COUNTERPARTY AND LIQUIDITY RISK

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ABSTRACT

In this study we analyse the equivalence between credit default swap (CDS) spreads and corporate bond yield spreads from March 2007 to March 2011 for the reference entity France Telecom. We find evidence of cointegration between the two markets in the 3-year and 5-year maturities and that CDS prices tends to lead corporate yield spreads in all analysed maturities. We find support for significant effects of counterparty and funding risks in the basis, measured as the difference between CDS and corporate yield spreads, with negative impact, and that liquidity also matters in this context.

In the past several years, the importance of credit derivative markets has been growing rapidly. The single most important instrument in this market is the credit default swap (CDS). A CDS is a bilateral agreement to exchange the credit risk of a reference entity. In this agreement, one party (the protection buyer) pays a periodic fee (CDS premium) to another party (the protection seller) in exchange for compensation in case of a credit event (bankruptcy, failure to pay, default, restructuring, repudiation or moratorium, among others) of a given reference entity. In theory, this CDS premium is expected to reflect the perceived credit risk of the reference entity in a pure way.

Therefore, these CDS contracts provides a new way to measure the size of the default component in corporate spreads and many authors argue that an arbitrage relationship exists between CDS prices and corporate yield spreads for a given reference entity, as first discussed by Duffie (1999)[1] and then pointed out by Blanco, Brennan et al. (2005) in their empirical analysis of the dynamic relations between bonds and CDS markets.

Blanco, Brennan et al. (2005) argue that if an investor buys a T year par bond with yield to maturity y and at the same time buys credit protection in CDS market on the same reference entity for T years at a cost of p_{CDS} (annually), she has eliminated most of the default risk associated with the bond at an annual return of y - p_{CDS}. By arbitrage, this net return should be approximately equal to the T year risk free rate, x.

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1- Duffie (1999) has demonstrated that the CDS price should be equal to the spread between a par risky floating rate note over a risk free floating rate note.

For example, if y - p_{CDS} is less than x, then shorting the bond, selling protection in CDS market and buying the risk free instrument would be a profitable arbitrage opportunity[2].

In this context, an equilibrium theoretical condition is expected to hold in the long run between the corporate yield spreads and the CDS prices, even though, significant deviations are documented in many empirical studies, especially in the short term. Why this basis, between CDS prices and corporate yield spreads, deviates from zero? If in one hand, a liquidity premium may be included in the corporate yield spreads, driving this basis negative, in the other hand, other factors affecting the CDS premium also contribute to obscure this relationship, namely the counterparty risk (as CDS are OTC products, this risk tend to lower the CDS premium because protection buyers face greater uncertainty in receiving the asset value should the default occur, and therefore are only willing to pay a lower premium as argued by De Wit (2006)) and the liquidity risk of the CDS itself, which would tend to turn the basis positive.

The notion that liquidity is priced in corporate yield spreads started with Amihud and Mendelson (1986). They studied the effect of bid-ask spreads in asset pricing and returns. Among other relevant articles, Ericsson and Renault (2006) provides a comprehensive insight on the impact of the liquidity risk in the corporate yield spreads, developing a structural model that simultaneously captures liquidity and credit risk. This study documents positive correlation between illiquidity and default component and supports a downward-sloping term structure for liquidity spreads. Chen, Lesmond et al. (2007) provides an extensive analysis on how "more illiquid bonds earn higher yield spreads" using several liquidity measures and covering more than 4,000 corporate bonds, over different categories.

The recent financial crisis has stressed out the importance of the liquidity risk in the financial markets. In this period, the CDS premium has experienced a tremendous increase, as much as many studies documented the basis (between CDS and corporate yield spreads) to be strongly negative. This fact sparked new questions about the possibility of CDS prices to include significant risks other than credit risk, namely the counterparty and CDS own liquidity as stated before, not pricing correctly the reference entity default risk, which also has increased tremendously in this period with great impact in the corporate bond yields.

In this context, the present study proposes, under the non-arbitrage condition above discussed, an empirical assessment in to what extend the equilibrium between the CDS prices and the corporate yield spreads has hold in the last few years and what were the determinants of the basis spread changes for the reference entity France Telecom, including the role of counterparty and liquidity risk.

The reminder of this text is organized as follows. Section 1 defines the main concepts and discusses the general theoretical approach and main estimation methods to be applied in the empirical analysis developed later on. Section 2 presents the case study of France Telecom in order to provide more details on the conceptual framework, including a cointegration analysis, the lead-lag relationship between CDS and bond markets and a regression analysis on the determinants of the basis spread changes with proxies for counterparty risk, liquidity risk and

2- Likewise, the same authors explain that, if y - p_{CDS} is more than x, buying the bond, buying protection in CDS market and shorting the risk free instrument would then be profitable.

other market conditions. Section 3 contains concluding remarks. This article is the first part of this study. Part II, not included in this text, extends this approach to a set of investment graded firms in the Eurozone.

I. CONCEPTUAL FRAMEWORK

At this point, it is useful to clarify some of the concepts and terminology that will be used throughout this text. The CDS premium (or sometimes referred to as CDS price, or CDS spread, or just CDS) is the premium paid by the protection buyer to the protection seller, quoted in basis points per annum (usually paid quarterly) and it is a very straightforward measure that tends to reflect the credit risk of a given reference entity.

However, different concepts of corporate yield spreads exist, depending on the riskless benchmark choice and the calculation procedures. For the purpose of this study, the term bond spread will be used to denote the difference between the yield on a corporate bond and the yield on a riskless bond with identical promised cash flows, as defined in Longstaff, Mithal et al. (2005), with the riskless benchmark being the European Central Bank (ECB) spot yield curve[3].

A second approach to the corporate yield spread will also be used as alternative to the bond spread above defined, as many authors, including Blanco, Brennan et al. (2005), now argue that government bonds are no longer the ideal proxy for the risk free rate, naming factors like taxation treatment, repo specialness, scarcity premium, impacting its behaviour. Also, Longstaff, Mithal et al. (2005) use three different alternatives of risk-free rate to generate their riskless discount function in order to robust check their findings.

Therefore an alternative proxy of the risk-free rate, very much used nowadays, is the interest rate swap curve, although some may argue that swaps contain a credit premium because there is some counterparty risk. The differential between the yield on a corporate bond and the interpolated swap rates[4] is called i-spread and will be used as an alternative measure of corporate yield spread and be denoted as i-spread.

Both spread measures above will be expressed in basis points per annum, in order to compare with the CDS spread, originating two more measures: the CDS-bond basis, as the difference between the CDS spread and the bond spread (using government bonds as the benchmark) and the CDS-i-spread basis as the differential between the CDS spread and the i-spread (using the swap curve as the benchmark).

With the purpose to access (1) the equilibrium condition between the CDS prices and the corporate yield spreads and (2) the determinants of the basis spread changes, and considering that the data to be processed will consist in time series observations for each variable, it is necessary to evaluate and select an appropriate estimation method.

The first approach would be to use a standard ordinary least square (OLS) method to estimate a regression model with selected explanatory variables but, since the use of non stationary variables can lead to a spurious regression, the evaluation of that condition and the estimation model to be applied will have to take this into

3- This (spot) yield curve is estimated from a sample of "AAA-rated" euro area central government bonds, using the Svensson model. The selection criteria and additional information are available in the ECB website.

4- In this case euro vs. euribor (one year) interest rate swap.

consideration.

A stationary series can be defined as one with a constant mean, constant variance and constant autocovariances for each given lag, Brooks (2008). For a stationary series, the "shocks" will gradually die away and the series will cross its mean value frequently. In a non stationary series, shocks to the system will persist in time and the series can drift long time away form their mean, which they cross rarely.

A standard way to cope with this problem (of regressing non stationary variables) is to differentiate the series instead of using the levels. If a non stationary series have to be differentiated one time before becoming stationary it is said to contain one unit root, or to be integrated of order one, I(1). If it has to be differentiated d times before it becomes stationary, it is said to be integrated of order d, I(d).

Still according to Brooks (2008), most financial time series contains one unit root, so testing this hypotheses will be the first step before any estimation procedure[5]. For the purpose of this study, and among others available methods, the augmented Dickey-Fuller test[6] (ADF test) will be used for unit root testing and, in other to test the robustness of the results, the KPSS[7] test, Kwiatkowski, Phillips et al. (1992), will be performed, following the *confirmatory data analysis* proposed in Brooks (2008).

In order to evaluate the equilibrium condition between CDS and bond markets, an *error correction model* will be used. Considering that pure first difference models have no long term solution[8], *error correction models* (or *equilibrium correction models*) can overcome the non stationarity issue by combining first differences and lagged levels of cointegrated[9] variables. These models are in the base of the modelling strategy called the *Engle-Granger 2-step method*, in which, using a residual based approach, in the first step, a cointegrating equation is estimated.

If a cointegrating relationship is found in step 1, the appropriate modelling strategy in this framework is to use this stationary linear combination of the variables in hand in a general equilibrium model for the analysis. If not, the appropriate strategy for econometric modelling would be than to use first differences specifications only. This strategy will be detailed in the next section case study of France Telecom to analyse cointegration and lead-lag relationship between CDS and bond markets.

5- This is an important issue as differentiating more than necessary to achieve stationarity will introduce an MA (moving average) structure to the errors, and not differentiating enough times will still lead to a non stationary series, both undesirable situations.

6- Developed by Fuller (1976) and Dickey and Fuller (1979), this test has unit root under the null hypothesis.

7- Kwiatkowski-Phillips-Schmidt-Shin test. This test is known as a stationarity test as the null hypothesis in this case is stationarity.

8- As pointed out in Brooks (2008) , if we consider two series y_t and x_t, both I(1), the model one may consider estimating is $\Delta y_t = \beta \Delta x_t + \varepsilon_t$. For the model to have a long run solution, the variables must converge to some long term value and so, no longer changing, meaning $y_t = y_{t-1} = y$ and $x_t = x_{t-1} = x$, i.e. $\Delta y = 0$ and $\Delta x = 0$, cancelling everything in the equation. Therefore this model has little to say about any equilibrium condition between y_t and x_t.

9- In most cases, the linear combination of two I(1) variables will also be I(1). Even so, sometimes, some series are non stationary but tend to move together in time, like they are bound by some kind of long term relationship, despite some short term deviations. In this case there is a linear combination of these (two) I(1) variables that is stationary. If that is the case, the variables are said to be cointegrated. A general definition of cointegration is detailed in Engle and Granger (1987).

II. METHODOLOGY ILLUSTRATION: FRANCE TELECOM CASE STUDY

In order to address the investigation problem in hand, it is useful to illustrate the above discussed methodology via a case study, France Telecom, during the period from 2007, i.e. before the 2008 financial crisis, to the present (March 2011). This timeframe comprises both pre-crisis and post-crisis scenarios, as well as the great financial markets turmoil period of 2008.

A. THE BASIS

The CDS data consists of daily mid, bid and ask quotations for credit default swaps on senior France Telecom debt, with maturities of 3, 5, 7 and 10 years, obtained from a Bloomberg financial terminal covering the period from March 2007 to March 2011. Figure 1 plots the evolution of the CDS spreads over the analysis period. As shown, the premium increases with the maturity most of the time, as expected, and an enormous enlargement occurred during the 2008 crisis period from around 20 basis points in the 5 year tenor to more than 100 basis points. The after crisis period, in 2009, is characterized by a steady upward trend in all maturities, except for the 3 year tenor, after the decrease from the extremely high 2008 values.

Since all the CDS in the sample have constant maturities, the problem now is to find the appropriate corporate spread measure to compare with. While it is not possible to always find a bond with an exact maturity to match with the CDS premium, and then compare the spreads, it is necessary to find an appropriate approach to this maturity matching problem. Many approaches are available in the related literature, including Gaspar and Pereira (2010), but in this regard, a quite robust one is presented in Longstaff, Mithal et al. (2005). Rather then focusing in a specific bond to compute the corporate yield spread, those authors prefer to apply a disjoint method, in which they propose to select a basket of bonds with maturities that bracket the desired horizon (5 year in their case) to compute the corporate yield spread.

Figure 1 - Time series plot of France Telecom CDS premium mid quotations at 3, 5, 7 and 10 years maturity

To compute the corporate yield spread, they use the following procedure: for each bond in the basket set, they solve for the yield on a riskless bond with the same maturity and coupon rate, using three different riskless benchmark curves. Subtracting this riskless yield to the respective corporate bond yield, they find the yield spread for that particular bond. To obtain the desired 5-year maturity, they regress the yield spreads obtained for each bond in the basket set on their maturity and use fitted value at 5-year as the estimate for the corporate yield spread. They also present in the appendix B of their paper a very useful list of criteria for the bonds selection process.

Following this procedure, a set of eight bonds were selected for the France Telecom case study, with maturities ranging from less than 3-years to 25-years, to cover all maturities in analysis and with a "term structure" the most homogeneous as possible. The bond selection criteria included only large issued senior debt, denominated in euro and with fixed coupon rate.

Table 1 - Basket of France Telecom bonds for the corporate yield spread calculation

ISIN Code	Name	Issue Date	Maturity	Coupon
FR0000471476	FRTEL 7 12/09	23-12-2002	23-12-2009	7,00%
FR0010245548	FRTEL 3 10/10	14-10-2005	14-10-2010	3,00%
FR0010038984	FRTEL 4-5/8 01/12	23-01-2004	23-01-2012	4,63%
FR0000471948	FRTEL 7-1/4 01/13	28-01-2003	28-01-2013	7,25%
XS0365092872	FRTEL 5-1/4 05/14	22-05-2008	22-05-2014	5,25%
XS0286705321	FRTEL 4-3/4 02/17	21-02-2007	21-02-2017	4,75%
XS0500397905	FRTEL 3-7/8 04/20	09-04-2010	09-04-2020	3,88%
FR0000471930	FRTEL 8-1/8 01/33	28-01-2003	28-01-2033	8,13%

As above stated, two alternative corporate yield spread measures will be used in this study. The bond spread, with the riskless benchmark being the ECB spot yield curve, and the i-spread, that uses the interest rate swap curve as benchmark. Three sets of data are required at this point: bond data, ECB yield curve data and swap curve rates.

Full description of the bonds, including ISIN code, name, coupon rate, maturity, rating and daily series of bid, ask and mid quotations for prices and yields to maturity were obtained from a Bloomberg financial terminal covering the period in analysis.

The ECB yield curve is based in the Svensson model and the spot rate, z, for any desired maturity can be obtained using the following equation:

$$z(TTM) = \beta_0 + \beta_1 \left[\frac{1 - e^{\left(\frac{-TTM}{\tau_1}\right)}}{\left(\frac{TTM}{\tau_1}\right)} \right] + \beta_2 \left[\frac{1 - e^{\left(\frac{-TTM}{\tau_1}\right)}}{\left(\frac{TTM}{\tau_1}\right)} - e^{\left(\frac{-TTM}{\tau_1}\right)} \right] + \beta_3 \left[\frac{1 - e^{\left(\frac{-TTM}{\tau_2}\right)}}{\left(\frac{TTM}{\tau_2}\right)} - e^{\left(\frac{-TTM}{\tau_2}\right)} \right] \quad (1)$$

Where *TTM* is the term to maturity and β_i and τ_i are the model parameters to be estimated. The ECB provides daily series for the parameters above, so daily discount factors for our riskless bond with the same maturity and coupon rate can be computed. In this case, for each bond in the basket set and in a daily basis, an identical bond with the same promised cash flows was considered and each cash flow was discounted at its own riskless rate to obtain the riskless yield for that particular bond.

For the alternative measure, i-spread, the difference between the yield to maturity of each bond in the basket set and the interpolated swap rate was computed. Table 2 details the calculations for the first bond of France Telecom case study in reference to the 20th of March 2007 (the first day of the analysis period).

Table 2 - Bond spread and credit spread computation procedure

This table reports the computation procedure for bond spread and i-spread measures for the bond FR0000471476 FRTEL 7 12/09. For each day in the sample, the 20th of March 2007 in this example, the Svensson model parameters for the AAA-rated eurozone government bonds yield curve were retrieved from the ECB in order to compute the discount factors to apply to the promised cash flows of an equivalent bond and to determine its theoretical risk free price and then its yield (y_{RF}, that was 3,93% in this case). The SWAP interest rates were downloaded from Bloomberg financial terminal, and interpolated for the maturity of the bond in analysis in the 20th of March 2007, 2,76 years. The spreads were computed as the respective differences in basis points to the bond yield to maturity in that date, 4,36%.

Date: 20-03-2007

ECB Svensson Model Parameters	
β_0	4,2429
β_1	-0,7780
β_2	0,3560
β_3	-1,3269
τ_1	0,4377
τ_2	3,0657

Swap Interest Rate	
2-years	4,1545
3-years	4,1265

FR0000471476 FRTEL 7 12/09

Bond Price:	101,1410
Bond Yield:	4,3553

		23-12-2007	23-12-2008	23-12-2009
Cash Flows		7%	7%	107%
TTM (D)		278	644	1009
TTM (Y)		0,7616	1,7596	2,7644
z(TTM)=r(t,T)		3,8405	3,8712	3,8398
B(t,T)	(discount factors)	0,9712	0,9342	0,8993

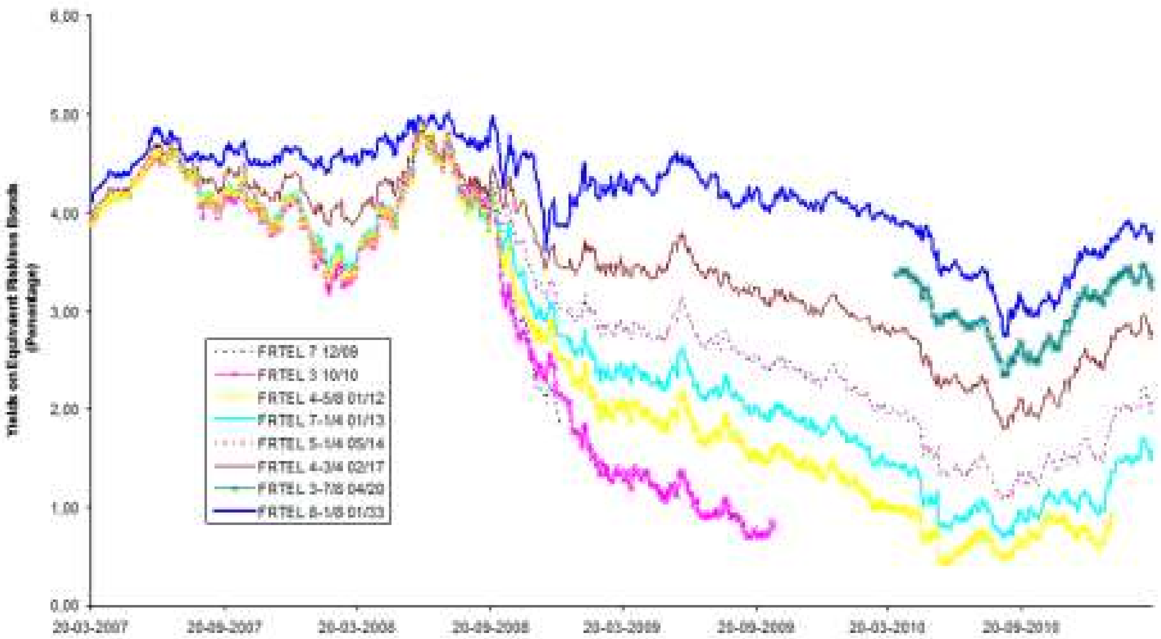
Gross $Price_{RF}$	Settl. Date	Int. Accr. Date	Accr. Int.	Clean $Price_{RF}$
109,5615	23-03-2007	23-12-2006	1,7260	107,8355

y_{RF} (%)	3,9322	Bond Spread (bp)	33,4655
i-swap rate (%)	4,1331	I-Spread (bp)	13,3719

The above procedure was repeated for the remaining bonds in the basket set and for the period in analysis. Figure 2 pictures the evolution of the riskless yield obtained for each bond in the set. As expected the riskless bonds with high maturity presented higher yields during most of the period, especially after the 2008 period. It is remarkable the flattening of the yields that has occurred in June 2008, few months before the Lehman Brothers collapse and great turmoil in financial markets. The short term interest rates were very high at that point.

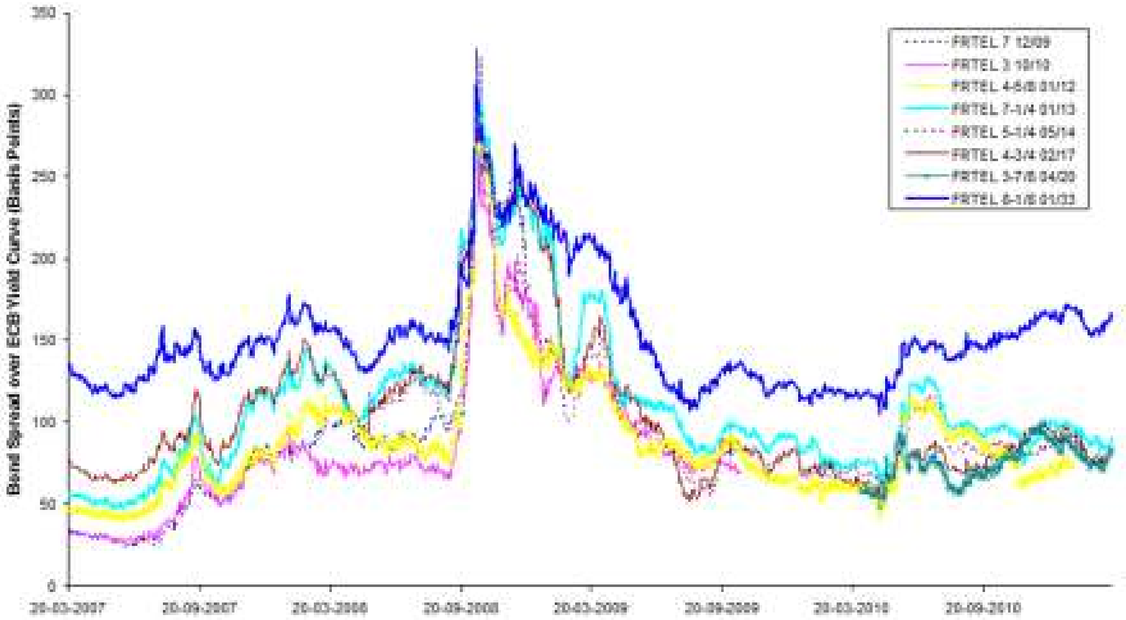
This flattening effect, not as narrow as in the riskless yield curves, has occurred in the bond yields mostly in October 2008, just after the Lehman Brothers collapse in September. At this point, after some intervention of the authorities lowering the short term interest rates, the shape of the yield curves began to normalize.

Figure 2 - Computed yields on equivalent riskless bonds
The pre-crisis period was characterized by the flattening of the yield curve, namely in June 2008.



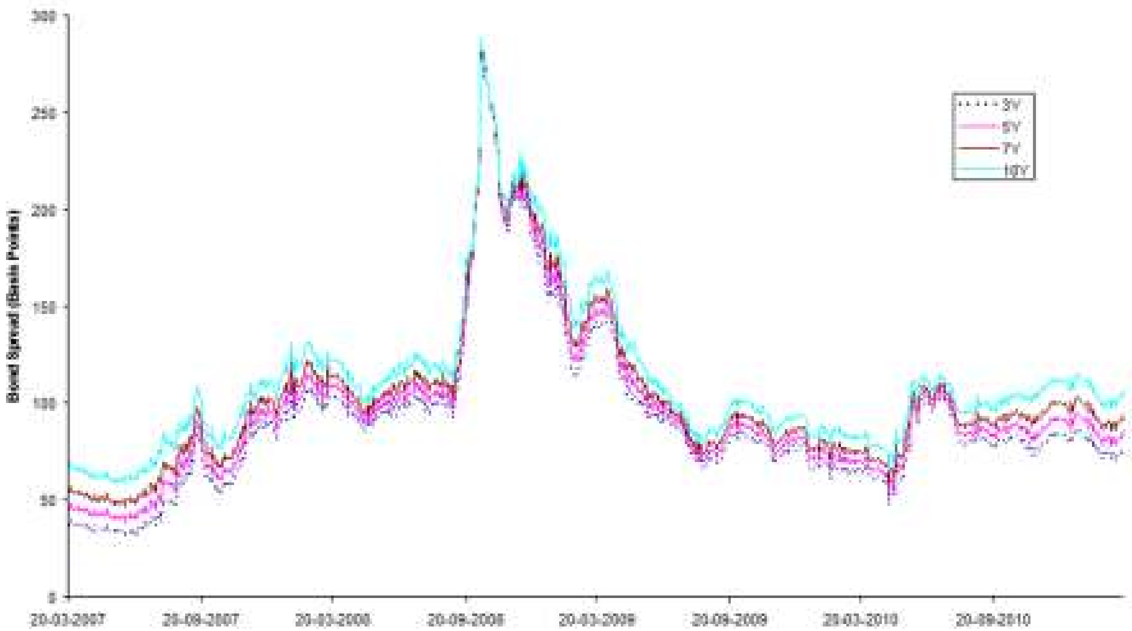
Following Longstaff, Mithal et al. (2005) procedure, Figure 3 presents the corporate yield spread over ECB spot yield curve obtained for each France Telecom bond in the set for the period in analysis. These spreads contained the desired maturities of the CDS.

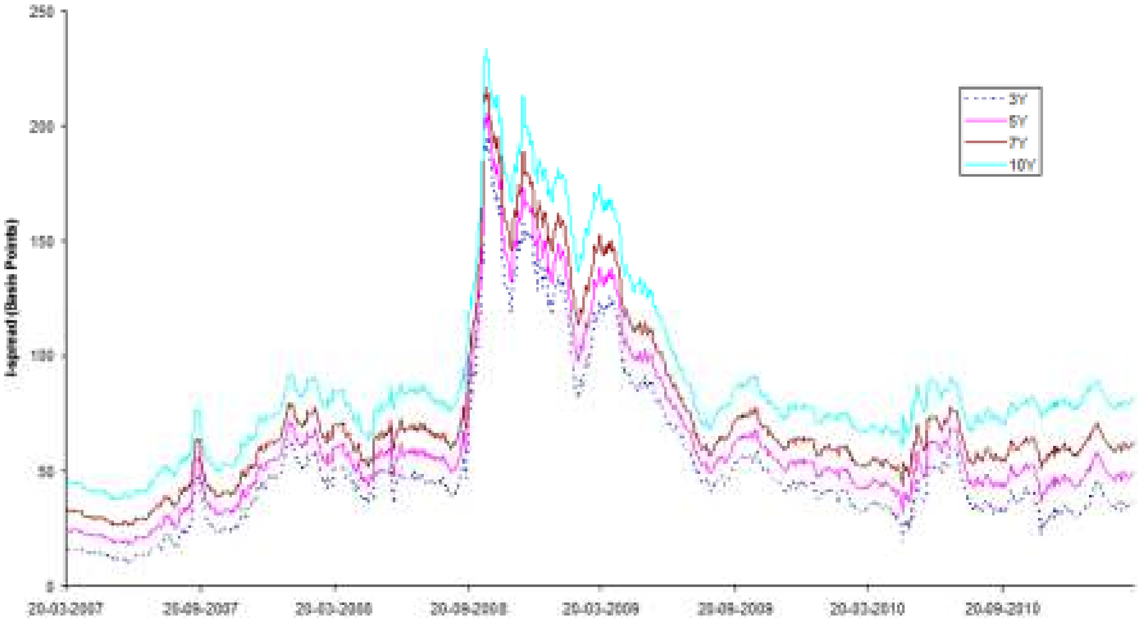
Figure 3 - Individual bond spreads (ECB yield curve as benchmark) for each France Telecom selected bonds, from March 2007 to March 2011.



The next step was to regress them on their maturities in order to obtain four time series to compare with the CDS series on the selected maturities of 3-years, 5-years 7-years and 10-years. Figure 4 (top) presents the obtained results. An equivalent procedure was followed for the i-spread. After interpolating the swap rates for each bond in the basket set and obtained the respective i-spread series, the adjusted curve for the desired maturities were obtained by regression, as also presented in Figure 4 (bottom).

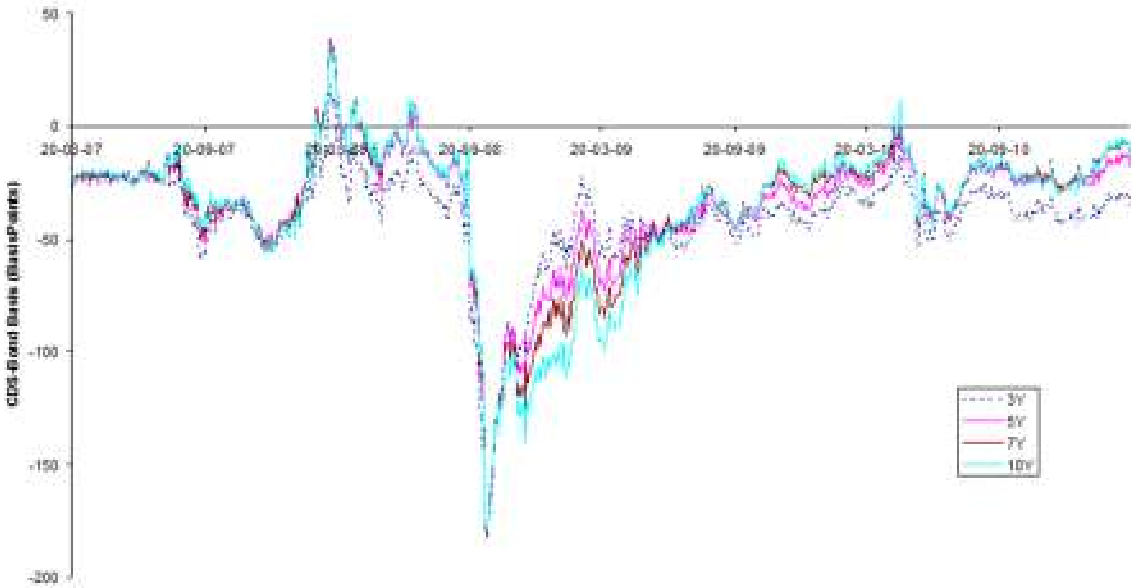
Figure 4 - Corporate spread measures, bond spread on top and i-spread bellow, for France Telecom from March 2007 to March 2011





The basis, which is the difference between the CDS premium (from Figure 1) and corporate spreads (from Figure 4) are presented in Figure 5.

Figure 5 - Corporate basis measures, CDS-Bond basis on top and CDS-i-Spread basis bellow, for France Telecom from March 2007 to March 2011



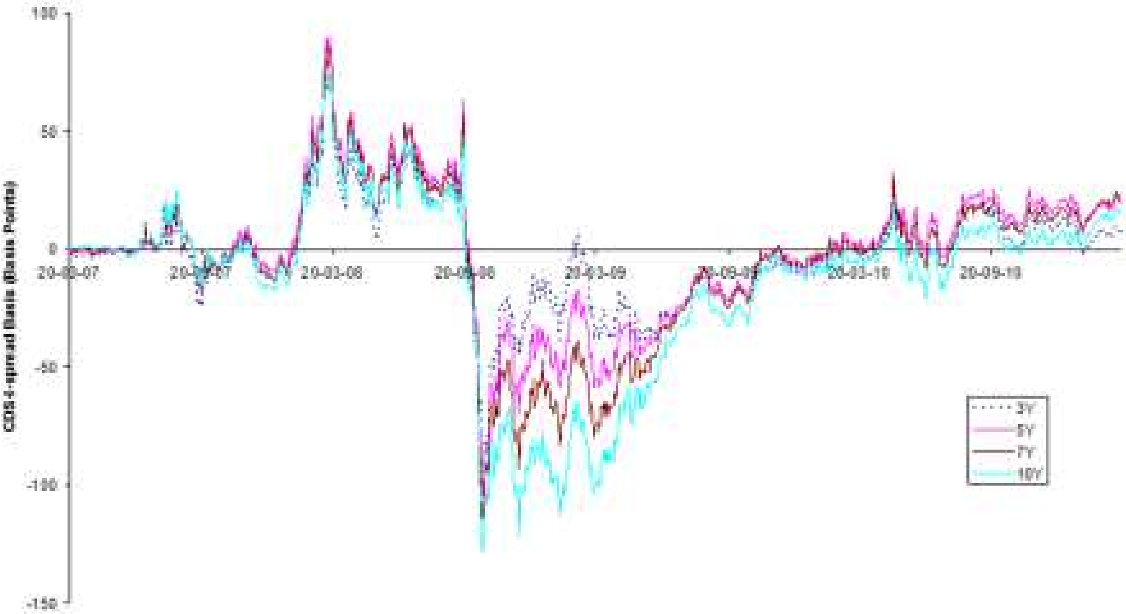


Figure 5 reports the CDS-bond basis essentially negative during the analysis period with a massive decrease in the post Lehman Brothers crisis period. The CDS-i-spread basis exhibited a similar evolution pattern and a consistent average of 30 basis point in addition to the CDS-bond basis. This difference is related to the use of different risk-free rate proxies, as above discussed, and may include, among others, factors like liquidity differences between bonds and swap markets, taxation treatment or repo specialness.

It is possible then to split the analysis period in four, a pre crisis period in 2007 (up to the end of the year), a crisis period before Lehman Brothers collapse and another after this event in September 2008 and a post crisis period with the markets recovery that began in March 2009.

Table 3 - Descriptive Statistics

Var.	Period	Term	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis	Obs
CDS	I	3	20,1918	8,7599	9,7920	41,0710	0,6970	-0,7281	197
CDS	I	5	30,6517	9,9772	17,4000	50,5660	0,3493	-1,3769	197
CDS	I	7	38,6019	9,4084	24,8840	57,0990	0,2319	-1,4013	197
CDS	I	10	50,8692	9,5891	35,6580	73,6900	0,3310	-1,0294	197
CDS	II	3	72,2365	14,8815	35,7030	118,3270	0,5530	1,1014	167
CDS	II	5	91,7109	18,0848	45,6010	144,7260	0,2559	0,8736	167
CDS	II	7	98,1469	18,1462	50,3960	148,9720	0,1237	0,6204	167
CDS	II	10	106,2957	18,3529	57,8960	156,8530	0,0448	0,4728	167
CDS	III	3	97,3141	15,4333	65,7640	124,3910	-0,1724	-0,9014	148
CDS	III	5	96,7652	12,4897	72,9010	125,0670	-0,0612	-0,8849	148
CDS	III	7	94,2168	14,6223	65,5400	130,7870	-0,0981	-0,5487	148
CDS	III	10	92,4589	17,9889	59,6290	140,6120	0,1008	-0,7016	148
CDS	IV	3	42,4446	10,3548	28,5640	94,4270	1,6847	4,3673	506
CDS	IV	5	56,2684	10,3579	37,1600	87,9340	0,0425	-0,9533	506
CDS	IV	7	63,8238	10,3582	44,2220	84,6260	0,0035	-1,0953	506
CDS	IV	10	71,5298	11,5916	48,9390	97,8420	0,1217	-0,7558	506
BAS CDS	I	3	3,2147	0,6366	1,2330	4,8380	-0,3935	0,8274	197
BAS CDS	I	5	2,7994	0,7817	1,4720	6,7900	2,5116	8,6234	197
BAS CDS	I	7	4,2750	1,0985	0,9250	15,1380	4,7899	49,4242	197
BAS CDS	I	10	3,6967	0,9342	0,5850	8,1560	0,9069	5,3275	197
BAS CDS	II	3	6,4260	1,1855	3,5310	8,9030	-0,1908	-0,8554	167
BAS CDS	II	5	6,1065	1,6180	3,0000	18,5340	3,6196	24,2398	167
BAS CDS	II	7	6,8250	1,3462	4,4310	10,0880	0,4751	-0,7771	167
BAS CDS	II	10	6,7335	1,3568	1,8900	13,4060	0,8598	3,2909	167
BAS CDS	III	3	7,9389	2,3441	1.4630	15.6580	0.3097	0.8514	148
BAS CDS	III	5	6,4955	1,6265	2,9900	10,3100	0,1042	-0,8085	148
BAS CDS	III	7	6,4089	1,4604	2,3250	9,3740	-0,7347	1,0339	148
BAS CDS	III	10	5,8888	1,7184	0,6740	9,9500	-0,5596	0,5442	148
BAS CDS	IV	3	4,5772	1,6481	1,7550	11,8430	1,3622	1,9142	506
BAS CDS	IV	5	3,2623	0,6610	1,7510	5,3630	0,6763	0,1873	506
BAS CDS	IV	7	4,7827	1,0389	0,9530	12,1270	1,1986	6,4347	506
BAS CDS	IV	10	4,5149	1,3535	1,9620	11,6240	0,6736	1,0124	506
Bond Spread	I	3	53,1325	18,6095	30,2918	91,5612	0,5995	-0,9259	197
Bond Spread	I	5	60,6092	17,9351	38,3848	97,3636	0,5817	-0,9295	197
Bond Spread	I	7	68,0859	17,2840	46,4777	103,2225	0,5592	-0,9371	197
Bond Spread	I	10	79,3011	16,3573	58,3219	112,3461	0,5162	-0,9582	197
Bond Spread	II	3	97,3131	5,0250	80,3725	109,3556	-0,2932	0,3364	167
Bond Spread	II	5	102,8591	5,4537	86,3899	115,0750	-0,3047	0,1799	167
Bond Spread	II	7	108,4060	5,9565	92,4073	121,8759	-0,3317	0,1034	167
Bond Spread	II	10	116,7239	6,8135	100,6454	132,0773	-0,3761	0,0565	167
Bond Spread	III	3	171,3890	45,4732	91,6829	283,3086	0,5009	-0,4405	148
Bond Spread	III	5	176,3801	43,5342	97,0599	284,8146	0,4741	-0,3973	148
Bond Spread	III	7	181,3712	41,6408	102,4368	286,3206	0,4423	-0,3483	148
Bond Spread	III	10	188,8578	38,9005	110,5023	288,5795	0,3840	-0,2620	148
Bond Spread	IV	3	80,7948	14,5601	47,1634	148,0443	1,3781	3,8243	506
Bond Spread	IV	5	86,1468	14,6123	52,3644	153,7040	1,3699	4,0072	506
Bond Spread	IV	7	91,4988	14,8281	57,5655	159,4545	1,3334	3,9458	506
Bond Spread	IV	10	99,5269	15,4423	65,3671	168,5674	1,2437	3,4554	506
BAS BY	I	3	6,1835	2,4715	3,5262	10,3900	0,5482	-1,4804	197
BAS BY	I	5	5,8157	2,2382	3,3450	9,6703	0,5537	-1,4592	197
BAS BY	I	7	5,4479	2,0065	3,1637	8,9505	0,5582	-1,4304	197
BAS BY	I	10	4,8962	1,6632	2,8918	7,8710	0,5587	-1,3638	197
BAS BY	II	3	12,2008	1,7056	7,4121	14,7223	-0,3968	-0,6906	167
BAS BY	II	5	11,1979	1,4986	7,0410	13,5003	-0,3782	-0,7037	167
BAS BY	II	7	10,1950	1,2935	6,6699	12,2782	-0,3521	-0,7175	167
BAS BY	II	10	8,6906	0,9923	6,1132	10,4451	-0,2899	-0,7276	167
BAS BY	III	3	12,4768	1,6430	9.3375	15.5261	0.0133	-1.1066	148
BAS BY	III	5	11,4524	1,4863	8,6478	14,1845	0,0006	-1,0871	148
BAS BY	III	7	10,4280	1,3329	7,7944	12,8429	-0,0241	-1,0509	148
BAS BY	III	10	8,8914	1,1122	6,4790	10,9076	-0,1037	-0,9278	148

Table 3 presents descriptive statistics for the above discussed variables obtained for France Telecom. In the period I, the CDS premium and the bond spreads were relatively low and the basis measures were at their equilibrium point. The CDS-i-spread basis was near zero, suggesting that the theoretical non arbitrage condition was holding relatively well during this period. The CDS-bond basis was 30bp negative, but this difference may be related to liquidity and other factors as above discussed.

Table 3 (continued)

BAS BY	IV	3	9,3608	2,7752	3,9648	15,4879	0,3996	-0,8301	506
BAS BY	IV	5	8,5542	2,4373	4,2267	13,9471	0,4656	-0,7598	506
BAS BY	IV	7	7,7476	2,1105	3,8762	12,4701	0,5372	-0,6531	506
BAS BY	IV	10	6,5377	1,6559	3,3504	10,4753	0,6408	-0,4524	506
CDS-Bond Basis	I	3	-32,9407	11,4245	-59,0772	-17,5645	-0,6531	-0,9349	197
CDS-Bond Basis	I	5	-29,9575	10,3162	-52,7770	-11,8185	-0,6348	-0,8171	197
CDS-Bond Basis	I	7	-29,4840	10,3266	-54,7175	-12,3080	-0,6999	-0,5802	197
CDS-Bond Basis	I	10	-28,4319	10,9260	-56,1031	-7,2968	-0,7667	-0,1649	197
CDS-Bond Basis	II	3	-25,0766	12,7240	-49,4040	17,9999	0,7230	1,3384	167
CDS-Bond Basis	II	5	-11,1482	16,2165	-44,9282	39,0674	0,2621	0,8488	167
CDS-Bond Basis	II	7	-10,2581	16,4460	-45,5235	35,6476	0,0230	0,5208	167
CDS-Bond Basis	II	10	-10,4281	17,0571	-49,7109	34,1647	-0,1696	0,4193	167
CDS-Bond Basis	III	3	-74,0749	38,7744	-181,9206	-22,4193	-0,9362	0,2602	148
CDS-Bond Basis	III	5	-79,6149	35,7294	-181,5497	-12,5599	-0,6199	0,5300	148
CDS-Bond Basis	III	7	-87,1544	34,3803	-180,6653	-10,7718	-0,1420	0,6437	148
CDS-Bond Basis	III	10	-96,3989	34,4348	-179,3332	-9,5043	0,5220	0,8322	148
CDS-Bond Basis	IV	3	-38,3502	8,3108	-59,2190	-6,0300	0,1832	0,1839	506
CDS-Bond Basis	IV	5	-29,8784	11,9332	-69,8379	6,4446	-0,5433	0,4095	506
CDS-Bond Basis	IV	7	-27,6751	14,1999	-80,9007	10,7972	-0,9871	1,4808	506
CDS-Bond Basis	IV	10	-27,9971	16,2682	-90,5962	12,4362	-1,3354	2,5830	506
i-Spread	I	3	22,6453	10,4684	9,8413	48,0182	0,9222	-0,2068	197
i-Spread	I	5	30,8013	10,5107	17,9056	55,7649	0,8800	-0,2616	197
i-Spread	I	7	38,9574	10,5785	25,9699	63,8259	0,8311	-0,3228	197
i-Spread	I	10	51,1915	10,7270	37,6362	76,3656	0,7492	-0,4244	197
i-Spread	II	3	47,8684	5,6237	35,2871	64,0272	0,3525	0,2445	167
i-Spread	II	5	57,2325	5,5156	43,3122	71,9282	0,0710	0,2982	167
i-Spread	II	7	66,5967	5,6125	51,3374	79,8292	-0,2800	0,3724	167
i-Spread	II	10	80,6430	6,1151	63,3751	92,3579	-0,7043	0,4217	167
i-Spread	III	3	120,6170	35,5567	39,2980	195,2847	-0,3670	0,0117	148
i-Spread	III	5	133,7812	35,1049	50,2817	205,3036	-0,4936	0,1779	148
i-Spread	III	7	146,9455	34,7400	61,2653	216,4207	-0,6272	0,3693	148
i-Spread	III	10	166,6919	34,3609	77,7408	233,0963	-0,8343	0,6942	148
i-Spread	IV	3	46,8261	18,4879	19,2293	126,3211	1,8631	3,7007	506
i-Spread	IV	5	57,4353	18,4164	31,2591	138,2601	2,0655	4,4044	506
i-Spread	IV	7	68,0444	18,5138	43,2889	150,1990	2,2065	4,9304	506
i-Spread	IV	10	83,9582	18,9702	61,3189	168,1074	2,2882	5,2772	506
CDS-i-Spread Basis	I	3	-2,4535	6,2092	-24,5164	14,8086	-0,8025	2,2427	197
CDS-i-Spread Basis	I	5	-0,1497	6,4459	-19,6141	21,0218	0,3412	1,4373	197
CDS-i-Spread Basis	I	7	-0,3555	6,4133	-16,1118	21,0976	0,3632	1,2329	197
CDS-i-Spread Basis	I	10	-0,3223	7,8016	-17,5716	25,1500	0,3360	1,1419	197
CDS-i-Spread Basis	II	3	24,3682	16,2641	-12,1822	73,2778	0,1847	1,1738	167
CDS-i-Spread Basis	II	5	34,4783	19,1973	-9,3846	90,0461	-0,0315	1,0274	167
CDS-i-Spread Basis	II	7	31,5502	18,8023	-12,6698	85,3723	-0,1173	0,8735	167
CDS-i-Spread Basis	II	10	25,6528	18,3556	-17,2900	76,4087	-0,1324	0,8156	167
CDS-i-Spread Basis	III	3	-23,3028	26,3342	-94,7673	52,1188	-0,0930	1,2535	148
CDS-i-Spread Basis	III	5	-37,0160	30,9157	-105,2046	63,6214	1,0262	1,6218	148
CDS-i-Spread Basis	III	7	-52,7288	34,2627	-114,4307	57,6139	1,4227	1,7707	148
CDS-i-Spread Basis	III	10	-74,2330	39,0970	-128,2483	47,6533	1,6140	1,7395	148
CDS-i-Spread Basis	IV	3	-4,3815	15,2003	-38,8567	27,3837	-0,4956	-0,6435	506
CDS-i-Spread Basis	IV	5	-1,1668	19,5958	-55,7566	32,8559	-0,7384	-0,2973	506
CDS-i-Spread Basis	IV	7	-4,2207	21,4726	-71,7360	30,2061	-1,1180	0,6374	506
CDS-i-Spread Basis	IV	10	-12,4285	23,2986	-90,8504	21,3415	-1,4472	1,6094	506

The period II saw a large increase of the CDS premium, leading to what would be the tendency later on for the corporate spread measures, suggesting this leading effect of the CDS prices in its lead-lag dynamics with corporate yield spreads, documented by many authors, including Blanco, Brennan et al. (2005), that argue that price discovery tends to occur in the CDS market, that leads to some extend corporate spreads in the short term. As a result, the basis, measured with swap benchmark turned into positive territory. Other possible factors that could drive the basis positive is discussed by De Wit (2006), and may include CDS cheapest to deliver option, as in case of default, protection buyers hold a delivery option and are free to choose the cheapest from a basket of deliverable bonds. Protection sellers will tend receive the less favourable option and therefore tend to increase the CDS premium if this risk increases. He also appoints other factors like bonds trading bellow par and profit realization, among others.

Period III documents a large increase in the corporate yield spread measures reflecting in part the great increase of the default risk that occurred in this period, after the Lehman Brothers collapsed. The level of CDS spreads were not increasing as much as the corporate spreads and the basis became highly negative. Some authors, like De Wit (2006), could argue that the CDS premium was reflecting some of the high counterparty risk that CDS market was experiencing in that period, when banks were not lending to each other on generalized bankruptcy fears, lowering the CDS premium as protection buyers were facing great uncertainty in receiving the defaulted bond value from CDS sellers. Others may find that liquidity scarcity was the major issue driving the basis negative. Probably both factors played a significant role in this case, as well as other factors also pointed out by De Wit (2006) like funding issues and technical factors.

In the period IV it was possible to see some normalization returning to the markets. CDS spreads decreased significantly as a result of strong interventions from the authorities in both providing liquidity and implementing measures to restore confidence on the financial system. One set of measures to reduce systemic risk and improve market transparency was the introduction of the central counterparties (CCP) in securities lending.

B. Lead-Lag and Long Term Relationship Between CDS and Bond Markets

The present section will concentrate on the cointegration analysis between the CDS and corporate yield spreads and will evaluate to what extend the lead-lag relationship argued by Blanco, Brennan et al. (2005) held in the period in analysis for France Telecom. This analysis will be conducted within the *Engle-Granger 2 step method* procedure above mentioned and, in the first step, it will be possible to assess whether a cointegrating relationship exists between the two variables.

The variables in hand are, the CDS premium at 3, 5, 7 and 10 years maturities and the correspondent (1) bond spreads and (2) i-spreads. The first step is to test all series for the existence of a unit root using ADF test[10]. To make sure the order of integration of the variables is

10- H_0: Series contains a unit root. Critical values for intercept / no trend: -3,4366 at 1% level; -2,8642 at 5% level and -2,5682 at 10% level. Critical values for intercept / linear trend: -3,9671 at 1% level; -3,4142 at 5% level and -3,1292 at 10% level; Fuller (1976).

I (1), first differences are also tested and, finally, confirmatory analysis is conducted on the variables in levels using KPSS[11] test as above discussed. Table 4 summarises the results of ADF tests and, as one might anticipate, all series contained one unit root.

Null hypothesis of a unit root could not be rejected for all variables in levels at 10% level, and was strongly rejected for all variables in first differences. KPSS test confirmed these results, as shown Table 5 for all variables in level.

Table 4 - Unit root testing

This table reports the results of ADF test conducted in CDS premium at 3, 5, 7 and 10 years maturities and the correspondent bond spreads and i-spreads. It included up to 1018 observations (sample adjusted from 20/03/2007 to 18/03/2011, depending on the number of lags selected) and the number of lags was selected according to Schwarz Info Criterion. Test regression included a constant for all variables and, because a trend could be identified in the data series under the null hypothesis, a trend for CDS premium at 5, 7 and 10 years, as indicated in specification column [Lags / Intercept (Y/N) / Trend (Y/N)]. * denotes null hypothesis cannot be rejected at 1% level, ** denotes null hypothesis cannot be rejected at 5% level, *** denotes null hypothesis cannot be rejected at 10% level. [1] denotes MacKinnon, Haug et al. (1999) one-sided p-values.

Augmented Dickey-Fuller Unit Root Test

Var.	Term	Specification	Test Stat	p-value [1]	Conclusion
CDS Levels	3	1 / Y / N	-2,0233	0,2769	unit root***
CDS Levels	5	1 / Y / Y	-2,2844	0,4416	unit root***
CDS Levels	7	1 / Y / Y	-2,3422	0,4101	unit root***
CDS Levels	10	0 / Y / Y	-2,3088	0,4282	unit root***
Δ(CDS)	3	0 / Y / N	-27,7225	0,0000	stationary
Δ(CDS)	5	0 / Y / Y	-26,3875	0,0000	stationary
Δ(CDS)	7	0 / Y / Y	-28,1438	0,0000	stationary
Δ(CDS)	10	0 / Y / Y	-30,1556	0,0000	stationary
Bond Spread Levels	3	5 / Y / N	-2,3560	0,1548	unit root***
Bond Spread Levels	5	5 / Y / N	-2,3160	0,1671	unit root***
Bond Spread Levels	7	5 / Y / N	-2,2672	0,1830	unit root***
Bond Spread Levels	10	5 / Y / N	-2,1822	0,2131	unit root***
Δ(Bond Spread)	3	4 / Y / N	-9,7259	0,0000	stationary
Δ(Bond Spread)	5	4 / Y / N	-9,8986	0,0000	stationary
Δ(Bond Spread)	7	4 / Y / N	-10,1450	0,0000	stationary
Δ(Bond Spread)	10	4 / Y / N	-10,6463	0,0000	stationary
i-Spread Levels	3	4 / Y / N	-2,3163	0,1670	unit root***
i-Spread Levels	5	4 / Y / N	-2,2440	0,1909	unit root***
i-Spread Levels	7	4 / Y / N	-2,1661	0,2191	unit root***
i-Spread Levels	10	4 / Y / N	-2,0375	0,2708	unit root***
Δ(i-Spread)	3	3 / Y / N	-11,3056	0,0000	stationary
Δ(i-Spread)	5	3 / Y / N	-11,1349	0,0000	stationary
Δ(i-Spread)	7	3 / Y / N	-11,0958	0,0000	stationary
Δ(i-Spread)	10	3 / Y / N	-11,3383	0,0000	stationary

11- H_0: The series is stationary. Asymptotic critical values for intercept / no trend: 0,739 at 1% level; 0,463 at 5% level and 0,347 at 10% level. Asymptotic critical values for intercept / linear trend: 0,216 at 1% level; 0,146 at 5% level and 0,119 at 10% level; Kwiatkowski, Phillips et al. (1992).

Table 5 - Stationarity testing

This table reports the results of KPSS test for the same variables in levels. It included 1018 observations (sample from 20/03/2007 to 18/03/2011). Specification column indicates the inclusion of intercept and trend in the test [Intercept (Y/N) / Trend (Y/N)]. * denotes null hypothesis is rejected at 10% level, ** denotes null hypothesis is rejected at 5% level, *** denotes null hypothesis is rejected at 1% level.

KPSS Unit Root Test

Var.	Term	Specification	Test Stat	Conclusion
CDS Levels	3	Y / N	0,5676	reject Ho **
CDS Levels	5	Y / Y	0,5160	reject Ho ***
CDS Levels	7	Y / Y	0,4920	reject Ho ***
CDS Levels	10	Y / Y	0,4245	reject Ho ***
Bond Spread Levels	3	Y / N	0,5302	reject Ho **
Bond Spread Levels	5	Y / N	0,5242	reject Ho **
Bond Spread Levels	7	Y / N	0,5180	reject Ho **
Bond Spread Levels	10	Y / N	0,5088	reject Ho **
i-Spread Levels	3	Y / N	0,6210	reject Ho **
i-Spread Levels	5	Y / N	0,6157	reject Ho **
i-Spread Levels	7	Y / N	0,6140	reject Ho **
i-Spread Levels	10	Y / N	0,6165	reject Ho **

Therefore, in order to avoid regressing non stationary series, a statistically valid model would be in first differences and, for this model to have a long run solution, a cointegrating relationship (suggested by the theory) should be found first and then it is valid to include this cointegrating term (which is also stationary), along with first differenced terms, in an error correction model in a second step.

Engle-Granger 2 step method

Step 1: Estimation of cointegrating equation

This method tests for cointegration in a regression using a residual based approach. For each maturity, the residuals of a standard OLS regression between the corporate yield spread and the CDS spread should be tested for the existence of a unit root. If this residual series can be considered stationary, one can conclude that the two variables are cointegrated. Therefore, the residuals (u_t) of the following potential cointegrating equation should be tested:

$$Bondspread_t = \gamma_0 + \gamma_1 CDS_t + u_t \qquad (2)$$

If the residuals u_t can be considered stationary, one can conclude for the existence of a cointegrating relationship between the two variables. In this case, the estimated stationary liner combination of CDS and bond spread, $\hat{u}_t = bondspread_t - \hat{\gamma}_0 - \hat{\gamma}_1 CDS_t$, is know as the cointegrating term. In this case the cointegrating vector would be $[1 \ -\hat{\gamma}_1]$. The results for France Telecom are given in Table 6.

Table 6 - Estimated potentially cointegrating equations and residual tests for France Telecom

This table reports the results of standard OLS regression between corporate yield spreads and CDS prices and the correspondent residual tests using ADF and KPSS tests. The cointegrating equations are $bondspread_t = \gamma_0 + \gamma_1 CDS_t + u_t$ and $i\text{-}spread_t = \gamma_0 + \gamma_1 CDS_t + u_t$ Included observations: 1018, from 20/03/2007 to 18/03/2011 for OLS regression and KPSS test (and adjusted for ADF test depending of number of lags included). In ADF tests * denotes null hypothesis is rejected at 10% level, ** denotes null hypothesis is rejected at 5% level, *** denotes null hypothesis is rejected at 1% level. In KPSS tests * denotes null hypothesis cannot be rejected at 1% level, ** denotes null hypothesis cannot be rejected at 5% level, *** denotes null hypothesis cannot be rejected at 10% level.

				Residuals ADF Unit Root Test			esiduals KPSS Unit Root Te		
Var.	Term	γ_0	γ_1	Test Stat.	p-value [1]	Conclusion	Test Stat.	Conclusion	
Bond Spread	3	23,6597	1,3266	-3,4143	0,0107	Stationary **	0,1151	Stationary ***	Cointegrated
Bond Spread	5	20,4752	1,2155	-2,6997	0,0744	Stationary *	0,2928	Stationary ***	Cointegrated
Bond Spread	7	23,0305	1,1563	-2,3801	0,1477	unit root***	0,3891	Stationary **	Not Cointegrated
Bond Spread	10	36,5349	0,9818	-2,0787	0,2535	unit root***	0,4486	Stationary **	Not Cointegrated
i-Spread	3	0,2585	1,0350	-3,2346	0,0184	Stationary **	0,3639	Stationary **	Cointegrated
i-Spread	5	7,0384	0,8936	-2,4160	0,1375	unit root***	0,4639	Stationary *	Not Cointegrated
i-Spread	7	15,8963	0,8371	-2,0514	0,2649	unit root***	0,5043	Stationary *	Not Cointegrated
i-Spread	10	37,6447	0,6746	-1,6841	0,4391	unit root***	0,5507	Stationary *	Not Cointegrated

Using the *confirmatory data analysis*, the conclusion from Table 6 is that bond spreads and CDS were cointegrated in the 3-year and 5-year maturity for France Telecom in the period in analysis. The cointegration between i-spreads and CDS only held for the 3-year term. The estimated slope coefficient in the cointegrating equation is close to unity, as expected from theory.

Step 2: Error correction model

The final step in this framework is to use a lag of the first step residuals, $\hat{u}_{t-1}$, in levels, as the equilibrium correction term in the general equation when the cointegrating relation holds (the error correction model), or estimate a model with just differences if not. In the last case it will be a short term model.

The overall model is:

$$\Delta(bondspread)_t = \beta_0 + \beta_1\,\Delta(bondspread)_{t-1} + \alpha_1 \Delta(CDS)_{t-1} + \delta\, u_{t-1} + \varepsilon_t \qquad (3)$$

The general error correction model allows for actual, t, and lagged terms, t-1, t-2, etc. In the present case, we are specifically interested in the effects of lagged changes of CDS prices, therefore, following one of the approaches described in Brooks, Rew et al. (2001) in the context of spot and futures markets, only one lagged term of the variables are included in the general error correction model. Brooks, Rew et al. (2001) examined the lead-lag relationship between the FTSE 100 index and its futures contract using a number of models and found that lagged changes in future prices can help to predict spot price changes.

Table 7 reports the coefficient estimates for this model in the case of France Telecom. It is valid to analyse the signals and the significance of the coefficient estimates because all variables in the equation are stationary. Considering first the $\Delta(CDS)_{t-1}$, the estimate for α_1 is positive and highly significant for the four analysed maturities. This indicates that CDS do indeed lead corporate yield spreads (both bond and i-spreads as above defined), since lagged changes in CDS prices lead to a positive change in the subsequent corporate yield spread.

Table 7 - Estimated error correction model for France Telecom

This table reports the results of standard OLS regression between corporate yield spread changes and lagged CDS changes, including an error correction term when cointegration holds. The equations are $\Delta(bondspread)_t = \beta_0 + \beta_1 \Delta(bondspread)_{t-1} + \alpha_1 \Delta(CDS)_{t-1} + \delta u_{t-1} + \varepsilon_t$ and $\Delta(i\text{-}spread)_t = \beta_0 + \beta_1 \Delta(i\text{-}spread)_{t-1} + \alpha_1 \Delta(CDS)_{t-1} + \delta u_{t-1} + \varepsilon_t$. Included observations: 1016 after adjustments, from 22/03/2011 to 18/03/2011.

Var.	Term	β_0	p-value	β_1	p-value	α_1	p-value	δ	p-value	Adj R-Square
Δ(Bond Spread)	3	0,0387	0,7369	-0,0959	0,0029	0,1886	0,0000	-0,0045	0,4131	0,0197
Δ(Bond Spread)	5	0,0363	0,7462	-0,0868	0,0060	0,1668	0,0001	-0,0099	0,0208	0,0242
Δ(i-Spread)	3	0,0135	0,8809	0,1505	0,0000	0,1175	0,0007	-0,0114	0,0078	0,0396
Δ(i-Spread)	5	0,0150	0,8618	0,1706	0,0000	0,1182	0,0002	-	-	0,0408

β_1 is the coefficient on lagged corporate yield spread. It is also highly significant, indicating autocorrelation in corporate spreads (positive auto correlation in the case of credit spread at 3 year maturity). Finally, δ, the coefficient on the error correction term, is negative and significant for bond spread at 5 year maturity and i-spread at 3 year maturity. This means that if the difference between corporate yield spreads and CDS is positive in one period, the corporate yield spreads will fall in the next to restore equilibrium, and vice versa. This dynamic could not be proved for the bond spread at 3 year maturity, as δ revealed not significant.

C. THE DETERMINANTS OF BASIS SPREAD CHANGES

This section concludes the proposed negative basis analysis by using variables suggested by theory to model the dynamics of the basis spreads changes. In this respect, one can identify two approaches in the literature. If in one hand, some studies, such as Longstaff, Mithal et al. (2005) and Zhu (2006) examines the properties of the basis, after isolating the default component in the first case or directly after computing the difference between CDS and corporate yield spreads in the second, in the other hand, many studies focus on the analysis of the full measure of the corporate spread against proxies of explanatory variables, namely Collin-Dufresne, Goldstein et al. (2001), Blanco, Brennan et al. (2005), Ericsson and Renault (2006), among others.

Longstaff, Mithal et al. (2005), in line with Elton, Gruber et al. (2001), argue that asymmetry in taxation between corporate bonds and treasuries may explain a portion of the basis, as treasures are exempted from local and state taxes and corporate bonds are not. Therefore, being CDS purely contractual in nature, CDS premium should not include a tax related component and reflect only the credit risk of the underlying entities. Another possible determinant of non default component appointed by Longstaff, Mithal et al. (2005) is the illiquidity of corporate bonds. Therefore these authors test for tax effects, using coupon rate as proxy and liquidity factors using the following proxies: average bid-ask spread, notional amount (to measure the overall availability), age, time to maturity of selected bonds, among others. They also perform a time series analysis against market liquidity measures. They report to have found evidence that the non default component is strongly related to liquidity measures, while for the taxation issues the results were not conclusive.

Zhu (2006) uses panel data techniques to explain the determinants of basis spread movements, and explanatory variables included lagged basis spreads, changes in CDS spreads, ratings and rating events, contractual arrangements (using dummy variables) liquidity factors (using bid-ask spreads in CDS and bond markets) and proxies for broad market conditions (including equity indexes).

The approach followed by Blanco, Brennan et al. (2005) in this respect has its roots in the work of Collin-Dufresne, Goldstein et al. (2001). They argue that yield spreads on corporate bonds occur for mainly two reasons: the possibility of default and the recovery rate (as the bond holder receives only a portion of the contracted payments, should the default occur). As such, they consider several variables as proxies for default component (namely changes in the spot interest rate, changes in the slope of the yield curve, changes in equity prices, changes in implied volatility) and for recovery rate (which they relate with overall business conditions). Additionally, they also refer to changes in liquidity affecting both changes in corporate spreads and CDS prices (and proxy it with on-the-run/off-the-run spread of long-dated US treasury yields). They use OLS regression individually for each reference entity and cross sectional regressions and pooled estimates.

Another set of articles focus more in the liquidity effects on corporate yields. Following the work of Amihud and Mendelson (1986), Bangia, Diebold et al. (1998) provides a more general approach to liquidity risk, developing a liquidity methodology that can be integrated in standard value-at-risk models, referring to the concepts of exogenous liquidity, associated with general market characteristics, which include measures like conventional bid-ask spread, percentage quoted spread and other spread measures; and endogenous liquidity, associated with specific positions and exposure of one participant due to its own actions. In this respect, a study by Gaspar and Sousa (2010) provides an application of Bangia, Diebold et al. (1998) model to the insurance sector in Portugal, computing the liquidity risk using the percentage quoted spread.

Specific approaches to liquidity in corporate yield spreads include the works of Ericsson and Renault (2006) and Chen, Lesmond et al. (2007), as above discussed. They refer to different proxies for liquidity including bid-ask spreads of corporate bonds.

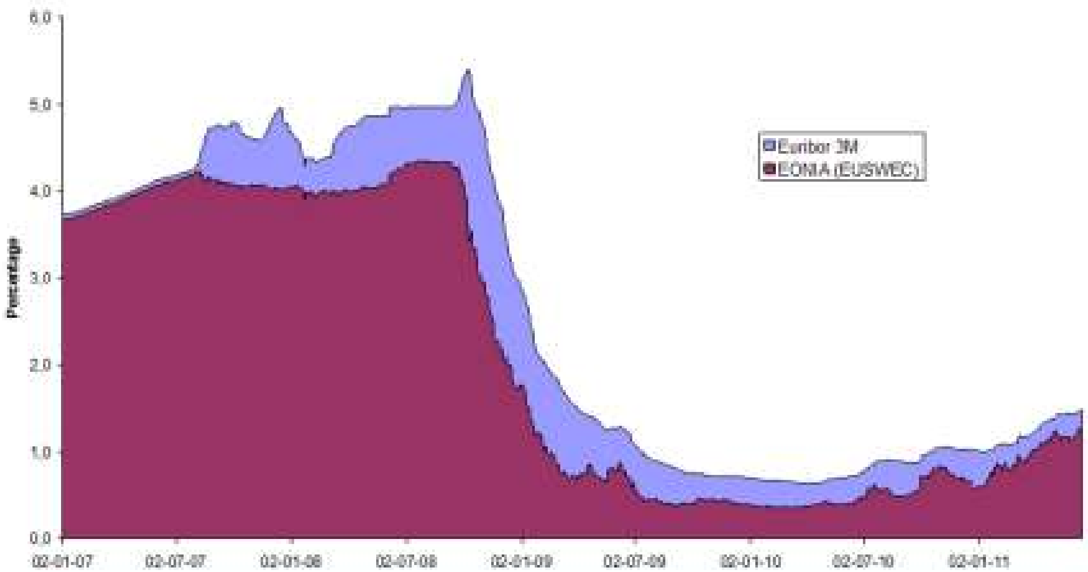
The above authors mainly focus on the effects of liquidity in bond markets, except for Zhu (2006), which specifically used CDS bid-ask spreads in his analysis. In this respect, another set of recent researches explore in more detail the effects of liquidity in CDS pricing. For example, Yan and Tang (2007), that estimated a 20% liquidity premium in CDS prices, Bühler and Trapp (2009) and Fontana (2010), that also explored the issue of counterparty risk in CDS markets and included as proxy the Libor-OIS spread (LOIS), arguing that if Libor 3 months is the rate by which banks are willing to lend to each other and OIS the overnight rate on a derivative contract generally fixed by central bank and considered risk free in the US, the (widening of the) gap between the two can be considered as a measure of the risk in the interbank lending market because it reflects what the banks believe is the risk of default in lending to other banks.

Based upon the literature, it is now proposed the following variables to analyse the determinants of basis changes:

1. *Lagged basis changes*. With this variable it will be possible to evaluate the autocorrelation on the basis changes, specifically, and as stressed in Zhu (2006), being average basis a mean reverting process, a coefficient between 0 and 1 confirms the mean reverting feature (the smaller the faster the speed of adjustment to the long run equilibrium).

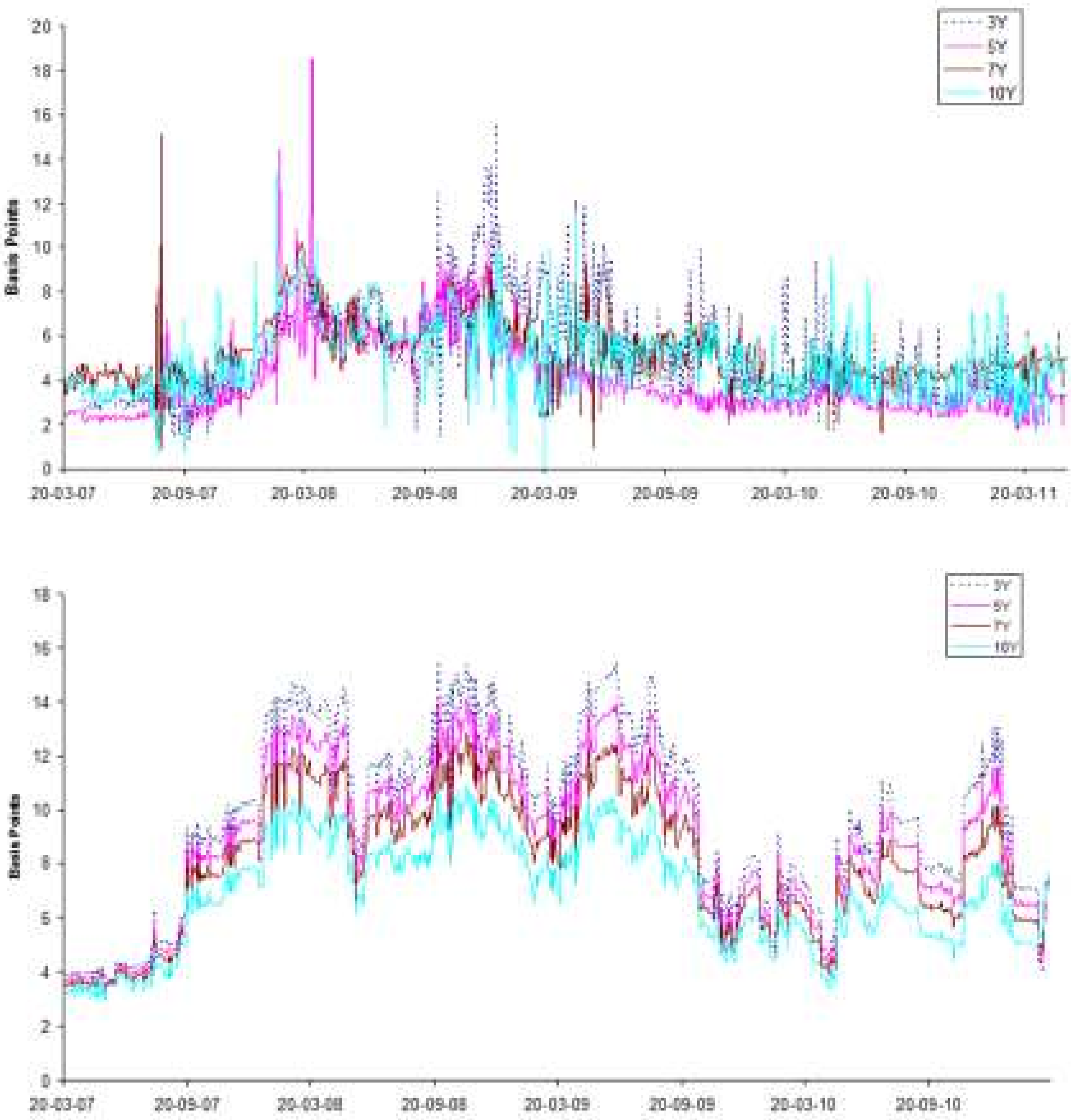
2. *Changes in Euribor 3 months – EONIA spread*. This can be considered as the equivalent in Europe of LOIS. As used in Fontana (2010), one can assess the effects of counterparty and funding liquidity risks with this variable. Figure 6 shows its evolution in the period in analysis. It is possible to verify a great widening of this spread in the second semester of 2007, from about 6 bp to more than 50 bp. In 2008, after the Lehman Brothers collapse it reach its peak with near 200 bp.

Figure 6 - Euribor-EONIA spread evolution in 2007-2011 period



3. *Liquidity proxies*. In order to assess the liquidity of both markets effects on the basis, the bid-ask spread (BAS) is taken as proxy, as it is not easy to implement other measures (mostly due to the lack of availability of data). In the case of CDS markets, BAS is available from Bloomberg for CDS premium for all maturities. Concerning bond market it is possible find in Bloomberg bid and ask quotations for both bond prices and yields. While some studies average them out and use one measure, there is no reason to believe that this measure is the same for all maturities. In CDS market the 5 year segment tends to be more liquid, and the BAS tends to be smaller. Ericsson and Renault (2006) found support for a downward-sloping term structure of liquidity spreads in corporate bonds. Therefore to measure bond liquidity, it is used bond yield BAS in this study, following the same maturity matching procedure above discussed for the bond spread: computing the BAS spread for each bond in the basket set and regressing them to the desired maturity. Figure 7 illustrates the results for France Telecom case.

Figure 7 - Bid-Ask spreads for France Telecom CDS (on top) and bond yields (bellow)



4. *Market conditions.* In order to assess the effects of general market conditions, three variables are included: a volatility index, which tend to be associated with instability in the markets and with the risk of default (VDAX), an equity index (CAC 40 in this case) and one proxy for the country risk of default (France sovereign CDS at 5 year maturity in this case). After ensuring that all variables are I (1), the following model is applied:

$$\begin{aligned}
&\Delta(CDS - Bond_Basis)_t \\
&= \beta_1 \Delta(CDS - Bond_Basis)_{t-1} \\
&+ \beta_2 \Delta(EES)_t + \quad \beta_3 \Delta(BAS^{CDS})_t \\
&+ \beta_4 \Delta(BAS^{Bond})_t \quad + \beta_5 \Delta(VDAX)_t \\
&+ \beta_6 \Delta \log(CAC40)_t \quad + \beta_7 \Delta(CDS^{France})_t + \varepsilon_t
\end{aligned} \qquad (4)$$

Where *EES* denotes Euribor 3 months - EONIA spread and ε_t is an error term. Table 8 presents the results for France Telecom.

Table 8 - Regression of basis spreads on counterparty and funding risks, liquidity and broad market conditions proxies for France Telecom

This table reports the results form regressing the CDS-Bond basis and CDS-i-Spread changes, in basis points, for maturities ranging from 3 years to 10 years, against the proxies of counterparty and funding risks, liquidity and broad market conditions. Included observations: 916 after adjustments, from 22/03/2007 to 18/03/2011.

$$\Delta(CDS\text{-}Bond\_Basis)_t = \beta_1\Delta(CDS\text{-}Bond\_Basis)_{t-1} + \beta_2\Delta(EES)_t + \beta_3\Delta(BAS^{CDS})_t + \beta_4\Delta(BAS^{Bond})_t + \beta_5\Delta(VDAX)_t + \beta_6\Delta\log(CAC40)_t + \beta_7\Delta(CDS^{France})_t + \varepsilon_t$$

Var.	Term	β_1	β_2	β_3	β_4	β_5	β_6	β_7	Adj R-Squared	N
Δ(CDS-Bond Basis)	3	-0,0509	-0,0928	-0,0888	-0,0578	-0,0964	-58,8411	0,1517	0,0654	916
		(0,1265)	(0,0521)	(0,354)	(0,7737)	(0,2940)	(0,0000)	(0,0049)		
Δ(CDS-Bond Basis)	5	-0,0085	-0,1628	0,0547	-0,1162	-0,0677	-72,4846	0,1561	0,0996	916
		(0,7918)	(0,0008)	(0,6446)	(0,6154)	(0,4680)	(0,0000)	(0,0044)		
Δ(CDS-Bond Basis)	7	-0,0109	-0,1774	0,0311	-0,0566	-0,0103	-66,0059	0,1815	0,0944	916
		(0,7349)	(0,0003)	(0,7864)	(0,8323)	(0,9140)	(0,0000)	(0,0011)		
Δ(CDS-Bond Basis)	10	0,0159	-0,2162	0,4235	-0,2392	0,0051	-67,7470	0,1741	0,1272	916
		(0,6145)	(0,0000)	(0,0000)	(0,4574)	(0,9569)	(0,0000)	(0,0019)		
Δ(CDS-i-Spread Basis)	3	0,0842	0,0222	0,0009	0,3289	-0,0475	-58,2748	0,0847	0,0926	916
		(0,0090)	(0,6148)	(0,9923)	(0,0776)	(0,5767)	(0,0000)	(0,0907)		
Δ(CDS-i-Spread Basis)	5	0,1267	-0,0511	0,3975	0,3668	-0,0552	-69,4907	0,0890	0,1433	916
		(0,0000)	(0,2485)	(0,0003)	(0,0818)	(0,5178)	(0,0000)	(0,0757)		
Δ(CDS-i-Spread Basis)	7	0,1284	-0,0599	0,1833	0,5002	-0,0261	-63,9758	0,1029	0,1189	916
		(0,0000)	(0,1825)	(0,0794)	(0,0393)	(0,7635)	(0,0000)	(0,0425)		
Δ(CDS-i-Spread Basis)	10	0,0946	-0,1041	0,1581	0,4226	-0,1035	-70,5168	0,0878	0,1059	916
		(0,0027)	(0,0258)	(0,0843)	(0,1633)	(0,2497)	(0,0000)	(0,0963)		

Several findings emerge from Table 8. First, broad market conditions, except for the volatility index, were highly significant in the period in analysis. The equity index had a negative impact on the basis across all maturities and its magnitude was stable. The perceived country risk of default had a positive impact on the basis but its magnitude was much greater in the CDS-Bond basis than in CDS-i-Spread Basis. Some authors may argue that in equilibrium these factors should be equally priced in both CDS and bond markets and therefore these variables should not be significant. Nevertheless, considering the crisis period, these findings supports the idea that in this period credit conditions was not efficiently priced in the two markets (or at least not equally).

Second, the counterparty and funding risks, measured by the Euribor-Eonia spread was significant for CDS-Bond basis and with negative impact on the basis. This result suggests that counterparty risk have negative impact in the CDS prices, as the bond spreads, especially when using government bonds as benchmark, is less sensitive to this risk. This result did not hold for the CDS-i-Spread basis. One possible explanation is that i-spreads uses swap curve as benchmark and swaps, being OTC products, may be more sensitive to counterparty risk than government risk free instruments, as above mentioned.

Finally, lagged basis revealed significant for the CDS-i-Spread basis. Its value is less than 1, suggesting to some extend (this result could not be proven for the CDS-Bond basis) the mean reverting feature expected for the basis (cointegration).

III. Conclusions and Future Research

This project has examined the basis between CDS and corporate yield spreads and how CDS relates with those spreads. Even though significant deviations between the two measures are documented, especially during the crisis period, the analysis confirms the theoretical equilibrium predicted by theory. CDS and corporate bond yields should be on average equal for France Telecom. The error correction analysis performed suggests that cointegration between the two markets broadly holds and indicates that CDS prices do indeed lead corporate yield spreads.

During the analysis period, market conditions significantly affected the basis, as reported in the final regression analysis, both for CDS-Bond basis and for CDS-i-Spread basis, which are reported to be, on average, negative (-34,05 bp) in the first case and close to zero (-0,33 bp) in the second, between March 2007 and March 2011 for France Telecom at 5-year maturity.

There is evidence that counterparty and funding risks significantly affected the basis, with negative impact in CDS prices and then in the basis, (particularly in the CDS-Bond basis). Liquidity proxies were found to be significant, especially for CDS-i-Spread basis.

This project mainly focused in the effects of counterparty and liquidity risks in the basis and used *Engle-Granger 2-step method* to analyse cointegration and lead-lad relationship between CDS and bond markets. One of the problems in assessing cointegration in this framework is the lack of power in unit root testing and the impossibility to perform any hypothesis tests on the cointegrating relationship estimated in step 1. One step further would be to use more advanced techniques in this respect, namely the *Johansen method* to study cointegration and *Vector Error Correction Model* and *Granger Causality* to study lead-lag relationship between CDS and bond markets.

Future research could focus in more detailed analysis of the differences between the four periods above mentioned in respect to cointegration and basis drivers, or extend the analysis to speculative-graded corporate entities. Different variables could also be used to proxy the basis drivers above discussed, namely the so called *TED spread* as proxy for counterparty risk, and more advanced econometric models, such as the fixed effects framework, could be used to yield better insights regarding the relative importance of the different factors in the basis.

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