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On the Informational Market Efficiency of the Worldwide Sovereign Credit Default Swap

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Abstract

In this globalized world, market efficiency is one of the main determinants of country positions in the international economic and financial space. Aware of this crucial issue, this article aims to provide further evidence on the weak form of the Efficiency Hypothesis in Sovereign CDS markets in 37 countries around the world from January 2006 to March 2017. The econometric framework used in this research is based on a VECM-FIGARCH(1,d,1) approach that considers for long term equilibrium as well as volatility stylized facts such as clustering and long-memory. Based on the entire period analysis and against all odds, the results clearly reject the randomness of each CDS spread studied. However, the sub-period analysis shows significant evidence of structural breaks in the price predictability pattern, characterized by some efficiency decline over the last two financial tensions. The significant impact of crises on market efficiency is all the more justified because, during the post-crisis period, historical prices are found to be completely irrelevant in predicting current spreads. Moreover, our results show that each country of the economically heterogeneous studied sample exhibit different efficiency status that cannot be adequately explained by the sovereign credit risk level.

JEL Classification: G01, G14
Keywords: Market Efficiency, Worldwide Sovereign CDS, VECM-FIGARCH.

1 Introduction

Over the last few decades, the financial asset prices predictability and the Efficient Market Hypothesis (EMH) legitimacy have been the most difficult financial challenges in both academic and non-academic settings. While economists and researchers seem to be unanimous about the efficiency of international equity markets, many questions and criticisms are perpetually raised concerning the efficiency of derivatives markets. Particularly, the credit derivatives prices are castigated for being irrational and predictable, which explains allowing market participants to use them in speculative and arbitrage transactions rather than as part of the hedging process. Hence, whether the Credit Default Swaps (CDS) markets are informationally efficient or not is a controversy subject, especially during the recent financial crises in which financial markets have behaved unexpectedly. This article aims to pay more attention to the international sovereign CDS markets by providing additional evidence on their weak-form informational efficiency hypothesis and its validity during the Global Financial Crisis and the Sovereign Debt Crisis.

A number of authors in the literature, beginning with Fama (1970), focus on the extent and speed with which past information is incorporated into current asset prices. Whether in its weak, semi-strong or strong form, a market is considered efficient if its assets instantly reflect relevant information sets in their prices, evolve unpredictably, and are consistent with the random walk theory. In other words, if the randomness of the financial assets is verified, then an undeniable conclusion about the market efficiency can be drawn. Based on this reasoning pattern, several empirical studies have investigated the CDS spreads efficiency in both corporate and sovereign markets: (Zhang and Zhang, 2013; Avino and Nneji, 2014; Kiesel et al., 2016; Chang et al., 2015; Norden, 2017). Despite the growing need for conclusive and robust results, the empirical evidence of the sovereign CDS predictability remains an open issue that suggests a contradictory conclusion. Moreover, to the best of our knowledge, only one article studies the impact of crisis on the efficiency degree in sovereign credit derivatives market presents questionable results: see (Sensoy et al., 2017). In fact, these authors argue that financial troubles have no impact on the efficiency of CDS spreads, which is preposterously incoherent from a realistic perspective as some favorable arbitrage and speculative strategies based on credit derivatives were observed, leading to financial instability. Furthermore, the future pattern of financial assets in general and CDS spreads in particular is difficult to predict and the existing empirical tests can only give a preliminary insight of the market effectiveness characteristics. As these tools are not strict enough, and since CDS market highly impacts the real economy through its risk-transfer role, more studies using further approaches are needed to be sure about the market efficiency.

Our article contributes to the literature in several ways. First, we complement the few existing empirical studies on the efficiency of CDS spreads and give international evidence by using daily spreads of 37 worldwide heterogeneous countries, ranging from January 2nd, 2006 to March 31st, 2017. As far as we are concerned, our database is the largest dataset ever used in studying sovereign CDS efficiency in terms of size and time-period. The analysis is conducted on both the whole studied period and four sub-periods (pre-crisis, crisis and post-crisis phases) defined according to range-based volatility, so we can assess the impact of crises on market effectiveness. Second, contrarily to previous studies, our methodological framework is heteroscedasticity-robust and is the only one that takes into account, simultaneously, the long-run properties, the volatility clustering and long-memory behavior of financial data. Third, apart from what is commonly agreed in the study of the weak-form market efficiency, the current investigation attempts to detect any reflection of past information into current CDS spreads that is available not only in the CDS market but also in the corresponding bond market.

While the existing literature seems to give a common evidence about the efficiency of sovereign CDS markets, our findings show that spreads composing our sample are predictable

from both their own historical values and the past values of the underlying bond yields. Furthermore, crises negatively impact the randomness of CDS spreads with a significant increase in the number of forecastle prices, especially during the Sovereign Debt Crisis. According to our heterogeneous results, we notice that timeless general conclusion should not be given on worldwide CDS markets and a perpetual revision of regulatory operations and investment strategies should take place according to whether the market is impeccably efficient or glossy inefficient.

The rest of the article is organized as follows: Section 2 gives a brief review on theoretical background on the Efficiency Market Hypothesis and the related empirical evidence of CDS spreads efficiency. We present the empirical data and the methodological framework used to detect randomness in Section 3. Section 4 displays the data analysis and the model estimation, while the Section 5 concludes the article.

2 Literature review

This section provides a brief review of theoretical and empirical works on the efficiency hypothesis and the related theories, in the first place. Next, an exhaustive literature review of the CDS spreads informational efficiency is presented.

2.1 Theoretical background on the Efficient Market Hypothesis

By taking stock of the theoretical and empirical existing literature concerning the market efficiency, we notice a particular definition that is commonly used by researchers and according to which the financial market is considered as efficient if its assets' prices always completely, instantaneously and properly [1] reflect available and relevant information(Fama, 1970; Bollerslev and Hodrick, 1992).

This definition gives rise to three interpretations: First, given a set of information, the expected returns of financial assets are assumed to follow a "fair game" model in which the equilibrium prices are determined according to their risk levels. This implies that long-term equilibrium prices should not exceed limits fixed by expectation model and that the excess volatility is a sign of market inefficiency (Shiller, 1979, 1981, 1992; Cuthbertson and Hyde, 2002). Second, in an efficient market context, next period's asset prices - respecting the current information sequence - are greater than the actual prices. This means that the conditional expected prices are following a sub-martingale model[2](LeRoy, 1989). Third, the financial market efficiency analysis is intimately related to the random walk theory. This theory denotes that the assets' prices fluctuate randomly meaning that successive price changes are independent and identically distributed (Samuelson, 1965; Lo and MacKinlay, 1988; Fama, 1995). Yet, Malkiel (2003) explains this random walk idea by the fact that the financial time series have no long-run or short-run memory and that today's prices are independent from previous prices and only depends on today's available and known information.

This immediate and fully incorporation of information flows into asset prices is based on the assumption of the market rationality and the nonexistence of arbitrage opportunities[3]. On the one hand, the information must be translated and understood in the same way by all the market participants who implement their investment strategies on the basis of reflective and profit-maximization reasoning. On the other hand, since new information flows randomly,

[1]The term properly in this article means without bias.

[2]The sub-martingale model is defined by the following equations: $E(x_{t+1}/\mathcal{F}_t >= x_t)$ and $E(y_{t+1}/\mathcal{F}_t >= 0)$ where x_{t+1} and y_{t+1} are respectively the expected return and the expected returns changes, and $\mathcal{F}_t$ is the information set available at the time t.

[3]Several conditions must be met to reach the informational efficiency of financial markets, namely: stocks are traded without any transactions fees and the information is transparent and free for all investors.

the prices should be unpredictable making investors unable to realize better returns than what they could expect from another randomly selected portfolio for the same risk-level, as argued by Malkiel (2003). However, the analysis of stock markets behavior show that several irregularities exist hindering a correctly price formation. In fact, Malkiel (2005) underlines some irrational investment activities notably during the dot-com bubble when investors excessively speculate on unreasonable positions. The behavioral finance supports this market irrationality and argues that investors' decisions are based on considerations unrelated to fundamentals and are affected by systemic psychological errors in the way that market participants think (Fama, 1998; Ritter, 2003; Hirshleifer et al., 2006). Yet, Lo and MacKinlay (1988), Huang (1995) and Urrutia (1995), among other authors, argue that financial assets do not necessarily follow a random walk and are rather characterized by a predictable pattern which rejects the nonexistence of arbitrage opportunities hypothesis. However, Fama (1970) argues that the non-respect of these conditions does not necessarily imply the inefficiency of financial markets.

While emphasizing the fact that efficient market theory is based on a timely incorporation of relevant information into asset prices, authors distinguish three forms of market efficiency(Roberts, 1959; Fama, 1970): (i) a weak form where the available information concerns only the historical prices and market's past behavior (Sensoy et al., 2017), (ii) a semi-strong form in which the information sequence is rather composed by publicly released information (earnings surprises, rating publications, credit events, M&A announcements, financial accounts disclosure...) (Zhang and Zhang, 2013; Norden and Weber, 2004; da Silva et al., 2015; Jenkins et al., 2016; Kiesel et al., 2016; Norden, 2017), and (iii) a strong form in which the information set made of pertinent private information - initially held by investors or financial groups in a monopolistic way - that have been recently released.

Several parametric and non-parametric statistics are used to test for the weak-form of the EMH. Bollerslev and Hodrick (1992) review the empirical literature on the theory of the efficient market and provide a selective synthesis of the existing econometric approaches to test for the information efficiency in the stock market using data[4] on NYSE-traded stocks. Serial correlation tests in the short-term and the long-term, multi-period regression tests and variance bounds tests are discussed in their article and reject, for the most, the market efficiency. Another approach to test for the market efficiency hypothesis is to focus on the asset prices' volatility rather than on their predictability. This econometric method is based on the idea that the excess volatility indicates the inefficiency of the market: Financial markets are too volatile to be efficient (Fakhry and Richter, 2015; Fakhry et al., 2016; Richter and Fakhry, 2016).

2.2 The efficiency of the CDS market

Following the primary objective of this article, the following literature review is only limited to the existing works on the CDS market. Even though there are several works studying the dynamic of CDS spreads, very few of them focus on the efficiency of the CDS markets and even less on the sovereign CDS markets. Norden and Weber (2004) study the information efficiency of the CDS market and the stock market of 1000 corporate and sovereign entities over the period spanning from 2000 to 2002. The authors use a univariate and a comparative event study to argue that the rating announcements significantly impact the direction and the magnitude in which the studied CDS spreads and stock returns move. Results also show that downgrades events by Standard&Poor's and Moody's are reflected in a greater extent than the reviews downgrade of the other rating agencies. Imbierowicz and Cserna (2008) apply several structural credit risk models[5] to CDS spreads of 808 firms belonging to 10 different industries from 2002 to 2006. The authors find a strong arbitrage strategies' opportunities given

[4] Prices, dividends and returns.

[5] The CreditGrades, Leland and Toft (1996) and Zhou(2001) models (Imbierowicz and Cserna, 2008).

the convergence between the produced spreads and the observed ones. The market efficiency hypothesis is still rejected even after controlling for the transactions fees.

In the same context of semi-strong efficiency study, Zhang and Zhang (2013) use a sample composed by 633 US firms to study the information efficiency and the reaction of the single-name CDS spreads following earnings announcements from 2001 to 2005. Results show that positive and negative earnings news significantly impact CDS spreads in different extents confirming the efficiency theory. Nonetheless, the sensitivity extent and the time of reactions are different for investment-grade firms and speculative-grade firms. Similarly, da Silva et al. (2015) argue that the CDS market is more efficient than the stock market. These authors analysis the patterns of CDS spreads and the stock prices of US and western European firms before and after the announcements of Mergers and Acquisitions (M&A) events from 2006 to 2013. Results show that private information is reflected in CDS spreads before its assimilation into stock prices.

By analyzing the iTraxx Europe index From September 2005 to September 2010, Avino and Nneji (2014) find that the corporate CDS spreads exhibit a predictable pattern, rejecting, thus, the weak-form efficiency market hypothesis. Results of this forecasting ability are based on both linear (least square method) and non-linear (Markov switching and Markov Switching structural model) approaches explaining CDS spreads by their lagged values. Everlastingly focusing on the weak-form efficiency, Kiesel et al. (2016) study the information efficiency of corporate CDS and the corresponding equity markets for countries from the US and Europe. Based on an event study approach and by concentrating the studied period around credit events, the authors find, among others, that the CDS market is lagging the equity market in the price formation process though both markets are relatively efficient, confirming that investors are not able to rigorously and timely assess the effect of sudden events. More lately, Norden (2017) analyze the credit rating announcements' reactions of 95 international industrial and financial companies from 2000 to 2006. Based on the results of an event study and multiple regression analysis, these authors show that financial news is reliably and instantly reflected into CDS spreads and that the corporate CDS market is in line with the efficiency hypothesis. Moreover, the CDS markets' efficiency ranks of companies with important bank interconnections are the greatest.

The study of sovereign CDS efficiency has started more recently with Gündüz and Kaya (2013) who test the presence of a long memory behavior in the sovereign CDS markets of 10 Eurozone countries using both CDS changes and the corresponding volatility as proxies for respectively the price efficiency and the sovereign risk. Results show, among other findings, that the CDS markets are efficient given that no long-run dependence is observed between CDS spreads changes' observations. Likewise, Chang et al. (2015) study the arbitrage condition between the European CDS markets and the corresponding bond markets during the sovereign debt crisis from 2010 to 2013. Results show that the efficiency hypothesis between these credit markets is only confirmed in the long-run.

The recent study conducted in the context of sovereign weak-form market efficiency is conducted by Sensoy et al. (2017). Based on a permutation entropy method, the authors study the weak-form efficiency of CDS markets of 15 sovereigns. Results of these authors show that the efficiency-level differs from one country to another and that crisis periods don't affect the markets' efficiency degrees. Unlike previous studies, Sensoy et al. (2017) do not impose a single fixed efficiency degree throughout the studied period and allow, thus, more flexibility to the approach. Yet, in order to not reduce the statistical reliability of the permutation entropy approach, the volatility clustering behavior and the ARCH effect exhibited in the CDS spreads data are taking into account by requiring the analysis to rather be based on GARCH filtered data.

2.3 Limits of the CDS efficient market studies

As already shown, the literature comprises a restricted number of nine articles that empirically examine the efficiency of CDS spreads, among which only 4 studies deal with the sovereign markets. Broadly, studies are based either on European countries or on emerging countries where the credit risk is known to be misestimated especially during crisis episodes. Evidences show, mostly, that the informational market efficiency is supported even during crisis periods, which is an antagonist to economists and practitioners' opinions who argue that CDS allow for profitable speculative and arbitrage operations. Our article fills this gap by considering a wide range of heterogeneous cross-country sample representative of the worldwide sovereign CDS markets. For sake of accuracy, the studied period is divided into 4 sub-periods during which financial markets effectiveness is expected to behave abnormally.

On the other hand, most of the above-mentioned studies - whether on private or sovereign CDS markets - present some methodological shortcomings. First, the several statistic tests for the random walk hypothesis have only power to detect alternatives to randomness which constitutes neither necessary nor sufficiency to affirm with certainty or discredit the EMH. Second, except for Sensoy et al. (2017) who use a GARCH filter that takes into account ARCH effects, the other econometric methods used in the CDS literature don't control for financial markets' stylized facts (Volatility clustering, asymmetries, fat tails...). As opposed to these studies, our econometric approach takes into account, at the same time, long-run properties, volatility clustering and long-memory behavior while investigating the price efficiency of sovereign CDS.

Finally, weak-form empirical investigations in the literature are conducted in such a way that it only takes account of the impact of recent accessible information in the CDS markets. However, as derivatives and credit markets highly comove[6], it is interesting to consider, as well, for the past information available in both CDS and the underlying bond prices and their reflection into current CDS spreads. In this article, the long-run properties between these two markets and their impact of the dynamic spreads formation are taken into consideration through a two-step VECM model.

3 Data and methodology

3.1 Sample and data description

The sample under study in this article is composed by 37 countries that cover five geographical areas from all over the world (Eastern Europe, South and Central America, Asia and Western Europe) and belong to different economic categories (developed countries, newly industrialized countries and emerging countries). The complete list of these countries with their economic and geographical status is given in Table 1.

To examine the efficiency of these sovereign CDS markets, daily CDS spreads (and their underlying bond yields) with 5 years maturity denominated in USD are collected from Thomson Reuters ®for a period going from January 2nd, 2006 to March 31st, 2017. As mentioned before, to the best of our knowledge, our database is the largest dataset ever used in studying sovereign CDS efficiency in terms of size and time-period.

3.2 Econometric methodology: a VECM-FIGARCH methodology

By inspiring from the work of Sogiakas and Karathanassis (2015) on spot and derivatives markets, our analysis is based on a VECM-FIGARCH(1,d,1)-DCC model. This approach

[6]See for example Sabkha et al. (2017b) for an empirical study on the interconnectedness and the risk spillover between CDS and the corresponding bond markets.

Table 1: Data sample and countries' classification into economic and geographical categories

Country	Geographical position	Country	Geographical position
Developed countries (21)		**Newly industrialized countries (6)**	
Austria	Western Europe	Brazil	South America
Belgium	Western Europe	China	Asia
Denmark	Western Europe	Mexico	North America
Estonia	Eastern Europe	Philippines	Asia
Finland	Western Europe	Thailand	Asia
France	Western Europe	Turkey	Asia
Germany	Western Europe	**Emerging countries (11)**	
Ireland	Western Europe	Bulgaria	Eastern Europe
Italy	Western Europe	Croatia	Eastern Europe
Japan	Asia	Czech	Eastern Europe
Latvia	Eastern Europe	Hungary	Western Europe
Lithuania	Eastern Europe	Greece	Western Europe
Netherlands	Western Europe	Indonesia	Asia
Norway	Western Europe	Poland	Eastern Europe
Portugal	Western Europe	Romania	Eastern Europe
Slovakia	Eastern Europe	Russia	Asia
Slovenia	Eastern Europe	Ukraine	Eastern Europe
Spain	Western Europe	Venezuela	South America
Sweden	Western Europe		
UK	Western Europe		
USA	North America		

Countries decomposition into these categories is made according to the NU, the CIA world Factbook, the IMF and the world Bank criteria.

assesses the contribution degree of each market in the information efficiency of the worldwide CDS markets. The VECM-FIGARCH-DCC model allows to take into account simultaneously the non-stationarity of our time series in the conditional mean equation and the volatility clustering, the heteroscedasticity and the long-memory behavior in the conditional variance equation.

The informational efficiency of the credit derivative market is investigated following three iterative steps:

Step 1. Estimation of the Conditional mean equation through the VECM model

This model assesses each market's contribution in the innovations of the random walk efficient price. The VECM is used rather than the unrestricted VAR to avoid information loss and to avoid linking disrupt between variables due to stationarity techniques. Taking account of the long-run properties of the CDS-Bond relationship, the VECM model can be expressed as functions of the cointegrating terms and their mutual lagged values:

$$\Delta X_t = \mu + \Gamma \Xi^{'} X_{t-1} + \sum_{k=1}^{p} \Pi_k \Delta X_{t-k} + \upsilon_t, \tag{1}$$

With X_t is a vector of 2 variables (CDS spreads and bond yields) at time t, Π is 2× 2 parameters matrix of the short-run relationship, Γ and $\Xi^{'}$ denote matrices of receptively the error correction terms and the long-run coefficients, μ is a deterministic component

and υ_t represents the innovations. In a simpler way, the cointegrated vector autoregressive model, can be written, through two equations where the CDS spreads and the bond yields are expressed as functions of the cointegrating terms and their mutual lagged values:

$$\Delta x_{1,t} = \lambda_1 \xi_{t-1} + \sum_{k=1}^{p} \gamma_1 \Delta x_{1,t-k} + \sum_{k=1}^{p} \delta_1 \Delta x_{2,t-k} + \upsilon_{1,t}, \tag{2}$$

$$\Delta x_{2,t} = \lambda_2 \xi_{t-1} + \sum_{k=1}^{p} \gamma_2 \Delta x_{2,t-k} + \sum_{k=1}^{p} \delta_2 \Delta x_{1,t-k} + \upsilon_{2,t}, \tag{3}$$

where x_1 and x_2 represent respectively the sovereign CDS spreads and the government bonds yields, λ is the adjustment coefficient of each market and ξ_t is the deviation from the long-run equilibrium estimated from the following equation: $x_{1,t} = c_0 + c_1 \xi_{2,t} + \xi_t$. $\upsilon_{1,t}$ and $\upsilon_{2,t}$ are the residuals of the VECM models.

Step 2. Estimation of the FIGARCH(1,d,1) model

The univariate model is applied to the residuals of the VECM model ($\upsilon_{1,t}$ and $\upsilon_{2,t}$). A univariate volatility model is estimated following a more flexible class of GARCH models that take into account a new feature of the unit root for the variance, proposed by Baillie et al. (1996) and so-called FIGARCH. This model highlights the fact that - unlike basic models where the persistence of volatility shocks is subject to an exponential decay - in real financial time series, the impact of lagged errors on future volatility occurs at a slow hyperbolic rate of decay. The FIGARCH model allows, thus, to capture the long memory of autocorrelation in volatility processes with a complete flexibility regarding the persistence degree via the differencing fractional parameter (d). The FIGARCH (1,d,1) is written as follows:

$$\upsilon_t \sim \mathcal{P}(0, \sigma_t^2), \tag{4}$$

$$\sigma_{i,t}^2 = \alpha_0 + [1 - (1 - \Theta(L))^{-1}(1 - \phi(L))(1 - L)^d]\upsilon_{i,t}^2 + \beta \sigma_{i,t-1}^2, \tag{5}$$

where $\upsilon_t = e_t \sigma_t^2$, with e_t are independent and identically distributed random variables and σ_t is the conditional volatility of υ_t given the information set at the moment $t-1$ ($\mathcal{F}_{t-1}$. with $0 < d < 1$. When d=1, the FIGARCH (1,d,1) is equivalent to an IGARCH (1,1) where the persistence of conditional variance is supposed to be complete, while when d=0, it is rather equivalent to a GARCH (1,1) and no volatility persistence is taken into consideration. L is the lag operator and $(1-L)^d$ is the financial fractional differencing operator.

Step 3. Re-estimating the VECM model using transformed data

To overcome non-stationarity, heteroscedasticity and long-memory issues and take account at the same time of the long-run cointegration properties characterizing financial data, the VECM is once again estimated using not the raw data but reconstructed time series. We propose a special treatment that is applied to each series of each country though the following transformation-equation:

$$y_1 = x_1, \tag{6}$$

$$y_t = \hat{\omega} + y_{t-1} + \frac{\hat{\varepsilon}_t}{\hat{\sigma}_t}, \text{ for } t = 2, \ldots, T, \tag{7}$$

with

$$\hat{\omega} = \frac{1}{T-1} \sum_{t=2}^{T} \Delta y_t \tag{8}$$

and

$$\hat{\varepsilon}_t = \Delta y_t + \hat{\omega}, \tag{9}$$

where y_t is the new transformed time series, x_t is the CDS (or Bond) spread at time t, μ_t and σ_t^2 are respectively the conditional mean and the conditional variance of the spread obtained from the estimation of the univariate FIEGARCH model. In this way, heteroscedastic properties and long-memory behavior of CDS and bond spreads are considered in the converted-time series.

The VECM model, applied to transformed time series, is re-written as follows:

$$\Delta y_{1,t} = \lambda_1^{'}\xi_{t-1}^{'} + \sum_{k=1}^{p}\gamma_1^{'}\Delta y_{1,t-k} + \sum_{k=1}^{p}\delta_1^{'}\Delta y_{2,t-k} + \upsilon_{1,t}^{'}, \tag{10}$$

$$\Delta y_{2,t} = \lambda_2^{'}\xi_{t-1}^{'} + \sum_{k=1}^{p}\gamma_2^{'}\Delta y_{2,t-k} + \sum_{k=1}^{p}\delta_2^{'}\Delta y_{1,t-k} + \upsilon_{2,t}^{'}. \tag{11}$$

If only one coefficient of the lagged variables ($\gamma_1^{'}, \gamma_2^{'}, \delta_1^{'}$ or $\delta_2^{'}$) is statistically significant, then a predictable pattern is detected and the EMH doesn't hold in the Sovereign CDS market.

3.3 Market efficiency during crisis periods

The impact of crises on the Sovereign CDS markets is investigated through the same VECM-FIGARCH (1,d,1) explained above. The third step VECM(2) is once again applied on the reconstructed time series over four subperiods: a pre-crisis period, a first-crisis period (Global Financial Crisis), a second-crisis period (The European Debt Crisis) and a post-crisis period. Analysis of the statistically significance of the lagged coefficients coefficients is based on the results of the Block Exogeneity and Lag Exclusion Wald Tests over these sub-periods.

The crises timeline is defined in this paper is the same way as in Sabkha et al. (2017a). We start by defining a relatively long period covering both the international financial crisis and the European debt crisis. The length as well as the different phases of the first crisis period are determined by referring to the official timeline provided by the BIS (2009). (i) A quit period spanning from January 2006 to the third quarter of 2007, in which the global banking system was healthy and the economic climate was globally healthye. (ii) A 1st crisis period, characterized by an increase in the inability of market participants to correctly price some risky structured credit products (namely the subprime). This "initial financial turmoil" spans from July 2007 to mid-September 2008. (iii) A 2nd turmoil phase, defined as a "Sharp financial market deterioration", starting up from mid-September 2008 until late 2008. At this stage, the whole world perspectives have sharply changed due to Lehman Brothers Bankruptcy. The 3rd crisis phase is defined as a "macroeconomic deterioration" because of the role played by the drastic policy measures in the financial system, the market stabilization and the counterparty risk reduction. It extends from late 2008 to the end of the first quarter of 2009.

Referring to the Thomson Reuters official publications, the European debt crisis goes through four phases: (i) From October 2009 to April 2010, "Greek accounting unravels" phase when the world has figured out that the Greek budget deficit was much higher than what the country announced. (ii) The 2nd phase started after the adoption of EU and IMF bailout measures following the increase in sovereign credit risk. This phase is called "the crisis spreads" and runs from May 2010 to June 2011. (iii) From July 2011 to March 2012, the crisis deepens and the sovereign risk rises to new high levels since the Eurozone finance ministers put off any decision on the sovereign debt program. (iv) Starting in April 2012, the Euro area is experiencing a phase of "containing the crisis" with the adoption of a permanent rescue fund whose role is to obtain countries and banks balance sheets under control.

Next, since financial crises are characterized by a sharp increase in financial assets volatility, we check the phases of excessive volatility for each of the CDS markets using Markov's switching ARMA model. As explained by Sabkha et al. (2017a), this model class takes into account structural breaks with two regimes: stable and volatile, where 0 corresponds to a low conditional volatility and 1 to a high conditional volatility. Thus, this model allows us to define different sub-periods of the crisis. Results of the regime classification based on smoothed probabilities are presented in Table 8 (Appendix 1).

Thus, the Global Financial Crisis could be defined from August 2007 to March 2009 and the European debt crisis could be defined from October 2009 to March 2012 (See Figure 4, Appendix 1).

By taking stock of the results of these two previous methods, the period studied can be divided into 4 sub-periods:

- From January 2006 to June 2007: a reference period (quiet period);
- From July 2007 to March 2009: 1st crisis period (credit crunch);
- From April 2009 to March 2012: 2nd crisis period (European Debt crisis);
- From March 2012 to March 2017: Post-crisis period (quiet period).

4 Empirical results

This section displays descriptive statistics and brief analysis of the preliminary properties of credit markets. It models, as well, the joint dynamics of the CDS spreads and their underlying bond using a VECM-FIGARCH model in order to capture at the same time cointegrating relations, clustering volatility and long memory behavior.

4.1 Data analysis

Table 3 shows descriptive statistics for the CDS spreads and their corresponding bond yields. Panels A, B and C correspond respectively to developed countries, newly industrialized countries and emerging countries. Time series of each country under study are composed by 2936 observations.

Unsurprisingly, the highest spreads are recorded in the Greek market during the sovereign debt crisis, followed by Ukraine (15028 bp) and Venezuela(10995 bp). These high values are reported respectively during the European Debt crisis, the Ukrainian political crisis[7] and the Venezuelan economic recession[8], as shown in Figure 1. The situation is also dramatic in other countries (Ireland, Latvia, Portugal, Indonesia and Russia) but to a lesser extent. This can be explained by the considerable and long-lasting impact of the two recent worldwide financial crises on these countries' economy. Interestingly, the highest bond yields are recorded in almost the same countries (Ireland, Latvia, Portugal, Ukraine, Venezuela...) which makes sense with the common result found in literature regarding the positive correlation between the CDS and the underlying bond markets (Sabkha et al., 2017a).

The Levin et al. (2002) panel unit root test does not reject the null hypothesis of the unit root presence and confirms the common non-stationarity of the CDS spreads and bond yields. Yet, the Johansen Cointegration test, based on the quadratic specification, exhibits at least

[7] Even though the crisis in Ukraine has started in 2013, the highest levels in CDS spreads are recorded during 2015 when economists affirm that "Ukraine Sovereign CDS Spread back to pre-war/pre-revolution levels".

[8] Venezuela has been in socioeconomic crisis since 2014, but by 2016 (The year during which spreads stood at their highest levels in its history) the situation in this country got worse with an 800% inflation rate.

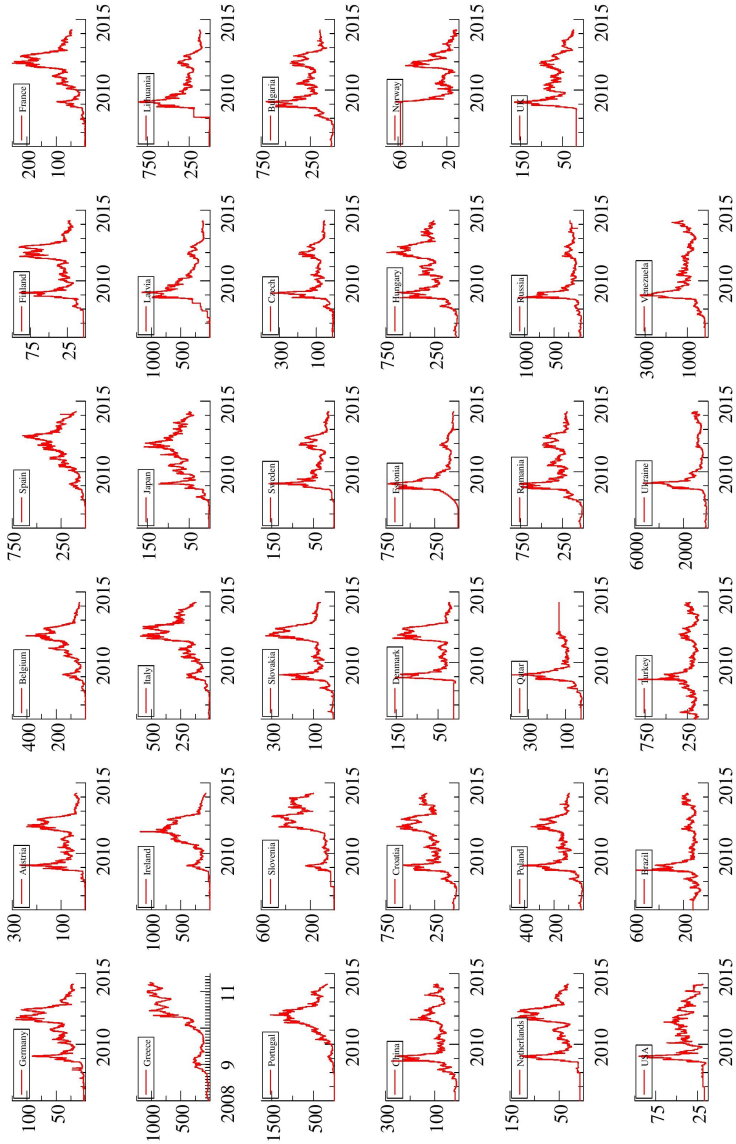

Figure 1: Time-varying evolution of CDS spreads of some countries

one cointerating relation between the two-time series of each studied country. Results of both stationnarity and cointegration tests are suitable for modeling our credit data using a Vector autoregressive with error correction.

Table 3: Descriptive statistics and non-stationary tests of CDS spreads and bond yields

		Obs.	Min	Mean	Max	Std. Dev	LLC test Statistic	Number of CI relations Trace test	Max-Eig test
Panel A: Developed countries									
Austria	CDS	2936	1.40	36.13	132.77	24.96	0.38327	2	2
	BOND	2936	-0.51	1.93	4.88	1.58			
Belgium	CDS	2936	2.05	72.39	398.78	74.62	0.43877	1	0
	BOND	2936	-0.52	2.14	5.62	1.60			
Denmark	CDS	2936	11.25	36.65	157.46	32.94	-0.12334	2	2
	BOND	2936	-0.50	1.83	5.09	1.62			
Finland	CDS	2936	2.69	26.85	94.00	19.24	-0.75381	2	2
	BOND	2936	-0.53	1.78	4.88	1.56			
France	CDS	2936	1.50	54.30	245.27	50.56	0.09455	1	0
	BOND	2936	-0.46	1.92	4.91	1.50			
Germany	CDS	2936	1.40	28.77	118.38	24.50	-0.83017	1	1
	BOND	2936	-0.62	1.61	4.77	1.56			
Ireland	CDS	2936	1.75	188.89	1249.30	234.02	0.11659	1	1
	BOND	2936	-0.34	3.40	17.61	2.79			
Italy	CDS	2936	5.58	151.75	586.70	127.38	-0.88370	1	1
	BOND	2936	0.20	3.01	7.78	1.59			
Japan	CDS	2936	2.13	49.26	152.64	33.28	-0.83411	1	1
	BOND	2936	-0.37	0.49	1.60	0.47			
Latvia	CDS	2936	5.50	210.89	1176.30	216.13	-0.26628	1	0
	BOND	2936	0.10	4.02	16.49	3.21			
Lithuania	CDS	2936	6.00	169.21	850.00	154.01	0.03087	2	2
	BOND	2936	0.05	4.06	13.70	2.97			
Netherlands	CDS	2936	7.67	37.13	133.84	29.50	-0.48263	2	2
	BOND	2936	-0.57	1.78	4.88	1.56			
Norway	CDS	2936	10.59	30.95	62.00	17.82	-0.99822	2	2
	BOND	2936	0.53	2.52	5.39	1.34			
Portugal	CDS	2936	4.02	289.89	1600.98	323.68	-0.02785	1	1
	BOND	2936	0.84	4.89	23.42	4.02			
Slovakia	CDS	2936	5.33	77.52	306.01	66.71	-0.33187	2	2
	BOND	2936	-0.33	2.74	5.76	1.83			
Slovenia	CDS	2936	4.25	131.24	488.58	114.88	-0.40258	1	0
	BOND	2936	-0.07	3.07	6.92	2.17			
Spain	CDS	2936	2.55	144.63	634.35	135.01	-0.40593	1	1
	BOND	2936	0.04	3.00	7.73	1.62			
Sweden	CDS	2936	1.63	27.17	159.00	25.70	-0.78589	2	2
	BOND	2936	-0.40	1.92	4.74	1.44			
UK	CDS	2936	16.50	42.89	165.00	28.11	-1.04744	2	2
	BOND	2936	0.16	2.33	5.76	1.56			
USA	CDS	2936	10.02	24.01	90.00	11.11	-1.86194	2	2
	BOND	2936	0.54	2.15	5.24	1.26			
Panel B: Newly Industrialized countries									
Brazil	CDS	2936	61.50	178.55	606.31	94.86	-0.61737	2	0
	BOND	2935	4.79	11.61	17.86	2.51			
China	CDS	2936	10.00	82.44	276.30	43.56	-0.60868	2	0
	BOND	2936	2.38	4.22	5.99	0.64			
Mexico	CDS	2936	64.17	141.89	613.11	59.36	-0.43577	1	0
	Bond	2936	4.07	6.31	9.42	1.27			
Philippines	CDS	2936	78.30	188.72	840.00	101.70	-0.70327	2	2
	BOND	2936	2.39	5.37	11.04	1.70			
Thailand	CDS	2936	51.01	120.94	500.00	41.89	-0.40863	2	2
	BOND	2936	1.42	3.31	5.75	0.97			
Turkey	CDS	2936	109.82	217.65	835.01	72.41	-0.52148	2	2
	BOND	2936	5.65	11.64	24.62	4.08			
Panel C: Emerging countries									
Bulgaria	CDS	2936	13.22	180.37	692.65	121.88	0.06721	2	2
	BOND	2936	0.41	3.63	7.74	1.87			
Croatia	CDS	2936	24.88	244.20	592.50	128.47	0.17809	1	1
	BOND	2936	1.54	4.55	7.52	1.41			
Czech	CDS	2931	3.41	66.89	350.00	49.54	0.56910	1	0
	BOND	2936	-0.36	2.21	5.32	1.59			
Greece	CDS	2936	5.20	9508.85	37081.41	15351.1	-0.17131	1	1
	BOND	2936	3.06	17.40	64.99	18.84			
Hungary	CDS	2936	17.34	225.98	729.89	153.05	-1.00460	2	2
	BOND	2936	1.77	6.29	13.69	2.57			
Indonesia	CDS	2936	118.09	219.29	1240.00	116.83	-0.27096	2	2
	BOND	2936	4.39	8.36	19.65	2.30			
Poland	CDS	2936	7.67	101.35	421.00	73.12	0.00223	1	0
	BOND	2936	1.68	4.41	7.61	1.40			
Romania	CDS	2936	0.00	204.20	767.70	144.27	-1.01639	2	2
	BOND	2936	2.07	6.51	15.50	3.01			
Russia	CDS	2936	0.00	209.09	1106.01	147.92	0.28748	2	2
	BOND	2936	6.05	8.29	17.94	2.21			
Ukraine	CDS	2936	1.00	2173.76	15028.76	3969.28	0.06110	2	2
	BOND	2936	9.07	17.10	28.00	2.70			
Venezuela	CDS	2936	124.62	1771.08	10995.67	1869.79	-0.40778	2	0
	BOND	2936	4.68	12.91	19.93	4.34			

The table reports descriptive statistics for the daily CDS spreads expressed in basis points. Min., Max. and Std. Dev. refer respectively to the minimum, the maximum and the standard deviation. LLC denotes the panel unit root of Levin, Lin and Chu (with individual intercept in the test equation): The null hypothesis is the presence of a unit root in all the process (non stationary time series). Finally, number of CI relations denotes the number of cointegration relations based on Trace test and Max-Eig test (denoting trace and maximum eigenvalues tests) in the Johansen Cointegration model with quadratic specification.

The Q-Q probability charts and the empirical density of each stationnarized time-series, as displayed in Figure 2 and Figure 3, compare the probability distribution of our time series against the normal distribution. Graphs clearly show that these CDS spreads are not normally

distributed. In fact, the scatter points are not close enough to the reference line (Figure 2) and the probability density function is not in shape of the standard Gaussian distribution curve (Figure 3). Given that the random walk hypothesis is based on the assumption of normal distribution, based on the results of the normality tests, we can ostensibly say that the sovereign CDS markets are not efficient. However, the normality of our data's distribution is necessary but not sufficient condition to confirm or refute the predictability of the studied non-cash assets' prices. That's why, deeper analysis is proposed in this article.

Preliminary tests on the residuals of the VECM mean equation confirm the appropriate use of FIGARCH(1,d,1) to model the conditional variance equation (Table 4). First, regardless the lag order, ARCH effects are detected in almost all the considered series (Except for CDS of Norway, Greece and Ukraine and Bond of Venezuela). Second, strong evidence of credit markets' long-memory behavior is found using the Rescaled Range test. Yet, the proxied unconditional volatility of all studied countries are following a fractionally integrated process (Exception for CDS Greece and Ukraine, and Bond of Croatia and Venezuela). Finally, results of the Jarque-Bera test, confirmed by significant Skewness excess of Kurtosis, show that the studied time series exhibit leptokurtic properties, implying the rejection of the null hypothesis of normality. To overcome the distribution issue, residuals are allowed to follow a Gaussian, a student and a Generalized Error Distribution (G.E.D)[9].

Table 4: Preliminary tests on the VECM mean equation's residuals

		Skweness		Excess Kurtosis		Jarque-Bera		ARCH-LM(2)		ARCH-LM(5)		ARCH-LM(10)		R/S	
Panel A: Developed countries															
Austria	CDS	0.37	***	24.33	***	72376	***	34.21	***	59.07	***	31.31	***	2.56	***
	Bond	0.67	***	7.92	***	7886	***	25.36	***	26.49		21.29	***	4.08	***
Belgium	CDS	-0.69	***	28.87	***	10207	***	120.58	***	64.52	***	52.91	***	3.65	***
	Bond	0.17	***	10.483	***	13440	***	144.19	***	119.95	***	68.545	***	3.60	***
Denmark	CDS	0.22	***	25.92	***	82	***	100.28	***	59.27	***	53.71	***	3.37	***
	Bond	-0.31	***	26.55	***	86142	***	24.00	***	13.21		10.90	***	2.63	***
Finland	CDS	0.23	***	18.06	***	39869	***	116.97	***	89.33	***	47.59	***	3.83	***
	Bond	-0.66	***	25.85	***	81853	***	16.46	***	7.91		9.95	***	2.84	***
France	CDS	-0.08	*	19.21	***	45075	***	152.09	***	94.54	***	59.71	***	3.80	***
	Bond	0.21	***	3.78	***	1770	***	53.30	***	41.09		25.58	***	4.43	***
Germany	CDS	-0.30	***	24.97	***	76220	***	262.48	***	135.23	***	69.04	***	3.16	***
	Bond	-0.85	***	40.17	***	19746	***	8.84	***	4.19		4.51	***	2.94	***
Ireland	CDS	-0.82	***	31.94	***	12495	***	165.99	***	98.30	***	58.36	***	3.30	***
	Bond	0.18	***	28.68	***	10048	***	100.30	***	67.70		49.04	***	2.91	***
Italy	CDS	0.25	***	31.16	***	11862	***	188.52	***	84.95	***	46.00	***	3.23	***
	Bond	-0.61	***	50.38	***	50	***	51.66	***	32.92		17.52	***	3.23	***
Japan	CDS	0.73	***	34.78	***	14802	***	127.61	***	60.12	***	30.59	***	2.85	***
	Bond	-0.13	***	24.70	***	74552	***	77.11	***	34.92		16.50	***	3.02	***
Latvia	CDS	0.63	***	54.36	***	36114	***	382.16	***	344.83	***	179.29	***	2.58	***
	Bond	3.66	***	165.57	***	33554	***	14.64	***	12.39		7.72	***	2.27	***
Lithuania	CDS	-0.18	***	67.27	***	55289	***	650.39	***	263.93	***	136.74	***	2.28	***
	Bond	-1.57	***	78.72	***	75822	***	79.58	***	60.67		34.18	***	2.85	***
Netherlands	CDS	0.41	***	20.94	***	53663	***	105.78	***	68.51	***	37.33	***	3.93	***
	Bond	-0.54	***	24.03	***	70679	***	15.63	***	6.83		6.94	***	2.89	***
Norway	CDS	-6.04	***	202.76	***	50405	***	0.18		0.19		0.19		1.93	**
	Bond	-0.40	***	29.14	***	10383	***	31.31	***	12.94		8.14	***	2.42	***
Portugal	CDS	-0.70	***	32.93	***	13267	***	70.22	***	49.67	***	30.62	***	3.71	***
	Bond	-3.47	***	181.81	***	40442	***	3.54	**	1.71		4.06	***	2.58	***
Slovakia	CDS	1.52	***	50.53	***	31299	***	111.63	***	152.14	***	93.48	***	2.31	***
	Bond	0.10	**	49.19	***	29561	***	56.34	***	32.69		18.63	***	1.76	*
Slovenia	CDS	5.20	***	111.03	***	15193	***	6.72	***	3.59	***	8.99	***	2.06	**
	Bond	4.69	***	94.75	***	11076	***	168.43	***	92.50		46.30	***	1.89	**
Spain	CDS	-0.46	***	15.13	***	28050	***	96.00	***	68.44	***	42.11	***	4.39	***
	Bond	0.27	***	50.70	***	31403	***	54.75	***	45.41		23.76	***	2.73	***
Sweden	CDS	0.93	***	34.49	***	14577	***	72.69	***	50.56	***	35.50	***	3.41	***
	Bond	-0.41	***	46.85	***	26827	***	22.54	***	10.95		6.31	***	2.54	***
UK	CDS	-0.08	*	20.18	***	49731	***	119.50	***	61.39	***	43.94	***	4.07	***
	Bond	-0.44	***	32.20	***	12678	***	20.47	***	9.01		5.17	***	2.68	***
USA	CDS	1.02	***	15.82	***	31060	***	85.82	***	55.41	***	31.48	***	3.64	***
	Bond	-0.64	***	26.29	***	84607	***	43.49	***	18.58		9.99	***	3.22	***
Panel B: Newly Industrialized countries															
Brazil	CDS	4.94	***	142.95	***	25083	***	19.73	***	44.21	***	27.45	***	2.08	**
	Bond	0.80	***	112.00	***	15327	***	288.84	***	138.41		109.60	***	2.30	***
China	CDS	0.29	***	52.26	***	33372	***	177.83	***	158.89	***	121.85	***	1.93	**
	Bond	1.02	***	64.35	***	50643	***	93.06	***	39.78		50.00	***	2.62	***
Mexico	CDS	3.29	***	124.43	***	18967	***	312.76	***	163.55	***	128.74	***	1.76	*
	Bond	0.59	***	12.89	***	20471	***	108.68	***	45.59		23.55	***	2.01	**
Philippines	CDS	4.09	***	169.29	***	35094	***	465.60	***	267.59	**	191.10	***	3.04	***
	Bond	0.75	***	17.98	***	39760	***	242.38	***	103.70		53.68	***	2.35	***
Thailand	CDS	1.54	***	133.05	***	21637	***	156.01	***	273.22	***	209.41	***	2.94	***
	Bond	0.26	***	9.77	***	11705	***	19.54	***	11.87		10.41	***	3.38	***
Turkey	Bond	2.53	***	57.66	***	40928	***	94.00	***	335.74	***	182.61	***	1.98	**
	CDS	0.25	***	23.90	***	69793	***	87.82	***	40.73		44.22	***	2.70	***
Panel C: Emerging countries															
Bulgaria	CDS	1.20	***	47.54	***	27683	***	73.25	***	82.57	***	58.45	***	2.64	***
	Bond	-0.85	***	35.88	***	15764	***	23.90	***	11.68		9.42	***	2.38	***

[9]Innovations of the variance equation are allowed, as well, to follow a skewed student distribution, but no optimal estimation with this distribution is found.

Table 4: Preliminary tests on the VECM mean equation's residuals (*Continued*)

		Skweness		Excess Kurtosis		Jarque-Bera		ARCH-LM(2)		ARCH-LM(5)		ARCH-LM(10)		R/S	
Croatia	CDS	-0.55	***	23.26	***	66235	***	128.65	***	122.05	***	67.42	***	2.90	***
	Bond	4.51	***	115.28	***	16336	***	14.60	***	5.93		3.00	***	0.97	
Czech	CDS	-0.24	***	52.55	***	33737	***	173.41	***	124.38	***	97.48	***	2.59	***
	Bond	1.27	***	15.04	***	28416	***	105.35	***	87.47		46.64	***	2.94	***
Greece	CDS	-45.08	***	2324.30	***	661010	***	0.00		0.00		0.00		0.99	
	Bond	-2.22	***	175.84	***	37796	***	24.48	***	11.97		6.32	***	2.08	**
Hungary	CDS	1.45	***	39.04	***	18721	***	128.55	***	103.60	***	60.36	***	2.57	***
	Bond	-0.94	***	50.02	***	30605	***	57.28	***	23.24		29.95	***	2.54	***
Indonesia	CDS	2.70	***	119.09	***	17362	***	355.20	***	227.61	***	165.31	***	1.82	*
	Bond	-0.16	***	50.38	***	31014	***	200.01	***	83.83		42.73	***	2.46	***
Poland	CDS	-0.26	***	41.40	***	20946	***	266.88	***	133.10	***	84.45	***	2.69	***
	Bond	1.56	***	45.83	***	25782	***	3.12	**	8.48		4.73	***	1.82	*
Romania	CDS	2.17	***	86.22	***	91053	***	178.12	***	124.79	***	67.63	***	2.06	***
	Bond	-0.05		54.25	***	35947	***	35.29	***	18.15		15.90	***	3.37	***
Russia	CDS	2.41	***	73.30	***	65924	***	164.87	***	100.62	***	86.31	***	2.15	***
	Bond	2.60	***	77.56	***	73824	***	188.10	***	90.96		63.97	***	1.91	**
Ukraine	CDS	-24.41	***	1339.10	***	219370	***	0.00		0.36		0.18		1.24	
	Bond	3.92	***	248.67	***	7561	***	60.40	***	24.71		12.39	***	2.12	***
Venezuela	CDS	-1.46	***	49.04	***	29485	***	62.32	***	75.00	***	41.32	***	3.51	***
	Bond	52.83	***	2834.50	***	982930	***	7,3e-05		1,8e-04		2,7e-04		1.00	

The Engle's ARCH-LM test with 2, 5 and 10 lag orders is used to detect ARCH effects in the series under the null hypothesis of no autocorrelations in the squared residuals. R/S denotes the rescaled range test (number of autorcorrelations=10) is applied to the squared arithmetic returns (as proxy for unconditional volatility) to detect any long-term dependence under the null assumption of no long-memory behavior in the volatility process. *, ** and *** denote statistical significance at respectively 10%, 5% and 1%.

4.2 Empirical findings

As mentioned before, volatility clustering, long-memory behavior as well as the long-run relationship between CDS spreads and bond yields are taken into account through a VECM(2)-FIGARCH(1,d,1) model. Results of the model estimation, presented in Table 5, confirm the appropriate use of the fractionally integrated model since the coefficients are statistically significant in most cases. The specification of the mean equation is chosen according to the AIC information criterion that selects 2 as the number of lag intervals for exogenous. The lagged term γ_1 (γ_2) is significant in 33 (22) CDS markets and 33 (25) bond markets, which suggest that market information is rapidly reflected in CDS spreads and bond yields of most studied countries.

The conditional volatility of worldwide CDS and bond markets seem to exhibit common behavior. The conditional variance is more sensitive to its own lagged values (97% of the estimated equations) than to the its lagged errors (78%). ARCH and GARCH terms are always positive suggesting that the current conditional market volatility is positively dependent with past shocks and volatility. The magnitude of these coefficients vary greatly from one market to another and from one country to another, which indicates that the volatility evolves continuously over time with regard to the corresponding impact degree of impulsion in both past errors and volatility. The persistence behavior of volatility process is captured as well with the fractional integration parameter (d) that is highly significant in all cases, justifying the accuracy of the FIGARCH(1,d,1). The d parameter varies from 0.10 to 0.92 depending on both the market and the country, with the memory degree of the FIGARCH increase as it gets closer to zero. Drawing on the idea of Charfeddine and Khediri (2016), the markets' efficiency is ranked according to the value of the integrated long-memory parameter (d): the greater the parameter is, the fewer the market is efficient. The estimators provide heterogeneous efficiency levels for each studied country which confirms that worldwide sovereign CDS spreads exhibit different long-memory behavior and different efficiency nature. Thus, estimates show that, the most efficient market seems to be the USA, followed by Ukraine, and the least is Slovakia. Nonetheless, this ranking method supposes that the markets are already found to be efficient which is not the case.

In the second step, the long-run cointegration relationship between the transformed time series is modeled through a VECM. If only one coefficient of the lagged variables ($\gamma_1^{'}, \gamma_2^{'}, \delta_1^{'}$ or $\delta_2^{'}$) is statistically significant, then a predictable pattern is detected and the EMH doesn't hold in the Sovereign CDS market. In order to better understand the reaction of markets to crises, the VECM(2) estimation is conducted over four sub-periods.

Since the aim of this article is to examine the CDS market efficiency, we only focus on the

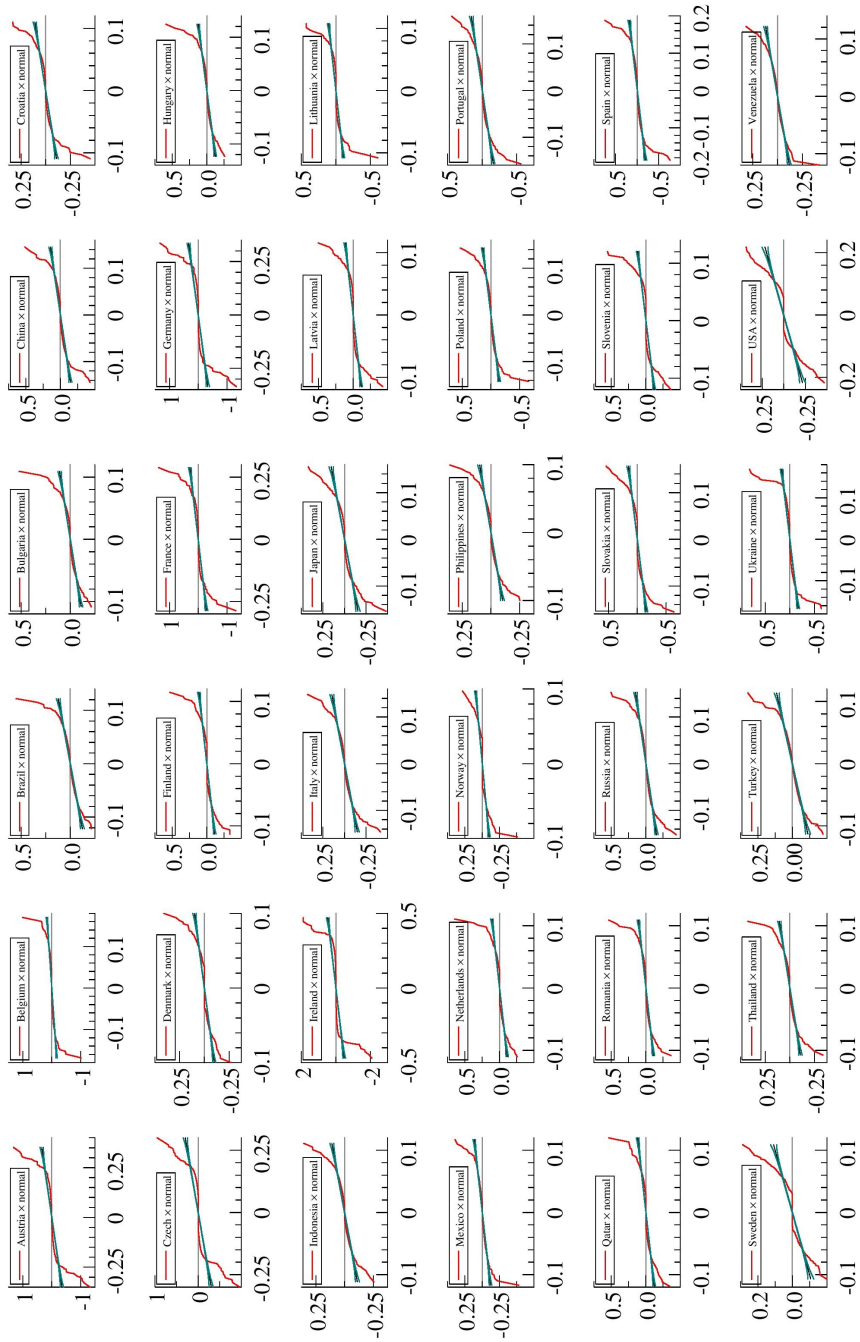

Figure 2: Sample Quantiles and Normal theoretical Quantiles

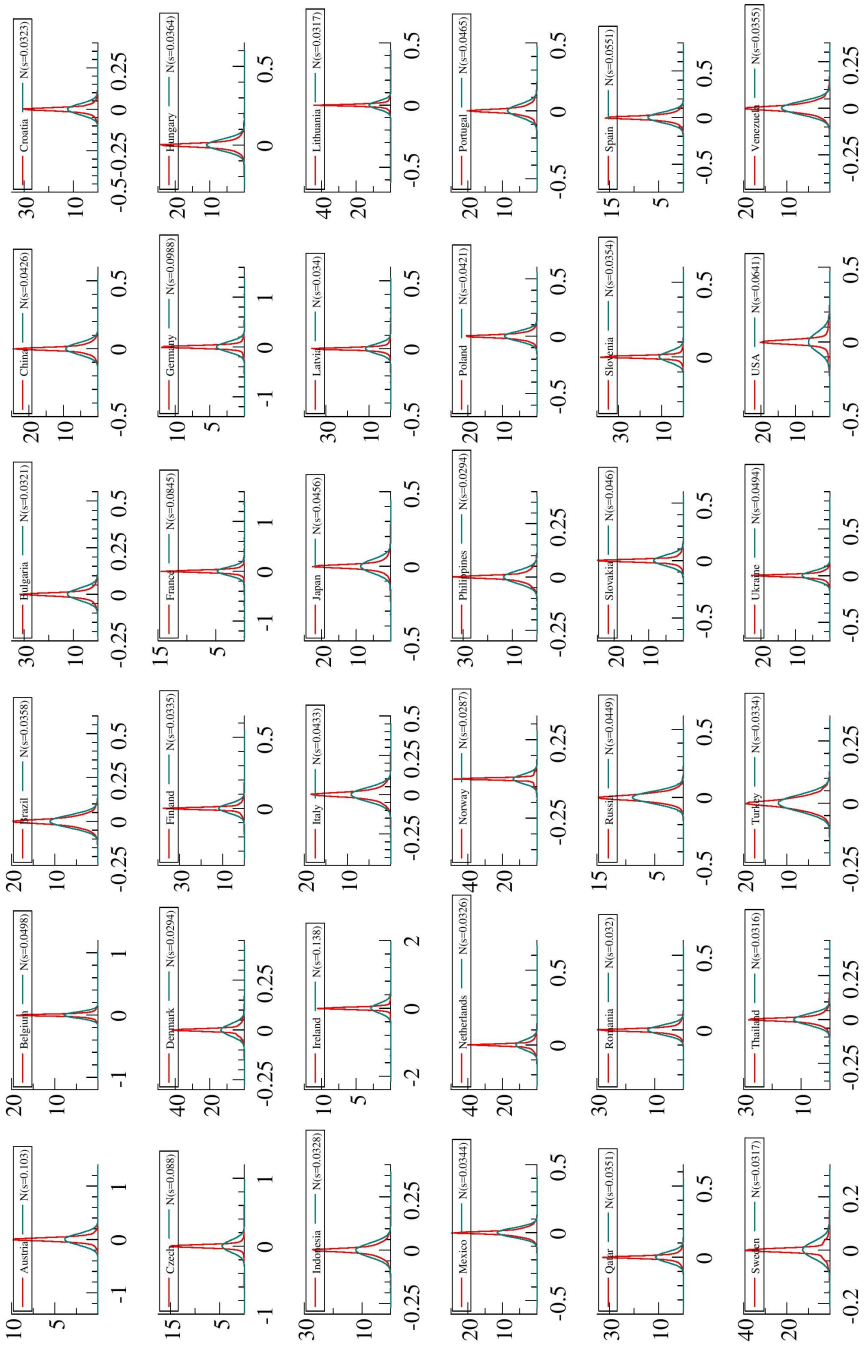

Figure 3: Empirical Density and Normal Distribution Fit

Table 5: Estimation results of the VECM(2)-FIGARCH(1,d,1)

		Mean Equation												Variance Equation											
		Cst(M)		λ		γ_1		γ_2		δ_1		δ_2		Cst(V)		d-Figarch		ARCH (ϕ)		GARCH (θ)		Student		GED	
Panel A: Developed countries																									
Austria	CDS	0,01603		-0,00478	**	-0,03434	*	0,02044		-2,19492	**	-0,46027		0,15926		0,35091	***	0,16434	*	0,26916	***			0,82062	***
		(0,0398)		(0,0018)		(0,0185)		(0,0185)		(0,7872)		(0,7879)		(0,1062)		(0,0423)		(0,0948)		(0,0898)				(0,0425)	
	Bond	-0,00109		-0,00008	*	0,01162		0,02311		0,00083	*	0,00054		44,74156	***	0,57020	***	0,26470	***	0,75206	***	4,44826	***		
		(0,0009)		(4,32E-5)		(0,0185)		(0,0185)		(0,0004)		(0,0004)		(15,6380)		(0,0593)		(0,0456)		(0,0548)		(0,3076)			
Belgium	CDS	0,00919		-0,00191	*	0,22410	**	-0,03939	**	0,05011		2,04255	**	4,00333	***	0,73178	***	0,18314	**	0,58550	***	0,70555	***		
		(0,0747)		(0,0010)		(0,0185)		(0,0190)		(0,9912)		(0,9722)		(0,9359)		(0,0325)		(0,0895)		(0,1021)		(0,0252)			
	Bond	-0,00135		-0,00002		-0,16186	**	0,01659		0,00398	**	0,00155	**	83,38401	***	0,60637	***	0,26714	***	0,67713	***	4,40646	***		
		(0,0014)		(1,87E-5)		(0,0185)		(0,0181)		(0,0003)		(0,0004)		(29,4730)		(0,0478)		(0,0720)		(0,0862)		(0,3036)			
Denmark	CDS	0,00027		-0,00166	**	0,33109	**	-0,03665	**	-0,58729	**	-0,17622		7,44651	***	0,85723	***	0,42648	***	0,79704	***			0,65911	***
		(0,0325)		(0,0007)		(0,0185)		(0,0185)		(0,2153)		(0,2154)		(2,0686)		(0,0456)		(0,0577)		(0,0484)				(0,0255)	
	Bond	-0,00137		0,00004		-0,21589	**	-0,04875	**	-0,00467	**	0,00202		100,00	**	0,25162	***	0,46915	***	0,65631	***				
		(0,0028)		(0,0001)		(0,0185)		(0,0185)		(0,0016)		(0,0016)		(38,7710)		(0,0606)		(0,0871)		(0,1030)					
Finland	CDS	0,00540		-0,00229	*	0,11074	**	0,10112	**	-0,02232		-0,07267		0,02767		0,60166	***	0,30476	***	0,79598	***				
		(0,0215)		(0,0012)		(0,0184)		(0,0184)		(0,1541)		(0,1540)		(0,0272)		(0,1328)		(0,1078)		(0,1119)					
	Bond	-0,00143		-0,00019		-0,20423	**	-0,03340	*	-0,00257		0,00527	**	100,00	**	0,37079	***	0,47838	***	0,75442	***				
		(0,0026)		(0,0001)		(0,0185)		(0,0185)		(0,0022)		(0,0022)		(41,9140)		(0,0679)		(0,0803)		(0,0555)					
France	CDS	0,01390		-0,00193	*	0,20179	**	0,00663		-2,43449	**	3,17249	**	2,76390	***	0,69188	***	0,24183	***	0,64285	***	2,91107	***		
		(0,0500)		(0,0010)		(0,0185)		(0,0185)		(1,0517)		(1,0520)		(0,7750)		(0,0390)		(0,0660)		(0,0621)		(0,0787)			
	Bond	-0,00101		-0,00003		0,01923		-0,00852		0,00057	*	0,00041		30,18740	**	0,57653	***	0,35885	***	0,80313	***	5,53744	***		
		(0,0009)		(1,81E-5)		(0,0185)		(0,0185)		(0,0003)		(0,0003)		(12,5470)		(0,0776)		(0,0533)		(0,0597)		(0,4872)			
Germany	CDS	0,00401		-0,00029		0,06087	**	0,03404	*	-0,51639	**	-0,15535		0,43204		0,73315	***	0,16224	**	0,60483	***			0,54262	***
		(0,0298)		(0,0002)		(0,0185)		(0,0185)		(0,1990)		(0,1990)		(0,8962)		(0,0457)		(0,0753)		(0,0874)				(0,0163)	
	Bond	-0,00144		0,00003	*	-0,17283	**	-0,05248	**	-0,00366	**	0,00093		100,00	***	0,16440	***	0,68666	***	0,08239	***	2,25694	***		
Japan		(0,0028)		(1,89E-5)		(0,0185)		(0,0185)		(0,0017)		(0,0017)		(16,9510)		(0,0350)		(0,0439)		(0,0242)		(0,0164)			
Ireland	CDS	0,02705		-0,00331	**	0,16995	**	-0,01138		9,68159	**	2,39312	*	1,43914	***	0,44356	***	0,49708	***	0,11800	***			4,31264	***
		(0,1849)		(0,0013)		(0,0201)		(0,0199)		(1,3520)		(1,3592)		(0,5277)		(0,0015)		(0,0015)		(5,94E-9)				(4,66E-9)	
	Bond	-0,00108		-0,00001		-0,06383	**	0,00049		0,00257	**	0,00062	**	2,74285		0,42861	***	0,23201	**	0,55353	***				
		(0,0028)		(1,90E-5)		(0,0202)		(0,0203)		(0,0003)		(0,0003)		(3,7186)		(0,1429)		(0,1133)		(0,1689)					
Italy	CDS	0,04924		0,00004		0,13713	**	-0,05450	**	0,38080		-0,60704		0,36451	*	0,54841	***	0,13240	**	0,50672	***				
		(0,1472)		(0,0002)		(0,0186)		-(0,0186)		(0,5832)		(0,5814)		(0,1869)		(0,0578)		(0,0593)		(0,0711)					
	Bond	-0,00111		0,00002	**	-0,25248	**	-0,09682	**	0,00266	**	0,00087		1,00E+06		0,41285	***	0,44200	***	0,77822	***				
		(0,0047)		(7,60E-6)		(0,0186)		(0,0185)		(0,0006)		(0,0006)		(66,9460)		(0,0878)		(0,0730)		(0,0466)					
Japan	CDS	0,00644		-0,00079		0,04652	**	0,04519	**	-0,50771		-0,21344		0,00639		0,50589	***	0,36320	***	0,75457	***				
		(0,0394)		(0,0011)		(0,0185)		(0,0185)		(0,7727)		(0,7717)		(0,0060)		(0,1105)		(0,0678)		(0,1041)					
	Bond	-0,00045		-0,00007	**	-0,26790	**	-0,06039	**	-0,00028		0,00035		1,00E+06	**	0,32859	***	0,60090	***	0,11405	***			0,44246	***
		(0,0009)		(2,59E-5)		(0,0185)		(0,0184)		(0,0004)		(0,0004)		(47,2770)		(0,0536)		(0,0421)		(0,0194)				(0,0111)	
Latvia	CDS	0,01685		-0,00263	*	-0,29721	**	0,31165	**	1,98336		-1,13320		100,00	***	0,81164	***	0,00000		0,37281	***			0,67256	***
		(0,2639)		(0,0015)		(0,0176)		(0,0176)		(1,2496)		(1,2500)		(25,6350)		(0,0247)		(0,0682)		(0,0685)				(0,0421)	
	Bond	-0,00153		0,00005	**	-0,09567	**	-0,10780	**	-0,00018		-0,00034		1,00E+06	**	0,12500	*	0,39570	**	0,50097	***				
		(0,0039)		(2,10E-5)		(0,0184)		(0,0184)		(0,0003)		(0,0003)		(50,9610)		(0,0730)		(0,1829)		(0,2225)					
Lithuania	CDS	0,01595		-0,00120		-0,21318	**	0,21932	**	0,11452		-0,12791		43,00145	**	0,80289	***	0,00000		0,40491	***			0,61263	***
		(0,1806)		(0,0014)		(0,0181)		(0,0181)		(0,3013)		(0,2981)		(18,2760)		(0,0366)		(0,0673)		(0,0726)				(0,0537)	
	Bond	-0,00138		0,00056	**	-0,31713	**	-0,10274	**	-0,00486	**	-0,00370	**	2,66029	***	0,48697	***	0,50907	***	0,14093	***	2,31539	***		
		(0,0111)		(0,0001)		(0,0185)		(0,0183)		(0,0011)		(0,0011)		(0,2975)		(0,0130)		(0,0116)		(0,0014)		(0,0228)			
Netherlands	CDS	0,00455		-0,00219	**	0,24003	**	-0,01865		-0,11769		-0,04119		0,47512		0,57924	***	0,35482	***	0,74616	***				
		(0,0311)		-(0,0010)		-(0,0185)		-(0,0185)		-(0,2297)		-(0,2297)		(0,6550)		(0,1034)		(0,1312)		(0,0790)					
	Bond	-0,00137		-0,00002		-0,20379	**	-0,04724	**	-0,00121		0,00048		1,00E+06	***	0,11001	***	0,76971	***	0,10800	***	2,23201	***		
		(0,0025)		-(0,0001)		-(0,0185)		-(0,0185)		-(0,0015)		-(0,0015)		(0,0009)		(0,0000)		(0,0000)		(0,0000)		(0,0162)			
Norway	CDS	-0,01310		-0,00222	*	0,03828	**	0,02197		-0,09738		-0,03504		5,75E+05		0,26970	***	0,58814	***	0,08793	***			1,54461	***
		(0,0155)		(0,0012)		(0,0185)		(0,0185)		(0,0938)		(0,0935)		(70,3760)		(0,6738)		5,2485-e1		(0,5227)				(0,1735)	
	Bond	-0,00127		0,00119	**	-0,17959	**	-0,04881	**	-0,00774	**	-0,00667	*	1,00E+06	***	0,37703	***	0,42225	***	0,72932	***				
		(0,0031)		(0,0002)		(0,0185)		(0,0185)		(0,0037)		(0,0037)		(57,8020)		(0,0743)		(0,0561)		(0,0572)					
Portugal	CDS	0,06646		-0,00470	**	0,14837	**	0,05766	**	8,25213	**	-3,22191	**	36,28834	***	0,57136	***	0,16088	**	0,44539	***	3,55517	***		
		(0,2829)		(0,0018)		(0,0193)		(0,0192)		(1,4001)		(1,4067)		(7,7017)		(0,0449)		(0,0769)		(0,0948)		(0,2007)			
	Bond	-0,00037		0,00003		0,05749	**	-0,01623		0,00124	**	-0,00007		1,00E+06	**	0,48261	***	0,66683	***	0,90662	***				
		(0,0039)		(2,50E-5)		(0,0194)		(0,0194)		(0,0003)		(0,0003)		(40,4060)		(0,0833)		(0,0774)		(0,0347)					

Table 5: Estimation results of the VECM(2)-FIGARCH(1,d,1) (*Continued*)

		Mean Equation												Variance Equation											
		Cst(M)		λ		γ_1		γ_2		δ_1		δ_2		Cst(V)		d-Figarch		ARCH (ϕ)		GARCH (θ)		Student		GED	
Slovakia	CDS	0,01024		-0,00209	**	0,10633	**	0,04317	**	0,06044		-0,08743		63,05347	***	0,86935	***	0,29401	***	0,75353	***	0,50624	***		
		(0,0689)		(0,0009)		(0,0185)		(0,0185)		(0,4396)		(0,4392)		(17,0370)		(0,0247)		(0,0605)		(0,0507)		(0,0126)			
	Bond	-0,00181		-4,34E-06		-0,32638	**	-0,13672	**	0,00114		0,00065		597,86000		0,73861	***	0,54819	***	0,36158	***	4,02731	***		
		(0,0029)		(3,90E-5)		(0,0183)		(0,0183)		(0,0008)		(0,0008)		(6,1551)		(0,0002)		(0,0003)		(0,0002)		(1,0849)			
Slovenia	CDS	0,02085		-0,00060	*	0,14145	**	0,07850	**	0,18194		0,24342		11,31456		0,53317	***	0,00000		0,42984	***				
		(0,0864)		(0,0004)		(0,0184)		(0,0184)		(0,2426)		(0,2415)		(10,3120)		(0,0492)		(0,1452)		(0,1397)					
	Bond	-0,00015		0,00007	**	-0,44532	**	-0,24149	**	0,00287	**	0,00066		1,00E+06	***	0,63715	***	0,77353	***	0,59658	***	2,46385	***		
		(0,0064)		(2,73E-5)		(0,0181)		(0,0180)		(0,0014)		(0,0014)		(10,3080)		(0,0038)		(0,0000)		(0,0023)		(0,0193)			
Spain	CDS	0,02288		-0,00028		0,18851	**	-0,06424	**	0,26451		0,40324		0,06823		0,47131	***	0,02794		0,37120					
		(0,1394)		(0,0006)		(0,0186)		(0,0187)		(0,6269)		(0,6249)		(0,0651)		(0,1346)		(0,1365)		(0,2416)					
	Bond	-0,00129		0,00005	**	-0,28558	**	-0,11048	**	0,00299	**	0,00072		1,00E+06		0,47228	***	0,44768	***	0,82142	***				
		(0,0041)		(1,90E-5)		(0,0186)		(0,0185)		(0,0006)		(0,0006)		(78,3650)		(0,0854)		(0,0976)		(0,0637)					
Sweden	CDS	0,00401		-0,00014		0,26484	**	0,01940		-0,02763		-0,24443		1,25541	***	0,79675	***	0,35970	***	0,63089	***	2,67061	***		
		(0,0284)		(0,0001)		(0,0185)		(0,0185)		(0,1617)		(0,1615)		(0,4065)		(0,0471)		(0,1260)		(0,1423)		(0,0614)			
	Bond	-0,00134		0,00003	**	-0,19281	**	-0,04177	**	-0,00075		0,00053		1,00E+06		0,42504	***	0,41349	***	0,77124	***				
		(0,0032)		(1,36E-5)		(0,0185)		(0,0185)		(0,0021)		(0,0021)		(79,8630)		(0,0783)		(0,0703)		(0,0517)					
UK	CDS	0,00333		0,00015		0,15226	**	0,02203		-0,23835		-0,03585		0,04708	***	0,64598	***	0,16182	**	0,48919	***	2,69709	***		
		(0,0339)		(0,0004)		(0,0185)		(0,0185)		(0,1874)		(0,1871)		(0,0149)		(0,0456)		(0,0817)		(0,0909)		(0,0666)			
	Bond	-0,00152		-0,00011	**	-0,19866	**	-0,05309	**	-0,00429	**	-0,00019		1,00E+06	**	0,33443	***	0,47171	***	0,72979	***				
		(0,0033)		(4,17E-5)		(0,0185)		(0,0184)		(0,0018)		(0,0018)		(48,6240)		(0,0662)		(0,0844)		(0,0635)					
USA	CDS	-0,00040		-0,00559	**	-0,23325	**	-0,05240	**	-0,01238		-0,07957		1,00E+06	***	0,10410	***	0,61118	***	0,05296	**	0,44407	***	0,44407	***
		(0,0318)		(0,0024)		(0,0185)		(0,0185)		(0,1729)		(0,1727)		(27,8850)		(0,0239)		(0,0512)		(0,0233)		(0,0115)		(0,0115)	
	Bond	-0,00107		-0,00060	**	-0,26256	**	-0,06776	**	-0,00192		-0,00045		0,08131		0,68046	***	0,46002	***	0,23625	***	4,41477	***		
		(0,0034)		(0,0003)		(0,0185)		(0,0184)		(0,0020)		(0,0020)		(4,1059)		(7,40E-6)		(5,49E-6)		(6,46E-6)		(0,1152)			
Panel B: Newly Industrialized countries																									
Brazil	CDS	0,02884		-0,00225	*	0,14705	**	-0,01815		0,03594		0,13663		10,26098	***	0,60344	***	0,01630		0,49738	***			0,99958	***
		(0,1645)		(0,0011)		(0,0186)		(0,0186)		(0,3103)		(0,3083)		(1,9567)		(0,0718)		(0,0582)		(0,0919)				(0,0746)	
	Bond	0,00206		0,00027	**	-0,32622	**	-0,19957	**	0,00221	**	0,00183	*	11,44751		0,73946	***	0,08976		0,76523	***			1,68271	***
		(0,0097)		(0,0001)		(0,0183)		(0,0182)		(0,0011)		(0,0011)		(60,5660)		(0,0931)		(0,1013)		(0,1379)				(0,2368)	
China	CDS	0,02229		-0,00116		0,10633	**	0,15876	**	0,09830		0,31921		0,06302	***	0,68063	***	0,45991	***	0,23619	***	4,41389	***		
		(0,0714)		(0,0007)		(0,0182)		(0,0183)		(0,6784)		(0,6763)		(0,0242)		(5,53E-6)		(6,22E-6)		(0,0000)		(0,1239)			
	Bond	0,00096		0,00007	**	-0,31402	**	-0,12686	**	-0,00076		-0,00030		30,28539	***	0,28642	***	0,67920	***	0,53845	***	3,42428	***		
		(0,0019)		(2,E-05)		(0,0184)		(0,0183)		(0,0005)		(0,0005)		(9,0091)		(0,0548)		(0,0996)		(0,1217)		(0,1389)			
Mexico	CDS	0,00097		-0,01235	**	0,19612	**	-0,10331	**	10,71790	**	0,59183		4,57495	**	0,59541	***	0,00		0,40579	**			1,22862	***
		(0,1484)		(0,0028)		(0,0187)		(0,0186)		(2,0145)		(2,0234)		(2,0607)		(0,0518)		(0,1223)		(0,1688)				(0,0585)	
	Bond	-0,00031		-0,00005	*	-0,07956	**	-0,01530		0,00067	**	-0,00009		6,05E+05		0,47652	***	0,74209	***	0,88748	***	3,69180	***		
		(0,0014)		(0,0000)		(0,0189)		(0,0190)		(0,0002)		(0,0002)		(40,5720)		(0,0797)		(0,0715)		(0,0347)		(0,1974)			
Philippines	CDS	-0,06587		-0,00814	**	0,25989	**	-0,04700	**	-2,62345	**	0,64073		1,35335	*	0,64848	***	0,00000		0,38748	***	5,06109	***		
		(0,1528)		(0,0026)		(0,0186)		(0,0190)		(1,1865)		(1,1754)		(0,7190)		(0,0380)		(0,0856)		(0,1039)		(0,3808)			
	Bond	-0,00163		0,00013	**	-0,19287	**	0,05929	**	0,00294	**	0,00037		0,05004	***	0,28555	***	0,73621	***	0,46634	***			0,70932	***
		(0,0024)		(0,0000)		(0,0185)		(0,0184)		(0,0003)		(0,0003)		(0,0160)		(0,0879)		(0,1078)		(0,0740)				(0,0230)	
Thailand	CDS	-0,01502		-0,01346	**	0,13940	**	0,15801	**	-2,54222		-0,15094		0,15566	**	0,60816	***	0,03382		0,42950	***	3,95321	***		
		(0,1077)		(0,0026)		(0,0182)		(0,0183)		(2,0300)		(2,0301)		(0,0755)		(0,0431)		(0,0556)		(0,0796)		(0,2081)			
	Bond	-0,00103		-0,00009	**	-0,02009		0,01618		0,00018		-0,00024		4,97E+05	***	0,39529	***	0,33306	**	0,52026	***	3,33148	***		
		(0,0010)		(0,0000)		(0,0185)		(0,0185)		(0,0002)		(0,0002)		(16,9480)		(0,0440)		(0,1327)		(0,1351)		(0,1674)			
Turkey	CDS	0,02619		-0,01296	**	0,18354	**	0,06516	**	0,29428		-0,13366		100,00	**	0,57427	***	0,03005		0,45329	***	0,90203	***		
		(0,1767)		(0,0026)		(0,0184)		(0,0185)		(0,2454)		(0,2452)		(46,4680)		(0,0792)		(0,0627)		(0,1219)		(0,0660)			
	Bond	-0,00160		0,00004		-0,37733	**	-0,16636	**	0,00445	**	0,00197		1,45284	***	0,36173	***	0,81993	***	0,52211	***			0,46137	***
		(0,0132)		(0,0002)		(0,0183)		(0,0183)		(0,0014)		(0,0014)		(0,0802)		(0,0002)		(0,0000)		(0,0290)				(0,0116)	
Panel C: Emerging countries																									
Bulgaria	CDS	0,02141		-0,00354	**	0,16659	**	0,01015		-0,11537		-1,26700		100,00	***	0,77076	***	0,11981	*	0,57715	***			0,68215	***
		(0,1485)		(0,0013)		(0,0185)		(0,0185)		(1,1182)		(1,1180)		(25,9070)		(0,0367)		(0,0659)		(0,0633)				(0,0391)	
	Bond	-0,00153		0,00001		-0,28567	**	-0,17039	**	0,00001		-0,00012		100,00000	*	0,92953	***	0,00000		0,46211	***			0,39534	***
		(0,0024)		(0,0000)		(0,0182)		(0,0182)		(0,0003)		(0,0003)		(53,8920)		(0,0170)		(0,0400)		(0,0375)				(0,0159)	
Croatia	CDS	0,03188		-0,00289	**	0,16267	**	0,07176	**	-0,01363		0,53836		1,77963	**	0,48741	***	0,30045	**	0,57255	***				
		(0,1340)		(0,0012)		(0,0184)		(0,0185)		(1,2996)		(1,2976)		(0,8565)		(0,0625)		(0,1229)		(0,1255)					
	Bond	-0,00078		0,00000		-0,31422	**	-0,08297	**	0,00067	**	0,00035		9,91E+03	***	0,09800	***	0,86944	***	0,38441	***				

Table 5: Estimation results of the VECM(2)-FIGARCH(1,d,1) (*Continued*)

		Mean Equation												Variance Equation											
		Cst(M)		λ		γ_1		γ_2		δ_1		δ_2		Cst(V)		d-Figarch		ARCH (ϕ)		GARCH (θ)		Student		GED	
		(0,0019)		(0,0000)		(0,0184)		(0,0184)		(0,0003)		(0,0003)		(0,1453)		(0,0277)		(0,0133)		(0,0386)					
Czech	CDS	0,02252		-0,00459	**	-0,00596		0,00812		5,27601	**	4,54805	**	17,15734	***	0,78626	***	0,13992	*	0,67917	***			0,58558	***
		(0,0836)		(0,0017)		(0,0185)		(0,0185)		(1,4499)		(1,4509)		(6,4380)		(0,0290)		(0,0806)		(0,0725)				(0,0168)	
	Bond	-0,00125		0,00001		-0,20060	**	-0,02795		0,00071	**	0,00000		100,00	***	0,51234	***	0,61883	***	0,76943	***	3,23696	***		
		(0,0011)		(0,0000)		(0,0185)		(0,0185)		(0,0002)		(0,0002)		(35,6350)		(0,0590)		(0,1767)		(0,1573)		(0,1541)			
Greece	CDS	0,29641		-0,00401	**	0,02315		0,02745		-11,42562	*	1,89926		100,00		0,40841	***	0,58252	***	0,84346	***				
		(13,0929)		(0,0009)		(0,0184)		(0,0184)		(5,9338)		(5,9214)		(6,5014)		(0,0002)		(0,0002)		(0,0759)					
	Bond	0,00063		0,00001	**	-0,20140	**	-0,05316	**	4,49E-06		0,00003		0,14810		0,28294	**	0,48685	**	0,72087	***				
		(0,0410)		(3,E-06)		(0,0186)		(0,0185)		(0,0001)		(0,0001)		(0,3414)		(0,1099)		(0,2162)		(0,0830)				-	
Hungary	CDS	0,02714		-0,00131	*	0,14437	**	0,03725	**	0,38841		1,20304	**	17,86708	***	0,63346	***	0,23725	***	0,60049	***	2,94579	***		
		(0,1800)		(0,0007)		(0,0185)		(0,0185)		(0,4574)		(0,4558)		(4,8448)		(0,0372)		(0,0755)		(0,0811)		(0,0845)			
	Bond	-0,00226		0,00008	**	-0,27094	**	-0,07078	**	0,00251	**	-0,00009		0,49454	*	0,34083	***	0,77885	***	0,36075	***	2,20248	***		
		(0,0073)		(0,0000)		(0,0185)		(0,0185)		(0,0007)		(0,0007)		(0,2568)		(0,0742)		(0,0474)		(0,0834)		(0,0164)			
Indonesia	CDS	-0,03233		-0,01391	**	0,10943	**	-0,01999		0,99331		0,94208		1,06795		0,65562	***	0,02897		0,42251	**			1,00722	***
		(0,2529)		(0,0031)		(0,0187)		(0,0193)		(1,4399)		(1,4073)		(1,3898)		(0,0401)		(0,1414)		(0,1686)				(0,0513)	
	Bond	-0,00250		-0,00002		-0,20864	**	-0,04579	**	0,00331	**	0,00205	**	0,03550		0,47946	***	0,14024		0,28483	**	3,07308	***		
		(0,0033)		(0,0000)		(0,0186)		(0,0182)		(0,0002)		(0,0002)		(0,0236)		(0,0465)		(0,1255)		(0,1324)		(0,1277)			
Poland	CDS	0,02833		-0,00359	**	0,08299	**	-0,00432		10,07558	**	5,01618	**	29,02422	***	0,76106	***	0,20041	***	0,62960	***	3,22280	***		
		(0,1020)		(0,0014)		(0,0188)		(0,0187)		(1,7540)		(1,7636)		(8,7048)		(0,0342)		(0,0624)		(0,0560)		(0,1138)			
	Bond	-0,00062		-0,00001		0,04857	**	0,02401		-0,00008		-0,00041	**	3,63E+05	**	0,24290	**	0,90117	***	0,94021	***				
		(0,0011)		(0,0000)		(0,0188)		(0,0189)		(0,0002)		(0,0002)		(16,3030)		(0,1025)		(0,0377)		(0,0129)					
Romania	CDS	0,02133		-0,00352	**	0,08813	**	-0,08616	**	0,60358		-1,21065	**	46,30649	***	0,68704	***	0,00000		0,47018	***	3,12447	***		
		(0,1951)		(0,0012)		(0,0184)		(0,0184)		(0,5103)		(0,5095)		(9,6511)		(0,0276)		(0,0820)		(0,0791)		(0,1406)			
	Bond	-0,00183		0,00011	**	-0,26456	**	-0,01888		-0,00104		-0,00056		1,00E+06	*	0,36877	***	0,57785		0,83154	***				
		(0,0071)		(0,0000)		(0,0185)		(0,0185)		(0,0007)		(0,0007)		(52,9530)		(0,1293)		(0,3690)		(0,0964)					
Russia	CDS	0,03032		-0,01612	**	0,01354		0,06830	**	0,30100		0,15939		68,74330	***	0,68865	***	0,10692	*	0,51764	***	4,05454	***		
		(0,3196)		(0,0040)		(0,0188)		(0,0188)		(1,3772)		(1,3735)		(17,9620)		(0,0338)		(0,0558)		(0,0627)		(0,2596)			
	Bond	0,00074		0,00024	**	-0,27322	**	0,01728		0,00088	**	0,00056	**	1,00E+06	**	0,32281	***	0,91632	***	0,78973	***			0,71952	***
		(0,0044)		(0,0001)		(0,0187)		(0,0187)		(0,0003)		(0,0003)		(48,6280)		(0,0854)		(0,0300)		(0,0343)				(0,0270)	
Ukraine	CDS	0,36862		0,00025		-0,00215		-0,01409		1,55053		0,36856		87,89872		0,24316	***	0,65661	***	0,80777	***				
		(5,3959)		(0,0005)		(0,0185)		(0,0185)		(9,1411)		(9,1293)		(67,2750)		(0,5863)		(0,5870)		(0,5868)					
	Bond	-0,00050		0,00001	**	-0,05046	**	-0,17064	**	-0,00001		-0,00001		0,25005	***	0,44288	***	0,09842	***	0,40942	***			1,96857	***
		(0,0108)		(0,0000)		(0,0182)		(0,0182)		(0,0000)		(0,0000)		(0,0108)		(0,0802)		(0,0304)		(0,0200)				(0,0269)	
Venezuela	CDS	0,98589		-0,00001		0,20342	**	0,02869		-0,04938		-0,02799		4,85856	***	0,41161	***	0,00000		0,17876		4,85686	***		
		(2,4423)		(0,0000)		(0,0185)		(0,0185)		(0,1016)		(0,0723)		(0,9018)		(0,0338)		(0,1693)		(0,1905)		(0,3035)			
	Bond	-0,00324		0,00014	**	-0,02448		-0,01215		-0,00032		0,00011		239,49000		0,67768	***	0,46262	***	0,23737	***	4,39446	***		
		(0,6243)		(0,0000)		(0,0260)		(0,0185)		(0,0047)		(0,0047)		(4,8438)		(0,0001)		(0,0001)		(0,0001)		(0,1430)			

This table reports the results of the VECM-FIGARCH(1,d,1) model for each studied country. *, ** and *** denote statistical significance at respectively 10%, 5% and 1%.

regression equation of CDS spreads (Table 6). We find that the one-period autoregressive term, designed by the coefficient γ_1, significantly impacts current sovereign CDS spreads in almost all the studied countries (Except for Austria and Latvia), while the two-period autoregressive term, represented by γ_2, is significantly different from zero in 62% of the sample countries (The two-period lagged value of CDS Austria insignificant as well, whereas the lagged value of Latvia CDS becomes statistically significant at 1% level). These findings imply a short-run predictability in CDS prices of all studied countries, except Austria. Furthermore, the lagged values of bond yields at the first (second) order, as denoted by γ_1 (γ_2), are statistically significant in 52%(24%) of the cases, which implies that a significant dependence between current CDS spreads and past bond yields exists in some countries, including Austria. Whether based on former realizations of CDS or bond prices, these non-randomness is detected in these countries suggesting a direct evidence of CDS predictability. Therefore, the weak-form market efficiency hypothesis is rejected in the sovereign CDS markets of our studied sample.

Table 6: Estimation of the VECM(2) model for the transformed time series

		VECM(2)											
		Cst(M)		λ		γ_1		γ_2		δ_1		δ_2	
Panel A: Developed countries													
Austria	CDS	0,01844		-0,00189	*	0,01153		0,01250		-0,05401	***	-0,00878	
		(0,0133)		(0,0008)		(0,0189)		(0,0188)		(0,0148)		(0,0148)	
	Bond	-0,05661	***	-0,00239	*	-0,01246		0,00667		0,02756		0,01241	
		(0,0170)		(0,0010)		(0,0189)		(0,0189)		(0,0241)		(0,0240)	
Belgium	CDS	0,01147		-0,00066	*	0,18464	***	0,01723		-0,00451		0,03412	**
		(0,0136)		(0,0003)		(0,0185)		(0,0185)		(0,0164)		(0,0163)	
	Bond	-0,04703	***	-0,00056	*	-0,09803	***	0,01146		0,09674	***	0,01934	
		(0,0154)		(0,0003)		(0,0185)		(0,0184)		(0,0208)		(0,0209)	
Denmark	CDS	-0,00617		-0,00106	*	0,16685	***	0,02496		-0,05629	***	-0,05124	***
		(0,0120)		(0,0005)		(0,0185)		(0,0184)		(0,0167)		(0,0168)	
	Bond	-0,02184		-0,00001		-0,22211	***	-0,06050	***	-0,03132		0,01096	
		(0,0133)		(0,0005)		(0,0185)		(0,0185)		(0,0204)		(0,0204)	
Finland	CDS	0,03678	***	-0,00149	***	0,06951	***	0,07099	***	-0,01609		-0,00274	
		(0,0138)		(0,0005)		(0,0184)		(0,0184)		(0,0194)		(0,0194)	
	Bond	-0,02090		-0,00069		-0,23443	***	-0,04543	*	-0,02195		0,03535	**
		(0,0131)		(0,0005)		(0,0185)		(0,0185)		(0,0175)		(0,0175)	
France	CDS	0,02315	*	-0,00088	*	0,19616	***	0,06023	***	-0,04784	***	0,03651	**
		(0,0133)		(0,0005)		(0,0184)		(0,0184)		(0,0149)		(0,0149)	
	Bond	-0,04713	***	-0,00103	*	0,00705		-0,02528		0,00522		-0,01060	
		(0,0165)		(0,0006)		(0,0185)		(0,0185)		(0,0228)		(0,0228)	
Germany	CDS	0,00791		-0,00093	*	0,10675	***	0,05165	***	-0,04988	***	-0,00188	
		(0,0127)		(0,0004)		(0,0185)		(0,0184)		(0,0182)		(0,0182)	
	Bond	-0,02140	*	-0,00007		-0,22913	***	-0,08028	***	-0,03504	*	-0,00528	
Japan		(0,0129)		(0,0004)		(0,0185)		(0,0185)		(0,0188)		(0,0187)	
Ireland	CDS	0,08732	***	-		1,13807	***	-0,13887	***	0,09155	***	-0,09099	***
		(0,0294)				(0,0189)		(0,0189)		(0,0177)		(0,0177)	
	Bond	-0,01760		-		0,93369	***	0,06639	***	0,16257	***	-0,16269	***
		(0,0316)				(0,0190)		(0,0190)		(0,0203)		(0,0203)	
Italy	CDS	0,10302	***	-0,00085	***	0,15543	***	-0,00312		0,00106		-0,00523	
		(0,0158)		(0,0002)		(0,0186)		(0,0186)		(0,0228)		(0,0228)	
	Bond	-0,01309		-0,00021		-0,26703	***	-0,10280	***	0,04807	***	-0,01069	
		(0,0128)		(0,0002)		(0,0185)		(0,0185)		(0,0151)		(0,0151)	
Japan	CDS	0,01731		-0,00118	*	0,05575	***	0,06345	***	-0,00243		0,01507	
		(0,0151)		(0,0005)		(0,0185)		(0,0185)		(0,0242)		(0,0242)	
	Bond	-0,01768		-0,00046		-0,22114	***	-0,05700	***	-0,01879		-0,00511	
		(0,0116)		(0,0004)		(0,0185)		(0,0185)		(0,0141)		(0,0141)	
Latvia	CDS	0,00426		-0,00131	*	0,00156		0,15906	***	0,04553	*	0,02671	
		(0,0102)		(0,0005)		(0,0183)		(0,0183)		(0,0232)		(0,0233)	
	Bond	-0,03567	***	-0,00034		-0,16054	***	-0,06624	***	-0,01661		-0,01045	
		(0,0081)		(0,0004)		(0,0185)		(0,0186)		(0,0145)		(0,0145)	
Lithuania	CDS	0,00236		-0,00084		0,10602	***	0,11277	***	-0,00883		0,00834	
		(0,0090)		(0,0009)		(0,0184)		(0,0184)		(0,0142)		(0,0142)	
	Bond	-0,00734		0,00370	***	-0,30032	***	-0,09937	***	-0,02391		-0,01519	
		(0,0117)		(0,0012)		(0,0184)		(0,0184)		(0,0238)		(0,0238)	
Netherlands	CDS	0,01102		-0,00149	*	0,15226	***	0,02475		-0,03567	*	-0,00076	
		(0,0131)		(0,0007)		(0,0185)		(0,0185)		(0,0195)		(0,0195)	
	Bond	-0,02059	*	-0,00037		-0,23589	***	-0,06423	***	-0,01861		-0,00797	
		(0,0124)		(0,0006)		(0,0185)		(0,0185)		(0,0175)		(0,0175)	
Norway	CDS	-0,04335	***	-0,00095		0,06429	***	0,02598		-0,00950		-0,00266	
		(0,0079)		(0,0007)		(0,0185)		(0,0185)		(0,0106)		(0,0105)	
	Bond	-0,02044		0,00631	***	-0,19415	***	-0,06451	***	-0,06389	*	-0,05145	
		(0,0139)		(0,0012)		(0,0185)		(0,0184)		(0,0325)		(0,0325)	
Portugal	CDS	0,09666	***	-0,00029	***	0,18304	***	0,02889		0,09451	***	-0,04032	*
		(0,0145)		(0,0001)		(0,0191)		(0,0190)		(0,0194)		(0,0195)	
	Bond	-0,00933		-0,00006		0,05103	***	0,00164		0,07792	***	-0,01353	
		(0,0142)		(0,0001)		(0,0191)		(0,0192)		(0,0188)		(0,0187)	
Slovakia	CDS	0,01292		-0,00085	*	0,08461	***	0,05586	***	0,01586		-0,00890	
		(0,0115)		(0,0004)		(0,0185)		(0,0185)		(0,0176)		(0,0176)	
	Bond	-0,03540	***	0,00002		-0,32445	***	-0,12066	***	0,02342		0,00853	
		(0,0120)		(0,0004)		(0,0184)		(0,0184)		(0,0192)		(0,0192)	
Slovenia	CDS	0,99973	***	-		1,15128	***	-0,15067	***	0,04188		-0,03799	
		(0,9997)				(0,0183)		(0,0183)		(0,0357)		(0,0357)	
	Bond	0,99818	***	-		0,71141	***	0,28681	***	0,03007	***	-0,03040	***
		(0,9982)				(0,0177)		(0,0177)		(0,0091)		(0,0091)	
Spain	CDS	0,06493	***	-0,00075	***	0,14065	***	0,01597		-0,00613		-0,00727	
		(0,0163)		(0,0002)		(0,0186)		(0,0187)		(0,0248)		(0,0248)	
	Bond	-0,01865		0,00000		-0,25869	***	-0,08985	***	0,05226	***	0,00546	
		(0,0122)		(0,0002)		(0,0186)		(0,0186)		(0,0140)		(0,0140)	
Sweden	CDS	0,02242	*	-0,00107	***	0,10317	***	0,06259	***	-0,03521	*	-0,02030	
		(0,0119)		(0,0003)		(0,0184)		(0,0184)		(0,0180)		(0,0180)	

Table 6: Estimation of the VECM(2) model for the transformed time series (*Continued*)

		VECM(2)											
		Cst(M)		λ		γ_1		γ_2		δ_1		δ_2	
	Bond	-0,01982		-0,00017		-0,25198	***	-0,06017	***	-0,03424	*	-0,01623	
		(0,0122)		(0,0004)		(0,0185)		(0,0185)		(0,0189)		(0,0189)	
UK	CDS	0,01348		-0,00107	***	0,15833	***	0,04593	**	-0,04814	*	0,00518	
		(0,0137)		(0,0004)		(0,0185)		(0,0185)		(0,0202)		(0,0202)	
	Bond	-0,01727		0,00009		-0,21803	***	-0,06988	***	-0,05041	***	-0,00634	
		(0,0126)		(0,0003)		(0,0185)		(0,0185)		(0,0169)		(0,0169)	
USA	CDS	-0,00350		-0,00440	*	-0,23041	***	-0,02717		0,00255		-0,01917	
		(0,0107)		(0,0018)		(0,0185)		(0,0185)		(0,0170)		(0,0170)	
	Bond	-0,01502		0,00161		-0,26591	***	-0,08238	***	-0,03592	*	-0,02805	
		(0,0116)		(0,0019)		(0,0184)		(0,0184)		(0,0201)		(0,0201)	
Panel B: Newly Industrialized countries													
Brazil	CDS	0,03334	**	-0,00147		0,09586	***	0,00586		0,05387	**	0,03251	
		(0,0146)		(0,0009)		(0,0191)		(0,0190)		(0,0218)		(0,0218)	
	Bond	0,02653	**	0,00139	*	-0,14160	***	-0,01601		0,06930	***	0,01357	
		(0,0127)		(0,0008)		(0,0191)		(0,0191)		(0,0167)		(0,0166)	
China	CDS	0,05476	***	-0,00033		0,03587	*	0,09022	***	-0,00374		0,01668	
		(0,0123)		(0,0003)		(0,0184)		(0,0184)		(0,0160)		(0,0159)	
	Bond	0,01706		0,00092	***	-0,13934	***	-0,07111	***	-0,03902	*	-0,01460	
		(0,0143)		(0,0004)		(0,0185)		(0,0184)		(0,0213)		(0,0213)	
Mexico	CDS	0,99468	***	-		1,11019	***	-0,11028	***	0,07209	***	-0,07255	***
		(0,9947)				(0,0185)		(0,0185)		(0,0211)		(0,0211)	
	Bond	0,99924	***	-		1,02762	***	-0,02806		0,02824	*	-0,02845	*
		(0,9992)				(0,0187)		(0,0187)		(0,0163)		(0,0163)	
Philippines	CDS	-0,12461	***	0,00006		0,06525	***	0,02365		-0,06389	***	0,01379	
		(0,0136)		(0,0001)		(0,0185)		(0,0186)		(0,0196)		(0,0196)	
	Bond	-0,03545	***	0,00042	***	-0,15396	***	0,05181	***	0,07965	***	0,01561	
		(0,0129)		(0,0001)		(0,0185)		(0,0185)		(0,0175)		(0,0176)	
Thailand	CDS	0,2668	**	-		1,087077	***	-0,0902	***	0,00234		-0,00048	
		(0,1219)				(0,0184)		(0,0184)		(0,0188)		(0,0188)	
	Bond	0,1012		-		1,015255	***	-0,0146		0,01248		-0,01437	
		(0,1201)				(0,0185)		(0,0185)		(0,0181)		(0,0181)	
Turkey	CDS	0,02338	*	-0,00248	*	0,15177	***	-0,00567		0,05174	**	0,02405	
		(0,0142)		(0,0010)		(0,0186)		(0,0183)		(0,0234)		(0,0233)	
	Bond	-0,01486		-0,00176	*	-0,32566	***	-0,08959	***	0,06598	***	0,01930	
		(0,0113)		(0,0008)		(0,0186)		(0,0185)		(0,0148)		(0,0145)	
Panel C: Emerging countries													
Bulgaria	CDS	0,02091	*	-0,00100	*	0,17708	***	0,07387	***	-0,00595		-0,01642	
		(0,0116)		(0,0005)		(0,0184)		(0,0184)		(0,0196)		(0,0196)	
	Bond	-0,02679	*	-0,00077	*	-0,40603	***	-0,21580	***	0,01769		-0,00578	
		(0,0107)		(0,0005)		(0,0181)		(0,0181)		(0,0170)		(0,0169)	
Croatia	CDS	0,04542	***	-0,00038	*	0,15920	***	0,11147	***	-0,00714		-0,00435	
		(0,0142)		(0,0002)		(0,0184)		(0,0184)		(0,0300)		(0,0300)	
	Bond	-0,02107	*	-0,00015		-0,36170	***	-0,11586	***	0,03036	***	0,01094	
		(0,0087)		(0,0001)		(0,0184)		(0,0183)		(0,0112)		(0,0113)	
Czech	CDS	0,01984		-0,00785	***	-0,50708	***	-0,21857	***	0,06894		-0,04298	
		(0,0469)		(0,0029)		(0,0181)		(0,0180)		(0,0606)		(0,0606)	
	Bond	-0,07180	***	-0,00172	*	-0,18678	***	-0,01123		0,01258	**	0,00691	
		(0,0143)		(0,0009)		(0,0185)		(0,0185)		(0,0055)		(0,0055)	
Greece	CDS	0,23069	***	-0,00009	*	0,19289	***	0,13450	***	-0,04113	***	0,02340	*
		(0,0102)		(4,90E-5)		(0,0183)		(0,0183)		(0,0128)		(0,0127)	
	Bond	-0,02340		0,00035	***	-0,21263	***	-0,07824	***	0,03525		0,04990	*
		(0,0148)		(0,0001)		(0,0185)		(0,0185)		(0,0267)		(0,0266)	
Hungary	CDS	0,02208		-0,00109	*	0,16388	***	0,05257	***	0,03216		0,02799	
		(0,0135)		(0,0004)		(0,0185)		(0,0185)		(0,0217)		(0,0217)	
	Bond	-0,01663		-0,00004		-0,25745	***	-0,07581	***	0,05792	***	0,03060	*
		(0,0115)		(0,0004)		(0,0185)		(0,0185)		(0,0158)		(0,0158)	
Indonesia	CDS	-0,06048	***	-0,00202	*	0,09486	***	0,02760		0,04759	**	-0,00600	
		(0,0146)		(0,0009)		(0,0188)		(0,0191)		(0,0210)		(0,0208)	
	Bond	-0,02828	*	0,00079		-0,05999	***	0,01914		0,15989	***	0,07701	***
		(0,0130)		(0,0008)		(0,0188)		(0,0186)		(0,0168)		(0,0171)	
Poland	CDS	0,02882	**	-0,00119	*	0,09776	***	0,04387	**	0,12516	***	0,06215	***
		(0,0126)		(0,0006)		(0,0187)		(0,0185)		(0,0199)		(0,0201)	
	Bond	-0,03086	***	-0,00092		0,02084		0,00045		0,05258	***	-0,02359	
		(0,0118)		(0,0006)		(0,0187)		(0,0188)		(0,0175)		(0,0174)	
Romania	CDS	0,01230		-0,00127	*	0,17604	***	0,07531	***	0,00774		-0,01375	
		(0,0097)		(0,0005)		(0,0184)		(0,0184)		(0,0156)		(0,0156)	
	Bond	-0,02052	*	-0,00025		-0,34011	***	-0,06467	***	0,02022		0,04570	**
		(0,0115)		(0,0006)		(0,0184)		(0,0184)		(0,0218)		(0,0218)	
Russia	CDS	0,99961	***	-		1,07394	***	-0,07368	***	0,08130	***	-0,08151	***
		(0,9996)				(0,0193)		(0,0193)		(0,0184)		(0,0184)	
	Bond	0,99763	***	-		0,88846	***	0,11009	***	0,14091	***	-0,14076	***
		(0,9976)				(0,0193)		(0,0193)		(0,0202)		(0,0202)	
Ukraine	CDS	0,32911	***	-0,00004	***	0,12320	***	0,06489	***	0,03285	**	0,00878	
		(0,0143)		(9,60E-6)		(0,0185)		(0,0184)		(0,0150)		(0,0150)	
	Bond	-0,01866		-0,00004	***	-0,08300	***	-0,06478	***	-0,00145		0,03250	
		(0,0177)		(1,20E-5)		(0,0185)		(0,0185)		(0,0228)		(0,0228)	
Venezuela	CDS	0,98589		-0,00001		0,20342	***	0,02869		-0,04938		-0,02799	
		(2,4423)		(1,74E-5)		(0,0185)		(0,0185)		(0,1016)		(0,0723)	
	Bond	-0,00324		0,00014	***	-0,02448		-0,01215		-0,00032		0,00011	
		(0,6243)		(4,45E-6)		(0,0260)		(0,0185)		(0,0047)		(0,0047)	

This table reports the results of the VECM model applied to the restructured time series for each studied country. The lag order is defined according to the AIC information criterion. For Ireland, Slovenia, Mexico, Thailand and Russia, a VAR(2) is estimated rather than the VECM (No cointegrating relationship is found between CDS spreads and Bond yields of these countries) *, ** and *** denotes statistical significance at respectively 10%, 5% and 1%.

The VECM(2) is once again applied on the reconstructed time series over four subperiods: a pre-crisis period, a first-crisis period (Global Financial Crisis), a second-crisis period (The European Debt Crisis) and a post-crisis period. Results are not reported here but can be provided upon request. Table 7 depicts the Block Exogeneity and Lag Exclusion Wald Tests over the sub-periods. The aim of this test is to analysis the statistically significance of the lagged coefficients coefficients.

Table 7: Block Exogeneity and Lag Exclusion Wald Tests

	Pre-crisis period				1st crisis period				2nd crisis period				Post crisis-period		
	$\gamma_{1,1}$	$\gamma_{1,2}$	δ_1		$\gamma_{1,1}$	$\gamma_{1,2}$	δ_1		$\gamma_{1,1}$	$\gamma_{1,2}$	δ_1		$\gamma_{1,1}$	$\gamma_{1,2}$	δ_1
Panel A: Developed countries															
Austria	48,95	17,78	0,66		1,98	7,86	2,16	*	1,1E-8	0,07	0,01	**	1,2E-4	4,5E-3	0,00
Belgium	66,18	14,19	2,28		5,73	1,17	1,06		7,7E-8	0,31	0,07	*	4,0E-9	0,12	0,16
Denmark	36,20	28,79	98,84	***	96,91	1,94	6,91	**	5,4E-9	0,41	0,21		0,20	1,9E-3	0,01
Finland	3,10	5,35	3,33		14,02	6,00	0,45		2,5E-5	0,50	0,05	*	0,24	0,11	0,30
France	14,06	49,22	5,34	*	15,54	1,60	1,35	*	5,2E-13	0,04	6,0E-4	***	7,3E-9	0,01	0,37
Germany	32,13	17,25	0,10		6,00	9,03	1,08	*	1,3E-6	0,96	0,03	**	1,7E-3	2,1E-3	0,14
Ireland	14,16	2,09	0,02		0,20	10,04	0,78		1,2E-9	0,63	3,0E-3	***	2,3E-12	1,5E-3	1,4E-3
Italy	8,71	1,04	4,44		3,58	8,29	8,19	**	3,0E-11	0,12	0,96	**	3,9E-8	0,76	0,69
Japan	29,78	16,33	1,46		12,06	0,94	0,92		0,05	0,33	0,75		1,9E-4	4,8E-3	0,82
Latvia	1,46	4,05	0,93		11,87	13,93	3,39		0,04	0,03	0,23		0,15	0,09	0,40
Lithuania	1,62	0,63	1,74		9,71	10,45	3,17		0,01	0,20	0,57	*	1,3E-8	0,01	0,79
Netherlands	1,34	1,25	0,86	***	39,36	4,22	0,14	**	8,5E-8	0,41	0,33	**	0,13	0,44	0,69
Norway	2,08	27,74	3,71		53,20	2,21	0,33		5,4E-4	0,84	0,83		0,24	0,36	0,71
Portugal	47,43	15,38	2,34		0,05	9,06	9,08	**	1,9E-9	0,08	0,04	**	0,00	0,26	2,0E-4
Slovakia	13,88	2,22	0,97		13,88	2,22	0,97		2,4E-5	0,33	0,52		0,37	0,09	0,42
Slovenia	0,04	20,26	0,03		7,34	3,37	0,12		4,3E-7	0,17	0,17		2,5E-4	0,03	0,12
Spain	32,13	12,70	1,31		1,66	9,42	8,68	**	9,2E-7	0,59	0,97	**	4,0E-7	0,32	0,44
Sweden	8,35	2,81	2,78		46,02	5,43	5,50	*	4,5E-5	0,45	0,25		0,14	0,06	0,00
UK	2,82	10,07	26,09	***	23,95	1,55	1,59		1,1E-6	0,20	0,23	***	2,0E-4	4,8E-3	0,02
USA	1,15	2,68	2,95	***	27,69	2,42	0,41	*	4,8E-5	0,60	0,94	*	0,00	2,8E-5	0,20
Panel B: Newly Industrialized countries															
Brazil	5,74	3,97	3,43		4,95	2,93	4,26		0,03	0,02	0,08	*	1,8E-5	0,67	0,01
China	25,51	1,52	4,67	*	4,38	7,92	2,35	**	0,97	0,25	0,79		0,18	6,5E-4	0,11
Mexico	1,10	0,70	0,14	***	16,66	2,11	12,18	***	0,01	0,20	0,54		1,3E-5	0,99	0,09
Philippines	3,27	0,23	32,48	***	7,18	3,43	1,98	**	0,85	0,40	0,77	*	2,4E-4	0,56	1,8E-3
Thailand	1,51	0,19	0,05	***	10,02	4,19	1,69		0,52	0,04	0,97		3,8E-3	0,34	1,8E-1
Turkey	20,21	0,70	0,96		11,98	0,42	1,75		2,3E-3	0,85	0,73		1,4E-6	0,69	0,60
Panel C: Emerging countries															
Bulgaria	7,93	4,27	1,01		17,64	10,39	7,02	**	9,1E-8	0,07	0,46	**	2,9E-5	0,15	0,30
Croatia	0,69	5,71	0,26		11,48	5,73	0,53		4,4E-8	0,15	0,54		2,9E-6	5,5E-5	0,62
Czech	0,36	12,40	6,76	**	2,09	1,99	1,36		2,1E-4	0,53	0,89	*	0,00	3,3E-16	0,22
Greece	76,47	1,19	1,31		24,53	9,85	3,47		8,0E-6	0,01	0,56	***	0,00	2,9E-3	0,00
Hungary	11,31	8,12	3,69		4,68	4,60	3,49		9,0E-6	0,42	0,47		1,7E-12	0,13	0,56
Indonesia	0,35	1,51	2,74		1,96	1,61	1,30		0,70	0,25	0,55	**	1,8E-7	0,44	0,08
Poland	20,56	8,84	25,37	***	14,91	9,16	12,21	***	7,1E-6	0,01	0,01	***	3,2E-9	0,17	0,00
Romania	10,43	7,51	0,04		8,90	4,69	0,66		5,5E-7	0,12	0,57	**	6,7E-7	0,24	0,96
Russia	7,25	2,48	3,32		11,46	1,22	5,18	*	2,7E-4	0,34	0,56		4,2E-5	0,47	0,00
Ukraine	4,95	0,61	0,32		21,37	9,13	11,14	***	2,0E-4	0,22	0,01	**	0,01	0,04	0,74
Venezuela	61,96	5,63	1,86		36,12	5,38	4,98	*	5,1E-9	0,84	0,08	*	0,00	0,70	0,00

The Wald Chi-Squared Test is a parametric econometric test that verifies whether the parameters are statistically significant or not, based on a prior model estimation. $\gamma_{1,1}$ and $\gamma_{1,2}$ denote the single parameters of CDS lags values; whilst δ_1 denote the joint/multiple parameters of the Bond lags values. The parameters are tested in order to verify their significant impact on the price formation (Dependent variable: D[CDS]). *, ** and *** denotes statistical significance at respectively 10%, 5% and 1%.

Unlike the VECM(2) results over the full period, Wald tests show that, depending on the period or the country is, CDS spreads can be predicted or not from its past values. Focusing on the pre-crisis period, the coefficient δ_1 is significant in at least 10% level in 27% of the studied period. With the start of turmoil subperiods, the number of significant lagged bond yields coefficients have increased to 48% and 62% respectively during the Global Financial Crisis and the European Debt crisis. Interestingly, Wald tests don't detect any significant coefficient during the post-crisis period.

The results of the short run predictability show that during the period prior to financial tensions, the efficient market hypothesis is rejected in 10 countries (Denmark, France, Netherlands, the UK, the USA, China, Mexico, Philippines, Czech and Poland). The CDS spreads of these countries can thus be predicted not from their previous prices but rather from previous values of their underlying bond yields. Crises have, obviously, changed some markets' behavior in an unexpected way. Interestingly, more CDS markets become inefficient during crises. In fact, whether during the first or the second crisis, the number of markets in which the null hypothesis of randomness is rejected, sharply increases to 18 countries and 23 countries respectively during the Global Financial crisis and the Sovereign Debt crisis. While the markets, broadly efficient, become less sensitive to fundamentals during crisis periods, the opposite reaction is observed during the post-crisis period. After the financial situation being calmed by mid 2012, the null hypothesis is accepted in all the 35 studied markets. That is, the CDS spreads in these countries exhibit an unpredictable behavior accepting, therefore, the random walk and the efficiency hypotheses.

4.3 Discussion

As mentioned before, the study of the Sovereign CDS spreads efficiency is a substantial research issue that concerns both academic and non-academic communities. In fact, a good understanding of the spreads evolution's pattern is crucial to implement an allocative efficiency of credit markets and ensure financial stability of the real sphere.

Preliminary analysis shows that, whatever the degree of indebtedness or credit risk, all the studied countries exhibit inefficient credit markets where historical data significantly impact the direction of future CDS prices fluctuations. This is a particularly important finding given that our sample is composed by economically heterogeneous countries with different liquidity and risk characteristics. Since the random walk hypothesis is globally rejected, it can be understandable that these markets are potentially used to speculation and to achieve excess returns from arbitrage strategies. These irregularities imply, as well, that investors of sovereign CDS markets are obviously interpreting prices evolution in an inefficient way due to the financial sector complexity.

The credit prices predictability of Sovereigns raises a serious concern about their potential exposure to common risk during periods of financial tensions, given that credit derivatives markets can contribute to the increase of financial market instability because of their huge outstanding amounts. Our results, based on a sub-periods analysis, confirm this perception and reveal that the number of inefficient markets increases during the Global Financial Crisis and the Sovereign Debt crisis, and even right after the earliest signs of the crisis (pre-crisis period). This implies that market efficiency is a time-varying phenomenon characterized by a regime switching during tension episodes.

Focusing on the second sub-period representing the Global Financial Crisis, the Wald tests detect several significant relationship between current and past observations in Portugal, Ireland, Estonia and Ukraine. The second crisis is also characterized by a change in the markets' nature with an increase in the number of forecastle prices based on previous behavior of the credit market. In general, we can see that crises negatively impact the randomness of the

CDS markets with a more important decrease in the number of efficient countries compared to the whole studied period, particularly during the second crisis. This suggests that, since the European Debt crisis's intensity and severity are more important than in the Global Financial Crisis, the misperception of financial signals by investors is all the more important that the crisis is harsh.

The random walk analysis gives heterogeneous efficiency status for each studied country and for each sub-period. The overall consistency between our results that a timeless general conclusion should not be given on worldwide CDS markets and that regulators and market participants should perpetually revise their strategies according to whether the market is impeccably efficient or glossy inefficient.

5 Conclusion

The aim of this article is to empirically investigate the weak-form EMH on 37 worldwide sovereign CDS markets, from January 2006 to March 2017. Similar studies are scarce, and for the most part the evidence wholly supports the randomness of CDS regardless of the crises' effects and the country risk profile. Our study tries to fill this gap by focusing on countries with different economic and financial status and conducting the analysis throughout the entire period as well as over sub-periods of strong and weak financial tensions. Our methodological framework is particularly suitable to the context, as it takes into account most of CDS markets' stylized facts. Yet, the examination of CDS spreads' predictability is based on past information available not only on the CDS market but also on the underlying bond market.

Results of the VECM-FIGARCH(1,d,1) framework on the whole period are not in line with common findings and suggest that sovereign CDS markets of developed, newly industrialized and emerging countries are not weak-form efficient. Further, as opposed to previous studies, our sub-periods analysis reveals that the efficiency of the major studied markets is actually impacted by financial tensions even before the crisis-official onset and that the global randomness is observed exclusively during the post-crisis period. Surprisingly current CDS spreads are found to be only predictable from the past bond markets information with no role played by previous CDS fluctuations. Finally, our findings show that the structural breaks in countries' efficiency behavior do not depend on the Sovereign credit risk degree.

In this constantly evolving worldwide credit market, the study of the CDS spreads efficiency needs to keep pace with this change. First, as these markets are becoming less efficient during crisis periods, then we expect a detection of the CDS spreads predictability by practitioners, and upgraded trading strategies, a readapted portfolio management techniques and an implementation of beneficial speculative and arbitrage operations. At the opposite, the validity of the CDS markets efficiency all along the post-crisis period implies less trading profitability and better asset pricing. Second, since the CDS markets have become a financial stability indicator used in the assessment of the real economy suitability and sovereign creditworthiness in particular, CDS spreads should completely and appropriately reflect all the available information. Hence, based on our results, policymakers have to examine the reasons behind market anomalies observed in some countries during pre-crisis period, the Global Financial Crisis and the European Debt Crisis. Authorities should, as well, avoid market inefficiency by ensuring compliance with random walk conditions (costless CDS trading, free and transparent information for all investors ...). Until the CDS market becomes efficient again - due to multiple transactions carried out to profit from irregularities - a regulatory framework should be put in place: National and international regulators can make the market more liquid, through securitization operations (such as Collateralized Debt Obligations and Mortgage-Backed Securities) for example, or increase transaction costs as to be more important than the arbitrage and speculation's expected benefits making trading structure worthless and fruitless.

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Appendices

Appendix 1

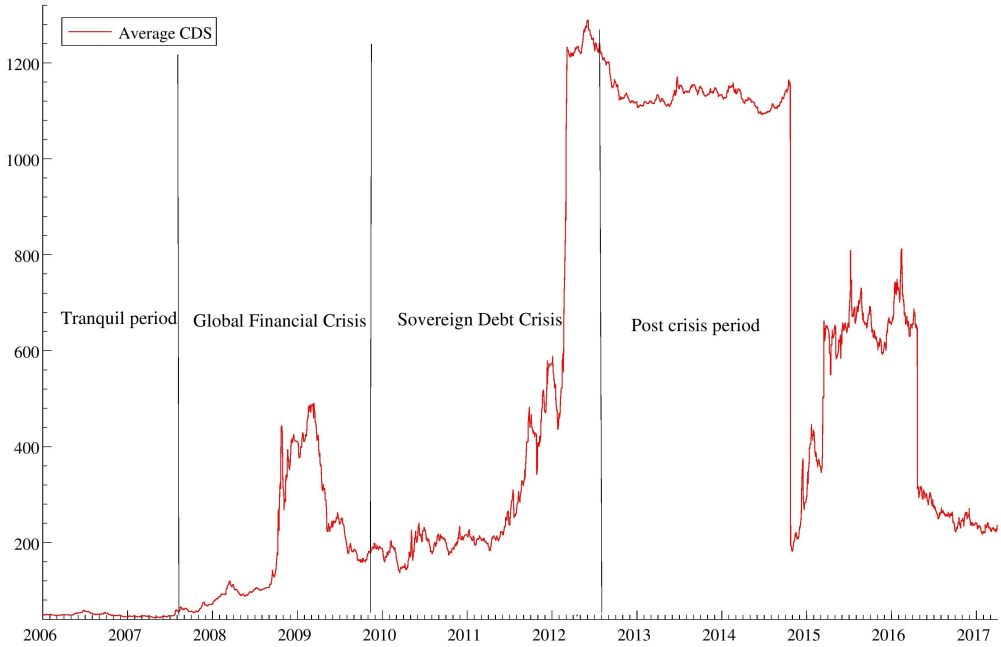

Figure 4: Time-varying average CDS spreads between the studied countries

Table 8: Regime Switching classification

Date	Days	Average probability
Regime 0		
2006-01-02 - 2007-11-21	493	0.999
Total: 493 days (16.79%) with average duration of 493.00 days.		
Regime 1		
2007-11-21 - 2012-05-31	1181	0.998
Total: 1181 days (40.22%) with average duration of 1181.00 days.		
Regime 1		
2012-03-31 - 2017-05-31	1262	0.999
Total: 1262 days (42.98%) with average duration of 1262.00 days.		