REVISTA DE METODOS CUANTITATIVOS PARA LA ECONOMÍA Y LA EMPRESA (30). Páginas 58-78.
Diciembre de 2020. ISSN: 1886-516X. D.L: SE-2927-06.
www.upo.es/revistas/index.php/RevMetCuant/article/view/3872

Sovereign bond spreads and CDS premia in the Eurozone: A causality analysis

TÉLLEZ VALLE, CECILIA
Department of Financial Economics and Accounting, Pablo de Olavide University (Spain)
Correo electrónico: ctelval@upo.es

MARTÍN GARCÍA, MARGARITA
Department of Financial Economics and Accounting, Pablo de Olavide University
Correo electrónico: mmargar3@upo.es

RAMÓN-JERÓNIMO, MARÍA A.
Department of Business Administration and Marketing, Pablo de Olavide University
Correo electrónico: maramjer@upo.es

MARTÍN MARÍN, JOSÉ LUIS
Department of Financial Economics and Accounting, Pablo de Olavide University
Correo electrónico: jlmartin@upo.es

ABSTRACT

This article presents an analysis of the possible relationship between the spreads of sovereign bonds and the premia of credit default swaps (CDS) to determine whether they are useful tools for the measurement of the sovereign risk either separately or by taking into account the joint evolution of their values. The data refer to ten countries in the Eurozone along 2008–2016. By applying the causality Granger test for these variables, after six different ways of proxy, CDS premia are found to be the cause of the risk spreads in certain cases, although a bidirectional relationship is predominant in many other cases. So the CDS market contains clear and highly useful information on the sovereign risk.

Keywords: sovereign risk, credit risk, CDS, causality.
JEL classification: G150; H630.
MSC2010: 62P20; 91B30; 91B84.

Artículo recibido el 26 de febrero de 2019 y aceptado el 17 de septiembre de 2019.

Diferenciales de bonos soberanos y primas de CDS en la zona euro: un análisis de causalidad

RESUMEN

Este artículo presenta un análisis de la posible relación existente entre los diferenciales de los bonos soberanos y las primas de las permutas financieras de riesgo de impago (CDS, Credit Default Swap), con el objeto de determinar si son herramientas útiles para la medida del riesgo soberano de forma separada o teniendo en cuenta ambas variables. Se toman datos de 10 países de la Eurozona para el periodo 2008-2016. Aplicando el test de causalidad de Granger para esas variables, después de utilizar seis formas distintas de comparación de diferenciales, se concluye que la prima del CDS causa el diferencial de riesgo de crédito en suficientes ocasiones, aunque predomina una relación bidireccional. Así que el mercado de CDS contiene información clara y útil para la evolución del riesgo soberano.

Palabras clave: riesgo soberano, riesgo de crédito, CDS, causalidad.
Clasificación JEL: G150; H630.
MSC2010: 62P20; 91B30; 91B84.

1. Introduction.

Our objective in this paper is to estimate the equilibrium relationships that may exist between the spreads of sovereign bonds and the premia of credit default swaps (CDS). Two specific questions are addressed: Do these two parameters converge in spite of the numerous frictions that arise in the market? Which provides the best measure of sovereign risk?

The main aim of this study is to analyse the degree of relationship between the spreads of the public debt and the CDS premia to determine whether they are useful tools for the measurement of sovereign risk either separately or by taking into account the joint evolution of their values. Data from ten European countries has been used as listed in the S&P/ISDA Eurozone Developed Nation Sovereign CDS Index. Of these ten countries, nine are analysed using the bonds and CDS of Germany as a benchmark.

The meaning of the term "sustainability of the sovereign debt of a country" is given from two different points of view. Firstly, from the point of view of the issuer, that is, from a specific public Treasury, this term refers to the fact that the debt service can be met, and the dreaded default can thereby be avoided. The ratio over GDP is taken as a measure of the volume of debt. These ratios are currently very high, such as those of Italy and Portugal, which exceed 100%.

Secondly, what is really important from the investors' point of view is the volatility of returns, especially the possibility of default of the issuer and the sensitivity of the market to the business cycle. Therefore, if there is a CDS market parallel to the sovereign debt market, the investors are able to hedge the risk of default in the payment of interest and of the principal. The latter is particularly interesting when the issuers' credit rating is low, whereby problems of insolvency are latent. Therefore, indirectly, a CDS market can help the sustainability of sovereign debt from the point of view of investors, because it ensures an interest in the corresponding issues. Other contributions on that issue include: Kim, Salem, and Wu (2015), who establish that market participants for sovereign credit protection pay more attention to good news than to bad news in times of financial instability; Zhang and Zhang (2013), whereby evidence is found for the efficiency of the CDS market during the 2008 financial crisis against those who argue that CDS could lead to a financial instability; Blommestein, Eijffinger, and Qian (2016), who study the main drivers of change in the sovereign CDS spreads and how their impact grows with market uncertainty; and Galariotis, Makrichoriti and Spyrou (2016), who show that this uncertainty varies from the European peripheral countries to the core countries.

Many econometric studies have been conducted to determine the equilibrium relationships between the spreads of bonds and CDS premia, by analysing whether or not the frictions in the market prevent their convergence. The majority of these studies are focused on the corporate level, with the aim being to analyse the behaviour of the basis between CDS and their underlying bond yield (see Hull & White 2004; Blanco, Brennan & Marsh 2005). There are other contributions in this area that use Gonzalo and Granger's test (see Gonzalo & Granger, 1995), such as the studies of Zhu (2006) and Forte and Peña (2009). By focusing on the European corporate markets, Alexopoulou, Andersson and Georgescu (2009) reach the conclusion that a relationship exists between these two markets in the long term, while Arce, Mayordomo, and Peña (2011) show persistent deviations in the pre-crisis and post-crisis periods.

Looking in greater depth at the sovereign market, most contributions are related to emerging markets. Bond spreads are found by Ammer and Cai (2011) to be leaders in the price discovery process, although a study by Bowe, Klimaviciene and Taylor (2009) shows country dependence in the leadership role. By taking into account the European markets, Fontana and Scheicher (2010) and Fontana and Sheicher (2016) graphically study the relationship between CDS premia and spreads of sovereign bonds related to the 10-year swap rate for ten countries of the Eurozone from 2006 to 2010. These authors use this benchmark following the contribution of Beber, Brandt and Kavajecz (2009), arguing that interest-rate swaps are commonly seen as the market participants' preferred measure of the risk-free rate. In conclusion, Fontana and Scheicher (2010) find the CDS spread to be situated above the bond spread,

and that, before the beginning of the crisis, bond spreads showed higher volatility. Furthermore, for these researchers, after 2008, the bond market had a predominant role in price discovery in core countries, whereas the CDS market led in the riskiest or most peripheral European countries, contrary to what was found by Delatte, Gex and López-Villavicencio (2012).

Several other contributions are focused on the evidence of contagion between countries, such as Broto and Pérez-Quirós (2015), Gómez-Puig and Sosvilla-Rivero (2014), and Muratori (2015). On the other hand, Ngene, Carley and Hassan (2014) explain how sovereign markets may suffer from structural breaks and from the persistence of volatility in the series of bonds and CDS. Moreover, Arce et al. (2011) and Arce, Mayordomo and Peña (2013), by following Hasbrouck (2016) and Gonzalo and Granger's methodologies (see Gonzalo and Granger, 1995), study whether the markets for five-year sovereign bond spreads and CDS spreads reflect the same information. The same relationship is analysed by Broto and Pérez- Quirós (2011) between CDS and bonds for ten countries, including some of the Eurozone and the US, the UK and Japan. In this paper, the spread of the sovereign bond is measured against the 10-year interest rate of the German bond and the cointegrated markets of Spain, Greece, Ireland, Italy and Portugal are considered. By employing the Granger causality test, Delis and Mylonidis (2011) discover a dynamic interrelation in both directions for CDS and bonds in the period 2004-2010 for Greece, Italy, Portugal and Spain, while Palladini and Portes (2011) find CDS markets to be the leaders in the period 2004-2011 in Austria, Belgium, Ireland, Italy and Portugal, but in Greece, bond spreads were the leaders. Moreover, Martín-García, Téllez-Valle, and Martín-Marín (2014b) study the relationship between the premia of 10-year CDS and bond spreads, calculated as the difference with the 10-year German bond, for a set of countries in the Eurozone, the UK, Japan and Latin America, and they show CDS to be the leading market. For a good approach to the sector of sovereign CDS, readers are referred to the report of the International Monetary Fund (see IMF 2013).

2. Materials and Methods.

In this section, a brief description is provided of the markets involved and of the data used in the study.

Before starting the empirical study, a graphical analysis of the two variables is undertaken with a view to determining whether there is any possible correlation between them. The countries to be considered are: France, Germany, Italy, Spain, Belgium, the Netherlands, Austria, Finland, Ireland and Portugal, as stated in Table 1.

Table 1. S&P/ISDA Eurozone Developed Nation Sovereign CDS Index.

Constituents	Weights (%)	S&P Ratings
France	23	AA
Germany	22	AAA
Italy	22	BBB
Spain	11	BBB
Belgium	7	AA
Netherlands	6	AAA
Austria	4	AA+
Finland	2	AA+
Ireland	2	A+
Portugal	1	BBB-

Source: ISDA and S&P. Weight index data (March 2012), S&P data (January 2018).

The CDS premia are obtained using daily data from January 2008 to September 2016 derived from the Thomson Reuters Datastream database. The maturity terms of these contracts are 10 and five

years. The market for five-year CDS is more active and therefore more liquid and efficient. The data obtained is not continuous: there are certain periods for which there is no information. This discontinuity is a consequence of the lack of transparency of this market, which is not organized or over-the-counter (OTC).

The market of sovereign CDS in the Eurozone has several particular features. First of all, the contracts are mainly denominated in US dollars. At first sight, this may appear surprising, but there is a reason: in the case of default of any given country, the euro could be depreciated and thus it is safer to maintain a position in US dollars. Second, the most liquid segment of the market is related to five-year contracts followed by 10-year contracts, as noted earlier. For this reason, many of the academic studies on sovereign CDS are based on the five-year tender.

A problem that has recently arisen is the ban imposed by the EU on the issue and trading of naked sovereign CDS, that is, when the protection buyer does not own the underlying bond. This ban, which aims to reduce speculation in the market, has been questioned by both practitioners and academics. From Table 2, which shows data for Spain and France, it can clearly be seen that after the EU announcement on banning naked sovereign CDS (October 2011) and putting the ban into effect (November 2012), activity in the market diminished strongly. For example, in the case of Spain, from a weekly notional average of US$1,500 million and 90 trades per day in the second quarter of 2011, negotiations dropped to US$150 million and 10 trades per day in the third quarter of 2014. Thus, lack of liquidity in the market has been one of the effects of the ban on naked CDS, a prohibition also strongly opposed by the IMF. Now, the question is: where did Europe's sovereign CDS trading go? The answer is: to emerging markets (see Ruffoni, 2014).

Table 2. Activity in the sovereign CDS market (2009–2014): Spain and France.

	Spain		France	
Quarters	Average daily notional value (US$ EQ)	Average number trades/day	Average daily notional value (US$ EQ)	Average number trades/day
20/06/2009–19/03/2010	500,000,000	26	200,000,000	7
22/03/2010–20/06/2010	500,000,000	34	275,000,000	13
21/06/2010–19/09/2010	500,000,000	34	275,000,000	13
20/09/2010–19/12/2010	924,066,884	52	533,461,972	33
20/12/2010–20/03/2011	1,000,000,000	70	575,000,000	34
21/03/2011–19/06/2011	1,500,000,000	90	550,000,000	24
20/06/2011–19/09/2011	1,075,000,000	87	1,325,000,000	102
20/09/2011–19/12/2011	950,000,000	77	1,600,000,000	116
20/12/2011–19/03/2012	775,000,000	55	775,000,000	46
20/03/2012–19/06/2012	975,000,000	75	950,000,000	58
20/06/2012–19/09/2012	850,000,000	68	825,000,000	51
20/09/2012–19/12/2012	850,000,000	67	925,000,000	50
20/12/2012–19/03/2013	425,000,000	27	350,000,000	22
20/03/2013–19/06/2013	500,000,000	33	400,000,000	18
20/06/2013–19/09/2013	1,025,000,000	38	875,000,000	23
20/09/2013–19/12/2013	675,000,000	35	575,000,000	20
20/12/2013–19/03/2014	400,000,000	23	250,000,000	10
20/03/2014–19/06/2014	275,000,000	12	850,000,000	15
20/06/2014–21/09/2014	150,000,000	10	150,000,000	7

Note: The transactions covered include only those that suppose market risk transfer activity.
Source: DTCC Trade Information Warehouse.

Three inputs are employed to calculate the spread of the bonds. In relative terms, the difference is taken between the yield of bonds with a term to maturity of 10 and five years and that of the German bond or bund; the premium of the CDS of the German bond is then added, in absolute terms, to the spread of the bond in question, with the aim of approximating the price of a notional risk-free asset. The formula is therefore as follows:

Spread of the bond of country A = (the interest rate of the 10- or 5-year bond of country A, minus the interest rate of the 10- or 5-year German bond), plus the 10- or 5-year German CDS.

This last approach is suggested by Arce et al. (2011) and by Fontana and Sheicher (2016) who call this method of calculus "adjusted basis". Other authors use different alternatives when calculating bond spreads and CDS premia, such as Arce et al. (2011), who employ the differential between the five-year bond yields and the yield of the German bond of the same maturity. Accordingly, they estimate the premia of five-year CDS. In this paper, the swap curve is also used in euros of ten and five years against the six-month LIBOR. This latter solution is that adopted by Fontana and Scheicher (2010), despite being criticized by other authors, such as Arce et al. (2011). In fact, those authors use the spread between the 10-year bond yield and the 10-year swap rate because the swap curve may be a good measure of the risk-free rate in the opinion of many market participants. In contrast, Broto and Pérez-Quirós (2011) make use of the 10-year bonds and the German bond of the same maturity for the calculation of the spreads. As for the CDS, they employ the 10-year contracts but also denominated in US dollars. Accordingly, Martín, Téllez and Martín (2014) assume the same criterion as that of Broto and Pérez- Quirós (2011) when calculating the spreads and use the 10-year term for both CDS (in US dollars) and bonds. The various ways of calculating the bond spreads and the CDS premia make it difficult to compare the results of studies on the risk of sovereign bonds. In short, the following calculations are carried out:

1. Bond spread of the country is calculated versus the yield of the 10-year German bond; 10-year CDS premia of the country in US dollars (relative approach).

2. Bond spread of the country is calculated versus the yield of the 10-year German bond plus the premium of the German 10-year CDS; 10-year CDS premia of the country in US dollars (absolute approach).

3. Bond spread of the country is calculated versus the yield of the 5-year German bond; 5-year CDS premia of the country in US dollars (relative approach).

4. Bond spread of the country is calculated versus the yield of the 5-year German bond plus the premium of the German 5-year CDS; 5-year CDS premia of the country in US dollars (absolute approach).

5. Bond spread of the country is calculated versus the 10-year swap EUR LIBOR; 10-year CDS premia of the country in US dollars.

6. Bond spread of the country is calculated versus the 5-year swap EUR LIBOR; 5-year CDS premia of the country in US dollars.

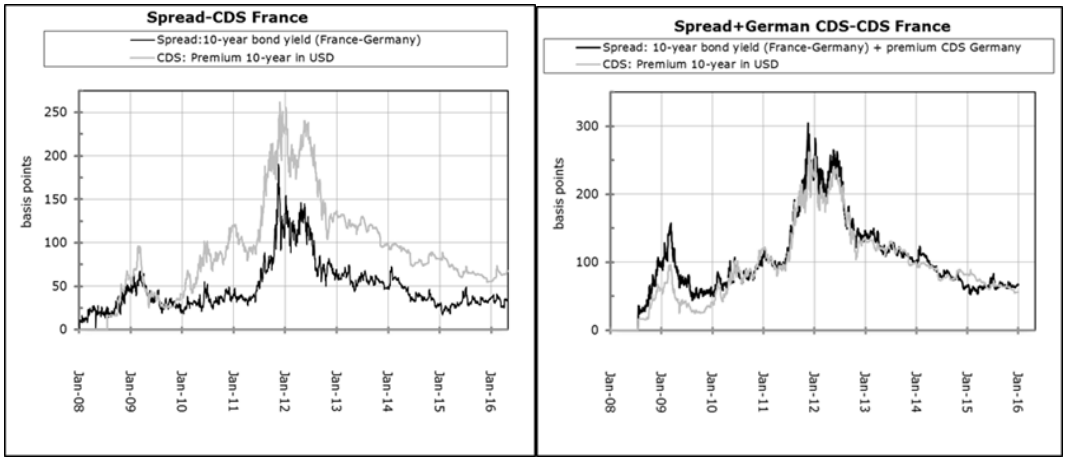
3. Results.

As stated in the previous section, we propose six different ways of calculating sovereign bond spreads. This section is divided into three stages. First both the individual characteristics of each CDS and spread series and their graphical analysis is studied, and then the Granger causality between the two variables can be tested.

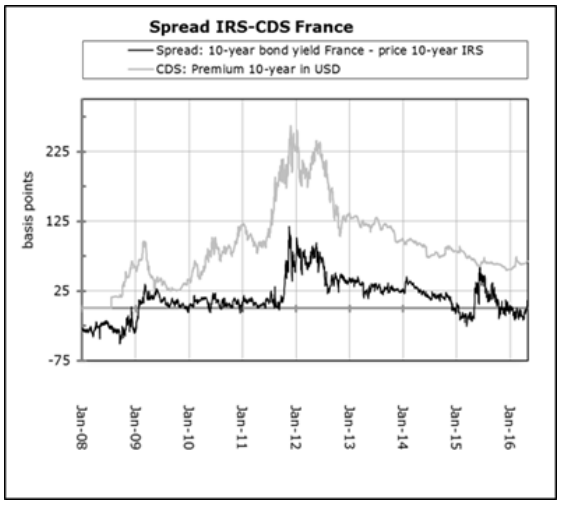
3.1. Graphical analyis.

Figures 1 to 4 show the evolution of the CDS premia and the spreads of the 10- and 5-year bonds of public debt for two of the selected countries, Spain and France, using the three aforementioned approaches, as examples. The degree of positive correlation between these two markets can be deduced from these graphs; that is, the extent to which the two variables grow in the same direction.

Figure 1. CDS premia and Sovereign Bond Spread (France 10-year term): (a) Spread of 10-year bond versus CDS premium 10-year bond in USD; (b) Spread of 10-year bond plus premium CDS German Bond versus CDS premium 10-year bond in USD; (c) Yield of 10-year bond minus price 10-year IRS versus CDS premium 10-year bond in USD.



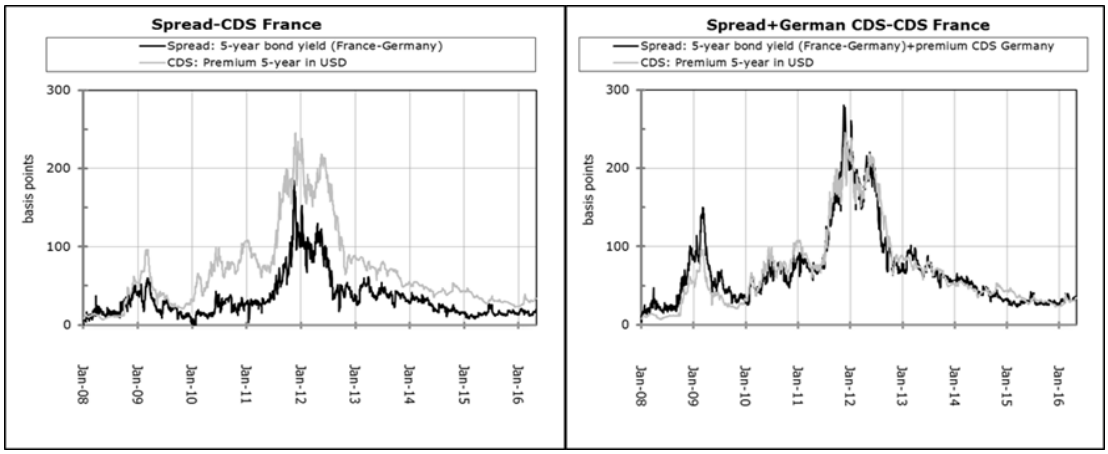
(a) (b)



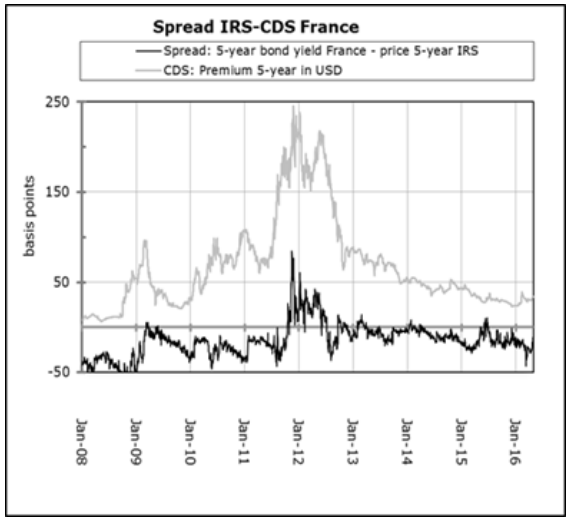
(c)

Source: Own elaboration.

Figure 2. CDS premia and Sovereign Bond Spread (France 5-year term): (a) Spread of 5-year bond versus CDS premium 5-year bond in USD; (b) Spread of 5-year bond plus premium CDS German Bond versus CDS premium 5-year bond in USD; (c) Yield of 5-year bond minus price 5-year IRS versus CDS premium 5-year bond in USD.



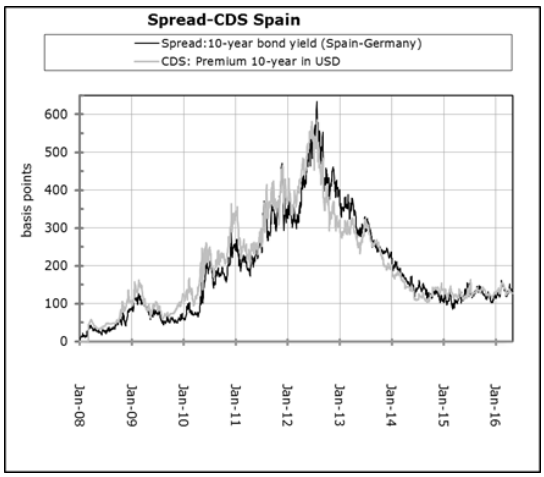
(a) (b)



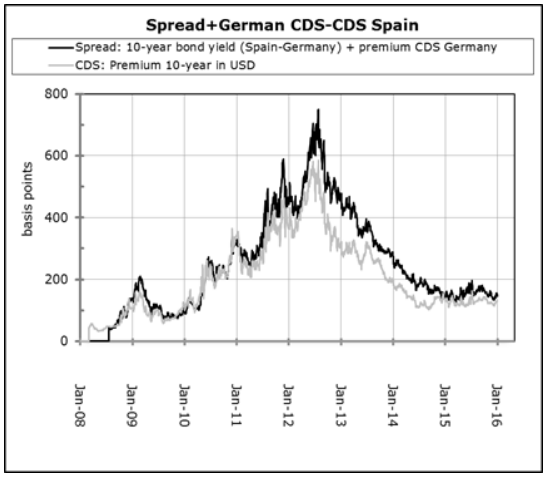
(c)

Source: Own elaboration.

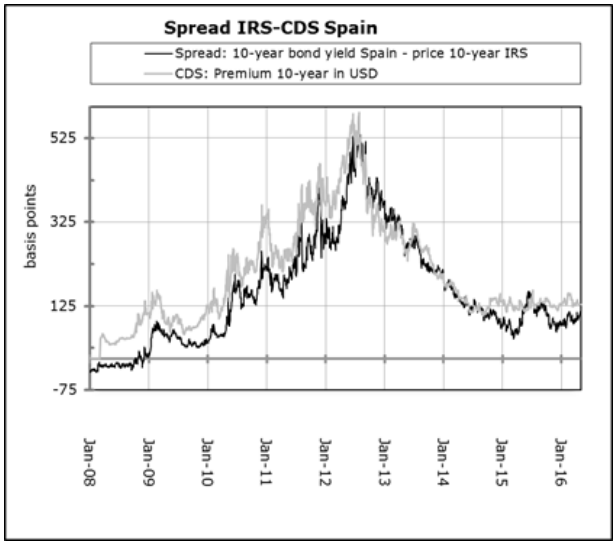
Figure 3. CDS premia and Sovereign Bond Spread (Spain 10-year term): (a) Spread of 10-year bond versus CDS premium 10-year bond in USD; (b) Spread of 10-year bond plus premium CDS German Bond versus CDS premium 10-year bond in USD; (c) Yield of 10-year bond minus price 10-year IRS versus CDS premium 10-year bond in USD.



(a)



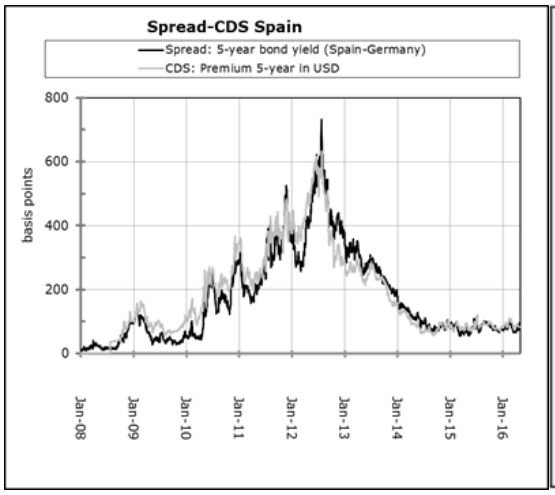
(b)



(c)

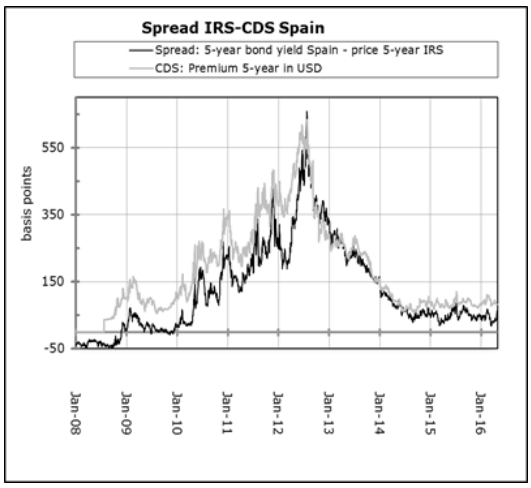
Source: Own elaboration.

Figure 4. CDS premia and Sovereign Bond Spread (Spain 5-year term): (a) Spread of 5-year bond versus CDS premium 5-year bond in USD; (b) Spread of 5-year bond plus premium CDS German Bond versus CDS premium 5-year bond in USD; (c) Yield of 5-year bond minus price 5-year IRS versus CDS premium 5-year bond in USD.



(a)

(b)



(c)

Source: Own elaboration.

It can be seen from these figures that, in general, the CDS premia remain above the bond spreads in the cases of Spain and France. Accordingly, Italy, Belgium, the Netherlands, Austria and Finland, which are not depicted in the figures, also show the same pattern. The exceptions are Ireland and Portugal. Given that the basis is defined as the difference between the CDS premia and the bond spreads, a positive basis is found in the Eurozone between sovereign bonds and CDS. Our results coincide with those of Fontana and Scheicher (2010), Arce et al. (2011), and Broto and Pérez- Quirós (2011).

It can also be observed that the basis changes as the German CDS premia are added to the differences between the yields of the bonds. As a result, the basis is negative for the nine countries analysed, that is, the bond spreads are greater than the CDS premia because the yield differentials are now measured against a truly risk-free asset.

Finally, the figures also show the changes produced when the swap rates are taken as the benchmark for the calculation of the spreads of the bonds. In this case, it can be appreciated that the correlation of these two variables is relatively low.

The spreads or differentials of the bonds with the risk-free assets and the CDS premia are variables that indicate the risk of default of the same debt of reference; therefore, it would be logical to suppose that they must be closely correlated. From the empirical models proposed on this subject, it can be deduced that these indicators are closely linked, especially when their behaviour is analysed over an extended time horizon. The works of Duffie (1999), Hull and White (2004), Blanco et al. (2005), Zhu (2006) and Alexopoulou et al. (2009) point in this direction. It should not be forgotten that, in an environment without frictions, the two measurements should tend to coincide, although the dynamics of the markets demonstrate that such a situation is very far from reality. In this respect, Arce et al. (2011) study the persistent deviations between the CDS premia and the bond spreads for the period 2005-2009.

As already stated, by designating the difference as the base, if the CDS premium is greater than the spread, then the base is considered positive, otherwise it is considered negative. In fact, the basis should tend towards zero but the frictions in the market and the difficulty of arbitrage drive its value away from the point of equilibrium. If the basis is positive, that is, the CDS premium is greater than the bond spread, then it is possible to arbitrage by selling CDS protection and short-selling the bond. This is the case for most sovereigns in the market, although the implementation of such arbitrage can be rather difficult. If the basis is negative, that is, the CDS premium is lower than the bond spread, then it is feasible to arbitrage by buying CDS protection and the bond. This is the case for most corporate bonds ever since the crisis and therefore the arbitrage has now become relatively easy to implement (see Fontana and Scheicher 2010).

3.2. Stationariety of the series.

The stationarity of the series has been checked using the Augmented Dickey-Fuller (ADF-test) and the Philips-Perron (P-P test) as shown in Tables 3 and 4, which refer respectively to the 5-year and 10-year tenders. In each table, four series are considered for every country, namely the premium of the CDS and the three kinds of bases as explained above. As the null hypothesis, both tests consider that the series possess a unit root and hence they are not stationary.

With a few exceptions, such as those in the cases of DE5, FR5, FR6, NL1, NL3, NL5, NL6, AT3, AT5, AT6, FI1, FI3, FI5 and FI6, non-stationarity is the rule. The existence of unit roots in the series is therefore predominant, and hence the use of first differences in the series is deemed necessary for further analysis.

Table 3. Stationarity test for 10-year term.

Country	ADF-test(p-value)	PP-test (p-value)
Germany DEGA$AC	-2.0245(0.5679)	-8.3067(0.6464)
Germany DE5	-3.502(0.0421)*	-163 (0.00)**
France FRGA$AC	-1.5243(0.7797)	-1.8304(0.6501)
France FR1	-2.1409(0.5187)	-2.807(0.2367)
France FR2	-1.747(0.6854)	-2.1842(0.5003)

France FR5	-2.9833(0.1620)	-4.7218(0.01)*
Italy ITGA$AC	-1.8395(0.6463)	-2.1776(0.5031)
Italy IT1	-1.6476(0.7275)	-1.818(0.6554)
Italy IT2	-1.5817(0.7554)	-1.7687(0.6762)
Italy IT5	-1.7359(0.6901)	-1.9354(0.6057)
Spain ESGA$AC	-1.5856(0.7538)	-1.9406(0.6035)
Spain ES1	-1.4054(0.8300)	-1.6745(0.7161)
Spain ES2	-1.3916(0.8359)	-1.6564(0.7238)
Spain ES5	-1.4797 (0.7986)	-1.7665 (0.6772)
Belgium BEGA$AC	-1.8421(0.6452)	-2.0787(0.5450)
Belgium BE1	-1.8851(0.6270)	-2.2286(0.4350)
Belgium BE2	-1.7304(0.6925)	-2.1146(0.5298)
Belgium BE5	-2.4419(0.3912)	-3.107(0.1097)
Netherlands NLGA$AC	-2.2077(0.4904)	-2.4707(0.3790)
Netherlands NL1	-3.2104(0.0861)	-4.2445(0.0100)*
Netherlands NL2	-2.2237(0.4836)	-2.6891(0.2866)
Netherlands NL5	-4.5236(0.0100)*	-9.7484(0.0100)*
Austria ATGA$AC	-3.0214(0.1459)	-3.3414(0.06353)
Austria AT1	-3.1058(0.1102)	-3.523(0.04008)
Austria AT2	-2.3725(0.4206)	-2.6826(0.2893)
Austria AT5	-4.4921(0.0100)*	-6.4304(0.0100)*
Finland FIGA$AC	-2.7081(0.2785)	-2.6405(0.3072)
Finland FI1	-3.3184(0.0674)	-6.263(0.010)*
Finland FI2	-2.3155(0.4448)	-2.8562(0.2158)
Finland FI5	-4.9548(0.010)*	-13.632(0.010)*
Ireland IEGA$AC	-2.0264(0.5671)	-2.4031(0.4077)
Ireland IE1	-1.8656(0.6352)	-2.049(0.5576)
Ireland IE2	-1.8361(0.6477)	-2.0469(0.5585)
Ireland IE5	-2.0008(0.5780)	-2.1793(0.5024)
Portugal PTGA$AC	-1.6437(0.7292)	-1.8492(0.6422)
Portugal PT1	-1.4314(0.8190)	-1.6200(0.7392)
Portugal PT2	-1.4035(0.8309)	-1.589(0.7523)
Portugal PT5	-1.5073(0.7869)	-1.6872(0.7107)

** significant on a 1%; * significant on a 5%

NOTE:

GA$AC: 10-year CDS premia in "the country" in USD. (The symbols are taken from Datastream).

1: Spread of "the country" calculated against the 10-year yield of the German bond.

2: Spread of "the country" calculated against the 10-year yield of the German bond plus the premium of German 10-year CDS in USD.

5: Spread of "the country" calculated against the 10-year swap EUR LIBOR.

Source: Own elaboration.

Table 4. Stationarity test for 5-year term.

Country	ADF-test(p-value)	PP-test (p-value)
Germany DEG5$AC	-2.5271(0.3552)	-11.567(0.4646)
Germany DE6	-2.5579(0.3421)	-19.391(0.08107)
France FRG5$AC	-1.7707(0.6754)	-2.0353 (0.5634)
France FR3	-2.3728(0.4205)	-3.1145 (0.1065)
France FR4	-2.0333(0.5642)	-2.4961(0.3683)
France FR6	-3.6197(0.0308)*	-4.8727(0.0100)
Italy ITG5$AC	-1.8297(0.6504)	-2.0846(0.5425)
Italy IT3	-1.7477(0.6851)	-1.8268(0.6517)
Italy IT4	-1.7223(0.6959)	-1.827(0.6516)
Italy IT6	-1.781(0.6710)	-1.8998(0.6207)
Spain ESG5$AC	-1.6495(0.7267)	-1.9192(0.6125)
Spain ES3	-1.6771(0.7150)	-1.8314(0.6497)
Spain ES4	-1.6884(0.7102)	-1.8584(0.6383)
Spain ES6	-1.6789(0.7143)	-1.8821(0.6282)
Belgium BEG5$AC	-1.9106(0.6162)	-2.0964(0.5375)
Belgium BE3	-2.0079(0.5750)	-2.4611(0.3831)
Belgium BE4	-1.859(0.6380)	-2.2648(0.4662)
Belgium BE6	-2.5586(0.3418)	-3.0809(0.1207)
Netherlands NLG5$AC	-2.5461(0.3471)	-2.7863(0.2454)
Netherlands NL3	-3.6674(0.0261)*	-4.54(0.0100)*
Netherlands NL4	-2.7017(0.2813)	-3.0352(0.1401)
Netherlands NL6	-4.0413(0.0100)*	-4.8549(0.0100)*
Austria ATG5$AC	-3.1178(0.1051)	-3.401(0.0532)
Austria AT3	-3.4571(0.0464)*	-3.8639(0.0157)*
Austria AT4	-2.7659(0.2541)	-3.0393(0.1383)
Austria AT6	-5.2419(0.0100)*	-5.7862(0.0100)*
Finland FIG5$AC	-2.978(0.1643)	-2.8969(0.1986)
Finland FI3	-3.4269(0.0493)*	-4.6443(0.0100)*
Finland FI4	-2.4351(0.3941)	-3.066(0.1270)
Finland FI6	-3.641(0.0287)	-4.5596(0.0100)*
Ireland IEG5$AC	-1.855(0.6397)	-2.0876(0.5413)
Ireland IE3	-2.0448(0.5593)	-2.1693(0.5067)
Ireland IE4	-2.0068(0.5755)	-2.1594(0.5108)
Ireland IE6	-2.1135(0.5302)	-2.2548(0.4705)
Portugal PTG5$AC	-1.553(0.7676)	-1.6461(0.7281)
Portugal PT3	-1.4483(0.8119)	-1.6112(0.7429)
Portugal PT4	-1.4369(0.8167)	-1.6000(0.7476)
Portugal PT6	-1.4909(0.7939)	-1.6637(0.7207)

** significant on a 1%; * significant on a 5%

NOTE: G5$AC: 5 years CDS premia in "the country" in USD. (The symbols are taken from Datastream).

3: Spread of "the country" calculated against the 5-year yield of the German bond.

4: Spread of "the country" calculated against the 5-year yield of the German bond plus the premium of German 10-year CDS in USD.

6: Spread of "the country" calculated against the 5-year swap EUR LIBOR. Source: Own elaboration.

3.3. Causality test.

In order to transform the series into being stationary, the first differences have been calculated. Granger causality tests are then used, based on Chan-Lau and Kim (2004) and Schuster (2005). Mere correlation analysis does not necessarily imply causality in the sense in which this is usually understood. With this analysis, we strive to determine, in various cases, whether it can be stated that *x* statistically provides more information about future values of *y* than do past values of *y* alone. That is, the method to perform Granger causality in bivariate series involves using the Wald test to compare the unrestricted model, in which *y* is explained by the lags of *y* and *x*, and the restricted model, in which *y* is only explained by the lags of *y*. The models are represented as follows:

Restricted model: $y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \beta_k y_{t-k} + \varepsilon$

Unrestricted model: $y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \beta_k y_{t-k} + \alpha_1 x_{t-1} + \ldots + \alpha_k x_{t-k} + \varepsilon$

where *k* is the lag considered. The Wald test (Granger test in R) is calculated to test the following null and alternate hypotheses:

H0: $\alpha_i = 0$ for each i of the element [1,k]

H1: $\alpha_i \neq 0$ for at least one i of the element [1,k]

Cases:

a. Unidirectional causality: spread causes CDS premium.

b. Unidirectional causality: CDS premium causes spread.

c. Bidirectional causality: feedback between spread and CDS premium.

d. Causal independence: Causality between spread and CDS premium does not exist.

From Tables 5 and 6, it can be observed that, although the causal relationship runs in both directions, it is also manifested in favour of the CDS premia in several cases. If the CDS premia precede the risk spreads of bonds, then it is possible to draw the following conclusion: the use of these insurance contracts is a good way of measuring sovereign risk, since if the CDS premia move before the spreads, then it must be because they react more rapidly to changes in the market variables of the country in question.

A closer look at Table 5, referring to the 10-year horizon, provides more information. At the 99% level, case (c) predominates, followed by (b); that is, bidirectional causality is the most frequent output, followed by the case in which the CDS premium causes the spread. Only in two cases does the spread cause CDS premium (a). At the 95% level the results are very similar: bidirectional causality again predominates, and, in second place, the CDS premium causes the spread.

Table 5. Causality test 10-year term (lag1).

Country	Causality (Y<-X)	F- Statistic	Probability	Cases
Germany 5	DER5<-DEGA$AC	3.7794	0.05202	d
	DEGA$AC<-DE5	0.0546	0.8153	
France 1	FR1<- FRGA$AC	17.286	3.345e-05 **	b
	FRGA$AC <- FR1	3.3186	0.06864	
France 2	FR2<- FRGA$AC	27.476	.751e-07 **	c
	FRGA$AC <- FR2	13.197	0.0002872 **	
France 5	FR5<- FRGA$AC	26.575	2.774e-07 **	b
	FRGA$AC <- FR5	1.3064	0.2532	
Italy 1	ITL1<-ITGA$AC	3.0328	0.08175	a
	ITGA$AC<-ITL1	19.263	1.196e-05 **	
Italy 2	ITL2<-ITGA$AC	3.5859	0.05841	a
	ITGA$AC<-ITL2	20.479	6.368e-06 **	
Italy 5	ITL5<-ITGA$AC	58.258	3.474e-14 **	c
	ITGA$AC<-ITL5	17.17	3.554e-05 **	
Spain 1	ESP1<-ESGA$AC	6.5558	0.001451 *	c
	ESGA$AC<-ESP1	855.59	<2.2e-16 **	
Spain 2	ESP2<-ESGA$AC	8.1596	0.0002952 **	c
	ESGA$AC<-ESP2	1081	< 2.2e-16 **	
Spain 5	ESP5<-ESGA$AC	5.6965	0.00341 *	c
	ESGA$AC<-ESP5	473.72	< 2.2e-16 **	
Belgium 1	BEL1<-BEGA$AC	23.139	1.614e-06 **	c
	BEGA$AC<-BEL1	22.905	1.822e-06 **	
Belgium 2	BEL2<-BEGA$AC	20.957	4.974e-06 **	c
	BEGA$AC<-BEL2	32.552	1.326e-08 **	
Belgium 5	BEL5<-BEGA$AC	20.957	4.974e-06 **	c
	BEGA$AC<-BEL5	32.552	1.326e-08 **	
Netherlands 1	NL1<- NLGA$AC	137.86	<2.2e-16 **	b
	NLGA$AC<- NL1	0.0453	0.8314	
Netherlands 2	NL2<- NLGA$AC	737.12	<2.2e-16 **	b
	NLGA$AC<- NL2	0.1729	0.6776	
Netherlands 5	NL5<- NLGA$AC	6.4142	0.01139 *	b
	NLGA$AC<- NL5	0.1797	0.6717	
Austria 1	AUS1<-ATGA$AC	42.078	1.092e-10 **	b
	ATGA$AC<-AUS1	0.1371	0.7112	
Austria 2	AUS2<-ATGA$AC	56.074	1.024e-13 **	c
	ATGA$AC<-AUS2	5.6894	0.01716 *	
Austria 5	AUS5<-ATGA$AC	33.98	6.435e-09 **	b
	ATGA$AC<-AUS5	2.192	0.1389	
Finland 1	FIN1<-FIGA$AC	21.328	4.106e-06 **	b
	FIGA$AC<-FIN1	0.0086	0.926	
Finland 2	FIN2<-FIGA$AC	199.23	<2.2e-16 **	b
	FIGA$AC<-FIN2	2.4935	0.1145	

Finland 5	FIN5<-FIGA$AC	0.8406	0.3593	d
	FIGA$AC<-FIN5	0.3948	0.5299	
Ireland 1	IRL1<-IEGA$AC	28.878	8.57e-08 **	c
	IEGA$AC<-IRL1	41.903	1.192e-10 **	
Ireland 2	IRL2<-IEGA$AC	27.378	1.84e-07 **	c
	IEGA$AC<-IRL2	45.085	2.424e-11 **	
Ireland 5	IRL5<-IEGA$AC	73.719	< 2.2e-16 **	c
	IEGA$AC<-IRL5	36.457	1.842e-09 **	
Portugal 1	POR1<-PTGA$AC	50.154	1.935e-12 **	c
	PTGA$AC<-POR1	32.563	1.318e-08 **	
Portugal 2	POR2<-PTGA$AC	46.544	1.17e-11 **	c
	PTGA$AC<-POR2	34.039	6.246e-09 **	
Portugal 5	POR5<-PTGA$AC	71.349	< 2.2e-16 **	c
	PTGA$AC<-POR5	31.304	2.496e-08 **	

** significant on a 1%; * significant on a 5%

Notes:

1. Spread of "the country" calculated against the 10-year yield of the German bond and 10-year CDS premia in "the country" in USD (relative approach).

2. Spread of "the country" calculated against the 10-year yield of the German bond plus the premium of German 10-year CDS in USD and 10-year CDS premia in "the country" in USD (absolute approach).

5. Spread of "the country" calculated against the 10-year swap EUR LIBOR and 10-year CDS premia in "the country" in USD.

a. Unidirectional causality: spread causes CDS premium.

b. Unidirectional causality: CDS premium causes spread.

c. Bidirectional causality: feedback between spread and CDS premium.

d. Causal independence: causality between spread and CDS premium does not exist.

Source: Own elaboration.

Considering Table 6, referring to the five-year horizon, at the 99% level case (c) predominates, followed by case (b); that is, bidirectional causality is again the most frequent output followed by the case in which the CDS premium causes the spread. However, in the case of Italy and Spain, spread now causes the CDS premium. At the 95% level, the outcomes are similar: bidirectional causality again prevails, and, in second place, the CDS premium causes the spread.

Table 6. Causality test 5-year term (lag1).

Country	Causality (Y<-X)	F- Statistic	Probability	Cases
Germany 6	DE6<-DEG5$AC	5.8017	0.0161*	b
	DEG5AC<-DE6	0.1013	0.7503	
France 3	FR3<-FRG5$AC	15.715	7.613e-05 **	b
	FRG5$AC<-FR3	3.2327	0.07233	
France 4	FR4<-FRG5$AC	33.011	1.051e-08 **	c
	FRG5$AC<-FR4	11.89	0.0005756 **	
France 6	FR6<-FRG5$AC	10.042	0.001553 **	b
	FRG5$AC<-FR6	1.454	0.228	
Italy 3	ITL3<-ITG5$AC	0.1831	0.6688	a
	ITG5$AC<-ITL3	88.832	<2.2e-16 **	

Italy 4	ITL4<-ITG5$AC	0.3107	0.5773	a
	ITG5$AC<-ITL4	99.072	< 2.2e-16 **	
Italy 6	ITL6<-ITG5$AC	0.1158	0.7337	a
	ITG5$AC<-ITL6	99.021	< 2.2e-16 **	
Spain 3	ESP3<-ESG5$AC	3.6058	0.05772	a
	ESG5$AC<-ESP3	1493.1	< 2.2e-16 **	
Spain 4	ESP4<-ESG5$AC	2.5756	0.1087	a
	ESG5$AC<-ESP4	1875.5	< 2.2e-16**	
Spain 6	ESP6<-ESG5$AC	7.3456	0.006778 **	c
	ESG5$AC<-ESP6	1315.1	< 2.2e-16 **	
Belgium 3	BEL3<-BEG5$AC	9.3694	0.002234 **	c
	BEG5$AC<-BEL3	34.634	4.624e-09 **	
Belgium 4	BEL4<-BEG5$AC	9.9599	0.001623 *	c
	BEG5$AC<-BEL4	43.466	5.449e-11 **	
Belgium 6	BEL6<-BEG5$AC	14.669	0.0001319 **	c
	BEG5$AC<-BEL6	42.175	1.04e-10 **	
Netherlands 3	NL3<-NLG5$AC	132.57	< 2.2e-16 **	b
	NLG5$AC<-NL3	0.5472	0.4595	
Netherlands 4	NL4<-NLG5$AC	659.92	< 2.2e-16 **	b
	NLG5$AC<-NL4	0.473	0.4917	
Netherlands 6	NL6<-NLG5$AC	22.542	2.196e-06 **	b
	NLG5$AC<-NL6	0.0259	0.8721	
Austria 3	AUS3<-ATG5$AC	60.99	9.011e-15 **	b
	ATG5$AC<-AUS3	3.0583	0.08047	
Austria 4	AUS4<-ATG5$AC	75.611	< 2.2e-16 **	c
	ATG5$AC<-AUS4	11.295	0.000791 **	
Austria 6	AUS6<-ATG5$AC	50.904	1.332e-12 **	b
	ATG5$AC<-AUS6	1.0463	0.3065	
Finland 3	FIN3<-FIG5$AC	19.297	1.175e-05 **	b
	FIG5$AC<-FIN3	0.0858	0.7696	
Finland 4	FIN4<-FIG5$AC	255.5	< 2.2e-16 **	c
	FIG5$AC<-FIN4	3.9138	0.04802 *	
Finland 6	FIN6<-FIG5$AC	2.677	0.102	d
	FIG5$AC<-FIN6	0.5445	0.4607	
Ireland 3	IRL3<-IEG5$AC	30.55	3.661e-08 **	c
	IEG5$AC<-IRL3	117.19	< 2.2e-16 **	
Ireland 4	IRL4<-IEG5$AC	29.609	5.906e-08 **	c
	IEG5$AC<-IRL4	121.85	< 2.2e-16 **	
Ireland 6	IRL6<-IEG5$AC	37.761	9.55e-10 **	c
	IEG5$AC<-IRL6	115.49	< 2.2e-16 **	
Portugal 3	POR3<-PTG5$AC	96.2	< 2.2e-16 **	c
	PTG5$AC<-POR3	52.459	6.15e-13 **	
Portugal 4	POR4<-PTG5$AC	94.355	< 2.2e-16 **	c
	PTG5$AC<-POR4	54.645	2.079e-13 **	

Portugal 6	POR6<-PTG5$AC	101.11	< 2.2e-16 **	c
	PTG5$AC<-POR6	52.227	6.902e-13 **	

** significant on a 1%; * significant on a 5%

Notes:

3. Spread of "the country" calculated against the 5-year yield of the German bond and 5-year CDS premia in "the country" in USD (relative approach).

4. Spread of "the country" calculated against the 5-year yield of the German bond plus the premium of German 5-year CDS in USD and 5-year CDS premia in "the country" in USD (absolute approach).

6. Spread of "the country" calculated against the 5-year swap EUR LIBOR and 5-year CDS premia in "the country" in USD.

a. Unidirectional causality: spread causes CDS premium.

b. Unidirectional causality: CDS premium causes spread.

c. Bidirectional causality: feedback between spread and CDS premium.

d. Causal independence: causality between spread and CDS premium does not exist.

Source: Own elaboration.

4. Conclusion.

This paper studies the relationship between the differentials of sovereign bond spreads and the market for CDS for ten countries of the Eurozone in the period 2008-2016. It is necessary to determine whether the CDS premia represent an alternative means of estimating changes in sovereign risks and whether these premia might serve to estimate the probability of non-compliance of a country. The main contribution of this paper involves the study of all the scenarios in various terms and benchmarks (relative or absolute approach, and IRS). Do these two parameters converge in spite of the numerous frictions that arise in the market? Which is the best measure of sovereign risk?

Before this current crisis, the risks of default by developed economies could not be measured using the CDS since this market lacked liquidity. After the start of the crisis in public debt in May 2010, there was an increase in both the trading volumes and the premia quoted; the largest increases related to Ireland, Greece and Portugal, whereas those of France and Germany were lower. Therefore, in the sovereign CDS markets, a discrimination of assets was recorded that did not occur before the financial crisis. According to the Bank for International Settlements data, the proportion of the total CDS market accounting for sovereign debt was 13% in 2010, compared to 6% in 2007.

The best measure of sovereign risk seems to be the CDS premia (in 82% of the cases), located as the leader or in a bidirectional causal relationship (50% of the cases) with the spread of the bond. A bidirectional relationship means that the CDS contracts constitute good instruments of measurement of sovereign risk because their prices (i.e. premia) are closely related to the spread of the bonds.

If the CDS premia are related to the spreads, then the conclusion can be drawn that the use of credit contracts constitutes a good way of measuring the sovereign risk since these contracts react when there are changes in the market variables of the country in question. On the other hand, one of the disadvantages of using the CDS premia as a measure of sovereign risk is the relatively small size of this market. During the first years of the crisis, the CDS market grew strongly until mid-2011. However, with the announcement of the EU ban on naked CDS in October 2011 and its coming into effect in November 2012, the liquidity of the market dropped considerably. This new situation may hinder the utility of the sovereign CDS as a tool for measuring the risk and the probability of default of the issues of public debt in the Eurozone.

Contrary to the findings of Fontana and Sheicher (2016), CDS leads in most countries, and not only in the peripheral countries. In the study of Delis and Mylonidis (2011), a Granger bidirectionality is found in peripheral countries; in our study these cases are enhanced to include other countries, such as Finland, Belgium, France and Austria, if the absolute approach is given (spread of "the country"

calculated against the yield of the German bond plus the premium of German CDS in USD and CDS premia in "the country" in USD). Except for the case of Belgium, the other three countries present a change from leadership of CDS to bidirectionality when the absolute approach is taken into consideration (Finland just in the case of 10-year term).

The two principal reasons why CDS should be considered as a measure of sovereign risk in times of crisis are:

Using the differentials of debt, we are not analysing, in absolute terms, the evolution of a particular sovereign issue since this depends on the asset of reference chosen as being risk-free. For this reason, the premium of the CDS for Germany has been added to the spread. The differentials have also been used in a relative way, as is normal practice. Calculating the spreads of the bonds against other benchmarks, such as the swap rates, does not seem to produce better results than using the classic approaches of the yield of the German bond with or without the addition of the premium of the corresponding CDS.

The yields on bonds may offer an inadequate measure of sovereign risk in times of crisis because they may be "contaminated" by effects such as the investors' "flight to quality", which biases the risk premia of the most solvent countries towards lower values.

In our study, there is independence of the variables only in the case of Finland (both terms) and Germany (10-year term) when taking into account IRS as the risk-free rate, as Fontana and Scheicher (2010) propose. The case of the leadership of the spread of the bond is given by Italy (10-year term) or Italy and Spain (5-year term).

In summary, a certain relationship of causality exists between the spreads of sovereign bonds and the premia of CDS; it has also been demonstrated that the CDS premia cause the sovereign risk spreads in some cases. In the light of the data and its interpretation, we can conclude that trading in the CDS market contains clear and useful information on the sovereign risk of a country and CDS trading has become a parallel market with respect to the determination of the prices of public debt bonds. It is given also, the worst results taking into account the Interest Rate Swap. However, as remarked before, the market currently shows rather low activity caused by the EU regulation on naked trading. The almost unanimous opinion in the market and in academia is that this ban should be lifted, because, without a certain degree of speculation, the market could not be sustainable.

References

Alexopoulou, I., Andersson, M., & Georgescu O.M. (2009). *An Empirical Study on the Decoupling Movements between Corporate Bond and CDS Spreads*. Retrieved from: http://hdl.handle.net/10419/153519.

Ammer, J., & Cai, F. (2011). Sovereign CDS and Bond Pricing Dynamics in Emerging Markets: Does the Cheapest-to-Deliver Option Matter? *Journal of International Financial Markets, Institutions and Money, 21*, 369-87.

Arce, O., Mayordomo, S., & Peña, J.I. (2011). Do Sovereign CDS and Bond Markets Share the Same Information to Price Credit Risk? An Empirical Application to the European Monetary Union Case, *XIX Foro de Finanzas.*

Arce, O., Mayordomo, S., & Peña, J.I. (2013). Credit-Risk Valuation in the Sovereign CDS and Bonds Markets: Evidence from the Euro Area Crisis. *Journal of International Money and Finance, 35*, 124-

145.

Beber, A., Brandt, M.W., & Kavajecz, K.A. (2009). Flight-to-Quality or Flight-to-Liquidity? Evidence from the Euro-Area Bond Market. *Review of Financial Studies, 22*(3), 925-957.

Blanco, R., Brennan, S., & Marsh, I.W. (2005). An Empirical Analysis of the Dynamic Relation between Investment-Grade Bonds and Credit Default Swaps. *The Journal of Finance, October,* 2255-2281.

Blommestein, H., Eijffinger, S. & Qian, Z. (2016). Regime-Dependent Determinants of Euro Area Sovereign CDS Spreads. *Journal of Financial Stability, 22*, 10-21.

Bowe, M., Klimaviciene, A., & Taylor, A.P. (2009, March). Information Transmission and Price Discovery in Emerging Sovereign Credit Risk Markets. *Mid-West Finance Association Annual Conference, Chicago*.

Broto, C., & Pérez- Quirós, G. (2011). Sovereign CDS Premia during the Crisis and Their Interpretation as a Measuer of Risk. *Economic Bulletin*, (APR), 1-9.

Broto, C. & Pérez-Quirós, G. (2015). Disentangling Contagion among Sovereign CDS Spreads during the European Debt Crisis. *Journal of Empirical Finance, 32*, 165-179.

Chan-Lau, M.J.A., & Kim, M.Y.S. (2004). Equity Prices, Credit Default Swaps, and Bond Spreads in Emerging Markets, *International Monetary Fund, No. 4-27.*

Delatte, A.L., Gex, M., & López-Villavicencio, A. (2012). Has the CDS Market Influenced the Borrowing Cost of European Countries during the Sovereign Crisis?' *Journal of International Money and Finance, 31*(3, April), 481-497.

Delis, M.D., & Mylonidis, N. (2011). The Chicken or the Egg? A Note on the Dynamic Interrelation between Government Bond Spreads and Credit Default Swaps. *Finance Research Letters, 8*(3, September), 163-170.

Duffie, D. (1999). Credit Swap Valuation. *Financial Analysts Journal, 55*(1), 73-87.

Fontana, A., & Scheicher. M. (2010). *An Analysis of Euro Area Sovereign CDS and Their Relation with Government Bonds*. Frankfurt (Germany). Retrieved from: https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1271.pdf.

Fontana, A., & Sheicher, M. (2016). An Analysis of Euro Area Sovereign CDS and Their Relation with Government Bonds'. *Journal of Banking and Finance*, *62*, 26-40.

Forte, S., & Peña, J.I. (2009). Credit Spreads: An Empirical Analysis on the Informational Content of Stocks, Bonds, and CDS. *Journal of Banking and Finance* 33 (11, November), 2013-2025.

Galariotis, E.C., Makrichoriti, P., & Spyrou, S. (2016). Sovereign CDS Spread Determinants and Spill-over Effects during Financial Crisis: A Panel VAR Approach. *Journal of Financial Stability, 26*, 62-77.

Gómez-Puig, M., & Sosvilla-Rivero, S. (2014). Causality and Contagion in EMU Sovereign Debt Markets. *International Review of Economics and Finance, 33*, 12-27.

Gonzalo, J., & Granger, C. (1995). Estimation of Common Long-Memory Components in Cointegrated

Systems. *Journal of Business and Economic Statistics, 13*(1), 27-35.

Hasbrouck, J. (2016). One Security , Many Markets: Determining the Contributions to Price Discovery. *The Journal of Finance, 50*(4), 1175–1199. Retrieved from: http://www.jstor.org/stable/2329348.

Hull, J.C., & White, A.D. (2004). Valuation of a CDO and an n -Th to Default CDS Without Monte Carlo Simulation. *The Journal of Derivatives, 12*(2, Winter), 8-23.

International Monetary Fund (IMF) (2013). A New Look Aat the Role of Sovereign Credit Default Swaps.

Kim, S.J., Salem, L., & Wu, E. (2015). The Role of Macroeconomic News in Sovereign CDS Markets: Domestic and Spillover News Effects from the U.S., the Eurozone and China. *Journal of Financial Stability, 18*, 208-24.

Martín-García, M., Téllez-Valle, C., & Martín-Marín, J.L. (2014a). Evolution of Sovereign Rating Models in the Current Crisis. *Journal Globalization, Competitiveness and Governability, 8*(1), 16-33.

Martín-García, M, Téllez-Valle, C., & Martín-Marín, J.L. (2014b). Sovereign Bond Spreads and Credit Default Swap Premia: Cointegration and Causality. *Investment Management and Financial Innovations, 11(*2), 47-59.

Muratori, U. (2015). Contagion in the Euro Area Sovereign Bond Market. *Social Sciences, 4*(1), 66-82. Retrieved from: www.mdpi.com/journal/socsci.

Ngene, G., Carley, H., & Hassan, K.M. (2014). Persistence of volatilitu of sovereign credit risk in presence of structural breaks. *Jounal of Derivatives & Hedge Funds, 20*, 10-27.

Palladini, G., & Portes, R. (2011). *Sovereign CDS and Bonds Pricing Dynamics in the Euro-Area.* (No. w17586). National Bureau of Economic Research.

Ruffoni, S. (2014). Wherever Did Europe's Sovereign CDS Trading Go?. *Wall Street Journal, Moneybeat*. Retrieved from: https://blogs.wsj.com/moneybeat/2014/01/31/wherever-did-europes-sovereign-cds-trading-go/.

Schuster, G. (2005). Determinantes Del Riesgo País: Una Medición a Través de Los Swaps de Deuda'. *Premio Nacional de Derviados Mex-DER Asigna* México.

Zhang, G., & Zhang, S. (2013). Information Efficiency of the U.S. Credit Default Swap Market: Evidence from Earnings Surprises. *Journal of Financial Stability, 9*, 720-730.

Zhu, H. (2006). An Empirical Comparison of Credit Spreads between the Bond Market and the Credit Default Swap Market. *Journal of Financial Services Research, 29*(3), 211-235.