Impact of the Credit Rating Revision on the Eurozone Stock Markets

Trabelsi, Mohamed Ali and Hmida, Salma

Faculty of Economics and Management of Tunis, Tunisia.

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Salma Hmida [a]
University of Tunis El Manar,
Faculty of Economics and Management of Tunis, Tunisia.
e-mail : hmidasoulaima@gmail.com

Mohamed Ali Trabelsi [b]
University of Tunis El Manar,
Faculty of Economics and Management of Tunis, Tunisia.
e-mail : daly1704@yahoo.fr

Abstract :

The contagion generated by the US subprime crisis and the European sovereign debt crisis that hit the Eurozone stock markets is still a highly debated subject. In this paper, we try to analyze the revision effect of the credit ratings of the Eurozone countries.

To this end, we used a bivariate DCC-GARCH model to measure the extent of dynamic correlations between stock returns of our sample. Our results indicate that credit ratings revisions have a relatively limited effect on the dynamic correlations of the Eurozone stock markets.

Keywords: Financial contagion; European debt crisis; Dynamic conditional correlations.

JEL: G01, G15, C22

Introduction:

The turmoil that has characterized capital markets since the summer of 2007 and its intensification since mid-September 2008 have had a serious impact on the global economy. Although the US high-risk mortgage market is considered to be the immediate cause of this turmoil, in recent years Eurozone capital markets and financial institutions have taken their share of the extended credit cycle and have been hit hard by capital markets tensions (Trabelsi, 2012).

After disclosing the Greek deficit, leading to an increase in sovereign risk perception, the Greek crisis has spread to the most fragile Eurozone member countries (Ehrmann and Fratzscher, 2016). As a result, uncertainties about the Eurozone markets and the unpredictable nature of the European debt crisis have seriously undermined investor sentiment.

On the other hand, the successive and the massive credit rating downgrading of several Eurozone countries, in particular the most fragile ones, led to markets over-reacting to the bad news (Arezki et al., 2011). In the wake of the crisis, the Eurozone stock markets experienced massive depreciations coupled with high stock market volatility. Taking into account these turbulences, it seems therefore necessary to determine the extent of interdependence between the Eurozone stock markets and to examine whether there is a contagion relationship between these markets during the crises periods.

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a: Researcher in the Unit of Econometrics Applied to Finance, University of Tunis El Manar, Tunisia
b: Professor & Head of Laboratory Research: Econometrics Applied to Finance, Faculty of Economics and Management of Tunis, University of Tunis El Manar, Tunisia

Studying financial contagion effects across the Eurozone stock markets is very interesting because these markets are strongly integrated as suggested by several authors (Fratzscher, 2002, Bartram et al., 2007). Indeed, due to the factors relating countries trough trade and the banking sector, we should expect higher interdependence and contagion levels, both between and within the Eurozone markets and other countries' markets. Moreover, several authors like Savva (2009) and Connor and Suurlaht (2013) have pointed to an increasing correlation between European stock markets after introducing the Euro.

In this regard, in order to gather evidence about any contagion phenomenon across the Eurozone stock markets, we refer to the non-contingent crises theory where contagion is but a continuation of the interdependence process between markets (Forbes and Rigobon, 2002). We therefore study the impact of sovereign credit ratings revisions on co-movements between the markets in our sample. The aim is to see whether sovereign rating announcements news generates contagion effects across European stock market returns.

This paper is then structured as follows. Section 1 reviews the relevant theoretical and empirical literature. Section 2 presents our research methodology. Section 3 presents our econometric model and the main results. The final section discusses our findings.

1. Literature Review:

Several theoretical and empirical studies have focused on contagion. However, research on contagion during the European sovereign debt crisis using correlation analyses shows mixed results. Indeed, some studies found a significant increase in the correlation coefficients between the different financial markets returns during the European debt crisis (Claeys and Vasicek, 2014, Kalbaska and Gatkowski, 2012, Metiu 2012, Missio and Watzka, 2011, Andenmatten and Brill, 2011). Other researchers believe that correlations between financial markets did not show an upward trend during the same period suggesting the presence of a simple interdependence rather than contagion (Caporin et al., 2013, Briere et al., 2012). Samitas and Tsakalos (2013) examined the relationship between the Greek stock market and seven European stock markets using an asymmetric DCC model and copula functions to measure financial contagion. Their results point to the presence of a contagion phenomenon during the subprime crisis and reject the presence of this phenomenon during the European sovereign debt crisis. In his paper on financial contagion during the sovereign crisis, Horta (2012) suggests that the stock markets of the NYSE Euronext group, whose sovereign debt is not under market pressure, do not show contagion signs unlike at-risk countries, which showed the most serious debt problems with contagion signs. This result is similar to that reported by Kizys and Pierdzioch (2011).

Examining asymmetric conditional correlations between the US and European stock markets during the US subprime crisis and the European debt crisis, Kenourgios (2014) found contagion across these markets during both crises. Papavassiliou (2014) examined correlation between Greek sovereign stocks and bonds in order to study contagion of the Greek crisis. Using a DCC model, the author concluded that correlation between sovereign stocks and bonds returns increased significantly during the Greek debt crisis, pointing to the presence of a contagion effect cross the two markets. Similarly, Missio and Watzka (2011) used a DCC model to examine the dynamics of correlations between Greek sovereign returns and sovereign returns of Eurozone countries. The authors found financial contagion across the Belgian, Italian, Portuguese and Spanish sovereign debt markets. Afonso et al. (2012) examined whether sovereign returns and CDS spreads in a given country react to the sovereign ratings of other countries. They conclude to a contagion phenomenon, in particular from the lowest-rated countries to the highest-rated countries.

These mixed results reported by contagion literature are typical, as they are not unique to the Eurozone debt crisis. Indeed, such controversies stem from the different definitions given to contagion, the used measurement methods and the choice of the crisis periods.

2. Methodology:

In order to overcome the shortcomings of the CCC-GARCH model, Engle and Sheppard (2001), Engle (2002) and Tse and Tsui (2002) proposed the DCC-GARCH model, which is an original dynamic estimation of conditional correlations in Multivariate GARCH models. Their specification allows for a time varying matrix because the DCC-GARCH introduces equations describing the evolution of correlation coefficients in time.

Therefore, in order to measure dynamic conditional correlations, we apply the DCC-GARCH model proposed by Engle (2002). The multivariate model is defined as follows:

$$X_t = \mu_t + \epsilon_t \qquad (1)$$

where

X_t = (X_{1t} , X_{2t} ,……., X_{Nt}) is the vector of past observations;
μ_t = (μ_{1t} ,…,μ_{Nt}) is the vector of conditional returns;
ϵ_t = (ϵ_{1t} , ϵ_{2t} , ……….., ϵ_{Nt}) is the vector of standardized residuals;

We define also the matrix $H_t = (\epsilon_t \epsilon_t') = D_t R_t D_t$ (2)
Where

$R_t = (diag(Q_t))^{-1/2}\ Q_t (diag(Q_t))^{-1/2}$ is $(N \times N\ )$ a symmetric dynamic correlations matrix.

$D_t = diag\ (\ \sqrt{h_{11,t}}, \sqrt{h_{22,t}}, \dots \dots, \sqrt{h_{NN,t}}\ )$ is a diagonal matrix of standards deviations for each of the returns series obtained from estimating a univariate GARCH process in equation (1) formulated by the following equation:

$$h_{ii,t} = \omega_i + \alpha_{\mathrm{i}} \epsilon_{i,t-1}^2 + \beta_{\mathrm{i}} h_{t-1} \qquad (3)$$

Where

$h_{ii,t}$ represents conditional variance, which depends upon the mean volatility level ω_i, the news from previous period $\epsilon_{i,t-1}$ and conditional variance from the previous period h_{t-1}.
ω_i , α_i and β_i are unknown parameters to be estimated.
Finally, Q_t is $(N \times N)$ variance-covariance matrix of standardized residuals $\left(u_t = \frac{\epsilon_t}{\sqrt{h_t}}\right)$ will be defined by:

$$Q_t = (1 - \theta_1 - \theta_2)\bar{Q} + \theta_1 (u_{t-1} u_{t-1}') + \theta_2 Q_{t-1} \qquad (4)$$

Where $\overline{Q}$ = E $(u_t u_t')$ is a $(N \times N)$ symmetric positively defined matrix of the unconditional variance covariance of the standardized residuals. θ_1 and θ_2 are unknown parameters to be estimated. The sum of these two coefficients must be less than 1 in order to ensure positivity of the matrix Q_t.

Consequently, for a pair of markets i and j, their conditional correlation at a time t is such that:

$$\rho_{ij,t} = \frac{(1-\theta_1-\theta_2)\overline{q_{ij}} + \theta_1 u_{i,t-1} u_{j,t-1} + \theta_2 q_{ij,t-1}}{\sqrt{\left((1-\theta_1-\theta_2)\overline{q_{ii}} + \theta_1 u_{i,t-1}^2 + \theta_2 q_{i1,t-1}\right)\left((1-\theta_1-\theta_2)\overline{q_{jj}} + \theta_1 u_{j,t-1}^2 + \theta_2 q_{j1,t-1}\right)}} \qquad (5)$$

Where q_{ij} is the element of the i[th] row and the j[th] column of the matrix Q_t.

The parameters of the DCC model are estimated using the maximum likelihood method introduced by Bollerslev and Wooldridge (1992). This allows to obtain for each variable, variance and conditional covariance. Under the Gaussian hypothesis, the likelihood function can be expressed as follows:

$$
\begin{aligned}
\mathrm{L}(\theta) &= -\frac{1}{2}\sum_{t=1}^{T}\left(n\,log(2\pi) + 2\,log|H_t| + \epsilon_t' H_t^{-1}\epsilon_t\right) \\
&= -\frac{1}{2}\sum_{t=1}^{T}\left(n\,log(2\pi) + 2\,log|D_t R_t D_t| + \epsilon_t' D_t^{-1} R_t^{-1} D_t^{-1}\epsilon_t\right) \qquad (6) \\
&= -\frac{1}{2}\sum_{t=1}^{T}\left(n\,log(2\pi) + 2\,log|D_t| + log|R_t| + u_t' R_t^{-1} u_t\right)
\end{aligned}
$$

With $u_t = \frac{\epsilon_t}{\sqrt{h_t}} = D_t^{-1}\epsilon_t$

3. Empirical analysis:

3.1. Data and descriptive statistics:

In this study, we examine 7 Eurozone stock indices: Belgium (BEL20), Spain (IBEX35), France (CAC40), Greece (Athex Composite Index), Ireland (ISEQ overall price), Italy (FTSE MIB) and Portugal (PSI20). The study period stretches between 01/01/2004 and 12/31/2012 and includes 2348 daily observations for each index.

Table 1 reports the descriptive statistics of the daily stock returns series across the total period. The standard deviations present a measure of risk during the total study period. They indicate that the Greek market is the riskiest stock market of all the markets of the sample. Skewness is different from 0, indicating asymmetry for all the series. Moreover, all returns distributions show a statistically significant Kurtosis greater than 3, indicating that these distributions dispose of thicker tails than the normal distribution and that they are leptokurtic.

Table 1: Descriptive statistics of the returns series
For the full period (1/1/2004 - 12/31/2012)

	ATHEX	BEL20	CAC40	FTSEMIB	IBEX35	ISEQ	PSI20
Mean	-0.038908	0.004183	0.000984	-0.021243	0.002045	-0.015786	-0.007107
Maximum	13.43108	9.221261	10.59459	10.87425	13.48364	9.733092	10.19592
Minimum	-10.21404	-8.319283	-9.471537	-8.599092	-9.585865	-13.96357	-10.37918
Std. Dev.	1.802965	1.299611	1.457688	1.538879	1.517968	1.564369	1.185156
Skewness	0.004875	-0.182445	0.050558	-0.031786	0.141330	-0.595134	-0.132319
Kurtosis	7.445010	9.735571	10.11370	9.173992	10.54170	10.77158	13.20373
Jarque-Bera	1933.011*	4451.520*	4951.825*	3729.624*	5572.309*	6047.482*	10192.89*
LB Q(24)	53.5*	49.2*	60.1*	66.76*	54.3*	82.1*	48.7*
LB Q^2 (24)	1227.5*	3016.9*	2142.9*	2266*	1418*	2888.5*	1534.4*
ADF	-43.500***	-46.512***	-31.320***	-47.397***	-46.936***	-45.238***	-45.139***
PP	-43.450*	-46.474*	-50.475*	-47.398*	-47.034*	-45.147*	-45.116*

*Notes: ***and * denote statistical significance at the 1% and 10% respectively.*

The normality hypothesis of stock returns series is also rejected by the Jarque-Bera test, whose coefficients exceed the critical values, rejecting thus the null hypothesis of normality for the returns series. The ADF and PP tests, applied to the returns series, are significant at the 1% level, allowing us to reject the null hypothesis of the presence of a unit root, against the alternative hypothesis of stationarity of all returns series. All Ljung-Box test statistics for the returns series and the squared returns series are significant at the 1% level. Such statistics indicate the presence of first and second order serial auto-correlation. The existence of the latter implies the presence of a linear dependence and a nonlinear dependence (heteroscedasticity) between returns. This reflects the imperfection of the studied stock markets and attests for the presence of a clustering volatility phenomenon.

3.2. Contagion test:

In order to determine the presence of contagion effects generated by the subprime crisis and the European sovereign debt crisis, we follow Forbes and Rigobon (2002) who define contagion as a significant increase in the relationships between markets after a country shock. Moreover, in the absence of a significant trend of co-movements during crisis periods, the term interdependence is used to describe dynamics between markets.

Let X_t and Y_t be two stock returns series such that:

$$Y_t = \alpha + \beta X_t + \epsilon_t \tag{7}$$

Where α and β are constants and ϵ_t represents the error terms.

According to Forbes and Rigobon (2002), the correlation coefficient ρ between X_t and Y_t is adjusted by the following:

$$\rho^* = \frac{\rho}{\sqrt{1+\delta[1-\rho^2]}} \tag{8}$$

With $\delta = \frac{\sigma_x^c}{\sigma_x^t}$ - 1, where δ measures the relative increase in the volatility of x_t cross the two crises and stable periods and σ_x^c and σ_x^t are the conditional variances of the stochastic variable X_t respectively during the crisis period and the stable period.

The variable X_t represents the daily returns of the Greek stock index and the variable $Y_t$represents the daily returns of the other stock indexes of our sample. The following two alternative hypotheses are used to test the significance of the increase of the adjusted and unadjusted correlation coefficients: $\begin{cases} H_0\colon\ \rho^*{}_c = \rho^*{}_t \\ H_1\colon\ \rho^*{}_c > \rho^*{}_t \end{cases}$

Accepting the null hypothesis H_0 means that correlation between the two markets does not increase significantly across the two sub-periods. In this case, we conclude to a simple interdependence between markets and not a shift contagion.

Accepting the alternative hypothesis H_1 means that correlation between the two markets increased significantly across the two sub-periods, proving the presence of a shift contagion.

The t-Student test presented by Collins and Biekpe (2003) is used to examine these hypotheses. The test is given by:

$$\mathrm{t} = (\rho^*{}_c - \rho^*{}_t)\sqrt{\frac{n_c+n_t-4}{1-(\rho^*{}_c-\rho^*{}_t)^2}} \tag{9}$$

t is distributed with $(n_1 + n_2 - 4)$ degrees of freedom, n_c *and* n_t are respectively the number of observations during the crises periods and the stable period.

To this end, Trabelsi & Hmida (2018) used a bivariate Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroscedasticity (DCC-GARCH) model to measure the extent of dynamic correlations between the Greek stock market and the Belgian, French, Portuguese, Irish, Italian and Spanish stock markets during both crises periods. The results point to the presence of a contagion effect between all market pairs during the subprime crisis and between the Greek and Portuguese stock markets during the European sovereign debt crisis

3.3. The effect of sovereign credit-rating revisions on correlation coefficients:

Sovereign rating is the continuous assessment of each country's creditworthiness and measures default probability over a specific period of time. Since the sovereign debt crisis in Europe, the Eurozone has been pressured by rating agencies and their downward rating warnings. Indeed, several Eurozone countries have been degraded leading to fears of default for some of them. In this section, we examine the effect of downward sovereign ratings of the Eurozone countries of our sample (by the Big Three; namely Fitch, Standard & Poor's and Moody's) on bivariate dynamic conditional correlations. The aim is to investigate whether news about sovereign rating changes in one country triggers contagion effects on other countries in the region.

To examine changes in sovereign ratings, we began by calculating a complete credit rating measure through a standard linear transformation. Indeed, it is a question of assigning numerical values to the rating scales of the three agencies, which total 21 ratings on average. Therefore, a value of 20 is given to the highest rating AAA / Aaa issued by Fitch; S & P / Moody's respectively and a value of 0 to the lowest RD / SD / C rating, assessing a general default situation or selective default issued by Fitch / S & P / Moody's respectively. Then, we assign values to credit outlooks and watch changes. A negative outlook will add nothing to the value, while stable and positive outlooks add 1/3 and 2/3 to the rating values, respectively. Thus, a complete credit rating measure is obtained by summing the values of the first and second steps. Then, we define the following regression:

$$\rho_{ij,t} = \theta_0 + \theta_1 \rho_{ij,t-1} + \gamma_1 RC_{i,t}^{T} + \gamma_2 RC_{j,t}^{T} + \varepsilon_{ij,t} \text{ with } RC_{i(j),t}^{T} = \Delta v \qquad (10)$$

With $\rho_{ij,t}$ the bivariate conditional correlations of the Greek stock market and the six European stock markets;

$RC_{i(j),t}^{T}$ is an indicator variable that captures the effects of sovereign credit rating changes of country i (Greece) and countries j (the other countries in the sample) at time t = T.

$$RC_{i(j),t}^{T} = \begin{cases} \Delta v, & t = T \\ 0, & t \neq T \end{cases}$$

The methodology of Chiang et al. (2007) consists in setting:

Δv = 1 for an upgrade revision of one notch,

Δv = -2 for a downgrade revision of two notches,

Δv = -1/3 the case of an outlook or a watch change from positive to stable or from stable to negative.

Δv = -2/3 the case of an outlook or a watch change from positive to negative.

Note that regressions are concluded with Newey-West Standard Errors.

The results are presented in Table 2. Ljung-Box and ARCH tests reject the presence of serial autocorrelation in the residuals and squared residuals issued from all regressions. These are considered adequate. Our results indicate that three correlation pairs of the six positively and significantly react to sovereign rating revisions. These are the dynamic conditional correlations of ATHEX-CAC40, ATHEX-IBEX35 and ATHEX-PSI20.

These three correlation pairs tend to increase following a change in the debt rating of one of the two countries. Indeed, co-movements between the Greek and Spanish stock market tend to rise following the revision of the Greek sovereign credit ratings as γ_1 is positive and significant at the 10% level. However, co-movements between the Greek and the French stock markets, or the Greek and Portuguese stock markets are positively affected by changes in the French and Portuguese debt ratings respectively. Moreover, coefficients of γ_2 are positive and significant at the 5% and 1% levels respectively. The significant and positive effect on dynamic conditional correlations suggests that the revisions of debt ratings generate a contagion effect across the stock markets of the studied countries. Determining these effects is important for several reasons. Indeed, countries negatively affected by other countries' rating should avoid issuing new stocks in the period following that downgrading as such news will put upward pressure on the required return on their own new issue. In addition, market participants in asset pricing and allocation, as well as risk management can use these results.

Table 2: Effect of sovereign credit rating changes on stock return correlations

	γ_1	γ_2	LB Q(12)	ARCH Test	
				χ^2 ARCH	P-value
ATHEX-BEL20	0.00067	-0.00223	13.399	0.0168	(0.8968)
ATHEX-CAC40	0.00186	**0.00100****	7.366	1.7999	(0.1797)
ATHEX-FTSEMIB	0.00117	-0.00102	3.391	0.0146	(0.9037)
ATHEX-IBEX35	**0.00129***	-0.00232	12.359	0.0669	(0.7958)
ATHEX-ISEQ	0.00367	-0.00338	4.824	0.0331	(0.8555)
ATHEX-PSI20	0.00108	**0.00227*****	14.157	0.0050	(0.8219)

*Notes: ***, **,* denote statistical significance at the 1%, 5% et 10% levels respectively.*

Importantly, with these results as a whole, we notice that most of the dummy variables are non-significant. These results indicate that the effect of sovereign credit ratings revisions on Eurozone stock markets' co-movements is relatively limited. This is inconsistent with several studies, which pointed out that even if credit ratings do no generally impact stock markets, any downgrade sovereign rating systematically results in a decline in stock prices in the rated country (Iankova et al., 2009) and a regional contagion effect to neighboring countries through a wake-up call. Although our results point to significant dummy variables for three correlation pairs, we notice that these variables are poorly influenced by credit rating revisions. Our results suggest that investors in the Eurozone stock markets are generally not sensitive to sovereign rating revisions because they may consider them to be country-specific news.

4. Conclusion:

Contagion across the Eurozone stock markets is attracting the growing interest of analysts and researchers. Our study examined the relationship between the Greek stock market and six Eurozone stock markets. We applied the bivariate DCC-GARCH model to test this relationship over the 2004-2012 period.

Our results show that the revisions of the Greek, French and Portuguese credit ratings had a significant effect on the dynamic correlations between the Greek market and the Spanish, French and Portuguese markets respectively. The identification of a shift contagion phenomenon between Greek and Portuguese markets during both periods of crisis and the significant effect of the Portuguese debt rating on conditional correlations reveal that both investors and rating agencies play significant roles in shaping the structure of dynamic correlations between these two markets. It is important to note that the effect of sovereign ratings revisions on the co-movement of Eurozone stock market returns is relatively limited.

The obtained results are useful for investors, in particular for their portfolio diversification strategies. They are also useful for the monetary and financial authorities in their efforts to absorb shocks resulting from crises. Indeed, a good understanding of contagion effects is an important step towards designing portfolios trading, hedging and optimization strategies. Moreover, authorities' efforts during a financial crisis in a given country will only be effective if the relationships between the two countries are significantly different before and after the crisis. If, however, no contagion is determined, the efforts will have very limited effects since financing problems in this case result mainly from the country's fundamental economic and budgetary problems.

References:

Afonso A., Furceri D. & Gomes P. (2012). Sovereign credit rating and financial markets linkages, application to European data, *Journal of International Money and Finance,* 31(3), pp. 606-638.

Andenmatten S. & Brill F. (2011). Measuring comovements of CDS premia during the Greek debt crisis, *Discussion Paper, No. 11-04. University of Bern, Department of Economics.*

Arezki R, Candelon B. & Sy A.V.R (2011). Sovereign rating news and financial market spillovers, evidence from European debt crisis, *IMF working papers.*

Bartram S, Taylor S.J. & Wang Y. (2007). The euro and European financial market dependence», *Journal of Banking and Finance,* 51(5), pp.1461-1481.

Bollerslev T. & Wooldridge J.M. (1992). Quasi Maximum Likelihood Estimation and Inference in Dynamic Models with Time Varying Covariances, *Econometric Reviews,* 11, pp. 143-172.

Briere M., Chapelle A. & Szafaz A. (2012). No contagion, only globalization and flight to quality », *Amundi Asset Management Working Paper 023.*

Caporin M., Pelizzon L., Ravazzolo F. & Rigobon R. (2013). Measuring sovereign contagion in Europe», *NBER Working Paper 18741.*

Chiang T.C., Jeon B.N. & Li H. (2007). Dynamic analysis of financial contagion: evidence from Asian Markets », *Journal of International money and Finance,* 26, pp. 1206-1228.

Claeys P. & Vasicek B. (2014). Measuring bilateral spillover and testing contagion on sovereign bond markets in Europe, *Journal of Banking & Finance,* pp. 151–165.

Collins D. & Biekpe N. (2003). Contagion: a fear for African equity markets?, *Journal of Economics and Business 55,* pp.285-297.

Connor G. & Suurlaht A. (2013). Dynamic stock market covariances in the Eurozone. *Journal of International Money and Finance 37,* pp. 353-370.

Ehrmann M. & Fratzscher M. (2016). Euro area government bonds-Fragmentation and contagion during the sovereign debt crisis, *Journal of International Money and Finance, 70,* pp. 26-44.

Engle R.F & Sheppard K. (2001). Theoretical and Empirical Properties of Dynamic Conditional Correlation Multivariate GARCH, *NBER Working Paper 8554.*

Engle R.F. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroscedasticity models, *Journal of Business and Economic Statistics,* 20(3), pp. 339-350.

Forbes K. & Rigobon R. (2002). No contagion, only interdependence: Measuring stock market co-movements, *Journal of Finance,* 57(5), pp. 2223-2261.

Fratzscher M. (2002). Financial market integration in Europe: on the effect of EMU on stock markets, *International Journal of Finance and Economics,* 7(3), pp. 165-193.

Horta P. (2012). Contagion effect in the European NYSE Euronext stock market in the context of the 2010 sovereign debt crisis, *CEFAGEUE Working paper.*

Iankova E., Pochon F. & Teiletche J. (2009). L'impact des décisions des agences de notation sur les prix des actions : Une comparaison du cas français avec les cas européen et américain, *Economie Et Prévision,* 188, pp. 1-21.

Kalbaska A. & Gatkowski M. (2012). Eurozone sovereign contagion: evidence from the CDS market (2005-2010), *Journal of Economic Behavior and Organization,* 83(3), pp. 657-673.

Kerourgios D. (2014). On financial contagion and implied market volatility, *International Review of financial analysis,* 34, pp. 21-30

Kizys R. & Pierdzioch C. (2011). The financial crisis and the stock markets of the CEE countries, *Czech Journal of Economics and Finance, Charles University Prague, Faculty of social Sciences,* 61(2), pp. 153-172.

Metiu N. (2012). Sovereign risk contagion in the Eurozone, *Economic Letter* 117 (1), pp. 35– 38.

Missio S. & Watzka S. (2011). Financial contagion and the European debt crisis, *CESifo, Munich, Germany. Working Paper 3554.*

Papavassiliou V.G. (2014). Cross-Asset contagion in Times of Stress, *Journal of Economics and Business,* 76, pp. 133-139.

Samitas A. & Tsakalos I. (2013). How can a small country affect the European economy, The Greek contagion phenomenon, *Journal of International Financial Markets, Institutions and Money,* 25(6), pp. 18-32.

Savva C.S. (2009). International stock markets interactions and conditional correlations. *Journal of International Financial Markets, Institutions and Money,* 19(4), pp. 645-661.

Trabelsi M.A. (2012). The impact of the sovereign debt crisis on the Eurozone countries, *Procedia-Social and Behavioral Sciences*, 62, pp. 424-430.

Trabelsi M.A. & Hmida S. (2018). A Dynamic Correlation Analysis of Financial Contagion: Evidence from the Eurozone Stock Markets, *Entrepreneurial Business and Economics Review,* 6(3), pp. 129-141.

Tse Y. K. & Tsui A.K.C. (2002). A multivariate GARCH model with time-varying correlations, *Journal of Business and Economic Statistics,* 20, pp. 351-362.