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Are the Sovereign CDS Premia Sound Estimators of the Stock Market Returns? Evidence from the Eurozone

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ABSTRACT

In this paper, we explore the interconnection and existing relationships between the Sovereign Credit Default Swaps (henceforth, CDS) and the stock markets of the main European countries. Thus, the goal of this paper is to test if the CDS premia can predict the stock market returns of the most relevant economies within the Eurozone, so that, they serve as advanced indicators like mechanisms of price transmission. For this purpose, we apply the Granger Causality test to analyze ten main European stock markets from 2004 to 2016 by using daily data. Our hypothesis is proved to work for the largest economies with liquid CDS markets, whereas the transmission mechanism between CDS and stock prices is not so evident for the smallest ones.

Keywords: CDS premia; stock market index return; Granger causality test; Eurozone.
JEL classification: G12; G15; C22; C30.
MSC2010: 91B84; 91G70; 62M10.

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¿Son las primas CDS estimadores sólidos de los rendimientos del mercado de valores? Evidencia de la Eurozona

RESUMEN

En este documento, exploramos la interconexión y las relaciones existentes entre los Soberanos *Credit Default Swaps* (en adelante, CDS) y los mercados bursátiles de los principales países europeos. Por lo tanto, el objetivo de este documento es comprobar si las primas de CDS pueden predecir los rendimientos del mercado de valores de las economías más relevantes dentro de la zona euro, de modo que sirvan como indicadores avanzados como los mecanismos de transmisión de precios. Para este propósito, aplicamos la prueba de Causalidad de Granger para analizar los diez principales mercados bursátiles europeos desde 2004 a 2016 mediante el uso de datos diarios. Se ha demostrado que nuestra hipótesis funciona para las economías más grandes con mercados de CDS líquidos, mientras que el mecanismo de transmisión entre los CDS y los precios de las acciones no es tan evidente para los más pequeños.

Palabras claves: primas CDS; rendimiento de índices de mercado; test de causalidad de Granger; eurozona.
Clasificación JEL: G12; G15; C22; C30.
MSC2010: 91B84; 91G70; 62M10.

1. Introduction.

The objective of our study will be to analyze the relationship between the sovereign CDS premia and the stock market returns of the countries that make up the S & P / ISDA Eurozone CDS Index corresponding to ten major economies of the Eurozone.

Specifically, the relationship between the prices of sovereign CDS and a series of prices of certain stock indices, namely France, Germany, Italy, Spain, Belgium, the Netherlands, Austria, Finland, Ireland and Portugal, is measured.

Taking into account the scope of the present study, from the objective point of view, 10 countries, as temporary, more than 12 years, we understand that provide quite solid financial conclusions regarding the causal relationship between CDS at 5 and 10 years and the stock indices considered.

Our study differs from prior studies because it delves into the interrelationships between sovereign CDS and stock indexes, considering a broad temporal spectrum, from 2004 to 2016, which implies a better test and a stronger solidity in the financial conclusions. CDS premia have also been taken into account, both at 5 and 10 years.

In addition, our study is novel since the works so far has focused mainly on countries with stressed economies or emerging economies, but the main economies of the euro area as a whole have been scarcely taken into account.

Our paper introduces the use of causality tests, previously analyzing the stationarity of the data series used, to determine the relation of the prices or returns of the stock assets, namely shares, with those of the sovereign CDS to 5 and 10 years. It should be borne in mind that the fiscal sustainability measures applied by the states of the Eurozone make the risk premia smaller because there is less volatility.

We will use the methodological approach of Granger that is linear, keeping the VAR, Vector of Autoregression, constant.

The idea is to explore the possible direction of the relationship between the premia of sovereign CDS and the returns of the stock market indices using the framework of the Granger (1969) causality test. We use not only the principal indices of the market but also the sub-indices of the banking and insurance sectors if available and, in other cases, those of the financial sector.

Our principal hypothesis is that the CDS premia may cause, in the sense of Granger, the returns of the stock indices, that is, in some way the movements of the prices of shares. As we shall see, this hypothesis seems to be true when the liquidity of the markets, both sovereign CDS and stocks, is relatively high. But in the case of low liquidity, as in the minor countries of the Eurozone, the results are not clear enough.

2. Overview of the existing literature.

The recent sovereign debt crisis in Europe has exerted its adverse effects worldwide, highlighting the speed and force with which financial contagion can occur across national borders in the international financial system (Aizemann et al., 2011; Gabriel, 2015).The fact that derivatives markets can react more rapidly to news than traditional financial markets could be advantageous for the construction of an asset valuation model based on financial derivatives rather than spot market products (Borgy et al.,2011;Favero and Missale,2012).

Most of the existing literature on this topic has mainly focused on emerging economies, but less attention has been paid on the Eurozone. As for the review of the literature to date, Brunnermeier and Pedersen (2009) state that the initial fall in asset prices is aggravated if contract settlements increase, driven by the deterioration of the value of the portfolio at market prices. This theory suggests that small disturbances or shocks may involve large indirect effects. Brock et al. (2009) show that the proliferation of hedging instruments can destabilize the markets. The proposition that CDS tends to lower asset prices is demonstrated in Geanakoplos (2010).

The research by Ang and Longstaff (2013) shows that sovereign credit risk has shared simultaneous effects in all countries as a response to major shocks. Their results receive empirical support from Adrian and Brunnermeier (2008), while the presence of systemic sovereign risk is closely associated with financial crises (Bekaert et al., 2013).

On the other hand, Dieckmann and Planck (2012) provide empirical evidence of the phenomena of transfering private risk to the public, due to the global exposure of the banking sector and the rescues in Europe.

Adrian and Brunnermeier (2008) measure the systemic risk, including the banking sector, to provide evidence on the impact of such risk on the formation of assets.

Fong and Wong (2011) also assess sovereign systemic risk based on a small regional sample comprising the eleven largest economies in Asia and the Pacific during the period 2004-2009. Gennaioli et al. (2010) argue that sovereign risk affects banks through exposure to sovereign bonds. Huizinga and Demirguc-Kunt (2013) provide evidence in a large sample of countries that bank CDS spreads are negatively responding to the deterioration of public finances from 2008.

Acharya and Steffen (2013) find that banks in the Eurozone have actively participated, working with member states, during the crisis period, thereby increasing their exposure to sovereign debt, resulting in some cases, in the rescue of some institutions and even bankruptcy for others, Acharya et al., (2011). This represents a significant risk given the size of certain banks. Koy (2017) investigates the daily differentials of CDS in Italy, Ireland, Portugal and Spain, the countries most stressed during the crisis, through three different scenarios, depression, moderate growth and expansion. Blanco et al. (2005) verified that there are differences between CDS prices and credit spreads, both in the long and in the short term, mainly due to errors in the calculation of spreads and the imperfections of the CDS contracts. Zhu (2006) compares bond and CDS market prices and shows the existence of long-term parity, but not in the short-term, due to the responsiveness of CDS premia to changes in the credit conditions.

Apergis and Ajmi (2015) analyze the effects of sovereign risk on asset prices in four economies of the Eurozone (Greece, Ireland, Italy and Spain). They use the Sato et al. (2007) methodology, which introduces an autoregressive model with variables over time, as well as the asymmetric causality test of Hatemi (2012). The empirical results suggest that the presence of CDS influences the price of a certain number of assets, as reflected in the stock indices and the sub-indices of banks and insurance companies. They use a large time series with daily data, from January 2007 to September 2012, in order to capture any potential causal effect of the CDS premia on the four economies analyzed through the indicated variables. In fact, our paper follows the guidelines of the Apergis and Ajmi (2015) contribution.

This paper is structured as follows: Section 1 inform about goals of the paper and the author´s contribution to the existing literature, as well as it should contain research hypothesis; Section 2 provides an overview of the existing literature. Section 3 describes the data and the sample used in our study. In Section 4 the methodological framework and empirical analysis is explained and in Section 5 this analysis and the results are presented finally in Section 6 summarizes the main conclusions.

3. Data and Sample

In our study, we use daily return of the stock market indices of the ten largest countries in the Eurozone: France, Germany, Italy, Spain, Belgium, the Netherlands, Austria, Finland, Ireland and Portugal, during a period that runs from January 2004 to September 2016. In particular, we focused on the following variables:

- Stock market returns.
- Banking sector returns.
- Insurance sector returns.

With respect to the premia of the sovereign CDS, we analyze those for 10-year CDS and 5-year CDS, denominated in USD[1], and extracted from Datastream Thomson Reuters, as in the case of the stock market returns.

As a result, stock returns have been obtained from the following stock indices and sub-indices, as shown in Table 1. The reason for this empirical analysis is that the daily premia of the CDS provide a more direct measure of sovereign credit risk than the return of the stock indices, since the latter are influenced by the movements of interest rates, changes in supply and demand, lack of liquidity and other factors.

[1] The sovereign CDS are generally denominated in dollars and not in euros because, in case of the failure of the debt of a country, the European currency could decline. So this is a way of avoiding a possible exchange risk.

Table1: Stock indices and sub-indices.

Country	Market	Indices
France	Euronext Paris	CAC 40 Banks Non-life insurance
Germany	Deutsche Borse	DAX30 Credit banks Insurance
Italy	Borsa Italiana	FTSE MIB40 FTSE Italia banche FTSE Italia Assicurazioni
Spain	BME	IBEX-35 Bancos y Cajas de Ahorro Seguros
Belgium	Euronext Brussels	BEL20 BEL Financial services
The Netherlands	Euronext Amsterdam	AEX 25 AEX Financial services
Austria	Wien Stock Exchange	ATX 20 ATX Financials
Finland	NASDAQ Stock Exchange	OMX H25 OMX Banks
Ireland	Irish Stock Exchange	ISEQ 20 ISEQ Financials
Portugal	Euronext Lisbon	PSI20 PSI Banks PSI Financials

Source: Self-compilation

4. Methodological framework and empirical analysis.

In order to analyze the dynamic interactions between the time series of the sovereign CDS premia and the return of stock indices and sub-indices, we conduct a two-step statistical analysis. Firstly, we check if the time series have unit roots through the use of the Augmented Dickey Fuller test (henceforth, ADF), Dickey Fuller (1981) and, secondly, we analyze the causality between the time series by conducting the Granger´s causality test.

4.1. Series stationarity analysis.

It is assumed that the correlation is close between the CDS premia and the return of the assets analyzed. This does not mean dependence, but that the long-term trend is in the same direction. In this sense, Granger's causality test helps us to calibrate the potential relationship between CDS premia and stock market returns. Thus, the question is whether both variables move in the same direction, if the differences between them are stable and if there is an explanatory cause-effect relationship. For this purpose, we first analyze the time series to test if they are stationary or non-stationary. It should be noted that, as a previous analysis, the trend of the variables and the corresponding correlogram should be observed. When the process is non-stationary its function of autocorrelation decreases exponentially but very slowly (see Glynn et al., 2007).

I(0) Stationary Series: the price series are fixed. Mean stable value and constant variance. They do not present unit roots.

$$\left.\begin{aligned} &\mathrm{E}\ (Y_t) = \text{constant}\ \forall\ t \\ &\mathrm{Var}\ (Y_t) = \text{constant}\ \forall\ t \\ &\mathrm{Cov}\ (Y_{t1}\ , Y_{t-k}) = \text{constant}\ \forall_{t1}\ \forall_k \end{aligned}\right\} \qquad (1)$$

The ADF test should be applied to both the asset prices and the CDS premia. If the series is non-stationary, applying a first difference can make the series stationary. It would be called an integrated one-order process. Starting from a random walk, we can convert a non-stationary time series to stationary, or I(1), i.e., a non-stationary process whose regular difference of order one is a zero-order stationary process, I(0) (see Badillo et al.,2010).

The ADF test detects the possibility of having to differentiate the series. A series is integrated of order one, I(1), if

$$X_t = \emptyset_1 X_{t-1} + \varepsilon_t \qquad (2)$$

or

$$X_t = \partial + \emptyset_1 X_{t-1} + \varepsilon_t \qquad (3)$$

or

$$X_t = \delta + \beta t + \emptyset_1 X_{t-1} + \varepsilon_t \qquad (4)$$

where, X_t and X_{t-1} , are the variables, $\partial, \emptyset_1$and β parameters and ε_t the error term.

If $\emptyset_1 = 1$, the series is non-stationary, but if a first difference is applied, of (2) it follows that if $\emptyset_1 = 1, \Delta X_t = \varepsilon_t$.

The ADF test is based on this idea. Therefore, the equation (2) is estimated and the hypothesis to be tested is:

$$H_0 : \emptyset_1 = 1$$

$$H_1 : \emptyset_1 < 1$$

Alternatively, by subtracting X_{t-1} from both terms of the equation (4), we reach at:

$$\Delta X_t = \delta + \beta_t + (\emptyset_1 - 1)\, X_{t-1} + \varepsilon_t = \delta + \beta_t + \emptyset_1^* \, X_{t-1} + \varepsilon_t \quad ,$$

where, $\emptyset_1^* = \emptyset_1 - 1$.

Then, the test will be posed as:

$$H_0 \ : \ \emptyset_1^* = 0$$

$$H_1 \ : \emptyset_1^* < 0$$

Table 2 shows the ADF test results, when applied to the series of 10-year-CDS premia. By observing this table, we conclude that the value of the t-statistic is lower than the p-value of the MacKinnon table, in absolute terms, at both 0.01 and 0.05 significance level, except for France and Belgium and at 0.10, except for France, Germany and Belgium, MacKinnon, (1991) and Engle and Granger (1991). This means that the series have unitary roots or, in other words, are non-stationary, no rejecting the null hypothesis, H0, with the exceptions that we have indicated regarding France, Germany and Belgium. Analogously, Table 3 shows the results of the ADF test, when applied to the series of 5-year-CDS premia. In this particular case, we have similar results since the value of the t-statistic is lower than the p-value of the MacKinnon table, in absolute terms, at 0.01 and 0.05 except for France and Belgium and at 0.10, except for France, Belgium and Finland.

Table2:ADF test for 10-years-CDS.

		p-value MacKinnon		
Country	t-statistic	0.01	0.05	0.10
France	-3.059	-3.430	-2.860	-2.570
Germany	-2.667	-3.430	-2.860	-2.570
Italy	-2.046	-3.430	-2.860	-2.570
Spain	-2.252	-3.430	-2.860	-2.570
Belgium	-3.231	-3.430	-2.860	-2.570
The Netherlands	-1.695	-3.430	-2.860	-2.570
Austria	-2.095	-3.430	-2.860	-2.570
Finland	-2.133	-3.430	-2.860	-2.570
Ireland	-1.533	-3.430	-2.860	-2.570
Portugal	-1.612	-3.430	-2.860	-2.570

Source: Self-compilation

Table3:ADF test for 5-years-CDS.

		p-value MacKinnon		
Country	t-statistic	0.01	0.05	0.10
France	-3.211	-3.430	-2.860	-2.570
Germany	-1.457	-3.430	-2.860	-2.570
Italy	-1.970	-3.430	-2.860	-2.570
Spain	-1.850	-3.430	-2.860	-2.570
Belgium	-3.069	-3.430	-2.860	-2.570
The Netherlands	-1.425	-3.430	-2.860	-2.570
Austria	-2.045	-3.430	-2.860	-2.570
Finland	-2.682	-3.430	-2.860	-2.570
Ireland	-1.092	-3.430	-2.860	-2.570
Portugal	-1.293	-3.430	-2.860	-2.570

Source: Self-compilation

Table4: ADF test for the stock market indices.

p-value MacKinnon

Country	t-statistic	0.01	0.05	0.10
France				
CAC-40	-53.909	-3.430	-2.860	-2.570
Banking index	-49.603	-3.430	-2.860	-2.570
Insurance index	-49.270	-3.430	-2.860	-2.570
Germany				
DAX-30	-52.197	-3.430	-2.860	-2.570
Banking index	-49.103	-3.430	-2.860	-2.570
Insurance index	-52.043	-3.430	-2.860	-2.570
Italy				
FTSE-MBI-40	-53.746	-3.430	-2.860	-2.570
Banking index	-51.369	-3.430	-2.860	-2.570
Insurance index	-39.466	-3.430	-2.860	-2.570
Spain				
IBEX-35	-49.967	-3.430	-2.860	-2.570
Banking index	-47.845	-3.430	-2.860	-2.570
Insurance index	-52.777	-3.430	-2.860	-2.570
Belgium				
BEL-20	-50.662	-3.430	-2.860	-2.570
Banking index	-39.521	-3.430	-2.860	-2.570
The Netherlands				
AEX-25	-53.373	-3.430	-2.860	-2.570
AEX Financial services	-51.237	-3.430	-2.860	-2.570
Austria				
ATX-20	-48.144	-3.430	-2.860	-2.570
ATX Financials	-34.524	-3.430	-2.860	-2.570
Finland				
OMX H25	-53.332	-3.430	-2.860	-2.570
OMX Banks	-51.658	-3.430	-2.860	-2.570
Ireland				
ISEQ-20	-50.441	-3.430	-2.860	-2.570
ISEQ Financials	-47.458	-3.430	-2.860	-2.570
Portugal				
PSI-20	-48.888	-3.430	-2.860	-2.570
PSI Financials	-32.980	-3.430	-2.860	-2.570
PSI Banks	-33.026	-3.430	-2.860	-2.570

Source: Self-compilation

Table 4 shows the results of the ADF test, now applied to the series of market return indices. Returns are calculated from daily price data by taking the natural logarithm of the ratio of two successive quotes (see Brooks, 2008).In these statistics we conclude that the value of the t-statistic is greater than the p-value of the MacKinnon table, in absolute terms. This means that the series do not have unit roots, or what would be the same, are stationary, rejecting the null hypothesis, H_0.

Table 5 presents the probability of rejecting the null hypothesis. In the case of France, the level of 0.0297 means that there is a 2,97% probability of rejecting the null hypothesis and incurring in a type I error. When calculating the first difference, there is a zero probability of rejecting the null hypothesis and making a first type error. Therefore, we can conclude that the series has stabilized when differentiating. With regard to the returns of the stock indices, with the level data, the probability of rejecting the null hypothesis being 0, we can conclude that they are stationary series, thus not needing a subsequent differentiation. In the same way, we proceed with the remaining countries, whose results are shown in Table 5.

Finally, in table 6 we use the Philips-Perron test to the first differences of all series as robusteness check. The results show clearly the rejecting of the null hypothesis, the series are stationary without any doubt. In summary, we confirm that the yield series of stock indices and sub-indices are stationary, while the series of 5-year and 10-year CDS premia are generally non-stationary, with the exception of some countries.

Table5: Probability of rejecting the null hypothesis of non stationarity.

Country		Level (MacKinnon p-value)	1stDifference
France			
10-year CDS	ADF	0.0297	0.0000
5-year CDS	ADF	0.0194	0.0000
Return CAC-40	ADF	0.0000	-------
Return Banks	ADF	0.0000	-------
Return Insurance companies	ADF	0.0000	-------
Germany			
10-year CDS	ADF	0.0800	0.0000
5-year CDS	ADF	0.5548	0.0000
Return DAX-30	ADF	0.0000	-------
Return Banks	ADF	0.0000	-------
Return Insurance companies	ADF	0.0000	-------
Italy			
10-year CDS	ADF	0.2669	0.0000
5-year CDS	ADF	0.3001	0.0000
Return FTSE MIB-40	ADF	0.0000	-------
Return FTSE Banks	ADF	0.0000	-------
Return FTSE Insurance companies	ADF	0.0000	-------
Spain			
10-year CDS	ADF	0.1880	0.0000
5-year CDS	ADF	0.3560	0.0000
Return IBEX-35	ADF	0.0000	-------
Return Banks	ADF	0.0000	-------
Return Insurance companies	ADF	0.0000	-------
Belgium			
10-year CDS	ADF	0.0183	0.0000
5-year CDS	ADF	0.0289	0.0000
Return BEL-20	ADF	0.0000	-------
Return Financial services	ADF	0.0000	-------
The Netherlands			
10-year CDS	ADF	0.4336	0.0000
5-year CDS	ADF	0.5703	0.0000
Return AEX-25	ADF	0.0000	-------
Return Financial services	ADF	0.0000	-------

Country		Level (MacKinnon p-value)	1stDifference
Austria			
10-year CDS	ADF	0.2466	0.0000
5-year CDS	ADF	0.2670	0.0000
Return ATX-20	ADF	0.0000	-------
Return ATX Banks	ADF	0.0000	-------
Finland			
10-year CDS	ADF	0.2314	0.0000
5-year CDS	ADF	0.0772	0.0000
Return OMX H25	ADF	0.0000	-------
Return OMX Banks	ADF	0.0000	-------
Ireland			
10-year CDS	ADF	0.5170	0.0000
5-year CDS	ADF	0.7182	0.0000
Return ISEQ-20	ADF	0.0000	-------
Return ISEQ Banks	ADF	0.0000	-------
Portugal			
10-year CDS	ADF	0.4769	0.0000
5-year CDS	ADF	0.6326	0.0000
Return PSI-20	ADF	0.0000	-------
Return PSI Banks	ADF	0.0000	-------
Return PSI Insurance companies	ADF	0.0000	-------

Source: Self-compilation

Table 6: Probability of rejecting the null hypothesis of non stationarity.

Country		1st Difference
France		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return CAC-40	PP	0.0000
Return Banks	PP	0.0000
Return Insurance companies	PP	0.0000
Germany		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return DAX-30	PP	0.0000
Return Banks	PP	0.0000
Return Insurance companies	PP	0.0000
Italy		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return FTSE MIB-40	PP	0.0000
Return FTSE Banks	PP	0.0000
Return FTSE Insurance companies	PP	0.0000
Spain		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return IBEX-35	PP	0.0000
Return Banks	PP	0.0000
Return Insurance companies	PP	0.0000
Belgium		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return BEL-20	PP	0.0000
Return Financial services	PP	0.0000
The Netherlands		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return AEX-25	PP	0.0000
Return Financial services	PP	0.0000

Country		1st Difference
Austria		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return ATX-20	PP	0.0000
Return ATX Banks	PP	0.0000
Finland		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return OMX H25	PP	0.0000
Return OMX Banks	PP	0.0000
Ireland		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return ISEQ-20	PP	0.0000
Return ISEQ Banks	PP	0.0000
Portugal		
10-year CDS	PP	0.0000
5-year CDS	PP	0.0000
Return PSI-20	PP	0.0000
Return PSI Banks	PP	0.0000
Return PSI Insurance companies	PP	0.0000

Source: Self-compilation

4.2. Granger causality analysis

The aim of this statistical analysis is to describe the dynamic interactions between the time series as well as to reveal their independent movements.

The Granger test, Granger (1969), uses an extended concept of correlations to find causalities but, despite a positive test result, it should never be concluded that if X causes Y, the variable Y is the effect of X. That is, the existence of a correlation between two variables does not imply causality. That a variable correlates with another does not always imply that one of them is the cause of the other. This is not a cause-effect analysis, a classic type, but a statistical prediction technique. The notion of causality, according to Granger, is related to the idea of predicting one variable using the information of the other, rather than with the concept that one variable sequentially precedes the other. Reaching this point, it is time to explain the causal relationships between the 5-year and 10-year CDS premia and the stock market index returns (the general indices and the sub-indices, banking and insurance) for the European countries mentioned above from January 2004 to September 2016.

The test consists of checking if the results of one variable are useful to predict another and if this relationship is unidirectional or bidirectional. The Granger causality model is a naturally attractive approximation because the methodology simply requires determining whether the coefficients of the regression model, associated with past and present values, are significant.

In the Granger causality test, the vector of auto-regression, henceforth VAR, is an appropriate approach for those time series that are stationary to be modeled, since the properties of the VAR (expectations, variance and autocorrelation), do not vary over time. We have already mentioned before that the series must be stabilized if they are not stationary originally. With this same methodology, the works of Huizinga and Dermirguc-Kunt (2013), Gennaioli et al. (2010) and Acharya and Steffen (2013) show the bi-directional relationship between sovereigns and banks. Allen and Moessner (2010) shows that this interrelationship causes adverse effects of liquidity on the Eurozone's banks during the crisis, including a significant fall in the interbank lending since mid-2010 (as in Brunnermeier et al., 2009). Brock et al. (2009) and Simsek (2013) provide statistical support to the hypothesis that derivatives predict the behavior of stock markets and, finally Coimbra, (2014), has explicitly modeled the resulting feedback circuit, concluding that an increase in sovereign risk reduces the demand for sovereign bonds, thus raising risk premia.

To proceed, we should compare and deduce whether the current and past behavior of a time series A predict the behavior of a time series B. If the event occurs, it is said that result A causes result B. Then, the behavior is unidirectional. If the explanation happens and also the result B predicts the result A, the behavior is bidirectional, then the result A causes the result B and the result B causes the result A. This type of test allows us to anticipate the outcome in the previous analysis of a regression procedure.

Granger's causal contrast is based on the estimation of the following equations:

$$Y_t = a_0 + \sum_{i=1}^{n} a_{1i} Y_{t-i} + \sum_{j=0}^{m} a_{2j} X_{t-j} + \mu_{1t} \quad (5)$$

$$X_t = b_0 + \sum_{i=1}^{n} b_{1i} X_{t-i} + \sum_{j=0}^{m} b_{2j} Y_{t-j} + \mu_{2t} \quad (6)$$

where, a_0 , a_{1i}, a_{2j} , b_0 , b_{1i} and b_{2j} are parameters, μ_{1t} and μ_{2t} are terms of random perturbation and *"n"* and *"m"* are the number of lags of the variables included in the contrast.

If we can reject the null hypothesis, H_0, that $a_{2j} = 0$ $(\forall_j)$, we say that the variable X causes the variable Y. The alternative hypothesis is that, at least, one of the a_{02j} is different from 0. Similarly, if it is possible to reject the null hypothesis that $b_{2j} = 0$ $(\forall_j)$, we say that the variable Y is the cause of the variable X. The alternative hypothesis is that, at least, in both cases, we can admit that there is a simultaneous causal relationship between both variables. This is achieved by carrying out the Wald's F-test for joint significance of the parameters[2] . A first question to tackle, is the order of integration of the series used. To verify if the series show a steady behavior, we verified the presence of unit roots through the ADF contrast. In such case we conclude that the variable X causes the variable Y if we can reject the null hypothesis that $a_{2j} = 0$ $(\forall_j)$. Likewise, if it is possible to reject the null hypothesis $b_{2j} = 0$ $(\forall_j)$, we say that Y causes X. The decision criteria are stated as follows:

H_0: *The variable stock return is not the cause of the CDS variable. There is no causality.*

H_1:*The variable stock return is the cause of the CDS variable. There is causality.*

Therefore, the possible scenarios are as follows:

- Unidirectional causality: the price of shares (global, banking and insurance) causes the premia of the CDS.
- Unidirectional causality: the premia of the CDS causes the share prices (global, banking and insurance).
- Two-way causality: Feedback between both variables.
- Causal independence: there is no causality between the two variables.

If *p-value*<0.5, we reject H0, that is, the CDS premia cause the market return of the indices.

Tables 6 and 7 present the Granger causality tests, based on four lags[3], applied to the relationship between 10-year and 5-year CDS, and stock indices and sub-

[2] [2] For more details see: Lin, J-L. (2007) Notes on testing causality. Retrieved January 13, 2013 from http://faculty.ndhu.edu.tw

[3] [3] The lags have been setted according to the final prediction error (FPE) and Akaike's information criterion (AIC).

indices. Note that for the largest economies, such as France, Germany, Italy and Spain, CDS premia cause indices whereas, for the remaining countries, the evidence is contradictory.

Table 7: Granger causality test with four lags between 10-year-CDS and stock indices.

Country	Stock indices returns do not cause 10 year CDS premia F-statistic (Probability)	10 year CDS premia do not cause stock indices returns F-statistic (Probability)
France		
CDS →CAC-40	2.7275 (0.604)	82.70100 (0.00)
CDS →Banks	4.8736 (0.301)	112.6500 (0.00)
CDS →Insurance companies	5.3173 (0.256)	100.1600 (0.00)
Germany		
CDS →DAX-30	6.7393 (0.15)	25.0820 (0.00)
CDS →Banks	12.3900 (0.15)	27.7460 (0.00)
CDS →Insurance companies	13.0550 (0.011)	25.4020 (0.00)
Italy		
CDS →FTSE MIB-40	5.7294 (0.22)	132.0100 (0.00)
CDS →Banks	4.7517 (0.314)	135.8200 (0.00)
CDS →Insurance companies	6.5420 (0.162)	139.9400 (0.00)
Spain		
CDS →IBEX-35	3.6684 (0.453)	53.4140 (0.00)
CDS →Banks	3.3723 (0.498)	55.7290 (0.00)
CDS →Insurance companies	9.4667 (0.05)	44.7780 (0.00)
Belgium		
CDS ←BEL-20	34.0130 (0.00)	6.7883 (0.148)
CDS ←Banks	20.7730 (0.00)	6.6842 (0.154)
The Netherlands		
CDS ≠AEX-25	2.9489 (0.566)	7.3180 (0.12)
CDS ←Banks	11.1210 (0.025)	6.7450 (0.15)
Austria		
CDS ↔ATX-20	54.6580 (0.00)	20.2340 (0.00)
CDS ↔Banks	50.5410 (0.00)	14.7660 (0.005)
Finland		
CDS ≠OMX H25	3.7606 (0.439)	7.0671 (0.132)
CDS ≠Banks	4.2702 (0.371)	4.9836 (0.289)
Ireland		
CDS →ISEQ-20	3.4685 (0.483)	12.8220 (0.012)
CDS ←Banks	9.9283 (0.042)	6.9926 (0.136)
Portugal		
CDS ←PSI-20	26.7300 (0.00)	1.4741 (0.831)
CDS ←Banks	18.6640 (0.001)	0.59708 (0.963)
CDS ←Insurance companies	18.7000 (0.001)	0.58962 (0.964)

Note:
→, ←Causality direction
↔ Bidirectional causality
≠ Inexistence of causality

Source: Self-compilation

Table 8: Granger causality test with four lags between 5-year-CDS and stock indices.

Country	Stock indices returns do not cause 5 year CDS premia F-statistic (Probability)	5 year CDS premia do not cause stock indices returns F-statistic (Probability)
France		
CDS →CAC-40	2.3860 (0.665)	86.9910 (0.00)
CDS →Banks	3.6668 (0.453)	121.4400 (0.00)
CDS →Insurance companies	5.3947 (0.249)	106.7400 (0.00)
Germany		
CDS →DAX-30	6.7413 (0.15)	58.0900 (0.00)
CDS →Banks	22.3920 (0.00)	60.3450 (0.00)
CDS →Insurance companies	17.9180 (0.01)	60.6290 (0.00)
Italy		
CDS →FTSE MIB-40	5.3785 (0.251)	131.1700 (0.00)
CDS →Banks	4.5636 (0.335)	132.5700 (0.00)
CDS →Insurance companies	6.2733 (0.18)	138.0900 (0.00)
Spain		
CDS →IBEX-35	3.8240 (0.43)	34.9440 (0.00)
CDS →Banks	3.2116 (0.523)	32.4480 (0.00)
CDS →Insurance companies	10.1680 (0.038)	34.7460 (0.00)
Belgium		
CDS ←BEL-20	39.7560 (0.00)	6.6261 (0.157)
CDS ←Banks	23.2550 (0.00)	5.4940 (0.24)
The Netherlands		
CDS ≠AEX-25	2.5106 (0.643)	9.3096 (0.054)
CDS ←Banks	9.7925(0.044)	9.1547 (0.057)
Austria		
CDS ↔ATX-20	62.2510 (0.00)	20.2020 (0.00)
CDS ↔Banks	53.3060 (0.00)	15.6230 (0.004)
Finland		
CDS →OMX H25	2.2543 (0.689)	9.6610 (0.047)
CDS ≠Banks	1.4677 (0.832)	5.1508 (0.272)
Ireland		
CDS →ISEQ-20	3.2396 (0.519)	13.0120 (0.011)
CDS ≠Banks	8.1303 (0.087)	6.8158 (0.146)
Portugal		
CDS ←PSI-20	22.1150 (0.00)	0.71978 (0.949)
CDS ←Banks	16.6960 (0.002)	0.75533 (0.944)
CDS ←Insurance companies	16.7680 (0.002)	0.75515 (0.944)

Note:
→, ←Causality direction
↔ Bidirectional causality
≠ Inexistence of causality
Source: Self-compilation

5. Final remarks and conclusions

In this paper, we have examined the relationship between the CDS premia and the stock market returns in the Eurozone. In this sense, we find evidence that the CDS premia cause, by conducting the Granger's casuality test, the prices or returns of the main indices and sub-indices of the major Eurozone countries such as France, Germany, Italy and Spain. More specifically, in the case of France, the 10-year CDS premia predict the behavior of the CAC-40, the Banking sector index and the Insurance sector index. In the case of Germany, similarly, the 10-year CDS premia help to predict the behavior of the DAX-30, the Banking sector and the Insurance sector indices. In Italy, the 10-year CDS premia anticipate as well the performance of the FTSE MIB-40, the Banking and Insurance indices. And finally, the 10-year CDS premia estimate the behavior of the IBEX-35, the Banking index and the Insurance index for the Spanish market.

The exceptions are for the smallest European economies such as Belgium, the Netherlands, Austria, Finland, Ireland and Portugal where sometimes we find opposite relationships, when the indices and sub-indices cause the CDS premia, or there are some situations of dependence in both directions or even of causal independence.

For the 5-year CDS, behavior patterns are very similar to those observed for 10-year CDS. Once again, for the largest European economies, CDS premia cause the indices and sub-indices of the stock markets and, for smallest ones, cases of opposite causality (indices → CDS), of dependence in both directions and even causal independence are shown. Particularly, for France, the 5-years CDS premia help to predict the behavior of the CAC-40, Banks and Insurance companies stock indices. In the case of Germany, similarly, the 5-year CDS premia anticipate the behavior of the DAX-30, Banks and Insurance companies stock indices. In Italy, the 5-year CDS premia proxy the behavior of the FTSE MIB40, Banks and Insurance companies stock indices. And finally, in the case of Spain, the 5-year CDS premia help to predict the behavior of the IBEX-35, Banks and Insurance companies stock indices.

In a nutshell, we observe a differentiated pattern between the major and minor economies of the Eurozone. The cause may be in the volume and liquidity of CDS markets for the largest economies, presumably higher than for the smallest ones. More liquid CDS markets can serve as an early warning of changes in sovereign credit risk, thus anticipating the stock markets as far as price formation is concerned. On the contrary, less liquid CDS markets may not launch signals as unequivocal as the previous ones.

As for the transmission mechanism between the two markets, the hypothesis may be the following: banks and insurance companies usually have their balance sheets heavily loaded with public debt, especially of the country itself, so that its improvement or deterioration of quality may lead to changes in stock prices. In turn, the sub-indices of banks and insurers may influence the general index in which they tend to have a certain weighting, especially the banking entities. For example, the Spanish market index, IBEX-35, is a highly banked indicator. In short, in the largest economies, characterized by liquid CDS markets these can serve as advance indicators with respect to stock prices. However, in the smallest economies, the transmission mechanism between CDS and stock prices is not so clear.

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