Facultad de Ciencias Sociales de Cuenca

Documento de trabajo
SEMINARIO PERMANENTE DE CIENCIAS SOCIALES

BANK CDS SPREADS AND BANKING FRAGILITY

Laura Ballester
Barbara Casu
Ana González-Urteaga

SPCS Documento de trabajo 2013/9
http://www.uclm.es/CU/csociales/DocumentosTrabajo

Facultad de Ciencias Sociales de Cuenca | Avda. de los Alfares, 44 | 16.071–CUENCA
Teléfono (+34) 902 204 100 | Fax (+34) 902 204 130

Autores:
Laura Ballester
laura.ballester@uv.es
Barbara Casu
b.casu@city.ac.uk
Ana González-Urteaga
ana.gonzalezu@unavarra.es

Edita:

Facultad de Ciencias Sociales de Cuenca
Seminario Permanente de Ciencias Sociales
Codirectora: Pilar Domínguez Martínez
Codirectora: Silvia Valmaña Ochaita
Secretaria: María Cordente Rodríguez
Secretaria: Nuria Legazpe Moraleja
Avda. de los Alfares, 44
16.071–CUENCA
Teléfono (+34) 902 204 100
Fax (+34) 902 204 130
http://www.uclm.es/CU/csociales/DocumentosTrabajo

I.S.S.N.: 1887-3464 (ed. CD-ROM) 1988-1118 (ed. en línea)
D.L.: CU-532-2005

Impreso en España – Printed in Spain.

BANK CDS SPREADS AND BANKING FRAGILITY

Laura Ballester Miquel[*]

Universidad de Valencia

Barbara Casu Lukac

Cass Business School. City University London

Ana González-Urteaga[†]

Universidad Pública de Navarra

ABSTRACT

This paper empirically investigates the relationship between bank CDS spreads and banking fragility analysing: (i) the existence of common factors in the European and US bank CDS returns; (ii) the impact of the degree of co-movements between bank CDS, the iTraxx CDS market index and the sovereign debt CDS market. The sample covers the period January 2004 to March 2012, which allows us to investigate different sub-periods including the most recent debt crisis one. Our results are indicative of a change in the correlation structure of bank CDS returns due to the financial and actual sovereign debt crisis. During financial stability we find the natural relationships between iTraxx and bank CDS returns. The burst of the subprime crisis leads to iTraxx, which causes bank and sovereign debt CDS. The latter started to have a central role after 2010, during the notional debt troubles of some euro-zone countries, being the one who exclusively cause iTraxx and bank CDS returns.

Keywords: CDS spreads, large financial institutions, financial stability, financial crisis.

JEL-codes: G15, G21, C58

---

[*] Corresponding author: Laura.Ballester@uv.es. Laura Ballester would like to express her gratitude for the funding received from UV-INV-PRECOMP-80704 and PEII11-0031-6939.

[†] Ana González-Urteaga acknowledges financial support from ECO2009-12819-C03-01.

1. INTRODUCTION

The world financial system experienced a period of severe crisis during 2007-2009. Many of the factors that have contributed to the financial turmoil are similar to previous crises, such as the loose monetary policy or the intense competition; however, in the current crisis the key elements are the various ways through which banking firms have dramatically increased their risk transfer activities with different modalities of banking risk to the financial system. After that, during 2010, the country risk crisis evidenced the need to identify whether corporate sector credit default swaps (CDS, hereafter) spreads, especially bank CDS spreads, are linked to sovereign CDS spreads. The direct reaction of this sovereign debt crisis is that major banks of Europe and US were in distress and state intervention was required in order to mitigate systemic risk and its negative macroeconomic consequences.

It is noteworthy that for the first time the Basel Committee on Banking Supervision (BCBS) recognizes credit risk transfer instruments like CDS in a new capital adequacy framework for banks. In order to mitigate the possible effects in futures financial crises the BCBS has established a set of measures related with capital and liquidity, Basel III, with the objective to enhance the solvency of the banking system. One of the main changes in the Basel III reforms is the improvement of risk coverage, concretely the counterparty credit risk (Pillar 1) and the improvement of the risk management and supervision (Pillar 2) and market discipline (Pillar 3).

Large Financial Institutions (LFIs) are highly interconnected through derivative contracts and the default of one might trigger losses for counterparties, producing further defaults. This is the idea of the logic “too-big-to-fail”. After the financial crisis started in 2007, the importance of credit risk in the banking sector has increased and the search of a market price-based signal as indicator of the bank fragility is considered an important issue. In this sense, a greater understanding of the relationships between the CDS market, specifically bank CDS spreads, and measures of financial stability is of crucial importance in terms of supervision, regulation, market discipline and also for practitioners and academics.

The importance of the credit derivatives market has increased substantially in recent years and credit derivatives have begun to be actively traded in financial markets.

The use of the most common type of credit derivative, CDS, surged dramatically for financial institutions during the financial crisis. After the bankruptcy of Lehman Brothers, the fourth inversion bank in US, on September 2008, financial markets experienced tremendous disruptions and credit spreads widened to unprecedented levels. This fact had important consequences for the financial system not only in the domestic US market but also at the international level.

A CDS is essentially an insurance contract against a credit event of a specific reference entity. The CDS spread is the periodic rate that a protection buyer pays on the notional amount to the protection seller for transferring the risk of a credit event for some period. Since late 2008, the CDS market has attracted considerable attention and CDS are considered a good proxy for bank riskiness and default probability. The system´s financial stability is defined when there is a uniform reaction of the institution's risk profile, following a common credit market shock across systematically important global banks. Moreover, CDS spreads reflect market perceptions about the financial health of credit institutions and can be used by prudential authorities to extract warning signals regarding financial stability. Large capital losses in systemic banking firms can affect to the banking system's financial stability; for this reason CDS spreads must be monitored and measured.

The importance of study exclusively the banking sector is focus on their role as financial intermediaries in the economy, both as providers of liquidity transformation and monitoring services. Moreover, between 2000 and 2008, the derivatives market increased from $900 billion to more than $30 trillion, taking into account that, in contrast to traditional insurance, credit default swaps are totally unregulated market. For this reason, they played a pivotal role in the global financial crisis in late 2008 causing specially damage to the banking sector and consequently, over the financial stability.

In this sense, despite the importance of bank credit risk in the financial markets, relatively little research exploring the commonality in CDS spreads has appeared in the literature about CDS market. In this paper we focus our attention on two features of the relationship between bank CDS and banking fragility. Firstly, we analyse the existence of common factors in European and US bank CDS returns with the objective to determine the existence of common sources that would satisfactorily explain the correlations among bank CDS returns. Secondly, especially in the light of the present debt crisis, we study, with a multivariate model of co-movements, the propagation mechanism among CDS spreads for LFIs, the iTraxx CDS index and sovereign debt CDS returns.

The results of the empirical analysis are indicative of a change in the correlation structure of CDS returns due to the financial crisis. Before July 2007 CDS spreads exhibited a limited amount of co-movement. The onset of the subprime crisis and its continuity mostly for Europe shifts the correlation structure of CDS returns. The overall market situation reveals to be crucial. During financial stability we find the natural relationships between iTraxx and bank CDS returns, one cause the other and vice versa. Intertemporal co-movements changed after the burst of the subprime crisis. It leads to iTraxx which causes bank and sovereign debt CDS. From 2009-2012 the model confirms the power of sovereign debt CDS explaining future changes in banks' CDS

Our study differs from previous studies in three ways. We extract common factors in CDS spreads but focusing on the most important banking firms in Europe and US. Moreover, we want to check whether these common factors are different between geographical areas, whether they depend on the size of the bank, and distinguishing by pre, crisis and post-crisis periods. Finally, we study the dynamic coevolution among three important variables in CDS market: bank, iTraxx and sovereign CDS returns to cover banking, corporate and sovereign sector.

The remainder of the paper is organized as follows. Section 2 reviews the existing literature. Section 3 describes the data set and describes how bank CDS returns are calculated and section 4 analyses their correlation structure. Section 5 presents the results of the lead-lag relationships between banks and sovereign CDS returns. Finally, Section 6 draws some concluding remarks.

2. LITERATURE REVIEW

In recent years several studies have focused on the relationship between CDS market and capital regulation and bank fragility. These works can be classified into five strands of literature according to the topics, market and main purposes studied.

The first group deals with capital regulation for LFIs due to the fact that, during the recent financial crisis, the US banking sector lost big amounts of money derived from its exposure to residential mortgage securities. Theoretical papers as Kashyap et al. (2008) follow this approach. Following the idea of establishing a new capital regulation for LFIs, Hart and Zingales (2011) design a new capital requirement for LFIs that are "too big to fail". This mechanism, rather than micromanaging the activities of a LFIs, proposes to implement an early warning system that will alert the regulator to the fact that a LFIs is in trouble. This system mimics the way margin calls function and avoid the too big to fail and the political economy problems.

The second strand of research is formed by several papers whose principal objective is to analyse the relationship between CDS and bond markets (Longstaff et al. (2005), Delatte et al. (2011), among others). For the sovereign and financial sector, studies by Aktung et al. (2009), Ammer and Cai (2007) and Coudert and Gex (2011) investigate during the period of financial crisis how CDS and bond spreads adjust to each other and determine which one is the leading market in the price discovery process.

A third group of papers examine the relationship between CDS spreads and the stock market with different perspectives. In this sense, we can distinguish papers focused on the corporate sector using equity and iTraxx CDS indices, such as Berndt and Obreja (2010) that investigate the sources of common variation in returns for European CDS. For the particular case of the banking industry, Calice et al. (2011) investigate the potential impact of CDS indices on the global financial system for the pre-crisis period, specifically the impact of the degree of co-movements in the LFIs equity returns, as a market-measure of banks' fragility, and the most liquid CDS market indices. The only recent paper related to CDS spreads and equity prices that examines the banking sector at the individual level is Demirguc-Kunt and Huizinga (2010). This work investigates the impact of government debt and deficits on bank stock prices for an international sample of banks, making a distinction between systemically important and smaller banks, and they also consider the impact of government finances on expected losses on bank's liabilities as reflected in CDS spreads.

In sovereign market, Longstaff et al. (2011) study credit risk using a set of sovereign CDS contracts for 26 developed and emerging countries. In the same line, Pan and Singleton (2008) explore the time-series properties of the risk-neutral mean arrival rates of credit events implicit in the term structures of sovereign CDS spreads for Mexico, Turkey and Korea. To our best knowledge, Norden and Weber (2009) is the only paper that explores the relationship between CDS spreads, bond and stock markets at international level focusing on the intertemporal co-movement and the dynamic adjustment process between these markets in the period 2000-2002. With different perspective, Forte and Peña (2007) show that the stock market leads credit risk markets expressed by CDS and bond spreads.

And finally, the fifth strand of literature is related to the determinants or drivers of the CDS market. The credit risk literature identifies two different approaches in this sense: the structural and reduced form approach. Regarding the factors related with the CDS spreads, we can distinguish between papers focused on the banking industry such as Annaert et al. (2010), Chiaramonte and Casu (2012) and Demirguc-Kunt and Huizinga (2010)), and focused on the determinants and transmission in the sovereign markets such as Hull et al. (2004) and Longstaff et al. (2011).

However, the review of the recent literature about CDS market shows that there are few papers that address the issue of the potential impact of CDS on financial stability probably because the financial sector is considered an opaque industry where traditional credit risk models are likely to be less successful. Some exceptions are the previous mentioned papers like Annaert et al. (2010), Chiaramonte and Casu (2012) and Demirguc-Kunt and Huizinga (2010) and Calice et al. (2011).

To the best of our knowledge, there are no papers focusing on studies on detailed CDS spreads exclusive for the banking sector (also at individual-firm level) in both Europe and US markets. Moreover, we doesn´t found clear evidences about the propagation mechanism between bank CDS returns and other reference variables in the same market, as sovereign debt CDS returns and iTraxx index returns with a sample period that includes the 2007-2012 financial crisis.

This paper makes several scientific contributions to the related literature. Firstly, this will be the first study in CDS markets exclusively focused on the European and US banking industry with a large sample period that includes pre and crisis period until today covering from 2004 to 2012. The second contribution is to construct CDS returns series with CDS spreads applying Berndt an Obreja (2010) methodology for the first time exclusively for the banking industry. The third contribution is to investigate common factors in bank CDS returns using principal component analysis identifying patterns of commonality in the variation of CDS returns across all the banks in the sample. Finally, the last new contribution is to estimate a multivariate model to study the coevolution beetween three important variables in CDS market: bank, iTraxx and sovereign CDS returns to cover banking, corporate and sovereign sector.

3. DATA

3.1. CDS spreads

The sample consists of daily CDS spreads for the LFIs in Europe and US collected from Thomson Datastream database concretely obtained by CMA New York. The CDS spread shows the CDS premium mid, that is, the mid rate spread between the entity and the relevant benchmark curve expressed in basis points. CMA receives CDS prices (spreads) from a range of market contributors. These contributors consist of both buy and sell side institutions active in the fixed income markets such as asset managers, hedge funds and banks. These active market participants provide CMA with both real-time and delayed prices of executed trades, firm or indicative bid/offers on a specific entities, tenors, seniorities and restructuring types.

The sample covers the period January 2004 to March 2012[1]. This period of study allows us to investigate three sub-periods: the pre-crisis period between January 2004 and June 2007, the subprime crisis period between July 2007 and September 2009, and then, from October 2009 and March 2012 the most recent period (post-crisis, hereafter).

Banking firms are selected as the banks with the highest total assets value in each country as representatives of the large financial institutions in Europe and US. This criterion results in 108,883 (unbalanced) panel observations with 55 banks in 14

[1] Although CMA provide us CDS spreads data from January 2003, a few number of banks (the 18.18% of the banks in the sample) had CDS rates during 2003. In fact, the majority of the banks started to take part in CDS activities after 2004.

countries, 50 for Europe[2] and 5 for US in 2,148 days. The decision to focus on the banking sector limits the sample size, since only a restricted number of big banks are involved in CDS activities (see Chiaramonte and Casu, 2012 and Ashraf et.al, 2007). Table 1 shows all the banks included in the sample together with their label, abbreviation to which we will refer throughout the paper, and for each bank, the available number of observations, the total assets value and the credit quality. Country's credit rating is also provided.

The series are for 5-year CDS contracts denominated in € for European banks and denominated in US$ for US banks. The restructuring type (definition of what constitutes a default[3]) choice is based on regional preferences. Concretely, we use the modified-modified (MM) restructuring clause for senior euro-denominated CDS spread[4] and the no restructuring type (XR) for senior dollar-denominated CDS[5]. Following Jorion and Zhang (2007) we consider 5-year CDS quotes for senior debts issues since these contracts are generally considered the most liquid and constitute the majority of the entire CDS market.

Figure 1 represents, in Panel A, the daily time evolution of average CDS spread series for all, European and US banks, respectively. In these graphs we can distinguish the three sub-periods of analysis: pre-crisis period in blue line (January 2004-June 2007), crisis period in red line (July 2007-September 2009) and the last period in black line (October 2009-March 2012). It is clear that from July 2007 the CDS spread in level and volatility started to increase dramatically. Average CDS spreads were quite smooth until July 2007, when they started to grow considerably in response to the burst of the sub-prime crisis. In March 2009, they peaked at over 251 bp (245 bp in the case of Europe and 337 bp in US), what suggests that CDS spreads might not be fully explained by banks credit risk (default component), but also by the overall market situation (non-default component). After that, CDS spreads stabilized at values below those seen previously, especially for US banks, but higher than pre-crisis period values. In the case

[2] Austria (2), Belgium (2), Denmark (1), France (5), Germany (4), Greece (4), Italy (7), Netherlands (3), Norway (1), Portugal (3), Spain (6), Sweden (4), Switzerland (1) and UK (7).

[3] For more details see International Swaps and Derivatives Association (ISDA) agreement types.

[4] *Berndt et al. (2007)* document that the majority of European default swaps are transacted according to the modified-modified restructuring clause.

[5] In general, the following types should be used for the three regions: Asia, CR (fully restructured), Europe, MM (Modified-Modified) and US, XR (No restructuring).

of Europe, it is clear that this recovery phase was a mirage since the turmoil persisted after that. In fact, CDS rates began gradually to increase (from 98 bp in October 2009) and displayed record peaks (662 bp in November 2011). Besides, US banks showed in mean less level and volatility than the CDS spread curve for European banks, except in the sub-prime crisis period where US banks enlarged their CDS quotes more than European banks.

Table 2 presents in Panel A the descriptive statistics of the mean of the CDS spreads for all the banks included in the sample firstly sorted by country and secondly for individual banks, and divided in total, pre-crisis, subprime crisis and post-crisis periods.

As we can see, the levels of CDS spreads between 2004 and June 2007 are relatively stable for US and European banks, which maintain on average their CDS rates in similar levels, around 17 bp, and this is fairly homogeneous regardless of the country. The sole exceptions were the French BPCE and the Italian BI, whose means of 68.14 and 77.19 bp, respectively, rose pre-crisis period's maximum and mean of each countries[6].

These levels increased dramatically during the crisis period, mainly for US, what indicates their higher probability of default. The CDS spread percentage increase on average for all the international banking industry was 528.04% (from 17.75 to 111.47 bp), while US and European banks raised in 610.05% (from 17.66 to 125.42 bp) and 519.92% (from 17.76 to 110.07 bp), respectively, their CDS rates in two years, starting with the subprime crisis in July 2007 and continue with a constant increasing trend to March 2009. The minimum and maximum average CDS spreads corresponds to UK, 8.47 bp due to HSBC, and Italy, 498.42 bp due to BI, a bank that experienced a particularly exceptionally growth and high peak values during the subprime crisis (maximum: 1,327.86 bp)[7]. The mean ranged from 78.35 and 172.89 bp, in Netherlands and Belgium respectively. Indeed, the countries who were worst affected by the

[6] The Norwegian DNB bank did not have CDS contracts until May 2008. This is the reason why it has not statistics on Table 2 for the first sub-period The same happens with two Greek banks (NBG and PB, whose CDS spreads data started in September 2009) and US USB (starting on March 2008). However, since both countries have more banks in the sample there are not identified in the table.

[7] Other banks were also overwhelmed by the crisis: the French NTX (166.18 bp), the German HSH (171.81), the Greek NBG (140.15) and PB (163.09), the Spanish BPA (224.83) and BSB (183.54), and the US CITI (209.93).

financial crisis were Belgium, Austria and to a lesser extent, Italy, whose mean was noticeably enlarged by BI.

The third sub-period in our sample is the post subprime crisis period. In the following months after the crisis, the level of CDS spreads in US and Europe started to fall with a minimum rate (higher than the pre-crisis period) on December 2009 in both markets. After this date, the CDS market exhibit a striking different pattern in US and Europe. While European banks increased their CDS rates in 168.11% (from 110.07 to 295.12 bp), US banks maintain stable longer after the recovery phase, increasing the mean only in 5.87% (from 125.42 to 132.79 bp). Of particular interest are the cases of Greece (mean: 1,107.96 bp), Portugal (639.82 bp) and, to a lesser degree, Spain (362.17 bp), Belgium (295.68 bp) and Italy (244.87 bp). They exhibited exceptionally high values due to national debt crisis. In contrast, the minimum average CDS spread was 73.25 bp for Germany, far from the Greece's maximum of 1,182.37 bp.

3.2. CDS returns

Following *Berndt and Obreja (2010)* we convert these spreads into returns[8]. The strategy is replicating a leveraged position in the risky bond issued by each bank[9]. Hence, the CDS excess return, which we simply refer to it as CDS return, is given by

$$r_{CDS,t} = -\Delta CDS_t(T) \times A_t(T)$$

where $\Delta CDS_t(T)$ is the daily change in the CDS rate with T maturity and $A_t(T)$ is the value of a defaultable T-year annuity

$$A_t(T) = \frac{1}{4}\sum_{j=1}^{4T} \delta\left(t, \frac{j}{4}\right) q\left(t, \frac{j}{4}\right)$$

$\delta(t, s)$ denotes the risk-free discount factor for day t and s years out and are fitted from Datastream Euro zero curves that are constructed relative to the Euribor, and

[8] The main difficulty is that there is no time series data on actual transaction prices for a specific default swap contract, but there are at-market spreads for a newly issued CDS with constant maturity *T*.

[9] Concretely, it consists on consider a portfolio that contains a long position in a *T*-year par defaultable bond and a short position in a *T*-year par riskless bond. Although it is quite clear that for the arbitrage to work perfectly, the risk-free bond will be selling at par in the event of default, this is not guaranteed.

$q(t,s)$ is the risk-neutral survival probability of the bank over the next s years[10]. We follow *Berndt and Obreja (2010)* in order to estimate the survival probabilities

$$q(t,s) = e^{-\lambda(t-s)}$$

which allows us to express them, and consequently also the annuity $A_t(T)$, as a function of λ, the risk-neutral default intensity for each bank, which is assumed to be constant. As a consequence, λ can be computed directly from observed CDS spreads by the following equation[11]

$$\lambda = 4log\left(1 + \frac{CDS}{4L}\right)$$

Figure 1 (Panel B) shows the time evolution of average daily CDS returns series, while their summary statistics (minimum, maximum and mean) are reported in Panel B of Table 2 (expressed in basis points).

Returns remained relatively plain throughout the first sub-period. In general, all banks showed a positive average return. It is outstanding that the mean observed for Europe (0.073 bp) is noticeably higher (356% higher) than US mean (0.016 bp). This is due to the good performance of some particular banks: the French BPCE (mean: 0.993 bp), the Italian BI (0.581), the German HSH (0.269) and the UK AL (0.223). All this countries showed similar values of returns, although the Belgium DEX (-0.022), the UK BARC (-0.012), the Spanish BBVA (-0.002) and BPE (-0.021), and the Swiss CSG (-0.007), had a slightly negative average return, what diminished their country's mean. Finally, the Austrian RZ stood out with a fairly negative average CDS return of -0.316.

The volatility significantly increases after July 2007, especially for US banks, whose negative average CDS return (-0.711) was 69% lower than the European one (-0.421). Besides US, the countries with greatest negative results were Belgium (-0.943), Spain (-0.688) and Portugal (-0.558), hit by a major financial crisis which was de prelude of their posterior public debt troubles. In fact, the case is that all the banks in the sample experimented negative CDS returns during the subprime crisis started in July

[10] It is assumed risk-neutral independence between interest rates and the default time, which is standard in the CDS modeling and valuation literature.

[11] L denotes the risk-neutral expected fraction of notional lost in the event of default. It is fixed at 60%.

2007. The exception of Greece is due to the positive average return of PB (whose data started in September 2009 with large positive CDS spreads and decline afterwards), what increased the country's mean. But, the remaining Greek banks lead to the worst result (-1.474) among countries. Greece was actually suffering the effects of the sovereign debt crisis' initial stages.

In certain cases during this second period, CDS returns equalled zero when banks formally had a CDS contract but traded very little. Zero returns imply zero descriptive statistics. Hence, we do not consider them in order to compute the statistics of Table 2. Otherwise those will be distorted. This was the case of the French BPCE. The case of Greece is a bit special. AB and EFG banks had zero returns for almost all the sub sample (around 90%, corresponding to the beginning of the sample), while the remaining two Greek banks (NBG and PB) did not have data until September 2009. Thus, Greek's returns' statistics correspond just to 2009. Even so, we decide to maintain then in Table 2 in order to have a reference for Greece.

Finally, in third period, US banks recovered from the crisis and they showed a better result (mean: -0.022) than the value (-1.535) observed for Europe, who is still facing the difficulties that overwhelmed the banks in the previous crisis. Of particular interest are the cases of Greece and Portugal with extreme negative returns for all banks, and to a lesser extent, Belgium, Italy and Spain, due to sovereign debt crisis.

4. PRINCIPAL COMPONENTS ANALYSIS

With the objective to explore the sources of common variation in European and US bank CDS returns, a principal component analysis (PCA) is carried out. This approach can be used to synthesize the information contained in the data set because it permits to determine the minimum number of common factors that would satisfactorily explain the correlations among the variables. The objective of PCA is to reduce the dimensionality of the data set but retain most of their original variability.

Given the high correlations between the bank CDS returns pairs in the sample (not only among banks of the same countries, but also among different countries)[12], it

[12] Not shown, available upon request.

seems reasonable to summarize in few factors the fluctuation existing in these returns series.

With the objective to extract and identified common factors in bank CDS returns, we perform PCA, firstly, to the complete sample period, and secondly, to the three sub-periods, in order to capture the possible different common sources depending on the period selected as well as we compare these results with the ones obtained for the full period[13].

4.1. Complete sample period (January 2004 – March 2012)

Table 3, Panel A, reports summary statistics for the principal components analysis[14]. The first principal component (PC1) explains 43% of the total variation. The contribution of the following principal components is not that substantial, capturing about 6% (PC2), 5% (PC3) and 4% (PC4) of the variation. The remaining factors barely add explanation of the variance. Consequently, four components are finally selected, explaining more than 56% of the total variability. The results indicate a significant amount of commonality in the variation of CDS returns across all the banks in the sample. To understand the source of commonality we examine the weight vector associated with the principal components (Figure 2).

First Principal Component

In PC1 all the scoring coefficients are positive with different, but significant, values depending on the bank (Figure 2, Panel A). Financial institutions with higher weights are European banks with the highest total asset value[15]. Moreover, if we run regressions of PC1 on each single bank with high weight, the percentage of total variability in PC1 that is explained by bank CDS returns ranges between 66% and

[13] For the same purpose, we apply PCA to European banks separately and the results are quite similar.

[14] In this first analysis, eleven entities have been dropped because their CDS spreads data starts in 2005 or later. In particular, ten banks from Europe (France: BPCE; Greece: NBG, EFG and PB; Italy: BI; Norway: DNB; Spain: BSB and BKT; UK: SC and AL) and one bank in US (USB).

[15] France: BNP, SG and CA; Germany: DB and CB; Italy: UI, ISP and BMPS; Netherlands: ING; Spain: BST and BBVA; Switzerland: CS; UK: LBG, BARC and RBS. And also but with a slightly lower impact (as well as lower but still high size), Italy: BP; Netherlands: RBK and ABN; UK: HBOS.

82%[16]. This is not unexpected if we interpret PC1 as a value-weighted market portfolio of European banks.

Surprisingly, US banks (some of them with noticeably large total asset value) do not play an important role in this PC1. Since US banks tend to have in average lower credit spreads (87.70 versus the 163.42 bp of Europe), it seems that entities with low credit spreads are less valuable forming the first principal component. This explains also the exceptions among European banks: RBK (Netherlands), NB (Sweden) and HSBC (UK) are big banks (in terms of total asset value), but with low CDS spreads (49, 53 and 37 bp, respectively), what justifies their smaller weights in PC1. Therefore, the first principal component of CDS returns might be highly related to iTraxx, the representative CDS European index.

Second Principal Component

The highest factor loadings are negative and associated with US banks[17]. This second component could be interpreted as an area component that distinguishes the European, with positive weights, and US banks, with negative ones. The R squared obtained by regressing each European bank's CDS returns on PC2 is around 1% in mean, while it ranges between 38% and 54% for US entities (with an expected estimated negative coefficient).

Third Principal Component

In PC3 two countries stand out from the others. Denmark and Sweden´s banking institutions (all of them) have positive and large weights (above 0.3). Both are European non-euro countries with low levels of CDS spreads in this period[18]. Besides, they explain on average the 21% of PC3 (individually), comparing with the 2% explained by the remaining banking firms.

Fourth Principal Component

[16] Estimates and corresponding R^2 values are available upon request.

[17] Concretely, BOA, JPM, WFC and CITI (remember that the fifth US bank of the sample, USB, has been removed from the analysis because of the lack of data for the complete period).

[18] The other European non-euro countries are Norway, not included in the analysis (because of the lack of data until May 2008) and Switzerland and UK, countries that show negligible weights.

PC4 is related with mid-size banks in Europe. On the one hand, mid-size banks of Mediterranean countries: Greece (AB), Italy (UBI and BPM), Portugal (all the banks) and Spain (BPA), with positive weights and high CDS spread levels on average. And on the other hand, mid-size North European countries: France (NTX) and Sweden (NB and SH), with negative weights and low levels of CDS spreads (with the exception of NTX). Hence, we could interpret this component as the difference between middle size Mediterranean and North European countries. A closer inspection reveals that the clue might be the Mediterranean countries[19]. In fact, those four are precisely the countries with severe notional debt crisis, and this could be what PC4 captures.

4.2. Three sub-periods

In this section we perform PCA to the three sub-periods in order to capture the possible different common sources depending on the period selected as well as we compare these results with the ones obtained for the full period.

Pre-crisis period (January 2004 – June 2007)

When the sample is reduced to pre-crisis period[20], credit markets exhibited a limited amount of co-movement, with the PC1 of CDS returns capturing only about 17% of the variation. Adding up to four factors barely explains the 30% of the total variance of the returns. This suggests that during stability periods bank credit risk may not be driven by global macroeconomic forces, but they are some other factors which play a central role in determining CDS across countries. It would be interesting to investigate whether the level of commonality in bank CDS increases because of its membership to certain classes such as regions. PCA distinguishing between, euro and non-euro countries, and even a comparison of Mediterranean versus the rest of European countries might be useful to explain if commonality is due to a region-specific type of risk in times when CDS show a smooth pattern.

[19] The R squared obtained by regressing each bank on PC4 is considerably higher on average (67% higher) for the group of Mediterranean countries.

[20] Obviously, the same eleven entities of the full period are dropped to perform PCA in the pre-crisis period (no data until 2005).

The interpretation of the principal components persists. PC1 is related again with a European bank value-weighted market component. All the loadings (Figure 2, Panel B) are positive and the highest are linked to the most important banking firms in Europe confirming the relationship between this component and the set of the biggest banks attending to the total assets value[21]. PC2 seems to be related with an US area component as in the complete sample period. All US banks have big loads (around 0.5) forming PC2. The difference with the same component in the entire period is that in this first sub-period the coefficients are positive instead of negative. The reason might be the good performance of US banks during pre-crisis (average CDS spread levels of 18 bp) in comparison with the rest of the sample (levels of 125 and 133 bp, in second and third period). In fact, CDS spreads, and consequently returns, remained relatively plain until June 2007. The rest of PCs seem to be insignificant.

Crisis period (July 2007 – September 2009)

The picture changes dramatically when we focus on the crisis period. The PC1 now captures an impressive 40% in contrast with the 17% obtained in pre-crisis sub-period. The first three components explain the 51% proportion of variance (the double of the variance explained in the former period)[22].

The interpretation persists for PC1 (weights are shown in Figure 2, Panel C). It is related to a European bank value-weighted market portfolio[23]. PC2 differs from the previous results. The factor loadings with higher values correspond to two groups of banks: the first one are mid size banks in euro zone: while the second group are mid size banks in non-euro zone[24]. It suggests that being in the euro-zone starts to be important after the burst of the sub-prime crisis of July 2007. US banks are gathered by PC3,

[21] For these big institutions the R^2 measure of the regression analysis ranges between 35% and 49%.

[22] Eight banks are dropped from the sample in this case: the Greek NBG and PB, with data starting on September 2009, USB (US) starting on March 2008, DNB (Norway), due to the lack of data for the full sub-period, and BPCE (France) and HSBC (UK), because they remain constant during this period, what implies zero standard deviation. The case of the Greek AB and EFG is similar. They had zero returns for almost all the sub sample. Thus, Greece is completely removed from the sub sample.

[23] The R squared values are high (around 76% in mean for big banks) and similar to the ones obtained for the full sample.

[24] EBS and RZ (Austria), BPM (Italy), HSH (Germany), BPE (Spain), NTX (France) versus DKB (Denmark) and NB, SH, SEB and SA (Sweden).

which is thereby interpreted as a market portfolio of US Banks. The weights are high (around 0.5) and positive, probably motivated by their worst performance in comparison with Europe. PC4 seem to be negligible in order to explain total variation. Following the results of the full period, this is not surprising as we relate this component to the national debt crisis of some of the euro-zone countries, but during the third sub-period. The exception was Greece, which began in October 2008. However, we do not have available data for Greek banks until post-crisis period.

Post-crisis period (October 2009 – March 2012)

The results indicate that there is a significant amount of commonality in the variation of CDS spreads across all the 55 banks. PC1 captures even a bigger percentage in comparison to the previous sub-period of the variation of the correlation matrix (45% versus 40%). Again, big European banks (with negative CDS returns) present the highest weights forming the first principal component (Figure 2, Panel D).

PC2 seems to be related with an US area component as in the complete sample period, but there are some subtle. It might be reflecting a difference of areas, US, with negative weights and positive CDS returns, versus Europe, in general with positive weights and negative CDS returns. PC3 isolates the Greek sovereign debt crisis in contrast to the good performance of US financial institutions.

5. INTERTEMPORAL CO-MOVEMENT BETWEEN ITRAXX CDS INDEX, BANKS AND SOVEREIGN DEBT CDS SPREADS

In this section the objective is to conduct an empirical analysis of the impact of the degree of co-movements between iTraxx[25], Bank and sovereign debt CDS returns. Previous Principal Component Analysis shows the importance of a European value-weighted bank's CDS index in order to explain the total variation of individual CDS returns. The natural proxy could be the iTraxx index. Besides, euro zone notional debt

[25] The daily *iTraxx* 5-year index is the European main index for CDS. It is a general indicator of the credit conditions of the 125 largest firms in Europe. The dataset covers the entire history of the index (from 2005 to nowadays) and it is denoted in basis points.

troubles seem to play a central role too. We use 11 euro zone sovereign debt CDS spreads data[26].

Firstly, we calculate iTraxx and sovereign debt CDS returns following the methodology employed in section 3.2. Then, we extract the first principal component of sovereign debt CDS returns with the objective to have a global measure of the sovereign credit risk market. This first component is a weighted average of CDS returns and it accounts for a 65% of sample variation. It is associated to the level of sovereign risk in the economy.

Since one of the main objectives of the paper is to analyse the relationship between bank CDS spreads and banking fragility, in this section we examine the econometric properties of the bank (corporate) and sovereign debt credit risk indicators. To do this, we aply a Vector Autoregressive (VAR) model to extract the relevant information about the co-movements between (i) iTraxx returns, (ii) first principal component of LFIs and (iii) first principal component of euro-zone sovereign debt. In a simultaneous multivariate framework, this methodology has the advantage to capture lead-lag relationships within and between stationary variables.

The following equation models the mean equation as a VAR process

$$y_t = \mu + Zy_{t-1} + \varepsilon_t$$

where Z is a 3×3 matrix of lagged coefficients, μ is a vector of intercepts and ε_t the error term. Concretely, we estimate the following three-dimensional VAR model where the optimal lag has been chosen following the AIC criterion[27]

[26] The selected countries are Austria, Belgium, Finland, France, Germany, Greece, Netherlands, Ireland, Italy, Portugal and Spain. They are obtained from Datastream.

[27] The optimal lag length will be different depending on the sub-period analyzed. In the complete and post-crisis periods the optimal lag is 3 while the VAR lag in pre and crisis period is 1.

$$iTraxx_t = \mu_1 + \sum_{p=1}^{3} \beta_{1p} iTraxx_{t-p} + \sum_{p=1}^{3} \gamma_{1p} PC1_{t-p}^{B} + \sum_{p=1}^{3} \delta_{1p} PC1_{p-t}^{SD} + \varepsilon_{1t}$$

$$PC1_t^B = \mu_2 + \sum_{p=1}^{3} \beta_{2p} iTraxx_{t-p} + \sum_{p=1}^{3} \gamma_{2p} PC1_{t-p}^{B} + \sum_{p=1}^{3} \delta_{2p} PC1_{p-t}^{SD} + \varepsilon_{2t}$$

$$PC1_t^{SD} = \mu_3 + \sum_{p=1}^{3} \beta_{3p} iTraxx_{t-p} + \sum_{p=1}^{3} \gamma_{3p} PC1_{t-p}^{B} + \sum_{p=1}^{3} \delta_{3p} PC1_{p-t}^{SD} + \varepsilon_{3t}$$

The vector of interest is the VAR of the iTraxx CDS index returns and the first principal components of LFIs and sovereign debt, $y_t = \{iTraxx_t, PC1_t^B, PC1_t^{SD}\}$. We apply this model for the complete sample period and then, for the three sub-periods with the objective to analyse the potential different dymanics in co-movements beetween the European CDS index, and the most representative series that resume bank and sovereign debt CDS returns.

Table 4 presents the preliminary analysis of the series for whole period and sub-periods. Specifically, Panel A reports some summary statistics of the iTraxx returns, bank returns first principal component ($PC1^B$) and sovereign debt returns first principal component ($PC1^{SD}$).

The Jarque-Bera test rejects normality of the CDS returns for all the series and periods. This is caused mainly by the skewness and excess kurtosis statistics. The Ljung-Box statistics indicate significant autocorrelation for CDS returns and squared returns in all periods except for the PC series in pre-crisis period. This non lineal dependence result is associated with the presence of conditional heteroskedasticity. This idea is confirmed by the ARCH test. It is interesting to note that CDS returns series have common features typical in financial data, such as fat tails and non-normal distributions. The augmented Dickey Fuller (ADF) and Philips and Perron (PP) tests indicate that any of the series have a single unit root, they are stationary. Panel B shows the correlation matrix. The correlation coefficient increases over time suggesting that the co-movements between these variables (reported in Figure 3) are greater in crisis and post-crisis period and, therefore, this idea motivates the analysis that will follow. Finally, Panel C shows that the series are not cointegrated.

Table 5 reports VAR model estimation results for the full sample period as well as distinguishing by sub-periods. It displays the coefficients that are significantly different from cero at 0.01, 0.05 and 0.10 levels. We also report the cases in which the coefficients are jointly different form zero (Granger-causal). When interpreting these numbers, note that Granger causalities are almost all identified at 0.01 significant.

Results for the whole sample period provides evidence that sovereign debt market leads the iTraxx and bank CDS at aggregate level ($PC1^{B}$). However, this causality relationship disappears in pre-crisis and crisis periods. During pre-crisis, bank CDS cause iTraxx and vice versa (at 0.01-level), and there is one-way impact of bank CDS on sovereign debt CDS. With the burst of the subprime crisis and the consequent decline of the financial sector, iTraxx is the one who exclusively causes not only bank but also sovereign debt CDS (0.01-level). Post US subprime and Lehman period seems to shift the relations among the variables. Our results suggest that the passage from the crisis period to the last period (October 2009 – March 2012) seems to confirm the power of sovereign debt CDS in predicting future changes in banks' CDS. Granger causality tests still show an impact (not that strong this time, at 0.05-level) of iTraxx on sovereign debt CDS, but most of all stand out the opposite relationship (at 0.01-level) of sovereign debt CDS on iTraxx and also on bank CDS. This may emphasize the leading role of the sovereign debt CDS market, especially during country crisis periods. It differs from Dieckmann and Plank (2012), who find the opposite direction, a private to public risk transfer related to countries' exposures to the financial system from July 2007 to April 2010. Nevertheless, they sample period covers almost our two last periods, precisely where we identify the shift on the sovereign debt CDS' role.

Table 6 shows the decomposition of the variance of the *s*-step[28] forecast errors in a series into the parts attributable to each of a set of innovation (shock) processes for the VAR previous specification.

Regardless of the period, the iTraxx's variance forecast error is due basically to the innovation in itself. The other variables have negligible explanatory power for iTraxx. However, the more interesting information is at $PC1^{B}$ and $PC1^{SD}$'s variance decomposition, where the interactions among the variables start to become felt and

[28] Since results are fairly constant across steps, we only report the ones corresponding to a representative step forecast error. The remaining step's results are available upon request.

change over time. The principal factors driving bank CDS indicator $PC1^{B}$ are itself and iTraxx. The latter seems to be the prime mover, except for pre-crisis period, while innovations in $PC1^{SD}$ take until post-crisis period to have an effect on bank CDS (a minor effect, thought, in comparison to the others). Finally, euro-zone sovereign debt CDS indicator $PC1^{SD}$, shows a striking different pattern regarding the time period. Its forecast error's variance is due to the innovation in itself during financial stability (pre-crisis). Innovations in iTraxx and, to a lesser extent, $PC1^{B}$, does not become felt (explaining $PC1^{SD}$) until the crisis period, but it become stronger in post-crisis period, where the former evolve into the principal driver.

6. CONCLUSIONS

Since 2008 to nowadays, the CDS market has attracted considerable attention and CDS spreads are considered a good proxy for bank riskiness and default probability. It is well known that CDS spreads reflect market perceptions about the financial health of banking firms and the CDS levels can be used by economic authorities to extract signals regarding financial stability. CDS spreads must be monitored and measured because large capital losses in systemic banking firms can affect to the banking system's financial stability.

The general objective of this paper is to explore the relationship between bank CDS spreads and banking fragility during the period January 2004 to March 2012. Specifically, we focus on two important features. Firstly, we analyse the existence of common factors in European and US bank CDS returns to identify potential changes in the correlation structure of bank CDS returns and secondly, we investigate the impact of the degree of co-movements between bank CDS, the iTraxx CDS market index and the sovereign debt CDS market. Moreover, the sample period allows us to distinguish different sub-periods; pre-crisis (2004-2007), subprime crisis (2007-2009) and the most recent debt crisis period (2009-2012).

In a first step, bank CDS spreads are converted into CDS returns series replicating a leveraged position in the risky bond issued by each bank. In order to capture and identified the possible different common sources depending on the period selected we perform principal component analysis. In a second stage, we conduct an empirical analysis through a VAR model estimation of the impact of the degree of the intertemporal co-movements between iTraxx CDS index returns and bank and sovereign debt CDS returns.

Principal Component Analysis shows the importance of a European value-weighted bank's CDS index in order to explain the total variation of individual CDS returns. The results are indicative of a change in the correlation structure of CDS returns due to the financial crisis. While prior to July 2007 credit markets exhibited a limited amount of co-movement, the onset of the subprime crisis and its continuity mostly for Europe, shifts the correlation structure of CDS returns. The question that arises is why the co-movements became more striking after July 2007, and above all, what drives the commonality in bank CDS returns.

The overall market situation reveals to be crucial. During financial stability we find the natural relationships between iTraxx and bank CDS returns. Intertemporal co-movements changed after July 2007 in response to the turmoil started in US market. It leads to iTraxx which causes bank and sovereign debt CDS. The latter started to have a central role after the financial crisis, during the notional debt troubles of some euro-zone countries. In such a period, from October 2009 to March 2012, we find that sovereign debt CDS is the one who exclusively cause iTraxx and bank CDS. On the other hand, a closer inspection of the decomposition of the forecast error's variance reveals that a shock on the public indicator does not have a significant effect on the remaining variables. Innovations on the iTraxx are the ones who mostly affect, but only during financial instability.

REFERENCES

AKTUNG E., VASCONCELLOS G., and BAE Y. (2009). The Dynamics of Sovereign Credit Default Swap and Bond Markets: Empirical Evidence from the 2001-2007 Period. *Working Paper*.

AMMER J. and CAI F. (2007). Sovereign CDS and Bond Pricing Dynamics in Emerging Markets: Does the Cheapest-to-Deliver Option Matter?, *Board of Governors of the Federal Reserve System, International Finance Discussion Papers* 912.

ANNAERT, J., DE CEUSTER, M., VAN ROY, P., and VESPRO, C. (2010). What Determines Euro Area Bank CDS Spreads?, *National Bank of Belgium Working Paper* No. 190.

ASHRAF, D., ALTUNBAS, Y., and GODDARD, J. (2007). Who transfers credit risk? Determinants of the use of credit derivatives by large US banks, *The European Journal of Finance* 13, no. 5: 483-500.

BERNDT, A., JARROW, R., and KANG, C. (2007). Restructuring risk in credit default swaps: An empirical analysis, *Stochastic Processes and their Applications* 117, 1724-1749.

BERNDT, A. and OBREJA, I. (2010). Decomposing European CDS Returns, *Review of Finance*, 14, 189-233.

CALICE, G., IOANNIDIS, C., and WILLIAMS, J. (2011). Credit Derivatives and the Default Risk of Large Financial Institutions, *Journal of Financial Services Research*, 1-23.

CHIARAMONTE, L. and CASU, B. (2012). The Determinants of Bank CDS spreads: Evidence from the financial crisis, *The European Journal of Finance.* (Forthcoming).

COUDERT, V. and GEX, M. (2011). The Interactions between the Credit Default Swap and the Bond Markets in Financial Turmoil, *CEPII Working Papers* series 2011-02.

DELATTE, A. L., GEX, M. and LÓPEZ-VILLAVICENCIO, A. (2011). Has the CDS Market Influenced the Borrowing Cost of European Countries During the Sovereign Crisis? Available at SSRN: http://ssrn.com/abstract=1917219.

DEMIRGUC-KUNT, A. and HUIZINGA, H. (2010). Are banks too big to fail or too big to save? International evidence from equity prices and CDS spreads, *CEPR Discussion Paper* no. 7903. London, Centre for Economic Policy Research.

DICKEY, D. A. and FULLER, W.A. (1981). Likelihood Ratio Statistics for Autorregressive Time Series with a Unit Root. *Econometrica* 49, pp. 1057-1072.

DIECKMANN, S., and PLANK T. (2012). Default Risk of Advanced Economies: An Empirical Analysis of Credit Default Swaps during the Financial Crisis, *Review of Finance*, 16, 903-934.

ENGLE, R. F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica* 50, 987-1007.

FORTE S. and PEÑA J.I. (2007). Credit Spreads: Theory and Evidence on the Informational content of Stocks, Bonds and CDS, Universidad Carlos III, Business Economics, *Working Papers*, n.wb063310.

HART, O. and ZINGALES, L. (2011). A new capital regulation for large financial institutions, *American Law and Economics Review*, 13, 2, 453-490.

HULL, J., PREDESCU, M. and WHITE, A. (2004). The relationship between credit default swaps spreads, bond yields, and credit rating announcements, *Journal of banking and Finance, 28,* 2789-2811.

JOHANSEN, S. (1988). Statistical Analysis of Cointegration Vectors, *Journal of Economic Dynamics and Control* 12, 2-3, 231-254.

JORION, P. and ZHANG, G. (2007). Good and bad credit contagion: Evidence from credit default swaps, *Journal of Banking and Finance* 84, 860-883.

KASHYAP, A.K, RAJAN, R. and. STEIN, J.C. (2008). Rethinking Capital Regulation, Federal Reserve of Kansas City. *Working Paper*.

LONGSTAFF, F.A., MITHAL, S. and NEIS E. (2005). Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit-Default Swap, *Journal of Finance* 60, 2213-2253.

LONGSTAFF, F.A., PAN, J., PEDERSEN, L.H. and Singleton, K.J. (2011). How Sovereign Is Sovereign Credit Risk?, *American Economic Journal: Macroeconomics* 3.2, 75-103.

MACKINNON, J.G. (1991). Critical Values for Cointegration Tests, In R.F. Engle and C.W.J. Granger, eds., *Long-run Economic Relationships: Readings in Cointegration*. Oxford: Oxford University Press, Chapter 13.

Norden, L and Weber, M. (2009). The Co-movement of Credit Default Swap, Bond and Stock Markets: an Empirical Analysis, *European Financial Management*, 15, 529–562.

Osterwald-Lenum, M. (1992). A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics, *Oxford Bulletin of Economics and Statistics* 54, 3, 461-472.

Pan. J.P. and Singleton, K.J., 2008. Default and Recovery Implicit in the Term Structure of Sovereign CDS Spreads, *Journal of Finance* 63, 2345-2384.

Phillips, P.C.B. and Perron, P. (1988). Testing for a Unit Root in Time Series Regression, *Biometrica* 75, 335-346.

TABLE 1: List of European and US Banks sorted by country

Banks are assigned to countries based on Datastream classification. Obs. refers to the available number of observations (CDS spread) for each bank in the sample. Total assets (December 2011 data) are expressed in thousand Euros; for no Euro countries Datastream average exchange rate in December 2011 is used. Fitch long term credit ratings scales are the following: AAA (Highest credit quality), AA (Very high credit quality), A (High credit quality), BBB (Good credit quality), BB (Speculative), B (Highly speculative), CCC (Substantial credit risk), CC (Very high levels of credit risk) and C (Exceptionally high levels of credit risk). Date indicate the day when the rating was changed.

Country	Bank Name	Label	Obs.	Total Assets Mil EUR	Rating 12/2011	Rating Prev.	Date	Rating Country	Rating Country Prev.	Date
AUSTRIA	Erste Group Bank	EBS	2,148	209,304	A	A+	9/02/00	AAA	AAA	12/05
	Raiffeisen Zentralbank	RZ	2,148	146,627	A	A	24/05/11			
BELGIUM	KBC Bank	KBC	2,146	282,937	A	A+	14/05/09	AA+	AA+	05/06
	Dexia	DEX	2,148	412,051	A+	AA-	09/04/09			
DENMARK	Danske Bank	DKB	2,135	460,396	A	A+	14/12/11	AAA	AAA	12/05
FRANCE	BNP Paribas	BNP	2,148	1,955,940	A+	AA-	15/12/11	AAA	AAA	12/05
	Société Générale	SG	2,148	1,176,790	A+	AA-	15/09/09			
	Crédit Agricole	CA	2,147	1,718,513	A+	AA-	14/12/11			
	Natixis	NTX	2,148	504,495	A+	AA-	24/07/08			
	BPCE SA	BPCE	1,645	263,206	A+	AA-	31/07/09			
GERMANY	Deutsche Bank	DB	2,148	2,155,366	A+	AA-	15/12/11	AAA	AAA	12/05
	Commerzbank	CB	2,148	657,609	A+	A	09/04/09			
	Deutsche Postbank	DP	2121	191,578	A+	A-	09/04/09			
	HSH Nordbank	HSH	2,148	187,271	A-	A	12/07/10			
GREECE	National Bank of Greece	NBG	656	105,560	B-	B+	14/07/11	CCC	B+	07/11
	Alpha Bank	AB	2,148	57,681	B-	B+	14/07/11			
	EFG Eurobank Ergasias	EFG	1,676	75,096	B-	B+	14/07/11			
	Piraeus Bank	PB	668	48,174	B-	B+	14/07/11			
ITALY	Unicredito Italiano	UI	2,148	914,108	A	A+	16/04/09	A+	AA-	10/11
	Intesa San paolo	ISP	2,148	626,898	A	AA-	11/10/11			
	Banca Monte Paschi Siena	BMPS	2,148	234,029	BBB+	A-	11/10/11			
	Unione di Banche Italiane (Ubi Banca)	UBI	2,105	127,445	A-	A	11/10/11			
	Banco Popolare	BP	2,143	130,861	BBB+	A-	16/06/11			
	Banco Popolare Milano	BPM	2,148	51,222	BBB	A-	25/11/11			
	Banca Italease	BI	1,257	12,482	BBB+	BBB-	17/07/09			

TABLE 1 (continued): List of European and US Banks sorted by country

Country	Bank Name	Label	Obs.	Total Assets Mil EUR	Rating 12/2011	Rating Prev.	Date	Rating Country	Rating Country Prev.	Date
NETHERLANDS	ING Bank NV	ING	2,148	933,073	A+	AA-	12/08/09	AAA	AAA	12/05
	Rabobank	RBK	2,148	652,536	AA	AA+	14/02/11			
	ABN AMRO Bank	ABN	2,148	202,084	A+	AA-	08/02/10			
NORWAY	DNB NOR ASA	DNB	1,015	274,365	A+	A	02/12/97	AAA	AAA	12/05
PORTUGAL	Banco Espirito Santo	BES	2,148	79,525	BB-	BB	14/12/12	BB+	BBB-	11/11
	Banco Comercial Português	BCP	2,148	91,918	BB+	BBB-	25/11/11			
	Banco Português de Investimento	BPI	2,148	42,061	BB+	BBB-	25/11/11			
SPAIN	Banco Santander	BST	2,148	1,233,765	AA-	AA	11/10/11	AA	AA+	10/11
	Banco Bilbao Vizcaya Argentaria	BBVA	2,148	591,356	A+	AA-	11/10/11			
	Banco Popular Español	BPE	2,148	129,884	BBB+	A-	11/10/11			
	Banco de Sabadell	BSB	1,237	99,440	BBB+	A-	11/10/11			
	Bankinter	BKT	1,745	59,388	BBB+	A-	15/12/11			
	Banco Pastor	BPA	2,148	31,135	A-	A	3/10/08			
SWEDEN	Nordea Bank	NB	2,148	709,625	AA-	A+	16/08/01	AAA	AAA	12/05
	Svenska Handelsbanken	SH	2,148	272,183	AA-	AA	01/05/92			
	Skandinaviska Enskilda Banken	SEB	2,148	261,907	A+	AA-	01/07/92			
	Swedbank	SA	2,035	205,879	A	A+	28/04/09			
SWITZERLAND	Credit Suisse Group	CSG	2,148	847,570	A	AA-	15/12/11	AAA	AAA	12/05
UK	HSBC Holdings PLC	HSBC	2,148	1,945,118	AA	AA-	31/03/95	AAA	AAA	12/11
	Lloyds Banking Group	LBG	2,148	1,145,210	A	AA-	13/10/11			
	Standard Chartered	SC	1,791	456,713	AA-	A+	15/10/10			
	Alliance and Leicester PLC	AL	1,831	92,739	A	A+	14/03/08			
	Barclays	BARC	2,148	1,849,925	A	AA-	15/12/11			
	Royal Bank of Scotland Group	RBS	2,148	1,781,728	A	AA-	13/10/11			
	HBOS	HBOS	2,148	541,354	A	AA-	13/10/11			
US	Bank of America corporation	BOA	2,148	1,591,868	A	A+	15/12/11	AAA	AAA	12/05
	JP Morgan Chase & Co.	JPM	2,148	1,719,962	AA-	A+	16/02/07			
	US Bancorp	USB	1,055	258,187	AA-	AA	27/09/04			
	Wells Fargo & Co.	WFC	2,147	997,356	AA-	AA	22/07/09			
	Citigroup Inc	CITI	2,148	1,380,685	A	A+	15/12/11			

TABLE 2: Descriptive statistics of European and US bank CDS spread and return series

This table contains descriptive statistics for the average daily 5-year CDS spreads (Panel A) and returns (Panel B), firstly sorted by country (minimum, maximum and mean) and secondly for individual banks (mean and standard deviation). The results are also summarized by the mean for Europe, US and all the banks of the sample. All rates are reported in basis points. Results are shown for the complete period, from January 2004 to March 2012, and for three sub-periods: January 2004 to June 2007 (Pre-Crisis), July 2007 to September 2009 (Crisis) and October 2009 to March 2012 (Post-Crisis). Obs. refers to the available number of banks included in the sample. The lack of statistics for Norway in the first sub-period is due to the fact that DNB bank did not have CDS data until May 2008. The same happens with two Greek banks (NBG and PB, whose CDS spreads data started in September 2009) and US USB (starting on March 2008). However, since both countries have more banks in the sample there are not identified in country's panels. In the second sub-period Greek returns' statistics (Panel B) correspond just to 2009, because AB and EFG banks had zero returns for almost all the sub sample while the remaining two Greek banks NBG and PB did not have data until September 2009. However, they are maintained in the table in order to have a reference for Greece. Besides, French BPCE is not considered in order to compute the statistics of France in Panel B.1. It was traded very little, so CDS spreads remained constant and the returns equalled zero, what implies zero descriptive statistics.

Panel A.1

	CDS spreads (sorted by country)												
	Jan2004-Mar2012			Pre-Crisis Jan2004-Jun2007			Crisis Jul2007-Sep2009			Post-Crisis Oct2009-Mar2012			
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Obs.
Austria	104.11	123.05	113.58	19.70	32.40	26.05	146.73	193.46	170.10	184.24	186.75	185.49	2
Belgium	109.29	172.15	140.72	8.41	11.11	9.76	152.19	193.60	172.89	208.23	383.14	295.68	2
Denmark	67.36	67.36	67.36	8.80	8.80	8.80	81.76	81.76	81.76	135.53	135.53	135.53	1
France	59.78	101.63	77.63	8.89	68.14	21.23	14.78	166.18	78.85	132.80	171.80	154.66	5
Germany	46.90	121.11	77.61	14.68	22.45	19.05	54.66	171.81	99.02	73.25	214.96	140.34	4
Greece	357.02	1151.85	746.31	20.26	26.03	23.15	18.96	163.09	93.03	1051.64	1182.37	1107.96	4
Italy	83.38	350.63	141.91	13.25	77.19	28.45	67.71	498.42	144.21	195.25	326.49	244.87	7
Netherlands	48.73	80.04	64.51	6.73	9.72	8.54	75.11	82.74	78.35	83.91	181.57	130.73	3
Norway	96.62	96.62	96.62	-	-	-	103.21	103.21	103.21	92.88	92.88	92.88	1
Portugal	203.23	250.22	223.82	14.40	20.44	16.75	75.06	98.88	86.56	576.79	731.38	639.82	3
Spain	90.30	295.92	178.37	10.69	24.34	16.29	79.87	224.83	137.43	209.25	546.82	362.17	6
Sweden	45.12	84.54	63.06	12.42	23.68	16.09	61.23	123.90	88.46	76.52	123.87	103.45	4
Switzerland	67.33	67.33	67.33	16.25	16.25	16.25	99.82	99.82	99.82	109.76	109.76	109.76	1
UK	37.29	98.91	80.92	8.23	14.44	10.30	8.47	129.37	98.25	101.03	213.71	153.74	7
US	64.87	119.13	87.70	14.81	23.90	17.66	83.74	209.92	125.42	86.74	195.50	132.79	5
Europe	37.29	1151.85	163.42	6.73	77.19	17.76	8.47	498.42	110.07	73.25	1182.37	295.12	50
All	37.29	1151.85	156.54	6.73	77.19	17.75	8.47	498.42	111.47	73.25	1182.37	280.36	55

TABLE 2 (continued): Descriptive statistics of European and US bank CDS spread and return series

Panel A.2	CDS spreads (individual banks)								
	Jan2004-Mar2012		Pre-Crisis Jan2004-Jun2007		Crisis Jul2007-Sep2009		Post-Crisis Oct2009-Mar2012		
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Banks
Austria	104.111	101.763	19.701	11.379	146.731	107.876	184.237	74.088	EBS
	123.053	99.224	32.397	31.763	193.465	99.266	186.751	46.383	RZ
Belgium	109.286	112.570	11.108	3.195	152.191	85.190	208.229	101.836	KBC
	172.151	208.793	8.411	2.480	193.595	125.204	383.139	218.192	DEX
Denmark	67.356	75.900	8.796	4.158	81.760	61.973	135.528	76.670	DKB
France	59.782	65.979	8.894	2.592	58.243	24.461	132.799	69.997	BNP
	77.366	87.083	9.690	2.788	78.266	33.407	171.796	93.543	SG
	73.402	75.239	9.089	2.506	76.784	31.804	160.748	66.142	CA
	101.626	97.101	10.321	2.478	166.184	95.994	171.549	49.797	NTX
	75.962	79.379	68.137	55.374	14.785	0.000	136.413	83.495	BPCE
Germany	67.403	56.421	14.684	3.316	88.528	36.508	122.430	44.527	DB
	75.019	70.608	17.306	6.819	81.091	30.148	150.734	71.986	CB
	46.903	27.169	22.454	6.683	54.663	21.276	73.253	19.469	DP
	121.114	110.243	21.748	12.115	171.814	109.317	214.956	64.818	HSH
Greece	1040.528	657.282	-	-	140.153	3.550	1051.644	653.621	NBG
	357.018	618.711	26.034	5.313	49.920	56.841	1101.510	686.967	AB
	435.844	663.121	20.261	4.330	18.956	24.967	1096.316	652.341	EFG
	1151.849	782.455	-	-	163.085	12.418	1182.367	774.610	PB
Italy	97.620	119.762	13.246	2.729	89.655	47.226	223.596	139.870	UI
	83.378	107.898	13.991	5.445	67.709	36.636	195.252	133.480	ISP
	105.489	134.993	15.880	5.655	76.309	32.206	258.084	155.118	BMPS
	102.597	131.942	18.739	4.479	74.872	46.955	240.214	159.555	UBI
	150.372	178.865	40.522	23.403	125.730	74.439	326.489	227.045	BP
	103.269	145.665	19.601	4.975	76.799	36.438	245.042	196.233	BPM
	350.626	272.728	77.185	7.767	498.418	332.094	225.381	79.235	BI
Netherlands	64.774	60.846	9.190	3.738	82.744	40.406	126.698	47.905	ING
	48.730	46.059	6.728	1.909	75.108	49.319	83.910	21.633	RBK
	80.038	83.622	9.715	3.483	77.212	32.841	181.574	70.048	ABN
Norway	96.616	39.729	-	-	103.206	41.175	92.884	38.388	DNB
Portugal	218.024	320.049	15.421	4.723	98.878	42.354	611.285	335.521	BES
	250.220	429.119	14.396	4.675	85.731	34.656	731.379	524.350	BCP
	203.229	314.347	20.440	6.060	75.059	41.496	576.789	352.786	BPI
Spain	90.302	96.962	11.682	3.174	81.153	35.087	209.255	84.312	BST
	93.701	102.680	10.689	2.363	79.868	34.692	223.086	85.067	BBVA
	166.472	214.744	11.654	3.501	139.466	110.715	408.871	220.387	BPE
	295.923	197.337	24.200	0.000	183.541	94.884	398.318	210.023	BSB
	186.997	212.276	15.176	4.068	115.706	110.086	386.652	206.572	BKT
	236.842	290.371	24.342	6.961	224.825	206.924	546.819	284.253	BPA
Sweden	52.679	46.750	12.708	4.790	69.882	42.138	93.323	37.842	NB
	45.119	40.788	12.416	3.176	61.234	43.224	76.521	32.837	SH
	69.897	65.576	15.571	8.267	98.832	72.487	120.101	44.235	SEB
	84.541	80.572	23.679	7.999	123.903	109.344	123.869	44.035	SA

TABLE 2 (continued): Descriptive statistics of European and US bank CDS spread and return series

Panel A.2	CDS spreads (individual banks) *(continued)*								
	Jan2004-Mar2012		Pre-Crisis Jan2004-Jun2007		Crisis Jul2007-Sep2009		Post-Crisis Oct2009-Mar2012		
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Banks
Switzerland	67.333	55.166	16.246	4.168	99.815	51.356	109.759	35.212	CSG
UK	37.293	44.881	10.591	3.126	8.472	12.887	101.027	26.335	HSBC
	91.512	96.256	8.235	3.063	94.232	57.384	206.249	69.132	LBG
	78.188	66.511	10.475	4.080	112.042	75.244	105.463	36.934	SC
	93.182	77.546	14.437	12.413	122.685	80.287	138.714	49.440	AL
	75.364	70.139	9.298	2.294	109.111	56.989	137.723	47.832	BARC
	98.912	99.942	9.014	2.989	111.834	57.745	213.711	73.257	RBS
	91.957	82.979	10.025	3.510	129.370	65.729	173.318	39.361	HBOS
US	100.933	101.493	16.158	5.577	128.206	78.203	195.498	93.917	BOA
	64.866	45.143	23.902	7.557	97.010	43.461	93.350	29.158	JPM
	85.582	33.707	-	-	83.743	47.216	86.738	21.121	USB
	67.974	57.006	14.813	5.735	108.232	60.818	106.181	21.470	WFC
	119.125	123.280	15.784	5.687	209.925	154.746	182.176	46.012	CITI

TABLE 2 (continued): Descriptive statistics of European and US bank CDS spread and return series

Panel B.1	CDS returns (sorted by country)												
	Jan2004-Mar2012			Pre-Crisis Jan2004-Jun2007			Crisis Jul2007-Sep2009			Post-Crisis Oct2009-Mar2012			
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Obs.
Austria	-0.331	-0.248	-0.289	-0.316	0.181	-0.068	-0.729	0.123	-0.303	-0.690	-0.487	-0.588	2
Belgium	-0.995	-0.504	-0.749	-0.022	0.025	0.002	-1.016	-0.869	-0.943	-2.343	-0.914	-1.629	2
Denmark	-0.499	-0.499	-0.499	0.007	0.007	0.007	-0.428	-0.428	-0.428	-1.266	-1.266	-1.266	1
France	-0.470	-0.204	-0.350	0.011	0.993	0.209	-0.620	-0.333	-0.495	-1.143	-0.400	-0.907	5
Germany	-0.350	-0.059	-0.241	0.006	0.269	0.115	-1.420	-0.125	-0.587	-0.908	-0.148	-0.427	4
Greece	-4.993	-1.813	-3.342	0.016	0.136	0.076	-2.463	5.160	0.185	-5.298	-4.542	-4.895	4
Italy	-0.808	0.013	-0.528	0.016	0.581	0.137	-0.537	0.444	-0.222	-2.314	-0.395	-1.622	7
Netherlands	-0.434	-0.220	-0.327	0.010	0.038	0.025	-0.459	-0.336	-0.396	-1.060	-0.438	-0.760	3
Norway	-0.305	-0.305	-0.305	-	-	-	-0.003	-0.003	-0.003	-0.476	-0.476	-0.476	1
Portugal	-1.538	-1.304	-1.414	0.003	0.046	0.031	-0.729	-0.349	-0.558	-4.620	-3.720	-4.223	3
Spain	-1.493	-0.630	-0.892	-0.021	0.100	0.023	-0.875	-0.457	-0.688	-2.354	-1.608	-1.912	6
Sweden	-0.306	-0.211	-0.250	0.006	0.073	0.042	-0.703	-0.267	-0.462	-0.563	-0.229	-0.453	4
Switzerland	-0.233	-0.233	-0.233	-0.007	-0.007	-0.007	-0.351	-0.351	-0.351	-0.444	-0.444	-0.444	1
UK	-0.496	-0.214	-0.330	-0.011	0.223	0.058	-0.681	-0.236	-0.482	-1.071	-0.147	-0.673	7
US	-0.316	-0.104	-0.203	0.011	0.024	0.016	-1.192	-0.301	-0.711	-0.456	0.310	-0.022	5
Europe	-4.993	0.013	-0.736	-0.316	0.993	0.073	-2.463	5.160	-0.421	-5.298	-0.147	-1.535	50
All	-4.993	0.013	-0.687	-0.316	0.993	0.068	-2.463	5.160	-0.448	-5.298	0.310	-1.397	55

TABLE 2 (continued): Descriptive statistics of European and US bank CDS spread and return series

Panel B.2	CDS returns (individual banks)								
	Jan2004-Mar2012		Pre-Crisis Jan2004-Jun2007		Crisis Jul2007-Sep2009		Post-Crisis Oct2009-Mar2012		
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Banks
Austria	-0.331	47.213	0.181	58.073	-0.729	42.033	-0.690	32.257	EBS
	-0.248	55.198	-0.316	70.125	0.123	50.568	-0.487	29.344	RZ
Belgium	-0.504	32.791	0.025	2.481	-0.869	48.702	-0.914	37.386	KBC
	-0.995	41.043	-0.022	3.607	-1.016	51.304	-2.343	56.316	DEX
Denmark	-0.499	19.539	0.007	6.375	-0.428	26.334	-1.266	23.891	DKB
France	-0.350	23.781	0.013	2.469	-0.333	21.955	-0.876	37.781	BNP
	-0.470	28.924	0.011	2.174	-0.504	23.775	-1.115	47.451	SG
	-0.438	27.224	0.016	2.058	-0.523	23.772	-0.999	43.990	CA
	-0.285	35.447	0.013	2.504	-0.620	49.341	-0.400	44.100	NTX
	-0.204	76.908	0.993	148.587	0.000	0.000	-1.143	33.215	BPCE
Germany	-0.237	23.629	0.006	3.504	-0.420	30.459	-0.413	31.475	DB
	-0.350	27.045	0.069	3.318	-0.383	29.000	-0.908	40.549	CB
	-0.059	9.296	0.117	7.772	-0.125	12.001	-0.238	8.339	DP
	-0.319	38.450	0.269	35.654	-1.420	39.074	-0.148	41.525	HSH
Greece	-4.993	219.368	-	-	-2.463	12.731	-5.020	220.545	NBG
	-1.813	118.593	0.016	6.874	-0.805	36.338	-5.298	212.876	AB
	-2.127	141.968	0.136	10.004	-1.153	29.968	-4.542	226.286	EFG
	-4.438	219.499	-	-	5.160	19.127	-4.719	222.664	PB
Italy	-0.589	32.674	0.016	2.357	-0.363	32.094	-1.644	50.922	UI
	-0.556	29.225	0.058	2.708	-0.231	24.712	-1.713	47.576	ISP
	-0.691	32.228	0.058	2.968	-0.332	25.613	-2.071	53.207	BMPS
	-0.480	32.930	0.082	9.973	-0.307	19.141	-1.389	55.263	UBI
	-0.808	40.446	0.093	14.345	-0.537	33.504	-2.314	64.014	BP
	-0.586	31.858	0.068	4.171	-0.232	24.323	-1.828	52.908	BPM
	0.013	97.905	0.581	30.417	0.444	132.835	-0.395	50.387	BI
Netherlands	-0.328	19.879	0.038	2.412	-0.393	27.920	-0.783	24.359	ING
	-0.220	13.521	0.010	2.100	-0.336	20.371	-0.438	14.926	RBK
	-0.434	22.467	0.026	2.545	-0.459	28.954	-1.060	30.032	ABN
Norway	-0.305	20.494	-	-	-0.003	26.115	-0.476	16.491	DNB
Portugal	-1.304	53.498	0.043	2.794	-0.729	28.047	-3.720	93.537	BES
	-1.538	58.956	0.046	2.727	-0.596	24.722	-4.620	104.583	BCP
	-1.401	52.558	0.003	15.656	-0.349	27.082	-4.328	90.165	BPI
Spain	-0.630	29.240	0.003	2.529	-0.457	27.325	-1.676	46.310	BST
	-0.646	30.021	-0.002	2.266	-0.485	26.883	-1.699	48.181	BBVA
	-0.922	40.838	-0.021	5.445	-0.739	41.073	-2.354	62.850	BPE
	-1.493	50.537	-	-	-0.771	38.045	-2.149	59.643	BSB
	-0.838	42.012	0.100	3.201	-0.799	46.437	-1.608	52.767	BKT
	-0.825	59.204	0.033	9.142	-0.875	65.644	-1.984	87.082	BPA
Sweden	-0.233	16.075	0.046	10.866	-0.301	20.464	-0.563	17.607	NB
	-0.211	12.344	0.006	3.264	-0.267	18.360	-0.466	13.561	SH
	-0.306	18.572	0.045	5.331	-0.577	28.387	-0.555	19.269	SEB
	-0.248	22.173	0.073	4.784	-0.703	35.435	-0.229	19.373	SA

TABLE 2 (continued): Descriptive statistics of European and US bank CDS spread and return series

Panel B.2	**CDS returns (individual banks)** ***(continued)***								
	Jan2004-Mar2012		**Pre-Crisis Jan2004-Jun2007**		**Crisis Jul2007-Sep2009**		**Post-Crisis Oct2009-Mar2012**		
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Banks
Switzerland	-0.233	21.402	-0.007	2.952	-0.351	30.976	-0.444	25.191	CSG
UK	-0.270	14.706	0.049	3.214	-0.522	13.929	-0.490	22.929	HSBC
	-0.496	25.950	0.015	2.432	-0.681	30.152	-1.045	37.380	LBG
	-0.238	23.029	0.109	2.351	-0.325	33.615	-0.457	20.850	SC
	-0.311	52.652	0.223	66.586	-0.236	58.641	-0.869	25.374	AL
	-0.298	26.438	-0.011	2.334	-0.375	36.866	-0.630	32.783	BARC
	-0.482	29.761	0.012	2.677	-0.599	40.680	-1.071	37.712	RBS
	-0.214	34.317	0.011	2.296	-0.637	56.259	-0.147	31.971	HBOS
US	-0.316	35.171	0.017	2.910	-0.676	46.901	-0.456	45.721	BOA
	-0.115	22.162	0.011	4.187	-0.301	34.962	-0.123	22.216	JPM
	-0.269	18.683	-	-	-1.192	23.072	0.310	15.276	USB
	-0.104	25.472	0.024	3.034	-0.428	41.854	0.010	23.369	WFC
	-0.212	52.800	0.013	2.960	-0.956	91.756	0.148	39.802	CITI

TABLE 3: Principal Component Analysis
Proportion of variance explained by the principal components

Component	Individual Proportion	Cumulative Proportion
Panel A. Jan2004-Mar2012		
PC1	42.60%	42.60%
PC2	5.66%	48.25%
PC3	4.55%	52.81%
PC4	3.57%	56.38%
Panel B. Pre-Crisis. Jan2004-Jun2007		
PC1	17.14%	17.14%
PC2	5.01%	22.15%
PC3	3.37%	25.83%
PC4	3.31%	29.13%
Panel C. Crisis. Jul2007-Sep2009		
PC1	40.33%	40.33%
PC2	5.53%	45.85%
PC3	4.84%	50.69%
PC4	3.37%	54.06%
Panel D. Post-Crisis. Oct2009-Mar2012		
PC1	45.10%	45.10%
PC2	5.20%	50.30%
PC3	4.64%	54.94%
PC4	3.94%	58.88%

TABLE 4: Summary statistics, correlations and Johansen test

In Panel A, $iTraxx$, $PC1^B$ and $PC1^{SD}$ represents the $iTraxx$ CDS index returns, bank first principal component and sovereign debt first principal component. The Jarque-Bera statistic (JB) tests the normality of the series calculated as follows, $T(S^2/6+(K-3)^2/24)$ where S is the skewness coefficient and K is the kurtosis coefficient. Under the null hypothesis of normal distribution, the JB has $\chi^2(2)$ asymptotic distribution. $Q(10)$ and $Q^2(10)$ are Ljung-Box tests for tenth order serial correlation in the returns and squared returns. ARCH (10) is Engle (1982) test for tenth order ARCH, distributed as $X^2(10)$. The ADF (number of lags) and PP (truncation lag) refer to the Augmented Dickey and Fuller (1981) and Phillips and Perron (1988) unit root tests. Critical value at 5% significance level of Mackinnon (1991) for the ADF and PP tests (process with intercept but without trend) is -2.86. Panel B shows the correlation coefficients between the variables and Panel C describes the Johansen (1988) tests for cointegration. Lambda-max tests the null hypothesis that there are r cointegration relationships against the alternative that the number of cointegration vectors is greater than r + 1. Trace tests the null hypothesis that there are at most r cointegration relationships against the alternative there is not. Critical values are from Osterwald-Lenum (1992). The lag length is determined using the AIC criterion. As usual, ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.

Panel A. Summary statistics

	Mar2005-Mar2012			**Pre-Crisis: Mar2005-Jun2007**			**Crisis: Jul2007-Sep2009**			**Oct2009-Mar2012**		
	$iTraxx$	$PC1^B$	$PC1^{SD}$	$iTraxx$	$PC1^B$	$PC1^{SD}$	$iTraxx$	$PC1^B$	$PC1^{SD}$	$iTraxx$	$PC1^B$	$PC1^{SD}$
Mean	-0.174	-0.018	-0.0139	0.095	-0.096	-0.010	-0.431	-0.002	-0.000	-0.191	-0.0028	0.000
Var.	311.420	21.045	8.119	11.849	6.888	1.792	535.375	19.304	7.467	387.107	25.038	7.371
Skew.	0.483***	0.326***	0.305***	0.251**	-3.123***	-0.473***	0.142	0.353***	-0.237**	0.826***	0.254***	0.297***
Exc.Kurt.	11.479***	10.838***	15.346***	14.795***	37.759***	22.358***	2.702***	5.416***	8.392***	13.783***	5.613***	5.367***
JB	10001.400***	8885.900***	17777.600***	5396.300***	36069.800***	12331.500***	177.100***	716.060***	1695.810***	5154.770***	849.650***	779.940***
$Q(10)$	51.601***	178.676***	170.512***	106.877***	16.166*	9.451	21.857**	64.309***	169.269***	27.581***	82.326***	68.701***
$Q^2(10)$	472.375***	764.405***	733.524***	344.046***	6.602	2.698	154.554***	310.438***	176.279***	99.104***	146.373***	151.226***
ARCH(10)	84.321***	108.147***	115.224***	184.040***	6.506	3.375	113.546***	144.663***	122.988***	61.239***	81.411***	85.251***
ADF(4)	-20.735	-20.359	-20.548	-9.541	-11.208	-11.213	-11.408	-11.082	-8.667	-12.739	-12.097	-13.169
PP(6)	-35.855	-31.817	-31.720	-17.250	-21.839	-16.009	-19.159	-18.158	-12.329	-22.840	-18.358	-19.796

Panel B. Correlations

	Mar2005-Mar2012		**Pre-Crisis: Mar2005-Jun2007**		**Crisis: Jul2007-Sep2009**		**Post-Crisis: Oct2009-Mar2012**	
	$PC1^B$	$PC1^{SD}$	$PC1^B$	$PC1^{SD}$	$PC1^B$	$PC1^{SD}$	$PC1^B$	$PC1^{SD}$
$iTraxx$	0.778	0.594	0.398	-0.039	0.746	0.455	0.845	0.767
$PC1^B$		0.745		-0.023		0.529		0.818

Panel C. Johansen (1988) tests for cointegration.

		Null (Rank = r)					
		r = 0		r = 1		r = 2	
	lags	Lambda-max	Trace	Lambda-max	Trace	Lambda-max	Trace
Mar2005-Mar2012	3	641.08	1736.71	587.58	1095.63	508.04	508.04
Mar2005-Jun2007	1	484.24	1113.57	376.21	629.32	253.10	253.10
Jul2007-Sep2009	1	456.31	936.80	298.74	480.49	181.74	181.74
Oct2009-Mar2012	3	335.29	743.23	215.14	407.94	192.79	192.79
Critical value 95%		22.00	34.91	15.67	19.96	9.24	9.24

TABLE 5: Lead-lag analysis with a VAR model

VAR model consists of three-equations with the *iTraxx* return, the bank CDS returns first principal component ($PC1^B$) and the sovereign debt CDS returns first principal component ($PC1^{SD}$) as dependent variables respectively. In this table, we report coefficients identifying the ones which are significantly different from zero (Wald test). (F GC) points the cases for which we can reject the null hypotheses that lags 1 to *p*=3 have no joint explanatory power (Granger causality test). *Adj.R*^{2} shows the Adjusted R^2 for each estimated equation. As usual, ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.

Mar2005-Mar2012			
	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_{t-1}$	0.0223	0.0215**	-0.0022
$iTraxx_{t-2}$	-0.0765**	-0.0048	-0.0033
$iTraxx_{t-3}$	-0.0329	-0.0032	0.0031
$PC1_{t-1}^B$	0.0955	0.0789*	0.0018
$PC1_{t-2}^B$	-0.1197	-0.0033	-0.0029
$PC1_{t-3}^B$	-0.0886	-0.0777*	-0.0550**
$PC1_{t-1}^{SD}$	0.7674***	0.2810***	0.2619***
$PC1_{t-2}^{SD}$	0.0971	-0.0258	-0.0279
$PC1_{t-3}^{SD}$	-0.1063	-0.0135	-0.0854**
(F GC)	$^{(***)}$	$^{(***)}$	
Const.	-0.1778	-0.0111	-0.0126
Adj.R^2	3.13	9.50	8.48
Pre-Crisis: Mar2005-Jun2007			
	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_{t-1}$	0.2110$^{(***)}$	0.1459$^{(***)}$	-0.0092
$PC1_{t-1}^B$	0.2022$^{(***)}$	-0.0193	-0.0379$^{(*)}$
$PC1_{t-1}^{SD}$	-0.0261	0.0293	0.0644
Const.	0.1048	-0.1038	-0.0175
Adj.R^2	9.05	2.92	0.69
Crisis: Jul2007-Sep2009			
	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_{t-1}$	0.1427$^{(**)}$	0.0491$^{(***)}$	0.0206$^{(***)}$
$PC1_{t-1}^B$	-0.1942	0.0574	-0.0485
$PC1_{t-1}^{SD}$	0.5766	0.0560	0.4278$^{(***)}$
Const.	-0.3658	0.0187	0.0076
Adj.R^2	1.95	9.91	22.78
Post-Crisis: Oct2009-Mar2012			
Dep.Vble.	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_{t-1}$	-0.2867***	-0.0179	-0.0318***
$iTraxx_{t-2}$	-0.1338*	0.0098	-0.0162
$iTraxx_{t-3}$	-0.0868	-0.0063	-0.0045
(F GC)	$^{(***)}$		$^{(**)}$
$PC1_{t-1}^B$	0.5477	0.0557	0.0593
$PC1_{t-2}^B$	0.0506	-0.0785	0.0374
$PC1_{t-3}^B$	-0.0662	-0.1086	-0.0750*
$PC1_{t-1}^{SD}$	2.0839***	0.6525***	0.2960***
$PC1_{t-2}^{SD}$	0.2119	0.0429	-0.0370
$PC1_{t-3}^{SD}$	-0.3556	0.0477	-0.0655
(F GC)	$^{(***)}$	$^{(***)}$	$^{(***)}$
Const.	-0.2271	0.0040	-0.0057
Adj.R^2	6.75	12.99	9.79

Table 6

Decomposition of the variance for the VAR model

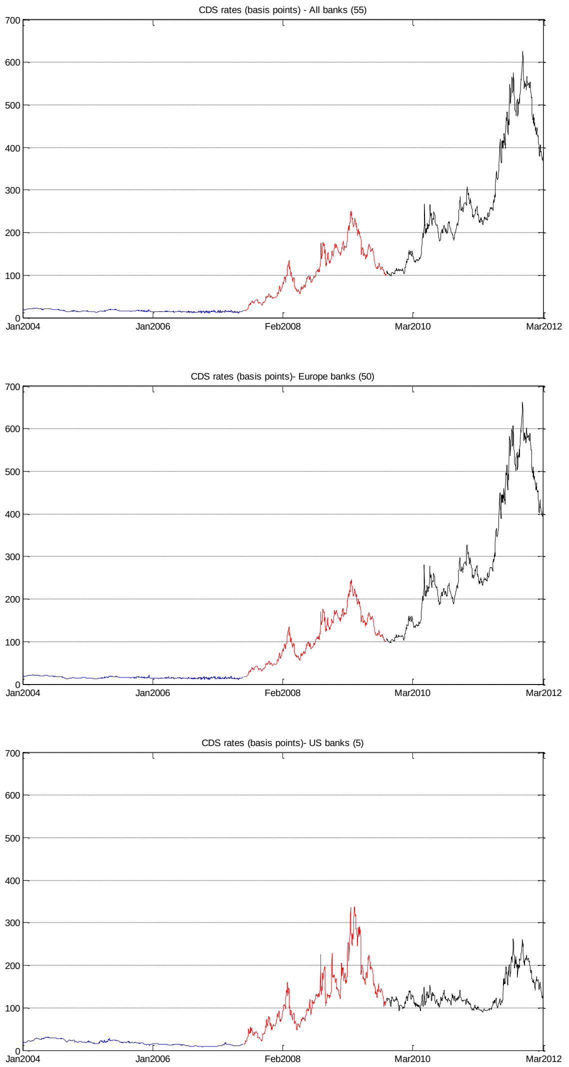
VAR model consists of three-equations with the *iTraxx* return, the bank CDS returns first principal component ($PC1^{B}$) and the sovereign debt CDS returns first principal component ($PC1^{SD}$) as dependent variables respectively. In this table, we report the decomposition of the variance of the *s*-step forecast errors in a series into the parts attributable to each of a set of innovation processes for the VAR specification. Since results are fairly constant across steps, we only report the ones corresponding to a representative step forecast error. The column of Std.Error is the standard error of forecast for this variable in the model. The remaining columns provide the decomposition (in percentage). In each row, they add up to 100%.

Mar2005-Mar2012				
Dep.Vble.	Std.Error	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_t$	17.6542	98.60	0.57	0.84
$PC1_t^B$	4.5888	61.11	37.41	1.47
$PC1_t^{SD}$	2.8497	33.73	20.26	46.01
Pre-Crisis: Mar2005-Jun2007				
Dep.Vble.	Std.Error	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_t$	3.4287	97.92	2.08	0.01
$PC1_t^B$	2.6174	16.58	83.40	0.02
$PC1_t^{SD}$	1.3311	0.31	0.48	99.22
Crisis: Jul2007-Sep2009				
Dep.Vble.	Std.Error	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_t$	23.1374	99.63	0.01	0.36
$PC1_t^B$	4.3937	60.07	39.77	0.16
$PC1_t^{SD}$	2.7323	25.54	4.99	69.47
Post-Crisis: Oct2009-Mar2012				
Dep.Vble.	Std.Error	$iTraxx_t$	$PC1_t^B$	$PC1_t^{SD}$
$iTraxx_t$	19.6134	94.18	3.02	2.80
$PC1_t^B$	5.0003	70.37	25.43	4.20
$PC1_t^{SD}$	2.7161	54.44	14.11	31.46

FIGURE 1: Time evolution of CDS spread and returns series

Daily time series of average CDS spreads (in basis points), Panel A, and CDS returns, Panel B, for the available 55 banks in the first panel. Second and third panels shows the case of European (50 banks) and US banks (5) separately. The sample period is January 2004 to March 2012 distinguished in three sub-periods: pre-crisis in blue (January 2004-June 2007), crisis in red (July 2007-September 2009) and the last period in black (October 2009-March 2012).

Panel A



Panel B

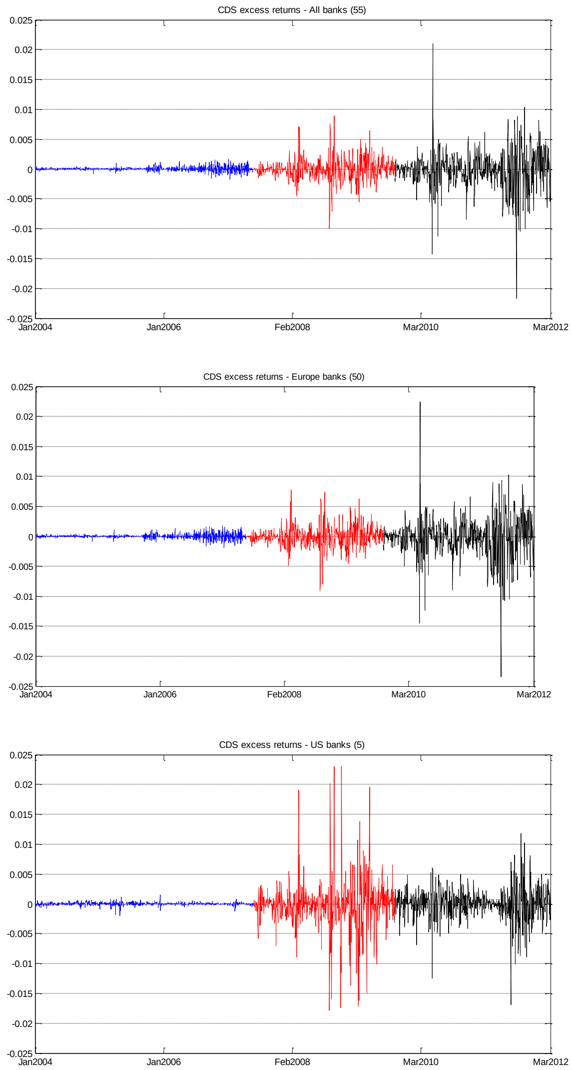
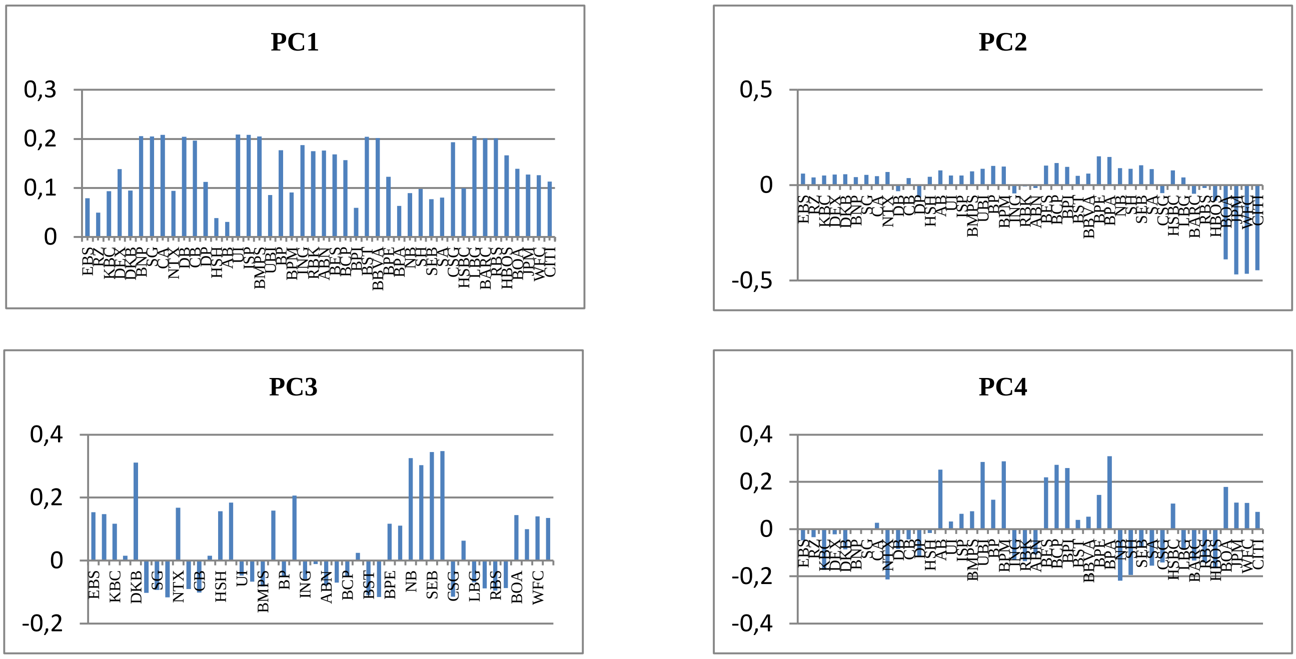


FIGURE 2: Histogram of factor loadings of the principal component analysis

Panel A. Jan2004-Mar2012



Panel B. Jan2004-Jun2007. Pre-Crisis

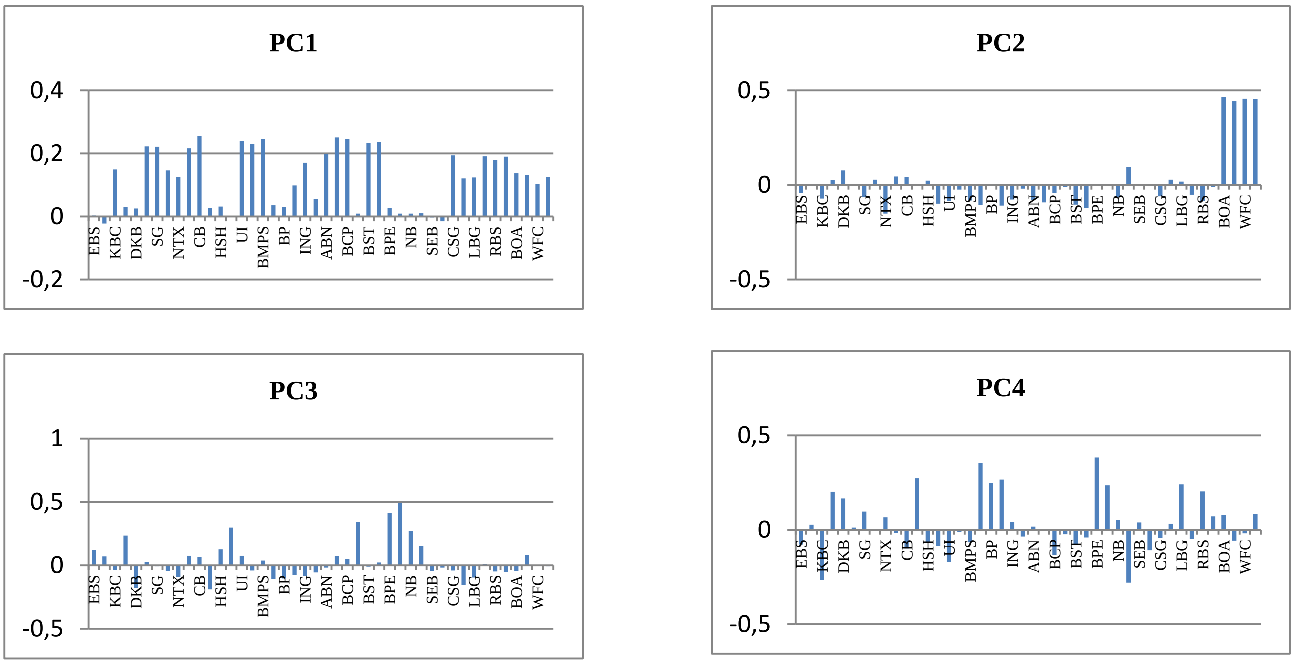
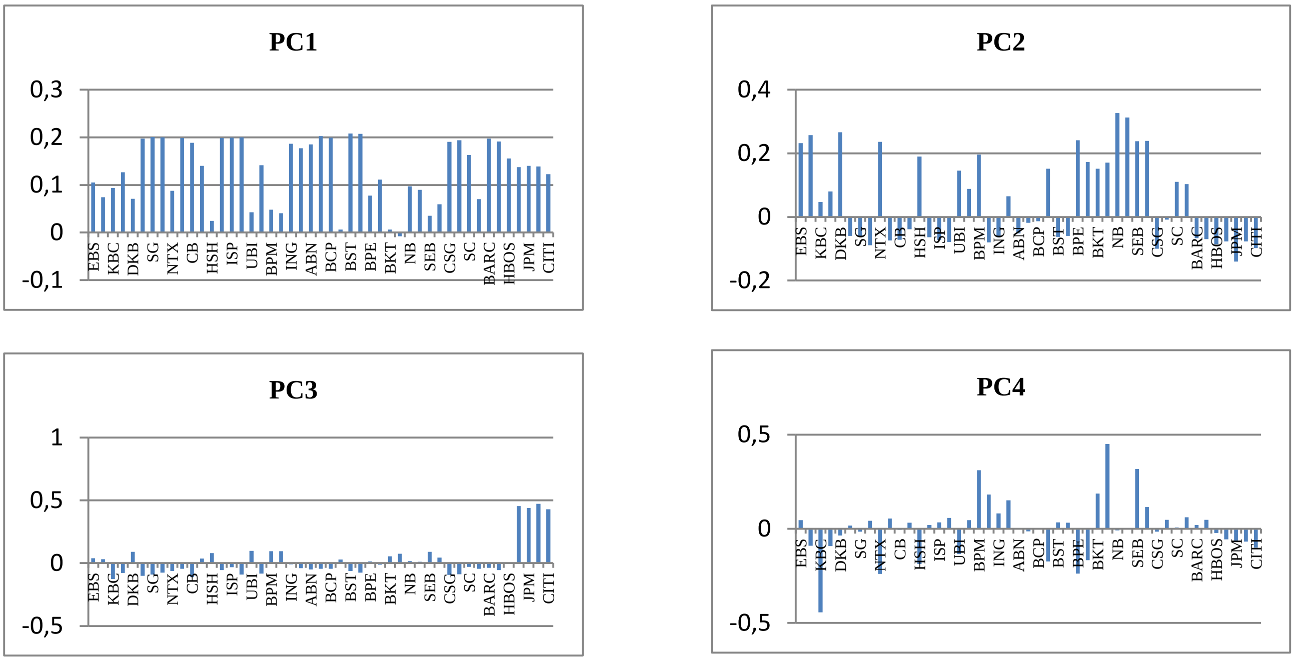


FIGURE 2 (continued): Histogram of factor loadings of the principal component analysis

Panel C. Jul2007-Sep2009. Crisis



Panel D. Oct2009-Mar2012. Post-Crisis

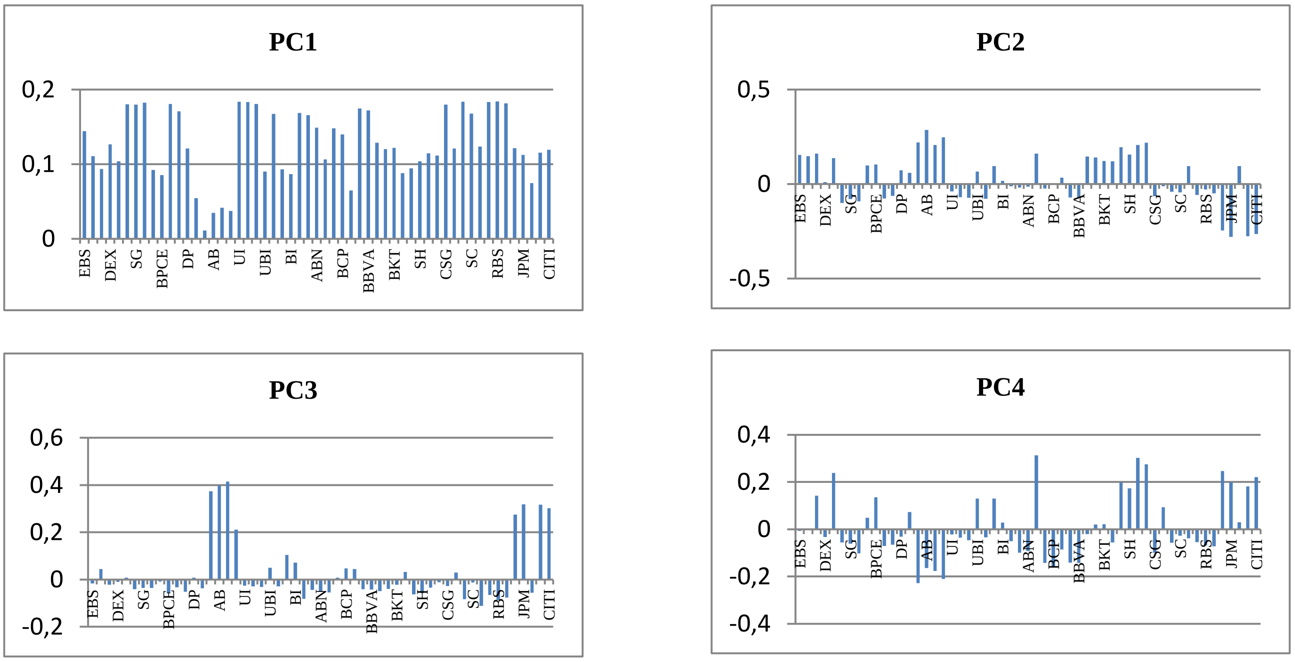
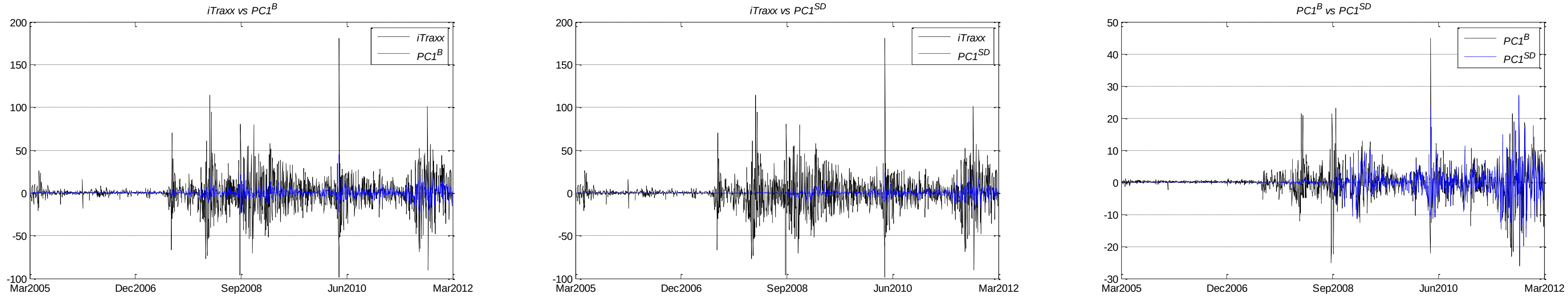


FIGURE 3: Time evolution of iTraxx CDS index returns and bank and sovereign debt CDS returns first principal component

Panel A: Mar2005-Mar2012



Panel B: Mar2005-Jun2007. Pre-Crisis

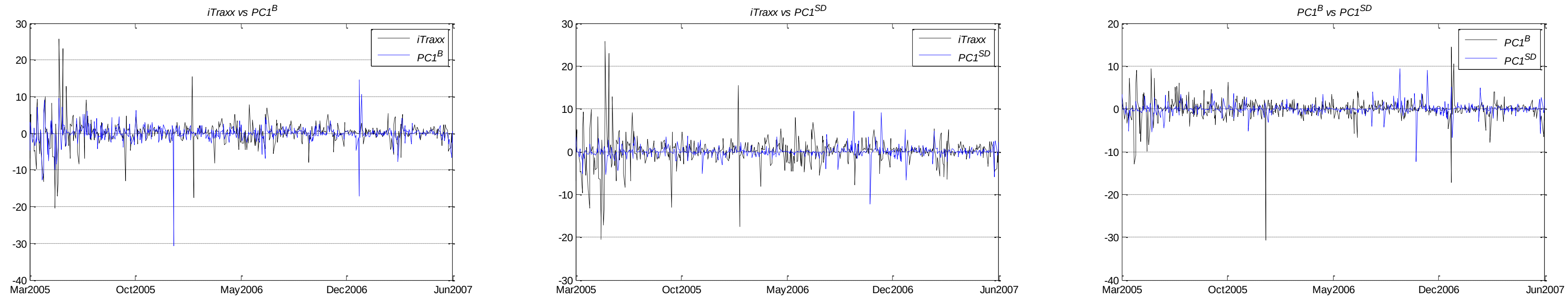
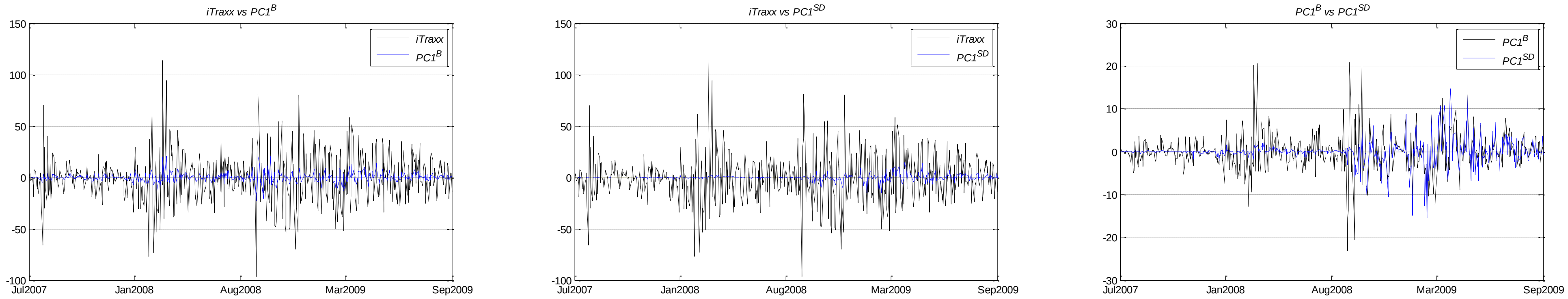


FIGURE 3 (continued): Time evolution of iTraxx CDS index returns and bank and sovereign debt CDS returns first principal component

Panel C: Jul2007-Sep2009. Crisis



Panel D: Oct2009-Mar2012. Post-Crisis