)

TESTING FOR HETEROSKEDASTICITY

	F-Statistic	Probability
Romania	0.02684	0.9735
Poland	0.47242	0.6236
Czech	0.07221	0.9303
Austria	0.72165	0.4861
Belgium	0.15594	0.8556
France	0.17930	0.8359
Germany	0.42394	0.6545
Italy	0.33887	0.7126
Spain	0.57081	0.5652

There are no more ARCH effects.

The models are well specified.

Table 4 – ARCH Test Results

Step 2: Extended GARCH

Mean-Volatility Spillover effects: Case of Romania, Poland and Czech

	Romania		Poland		Czech	
Mean equation	Coeff	Prob	Coeff	Prob	Coeff	Prob
AR(1)	0.134578	0.0001	0.957939	0.0000		
AR(3)					0.095569	0.0005
MA(1)			-0.895858	0.0000		
MA(2)	0.064220	0.0350				
Austria(-1)			0.031278	0.0001	0.039747	0.0058
Czech(-1)			-0.038149	0.0197		
Italy(-1)	0.020473	0.0027				
Poland(-1)	0.057494	0.0023			0.064561	0.0021
	Romania		Poland		Czech	
Volatility equation	Coeff	Prob	Coeff	Prob	Coeff	Prob
C	1.76E-07	0.0000	1.16E-07	0.0012	5.53E-08	0.0002
RESID(-1)^2	0.173887	0.0000	0.145267	0.0000	0.134590	0.0000
GARCH(-1)	0.709147	0.0000	0.779714	0.0000	0.832289	0.0000
Austria(-1)					0.004934	0.0063
Czech(-1)	0.040898	0.0000	0.099142	0.0005		

Table 5 – Extended GARCH: Romania, Poland and Czech

Mean-Volatility Spillover effects across European developed bond markets

	Austria		Belgium		France		Germany	
Mean equation	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
AR(1)			0.207619	0.0000				
AR(2)							-0.054104	0.0461
MA(1)	0.150059	0.0027						
Belgium(-1)	0.064331	0.0780			0.096986	0.0000	0.092873	0.0001
Germany(-1)	-0.123403	0.0001	-0.139701	0.0000				
	Austria		Belgium		France		Germany	
Volatility equation	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
C	4.24E-07	0.0018	5.06E-07	0.0008	3.40E-07	0.0003	2.09E-07	0.0432
RESID(-1)^2	0.056047	0.0050	0.124475	0.0000	0.075058	0.0000	0.056614	0.0000
GARCH(-1)	0.856169	0.0000	0.822129	0.0000	0.880011	0.0000	0.926066	0.0000
Belgium(-1)	0.036727	0.0252						
Italy(-1)			0.006143	0.1005	0.003090	0.0659		

Table 6 – Extended GARCH: Austria, Belgium, France and Germany

Mean-Volatility Spillover effects across European developed bond markets

	Spain		Italy	
Mean equation	Coeff	Prob	Coeff	Prob
AR(1)			0.146106	0.0000
MA(1)	0.199893	0.0000		
MA(2)			-0.116473	0.0000
Germany(-1)	-0.144174	0.0000	-0.092956	0.0007
	Spain		Italy	
Volatility equation	Coeff	Prob	Coeff	Prob
C	7.30E-07	0.0016	4.34E-07	0.0307
RESID(-1)^2	0.121068	0.0000	0.155258	0.0000
GARCH(-1)	0.828475	0.0000	0.822943	0.0000
Germany(-1)			0.034859	0.0981
Italy(-1)	0.042572	0.0460		

Table 7 – Extended GARCH: Spain and Italy

ROMANIAN BOND MARKET

- Current yields: 3Y -> 1.2%; 6Y -> 2.25%
- Comparing with Poland and Czech, Romania offers the highest yields
- One of the yield determinants of government bond is the country risk
- S&P upgraded Romania's rating to investment grade, later than Moody's
- The investors recognized the economic stable outlook of Romania before S&P's decision, because the yields of Romanian bonds were on a downside trend from the beginning of the year and there is still some downside potential for the yields.

EUR ROMANIA SOVEREIGN CURVE: DOWNSIDE TREND DECEMBER 2013 VS. JUNE 2014

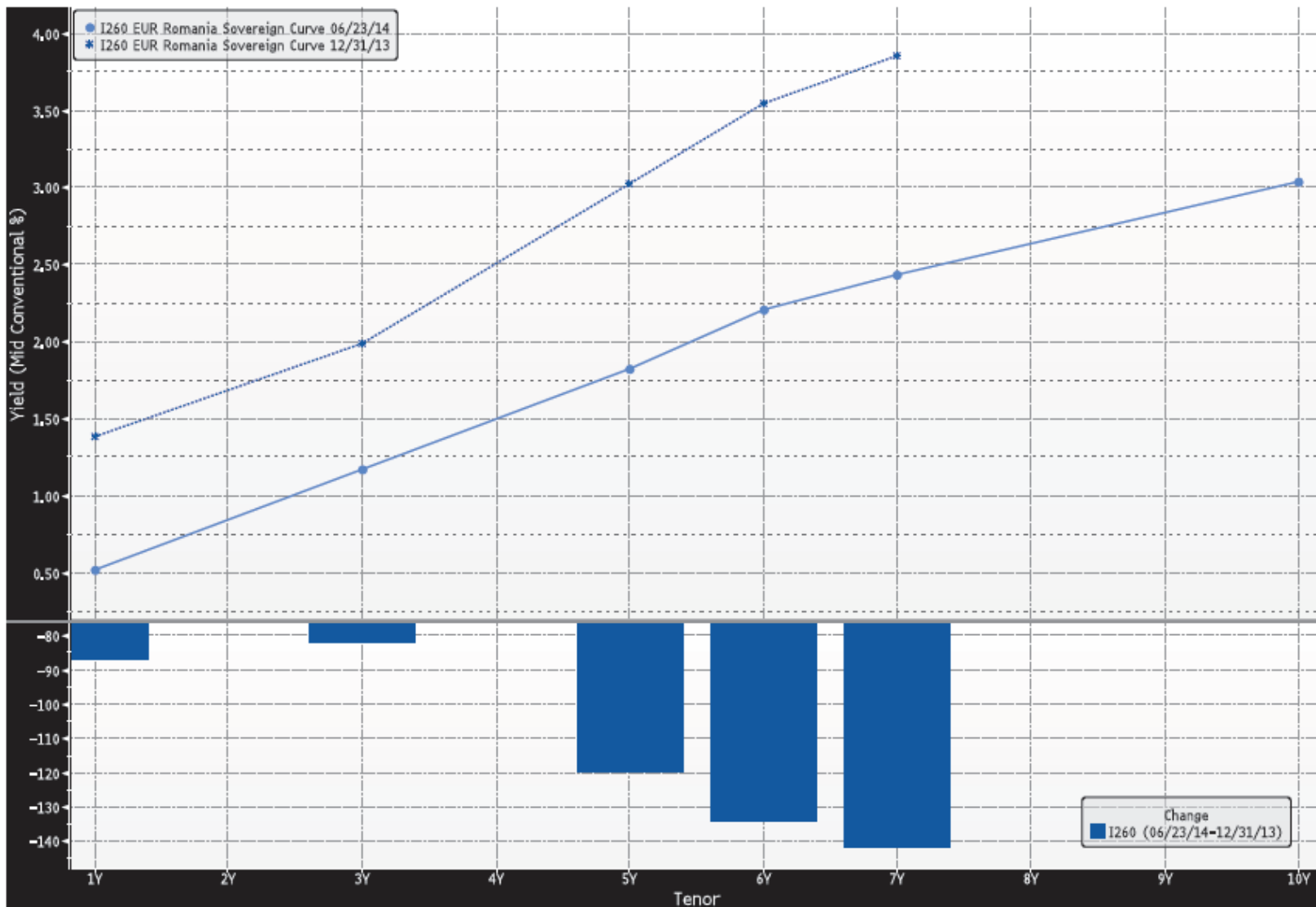


Figure 5 – EUR Romania Sovereign Curve

Source: Bloomberg

COMPARING YIELD CURVES: ROMANIA AND ITALY ARE PREFERRED BY INVESTORS WITH SIMILAR INVESTMENT RISK TOLERANCE

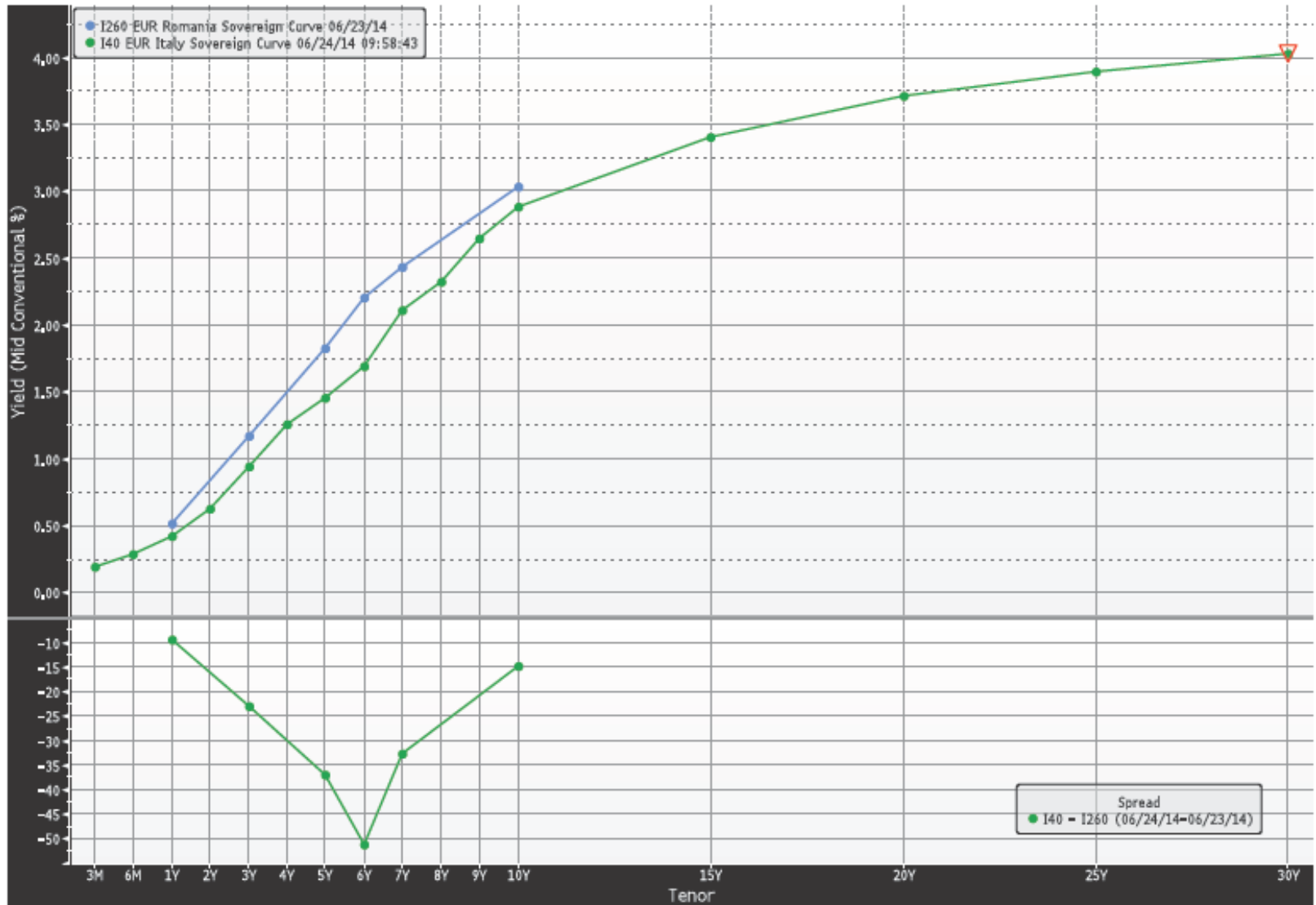


Figure 6 – EUR Romania and Italy Sovereign Curves

Source: Bloomberg

CONCLUSIONS

- There are spillover effects across European developed markets, from developed to emerging markets, but also across emerging markets
- Tendency: markets' integration
- Are there opportunities of diversification across European bond markets?
- Romanian investors might diversify their portfolios by investing in markets that are not highly correlated to Romanian bond market

THANK YOU!

