The dynamic relationship between the sovereign CDS market and the Eurozone sovereign bond market (classified by maturity): Contagion or Spillovers?

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Abstract:

This paper aims to test the Credit default swaps (CDS) as vectors of contagion towards the bond market, classified by maturity, during the sovereign crisis for a sample of 10 developed Eurozone countries. By implementing and approach based on a VECM model subject of several econometric tests, this paper contributes to the literature by providing conclusions about the impact of a maturity effect on the vulnerability of a sovereign bond in the contagion facing the sovereign CDS market. Our findings suggest that the dynamic relationship between the CDS market and the public bond market is significantly related to the quality of the debt studied.

Keywords: Sovereign CDS, sovereign bonds, contagion, spillover effects

1) Introduction:

The relationship between the Credit default swaps (CDS) market and the bond market has been widely studied by researchers, namely Zhu (2006), Ericsson et al (2009), Delatte et al (2011) and Kim et al (2016). These authors have explored the significance of the relationship between the two markets, where they point out the importance of the crisis effect in the relationship's study, especially since both markets are strongly affected by the sovereign crisis. Moreover, Broto and Pérez-Quiros (2015) have confirmed the contagion significance in this crisis period. As a result, this period of crisis brought attention[1] to the relationship between the two markets, rendering the subject of high relevance.

[1] Carboni (2011), Palladini et Portes(2011), Arce et al(2013) and Fontana et Scheicher (2016)

From another perspective, Ayadi et al (2006) insist that the analysis of changes between the fundamentals of two markets or countries should be in a stable context, as the stability of the framework is required when speaking about an interdependent transmission.

In this regard, Fobes and Rigobon (2002) add that it is in this case that the transmission related to a variation in volatility caused by non-contingent spillovers effects yet similar to a contagion. Hence, lies the complexity of the distinction between the two phenomena and the importance of conducting a study presenting both of the crisis effect and return to stability effect.

Therefore, this study aims to explore the dynamic relationship between the sovereign CDS and the Eurozone sovereign bonds to test whether evolution in sovereign CDS can amplify contagion towards the sovereign bond market.

This study presents an empirical focus on the classification by the maturity of obligations. To the best of our knowledge, scarce studies have approached the sensitivity of public bond maturities to contagion emanating from the CDS market. Therefore, our paper addresses this issue to underline the importance of choosing a sovereign bond's maturity based on its vulnerability to a shock coming from the sovereign CDS market.

Therefore, this paper scrutinizes the dynamics of the relationship between the two markets to ascertain if the sovereign CDS's evolution stimulates a contagion in the sovereign bond market (ranked by maturity).

Based on these grounds, this paper presents an empirical study based on the VECM (Vector error correction model) along with a series of econometric tests to detect the sensitivity of sovereign bond indices to the sovereign CDS indices changes.

2) Literature Review:

The contagion phenomenon, supposedly being the best remedy via its CDS' protection, has been accentuated following the financial crisis (2007-2008) (Bekaert et al (2013)). In this regard, Kim (2016) finds that this crisis highlights the risks associated with the CDSs market. Therefore, the assessment of contagion becomes a priority leading to a better evaluation of the CDS contracts and drawing several researchers' interest, such as Kalotychou et al (2014).

The interconnection between CDS market and the other markets, be they hedging markets, debt markets or even assets markets, favors the passage of shock between this market and its partners (Kim (2016) and Al Qaisi and Batayneh (2017)), which has been empirically supported by D'Errico et al (2017).

It is clear that the crisis context related to these products' emergence complicates their contributions' evaluations to the risky debt market. This complexity is explained by the fact that the period of crisis is always synonymous with an additional risk made more prominent for the already highly concentrated markets favoring a change of their relations[2].

An empirical study of Jorion and Zhang (2007) indicates a significant intra-industry contagion effect between daily CDS spreads during credit events. These spreads allow the projections of the risk levels in the different markets. They encourage the decision to resort to a debt market instead of other financial market by influencing the different markets' risk price with the different varieties that CDS present.

An analysis by Ejsing and Lemke (2011) of the joint movements between CDS spreads of 10 Eurozone countries and the CDS of their respective banks, from January 2008 to June 2009, demonstrates the ability of the governments risk to lower the CDS spreads of the banking sector and raise the price levels of sovereign CDS.

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2 See Bakaert et al (2005)

A similar study, conducted by Acharya et al (2011) on the Eurozone between 2007 and 2011, pointed out that following a study of changes in CDS spreads, interpretations of the risk levels affecting different markets can be drawn as well as the reliability of government interventions in terms of risk management. This result is further supported by Alter and Schuler (2012) and Tabak et al (2016).

Thus, changes in CDS spreads can provide interpretations of risk levels across different markets. In addition, they influence government interventions in risk management (Achaya et al (2011), Alter and Schuler (2012), and Tabak et al (2016)).

From another perspective, a comparison between the private and public CDS spreads of some European Monetary Union member countries and other non-members revealed that the public sector of the monetary union is most sensitive to contagion (Dieckmann and Plank (2012)).

To conclude, CDS spreads provide information on the existence of contagion[3]. Thus, their evolutions can be the reflection of a shock spread between the CDS market and one or several other markets.

The increase in protection price levels (CDS spreads) can be considered as a financial shock and therefore lead to contagion on the market to which it is transmitted (Tabak et al (2016)).

3) Hypotheses:

The contingent character of CDSs has been the subject of recent studies, beginning with the financial crisis (2007-2008) (Jorion and Zhang (2007), Alter et al. (2011), Alter and Schuler (2012), Fontana and Scheicher (2016)).

While Hull (2010) considers that the role played by the OTC derivatives can explain neither crisis nor the systemic risk transmission (source of contagion). Recent studies (e.g. Broto and Pérez-Quiros (2015), Cronin et al (2016), Kim (2016), Tabak et al (2016), Al Qaisi and Batayneh (2017) and D'Errico et al (2017)) confirm the contingent character of the most

[3] In reference to Brunnermeier et al (2013)

important type of these products (CDS market). This study adheres to the aforementioned studies by analyzing the sovereign bonds markets. Thus, we propose the following hypothesis:

H: Sovereign CDS stimulates contagion towards the Eurozone sovereign bond market, regardless of the bond maturity.

4) Methodology:

4.1: Sample and study period:

Our study sample was composed of 10 developed Eurozone countries (viz. Germany, Luxembourg, Austria, Finland, the Netherlands, France, Belgium, Italy, Ireland, and Portugal). The data collected[4] are of a daily nature with 1657 observations per data covering the period between March 22, 2010 and July 29, 2016.

The study period was divided, into two sub-periods. It is to be noted that the crisis effect detection occurs through the completion of a phase in the total study period associated with a crisis context. However, the crisis outbreak is easily detected by the realization of a critical event that affects the market and can spread to other markets or countries.

The problem lies in the choice of a date at which we can declare the crisis e[5], specially and since a crisis is not bound to be linked to a single critical event that is the source of contagion. On the contrary, it can present several events at different times (Tabak et al (2016)), hence the difficulty in analyzing this context.

Table 1 presents the Bai-Perron test results. This test is based on the structural fracture technique provided by literature[6] for detecting the regimes' changes. We can thus keep only one date of rupture, namely the date of November 26, 2011[7].

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[4] These data were collected from the rating agency Standard and Poors official website (www.sandpindices.com).

[5] According to: Tabak et al (2016)

[6] Stating: Forbes and Rigobon (2002), Fry et al (2010), and Cronin et al (2016),... Moreover, Forbes and Rigobon (2002) compare two periods (a calm period and a period of crisis) and assert the existence of contagion out of significant structural breaks.

[7] The choice of this period is supported by the literature (D e Backer (2015), Kraussl et al (2016))

(INSERT TABLE 1)

On this date, a change of regime is noted, which explains the change in the nature of the study period. We divided our period into two sub-periods: a period of crisis[8] (from March 22, 2011 to November 25, 2011) and a period of return to stability (from November 26, 2011 to July 29, 2016).

4.2: The variables:

Table 2 presents the variables used in our empirical work, which are depicted as follows:

- **CDS[9]:**

The choice of this variable as a representative of the CDS market is explained by the fact that 5 years maturity presents the largest percentage of transactions in this market[10]. Therefore, they can present the entire CDS market according to their evolution.

- **Sovereign bonds:** These indexes, developed by Standard and Poor's, indicate the performance of the euro zone sovereign bond market based on their maturities.

(INSERT TABLE 2)

Several studies analyzed the contagion between indexes as indicators of contagion among markets (e.g. Beine et al (2008), Kolb (2010), Hennani and Terraza (2014)).

4.3: Study approach:

After dividing the study period into two sub-periods, we proceeded with a periodical analysis of the studied variables' stationarity to detect their integration order.

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[8] Considering this period as a period of crisis is supported by literature, seeing that the end of 2010 presented the sovereign crisis peak (Fourie and Botha (2015), De Baker (2015), Kraussl et al (2016), Augustin et al (2016)). Hennani and Terraza (2014) report the same date, i.e. 25/11/2011, as a completion date for the crisis phase.

[9](S & P / ISDA Eurozone Developed Sovereign CDS OTR Index) measures the CDSs sovereign performance of the euro zone, particularly of a sample of developed countries, namely: Germany, Luxembourg, Austria, Finland, The Netherlands, France, Belgium, Ireland, Italy and Portugal. This index presents developments in the 5-years maturity CDSs sovereign.

[10] Several researchers, including Longstaff et al (2005), consider that the 5-years maturity CDS are the most traded.

Analyzing via VAR models and the Granger causality test as part of the changes assessment for the financial assets volatility has been adopted by several researchers, namely Sander and Kleimeier (2004), Gray (2009), Sgherri and Galesi (2009), Kalbaska and Galkowski (2012). Afterward, we analyzed the causality, using the Granger test

In this study, a VAR model (Vecteur Autoregressif model) with K = 7 variables and P = n was employed. The P choice was based on the AIC information criterion[11] for a p ranging from 1 to 5, seeing that it presents the indices publication' weekdays. The results are presented in the following table.

The Granger test, based on Engle and Granger (1987), only takes into consideration one cointegration relationship. To overcome this problem, we chose the Johansen[12] test favoring a multivariate cointegration approach, which is based on the maximum likelihood method. This method permits the identification of the number of relationships existing between our variables, in order to choose between a VAR model and an error correction model.

This study phase was followed by an analysis using the impulse response function (IRF)[13]. This function is occasionally combined with the Granger causality analysis (e.g. kalbaska and Gatkowski (2012)) to detect the model's variable response to a shock caused by another variable.

Then, a Wald test analysis was employed to judge the existence of a fundamental dynamic relationship between the two markets' indexes. This test proved to be appropriate the evaluation

[11] AIC: Akaike Information Criteria

[12] Proposed by Johansen (1988)

[13] These functions are useful for analyzing structural shocks that may affect a market resulting from of others. The analysis of responses to a shock between countries or markets belonging to the same zone is supported by literature (Bayoumi and Eichengreen(1992),Canova and De Nicolo(2003),..). In this study, we chose the innovations of the sovereign CDS variable as an impulse vector, so all the other variables present the answers to these innovations. This test is based on a dynamic presentation of the joint evolutions between the different variables.

of the spillover effects between markets, hence of shock transmission possibilities (Ghini and Saidi (2015).

Finally, we concluded our analysis by applying a contagion test. In this part, we sought to make a judgment on the nature of sovereign CDS's propagating character: either contingent or spillover effects. To do so, we relied on the changes in shocks' transmission channels between the two markets following the change of regime.

5) Results and interpretations:

5.1: Results of the stationarity analysis:

For the crisis phase, the Augmented Dickey-Fuller stationarity test presented in Tables 3 and 4 indicates that none of the variables are stationary at level, yet they are stationary in first differences. They all have the same order of integration equal to 1, which indicates a cointegration risk.

As for the return to stability phase, the results, presented in Table 3, indicate that some variables are stationary at level (CDS, ob2, ob3), while others are only stationary at the first differences. Hence, the existence of a cointegration risk between the variables belonging to the same order of integration is concluded.

(INSERT TABLE 3 AND 4)

This test enabled us to detect the possibility of a cointegration between variables in the two study periods. Thus, a VEC model is appropriate for our analysis.

5.2: Results of the Granger causality test: (Granger test (1969)):

Prior to the causality testing, we looked for the number of delays in this model using the AIC criterion (results are presented in Table 5).

For the crisis phase, this criterion indicates a delay of p = 2. Thus, to test the causality CDS-obligation we opted for a VAR (2) model with variables at level. As for the return to stability phase, we found a delay of p = 5. Thus, to test the causality CDS-obligation, we adopted a VAR (5) model.

(INSERT TABLE 5)

The Granger test results are presented in Table 6. The causal relationship results, in the crisis phase, allow us to conclude that the null hypothesis of non-causality between CDS and all the sovereign bonds is rejected in the crisis context. Hence, there is a causal relationship between sovereign CDSs and each class of sovereign bonds in the Eurozone. This relationship is significant on the order of 1%, in the context of crisis, for all CDS-sovereign bond couples of different maturities.

We can conclude that a change in the bond's index, regardless its maturity, can be explained by a change in the zone sovereign CDS index.

The CDS indices changes, in the period of crisis, can explain the changes of all bond indexes, regardless of the bond’s maturity.

(INSERT TABLE 6)

The validation of a causal relationship between both markets, indicates a significant impact of a variation in the sovereign CDS market on the public debt market. We can thus, witness a shock transfer between both markets, either via the spillovers effects or contagion.

5.4: Results of the impulse response function (IRF):

The Granger test indicated the existence of a causal relationship between the CDS and the other model variables. Thus, we applied the IRF to better analyze this relationship and detect the impact of a market innovation (i.e. CDS in this case) on in other markets.

5.4.1: the crisis phase:

Chart 1 shows that the response of all sovereign bonds to an innovation or shock from the sovereign CDS market is immediate, negative and dynamic. The shorter is the bond’s maturity, the faster is the recovery. Contrarily, for long-term sovereign bonds, the persistence of shocks is greater. Therefore, in this case, markets find it more difficult to stabilize following a shock.

Having confirmed the existence of a causal relationship between both markets, the IRF analysis confirms the shock's propagating character of the sovereign crisis, by indicating a sharper response for bonds with long maturities. We can conclude that there are differences in sovereign bonds responses to an innovation in the CDS market depending on the maturities.

(INSERT CHART 1)

This result underlines the sensitivity of a bond's maturity to information received from the partner protection market. Thus, the higher is the maturity, the more highlighted this sensitivity gets.

5.4.2: The return to stability phase:

Chart 2 shows the negative, immediate and dynamic response of sovereign bond indices to a shock emanating from the CDS market. This response answer is more acute than the maturity is long. However, it is followed by a quicker and greater recovery than that observed during the crisis phase.

(INSERT CHART 2)

We can conclude that, regardless of the study period, the long bonds are the most sensitive to innovation in the sovereign CDS market.

5.5: Wald test results:

As it can be noted from Table 7 (presenting the Wald's test results), the null hypothesis depicting the absence of a fundamental dynamic relationship between CDS indices and those of bonds (ob1, ob4, ob5, and ob6) is rejected for the crisis period. We can conclude that the dynamic response of these bonds to innovations in the CDS market is significantly related to a fundamental relationship linking both markets. Thus, a transmission of shocks between the two markets is mainly linked to a fundamental transmission channel, hence a direct channel.

(INSERT TABLE7)

For the ob2 and ob3 bonds, the dynamic relationship with the CDS market is not significantly explained by a fundamental dynamic relationship. Thus, interdependence alone cannot explain the dynamic relationships between the couples (CDS-ob2) and (CDS-ob3). There are then other relationships of an indirect order that have a significant explanatory power of the relationship dynamics. Also, a shock transmission cannot be explained by direct channels but by the appearance of specific channels between both markets.

Based on Table 7, the null hypothesis, stipulating the absence of a fundamental dynamic relation for the obligations 3, 5 and 6, is rejected for the return to stability phase. Therefore, the response of these bond categories to innovations affecting the zone's sovereign CDS market is significantly explained by the interdependent relationship between the two markets. In this case, the fundamental channel is the dominant one.

However, for the other couples, the shocks transmission from the CDS market is not significantly due to the interdependent relationship between the two markets, but to specific indirect relationships explaining the transmission of shocks between both markets.

In conclusion, the dynamic relationship between the CDS market and the sovereign bond market, in the crisis context, is generally dominated by shock transmission channels of a fundamental and direct order.

6) The contagion test:

In this part, we aimed to judge the nature of the propagating character of sovereign CDS: contingent or spillover effects. To do so, we relied on the shocks' transmission channels between the two markets following the change of regime.

The Literature have provided deciding criterion indicating that transmission of shocks via spillover effects is observed when a fundamental and significantly continuous relationship between the two markets that a change in the study context does not affect. Otherwise, if the fundamental relationships do not remain stable between a crisis phase and a calm one, a symptom of contagion is then observed.

Thus, the stability of a significant fundamental relationship between the two studied contexts indicates the existence of spillover effects. If not, the relationship between both markets is contingent.

We can conclude that the dynamics of short and medium-term bond indices in the context studied are explained by contagion emanating from the zone's sovereign CDS market. By inference, the sovereign CDSs have present contagion vectors for medium and short-term bonds.

The results presented in Table 8 allow us to accept the assumption for bonds with average and short average maturities, indicating that they have the highest exposure to contagion. In contrast, this assumption is rejected for longer bonds.

(INSERT TABLE 8)

These findings indicate that long bonds are less exposed to contagion related to the protection market, compared to short bonds. This may allow remade of the risk level of the sovereign bonds offered on the market.

7) Conclusion:

This paper tries to fill the gap pertaining the impact of the sovereign debt quality on its sensitivity to contagion emanating from the sovereign CDS market, while proposing a study based on the maturity effects.

As a conclusion, the study of the relationship dynamics between the two markets' indices allowed us to detect a difference in the behavior of sovereign bonds facing impulses affecting the sovereign CDS market. Thus, the dynamic relationship between the CDS market and the public bond market is significantly related to the quality of the debt studied. At this point, we have proved that bonds with short and medium maturities are the most susceptible to contagion.

In addition, the introduction of structural breaks has revealed changes in the relationship between the two markets among crisis phase and return to stability phase. These changes indicate a contagion symptom within the study area.

To the best of our knowledge, this work joins a very limited number of studies treating this this ranking of the bond market, which makes the conclusions drawn of high relevance.

The approach followed in this article can be extended to a study period that integrates the subprime 'crisis in order to analyze the sensitivity of the CDS contingent character to the nature of crisis.

Bibliographical references:

Acharya, V. V., Schaefer, S., & Zhang, Y. (2015). Liquidity risk and correlation risk: A clinical study of the General Motors and Ford Downgrade of May 2005. The Quarterly Journal of Finance, 5(02), 1550006.

Al-Qaisi, K. M., & Al-Batayneh, R. M. S. (2017). Credit Default Swap and Liquidity. International Journal of Economics and Financial Issues, 7(2), 697-700.

Alter, A., & Schüler, Y. S. (2012). Credit spread interdependencies of European states and banks during the financial crisis. Journal of Banking & Finance, 36(12), 3444-3468.

Ayadi, M., Boudhina, R., Khallouli, W., & Sandretto, R. (2006). La contagion de la crise asiatique: dynamiques de court terme et de long terme. Economie internationale, (1), 113-135.

Ballester Miquel, L., Casu, B., & González-Urteaga, A. (2016). Bank fragility and contagion: Evidence from the CDS market. Journal Of Empirical Finance, 2016, num. 39, p. 394-416.

Bayoumi, T., & Eichengreen, B. (1992). Shocking aspects of European monetary unification.

Beine, M., Capelle-Blancard, G., & Raymond, H. (2008). International nonlinear causality between stock markets. The European Journal of Finance, 14(8), 663-686.

Bekaert, G., Ehrmann, M., Fratzscher, M., & Mehl, A. (2014). The global crisis and equity market contagion. The Journal of Finance, 69(6), 2597-2649.

Broto, C., & Perez-Quiros, G. (2015). Disentangling contagion among sovereign CDS spreads

during the European debt crisis. Journal of Empirical Finance, 32, 165-179

Canova, F., & De Nicolò, G. (2003). On the Sources of Business Cycles in the G-7. Journal of international economics, 59(1), 77-100.

Cronin, D., Flavin, T. J., & Sheenan, L. (2016). Contagion in Eurozone sovereign bond markets? The good, the bad and the ugly. Economics Letters, 143, 5-8.

D'errico, M., Battiston, S., Peltonen, T., & Scheicher, M. (2018). How does risk flow in the credit default swap market?. Journal of Financial Stability, 35, 53-74.

Delatte, A. L., Gex, M., & López-Villavicencio, A. (2012). Has the CDS market influenced the borrowing cost of European countries during the sovereign crisis?. Journal of international Money and Finance, 31(3), 481-497.

Dieckmann, S., & Plank, T. (2012). Default risk of advanced economies: An empirical analysis of credit default swaps during the financial crisis. Review of Finance, 16(4), 903-934.

Ejsing, J., & Lemke, W. (2011). The Janus-headed salvation: Sovereign and bank credit risk premia during 2008–2009. Economics Letters, 110(1), 28-31.

El Ghini, A., & Saidi, Y. (2015). Transmission des chocs de rendement et de volatilité entre marchés boursiers: application de modèles GARCH multivariés. In Conference Paper presented at 47èmes Journées de Statistique de la SFdS, DOI (Vol. 10).

Ericsson, J., Jacobs, K., & Oviedo, R. (2009). The determinants of credit default swap premia. Journal of financial and quantitative analysis, 44(1), 109-132.

Fontana, A., & Scheicher, M. (2016). An analysis of euro area sovereign CDS and their relation with government bonds. Journal of Banking & Finance, 62, 126-140.

Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: measuring stock market comovements. The journal of Finance, 57(5), 2223-2261.

Gray, D. (2009). Financial contagion among members of the EU-8: A cointegration and Granger causality approach. International Journal of Emerging Markets.

Hennani, R., & Terraza, M. (2014). La crise des dettes souveraines: contagions ou interdépendances des principaux indices de la zone euro? (No. 14-04).

Hull, J. (2010) Produits dérivés de gré à gré et compensation centrale : Toutes les transactions peuvent-elles faire l'objet d'une compensation ?. Revue de la stabilité financière, 14: 81-91

Jorion, P., & Zhang, G. (2007). Good and bad credit contagion: Evidence from credit default swaps. Journal of Financial Economics, 84(3), 860-883.

Kalbaska, A., & Gątkowski, M. (2012). Eurozone sovereign contagion: Evidence from the CDS market (2005–2010). Journal of Economic Behavior & Organization, 83(3), 657-673.

Kalotychou, E., Remolona, E. M., & Wu, E. (2014). What makes systemic risk systemic? contagion and spillovers in the international sovereign debt market.

Kim, G. H. (2016). Credit derivatives as a commitment device: Evidence from the cost of corporate debt. Journal of Banking & Finance, 73, 67-83.

Kim, G. H., Li, H., & Zhang, W. (2017). The CDS-bond basis arbitrage and the cross section of corporate bond returns. Journal of Futures Markets, 37(8), 836-861.

Kolb, R.W. (2010) Financial contagion: the viral threat to the wealth of nations. Kolb series in finance, Essentiel perspectives

Sander, H., & Kleimeier, S. (2004). Convergence in euro-zone retail banking? What interest rate pass-through tells us about monetary policy transmission, competition and integration. Journal of International Money and Finance, 23(3), 461-492.f

Sgherri, M. S., & Galesi, M. A. (2009). Regional financial spillovers across Europe: A global VAR analysis. International Monetary Fund.

Tabak, B. M., de Castro Miranda, R., & da Silva Medeiros Jr, M. (2016). Contagion in CDS, banking and equity markets. Economic Systems, 40(1), 120-134.

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(3), 211-235.

Tables

Table1 : The Bai-Perron test results :

- The Bai-Perron test:

structural break points	F-stat	Critical values
1	8.439555	8.58
2	7.003446	7.22
3	4.819941	5.96
4	3.631764	4.99
5	2.337447	3.91

- Structural break dates :

1 date of Structural break	26/11/2011
2 dates of Structural break	26/11/2011, 04/12/2012
3 dates of Structural break	26/11/2011, 04/12/2012, 10/06/2014
4 dates of Structural break	26/11/2011, 04/12/2012, 10/06/2014, 08/07/2015
5 dates of Structural break	13/09/2011, 30/04/2012, 10/09/2013, 26/08/2014, 12/08/2015

Table 2: The variables used in our empirical work:

Variable	Definition
CDS	Sovereign CDS index of developed euro area countries
Ob1	Sovereign bond income index of the eurozone maturity (0-1year)
Ob2	Sovereign bond income index of the eurozone maturity (1-3years)
Ob3	Sovereign bond income index of the eurozone maturity (3-5 years)
Ob4	Sovereign bond income index of the eurozone maturity (5-7 years)
Ob5	Sovereign bond income index of the eurozone maturity (7-10 years)
Ob6	Sovereign bond income index of the eurozone maturity (+10 years)

Table 3 : Sovereign CDS index (crisis phase and return to stability phase)

	Sovereign CDS index	
	Crisis phase	Return to stability phase
Mean	175.0545	114.9598
Median	154	80
Skewness	1.041429	1.433995
Kurtosis	3.213831	3.824290
ADF	0.9534	0.0582
ADF results Result in first difference	Not stationary Stationary	Stationary

Table 4 : Sovereign bond index (crisis phase and return to stability phase)

	Sovereign bond (0-1year)	Sovereign bond (1-3years)	Sovereign bond (3-5years)	Sovereign bond (5-7years)	Sovereign bond (7-10years)	Sovereign bond (+10years)

	Crisis phase	Return to stability phase	Crisis phase	Return to stability phase	Crisis phase	Return to stability phase	Crisis phase	Return to stability phase	Crisis phase	Return to stability phase	Crisis phase	Return to stability phase
Mean	138.3	137.7	152.1	160.9	167.0	189.5	177.5	213.2	183.9	230.9	197.7	271.1
Median	138.4	138.0	152.2	162.3	167.1	191.0	177.2	214.3	184.2	228.9	196.7	262.0
Skewness	-0.87	-0.988	-1.941	-0.749	-0.05	-0.43	0.061	-0.272	0.167	-0.08	0.407	0.162
Kurtosis	3.914	2.818	9.652	2.434	16.22	2.001	2.148	1.794	1.867	1.670	3.365	1.667
ADF	0.9693	0.3278	0.93	0.0054	0.7606	0.0318	0.8637	0.1593	0.8144	0.6188	0.9052	0.9342
ADF results	Not stationary	Not stationary	Not stationary	Stationary	Not stationary	Stationary	Not stationary	Not stationary	Not stationary	Not stationary	Not stationary	Not stationary
Result in first difference	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary

Table 5: AIC criterion results

P	AIC	
	Crisis phase	Return to stability phase
1	3.355001	-2.621077
2	3.154628*	-2.720759
3	3.172922	-2.724436
4	3.279262	-2.715389
5	3.282291	-2.736356*

* indicates the p chosen by our criterion (namely the weakest)

Table 6: The Granger test

	Crisis phase		Return to stability phase	
	F-stat	Probability	F-stat	Probability
D(ob1) does not cause in the sense of Granger D(cds)	1.3911	0.2499	3.6192	0.0271**

D(cds) does not cause in the sense of Granger D(ob1)	23.256	3^{E}-010***	10.6645	3^{E}-05***
D(ob2) does not cause in the sense of Granger D(cds)	0.17117	0.8427	1.4786	0.2284
D(cds) does not cause in the sense of Granger D(ob2)	17.1346	7^{E}-08***	9.8159	6^{E}-05***
D(ob3) does not cause in the sense of Granger D(cds)	0.4563	0.6339	0.1117	0.8943
D(cds) does not cause in the sense of Granger D(ob3)	15.9587	2^{E}-07***	9.7684	6^{E}-05***
D(ob4) does not cause in the sense of Granger D(cds)	0.6427	0.7751	0.5398	0.583
D(cds) does not cause in the sense of Granger D(ob4)	16.4896	3^{E}-06***	8.5263	0.0002***
D(ob5) does not cause in the sense of Granger D(cds)	0.2548	0.7751	0.5916	0.5536
D(cds) does not cause in the sense of Granger D(ob5)	13.2191	3^{E}-06***	6.73514	0.0012**
D(ob6) does not cause in the sense of Granger D(cds)	0.575	0.5631	0.6759	0.5089
D(cds) does not cause in the sense of Granger D(ob6)	9.0976	0.0001***	2.5796	0.0762*

*** : significant for 1%, ** : significant for 5%, * : significant for 10%

Table 7: Wald's test results *:*

	Crisis phase	Return to stability phase
Ob1 (0-1year)	3.147564*	0.381825
Ob2 (1-3years)	0.051235	2.701559
Ob3 (3-5 years)	0.681857	4.349361**
Ob4 (5-7 years)	4.212082**	0.174035
Ob5 (7-10 years)	6.506691**	5.656504**
Ob6 (+10 years)	4.893442**	4.933078**

Note : rejection of the null hypothesis (No fundamental dynamic relation) at 1%, 5% and 10% noted respectively by ***, ** and * follows a Chi² distribution.

Table 8 : Contagion test results:

	Crisis phase	*Return to stability phase*	*Conclusion*
Ob1 (0-1year)	3.147564*	0.381825	Contagion
Ob2 (1-3years)	0.051235	2.701559	Contagion
Ob3 (3-5years)	0.681857	4.349361**	Contagion
Ob4 (5-7years)	4.212082**	0.174035	Contagion
Ob5 (7-10years)	6.506691**	5.656504**	Spillover effects
Ob6 (+10years)	4.893442**	4.933078**	Spillover effects