9. FINANCIAL MARKET REACTION TO CHANGES IN THE VOLATILITIES OF CDS RETURNS

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Abstract

The dynamics of the CDS sovereign instrument provides important information about the evolution of country risk as it is perceived by the financial markets. Therefore, if regime changes in these dynamics would signal a shift in investors' perceptions, such a change appearing simultaneously in more than one country, would flag the existence of contagion. This paper uses a methodology that relies on the identification of moments when regime shifts in the volatilities of CDS returns are realized simultaneously and uses these dates in an event study to quantify the reaction of three types of European financial assets to these common regime changes. Our approach showed that such reactions are found for each group of assets: foreign exchange rates, stock indices and bonds.

Keyword: GARCH class of models, spillover effects, eventy study, sovereign risk
JEL Classification: G14, G17

I. Introduction

During the last period, the development of the financial system and the economy as a whole has led to a powerful expansion of the market of credit derivatives. Credit default swaps (CDSs) represent the most popular and liquid instrument of the credit derivatives class. In the context of the financial crisis and more specific the sovereign debt crisis, credit default swaps came under an important dose of scrutiny from market participants,

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policy makers or regulatory institutions due to their speculative character and their linkages to other sectors of the financial markets, especially the bond market.

By definition, a CDS protects its buyer against counterpart defaults and credit risk in general. The logic of these instruments is the following: the seller offers to pay a sum of money when a third party defaults on a payment obligation issued towards the buyer. Therefore, the main characteristic of a CDS is the fact that it shifts credit exposure.

CDSs reflect the perceived sovereign risk in a dynamic manner. An efficient CDS market incorporates investors' perceptions concerning the new macroeconomic information that becomes publicly available.

In this paper we focus on the reaction of the financial market to changes in the volatily of CDSs. In order to have a clear picture of this reaction we use a wide range of financial instrumets, namely stock indices, bonds and exchange rates. We show that several relation points are found for each of the above mentioned financial assets.

The remainder of this paper is organized in the following way: Section II deals with an investigation of the literature considering CDS markets and volatility; Section III presents the data employed and the reseach methodology; Section IV reports the results of our research, while the final section concludes.

II. Literature review

The literature dedicated to the investigation of the characteristics of CDS markets and especialy to the connection with other financial markets is extensive and rapidly expanding. One of the first studies that consider the linkages between the CDS market and other financial areas such as the bond and stock markets has been put forward by Longstaff *et al.* (2003). Using a reduced form model on a Citigroup large scale data set, the authors observe that variations in CDS premia and stock returns impact the evolution of bond yields. Spillover effects were investigated usually with respect to the recent financial crisis. Lupu and Lupu (2009) provide strog evidence of increased correlations in the dynamics of the financial assets.

In an extensive approach focusing on 58 international companies, Norden and Weber (2004) show via a VAR approach that stock returns drive CDS and bond spread variations. Moreover, the authors report the fact that CDS spread leads to bond spread changes and the other way around. Another interesting contribution is the conclusion that CDS market has the most significant contribution to price discovery. Zhu (2006) targets the bond and CDS markets and observe that the spread of these financial assets tend to evolve in a parallel manner over time. The author finds that in some cases the CDS market surpasses the bond market in terms of price adjustments.

Alexander and Kaeck (2008) consider the influence of several CDS spreads characteristics on the dyanimics of the iTraxx indices for the 2004 – 2007 period. The authors use a Markov switching model and report that the above-mentioned indices are affected by stock volatily in times of CDS perturbations. Similar Markov approaches in relation to other financial assets can be found in Lupu and Călin (2014b) and Lupu and Călin (2014c).

In a research that focuses on the connections between the US stock market and the CDS market for the 2001 – 2007 period, Fung *et al.* (2008) observe the role of credit quality in the linkages between these markets. The investigation reports a mutual feedback among the markets in terms of pricing and volatility. Moreover, the authors report that the CDS market has a more significant contribution to volatility spillovers than the stock market.

Trutwein and Schiereck (2011) study the connection between the equity and credit markets considering the case of representative financial institutions in period of turmoil and significant credit risk. The research documents on the presence of a strong and positive relation between variations in credit default swap spread changes and option implied volatility. In addition to this, the authors observe that CDS and equity markets are regime dependent. This analysis in extended in Trutwein et al (2011) which use a large scale series of 633 credit events in order to discuss the influence of modifications in the dynamics of CDSs. They find that before the financial crises equity returns were sensible to events signaling credit expansion or reductions. The research confirms the above mentioned conclusion - the equity and credit markets are regime dependent.

Da Fonseca and Gottschalk (2012) use a co-movements approach to investigate several aspects related to the CDS markets of a series of countries (Austria, Korea, Hong Kong and Japan). In a VAR approach, the authors focus on the co-movements of CDS spreads, volatility and stock returns and find that stock markets influence the other two components.

Castellano and D'Ecclesia (2013) analyze the contribution of CDS volatility in offering details about the credit quality of companies. The authors employ an EGARCH (1,1) model and an event study methodology in order to assess CDS behavior in relation to news issued by Rating Agencies.

Fenech *et al.* (2013) observe that the linkages between CDS spreads and stock prices are positive in the case of the Australian market. In spite of this, using a copula based approach, the authors demonstrate that the relation becomes negative for the post-crisis period. Using a panel data methodology, Narayan *et al.* (2014) confirms the superiority of stock market in terms of price discovery, while acknowledging the role of the CDS market in the same respect.

CDS markets have been considered as vehicles that carry most important macroeconomic decisions such as central bank policies toward the financial markets. Criste and Lupu (2014) show that financial stability should be one of the most proactive roles of central bank policies, wich should be highly reflected in the dynamics of the financial markets. In this vein, Albu et al (2014a) study the sovereign CDS markets of nine CEE countries. The authors focus on the effects generated by the quantitative easing efforts of four main central banks and on the dynamics of CDS instruments as a proxy for credit risk in the specific area. The research is based on an event study analysis that demonstrates a strong impact of monetary policy on CDS returns. Albu et al (2014b) extend this approach by considering a wider set of measures employed by the European Central Bank and obtain similar results to the above-mentioned study. It shows that the unconventional monetary policies influence the evolution of CDS in the considered time frame in a percentage that ranges from 73.17% to 92.68%. Using a similar set of sovereign CDSs Lupu and Călin (2014a) address the same research question for the case of the Bank of Japan showing also the signs of an important effect induced by the quantitative easing initiatives.

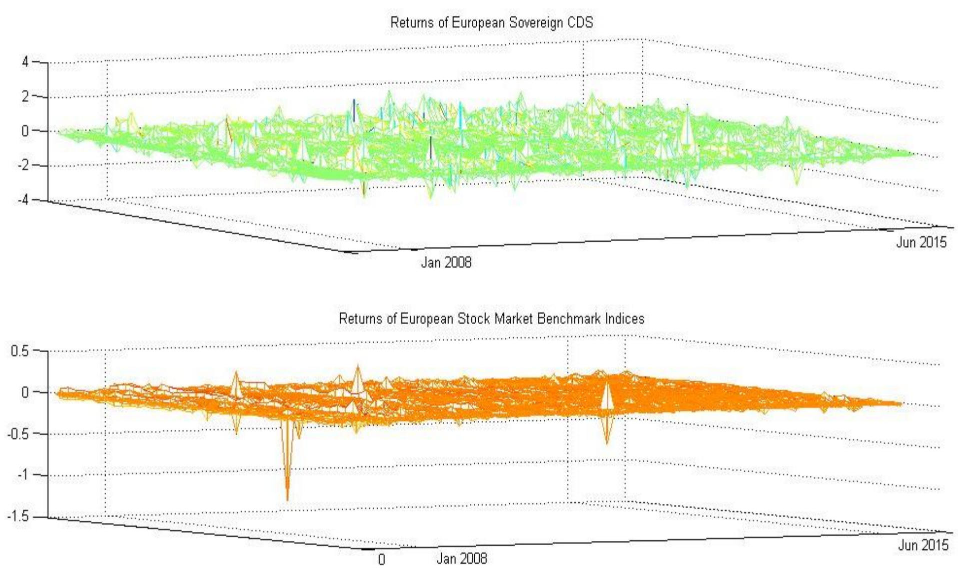
Hassan et al (2015) also focus on price discovery studying the CDS and bond markets. The authors conclude that the two markets are co-integrated and also that their dynamics is influenced by several common factors.

III. Data and Methodology

Two sets of data were used: on the one hand, we employed CDS market data for a set of 33 European countries, covering the developed, emerging and frontier markets, with a daily frequency; on the other hand we used stock market benchmark indices for a set of 36 countries, 19 sovereign bond instruments and 10 currency pairs, all European and with daily frequency. The data covers the period from January 2008 to June 2015 and was obtained from the Datastream database.

Figure 1

Dynamics of the log-returns for CDS and Stock Indices

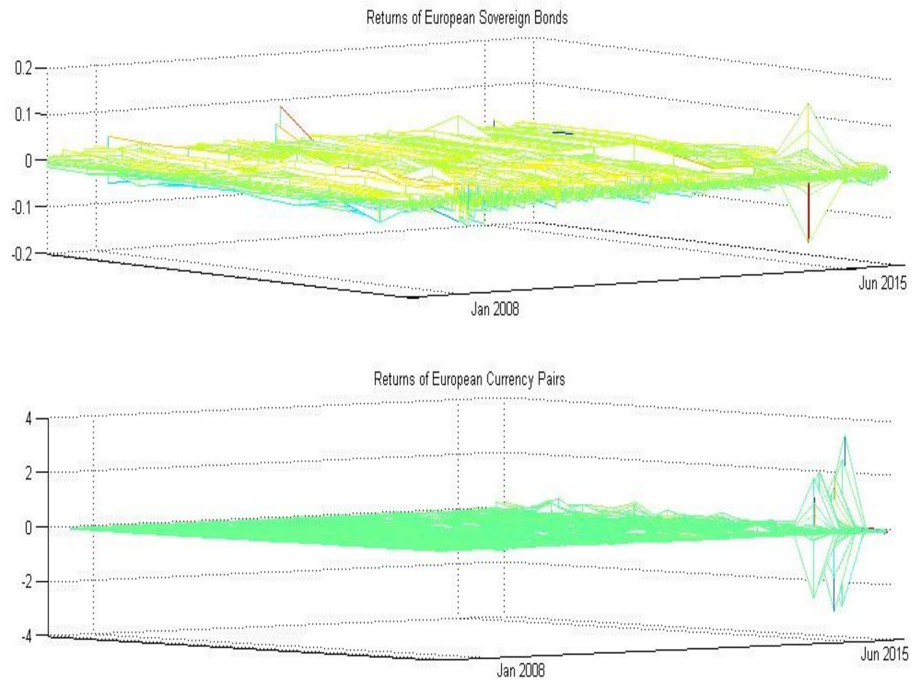


Source: Authors' calculations

Figure 1 shows that the dynamics of the CDS contracts exhibit more variation than those of the stock market indices. We notice that the two distributions could be different, with varying properties in time.

Figure 2

Dynamics of the log-returns for bonds and currency pairs



Source: Authors' calculations

Figure 2 presents the same features, with some discontinuous large moves, which seem to take place in the same time (especially at the end of the sample) and dynamic volatilities.

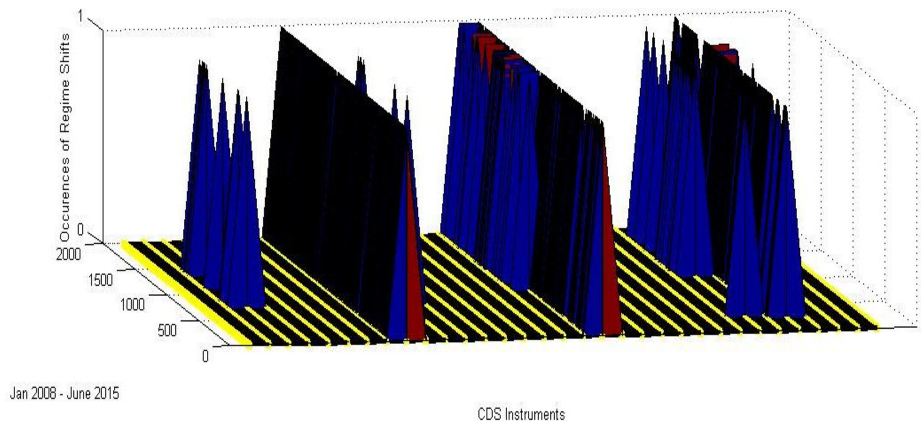
Methodology

We employed the Markov-switching algorithm to identify the regime changes in the dynamics of the CDS log-returns. These shifts were identified in a univariate manner, for each series of sovereign CDS premiums. We noticed that the moments of the switches in the volatility regimes of these log-returns tend to cluster around some instruments and some moments in time.

The moments when these changes took place in the same time for many CDS instruments was taken into account as evidence of contagion, or evidence of the fact that investors in sovereign instruments changed their perception concerning the macroeconomic uncertainty of the whole set of European countries on the whole.

Figure 3

Changes in the regime of volatilities for the CDS log-returns

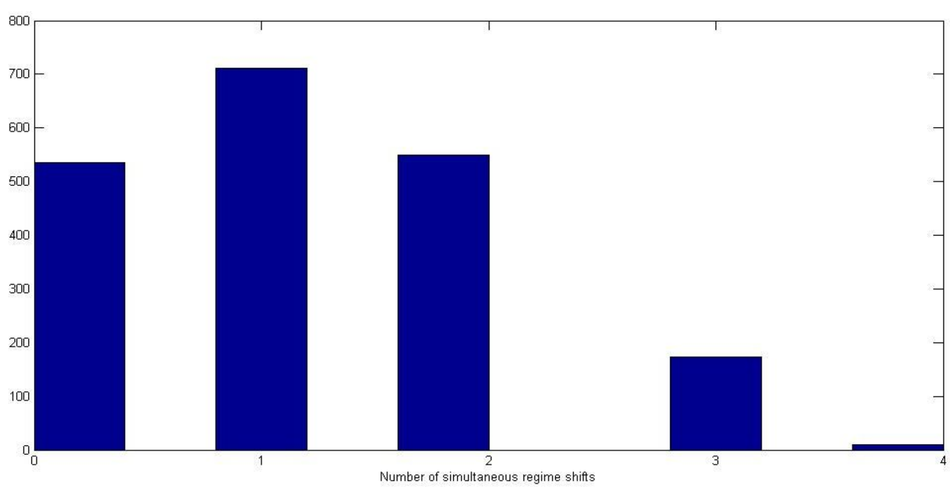


Source: Authors' calculations

The analysis that followed focused on the development of volatility event studies for the series of financial market instruments at the moments when the changes were simultaneous. We considered here only those situations when we had at least four simultaneous volatility regime shifts at the same time.

Figure 4

Histogram of common (simultaneous) regime shifts in volatilities of CDS log-returns



Source: Authors' calculations

The moments (days) with more than four simultaneous regime shifts were 28-Oct-2011, 04-Oct-2012, 05-Dec-2012, 14-Jan-2013, 21-Feb-2013, 02-May-2013, 21-May-2013, 27-May-2013 and 10-Jun-2014.

The event-study setup consisted in the use of the following set of model for the dynamics of the volatilies: GARCH(1,1), EGARCH(1,1), GJR-GARCH(1,1), APARCH(1,1), ZARCH(1,1) and NAGARCH(1,1). The above-mentioned models are defined by the following set of equations:[4]

GARCH

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{m} \alpha_i a_{t-i}^2 + \sum_{j=1}^{s} \beta_j \sigma_{t-j}^2$$

where

$$\alpha_0 > 0, \alpha_i \geq 0, \beta_j \geq 0$$

and

$$\sum_{i=1}^{\max(m,s)} (\alpha_i + \beta_i) < 1$$

EGARCH

$$y_t = \mu + a_t$$
$$a_t = \sigma_t \epsilon_t$$
$$\log \sigma_t^2 = \omega + \sum_{i=1}^{m} \beta_i \log \sigma_{t-i}^2 + \sum_{j=1}^{s} \alpha_j \left[\frac{|a_{t-j}|}{\sigma_{t-j}} - E\left(\frac{|a_{t-j}|}{\sigma_{t-j}} \right) \right] + \sum_{j=1}^{s} \gamma_j \left(\frac{a_{t-j}}{\sigma_{t-j}} \right)$$

GARCH – GJR

$$y_t = \mu + a_t$$
$$a_t = \sigma_t \epsilon_t$$
$$\sigma_t^2 = \omega + \sum_{i=1}^{m} \beta_i \sigma_{t-i}^2 + \sum_{j=1}^{s} \alpha_j a_{t-j}^2 + \sum_{j=1}^{s} \gamma_j I_{t-j} a_{t-j}^2$$

A-PARCH

$$y_t = \mu + a_t$$
$$a_t = \sigma_t \epsilon_t$$
$$\sigma_t^\delta = \omega + \sum_{i=1}^{m} \beta_i \sigma_{t-i}^\delta + \sum_{j=1}^{s} \alpha_j \left(|a_{t-j}| - \gamma_j a_{t-j} \right)^\delta$$

where:

$$\omega > 0, \delta \geq 0$$
$$\beta_i \geq 0$$
$$\alpha_j \geq 0$$

[4] For further reading on similar GARCH applications see for example: Albu et al (2015), Călin *et al.* (2014), or Lupu and Lupu (2007).

$$-1 < \gamma_j < 1$$

ZARCH

$$y_t = \mu + a_t$$
$$a_t = \sigma_t \epsilon_t$$
$$\sigma_t = \omega + \sum_{i=1}^{m} \beta_i \sigma_{t-i} + \sum_{j=1}^{s} (\alpha_j a_{t-j}^{+} + \gamma_j |a_{t-j}^{-}|)$$

where:

$$a^{+} = \max(a, 0) \ and\ a^{-} = \min(a, 0)$$

NAGARCH

$$\sigma_{t+1}^2 = \omega + \alpha R_t^2 + \beta'^{\sigma_t^2} - 2\alpha\delta z_t \sigma_t^2$$

where

$$\beta' \equiv \beta + \alpha\delta^2 > \beta' in\ the\ case\ in\ which\ \alpha > 0$$

We used a calibration sample of 700 observations (the fitting sample) and we kept a window of 10 days before and 10 days after the event identified as a regime shift in the volatilities of the CDS contract. This window of 21 observations will be considered the event window and will be used for the identification of abnormal volatility dynamics in the three types of assets under consideration.

IV. Results

Using all the six sets of models to reveal the reaction in volatility for the three asset classes around the moments with common regime shifts in the dynamics of the CDS contracts, we obtain rather similar results. There were nine moments in time that became origins of our event analysis that was computed for each asset (65 assets) and by using all the six models (hence 3510 different fits).

Table 1

Number of significant changes in volatilities for stock market indices

	GARCH	EGARCH	GJR-GARCH	APARCH	ZARCH	NAGARCH
28-Oct-11	38	39	37	37	33	37
04-Oct-12	13	10	13	6	12	14
05-Dec-12	10	9	8	6	5	10
14-Jan-13	31	30	34	21	27	32
21-Feb-13	24	20	26	16	19	22
02-May-13	24	25	25	25	27	26
21-May-13	18	26	20	23	20	23
27-May-13	20	25	23	26	20	24
10-Jun-14	12	8	9	11	9	9

Source: Authors' calculations

Tables 1, 2 and 3 summerize the number of significant abnormal volatilities across all models, all events and for each class of financial assets. One of the most important elements to conclude with when analysing these tables is the fact that the findings seem to be quite robust across each asset class and when compared along all the six model variants.

Table 2

Number of significant changes in volatilities for currency pairs

	GARCH	EGARCH	GJR-GARCH	APARCH	ZARCH	NAGARCH
28-Oct-11	31	29	30	27	29	31
04-Oct-12	0	1	0	1	1	1
05-Dec-12	0	0	0	0	0	0
14-Jan-13	9	4	11	3	7	9
21-Feb-13	18	15	17	14	18	15
02-May-13	9	7	8	9	7	8
21-May-13	7	7	9	5	3	6
27-May-13	8	4	5	1	5	6
10-Jun-14	4	5	4	4	4	4

Source: Authors' calculations.

The three tables are not to be compared among themselves in terms of number of significant abnormal volatilies but across models and events. Each table simply produces a count of the number of days in which all the financial instruments from one class (for instance, all the indices in Table 1) revealed significant abnormal variances at each moment considered as event for the all 21 days around it (from day -10 to day +10).

Table 3

Number of significant changes in volatilities for sovereign bonds

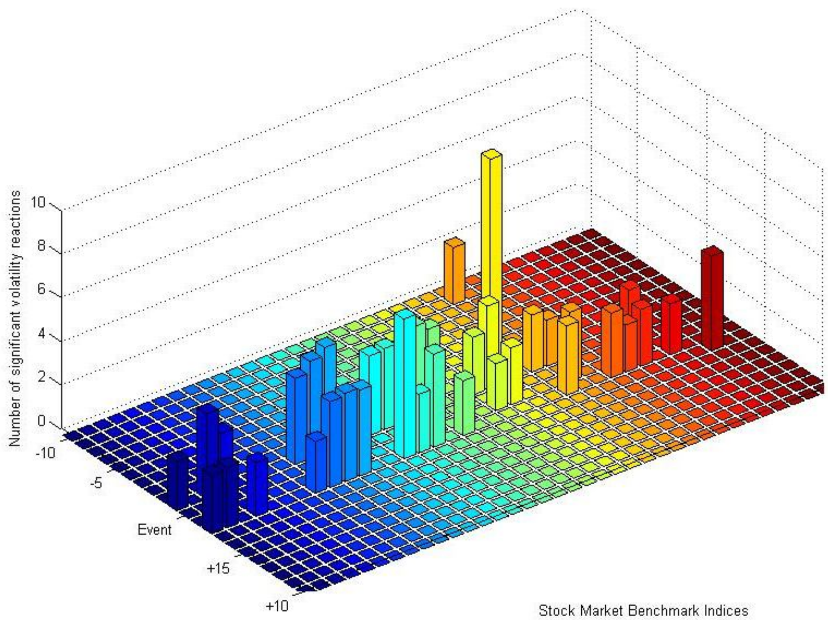
	GARCH	EGARCH	GJR-GARCH	APARCH	ZARCH	NAGARCH
28-Oct-11	45	45	44	43	44	46
04-Oct-12	10	7	8	7	10	9
05-Dec-12	3	4	4	3	4	4
14-Jan-13	23	23	22	25	23	26
21-Feb-13	10	15	14	9	13	15
02-May-13	18	17	19	15	19	20
21-May-13	22	23	26	26	27	21
27-May-13	18	13	13	8	17	22
10-Jun-14	25	27	29	22	28	32

Source: Authors' calculations.

Therefore, larger numbers in Table 1 simply reflect the existence of more indices in our analysis (36 different time series) than bonds (19 assets) or foreign exchanges (10 time series).

When reviewed across events, we notice that the numbers of significances tend to keep the same structure, *i.e.* the events 04-Oct-12, 05-Dec-12 and 10-Jun-14 tend to have a low number of significances as opposed to the other events (especially for the stock market indices and the sovereign bonds in Tables 1 and 2) and this is replicated along the columns of these tables, which means that the results hold across the models.

Figure 5
Significance of variances of stock indices' returns for the window around event 28-Oct-2011 with GARCH(1,1)



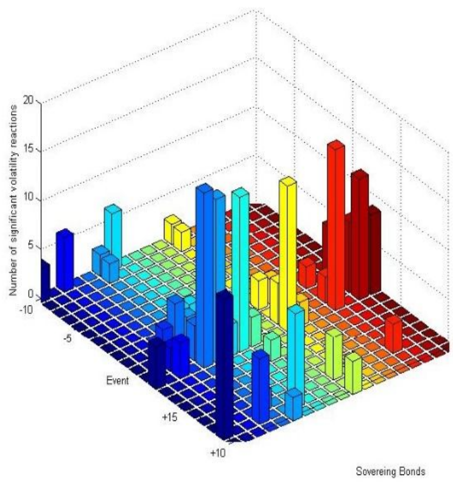
Source: Authors' calculations.

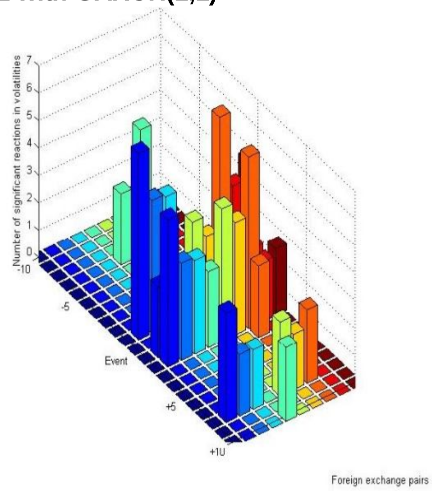
Figure 5 shows the reactions of all the stock market indices (the horizontal axis) in the event sample of ten days before and then days after the moment of October 28th 2011, our first event. One of the most important elements that can be obtained from this chart resides in the fact that, with very few exceptions, most of the reactions took place in the days around the event (day 0 in our event analysis).

With a higher number of exceptions, we can observe a similar structure of significant abnormal variances in the case of sovereign bonds and for currency pairs in Figure 6, in which we can notice the concentration of significant bars mostly around the event.

Figure 6

Significance of variances of bonds (left) and FX (right) returns for the window around event 28-Oct-2011 with GARCH(1,1)





Source: Authors' calculations,

Table 4

Significant changes in volatilities detected from day -2 until day +2 as percentage of all significant changes

	Asset type	GARCH	EGARCH	GJR-GARCH	APARCH	ZARCH	NAGARCH
10/28/2011	Indices	0.947	0.949	0.973	0.946	0.970	0.946
	FX	0.677	0.690	0.667	0.704	0.690	0.677
	Bonds	0.644	0.600	0.636	0.628	0.591	0.652
10/04/2012	Indices	0.385	0.400	0.462	0.500	0.500	0.429
	FX	-	1.000	-	1.000	1.000	1.000
	Bonds	0.100	0.143	0.125	0.143	0.100	0.111
12/05/2012	Indices	0.200	0.222	0.250	0.000	0.000	0.200
	FX	-	-	-	-	-	-
	Bonds	0.333	0.250	0.250	0.333	0.250	0.250
01/14/2013	Indices	0.097	0.100	0.088	0.048	0.074	0.094
	FX	0.444	0.500	0.364	0.000	0.429	0.444
	Bonds	0.174	0.130	0.091	0.160	0.130	0.154
02/21/2013	Indices	0.167	0.200	0.231	0.250	0.211	0.273
	FX	0.444	0.467	0.412	0.500	0.444	0.467
	Bonds	0.000	0.067	0.071	0.111	0.077	0.067
05/02/2013	Indices	0.208	0.280	0.280	0.240	0.185	0.192
	FX	0.111	0.143	0.125	0.111	0.143	0.250
	Bonds	0.167	0.176	0.211	0.133	0.158	0.200
05/21/2013	Indices	0.444	0.385	0.350	0.391	0.400	0.391
	FX	0.143	0.143	0.111	0.200	0.000	0.167
	Bonds	0.091	0.130	0.115	0.192	0.185	0.143

	Asset type	GARCH	EGARCH	GJR-GARCH	APARCH	ZARCH	NAGARCH
05/27/2013	Indices	0.550	0.560	0.565	0.577	0.550	0.583
	FX	0.250	0.000	0.400	0.000	0.400	0.333
	Bonds	0.333	0.385	0.308	0.375	0.353	0.318
06/10/2014	Indices	0.250	0.250	0.222	0.273	0.222	0.222
	FX	0.250	0.200	0.250	0.250	0.250	0.250
	Bonds	0.640	0.630	0.586	0.591	0.536	0.563

Source: Authors' calculations.

In order to investigate the importance of the event in the window that surrounds it, we looked at the significance of abnormal variances identified two days before and after the event, for each asset class. Table 4 shows these calculations and we notice that the event of October 28th 2011 is the one with the most consensus, *i.e.* the event in which all the asset classes provide reactions in the days around the event. The others show more dispersed significant results, with more reactions in the case of FX for the October 4th 2012 and June 10th 2014 for bonds.

V. Concluding remarks

Our paper studied the reaction of the European financial markets, divided into three different asset classes, to significant changes in the dynamics of the sovereign CDS contracts. Using a univariate regime shifting technique, we found the moments when the changes took place at the same time and we used these moments as inputs in an event study analysis. Using six different volatility specifications for the dynamics of the returns of financial assets, we showed that these returns exhibit relevant market abnormal volatilities around these events, which is consistent with the hypothesis of possible spillover effects determined by the common beliefs of the investors that are active in these markets. These results can be considered as important evidence that the phenomenon of contagion is felt both at the geographical level and at the level of instruments, showing that the phenomenon which generates a common reaction in some instruments can generate the same type of reaction in several types of other instruments. The analysis included financial assets that could be considered as proxies for large scale economic activity and therefore these results also have an impact on the investigation of the manner in which macroeconomic variables are connected to the financial assets in the European region.

References

Albu, L.L. Lupu, R. and Calin, A.C., 2015. Stock market asymmetric volatility and macroeconomic dynamics in Central and Eastern Europe. *Procedia Economics and Finance*, Volume 22, pp. 560–567.

Albu, L.L. Lupu, R. Calin A.C. and Popovici O. C., 2014a. Estimating the Impact of Quantitative Easing on Credit Risk through an ARMA – GARH Model. *Romanian Journal of Economic Forecasting*, 17(3), pp. 39-50.

Albu, L.L. Lupu, R. Calin, A.C., and Popovici, O. C., 2014b, The effect of ECB's Quantitative Easing on Credit Default Swap Instruments in Central and

Eastern Europe. *Procedia Economics and Finance,* Volume 8, pp. 122-128.

Alexander, C. and Kaeck, A., 2008. Regime Dependent Determinants of Credit Default Swap Spreads, *Journal of Banking & Finance,* 32, pp. 1008-1021.

Calin, A.C. Diaconescu T. and Popovici, O.C., 2014. Nonlinear Models for Economic Forecasting Applications: An Evolutionary Discussion. *Computational Methods in Social Sciences*, Vol II, Issue 1, pp. 42 – 47.

Castellano, R. D'Ecclesia, R., 2013. CDS volatility: the key signal of credit quality *Annals of Operations Research*, Volume 205, Issue 1, pp 89-107.

Criste, A. and Lupu, I., 2014. The Central Bank Policy between the Price Stability Objective and Promoting Financial Stability. *Procedia Economics and Finance*, 8, Elsevier, pp. 219-225.

da Fonseca, J. Gottschalk, K., 2012. The comovement of credit default swap spreads, stock market returns and volatilities: evidence from Asia-Pacific markets, *Working Paper AUT*. Auckland University of Technology, Auckland, New Zealand.

Fenech, J.P. Vosgha, H. and Shafik, S., 2013. Modelling the Dependence Structures of Australian iTraxx CDS Index, *Applied Economics,* 46 (4), pp. 420-431.

Fung, H.G. Sierra, G. E., Yau, J. and Zhang, G., 2008. Are the US Stock Market and Credit Default Swap Market Related? Evidence from the CDX Indices. *The Journal of Alternative Investments*, pp.43-61.

Hassan, M.K. Ngene, G.M. andYu, J.S., 2015. Credit default swaps and sovereign debt markets. *Economic Systems*, Volume 39, Issue 2, June 2015, pp. 240–252.

Longstaff, F.A. Mithal, S. and Neis, E., 2003. The credit-default swap market: Is credit protection priced correctly?. *Working paper*, Anderson School at UCLA.

Lupu, R. and Calin, A.C., 2014b. Co-movements of European Stock Markets using the Univariate Markov Regime Switching Model. *Internal Auditing & Risk Management*, IX, Nr.4 (36), pp. 33-44.

Lupu, R. and Calin, A.C., 2014a. To QE or not to QE. The Japanese Experience. *Hyperion Economic Journal*, Vol 2. Issue 2**.** pp. 3-10

Lupu, R. and Calin, A.C., 2014c. Co-movements of Regime Shifts in GBP currency pairs around BOE Quantitative Easing Announcements. *Financial Studies,* Volume 18, issue 3, pp. 89 – 101.

Lupu, R., and Lupu, I., 2007. Testing for Heteroskedasticity on the Bucharest Stock Exchange. *Romanian Economic Journal*, 11 (23), pp. 19-28.

Lupu, R. and Lupu, I., 2009. Contagion across Central and Eastern European Stock Markets: A Dynamic Conditional Correlation Test. *Economic Computation and Economic Cybernetics Studies and Research*, vol. 43, issue 4, pp. 173-186.

Narayan, P.K. Sharma, S.S. and Thuraisamy, K.S., 2014. An Analysis of Price Discovery from Panel Data Models of CDS and Equity Returns. *Journal of Banking & Finance,* 41, pp. 167-177.

Norden, L. and Weber, M., 2004. The comovement of credit default swap, bond and stock markets: An empirical analysis. *working paper*, University of Mannheim.

Trutwein, P. and Schiereck, D., 2011. The Fast and Furious – Stock Returns and CDS of Financial Institutions Under Stress, *Journal of International Financial Markets, Institutions & Money,* 21, pp. 157-175.

Trutwein, P. Ramchander, S. and Schiereck D., 2011. Jumps in Credit Default Swap Spreads and Stock Returns. *The Journal of Fixed Income,* Winter 2011, pp. 56-70.

Zhu, H., 2006. An Empirical Comparison of Credit Spreads between The Bond Market and The Credit Default Swap Market. *Journal of Financial Services Research*, 29, pp. 211–235.