A Case for Europe: the Relationship between Sovereign CDS and Stock Indexes

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Abstract

In 2010 we witnessed a major European sovereign debt crisis. By examining the links between sovereign Credit Default Swaps and stock indexes for eight European countries during the period 2007-2010, this paper studies the lead-lag relationships of the two markets which represent a country's credit and market risk. Through the use of a Vector Autoregressive model and a panel data model we find that the stock market plays a leading role during the sample period, but when 2010 is isolated a change in this relationship appears: a key role of sovereign CDS markets – the incorporation of new information - emerges. This phenomenon is most significant in countries with high risk spread.

Keywords: sovereign credit risk, sovereign credit derivatives, stock markets, lead-lag relationships.
JEL classification: G15, G14, G20

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1 - Introduction

In this article we study the lead-lag relationship between sovereign Credit Default Swaps (CDS) and stock markets for eight European countries during the period 2007-2010. The countries are Greece, Italy, Spain, Portugal, Ireland, UK, France and Germany. This is the first paper to look at the relationship between the two markets representing credit risk and market risk for a country.

The study of lead-lag relationships has become a fruitful method for the analysis of the dynamic behavior of different related markets or related asset prices. These relationships indicate if one market processes new information faster than another. The leading market is more sensitive to new information and more liquid, and it is where informed traders transact most. Lead-lag relations have been studied in similar frameworks analyzing credit risk, by, amongst others, Longstaff et al (2005), Blanco et al (2005), Norden and Weber (2009)[1].

The link between CDS spreads, bond spreads and equity markets has recently become an interesting field of studies.[2] The credit derivative market is growing rapidly and following Byström (2005) it is clear that the relationships within these three markets are important not only for risk managers using these markets for hedging purposes but for anyone trying to profit from arbitrage possibilities.[3]

At the level of individual companies, the link between CDS and bond spreads has been vastly documented. CDSs provide a very easy way to trade credit risk and are the most common type of credit derivatives while bond credit spreads have been the traditional indicator of the credit risk situation of a company. Recent studies have shown that the CDS market has taken the

[1] Other examples, though applied in different areas, are Engsted and Tangaard (2004), who study the co-movement of US and UK stock markets, or Gwilym and Mike (2001), whose subject is the lead-lag relationship between the FTSE100 stock index and its derivative contracts.

[2] The first paper to incorporate the three markets (assets) in an analysis was Longstaff at al. (2003). Studying lead-lag relationships between weekly single-name CDS spread changes, corporate bond spreads and stock returns of US firms, they find that both stock and CDS markets lead the bond market.

Another recent study, Norden and Weber (2009), has found a definite lead of the stock market relative to the CDS and bond markets. Forte and Peña (2009) constitutes another valuable article in establishing the link between the three assets.

[3] One such example is the paper by Figuerola-Ferretti and Paraskevopoulos (2011).

lead on the bond market. Information about credit risk flows rapidly into CDS prices, and the bond prices adjust to this (See for example Longstaff et al (2003), Norden and Weber (2004), Blanco et al. (2005), Zhu (2006), Forte and Peña (2009)). At a sovereign level, recent work by Coudert and Hex (2010) also corroborate findings from previous studies on the leadership of CDS prices. Arce et al (2012) also analyze sovereign CDS and Bond markets and find that the price discovery process is state dependent.

Given the previous evidence, in our analysis we have chosen CDS prices as the best proxy for sovereign credit risk.

The relationship between CDS spreads and equity prices[4] has been discussed in papers by Byström (2005) and Fung et al. (2008) among others. Using a sample of European i-Traxx CDS indexes, Byström (2005) obtains evidence of firm-specific information being embedded into stock prices before it is embedded into CDS spreads. He also finds that stock price volatility is significantly correlated with CDS spreads. Fung et al. (2008), using a VAR (Vector Autoregressive) model and daily index data, also document a leading role for stock markets in relation to the CDS market. During the 2007 credit crunch period, they find a closer relationship between the stock and CDS markets and an important role of the investment grade CDSs in incorporating information.

Norden and Weber (2009) and Peña and Forte (2009), whose papers studied the link between the three assets (bonds, CDSs and stocks), found a definite lead of the stock market relative to the CDS and bond markets. A very interesting finding in Norden and Weber (2009) is that the lower the quality of the credit, the greater the comovement between the CDS and stock markets. However, in Longstaff et al (2003) there is no clear lead of the stock market with respect to the CDS market.

In this paper we also focus on the study of the links between CDS spreads and market prices, however we are pioneers in using European sovereign data. To our knowledge, this is the first paper to look at the relationship between sovereign CDS and stock markets.

[4] The theoretical link between the credit market and the stock market information was already built by Merton (1974). The value of any credit derivative is linked to the probability of the underlying reference entity being exposed to a credit event at some point in the future, and for entities with traded equity the probability is often estimated using information from the stock market.

Due to the different nature of the two markets studied here, - one related to sovereign credit risk and the other related to market risk - it is not possible to perform a price discovery analysis.[5] Instead, we study Granger causality in VAR-in-differences to test for price leadership.

By analyzing daily prices of sovereign CDS premiums and stock indexes in eight different countries during the period from January 2007 until July 2010, this paper contributes to the existing literature in three ways.

First, we study the lead-lag relationship between the two markets (assets) in order to see if there is a market leading the process of pricing new information. We find a close relationship and a clear interdependency between both markets. Our results confirm the revised literature: the stock market mainly takes the lead. The country-specific results are robust to pooling countries into two groups according to their risk levels.

Our second objective is to test if there was a change in this relationship during 2010, i.e. during the European sovereign debt crisis. We clearly find that during this year CDS markets lead the movements in stock markets, reversing the previous tendency. Again, panel data confirm the results: the general market conditions underlying the credit information flow between the stock and CDS markets are important. This result was also found in Fung et al. (2008). Worsening credit conditions make this relationship stronger.

In line with previous research (Norden and Weber, 2009), we estimate a three dimensional VAR model, adding stock market volatility to check for a potential omitted variables problem. We do not encounter links between the implicit stock market volatility and CDS movements.

Our third contribution is to test for possible differences in behaviour in countries with lower credit quality and countries with higher credit quality. In other to test the hypothesis that such differences exist we split the sample into two subsamples: countries with higher CDS spreads (Greece, Ireland, Portugal, Spain and Italy) and countries with lower CDS spreads (France and Germany). Results corroborate previous findings. During the sample period (2007-2010) the stock market leads the process of incorporating new

[5] Other authors, like Blanco et al (2005), Forte and Peña (2009), Norden and Weber (2009) apply a VECM to their original series in levels and perform a price discovery analysis. In this article, we find that our series are not cointegrated. Therefore we cannot apply a VECM analysis and study the price discovery process; instead, we focus on the evolution of daily changes and price leaderships.

information, but when 2010 is isolated, the reverse information flow is found: the CDS market takes the lead. Like Norden and Weber (2009), we find that the lower the quality of the credit (in our case sovereign credit quality) the greater the co-movement between CDS markets and stock markets.

The rest of the article is structured as follows. We first describe sovereign CDSs and motivate our analysis. Next we take an exploratory look at the data and introduce the more formal model. In section 4 we document our country specific model and discuss some extensions of the basic model. In the first extension we divide the sample period into three different and non-overlapping sub-periods. The second extension includes implied volatility as a third factor, and the third extension develops a panel data model. Finally we conclude in section 5. References can be found at the end of the paper.

2 - Sovereign CDSs and the framework of our analysis

2010 will be known as the year of the European sovereign debt crisis. From the beginning of the year, the sovereign CDS spreads widened in Western Europe, and by late 2010 there were some countries with CDS premiums which were higher than those of some countries in Emerging Europe.[6]

During 2010, the spread of sovereign CDSs reached maximum levels as the euro zone economies came under pressure due to the increasing doubts about the ability of some European countries with stagnating economies to achieve large reductions in their budget deficits without defaulting or being rescued.

Credit Default Swaps are credit protection contracts whereby one party agrees, in exchange for a periodic premium, to make a contingent payment in the case of a defined credit event. For buyers of credit protection, the CDS market offers the opportunity to reduce credit concentration and regulatory capital while maintaining customer relationships. For sellers of protection, it offers the opportunity to take credit exposure over a customized term and earn income without having to fund the position.

[6] By November 30, the spread on the 5-year Spanish CDS was 365b.p. while the Polish CDS spread was 168b.p., and that of the Czech Republic 101b.p. Even the Rumanian CDS spread was lower: 335b.p.

Sovereign Credit Default Swaps pay the buyer the face value in exchange for the underlying securities or the cash equivalent should a sovereign nation default on its debt payments. Quoted in basis points per year, a CDS price indicates the cost per year to either buy or sell exposure to a sovereign defaulting or restructuring.

The main difference between a sovereign CDS and a corporate CDS is the definition of what constitutes a credit event. For a corporate, a credit event is a bankruptcy, a failure to pay, or sometimes, a restructuring. For Western European sovereigns, bankruptcy begins with a moratorium/repudiation.

Following ISDA,[7] we note that it is important to understand that sovereign CDSs are useful for controlling risk for investors and lenders. Sovereign CDSs provide effective hedges not only for holders of government bonds but also for international banks that extend credit to a particular country's corporations and banks, for investors in stocks and for entities that have significant real estate or corporate holdings in the country. For many of these participants, the sovereign CDS market is the most effective way of hedging credit risk in the country.[8]

Given the evident attractiveness of sovereign CDSs, it is not surprising to find that there is a broad set of investors using them. After the 2010 financial storm, ISDA reports that "recent anecdotal evidence indicates that banks with significant credit exposure to entities in Greece have been active purchasers of Greek Sovereign CDS protection".

As the debt crisis worsened, there were sharp declines in the affected countries' stock markets. Data in section 3 will confirm a strong inverse relationship: when credit premiums widen, stock market prices fall. At a firm level, finance theories suggest that the stock market, being efficient, should have already incorporated information pertaining to the default probability of firms. But what happens at a country level? Strictly speaking, there is no "equity" for countries, although it could be argued that the companies in any country are a proxy for "its equity" and that the credit information about a

[7] International Swaps and Derivatives Association, News Release, March 15, 2010.
[8] Liquidity in the Sovereign CDS market rose during 2009 and 2010: the net notional amounts outstanding on Sovereign CDS increased by 36% according to BIS (2010) data. In addition, if we look at the average number of trades per day we find countries like Spain and Portugal with increases of more than 30% in the number of trades, and Italy, Greece or France with rises in the number of daily trades of more than 50% (data source: The Depositary Trust and Clearing Corporation, DTCC, Trade Information Warehouse Data, 2010).

country would affect stock markets. Information about the wealth of a state will be embedded into the systematic discount factor that affects every company in that state.

Deteriorating credit quality in a country means that the government will need to raise funds at higher rates. This will cause a domino effect. There will be less money to invest and spend, with a high probability that taxes will be raised. As a result, levels of consumption and investment will fall, with a consequent reduction in company profits and a drop in their stock prices. Thus the credit risk problem also becomes a market risk problem and there is a vicious circle that becomes increasingly difficult to break because the relationship just described is not unidirectional: bad (or good) news related to the financial situation of a company in a country will affect the credit quality of that country' debt.

For these reasons, and given the relevance of the current financial crisis, especially as it affects sovereign credit risk, it is of interest to explore the links between the two markets: sovereign credit risk, proxied via CDS, and market risk, proxied via market stock indexes.

3 - An Exploratory Look at the Data

In this study we use the daily data of the closing price of 5-year sovereign CDS spreads and of stock indexes.[9] The benchmark maturity of sovereign CDSs tends to be five years, though contracts of 10 year maturity are also available. We use the mid-points between quoted bid and ask points for the 5-year maturity CDSs[10] denominated in USD. The sample contains data for eight European countries: Spain, Portugal, Italy, France, Ireland, United Kingdom, Greece and Germany. With regard to stock index prices, the sample contains the daily closing price for the IBEX 35 (Spain), the PSI 20 (Portugal), the FTSEMIB (Italy), the CAC 40 (France), the ISEQ 20 (Ireland), the FTSE 100 (United Kingdom), the FTSE Athex 20 (Greece) and the DAX (Germany).

This sample was selected in order to contrast our hypotheses. We needed a set of countries with a relatively high risk (i.e. countries with a high CDS premium), to document the relationship between stocks and CDSs

[9] Provided by Bloomberg; supplied by Credit Market Analytics (CMA) DataVision.
[10] The 5-Year CDS is more liquid and it is more often used as a reference in financial markets.

during and before the 2010 turmoil, and we needed safer countries (i.e. countries with lower credit risk premium) to find out if there was any difference in this relationship. These two subsamples can be found in Table 1.

Table 1

We report the CDS average premium for each country in 2010. Thus we can split the sample into groups: European countries with lower spreads (CDS average premium below 100 p. b) and European countries with higher spreads (CDS average above 100 p. b).

Country	CDS Average 2010
Greece	537,72
Portugal	217,32
Ireland	181,67
Spain	165,84
Italy	142,70
United Kingdom	81,42
France	60,55
Germany	38,30

Our sample coverage starts in January 2007 and ends in July 2010 and we analyze three different subsets: January 2007-December 2008; January 2009-December 2009; and January 2010-July 2010. Because the behavior of credit markets was so different during these sub periods, it was decided to examine the intertemporal stability of the co-movement of these markets.

Table 2 shows the main descriptive statistics for each country's CDS and stock index. It can be observed that the mean and median CDS premium for every country increased during 2010. In addition, daily changes in CDS and stock returns show significant kurtosis and skewness.

Spain

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	IBEX	ΔIBEX	VarIBEX	CDS	ΔCDS	VarCDS	IBEX	ΔIBEX	VarIBEX
N	924	923	924	898	897	898	140	140	140	137	137	137
Mean	66,0	0,5%	0,6%	11.957,1	-5,3%	0,0%	165,8	0,5%	0,7%	10.457,7	-0,1%	0,1%
Median	57,3	0,0%	0,3%	11.761,0	6,2%	0,0%	145,1	0,8%	0,5%	10.441,0	0,1%	0,0%
Maximum	274,9	75,6%	30,3%	15.945,7	1348,4%	0,4%	274,9	25,2%	5,7%	12.222,5	13,5%	0,3%
Minimum	2,6	-75,6%	0,1%	6.817,4	-958,6%	0,0%	93,8	-37,0%	0,1%	8.669,8	-6,9%	0,0%
Kurtosis	1,2	26,2	172,6	-1,2	6,7	15,4	-1,2	3,3	19,5	-0,8	9,7	10,0
Skewness	1,2	0,0	11,6	-0,1	0,3	3,6	0,5	-0,6	3,8	0,0	1,2	3,0

Portugal

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	PSI20	ΔPSI20	VarPSI20	CDS	ΔCDS	VarCDS	PSI20	ΔPSI20	VarPSI20
N	924	923	924	905	904	905	140	140	140	137	137	137
Mean	70,9	0,4%	0,5%	9.357,5	-6,2%	0,0%	217,3	0,8%	0,7%	7.646,8	-0,1%	0,0%
Median	47,7	0,0%	0,3%	8.479,3	1,7%	0,0%	192,3	0,4%	0,4%	7.569,3	0,0%	0,0%
Maximum	450,6	44,6%	5,2%	13.702,0	1019,6%	0,3%	450,6	20,5%	5,2%	8.839,8	10,2%	0,3%
Minimum	4,0	-47,4%	0,1%	5.743,1	-1037,9%	0,0%	81,4	-47,4%	0,1%	6.624,3	-5,5%	0,0%
Kurtosis	4,0	8,7	14,2	-1,4	8,4	23,5	-1,1	8,3	12,0	-0,8	7,3	11,6
Skewness	2,0	0,2	3,4	0,3	0,1	4,4	0,3	-1,2	3,2	0,3	0,9	3,1

Italy

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	FTSEMIB	ΔFTSEMIB	VarFTSEMIB	CDS	ΔCDS	VarCDS	FTSEMIB	ΔFTSEMIB	VarFTSEMIB
N	924	923	924	896	895	896	140	140	140	137	137	137
Mean	71,2	0,3%	0,3%	28.661,6	-9,7%	0,0%	142,7	0,3%	0,4%	21.434,9	-0,1%	0,0%
Median	60,4	0,0%	0,2%	24.344,0	0,0%	0,0%	130,0	0,2%	0,3%	21.501,2	0,1%	0,0%
Maximum	245,9	42,9%	3,9%	44.364,0	1087,4%	0,3%	245,9	19,7%	3,4%	23.811,1	9,9%	0,2%
Minimum	5,6	-43,7%	0,1%	12.621,0	-859,9%	0,0%	89,7	-43,7%	0,1%	18.382,7	-5,4%	0,0%
Kurtosis	-0,6	13,2	25,0	-1,4	5,3	13,4	-0,2	13,2	15,6	-1,1	5,7	6,0
Skewness	0,7	0,2	4,3	0,3	0,2	3,3	0,8	-1,7	3,6	-0,2	0,6	2,4

France

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	CAC	ΔCAC	VarCAC	CDS	ΔCDS	VarCDS	CAC	ΔCAC	VarCAC
N	924	923	924	904	903	904	140	140	140	137	137	137
Mean	26,8	0,4%	2,0%	4360,9	-6,9%	0,0%	60,5	0,7%	0,6%	3747,7	-0,1%	0,0%
Median	21,4	0,0%	0,5%	4038,7	-2,2%	0,0%	60,4	0,3%	0,6%	3739,5	0,0%	0,0%
Maximum	98,5	136,8%	82,4%	6168,2	1059,5%	0,4%	98,5	16,5%	1,7%	4065,7	9,2%	0,2%
Minimum	1,5	-131,1%	0,3%	2519,3	-947,2%	0,0%	29,7	-15,4%	0,3%	3331,3	-4,7%	0,0%
Kurtosis	-0,1	33,7	83,8	-1,3	5,9	18,0	-1,0	0,1	5,5	-1,2	5,9	9,5
Skewness	0,9	0,4	7,9	0,2	0,2	3,8	0,2	0,1	1,9	-0,2	0,6	2,9

Greece

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	FTSEAthex 20	ΔFTSEAthex 20	VarFTSE Athex20	CDS	ΔCDS	VarCDS	FTSEAthex 20	ΔFTSEAthex 20	VarFTSEAthe x20
N	924	923	924	882	881	882	140	140	140	133	133	133
Mean	154,1	0,5%	0,7%	1709,1	-10,8%	0,1%	537,7	0,8%	0,6%	904,6	-0,3%	0,1%
Median	79,3	0,0%	0,3%	1559,0	-0,6%	0,0%	419,7	0,2%	0,4%	938,1	-0,5%	0,1%
Maximum	1037,4	59,5%	21,9%	2841,2	1011,4%	0,4%	1037,4	23,1%	10,5%	1202,9	10,0%	0,3%
Minimum	5,2	-58,4%	0,2%	667,7	-979,6%	0,0%	247,0	-49,1%	0,2%	667,7	-7,6%	0,0%
Kurtosis	5,1	15,7	95,4	-1,6	2,2	7,5	-1,3	15,6	63,8	-1,2	0,6	4,6
Skewness	2,2	-0,1	8,3	0,1	-0,1	2,3	0,5	-2,0	7,3	-0,1	0,3	2,0

Ireland

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	ISEQ20	ΔISEQ20	VarISEQ20	CDS	ΔCDS	VarCDS	ISEQ20	ΔISEQ20	VarISEQ20
N	720	719	720	924	923	924	140	140	140	140	140	140
Mean	106,3	0,5%	-2,3%	5086,4	-0,1%	0,0%	181,7	0,3%	-11,7%	3063,8	0,0%	0,0%
Median	122,8	0,0%	0,9%	3465,0	0,0%	0,0%	155,2	0,0%	-11,4%	3035,8	0,0%	0,0%
Maximum	386,5	315,8%	3,1%	9981,1	10,0%	0,4%	287,8	26,8%	-8,5%	3497,2	7,6%	0,1%
Minimum	5,2	-32,7%	-15,5%	1916,4	-14,0%	0,0%	110,5	-32,7%	-15,5%	2776,6	-4,6%	0,0%
Kurtosis	-0,7	595,4	-0,4	-1,2	3,8	17,3	-1,2	7,9	-1,2	-0,2	2,3	2,5
Skewness	0,6	23,3	-0,9	0,6	-0,3	3,7	0,5	-0,2	-0,2	0,7	0,2	1,7

United Kingdom

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	FTSE100	ΔFTSE100	VarFTSE100	CDS	ΔCDS	VarCDS	FTSE100	ΔFTSE100	VarFTSE100
N	505	504	505	897	896	897	140	140	140	135	135	135
Mean	77,7	0,3%	0,2%	5.435,5	-2,9%	0,0%	81,4	-0,1%	0,1%	5.366,4	0,0%	0,0%
Median	79,1	0,0%	0,2%	5.473,5	2,4%	0,0%	80,9	-0,1%	0,1%	5.325,1	0,1%	0,0%
Maximum	164,9	26,9%	2,1%	6.732,4	938,4%	0,3%	94,7	10,4%	0,8%	5.825,0	5,0%	0,1%
Minimum	16,5	-17,7%	0,1%	3.512,1	-926,6%	0,0%	69,3	-14,4%	0,1%	4.805,8	-3,2%	0,0%
Kurtosis	0,5	7,8	74,5	-1,0	5,9	21,5	0,3	3,3	25,5	-1,0	2,3	2,5
Skewness	0,3	0,9	7,4	-0,3	-0,1	4,2	0,3	-0,4	4,4	0,0	0,1	1,6

Germany

	2007-2010						2010					
	CDS	ΔCDS	VarCDS	DAX	ΔDAX	VarDAX	CDS	ΔCDS	VarCDS	DAX	ΔDAX	VarDAX
N	924	923	924	897	896	897	140	140	140	137	137	137
Mean	22,1	0,3%	1,0%	6.187,4	-2,9%	0,0%	38,3	0,3%	0,7%	5.954,2	0,0%	0,0%
Median	19,6	0,0%	0,7%	6.183,5	6,9%	0,0%	40,3	0,1%	0,7%	5.984,8	0,2%	0,0%
Maximum	90,6	114,5%	17,8%	8.105,7	1079,7%	0,3%	56,9	13,7%	0,9%	6.332,1	5,2%	0,1%
Minimum	3,0	-87,9%	0,7%	3.666,4	-743,3%	0,0%	25,2	-11,4%	0,7%	5.434,3	-3,4%	0,0%
Kurtosis	1,2	43,0	78,4	-0,9	6,4	14,7	-0,9	1,0	1,7	-0,7	1,5	2,7
Skewness	1,1	0,6	8,1	-0,1	0,3	3,6	-0,1	0,1	1,5	-0,5	-0,1	1,8

For each country we show the main descriptive statistics, splitting the sample into two time series: January 2007-July 2010 and January 2010-July 2010. Also for each country, we include six different variables: CDS (sovereign CDS premium), ΔCDS (sovereign CDS premium daily changes), VarCDS (sovereign CDS premium variance calculated with a GARCH (1, 1)), stock index, stock index daily returns, and stock index variance (calculated with a GARCH (1, 1) of daily returns.

Figures 1 and 2 provide graphical evidence of the movements during the sample periods for both the CDS premiums and the stock indexes in Spain and Italy. Spreads on the CDS widen when deterioration in credit risk is detected or perceived by the market and tighten when less credit risk is perceived. It can be clearly observed that as the CDS premiums widen (the credit risk increases), the stock indexes fall (market risk also increases). Movements in both markets are inversely correlated.

Figure 1: Daily time series from Spain Sovereign CDS spread vs. IBEX 35 return.

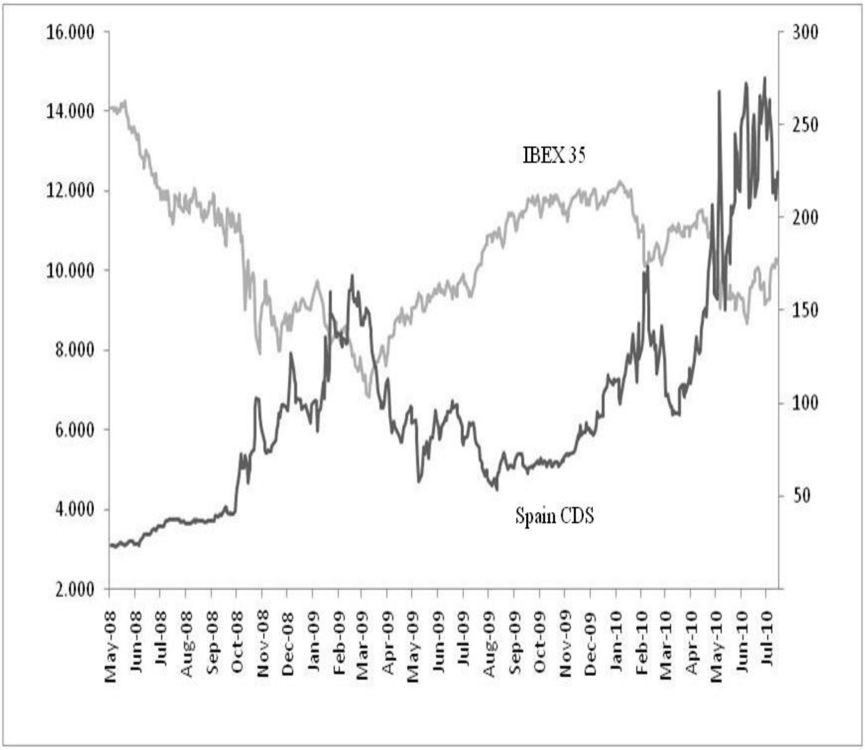
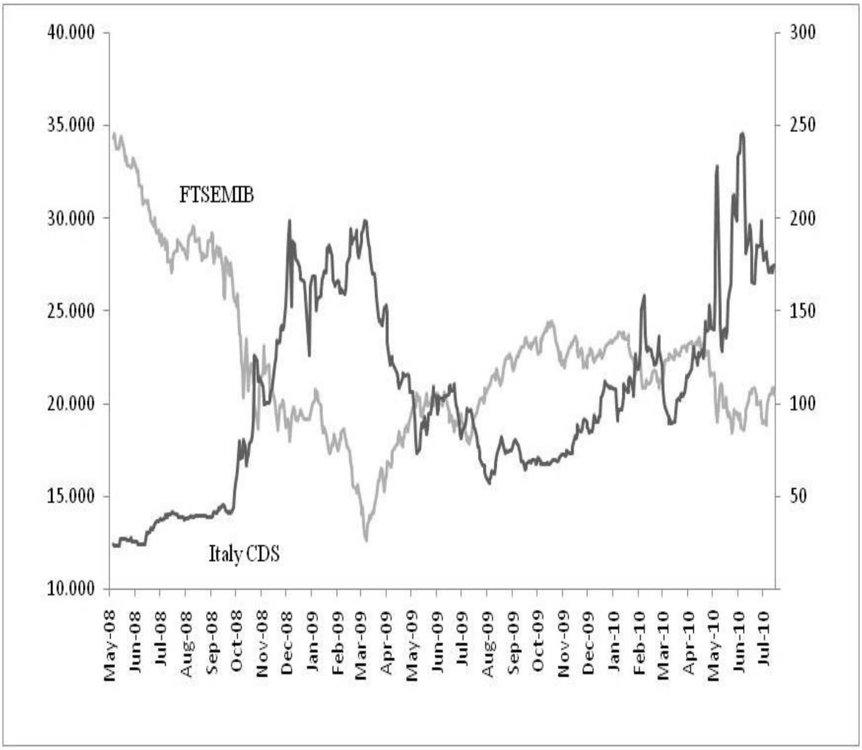


Figure 2: Daily time series from Italy Sovereign CDS spread vs. FTSE MIB return.



As one would expect, we find a large CDS spread when the stock market valuation is low and the volatility is high, and vice versa.

Table 3: shows Spearman´s rank correlation coefficients, calculated for a pair of country- specific time series (2007 to 2010): stock indexes S, CDS premium CDS; return stock indexes R, spread changes ΔCDS; log stock indexes volatility var ΔR and CDS premium volatility. ** mean significant correlation at a 5% level.

		ρ_s (R,CDS)	ρ_s (ΔR,ΔCDS)	ρ_s (var ΔR,var CDS)
Spain	2007-2008	-0,786**	-0,161**	-0,121**
	2009	-0,632**	-0,356**	0,366**
	2010	-0,814**	-0,507**	0,708**
Portugal	2007-2008	-0,815**	-0,144**	0,200**
	2009	-0,769**	-0,323**	0,309**
	2010	-0,883**	-0,567**	0,672**
Italy	2007-2008	-0,945**	-0,186**	0,402**
	2009	-0,799**	-0,423**	0,317**
	2010	-0,842**	-0,496**	0,718**
France	2007-2008	-0,863**	-0,060	- 0,226**
	2009	-0,854**	-0,271**	0,117
	2010	-0,837**	-0,430**	0,111
Greece	2007-2008	-0,773**	-0,144**	- 0,128**
	2009	-0,705**	-0,426**	0,422**
	2010	-0,926**	-0,576**	0,542**
Ireland	2007-2008	-0,485**	0,051	0,349**
	2009	-0,626**	-0,276**	0,673**
	2010	-0,270**	-0,223**	0,579**
United Kingdom	2007-2008	-0,763**	-0,234**	0
	2009	-0,768**	-0,245**	0,075
	2010	-0,468**	-0,439**	0,285**
Germany	2007-2008	-0,665**	-0,134**	0,142**
	2009	-0,894**	-0,236**	0,263**
	2010	-0,157*	-0,361**	0,086

The correlation coefficients are found to be significantly different from zero at the 0.10-level in almost all the countries and for each period. As expected, the correlation between sovereign CDSs and stock indexes is negative and higher when we size the risk and the stock prices in absolute terms. Furthermore when we size the correlation between changes in sovereign CDS and stock index returns we can clearly observe how these correlations have increased in time and become stronger. For almost every country in our sample, correlations between stock index returns and CDS spread changes reached maximum levels during 2010.

When we examine the variances, which we estimate with a GARCH (1, 1) model, the correlation, as expected, is positive. As the values of CDS variances increase, the values of the stock index variances also increase, and vice versa. However we find that these correlations with respect to the level of risk are more significant in the case of the countries with higher risk premiums, where we can also observe an increase in the size of the correlation. Germany, France and the UK, although they mainly show positive correlations between the risk of both markets, exhibit a weaker link.

All this statistical evidence confirms the connection between the sovereign credit market and the sovereign stock market and justifies more detailed empirical research.

Using the Augmented Dickey-Fuller test and the Phillips-Perron test we saw that while all series in levels were non-stationary, the first difference series were not. [11] This result allowed us to use a VAR model in the next section for the first-difference series. We also examined –see Table 4 below- possible serial correlation in the CDS changes and index returns series.

[11] Results are available upon request. Estimating the parameters in a VAR requires that the dependent and independent variables be covariance stationary, meaning that their first two moments exist and are time invariant. If they were not covariance stationary, but their first differences were, a vector-error correction model (VECM) could be used.

Table 4: p-values of Portmanteu test (Ljung-Box Test).

Series	2007-2010	2010
Spain CDS change	**0.0384**	**0.0028**
Return IBEX 35	**0.0003**	0.8943
Portugal CDS change	0.8334	**0.0187**
Return PSI20	**0.0330**	0.4128
Italy CDS change	0.5096	0.1230
Return FTSEMIB	**0.0000**	0.8264
France CDS change	**0.0000**	**0.0654**
Return CAC	**0.0000**	0.9264
Greece CDS change	**0.0000**	0.3193
Return FTSEAthex20	**0.0136**	**0.0440**
Ireland CDS change	1.0000	**0.0005**
Return ISEQ20	**0.0010**	0.5757
United Kingdom CDS change	**0.0001**	0.1056
Return FTSE100	**0.0000**	0.7701
Germany CDS change	**0.0000**	**0.0000**
Return DAX	**0.0000**	0.7866

As indicated by the Portmanteau test statistics, there are significant autocorrelations during the sample period for both markets. This is interesting since it indicates the existence of inefficient markets where predictable changes create profitable investment opportunities. VAR model results will confirm these findings. Data from 2010 show that autocorrelations for stock index returns disappeared during this year (except in the case of Greece), but there continues to be a significant autocorrelation effect in four CDS markets.

4 - Relationship between Sovereign CDS and Stock Markets

In this section, we analyze the intertemporal co-movement of sovereign CDS spread changes and stock index returns, using the VAR model to analyze the lead-lag relationship between both markets.

Previous literature (see Longstaff et al. (2003), Norden y Weber (2009) and Fung et al. (2008)) shows that the VAR model is appropriate for the analysis of the co-movement of markets because it captures lead-lag relationships within and between stationary variables in a simultaneous multivariate framework.

We estimate the following two dimensional VAR model

$$R_t = \alpha_1 + \sum_{p=1}^{p} \beta_{1p} R_{t-p} + \sum_{p=1}^{p} \gamma_{1p} \Delta CDS_{t-p} + \varepsilon_{1t}$$

$$\Delta CDS_t = \alpha_2 + \sum_{p=1}^{p} \beta_{2p} R_{t-p} + \sum_{p=1}^{p} \gamma_{2p} \Delta CDS_{t-p} + \varepsilon_{2t} \quad [1]$$

With R_t: stock index return in *t*,
ΔCDS_t: sovereign CDS spread change in *t*,
p: lag order index,
ε_t: disturbance term in *t*.

For the above model specification, the lag structure and the maximum lag order *p* have to be determined. For each country we found the optimal lag by computing the Akaike information criterion and the Schwarz Bayesian information criterion. In addition we used a Lagranger-Multiplier in order to confirm that there was no autocorrelation in the residuals in the lag order selected.

Evidence of VAR analysis results for the eight countries, with the corresponding optimal lag length, is found in Table 5. The entire time series sample is split into three different and non-overlapped subsets to generate a more detailed picture of the relationship between sovereign CDS and stock indexes. In addition, the estimation for the different time series will serve as robustness tests.

Table 5: Country-specific lead-lag analysis with two dimensional VAR model.The country-specific VAR model consists of two-equations with the log stock index return (R_t) and the CDS sovereign spread change (ΔCDS) as dependent variables respectively. This table shows the coefficients and the p-values. The latter indicate if the explanatory variable is significant for each country and for each period. The p-value for the Granger causality test (GC) is only highlighted in those cases in which p is significant at a 10% level.

Spain

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.05	0.10	-0.57	**0.00**	-0.09	0.04	-0.42	**0.01**	0.04	0.51	-0.99	**0.00**	-0.05	0.61	0.08	0.82
R_{t-2}	-0.06	0.06	-0.27	**0.04**	-0.08	0.07	-0.31	**0.07**	0.02	0.76	-0.55	**0.00**	-0.02	0.82	-0.01	0.96
R_{t-3}	-0.07	0.05	0.08	0.55	-0.08	0.06	-0.01	0.91	-0.09	0.19	0.08	0.68	-0.00	0.94	0.12	0.75
R_{t-4}	0.06	0.09	0.07	0.57	0.11	0.01	0.03	0.82	0.07	0.33	-0.08	0.66	0.05	0.61	-0.12	0.73
ΔCDS_{t-1}	-0.02	**0.02**	-0.24	0.00	-0.00	0.46	-0.36	0.00	-0.00	0.82	-0.04	0.48	-0.07	**0.01**	0.11	0.28
ΔCDS_{t-2}	-0.00	0.39	-0.09	0.01	-0.01	0.24	-0.09	0.06	-0.00	0.92	-0.02	0.00	0.06	**0.02**	-0.19	0.07
ΔCDS_{t-3}	-0.00	0.52	-0.03	0.30	-0.01	0.41	-0.00	0.87	-0.00	0.96	0.17	0.00	-0.04	0.12	-0.10	0.34
ΔCDS_{t-4}	0.01	0.12	0.08	0.01	-0.00	0.55	-0.01	0.76	0.01	0.52	-0.08	0.17	0.10	**0.00**	-0.32	0.00
Const.	-0.00	0.40	-0.00	0.00	-0.00	0.37	0.01	0.00	0.00	0.43	0.00	0.20	-0.00	0.32	0.00	0.30
Obs.	836		836		473		473		236		236		127		127	
R^2	0.02		0.07		0.03		0.12		0.01		0.18		0.20		0.17	
GC test		0.08		0.00		---		0.07		---		0.00		0.00		---

Portugal

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.00	0.84	-0.59	**0.00**	0.02	0.55	-0.53	**0.00**	-0.06	0.29	-1.04	**0.00**	-0.32	0.00	1,51	**0.00**
R_{t-2}	-0.04	0.18	-0.11	0.46	-0.03	0.43	-0.25	0.17	0.04	0.46	-0.54	**0.06**	-0.12	0.29	0.41	0.41
R_{t-3}	-0.03	0.40	0.39	**0.01**	-0.00	0.90	0.16	0.38	-0.07	0.25	0.21	0.47	-0.09	0.44	1.01	**0.04**
ΔCDS_{t-1}	-0.01	**0.02**	-0.07	0.03	-0.00	0.14	-0.24	0.00	-0.01	0.45	-0.12	0.05	-0.11	**0.00**	0.62	0.00
ΔCDS_{t-2}	-0.01	**0.07**	-0.04	0.20	-0.02	0.72	-0.10	0.02	-0.00	0.86	-0.03	0.61	0.00	0.80	-0.07	0.55
ΔCDS_{t-3}	-0.00	0.38	0.08	0.01	-0.01	**0.08**	0.08	0.08	0.01	0.39	0.21	0.00	-0.02	0.35	0.07	0.55
Const.	-0.00	0.19	0.00	0.02	-0.00	0.20	0.00	0.02	0.00	0.40	0.00	0.43	0.00	0.48	0.00	0.25
Obs.	851		851		482		482		240		240		129		129	
R^2	0.01		0.03		0.00		0.08		0.02		0.10		0.14		0.24	
GC test		0.05		0.00		---		0.01		---		0.00		0.0		0.00

Italy

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.02	0.49	-0.10	0.32	-0.09	0.05	0.09	0.50	0.86	0.22	-0.39	**0.00**	0.00	0.95	0.40	0.32
R_{t-2}	-0.05	0.17	-0.14	0.15	-0.11	0.01	-0.27	**0.04**	0.07	0.27	0.06	0.62	-0.20	0.85	0.06	0.87
R_{t-3}	-0.10	0.00	0.12	0.22	-0.15	0.00	0.08	0.52	-0.09	0.20	0.11	0.35	0.03	0.76	0.19	0.61
R_{t-4}	0.11	0.00	0.09	0.33	0.13	0.00	-0.24	**0.07**	0.13	0.05	-0.00	0.95	0.01	0.91	0.12	0.76
ΔCDS_{t-1}	-0.02	**0.06**	0.01	0.60	-0.01	0.27	-0.10	0.02	0.00	0.99	0.16	0.01	-0.04	**0.17**	0.33	0.00
ΔCDS_{t-2}	-0.00	0.45	-0.00	0.94	-0.03	**0.05**	0.01	0.79	0.03	0.43	0.05	0.45	0.05	**0.09**	-0.15	0.20
ΔCDS_{t-3}	-0.03	**0.01**	0.03	0.38	-0.04	**0.00**	0.11	0.01	-0.06	0.10	0.07	0.28	-0.04	0.19	-0.03	0.77
ΔCDS_{t-4}	0.00	0.58	-0.05	0.10	-0.04	**0.01**	0.01	0.67	0.05	0.13	-0.08	0.18	0.07	**0.01**	-0.11	0.30
Const.	-0.00	0.15	0.00	0.02	-0.00	0.15	0.00	0.01	0.00	0.90	0.00	0.89	-0.00	0.44	0.00	0.44
Obs.	824		824		461		461		236		236		127		127	
R^2	0.03		0.01		0.08		0.04		0.04		0.12		0.11		0.13	
GC test		0.04		---		0.00		0.08		---		0.02		0.03		---

France

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.09	0.00	-0.85	**0.00**	-0.13	0.00	-0.71	**0.05**	-0.01	0.82	-0.88	**0.00**	-0.11	0.21	-0.39	0.17
R_{t-2}	-0.07	0.03	-0.45	**0.05**	-0.11	0.01	-0.36	0.32	0.05	0.43	-0.41	**0.03**	-0.11	0.22	0.35	0.21
R_{t-3}	-0.08	0.01	-0.22	0.33	-0.10	0.02	-0.24	0.51	-0.05	0.46	0.00	0.96	-0.01	0.83	0.59	**0.04**
R_{t-4}	0.08	0.01	-0.20	0.38	0.12	0.00	-0.12	0.74	0.08	0.20	-0.40	**0.03**	-0.13	0.14	0.13	0.64
ΔCDS_{t-1}	-0.00	0.24	-0.37	0.00	-0.00	0.45	-0.41	0.00	0.01	0.57	0.03	0.56	-0.09	**0.00**	0.10	0.25
ΔCDS_{t-2}	-0.00	0.57	-0.18	0.00	-0.00	0.56	-0.21	0.00	0.02	0.26	-0.09	0.14	0.01	0.74	0.03	0.68
ΔCDS_{t-3}	-0.00	0.85	-0.10	0.00	-0.00	0.90	-0.13	0.00	0.01	0.57	0.10	0.09	-0.03	0.21	0.13	0.14
ΔCDS_{t-4}	-0.00	0.72	-0.15	0.00	-0.00	0.83	-0.17	0.00	-0.00	0.90	-0.15	0.00	-0.02	0.34	-0.10	0.26
Const.	-0.00	0.19	0.00	0.03	-0.00	0.08	0.01	0.05	0.00	0.66	0.00	0.75	-0.00	0.79	-0.00	0.16
Obs.	839		839		475		475		237		237		127		127	
R^2	0.02		0.14		0.05		0.16		0.02		0.15		0.11		0.09	
GC test		---		0.00		---		---		---		0.00		0.01		---

Greece

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	0.05	0.17	-0.54	**0.00**	0.06	0.21	-0.38	**0.06**	- 0.01	0.81	-0.34	**0.00**	0.10	0.40	0.07	0.81
R_{t-2}	-0.09	0.02	-0.20	**0.09**	-0.03	0.48	-0.13	0.53	-0.09	0.23	-0.03	0.80	-0.27	0.02	-0.12	0.67
ΔCDS_{t-1}	-0.01	0.23	-0.22	0.00	-0.00	0.77	-0.39	0.00	-0.06	**0.08**	0.00	0.96	0.00	0.97	0.27	0.02
ΔCDS_{t-2}	0.00	0.95	-0.16	0.00	0.00	0.48	-0.28	0.00	- 0.00	0.81	0.11	0.09	- 0.05	0.29	-0.19	0.11
Const.	-0.00	0.33	0.00	0.04	-0.00	0.16	0.00	0.03	0.00	0.55	0.00	0.91	-0.00	0.37	0.00	0.35
Obs.	697		697		366		366		219		219		112		112	
R^2	0.01		0.07		0.00		0.17		0.01		0.05		0.05		0.07	
GC test		---		0.00		---		---		---		0.03		---		---

Ireland

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	0.02	0.55	0.32	0.10	0.03	0.57	0.00	0.99	0.02	0.72	1.11	**0.06**	-0.20	0.02	0.45	0.14
R_{t-2}	-0.01	0.72	0.05	0.79	-0.03	0.48	-0.32	0.47	0.04	0.50	0.10	0.86	-0.06	0.46	0.14	0.65
ΔCDS_{t-1}	-0.00	0.64	0.03	0.39	-0.02	0.75	-0.15	0.00	-0.00	0.75	0.03	0.56	-0.07	**0.00**	0.32	0.00
ΔCDS_{t-2}	0.00	0.57	0.00	0.82	0.04	0.50	-0.00	0.90	0.00	0.67	0.01	0.82	0.02	0.33	-0.12	0.16
Const.	-0.00	0.11	0.00	0.22	-0.00	0.01	0.00	0.08	0.00	0.50	0.00	0.48	-0.00	0.94	0.00	0.56
Obs.	717		717		316		316		261		261		140		140	
R^2	0.00		0.00		0.00		0.02		0.00		0.01		0.07		0.09	
GC test		---		---		---		---		---		---		0.02		---

United Kingdom

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.02	0.56	-0.23	**0.02**	-0.04	0.70	-0.00	0.96	-0.03	0.62	-0.64	**0.00**	0.08	0.36	-0.23	0.29
R_{t-2}	-0.08	0.07	-0.26	**0.01**	-0.19	0.06	-0.23	0.21	0.04	0.48	-0.39	**0.01**	0.03	0.75	0.06	0.77
R_{t-3}	-0.09	0.04	-0.01	0.86	-0.11	0.26	0.04	0.79	-0.09	0.15	- 0.06	0.72	0.14	0.15	0.20	0.38
R_{t-4}	0.18	0.00	-0.15	0.12	0.20	0.04	-0.22	0.23	0.11	0.10	-0.05	0.77	0.02	0.83	-0.12	0.60
ΔCDS_{t-1}	0.02	0.52	0.03	0.51	0.07	0.18	0.09	0.39	0.02	0.39	-0.00	0.89	0.01	0.74	-0.23	0.01
ΔCDS_{t-2}	-0.00	0.20	0.09	0.04	-0.05	0.38	0.02	0.83	0.04	0.10	0.07	0.27	-0.00	0.86	0.12	0.18
ΔCDS_{t-3}	-0.02	0.87	0.05	0.21	0.00	0.90	-0.00	0.97	-0.01	0.47	0.12	0.04	-0.00	0.91	-0.01	0.88
ΔCDS_{t-4}	0.01	0.34	-0.09	0.05	0.00	0.97	-0.19	0.06	0.01	0.64	-0.04	0.50	0.04	0.21	-0.21	0.02
Const.	-0.00	0.51	0.00	0.08	-0.00	0.25	0.02	0.00	0.00	0.70	0.00	0.63	0.00	0.94	-0.00	0.35
Obs.	428		428		88		88		225		225		115		115	
R^2	0.0635		0.05		0.14		0.05		0.04		0.09		0.04		0.12	
GC test		---		0.01		---		---		---	0.00			---		---

Germany

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.03	0.260	-0.37	**0.06**	-0.06	0.16	-0.03	0.92	-0.00	0.90	-1.06	**0.00**	-0.07	0.45	0.22	0.46
R_{t-2}	-0.05	0.099	-0.31	0.12	-0.09	0.05	-0.32	0.30	0.02	0.67	-0.11	0.55	-0.12	0.19	0.33	0.26
R_{t-3}	-0.04	0.167	-0.37	**0.06**	-0.07	0.12	-0.51	0.10	0.01	0.84	-0.06	0.70	0.11	0.21	0.47	0.11
R_{t-4}	0.08	0.014	-0.27	0.17	0.10	0.02	-0.30	0.35	0.11	0.10	-0.15	0.38	-0.04	0.65	0.08	0.78
ΔCDS_{t-1}	- 0.00	0.747	-0.21	0.00	0.00	0.92	-0.25	0.00	-0.00	0.81	0.00	0.93	-0.06	**0.02**	0.37	0.00
ΔCDS_{t-2}	-0.00	0.250	-0.00	0.80	-0.00	0.18	-0.03	0.43	0.04	**0.07**	0.04	0.49	-0.02	0.33	0.08	0.39
ΔCDS_{t-3}	-0.00	0.615	-0.14	0.00	-0.00	0.34	-0.17	0.00	0.01	0.52	0.05	0.35	0.02	0.37	-0.14	0.11
ΔCDS_{t-4}	0.00	0.738	-0.11	0.00	0.00	0.96	-0.12	0.00	0.00	0.97	-0.08	0.11	0.00	0.83	0.07	0.44
Const.	-0.00	0.630	0.00	0.11	-0.00	0.26	0.00	0.14	0.00	0.53	0.00	0.54	0.00	0.75	0.00	0.44
Obs.	830		830		467		467		236		236		127		127	
R^2	0.01		0.07		0.03		0.09		0.02		0.15		0.08		0.19	
GC test		---		0.05		---		---		---	0.00			0.06		---

Lead-lag analyses are established on the basis of statistically significant coefficients. The analysis of the entire sample period (2007-2010) suggests that, for all the countries analyzed - except for Italy, where the CDS market leads the stock market, and for Ireland, where there is no apparent relationship between both markets - results are consistent with a leading role for the stock market. If we consider the different time series, it is noteworthy that the role of the CDS market becomes increasingly important over time. We can observe, for example, in the Spanish case for the entire sample period, that while sovereign CDS changes depend on the first and the second lags of the stock index return, the stock index returns only depend on the first lags of the sovereign CDS change. These results point to the leading role for the stock market during the period 2007-2010. From 2007 to 2009, the results show the same relationships: sovereign CDS changes depend on the first and the second lags of the stock index return, the latter does not depend on any CDS lag. However this relationship changes during 2010 when the CDS market moves ahead of the stock market: it can be seen that the stock index returns depend on the first, second and fourth lags of the CDS changes. Portugal or France are other good examples of this pattern, and in Italy, a similar pattern is observed: a strong role for the CDS market during the total 2007-2010 period with the exception of the year 2009, when the stock markets move ahead of the CDS market.

Although in other countries the data does not reveal this behavior with the same intensity, there is no evidence of other patterns that could lead us to different conclusions about the relationships between both markets. For instance, in the German case, for the total sample period the results show the leading role of the stock market, the sovereign CDS change depends on the first and the third lags of the stock index return. When considering the different non-overlapping periods, we find that for the years 2007, 2008 and 2010 the data does not reveal any relationship. However, during 2009, there is a feedback process between both markets.

After fitting a VAR, we want to know whether one variable “Granger-causes” another. A variable x is said to Granger-cause a variable y if, given the past values of y, past values of x are useful for predicting y. Note that Granger causality is not a causality in a deep sense of the word; it simply refers to linear prediction, and Granger causality is said to exist if one thing happens before another. There may be an unmodeled factor causing the response of *x* and *y*, and Granger causality will still be observed even though the real causality is different.

The test for Granger causality is a Wald test where the null hypothesis is that the lags of variable *x* do not Granger-cause variable *y*.

There is reciprocal Granger causality for a considerable number of countries, and there is evidence of a feedback process. The leading role of the stock exchanges throughout the period can be clearly appreciated. When the different subperiods are analyzed, a change in the lead-lag relationship becomes apparent. During 2009 the leading role of stocks becomes weaker, and finally, in 2010, the CDS market takes the lead in 6 out of the 8 countries. There is relatively little feedback during this year, corroborating the view that during the turmoil the CDS market has become the target where information and speculation is rapidly incorporated.

There is a clear increase in the model R^2 when the 2010 data is used, which indicates the greater suitability of this model during this period. Also, for almost all the significant coefficient cases, there is a correct negative sign, indicating an increase in credit risk with a decrease in stock market return.

4.1 - A three dimensional VAR model

As an additional check of the robustness of the results with respect to a potential omitted variable problem, we estimate a VAR model including the implicit volatility[12] of the stock indexes for these five countries: Spain, Greece, France, Germany and the UK. Implied stock volatility has already been used by Norden and Weber (2009) because it represents an important determinant of credit spreads[13]. Since we do not have at the money put options for sovereigns, we will use as a proxy the index puts.

[12] Daily data of the implicit volatility corresponds to at the money put options on each country's main stock index. We only found data available for the 5 above-mentioned countries.
[13] See Collin-Dufresne at al (2001). As we know, firms' options are very sensitive to decreases in the value of a firm. In this article, since we refer to stock index puts, it will be assumed that they are very sensitive to decreases in the value of a country's holdings.

We estimate the following three dimensional VAR model:

$$R_t = \alpha_1 + \sum_{p=1}^{p} \beta_{1p} R_{t-p} + \sum_{p=1}^{p} \gamma_{1p} \Delta CDS_{t-p} + \sum_{p=1}^{p} \varphi_{1p} \Delta volimplic_{t-p} + \varepsilon_{1t}$$

$$\Delta CDS_t = \alpha_2 + \sum_{p=1}^{p} \beta_{2p} R_{t-p} + \sum_{p=1}^{p} \gamma_{2p} \Delta CDS_{t-p} + \sum_{p=1}^{p} \varphi_{2p} \Delta volimplic_{t-p} + \varepsilon_{2t} \quad [3]$$

$$\Delta volimplic_t = \alpha_3 + \sum_{p=1}^{p} \beta_{3p} R_{t-p} + \sum_{p=1}^{p} \gamma_{3p} \Delta CDS_{t-p} + \sum_{p=1}^{p} \varphi_{3p} \Delta volimplic_{t-p} + \varepsilon_{3t}$$

with R_t being the stock index return of country *i* at time *t*, ΔCDS_t the change in sovereign CDS spread of country *i* at time *t*, $\Delta volimplic_t$ the change in the implicit volatility of country *i* at time *t*, *p* the lag order index and ε_{it} the disturbance term of country *i* at time *t*.

Table 6: This table shows the coefficients and the p-values. The latter indicate if the explanatory variable is significant for each country and for each period. The p-value for the Granger causality test (GC) is only highlighted in those cases in which p is significant at a 10% level, e.g. in the first column for Spain it can be seen that R_t GC causes both CDS changes and implied volatility changes.

Spain

	2007-2010						2010					
Dep.Var	R_t		ΔCDS_t		$\Delta Volimp_t$		R_t		ΔCDS_t		$\Delta Volimp_t$	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.02	0.57	-0.62	**0.00**	-1.26	**0.00**	-0.09	0.46	-0.00	0.99	-0.41	0.38
R_{t-2}	-0.05	0.16	-0.39	**0.00**	-0.41	0.12	0.03	0.77	-0.36	0.43	-0.25	0.59
ΔCDS_{t-1}	-0.01	**0.04**	-0.23	0.00	0.05	0.35	-0.10	**0.00**	0.22	0.03	0.38	**0.00**
ΔCDS_{t-2}	-0.00	0.55	-0.08	0.01	-0.00	0.91	0.05	0.10	-0.15	0.16	-0.17	0.11
$\Delta Volimp_{t-1}$	0.01	**0.03**	-0.02	0.23	-0.33	0.00	0.03	0.30	-0.16	0.13	-0.17	0.10
$\Delta Volimp_{t-2}$	0.00	0.69	-0.04	0.05	-0.08	0.02	-0.00	0.84	-0.10	0.31	0.08	0.43
Const.	-0.00	0.41	0.00	0.00	0.00	0.74	-0.00	0.47	0.00	0.44	0.00	0.53
Obs.	858		858		858		131		131		131	
R^2	0.01		0.06		0.08		0.00		0.06		0.00	
GC test R_t				---		---				0.00		---
GC test ΔCDS_t		0.00				---		---				---
GC test $\Delta Volimp_t$		0.00		---				---		0.00		

France

	2007-2010						2010					
Dep.Var	R_t		ΔCDS_t		$\Delta Volimp_t$		R_t		ΔCDS_t		$\Delta Volimp_t$	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.08	0.11	-0.92	**0.00**	-0.64	**0.00**	0.09	0.56	-0.14	0.76	-1.21	0.10
R_{t-2}	-0.06	0.23	-0.46	0.19	-0.21	0.26	-0.01	0.89	-0.28	0.54	-0.30	0.66
R_{t-3}	-0.13	0.01	0.02	0.95	-0.21	0.26	-0.26	0.08	0.43	0.36	-0.26	0.71
R_{t-4}	0.10	0.03	-0.56	0.11	-0.27	0.14	-0.23	0.13	0.04	0.92	1.44	**0.04**
ΔCDS_{t-1}	-0.00	0.23	-0.36	0.00	0.03	**0.05**	-0.10	**0.00**	0.12	0.18	0.35	**0.01**
ΔCDS_{t-2}	-0.00	0.56	-0.17	0.00	-0.00	0.91	0.01	0.59	0.04	0.61	0.16	0.26
ΔCDS_{t-3}	-0.00	0.82	-0.10	0.00	-0.00	0.62	-0.03	0.20	0.13	0.16	0.17	0.22
ΔCDS_{t-4}	-0.00	0.83	-0.16	0.00	-0.00	0.82	-0.02	0.37	-0.06	0.46	0.13	0.31
$\Delta Volimp_{t-1}$	0.00	0.80	-0.01	0.86	-0.21	0.00	0.06	0.06	0.03	0.73	-0.47	0.00
$\Delta Volimp_{t-2}$	0.00	0.77	-0.00	0.98	-0.10	0.04	0.01	0.64	-0.17	0.08	-0.26	0.08
$\Delta Volimp_{t-3}$	-0.01	0.18	-0.09	0.34	-0.00	0.93	-0.06	**0.04**	-0.04	0.65	-0.04	0.75
$\Delta Volimp_{t-4}$	0.01	0.44	-0.14	0.12	-0.09	0.06	-0.02	0.38	-0.03	0.77	0.12	0.43
Const.	-0.00	0.20	0.00	0.03	0.00	0.81	-0.00	0.78	0.00	0.19	-0.00	0.97
Obs.	839		839		839		127		127		127	
R^2	0.03		0.14		0.03		0.18		0.12		0.20	
GC test R_t				---		---				0.00		0.03
GC test ΔCDS_t		0.04				---		---				---
GC test $\Delta Volimp_t$		0.00		---				0.05		0.02		

Greece

	2007-2010						2010					
Dep.Var	R_t		ΔCDS_t		$\Delta Volimp_t$		R_t		ΔCDS_t		$\Delta Volimp_t$	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	0.03	0.36	-0.37	**0.00**	-0.19	**0.03**	0.15	0.20	0.12	0.73	-0.43	0.09
R_{t-2}	-0.23	0.00	-0.10	0.36	-0.18	0.05	-0.25	0.03	-0.25	0.48	-0.27	0.29
ΔCDS_{t-1}	-0.01	0.15	-0.20	0.00	0.06	**0.04**	-0.00	0.89	0.30	0.01	0.13	0.12
ΔCDS_{t-2}	-0.01	0.29	-0.14	0.00	0.01	0.67	-0.05	0.22	-0.16	0.16	-0.02	0.80
$\Delta Volimp_{t-1}$	-0.00	0.92	0.03	0.41	-0.23	0.00	0.05	0.20	-0.22	0.08	-0.36	0.00
$\Delta Volimp_{t-2}$	-0.01	0.26	-0.15	0.91	-0.06	0.05	-0.03	0.36	-0.05	0.65	-0.03	0.71
Const.	-0.00	0.20	0.00	0.05	0.00	0.98	-0.00	0.43	0.00	0.35	-0.00	0.80
Obs.	699		699		699		112		112		112	
R^2	0.04		0.06		0.06		0.08		0.09		0.20	
GC test R_t				---		---				---		---
GC test ΔCDS_t		0.002				---		---				---
GC test $\Delta Volimp_t$		0.018		---				---		---		

United Kingdom

	2007-2010						2010					
Dep.Var	R_t		ΔCDS_t		$\Delta Volimp_t$		R_t		ΔCDS_t		$\Delta Volimp_t$	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	0.02	0.77	-0.49	**0.00**	-0.41	0.12	0.33	0.05	-0.20	0.63	-0.73	0.48
R_{t-2}	-0.09	0.24	-0.34	**0.04**	0.00	0.99	-0.09	0.62	-0.22	0.61	0.84	0.44
ΔCDS_{t-1}	0.02	0.26	0.06	0.19	-0.12	0.09	0.00	0.91	-0.22	0.03	0.00	0.97
ΔCDS_{t-2}	-0.01	0.59	0.09	0.05	0.04	0.54	0.00	0.90	0.10	0.30	0.36	0.15
$\Delta Volimp_{t-1}$	0.02	0.30	-0.11	**0.01**	-0.12	0.11	0.06	**0.02**	-0.03	0.57	-0.16	0.33
$\Delta Volimp_{t-2}$	0.00	0.76	-0.03	0.43	-0.10	0.20	-0.01	0.55	-0.07	0.32	-0.03	0.84
Const.	-0.00	0.61	0.00	0.00	-0.00	0.95	0.00	0.96	-0.00	0.42	-0.00	0.98
Obs.	450		450		450		123		123		123	
R^2	0.02		0.04		0.02		0.03		0.07		0.07	
GC test R_t				---		---				---		0.08
GC test ΔCDS_t		0.00				0.04		---				---
GC test $\Delta Volimp_t$		---		---				---		---		

Germany

	2007-2010						2010					
Dep.Var	R_t		ΔCDS_t		$\Delta Volimp_t$		R_t		ΔCDS_t		$\Delta Volimp_t$	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.00	0.96	-0.78	**0.01**	-0.26	0.19	-0.15	0.32	-0.326	0.545	1.07	0.23
R_{t-2}	-0.00	0.88	-0.61	0.05	0.03	0.88	-0.18	0.24	-0.052	0.922	1.18	0.19
R_{t-3}	-0.06	0.22	-0.27	0.39	0.26	0.19	-0.18	0.24	0.462	0.383	0.83	0.35
R_{t-4}	0.06	0.23	-0.02	0.92	-0.25	0.21	-0.33	0.03	0.374	0.480	2.42	**0.00**
ΔCDS_{t-1}	-0.00	0.75	-0.21	0.00	0.00	0.77	-0.07	**0.00**	0.371	0.000	0.45	**0.00**
ΔCDS_{t-2}	-0.00	0.21	-0.00	0.88	0.02	0.24	-0.03	0.22	0.104	0.272	0.35	**0.02**
ΔCDS_{t-3}	-0.00	0.60	-0.14	0.00	0.00	0.69	0.03	0.28	-0.112	0.247	-0.11	0.46
ΔCDS_{t-4}	0.00	0.72	-0.11	0.00	0.00	0.81	0.02	0.37	0.081	0.378	-0.12	0.41
$\Delta Volimp_{t-1}$	0.01	0.36	-0.14	0.08	-0.12	0.02	-0.00	0.85	-0.120	0.202	-0.06	0.66
$\Delta Volimp_{t-2}$	0.01	0.25	-0.09	0.24	-0.05	0.33	-0.01	0.61	-0.104	0.271	-0.03	0.84
$\Delta Volimp_{t-3}$	-0.00	0.65	0.03	0.65	-0.03	0.56	-0.06	**0.02**	-0.037	0.689	0.23	0.12
$\Delta Volimp_{t-4}$	-0.00	0.65	0.07	0.37	-0.02	0.65	-0.07	**0.00**	0.037	0.684	0.40	0.01
Const.	-0.00	0.64	0.00	0.11	0.00	0.88	0.00	0.73	0.003	0.443	-0.02	0.84
Obs.	830		830		830		127		127		127	
R^2	0.01		0.07		0.02		0.01		0.042		0.07	
GC test R_t				---		---				0.00		0.01
GC test ΔCDS_t		0.04				---		---				---
GC test $\Delta Volimp_t$		---		---				0.02		0.00		

The country-specific VAR model consists of three-equations with the log stock index return (R_t), the CDS sovereign spread change (ΔCDS) and the implied volatility change (ΔVolimp) as dependent variables respectively. This table shows the coefficients and the p-values. The latter indicate if the explanatory variable is significant for each country and for each period. The p-value for the Granger causality test (GC) is only highlighted in those cases in which p is significant at a 10% level, e.g. in the first column for Spain it can be seen that R_t GC causes both CDS changes and implied volatility changes.

Overall results continue to be consistent with the fact that the stock markets led the CDS markets. Now the stock market is also found to lead the implied volatility movements.[14] We also observe the same turnaround in this relation during 2010 for three (Spain, France and Germany) out of the five countries, when CDS markets become the protagonists. There is no evidence of a leading role for the implicit volatility. Results for the two dimensional VAR model are corroborated.

4.2 - Panel Data Model

To provide a more complete insight into the relationship of the sovereign CDS and stock indexes a final test was performed: an estimation of the panel data model with the following structure:

$$R_{it} = \alpha_i + \sum_{p=1}^{p} \beta_p R_{t-p} + \sum_{p=1}^{p} \gamma_p \Delta CDS_{t-p} + \varepsilon_{it}$$

$$\Delta CDS_{it} = \alpha_i + \sum_{p=1}^{p} \beta_p R_{t-p} + \sum_{p=1}^{p} \gamma_p \Delta CDS_{t-p} + \varepsilon_{it} \qquad [2]$$

with R_t being the stock index return of country *i* at time *t*, ΔCDS_t the change in sovereign CDS spread of country *i* at time *t*, *p* the lag order index and ε_{it} the disturbance term of country *i* at time *t*.

[14] A similar result can be found in Alexander and Kaeck (2008).

Following Nickell (1980) we use a panel model with fixed effects.[15] Norden and Weber (2004) also follow this approach. Panel regressions confirm the previous results: the stock market clearly leads the CDS market, which supports the view that the stock market is relatively more sensitive to new information and more liquid. However we can observe a strong feedback process. These results are robust to time divisions.

Table 7: Aggregate lead-lag analysis with fixed-effect panel regressions. For each market (stock and CDS), fixed panel regressions are estimated to study the aggregate lead lag relationship across markets. Coefficients and p-values from fixed-effect models are shown. For each of the two equations in each panel, the overall R^2 (which is close to the within R^2) is given. The first table refers to seven countries (we exclude the United Kingdom because it has a different currency) and, the second and third refers to European countries with lower (France and Germany) and higher (Spain, Portugal, Italy, Greece and Ireland) spreads.

All the countries

	2007-2010				2007-2008				2009				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.01	0.27	-0.31	**0.00**	-0.03	0.04	-0.24	**0.00**	0.02	0.42	-0.36	**0.00**	-0.09	0.02	0.26	**0.05**
R_{t-2}	-0.07	0.00	-0.12	**0.05**	-0.12	0.00	-0.23	**0.00**	0.02	0.39	-0.08	**0.50**	-0.09	0.01	0.20	0.13
R_{t-3}	-0.04	0.00	0.05	0.40	-0.07	0.00	-0.11	0.21	-0.02	0.36	0.10	0.42	-0.03	0.44	0.46	**0.00**
R_{t-4}	0.05	0.00	0.01	0.85	0.07	0.00	-0.15	0.08	0.09	0.00	-0.01	0.90	-0.01	0.73	0.34	**0.01**
R_{t-5}	-0.09	0.00	-0.00	0.92	-0.16	0.00	-0.16	0.07	-0.00	0.91	0.22	0.07	0.01	0.64	0.07	0.61
ΔCDS_{t-1}	-0.00	**0.00**	-0.17	0.00	-0.00	0.22	-0.33	0.00	-0.00	0.50	0.01	0.47	-0.07	**0.00**	0.28	0.00
ΔCDS_{t-2}	-0.00	**0.06**	-0.04	0.00	-0.01	**0.01**	-0.13	0.00	0.00	0.45	-0.00	0.98	0.01	0.13	-0.08	0.05
ΔCDS_{t-3}	-0.00	0.21	-0.03	0.02	-0.00	**0.03**	-0.09	0.00	-0.00	0.87	0.03	0.21	-0.03	**0.00**	0.01	0.67
ΔCDS_{t-4}	0.00	0.10	-0.08	0.00	-0.00	0.17	-0.12	0.00	0.01	0.03	-0.02	0.24	0.05	**0.00**	-0.14	0.00
ΔCDS_{t-5}	0.00	0.97	-0.03	0.01	-0.00	0.66	-0.06	0.00	0.00	0.85	-0.02	0.37	-0.01	**0.09**	0.09	0.01
Const.	-0.08	0.00	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.21	-0.00	0.14	0.00	0.01
Obs.	5423		5506		2938		2990			1625		1647		860		869
R^2	0.02		0.03		0.05		0.10			0.01		0.01		0.09		0.14

15 Nickell (1980) shows that for samples with large time series observations and a relatively small number of *N* (countries), a panel data model with fixed effects is appropriate. See also Baltagi (2005), Cameron and Trivedi (2005).

European countries with lower spreads

	2007-2010				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.04	0.10	-0.63	**0.00**	-0.06	0.43	-0.11	0.65
R_{t-2}	-0.06	0.00	-0.38	**0.00**	-0.07	0.30	0.34	0.16
R_{t-3}	-0.08	0.00	-0.12	0.33	0.04	0.57	0.37	0.12
R_{t-4}	0.09	0.00	-0.23	**0.07**	-0.08	0.24	0.14	0.55
R_{t-5}	-0.09	0.00	-0.24	**0.06**	0.05	0.44	0.05	0.81
ΔCDS_{t-1}	-0.00	**0.07**	-0.32	0.00	-0.07	**0.00**	0.21	0.00
ΔCDS_{t-2}	-0.00	0.17	-0.13	0.00	0.03	0.17	-0.04	0.58
ΔCDS_{t-3}	-0.00	0.19	-0.08	0.00	-0.03	0.14	0.05	0.47
ΔCDS_{t-4}	-0.00	0.58	-0.17	0.00	0.02	0.21	-0.15	0.04
ΔCDS_{t-5}	0.00	0.52	-0.08	0.00	-0.03	0.89	0.13	0.06
Const.	-0.00	0.03	0.00	0.00	-0.00	0.44	0.00	0.17
Obs.	1639		1661			250		252
R^2	0.03		0.11			0.09		0.10

European countries with higher spreads

	2007-2010				2010			
Dep.Var	R_t		ΔCDS_t		R_t		ΔCDS_t	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
R_{t-1}	-0.01	0.30	-0.43	**0.00**	-0.08	0.14	0.43	**0.03**
R_{t-2}	-0.12	0.00	-0.19	**0.01**	-0.11	0.04	0.12	0.52
R_{t-3}	-0.04	0.00	-0.02	0.77	-0.08	0.14	0.58	**0.00**
R_{t-4}	0.04	0.02	-0.03	0.68	-0.01	0.85	0.33	**0.08**
R_{t-5}	-0.12	0.00	-0.01	0.84	0.00	0.95	0.17	0.39
ΔCDS_{t-1}	-0.01	**0.00**	-0.19	0.00	-0.07	**0.00**	0.33	0.00
ΔCDS_{t-2}	-0.01	**0.00**	-0.06	0.00	0.01	0.50	-0.10	0.07
ΔCDS_{t-3}	-0.00	0.13	-0.05	0.00	-0.04	**0.01**	0.05	0.38
ΔCDS_{t-4}	0.00	0.39	-0.08	0.00	0.05	**0.00**	-0.16	0.00
ΔCDS_{t-5}	-0.00	0.21	-0.04	0.02	-0.03	**0.05**	0.13	0.02
Const.	-0.00	0.08	0.00	0.00	-0.00	0.19	0.00	0.05
Obs.		3070		3131		470		477
R^2		0.03		0.04		0.11		0.17

If we divide the panel into two groups - countries with high CDS premium (Greece, Ireland, Spain, Portugal and Italy) and countries with lower risk premium (Germany, France)[16] - it becomes clear that the leadership of the CDS markets during 2010 was strengthened by the financial turmoil in Southern Europe. We can appreciate a more modest leading role of CDSs in the countries with lower spreads.

Recent work by Coudert and Gex (2010) looks at the links between sovereign CDSs and bonds and their results align with ours. Using a sample of sovereigns (and some corporates), the leading role of the CDS markets versus the bond markets is once more confirmed. Coudert and Gex find that the CDS market lead has been fuelled by the current crisis, although they find that for countries with low risk, the bond market has the lead on the CDS market.

5 - Conclusions

In this paper we have studied the relationship between stock index prices and the sovereign CDS market, using daily data from January 2007 to July 2010.

First, analyzing the country-specific market co-movements, we find that stock index returns and sovereign CDS spread changes show a significantly negative correlation. Second, stock index return volatility is also found to be considerably related to sovereign CDS spread movements, revealing a close link between both markets. Moreover, these correlations are more significant in the case of the countries with higher credit risk premiums (Italy, Greece, Spain, Italy and Portugal). However countries with lower CDS spreads (France, Germany and UK) show positive but weaker correlations between both markets.

Given the previous literature and these significant correlations, we use a VAR framework to examine the lead-lag relations between the sovereign credit-derivatives and the stock market. Stock indexes and sovereign CDS are generally expected to be contemporaneous but not cross-serially correlated if information is simultaneously embedded into these securities' prices. If the public and private information is not simultaneously embedded, a lead-lag

[16] We do not include here data from the UK due to the fact that it has a different currency.

relationship between the prices in the two markets can be observed. We find evidence that changes in stock price returns lead changes in sovereign CDS spreads during the period January 2007 to December 2009. In contrast, during the last period analyzed (January 2010-July 2010) sovereign CDSs lead stock markets.

To control for an omitted variables bias, implied market volatility is introduced in our analysis but there is no evidence of a link between it and the CDSs.

Finally, in order to test further the significance of these results, we estimate a panel data with all the countries and with the two subsamples (countries with higher and lower CDS spreads). Panel regressions confirm the previous results: the stock market clearly leads the CDS market, which supports the view that the stock market is relatively more sensitive to new information and more liquid. However we can observe a strong feedback process. These results are robust to time divisions.

If we divide the panel into two groups, - countries with high CDS premium (Greece, Ireland, Spain, Portugal and Italy) and countries with lower risk premium (Germany, France) – it can be seen that the leadership position of the CDS markets during 2010 was strengthened by the financial turmoil in Southern Europe. There is a more modest leading role of CDSs in the countries with lower spreads.

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