The chicken or the egg? A note on the dynamic interrelation between government bond spreads and credit default swaps

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Abstract

This note provides the first empirical assessment of the dynamic interrelation between government bond spreads and their associated credit default swaps (CDS). We use data for the Southern European countries (Greece, Italy, Portugal and Spain) that found themselves with a problematic public sector in the dawn of the recent financial distress. We find that CDS prices Granger-cause government bond spreads after the eruption of the 2007 subprime crisis. Feedback causality is detected during periods of financial and economic turmoil, thereby indicating that high risk aversion tends to perplex the transmission mechanism between CDS prices and government bond spreads.

Keywords: Government bonds; Credit default swaps; Rolling Granger-causality tests
JEL classification: G01; G12; F34

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1. Introduction

The recent financial turmoil has taken a heavy toll on the global economy and has had a devastating effect on public finances. One of the issues that attracted the attention of policy makers and market participants is whether changes in sovereign bond yield differentials cause changes in the associated credit defaults swaps (CDS) or *vice versa*. This note provides first-hand evidence to answer this question.

Our study is primarily motivated by the recent developments in the market for government securities. These securities were until recently considered to be virtually risk-free assets; clearly this is not the case anymore. Evidently, those countries that were already running a high public deficit and/or debt are agonizing to borrow money at low interest rates in the bond markets and to finance their debt without altering its structure. Greece, Portugal, Spain and Italy are probably the best examples of this state of affairs. The difficulties faced by these countries led some (primarily policy makers but also academics) to blame hedge funds for speculative attacks on CDS. On this basis, in the late 2009 and early 2010, individual country governments, the European Commission and the European Central Bank leveled a severe criticism on hedge funds and other financial institutions for speculative attacks on CDS.

The academic debate on this issue is based on economic theories of maturity transformation (Diamond and Dybvig, 1983), herding behavior (Scharfstein and Stein, 1990) and leverage cycles (Geanakoplos, 2009). These general mechanisms are thought to affect the CDS-bond linkages through short-term inefficiencies in the market. For example, any entity (private or public) that faces a maturity mismatch between its expected revenues and debt obligations, anticipates having to roll over its debt periodically. If investors are sufficiently pessimistic about its ability to refinance its debt, the entity (here the government) may face a run on its bonds and/or a buyout of the underlying CDS. Also, as Geanakoplos (2009) notes, naked CDS[1] contracts allow pessimists to leverage, which, in turn, increases the cost of borrowing and leads to further increases in the CDS (and the probability of insolvency). Both the Diamond-Dybvig and the Geneakoplos mechanisms can be exacerbated in periods of stress, when herding behavior of investors is a very common characteristic of the market.

The empirical literature that investigates the CDS-bond nexus has mainly concentrated on the relationship between corporate bonds and their underlying CDS (see Longstaff *et al.*, 2003; Blanco *et al.*, 2005; Forte and Pena, 2009). These studies uniformly agree that corporate CDS prices lead bond prices in the price discovering process. The explanation is that when e.g. risk perceptions concerning corporate bonds rise, investors already holding these bonds want to insure against this adjustment and so demand for CDS increases. Subsequently, this translates into higher interest rates on bond prices for new purchases or new investors on the bonds. Yet, in times of heightened economic and financial uncertainty, short-term inefficiencies of the kind described in the theoretical papers above may prevail, thereby altering the direction of causality (i.e. from bonds to CDS). Thus, it would be interesting to examine whether this is in fact the case at specific periods of severe stress in the markets.

Similar to existing empirical studies, in this note we examine the CDS-bond spreads linkages. Our analysis, however, possesses two main novelties. First, unlike the previous studies on corporate bonds, it uses data on 10-year government yield spreads (over a benchmark bond rate) and their underlying CDS, and focuses on the four Southern European countries (Greece, Italy, Portugal and Spain) that have found

[1] This term refers to the taking out insurance on bonds without actually owing these bonds.

themselves on the cyclone's eye over the last year. Second, it employs rolling Granger causality tests that, to the best of our knowledge, have not been used before to tackle the issue at hand. In particular, rolling analysis allows for the emergence of a clearer picture of the possible dynamic linkages between yield differentials and CDS prices since, although the sample size remains unchanged, the sample period moves ahead by one observation at a time. Therefore, the observed statistics at every stage provide a more thorough reflection of the sequence of events and allow detecting changes in the direction of causality over time.

The main findings are as follows. In line with the corporate finance literature, the results show that CDS Granger-cause bond spreads after the eruption of the subprime crisis in 2007. Nevertheless, feedback causality is also detected at specific points in time that are more or less common in all four countries considered. Notably, there is evidence of feedback causality during relatively short time periods when markets seem to have internalized (i) the costs of the sub-prime crisis in 2008, and (ii) the increases in the public deficits that came as a result of the crisis in the late 2009 and early 2010.

The rest of the note is organized along the following lines. Section 2 describes the data used in this study. Section 3 presents and discusses the empirical results. Section 4 concludes the paper.

2. Data

For the empirical analysis, we use daily data on 10-year government yield spreads (over the German Bund) for four euro area countries, namely Greece, Italy, Portugal and Spain. These spreads are matched with the corresponding 10-year euro-denominated CDS mid bid-ask prices. Data are collected from Bloomberg at the close of the European markets. The sample period for Greece and Italy runs from July 9, 2004 to May 25, 2010 and excludes holidays. Due to data availability and missing observations, the sample period for Spain and Portugal starts somewhat later (January 3, 2005 and July 13, 2006, respectively).

The sample covers the post-euro era, and thus it is free from any exchange rate risk, as all issues are in euros. However, bond spreads are still affected by domestic risk factors (i.e. credit risk and differences in market liquidity) and the concomitant changes in investors' preferences. Decomposing empirically credit and liquidity risk is cumbersome, since only the sum of these two components can be observed. A number of studies (Geyer *et al.*, 2004; Pagano and von Thadden, 2004) indicate that liquidity differences have at best a minor role in the time series behaviour of the sovereign yield spreads in the euro area countries. On the contrary, yield differentials are mainly driven by the credit default component. Therefore, the use of information in the underlying CDS can be viewed as a *high-frequency* measure of the credit default component of the government yield spreads.[2] This allows us to restrict our analysis in the bivariate case (spreads and CDS) and look for their dynamic interrelationship over time.

3. Empirical analysis

Granger causality tests necessitate that all data series involved are stationary; otherwise the inference from the *F*-statistic might be spurious due to non-standard distributions. To test for stationarity, we first perform conventional ADF unit root tests. Since these tests assume no structural break in the series, we also apply the

[2] Although CDS may also be affected by other factors (such as liquidity), they are viewed as the best measure of credit risk available at high frequency (Longstaff *et al.*, 2005).

Zivot-Andrews (1992) sequential test procedure for unit roots in which the breakpoint is estimated endogenously. The test results (not reported here but available from the authors on request) indicate that all series can be described as *I(1)* processes. Furthermore, the breakpoints, as identified by the Zivot-Andrews test, are statistically significant and vary across countries and estimated models.

Since all variables are *I(1)*, we also test for bilateral cointegration between government bond yield spreads and their corresponding CDS prices. Table 1 – Panel A reports the results of the cointegration tests using the Johansen (1988, 1991) procedure. The test results indicate the presence of a long-run relationship only in the case of Spanish spreads and their associated CDS prices. In all other instances, the maximum eigenvalue and trace test statistics are well below their 5% critical value. However, these tests do not account for endogenously determined structural changes. Therefore, we also use the Gregory and Hansen (1996) test for cointegration with a one shift in the cointegrating vector at some unknown date. These are residual-based tests for the null of no cointegration against three models of a regime shift, depending on whether the shift affects the intercept or the slope and whether a trend is included in the cointegrating regression. To test for cointegration with a structural change, Gregory and Hansen (1996) propose the use of three tests, which are modifications of the test statistics Z_a , Z_t (suggested by Phillips, 1987) and *ADF*. For brevity, we only report the results from the level shift model (model 2 in Gregory and Hansen's jargon). The test results are given in Table 1 – Panel B and almost uniformly reject the null of no cointegration, thereby suggesting the presence of a long-run relationship between government bond spreads and CDS prices.[3]

[3] Model 3 (level shift with trend) and Model 4 (regime shift) yield qualitatively similar results (available from the authors upon request).

In order to complete our preliminary analysis, Table 2 reports the results of standard Granger causality tests over the full sample period. These tests are conducted within a Vector Error Correction Model (VECM) with one cointegrating vector and no structural breaks. We find that, with the exception of Italy, spreads and CDS Granger-cause each other.[4] For Italy, the results provide evidence of unidirectional causality from spreads to CDS.

However, these findings are only indicative. The evidence reported in Table 1 indicates the presence of multiple breakpoints, and thus the possibility of time-varying causality between the corresponding markets. This substantiates the use of rolling Granger causality tests, which explicitly allow for changes in the bilateral interrelationship. Therefore, we perform a series of rolling Granger regressions in first difference form with the inclusion of an error correction term to account for the presence of cointegration between CDS and bond spreads. The corresponding *F*-statistics are calculated for a rolling 250-observations (approximately one calendar year) time window, by adding one observation to the end and removing the beginning observation. That is, starting with observations 1 to 250, the first *F*-statistic is calculated. Then, we calculate the *F*-statistics for observations 2 – 251, 3 – 252, etc. The sequences of these statistics (reported on the last day of the rolling sample period from which they are derived) are scaled by their 5% critical value. If the value of the scaled test statistic is above one, the null hypothesis of no Granger causality can be rejected at the 5% level for the specified sub-sample period. The plots of these rolling *F*-statistics are presented in Figures 1 to 4.

Evidently, for all four countries, CDS Granger-cause spreads from 2007 onwards (see top graphs in all four figures). Quite interestingly, for those countries

[4] This finding is in line with previous evidence on corporate bonds (see e.g. Zhu, 2006).

that data are available (i.e. Greece, Spain and Italy), we find no evidence for such causality prior to 2007. These findings are noteworthy, as they show that causality running from CDS to spreads works as a leading indicator of market anxiety. Therefore, when anxiety is built in the financial markets, government bonds are no longer identified as risk-free assets, their underlying CDS rise and this increase is transmitted to the bond spreads. In this fashion, the market for government securities works identically to the market for corporate securities (see e.g. Longstaff *et al.*, 2003; Blanco *et al.*, 2005; Forte and Pena, 2009).

Nevertheless, this transmission mechanism from CDS to bond spreads is less than clear cut. The findings of reverse causality from spreads to CDS (indicating bi-directional causality) at specific points in time are in our view even more interesting. In all countries considered, we identify an initial period where spreads also Granger-cause CDS. The timing, duration and magnitude of this causality somewhat differ among countries. For example, Greek and Portuguese spreads seem to Granger cause CDS for almost a full calendar year (2008:01 – 2009:1 and 2007:07 – 2008:07, respectively), whereas in the cases of Spain and Italy the same causality holds for a much shorter period of time (2007:12-2008:01 and 2007:07 – 2007:09, respectively). However, a common characteristic among the findings for all countries is that these periods practically coincide with the aftermath of the subprime mortgage crisis in the USA and the associated increased volatility in the stock markets.[5] Next, towards the end of 2008, early expectations were suggesting an exit from the crisis and conditions on government bond markets eased considerably. At this period, we observe that

[5] These findings are in line with the literature that shows that stock market fluctuations play an important role in determining the movements in the corporate bond and CDS prices (e.g. Forte and Pena, 2009).

causality from bond spreads to the underlying CDS diminishes to non-significant levels. However, government bond spreads in Greece, Portugal, and Spain (and to a lesser extent in Italy) started rising again sharply owing to fears concerning the public finances of these countries. Thus, the 2007 financial crisis was followed by a public debt crisis in the late 2009 - early 2010, during which spreads once again clearly Granger cause CDS.[6]

We contend that these findings are primarily consistent with herding behavior of the large players of the market, as formed by rational expectations. In times of heightened financial and economic uncertainty, investors typically have a higher preference for less risky and more liquid securities. In principle, this should benefit all government bonds as these are typically regarded as less risky than other asset classes such as stocks and corporate bonds. In the dawn of the debt crisis, however, Southern European government bonds became risky, illiquid and their spreads to the German Bund (the safest haven in the Eurozone) skyrocketed. Therefore, in times of high risk aversion, the *flight-to-safety* to the German government bond market becomes more pronounced, thereby disrupting the transmission mechanism from CDS to bond spreads. In other words, under stressful conditions CDS lose their leading role in the price discovery process. Last, but not least, the finding of bi-directional causality during the financial and debt crises mitigates the common conception of speculative attacks on countries' default. If that was the case, then we should have observed only unidirectional causality from CDS to bond spreads. Clearly more analysis is needed

[6] In the case of Spain, we also observe a third period (late 2008 – early 2009) where spreads Granger causes CDS. This may be associated with the significant and ongoing solvency problems of the Spanish banks.

on that front, involving the separation of herding behavior from speculative attacks and requiring data on the extent of naked CDS trading.

4. Concluding remarks

This paper examines for the first time the dynamic interrelation between government bond spreads and their underlying CDS prices. Using data on four Southern European countries and performing a series of rolling Granger-causality tests, we show that over the last five years CDS almost uniformly Granger-cause spreads. Feedback causality is, however, detected during times of intense financial and economic turbulences. This may indicate that high risk aversion tends to perplex the transmission mechanism between bond spreads and CDS prices.

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Table 1. Cointegration test results: Full sample period

Panel A: The Johansen procedure

		Max.eigenvalue		Trace statistic	
Country	Sample period	*r=0*	*r=1*	*r=0*	*r≤1*
Greece	09.07.04 - 25.05.10	15.75	2.64	18.39	2.64
Portugal	13.07.06 - 25.05.10	12.47	1.77	14.24	1.77
Spain	03.01.05 - 25.05.10	39.95*	4.48	44.43*	4.48
Italy	09.07.04 - 25.05.10	11.21	3.44	14.65	3.44

Panel B: Gregory & Hansen procedure

Country	Test statistic	A	Breakpoint
Greece	*ADF**	-3.93	08.11.2006
	Z_a^*	-62.87*	12.27.2006
	Z_t^*	-7.85*	02.20.2007
Portugal	*ADF**	-4.47	11.08.2007
	Z_a^*	-74.36*	01.02.2008
	Z_t^*	-7.02*	01.02.2008
Spain	*ADF**	-5.75*	07.30.2009
	Z_a^*	-154.34*	05.13.2009
	Z_t^*	-11.46*	05.13.2009
Italy	*ADF**	-5.80*	03.02.2006
	Z_a^*	-103.12*	02.24.2006
	Z_t^*	-9.23*	05.02.2006

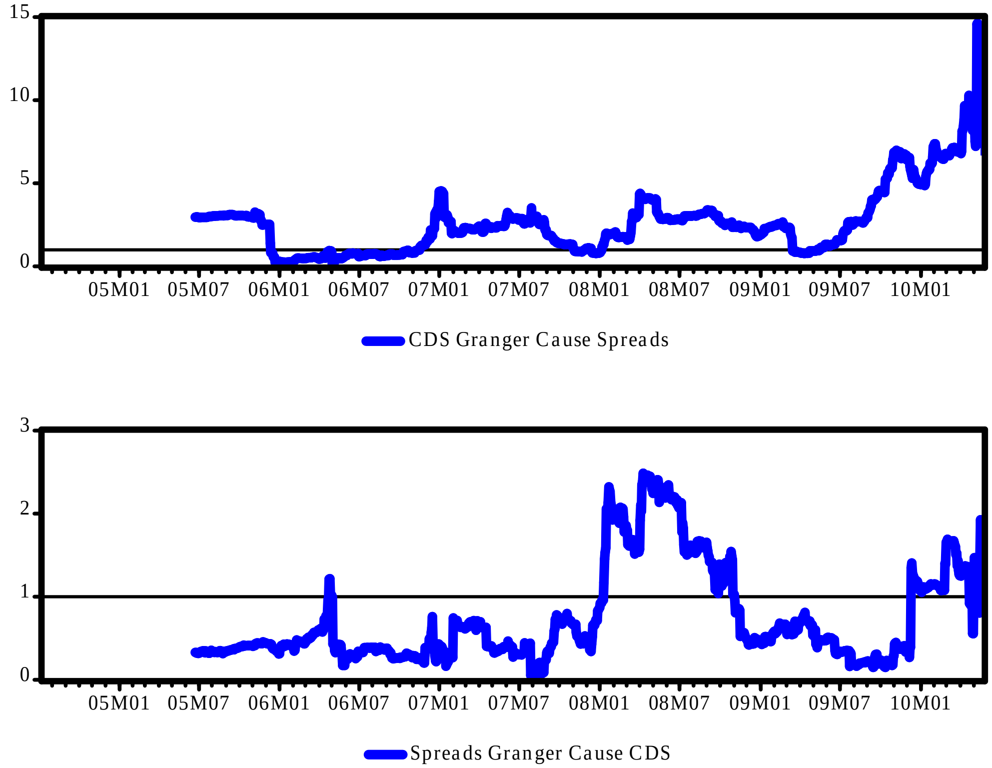
Notes: The 5% critical values for the trace test (for *r=0* and *r≤1*) are 20.26 and 9.16, respectively. The corresponding critical values for the maximal eigenvalue test (for *r=0* and *r=1*) are 15.89 and 9.16. Critical values are provided by MacKinnon *et al*. (1999). Both tests assume an intercept (but no trend) in the cointegrating equation and no intercept in the VAR. The optimal lag length of the VAR is chosen on the basis of Schwarz Information Criterion (SIC). The 5% critical values for *ADF**, Z_a^* and Z_t^* are -4.61, -40.48 and -4.61, respectively (see Table 1 in Gregory and Hansen (1996)). The breakpoints are reported as mm.dd.year. * indicates rejection of the null hypothesis at the 5% level.

Table 2. Tests of Granger causality: Full sample period

Country	Unidirectional CDS → Spreads	Reverse Spreads → CDS	Outcome
Greece	28.73*	19.93*	Feedback
Portugal	67.02*	65.57*	Feedback
Spain	347.23*	246.08*	Feedback
Italy	0.040	14.90*	Spreads → CDS

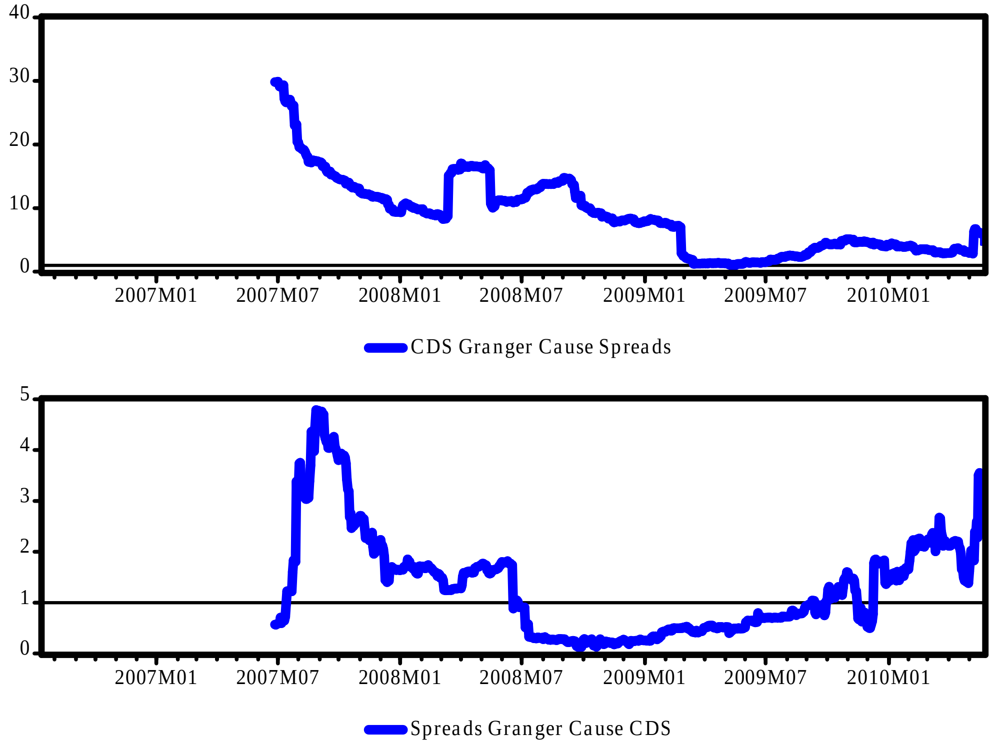
Notes: Granger causality tests are performed within a bivariate (*spreads* and *CDS prices*) VECM. The optimal lag length is chosen on the basis of Schwarz Information Criterion (SIC). Granger causality is examined by testing whether all coefficients of the independent variable are equal to zero using a standard *F*-test. CDS → Spreads stands for *CDS cause Spreads*, whereas Spreads → CDS stands for *Spreads cause CDS*. * indicates rejection of the null hypothesis (no Granger causality) at the 5% level.

Figure 1. Greece: Normalized Rolling Granger Causality Tests



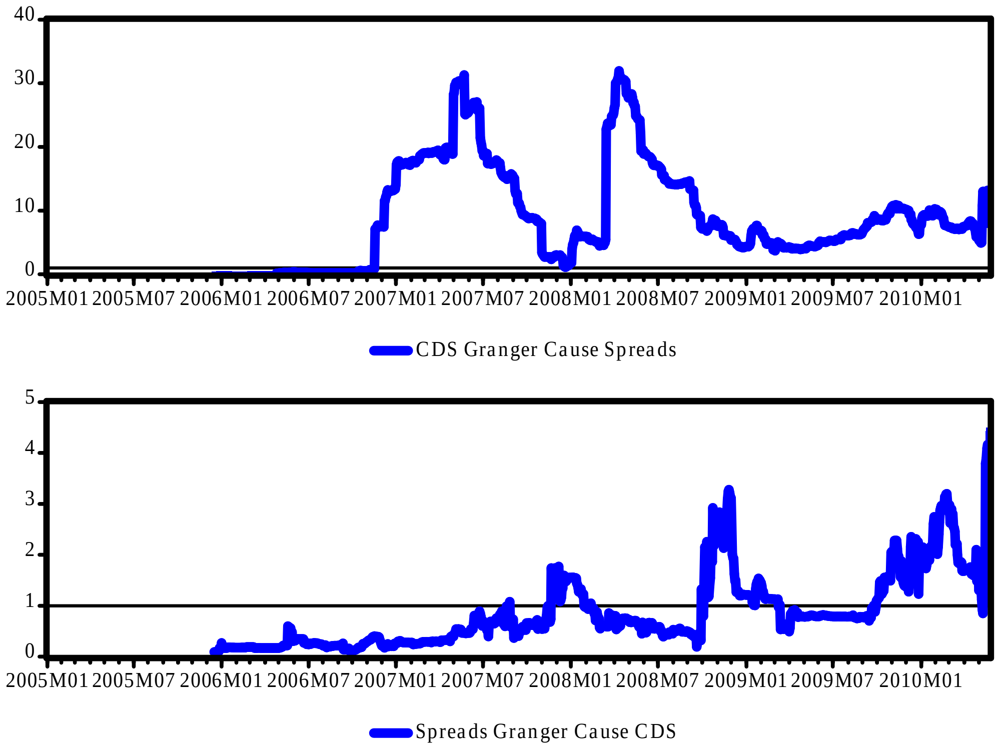
Notes: Rolling Granger causality tests are performed within a bivariate (*spreads* and *CDS prices*) VECM. The optimal lag length of the rolling Granger causality tests is selected on the basis of Schwarz Information Criterion (SIC) for the *full* sample period and is set equal to 5. The vertical axis shows the *F*-statistics scaled by the 5% critical value. Values greater than 1 indicate Granger causality at the 5% significance level.

Figure 2. Portugal: Normalized Rolling Granger Causality Tests



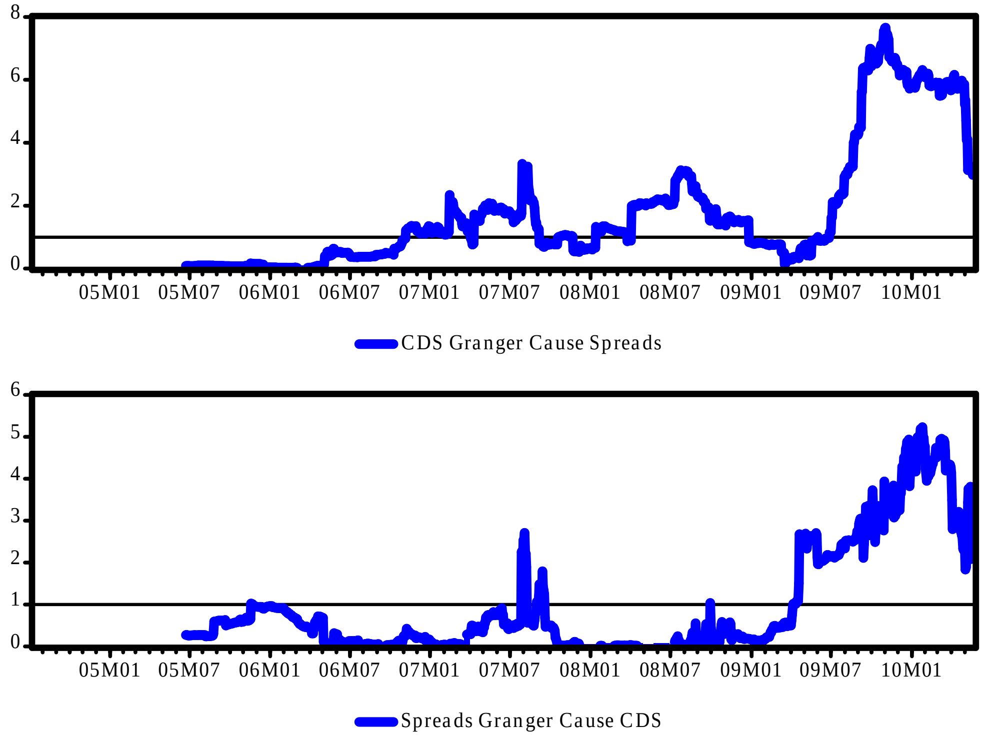
Notes: Rolling Granger causality tests are performed within a bivariate (*spreads* and *CDS prices*) VECM. The optimal lag length of the rolling Granger causality tests is selected on the basis of Schwarz Information Criterion (SIC) for the *full* sample period and is set equal to 5. The vertical axis shows the *F*-statistics scaled by the 5% critical value. Values greater than 1 indicate Granger causality at the 5% significance level.

Figure 3. Spain: Normalized Rolling Granger Causality Tests



Notes: Rolling Granger causality tests are performed within a bivariate (*spreads* and *CDS prices*) VECM. The optimal lag length of the rolling Granger causality tests is selected on the basis of Schwarz Information Criterion (SIC) for the *full* sample period and is set equal to 7. The vertical axis shows the *F*-statistics scaled by the 5% critical value. Values greater than 1 indicate Granger causality at the 5% significance level.

Figure 4. Italy: Normalized Rolling Granger Causality Tests



Notes: Rolling Granger causality tests are performed within a bivariate (*spreads* and *CDS prices*) VECM. The optimal lag length of the rolling Granger causality tests is selected on the basis of Schwarz Information Criterion (SIC) for the *full* sample period and is set equal to 1. The vertical axis shows the *F*-statistics scaled by the 5% critical value. Values greater than 1 indicate Granger causality at the 5% significance level.