UNIVERSIDADE CATÓLICA PORTUGUESA

Trading of Credit Indices – behaviour analysis

Final Work on Dissertation mode
presented to Universidade Católica Portuguesa
in order to obtain the master degree in Finance

by

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March, 2016

Resumo

Este documento foi realizado com o âmbito de analisar o comportamento do mercado dos Credit Default Swaps, com especial atenção para o *trading* de Índices de Crédito. Para efeitos deste estudo foi escolhido o seguinte Índice: iTraxx Financials Senior, com maturidade a 5 anos (índice europeu, criado pela Markit).

A um primeiro nível foi investigado se os Spreads do índice refletem a perceção de risco. Estudos passados apontam para a conclusão de que os índices de crédito são uma ferramente bastante viável para entender a qualidade de crédito de uma entidade. Esta questão é testada através da seguinte maneira: verificar se a volatilidade dos retornos apresenta as seguintes características – *Volatility Clustering*, Memória Longa e Excesso de *Kurtosis* – estas encontram-se tipicamente nas séries financeiras. De facto, conclui-se que um aumento do Spread é interpretado pelo mercado como uma deterioração da qualidade de crédito (da entidade de referência).

Numa segunda fase e após realizada uma análise preliminar é ainda testado se essa volatilidade apresenta outras características, tais como: Aversão ao Risco e *Leverage Effects* (estas características estão presentes no mercado acionista, por exemplo). Esta análise é realizada com recurso a um modelo T-GARCH.

Após esta análise conclui-se que os investidores presentes neste mercado (dos índices de crédito) não são avessos ao risco e não têm o tradicional repúdio por "más notícias" sobre o sistema financeiro. De facto a ausência de *Leverage Effects* é coerente com a participação de agentes que têm a ganhar com essas "más notícias".

Palavras-Chave: *Credit Default Swaps* | Índices de Crédito | Qualidade de Crédito.

Abstract

This document was written with the aim of analysing the behaviour of the Credit Default Swaps market, particularly the trading of Credit Indices. To do so it was chosen the following index: iTraxx Financials Senior, with 5-year maturity (European index, originally created by Markit). The econometric analysis is conducted with the help of a T-GARCH model.

On a first level it is investigated if the index spreads reflect the perceived credit risk of market participants. Past studies point out that the spreads of Credit Indices are in fact a good measure to understand the credit quality of an entity. This question is address by testing if the volatility of the index returns has the following properties: Volatility Clustering, Long Memory and Excess Kurtosis (these are typically present on financials time series). In fact, an increase of the Spread is perceived as a deterioration of the reference entity credit quality.

On a second level and after a preliminary analysis it is tested if these returns have the following characteristics: Risk Aversion and Leverage Effects (these are present on the stock market, for example). In order to do so it is estimated a T-GARCH model.

It is concluded that investors who trade in Credit Indices market are not risk averse and they do not fear "bad news" about the financial markets. In fact, these findings are in line with the theory that states that investors tend to win with the presence of these "bad news".

Keywords: Credit Default Swaps | Credit Indices | Credit Quality.

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Introduction

This document was written in order to obtain the Master Degree in Finance, under the guidance of Dr. Carlos Santos. It was chosen the following title: "Trading of Credit Indices – behaviour analysis" because the purpose of this document is to analyse trading behaviours of index derivative products and what strategies can we extract looking at the volatily of these indices returns. Furthermore it will be investigated if these returns are good indicators of an entity credit quality.

The answer to this type of question can be truly helpful in order to acquire more knowledge about the trading of these types of product and how investors can obtain high returns with "bad news" about the financial world.

Credit Default Swaps (CDSs) are on of the most recent financial products present in the market. The first product of this type was created by JP Morgan in 1994 and since then CDSs have been rising in popularity. For a long time (more than a decade!) these kinds of product were merely dedicated to corporate default risk because market participants' perceived risk of default of developed countries was very low, i.e., investors did not believe that developed economies could collapse. However, with the Amercian sub-prime crisis in 2007/2008 and the rising debt levels of some European governments, market participants reassessed their risk perception. Therefore, this last decade was entirely different from the first decade regarding the CDS market because the trade of sovereign products reached unprecedent levels.

These structured products called Index CDSs are known as multi-name CDSs because they are formed by a plurality of entities (that can be corporate or sovereign ones). But, why should we trade this type of product? Well, the main

reasons are Hedging and Trading motivations[1]. Hedging purposes can be seen as a way of how investors look at the creditworthiness of a reference entity, i.e., if an investor is forecasting a deterioration of an entity (present on the index) credit quality he will be fully compensated by its default (if it actually occurs). He also wins if the price of the index goes up, but now as a Trading perspective. Some market participants even believe that the volatility of the different indices can be seen as a guide to the credit quality of an entity, instead of using Credit Ratings provided by rating agencies. This is supported by the idea that index CDS trade continuously.

Trading indicators, such as volatility, returns and liquidity of these structured products are in fact a subject that few try to develop.

In order to study these indicators, this document is divided as follow:

- ✓ Chapter 1 provides an overview of the theoretical questions that can arise when talking about the CDS market itself. Thus, here it will be fully covered different types of CDSs, the usage that market participants give to these products and how the market is evolving;
- ✓ Chapter 2 is fully dedicated to the trading of Index CDS (this is just one type of CDS);
- ✓ Chapter 3 is all about the empirical analysis of the returns of iTraxx Financials Senior (5y). The questions presented on the beginning of this document will be fully answered when reading this third chapter.

[1] These topics will be further covered later on this document.

Chapter 1
Credit Default Swaps – Theoretical Framework

After the European debt crisis and the American financial turmoil, Credit Default Swaps (CDS) have become a regularly traded product, which nowadays requires a better understanding of how this product works, its strengths and weaknesses. Since its recent first appearance (1994), CDS's have seen a strong increase in usage, therefore understanding the mechanics of this product has become even more important, from both the perspective of individual market participant and regulatory bodies. In their recent written paper, (Vogel, Bannier, & Heidorn, 2013) even state that "over the past two decades the CDS market has become one of the leading indicators of an entity's default risk and the primary hedging and trading tool for credit risk".

But, what are CDS? Why should we try to understand their mechanics and how this market is evolving? Is there more than one type of CDS? And how should we use them for trading or even hedging credit risk? These are the type of questions that this chapter will try to answer, with special attention to the European CDS market.

In a practical way, CDS are like an insurance contract traded by two different parties, in order to transfer credit risk. During the life of a contract, the protection buyer pays periodic payments (usually quarterly) to the protection seller, expecting that a credit event[2] will happen with the reference entity (there is still a third party involved). If such an event occurs, it triggers the Protection Seller's settlement obligation.

Even though the classical CDS contract shares some similarities with a classic insurance contract, CDS incorporate certain elements that insurance contracts

2 See 1.2.4 – Credit Events

do not. One of the main differences between these two is that CDS purchasers do not need to have any financial stake in the reference entity. In a simpler way, we can compare it with an individual insuring his neighbour's car. Just like in a traditional insurance contract, the individual pays a periodic fee but, in this case, he will only receive his compensation if the credit event occurs (in this case, his neighbour being involved in a car accident). This individual is compensated, although he has no financial stake in his neighbour's car (Noeth & Sengupta, 2012).

According to the International Swaps and Derivatives Association (ISDA), CDS are "a bilateral agreement designed to explicitly shift credit risk between two parties". CDSs are Over-the-Counter (OTC) transactions and usually reference bonds or loans of a corporate or sovereign entity (reference entity).

Each contract is, therefore, defined by:

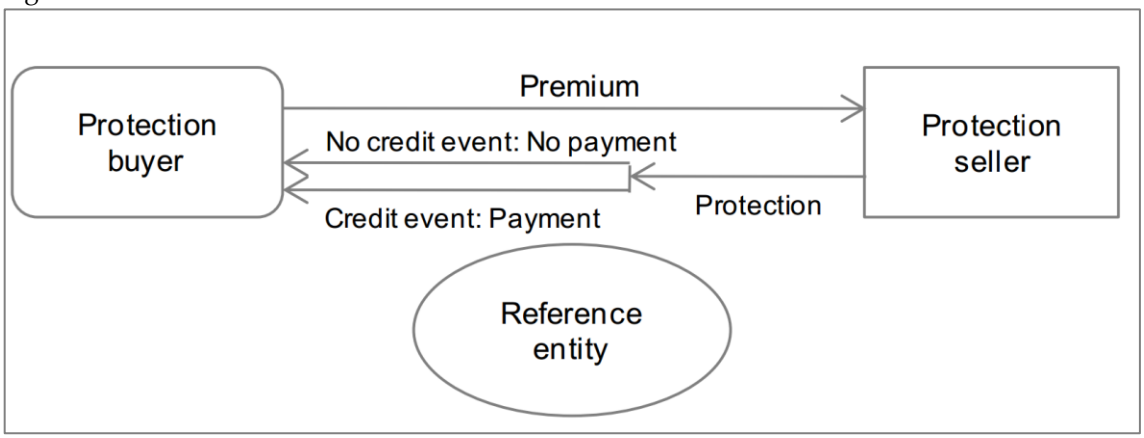
- ✓ A **Reference Entity** - the underlying entity on which one is buying/selling protection on;
- ✓ A **Reference Obligation** - a bond or loan that is being "insured" – CDS's can be issued not only on loans of corporate entities, but also on sovereign and municipal bonds;
- ✓ A **Term/Tenor** (5 years are the most liquid contracts);
- ✓ A **Notional Principal**;
- ✓ A **Credit Event** - a specific event triggering the protection seller to pay the protection buyer.

Source: (Markit, 2014).

All of the previous points will be further covered later on this document.

The following diagram summarizes a general CDS structure:

Figure 1 – **Structure of a CDS**



Source: (Weistroffer, 2009)

1.1 Foundations of CDS's

After a brief analysis of what CDS are, it is important to understand when and why this market was created. This event goes back to 1994, when JP Morgan tried to find a way for commercial banks to reduce excess credit risk exposure and therefore extend their loan capabilities. One of the first CDS was written by JP when Exxon needed to open a line of credit to cover "potential damages of USD 5bn", resulting from the 1989 Exxon Valdez oil spill (in *Fool's Gold: How the Bold Dream of a Small Tribe at J.P. Morgan Was Corrupted by Wall Street Greed and Unleashed a Catastrophe).*

Later on that year (1994), Blythe Masters, a member of JP Morgan's swaps team, came up with the following idea: JP would sell the credit risk to the European Bank of Reconstruction and Development (EBRD). So, in the case of an Exxon default, EBRD would be taking on the risk, while receiving a periodic fee from JP. As a result, Exxon would get its credit line and JP would get to honour one of its oldest client relationship. More important, JP would keep its

credit lines intact for more attractive activities. This kind of deal was so innovative that it didn't even have a name: eventually, later on, the one settled on was "Credit Default Swaps".

Since its first appearance, CDS products have become much more complex. This complexity may arise from different causes:

- ✓ First of all, its **exponential growth** - CDS gross notional amounts outstanding had reached an impressive peak of USD 58 trillion in 2007, while in 2005 this number was only slightly over the USD 10 trillion mark (Weistroffer, 2009);
- ✓ In addition, the interconnectedness of large market participants can raise a potential red flag, i.e., a collapse of a major player could have devastating consequences for the financial sector itself. This effect and the potential for contagion played an important role in the decision to grant public assistance to AIG in 2008 – one of the largest protection sellers. AIG's near-default led regulators to ask for greater transparency and additional measures to prevent and contain this kind of effect, once a "big player" fails. Many of these measures, whether proposed or already effectively implemented mean a transition from the current OTC model towards a more Exchange traded one (Weistroffer, 2009).

1.2 Main technical features

So far, most of the research focused essentially on corporate CDS, rather than sovereign. But, with the recent financial turmoil in the US (2007-2008) and the rising government debt levels throughout Europe, financial markets reassessed their risk perceptions, especially with sovereign issuers (Vogel et al., 2013). As seen before, CDS can only be written if there is a reference entity and it is

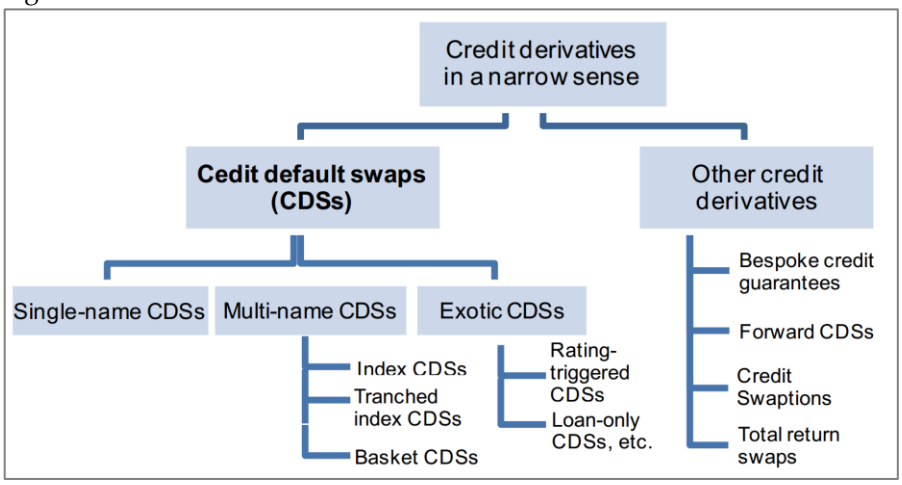
imperative that a CDS contract clearly specifies the reference entity that it protects. This so called 'reference entity' can be either a corporate or sovereign one, i.e., a CDS can be written regarding the credit event of a company or bank, or, in the second case it can be "any state, political subdivision or government, or any agency, instrumentality, ministry, department or other authority" (2003 ISDA Credit Derivatives definitions). This main difference is linked with the "Credit Event" section, because different types of CDS's (corporate vs sovereign) require different events in order to trigger the settlement protection[3].

1.2.1 Single name vs Multi name

CDSs can show up in multiple forms, depending on different contractual definitions. The most common distinction between CDSs is associated with the underlying reference entity.

Let's start with "Single-name" CDSs. This one is the most common form of CDS, which are referenced to an individual corporate or sovereign borrower. In contrast, "Multi-name CDSs" are referenced to multiple entities. This last form of CDS also includes index products, basket products and CDS tranches.

Figure 2 – **Different forms of CDS's**



Source: (Weistroffer, 2009).

[3] Fully covered in 1.2.4 - Credit Events

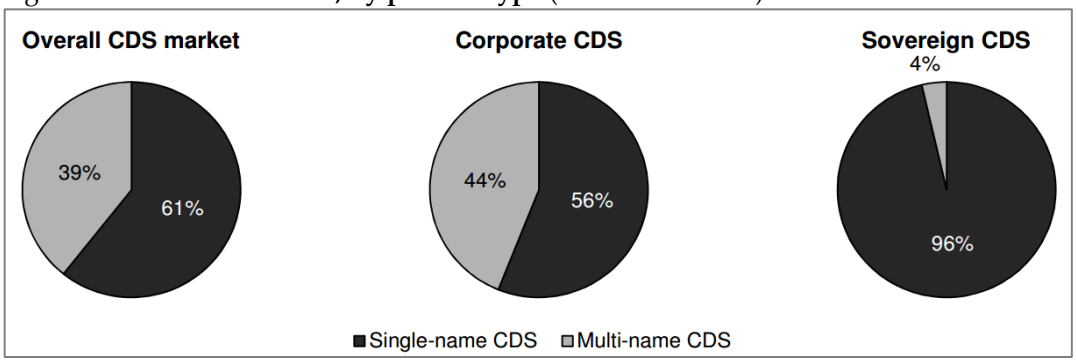
As it is possible to see in the figure above, CDS's can obtain many other complex forms (besides the ones distinguished before). This kind of financial instrument is even present outside the "spot market", i.e., it is possible to observe a market for **options** or **forwards** written on CDS's. The Options market is represented by the so called "CDS's swaptions", which "give the buyer or seller the right to buy or sell protection for a predetermined premium"(Vogel et al., 2013). "CDS forwards oblige the parties to buy or sell CDS protection in the future at a certain price" (Weistroffer, 2009).

Despite their existence and due to the financial crisis, the demand for more complex products, such has funded or unfunded synthetic Collateralized Debt Obligations (CDO's) or CDO's squared (CDO's on CDO's) has suddenly decreased and almost disappeared from the market (Fitch, 2009).

"According to the BIS Triennial Survey (2007), single and multi-name CDS's add up to about 88% of the overall credit derivatives market"(Weistroffer, 2009), which shows us the importance and strong usage of simpler products by market participants.

In terms of market share and now regarding only single/multi-name CDS's, it is possible to observe that the first kind of contract account for the majority of all trades (61%), for both sovereign and corporate markets, as it is possible to observe on the following figure.

Figure 3 – **CDS transactions, by product type** (as of March 2013)



Source: Vogel et al.,(2013), with data from DTCC (2012).

Despite this fact, nowadays multi-name contracts are becoming more and more popular throughout investors. This market growth is a result of "index trades being used increasingly for trading purposes as well as for proxy hedges". This kind of hedge is known as "the practice of buying protection for a reference entity whose default risk is closely correlated to the risk in question, for which a direct hedge in turn is not readily available" (Weistroffer, 2009).

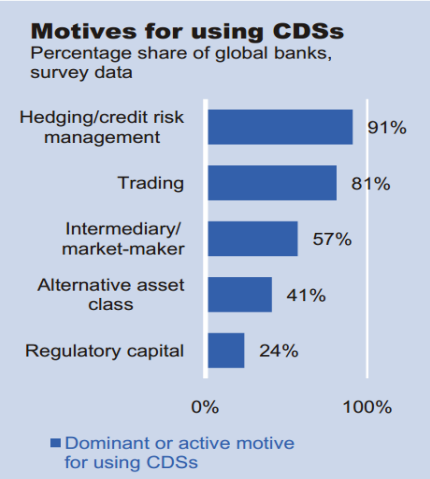
However, this paper will mainly focus on the trading of index CDS's (multi-name). This topic will be further investigated in Chapter 2 – Credit Indices.

1.2.2 Different motivations for using CDS's

As shown before, multi-name CDS's (particularly Index CDS's) are rising in "popularity" due to the simple fact of different usages that different market participants assign them (it is possible to see some of them in Figure 4).

According to an article published by Markit (Markit, 2014), the main usage of these kind of instrument is either to Invest (a mere trading instrument) or to Hedge (as a risk management tool). Whichever use we assign them, different advantages arise:

Figure 4 – **Motives for using CDS's**



Source: Weistroffer (2009), with data from Fitch (2009)

i. Investing

- ✓ Investors take a view on deterioration or improvement of credit quality of a reference credit;
- ✓ CDS offer the opportunity to take a view purely on credit;
- ✓ CDS offer access to hard to find credit (limited supply of bonds, small syndicate);
- ✓ CDS allow investors to invest in foreign credits without bearing unwanted currency risk;
- ✓ Investors can tailor their credit exposure to maturity requirements, as well as desired seniority in the capital structure;
- ✓ CDS require little cash outlay and therefore creates leverage.

ii. Hedging

- ✓ CDS allow capital or credit exposure constrained business (banks, for ex.) to free up capacity to facilitate doing more business;
- ✓ CDS can be a short credit positioning vehicle. It is easier to buy credit protection than short bonds;
- ✓ CDS may allow users to avoid triggering tax/accounting implications that arise from sale of assets.

Source: (Markit, 2014)

1.2.3 CDS Spread

As previously seen, a CDS contract is closely related to an insurance one, ie, the protection seller promises to "insure" the protection buyer (if a Credit Event occurs) and, in return, this last agent agrees to pay a periodic Spread.

First of all it is important to note that, in the scope of this analysis, Spread does not mean the difference between one rate and another. Fundamentally it is the differential between the "market price or cost of insurance for the protection buyer and the premium for the protection seller" (Vogel et al., 2013). CDS spreads are measured "as a percentage of the notional value of the reference obligation" (Packer & Chamaree, 2003).

The collapse of Lehman Brothers forced regulatory bodies to take a numerous amount of measures, in order to make this market more standardised (so that information assymetries could vanish). Thus, "both CDS spread setting and trading changed. CDS's now trade with standard coupon dates, an upfront payment and a standard coupon" (Vogel et al., 2013). Regarding coupon payment dates, these are made quarterly on the 20th of each month (March, June, September, December). Coupons are no longer paid on a running quote, it has been standardised. For example, "European sovereign and corporate CDSs typically use standard coupons of 25bps or 100bps, but in case of corporate CDSs they may also include 500bps and 1000bps, depending on credit quality" (Vogel et al., 2013). "The implication of using fixed coupons is that instead of paying the full CDS premium each year, an upfront payment will be exchanged based on the difference between the coupon and the 'spread' or 'premium'." (Naraparaju, Mahadevan, & Musfeldt, 2011)

$$\sum_{i=1}^{N} e^{-rt_i} Q(t_i)\rho = \int_0^{t_N} e^{-rt} \left(100\text{-}M_t\right) q(t)dt \qquad (1)$$

The payment of a CDS can be divided in two distinct categories: the premium leg (left hand side of the formula presented above) and the protection leg (right hand side). The left side corresponds to "the sum of all periodic spread payments of the protection buyer to the protection seller for taking on the risk. The protection leg is the compensatory payment from the protection seller to the protection buyer contingent on the triggering of a credit event" (Vogel et al., 2013). Precisely, the expected present value of the protection leg and premium leg need to be equal to zero at the time that the contract is initiated (at *t*=0).

The formula presented above can be analysed as follow:

- ✓ 'r' represents the constant risk-free rate;
- ✓ $Q(t_i)$ is the risk neutral survival probability at time t. i being equal to the function $1 - \int_0^{ti} q(t)dt$;
- ✓ M(t) is the market value of the underlying asset;
- ✓ ϱ represents the CDS spread.

The spread must be paid until the contract expires, which can happen if either the maturity of the contract is reached or a credit event occurs. In general, the most important idea of this topic is that "the spread will be higher for a riskier entity than for a less risky entity" (Vogel et al., 2013).

1.2.4 Credit Events

Almost every CDS definition refer to a so called "Credit Event", i.e., in simple words, the moment when the protection seller has to "compensate" the protection buyer. But, does every CDS contract reach that point? Well, the answer is simple… No! However, this is one of the most crucial elements of a CDS contract.

Despite CDS are OTC instruments, which offer the possibility of a bigger customization, many market participants choose to follow the standardised definition (of Credit Events) by ISDA (2003) (Vogel et al., 2013). This definition states that the main credit event triggers are: (1) Bankruptcy; (2) Failure to Pay; (3) Repudiation/Moratorium and (4) Restructuring. There are more types of Credit Events (such as Obligation Default or Obligation acceleration), but they are very rare, therefore they are not included in the scope of this document. These events can also be sub-classified as Hard or Soft. "Hard credit events are triggered automatically once the ISDA Determination Committee (DC) states that a credit event has occurred, e.g. a failure to pay. A soft credit event, in

contrast, has the option of being triggered, such as a debt restructuring" (Vogel et al., 2013)

From a contractual point of view, differences regarding the type of contract can lead to different Credit Events[4]. Basically, different events can be applied to European Sovereign CDS's but not to Corporate ones (check Table 1 for more details). Ultimately, the final word belongs to the DC, which determines whether a credit event has occurred, and whether an auction should take place to settle trades.

Table 1 – **Credit Event Triggers, by different type of CDS**

	Bankruptcy	Failure to Pay	Repudiation/ Moratorium	Restructuring (Old R.)	Restructuring (M. Modified)	Restructuring (Multiple Holder O.R.)
Sovereign	×	✓	✓	✓	×	✓
Corporate	✓	✓	×	×	✓	✓

Source: Vogel et al. (2013), with reference to ISDA 2012.

As it is possible to observe in the previous table, European Sovereign CDS's do not trigger with a Bankruptcy event, "due to the low likelihood of a sovereign declaring bankruptcy" (Vogel et al., 2013). On the other hand, they include events that corporate ones do not, like Repudiation/Moratorium.

After a general overview of which Credit Event trigger the protection payment (according to different types of CDS's) it is important to understand the meaning of each one.

Starting with the simplest case, as we checked before, Bankruptcy is only applied to Corporate CDSs. ISDA Definitions (2003) states that different ways of bankruptcy can occur, but ultimately this event is triggered when the reference entity files for bankruptcy or insolvency. ISDA (2003) also specifies that "an event occurs not only after a filling but also if the reference entity takes action that might lead to a filling for insolvency, liquidation, or an act of bankruptcy."

[4] These are periodically determined and published by ISDA.

The next event is the Failure to Pay which, as the name suggests, is when a corporate or sovereign entity "fails to make interest or principal payments when due, after the grace period[5] expires (if grace period is applicable in the trading documentation)" (ISDA Definitions 2003).

Repudiation/Moratorium is totally exclusive to sovereign CDS contracts. This event requires two distinct stages, before such an even is triggered:

i. Potential Repudiation or Moratorium: A government agency of the respective reference entity disclaims, invalidates one or more obligations, or imposes a moratorium, rollover or deferral of one or more obligations;
ii. The second occurrence is a failure to pay or a restructuring event with regard to one or more obligations on or prior to the repudiation moratorium evaluation date (Haworth, Porter, Gibney, & Sparks, 2010; Vogel et al., 2013).

The last event is the Restructuring one, which is considered a "soft" event, "whereby the loss to the owner of the reference obligation is not obvious" (Markit, 2014). This is the most important event for sovereign CDSs, as it is the most likely event to be triggered (Naraparaju et al., 2011). Basically, it refers to the changing of the relevant obligation terms and is a direct or indirect consequence of a deterioration of the reference entity's creditworthiness. For this event to be triggered, one of the following events has to occur:

i. A reduction in the rate or amount of interest;
ii. A reduction in the amount of principal;
iii. A postponement of payments of interest/principal/premium;

[5] This "grace period" is a period that is given to the reference entity, which is normally three business days after the specific payment date, after which the event is triggered (Naraparaju et al., 2011).

iv. A change in the currency in which the payments of interest/principal is carried.

Source: (Naraparaju et al., 2011)

Furthermore, it has to satisfy the Multiple Holder Obligation: "the Obligation that triggers the restructuring credit event must be held by more than three holders and at least 2/3 of holders must be required to consent to the event" (Haworth et al., 2010).

Table 1 shows different Restructuring types, according the type of CDS (this happens because they do not trade under the same restructuring clause). The main difference is related to the maturity limitation of the delivery obligation. Under the old restructuring clause of 1999, it is only possible to observe Sovereign CDSs trading. This clause basically states that there is no maturity limitation on deliverable obligations, beyond the usual 30 years.

As stated before, this kind of event is considered a Soft one, because it allows buyers and sellers of CDS contracts to vote on whether a specific credit event took place or not. This has to satisfy the Multiple Holder Obligation and, otherwise, "the credit event does not trigger even if the Determinations Committee, which is responsible for determining credit events, declares that a restructuring event has occurred" (Haworth et al., 2010).

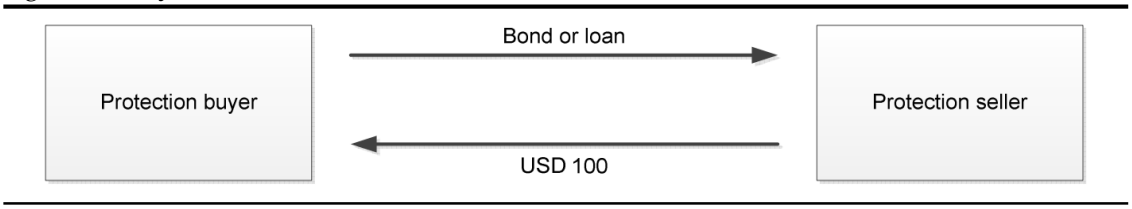
1.2.5 Settlement Method

When CDS contracts reach that so called "Credit Event", the protection seller must compensate the buyer. But, how does this trade happens? It can assume two distinct ways: (1) Physical Settlement and (2) Cash Settlement.

As it is possible to observe in Figure 5, Physical Settlment involves the transfer of the underlying obligation (from the protection buyer to the seller)

and, in return, the buyer receives the full face value as a compensation (in the figure bellow it is assumed that the nominal value equals 100 USD).

Figure 5 – **Physical Settlement Method**

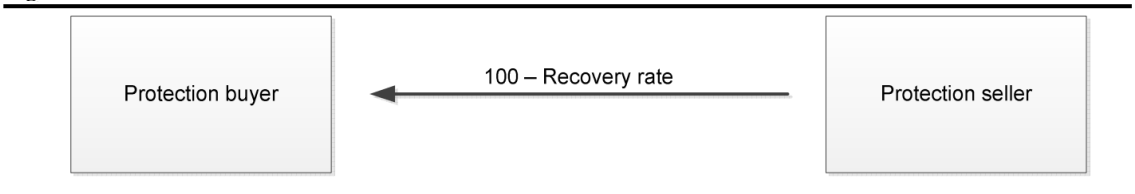


Source: Vogel et al, 2013.

"For a long time, the physical settlement of CDS contracts was the preferred choice due to the market's primary usage of CDSs as a hedging tool"(Vogel et al., 2013). In the beginning of this century this method was known as the most popular one (in 2005 more than 73% of CDS contracts were written with a physical settlement method!).

Despite that, the most popular method for European sovereign entities is the Cash Settlement one (Gaap & Corbi, 2012). This scenario does not involve the delivery of the underlying obligations anymore. As an alternative, the protection seller is required to transfer a specific amount of cash to the protection buyer (difference between the bond's nominal, which in the figure below is assumed to be 100, and the market value at the time of the settlement).

Figure 6 – **Cash Settlement Method**



Source: Vogel et al, 2013

1.2.6 Reference Entities

The reference entity "refers to the legal entity that is the subject of a CDS contract" (Markit, 2014). Basically is the entity that market participants are 'betting' that will fail in its future obligations and, as seen before, it can be either a corporate or a sovereign one. The existence of multiple legal entities can raise some questions, especially regarding subordinated companies and how does a credit event of a subordinated can affect CDS contracts of the parent company.

First of all it is highly recommended to understand the difference between Gross and Net Notional. According to the Deutsche Bank Research conducted by Christian Weistroffer (Weistroffer, 2009),Gross Notional Value "is the sum of CDS contracts bought (or equivalent sold) across all counterparties, where each trade is counted once". On the other hand, the author defines Net Notional Value as "the sum of net protection bought (or equivalent sold) across all counterparties. Net protection bought is evaluated at the level of individual counterparties, where protection sold will be offset by protection bought for the same reference entity". Thus, following a simpler perspective "while gross amounts correspond to the total sum of all CDS contracts, net amounts refer only to the net-risk positions of the contracting parties" (Vogel et al., 2013).

Using Depository Trust & Clearing Corporation database[6] (DTCC, 2015) it is possible to see that the largest notional amount outstanding of sovereign CDS contracts is the Brazilian Republic, followed by three Eurozone countries (Italy, Turkey and Russia). Among the top 15 single-name reference entities it is only possible to observe 1 corporate CDS (Transocean Inc.) and 6 (out of the remaining 14) are European sovereign contracts, which lead us to a possible indication of the "investors' fear of a sovereign default in the on-going

[6] Index Roll Report: 6 month analysis of the top 1000 Single Name CDS's, from 06/03/2015 through 28/08/2015, accessed 03/12/2015.

European debt crisis" (Vogel et al., 2013), regarding hedging and trading activities.

1.2.7 Currencies

The underlying currency of a CDS contract is one of the most important considerations for market participants, particularly the ones trading sovereign protection. Haworth et al. (2010) validate this theory by saying that a sovereign default can lead to a "potential currency devaluation or even, in extreme, currency redenomination". Within this scenario, a credit event could "coincide with a high degree of currency volatility and likely, weakness in the defaulting currency". Therefore, in order to diversify currency exposure, a big portion of sovereign contracts (regarding Eurozone countries) trade in USD and several other currencies.

Currency plays an important role because it can also trigger a credit event by itself. As seen before (in Credit Events section), "a change in principal or interest payments to a currency that is not a Permitted Currency[7] has the potential to trigger a restructuring credit event" (Haworth et al., 2010). For example, Italy (a G7 member) can re-denominate its government debt out of euros into a new currency without triggering a restructuring event; while on the other hand, Portugal cannot (except if Portugal can keep an AAA rating through its process, however such an event is unlikely to happen).

Table 2 provides information regarding the main currencies used in CDS contracts, as of December 2015. Among all outstanding contracts, the most used currency is the USD, with more than 58% of contracts (698.628 out of 1.191.677 total contracts). With a market share of approximately 37% among all

[7] Permitted Currencies are those of G7 or AAA-rated OECD countries.

outstanding contracts, the ones using Euro (€) as the underlying currency are the second most used by market participants (437.417 out of 1.191.677).

Table 2 – **Daily Aggregate Open Interest by Currency of Denomination**

Currency	Gross Notional Amount	Number of Contracts
AUD	659.520.000	44
CAD	7.037.360.000	252
CHF	2.039.444.073	396
EUR	4.818.646.313.549	437.417
GBP	6.140.403.058	1.113
JPY	31.055.764.075.731	53.791
SGD	115.644.766	26
USD	7.487.733.928.631	698.628
All other currencies USDEQ	30.565.327	10
Total Contracts	**43.378.167.255.135**	**1.191.677**

Source: Own table, with data from the DTCC as of December 2015.

1.2.8 The Overall OTC and CDS Market Size

The CDS market is going through rapid change since its early inception (1994). First of all it is possible to highlight 2007/2008 as the years when the biggest shift happened in the market. Since its inception the CDS market growth exponentially until those years when the number of CDS contracts reached its peak (around USD 60 trillion). Generally speaking, the overall CDS market developed from a small and exclusive market where a small number of participants were present (usually investment banks were the main "players") to a sizeable trading market. This improvement is well accepted amongst market participants because it provides the possibility to diversify credit risk more widely over the economy. The following analysis will mainly be made using statistics provided by the Bank for International Settlements (BIS), at end-June 2015(BIS, 2015).[8]

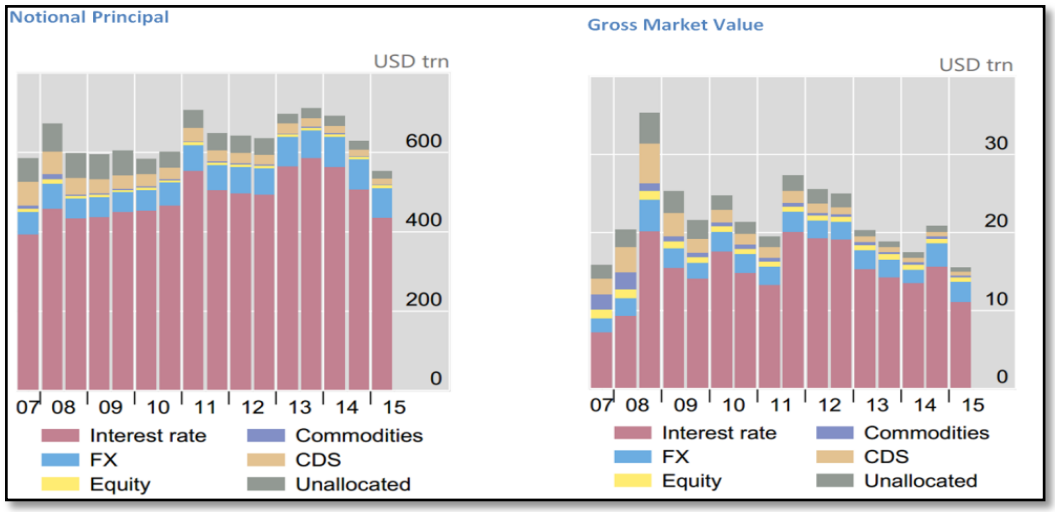
[8] The semester of analysis is between end-2014 and end-June 2015, the most recent public data published by the BIS, at the time.

1.2.8.1 OTC derivatives Market

Starting this analysis with a wider perspective of the overall OTC derivatives market, it is possible to notice that the OTC market has a big disadvantage in comparison with exchange-traded securities. There is still a limited availability of public data, i.e., specific contractual data may not be made public for OTC transactions, due to the mechanics behind this market. This can lead to imprecisions and different conclusions, depending on the data source.

As it is possible to notice in Figure 7 (left side graphic), both corporate and sovereign CDS represent only a small fraction of this market. Interest-rate contracts still represent the largest fraction of the overall OTC market share. According to the OTC derivatives statistics published by the BIS, "at end-June 2015, the notional amount of outstanding interest rate derivatives contracts totalled $435 trillion, which represented 79% of the global OTC derivatives market."

Figure 7 – **Global OTC Derivatives Market**



Source: BIS OTC statistics at end-June 2015. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Recent developments in OTC derivatives markets show that the overall size of this market continued to contract in the first semester of 2015. According to

the BIS statistics, the notional amount of outstanding OTC derivatives contracts[9] fell by 12% between the end of 2014 and end-June 2015 (from $629 trillion to $553 trillion). One possible explanation for this decline is the exchange rate movements that, according to the same statistics published by the BIS, "exaggerated the contraction of positions denominated in currencies other than the US dollar. (…) For example, the depreciation of the euro against the US dollar between end-December 2014 and end-June 2015 resulted in a decline in the reported US dollar value of positions denominated in euros." Yet, even after adjustments made to compensate this effect, notional amounts at end-June 2015 were about 10% lower than at end-2014.

In terms of gross market value of outstanding derivatives contracts[10], the same document states that it "sharply decreased in the first half of 2015." During this semester, market values decreased from $20.9 trillion to $15.5 trillion, their lowest level since 2007, as it is possible to see in Figure 7 (right side graphic). After a sporadic increase in the second half of 2014, the most recent semi-annual decline "brought gross market values back onto the downward trajectory they had been on since end-2011. (…) The decline is likely to have been caused by a combination of falling notional amounts and narrowing gaps between interest rates on the reporting date and rates at contract inception."

1.2.8.2 Credit Default Swaps Market

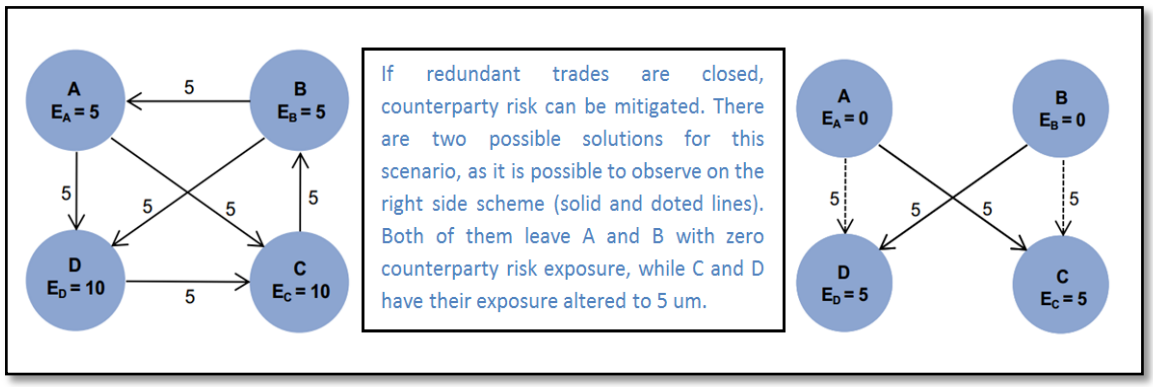
As stated before, 2007 and 2008 are years that require special attention because until then both OTC and CDS markets were steadily increasing in market share. However, the financial crisis that took place in those years and the collapse of Lehman Brothers forced many market participants to deleverage their balance sheet by using a mechanism that is known as **trade compression**,

[9] Determines contractual payments and is one indicator of positions.

[10] The cost of replacing all outstanding contracts at market prices prevailing on the reporting date.

"a practice which reduces gross exposure while leaving the net risk position of a financial institution unchanged"(Weistroffer, 2009). This kind of mechanism basically closes redundant contracts between two (or more) dealers without changing their net position, in order to mitigate the outstanding notional amount of dealers (as it shows on the following figure).

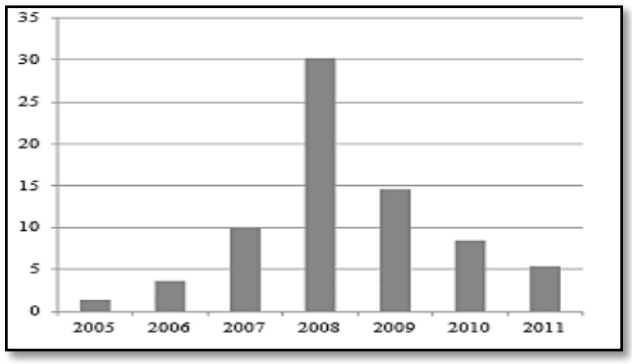
Figure 8 - **Example of a Trade Compression**



Source: Own diagram, with reference to (IMF, 2009). This example assumes that bilateral closeout netting is agreed among all participants.

With the development of this kind of transaction and in order to help market participants to estimate their net risk position a third party operator is introduced, such as TriOptima and CreditEx. This kind of companies provide a service of compression, which basically consists on helping market participants compute their net risk position and then assist them in the process of choosing which contracts should be terminated. Only if all the players involved in the initial deal accept the proposed offer, will the compression be executed. "TriOptima, the leading supplier of compression services, announced that it compressed USD 30.2 trillion of CDS contracts in 2008"(Duquerroy, Gex, & Gauthier, 2009), as it is illustrated in Figure 9.

Figure 9 – **Notional Value of CDS terminated by TriOptima (USD $ trillion)**



Source: Vogel et al, 2013.

Recent developments in the CDS market show that "the steady reduction in the size of the global credit derivatives market, which started in 2007, continued in the first half of 2015." (BIS, 2015). At end-June 2015 the notional amount of outstanding credit derivatives contracts were about $15 trillion, which merely represent a quarter of its peak -> $58 trillion, reached in end-2007.

These recent declines in the overall CDS activity, according to BIS, "reflected mainly a contraction in inter-dealer activity". At end-December 2014 the notional amount for contracts between reporting dealers were about $7.7 trillion, whereas this value suffered a contraction of approximately 15%, reaching the value of $6.5 trillion at end-June 2015. This measure also decreased for banks and securities firms in the first half of 2015, from $1.3 trillion to $1.2 trillion.[11]

A similar approach to Trade Compression is the act of trading CDSs through a Central Clearing Party (CCP). While the first one was applied bilaterally (between dealers), this new concept adds a new player to the deal. This idea arises mainly because of the demand of market participants, but also at the request of regulators who tried to mitigate systemic risks. "CCPs have shown significant activity for corporate CDS transactions. Even though they still play only a minor role for sovereign CDS markets, this may be expected to change

[11] In BIS statistics, table "10.1- OTC CDS, by type of position".

within the next few years" (Vogel et al., 2013). According to BIS statistics at end-June 2015, the share of CCPs is higher for multi-name products (around 39%) than for single-name products (24%). "One possible explanation is that contracts on CDS indices in the multi-name segment are more amenable to central clearing, as they tend to be more standardised than those in the single-name segment." (BIS, 2015).

Concerning the distribution of underlying reference entities, i.e., comparing the gross/net notional amounts of different CDS types (corporate vs sovereign), it is possible to notice right away "that the relative presence of contracts referencing sovereigns has increased steadily since the global financial crisis." (BIS, 2015). In absolute terms, the net notional amount of sovereign CDS contracts grew from $640 billion at the start of 2006 to $3.2 trillion, reaching its peak at end-June 2013. As of end-June 2015 this value declined back to $2.3 trillion.

Once more in absolute terms, the gross notional amount of sovereign CDS contracts grew substantially, from $950 billion at the start of 2006 to $3.7 trillion at end-June 2015. At mid-2013 this value reached its peak ($5.6 trillion) and it has constantly decreased.

"Nevertheless, sovereign CDS contracts' share has continued to increase due to the fact that the overall notional amount of credit derivatives outstanding has shrunk at an even faster pace". (BIS, 2015).

Chapter 2
Credit Indices

This section will focus exclusively on Credit Indices (as previously seen, this is just one kind of a **multi-name CDS**). A brief history is therefore needed to fully understand the benefits of trading this kind of instrument. This event goes back to 2001, "when JP Morgan launched the JECI and Hydi indices, and Morgan Stanley launched Synthetic TRACERS" (Markit, 2014). Two years later both firms merged their indices under the Trac-x name and during that period iBoxx launched credit derivatives indices. In 2004 Trac-x and iBoxx merged in order to form the CDX in North America and the iTraxx in Europe and Asia. In 2007 Markit acquired both families of indices and now owns the iTraxx, CDX, SovX, LevX and LCDX[12] indices for derivatives and the iBoxx indices for cash bonds.

"Credit Indices have expanded dramatically in recent years, with volumes rising, trading costs decreasing, and a growing visibility across financial markets" (Markit, 2014). Understanding the **benefits** of trading this kind of instrument is therefore needed. Markit points out some of them such as Tradability or Liquidity.

- ✓ Tradability: Credit indices can be traded and priced more easily than a basket of cash bond indices or single name CDS;
- ✓ Liquidity: Significant liquidity is available in indices and has also driven more liquidity in the single name market;
- ✓ Operational Efficiency: Standardized terms, legal documentation electronic straight-out processing;

[12] For more information about these indices, see Appendix – Synthetic Indices

- ✓ Industry Support: Credit Indices are supported by all major dealer banks, buy-side investment firms, and third parties (for ex, Markit offers transaction processing and valuations services);
- ✓ Transparency: Rules, constituents, fixed coupon, and daily prices are all available publicly.

According to a study published by Giovanni Calice (Calice, 2014), "CDS indices are benchmarks for protecting investors owning bonds against default, and traders use them to speculate on changes in credit quality." The author even claims that indices like iTraxx and CDX permit investors to take a position on a portfolio/basket of credit entities rather than invest on numerous single name CDS, which is significantly more expensive. "In fact, since these indices are standardised, the increased liquidity is likely to result in lower spreads being charged." In this paper (Calice, 2014) it is possible to see the relationship between the CDS index market and the equity returns of Systemically Important Financial Institutions (SIFI's)[13], particularly in the banking and insurance sector. Overall, using a multivariate VAR approach, the author found out "that the equity returns of all the SIFIs are significantly negatively related to changes in the CDX and iTraxx indices. (…) Large shocks in the CDS index market can substantially destabilise the financial system since all of the thirty SIFIs are prone to significant impacts." In order to establish volatility transmission effects from credit markets into SIFIs share prices, the author uses a GARCH model. One of the results present in that study is "that the volatility of the SIFIs equity returns are highly positively related to the volatility of the CDS and iTraxx indices. Thus, as CDS markets become more volatile, the stock

[13] These Institutions are important to the whole economy in the sense that the failure of one of them could trigger a global financial crisis.

market values of all the SIFIs deteriorate." This result is similar to previous empirical findings, such as (Ang & Longstaff, 2013).

2.1 Trading Overview

Before analysing the trading of Credit Indices and the theoretical framework already proposed by other authors, it is compulsory to understand some terminology involving this subject.

First of all, a brief distinction between the **different roles** that involves trading Credit Indices. The party that is selling protection is in fact the buyer of the Index, i.e., just like in any CDS trade the protection buyer pays a fixed coupon to the protection seller in order to transfer some risk. Thus, the exposure is passed to the protection seller (therefore with coupon payments the index is now on the "possession" of the protection seller, that's why it is called the buyer of the index). Markit proposes the use of the following analogy: "Buying and selling the indices can be compared to buying and selling portfolios of loans or bonds. A buyer [of the index or in this case of a portfolio] takes on the credit exposure to the loans or bonds, and is exposed to defaults; similar to buying a cash portfolio (buying the index is equivalent to selling protection). By selling the index [taking a short position], the exposure is passed on to another party. Exposure is similar is both cases" (Markit, 2014).

Regarding **coupon payments**, just like said before, CDS coupon payments (from the protection buyer to the protection seller) are usually made on a quarterly basis (thus, they are fixed). This rule also applies to the trading of Credit Indices and they are made on the 20th of each month (March, June, September and December), except for CDX.EM. In this case, if the master transaction is related to an Index with a reference date prior to 20/09/2009 the payments are semi-annual on June and December 20; on the other hand,

coupons are made quarterly, just like any other CDX indices. Coupons also accrue on an Actual/360.

One fundamental rule of Credit Indices is the fact that they **roll every six month**, i.e., "a new series of the index is created with updated constituents. The previous series continues trading, although liquidity is concentrated on the on-the-run series" (Markit, 2014).

Regarding different **trading conventions**, there is only a minor distinction to be made: Indices can trade either on **spread** or on **price**.[14] "This convention mimics the cash instrument where some bonds trade on yields, and others on price. The CDS indices convention matches that of the underlying cash instruments" (Markit). This so called Spread is closely related to the Credit Quality of an entity, i.e., market participants tend to use a CDS as an instrument that offers information on a reference entity's credit quality. Armin Rusis, the Co-Head of Fixed Income at Markit, even stated that the CDS market is "viewed as the barometer of health for the broad credit makers". Francis et al. (2003) suggest that a higher CDS spread indicates a higher default risk of the respective reference entity. This effect can be understood by looking at banks' hedging and trading actions: "with intimate knowledge of lending institutions about the default risk of their borrowers, an increasing CDS spread may easily be interpreted as an urgent need of the lending banks to hedge their risk exposures with regard to this reference entity. Increasing spread levels are then a signal of a higher demand for protection against default, as banks perceive a higher risk of these loans" (Vogel et al., 2013). Finally, to fully understand the importance of CDS Spreads many investors use them to measure the credit quality instead of using Credit Ratings, because they tend to be "more accurate assessments of credit conditions than rating agencies. While rating agencies are paid by an issuer and rating reviews can take weeks or months to complete,

[14] See appendix, Figure 1A – Trading Conventions

CDS trade continuously. Therefore, credit derivatives markets function as an important real-time signalling mechanism for market participants and observers." (Ice, 2010)

As previously seen, protection buyers only receive a compensation from the protection seller when a Credit Event occurs. Concerning Credit Indices, when a constituent of the CDS/LCDS index presents a Credit Event, "a new version of the index is published which assigns a zero percent weight on the relevant entity [the one that defaulted]. The notional amount on the index trade is reduced by the weight of the name in the index." (Markit, 2014)

Let's assume an index DEF[15] with 100 names in the index and there is a default of one of the constituent. Basically the new version of this index will contain only 99 names and its notional will need to be revised. Assuming this index had a notional of $10 million, after the Credit Event this value will be adjusted to $9.9 million[16]. After the Credit Event, these trades can either be Cash or Physically settled. Markit states that "Physical Settlement has been the traditional method of settlement, but runs into problems when the notional of the outstanding debt is less than the CDS/LCDS outstanding." However, "the mechanics of Cash Settlement are simpler, faster, and more operationally efficient than Physical Settlement, where an actual loan/bond trade takes place" (Markit, 2014).

[15] This is just an illustrative example, therefore this index does not exist.

[16] As all constituents have the same weight, the default of one entity represents a default of 1% of the constituents. Therefore it is necessary to subtract 1% of the notional to obtain its new revised value ($10.000.000 - $100.000 = $9.900.000)

To fully understand the mechanics behind the trading of Credit Indices it will be presented a **numerical example,** with three different moments in time:[17]

- ✓ Index **ABC** was launched with a price of **100** on **September 20th**, with a fixed coupon of **60**;
- ✓ Investor A buys **$10,000,000** notional protection on the index ABC on **November 30th**, when the spread has moved to **90** and corresponding price is **98.67** (the price is par minus the present value of the spread differences)[18];
- ✓ Risk-Free rate of 0.6%.

A. November 30th

1. First of all, Investor A needs to make an upfront payment to account for the change in spreads (between September 20th and November 30th):

- ✓ $Upfront\ Payment = 10{,}000{,}000 * \left(\frac{100-98.67}{100}\right)$
- ✓ $Upfront\ Payment = \$133{,}000$

2. In addition, Investor A will receive the accrued interest up to trade date (as he will have to make the full coupon on coupon payment date – this simplifies operations as all protection buyers make the same payment on the same date):

- ✓ $Accrued\ Interest$[19] $= \left(\frac{71}{360}\right) * 10{,}000{,}000 * 0.006$
- ✓ $Accrued\ Interest = \$11{,}833.3$

[17] This example was firstly presented by Markit on the following document: "Markit Credit Indices Primer" (Markit, 2014). The index ABC and Investor A were merely created as an illustrative example.

[18] The PV of the spread differences is computed as follow: $PV = \left(\frac{90-60}{90}\right) + 1 = 1.33$. Therefore, the new price is obtained as follow: $New\ Price = 100\ (initial\ Price) - 1.33 = 98.67$

[19] The value "71" is the number of days between September 20th and November 30th.

3. On November 30th Investor's A balance is the following:

- ✓ $Investor's\ A\ balance\ on\ November\ 30th = \$11{,}833.3 - \$133{,}000 = (\$121{,}166.67)$
- ✓ $Net\ Outflow = \$121{,}166.67$

B. *December 20th*

I. Reaching December 20th Investor A pays the fixed coupon:

- ✓ $Fixed\ Coupon\ Payment^{20} = 0.006 * 10{,}000{,}000 * \left(\frac{91}{360}\right) = (\$15{,}166.67)$
- ✓ $Net\ Outflow = \$15{,}166.67$

C. *March 13th*

I. On March 13th Investor A chooses to close the trade, when the spread is 120 and the equivalent price is 97.44.

II. Investor A has to pay to accrued interest up to trade date and receives payment:

- ✓ $Accrued\ Interest\ paid\ by\ A = \left(\frac{84}{360}\right) * 10{,}000{,}000 * 0.006 = \$14{,}000$
- ✓ $Amount\ Received\ by\ A = \left(\frac{100-97.44}{100}\right) * 10{,}000{,}000 = \$256{,}000$
- ✓ $Net\ \boldsymbol{Inflow} = Amount\ Received - Accrued\ Interest = \$242{,}000$

[20] The value "91" is the number of days between September 20th and December 20th.

Chapter 3
Empiric Analysis

3.1 Data Description

In order to conduct this study and deeply understand how index CDS returns have been changing throughout the years, it was selected the following European index: **iTraxx Europe Financials Senior (5Y)**. This index is a subdivision of the "Markit iTraxx Europe" main index, which comprises 30 Autos & Industrials, 30 Consumers, 20 Energy, 20 TMT (Telecomunications, Media and Technology) and 25 Financials.

In order to fully understand the mechanics behind this chapter it will be now presented some of this index (iTraxx Financials Senior) characteristics and the main reasons why it was chosen:

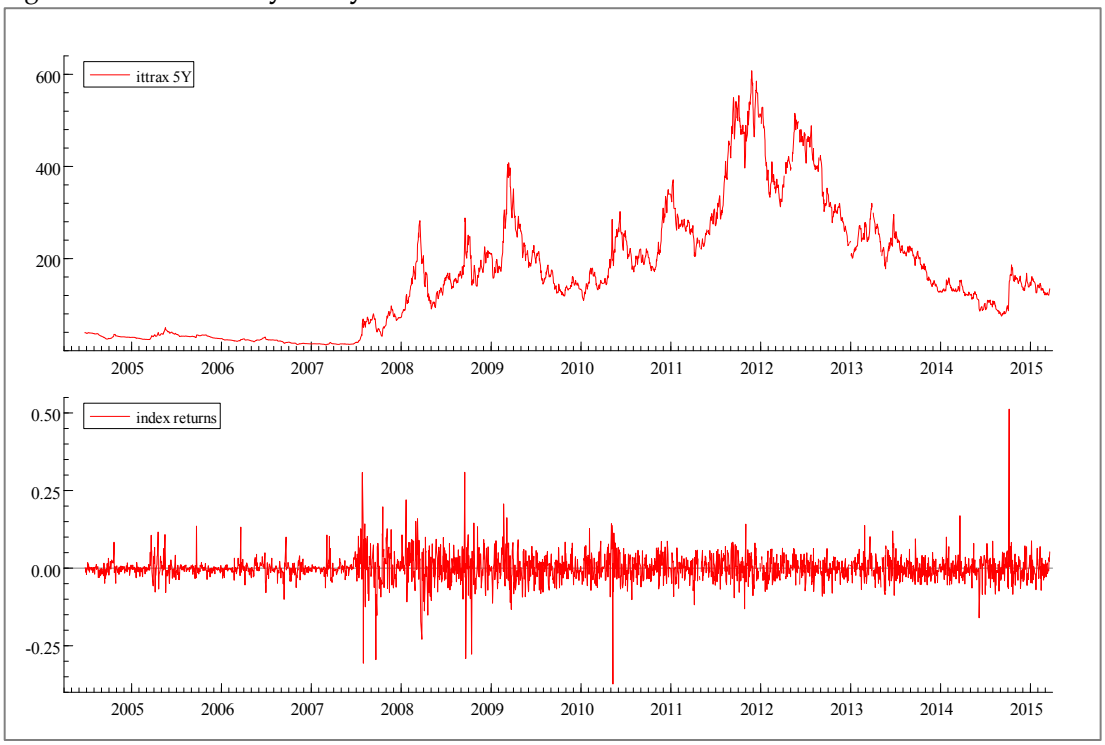
- ✓ First of all, this index is comprised by 25 Financial European entities and thus, at this point, it is clear to see that this is a Multi-name CDS contract (more than one reference entity). It is chosen the 5-year maturity, "which is the most traded in the CDS market" (Delatte et al., 2011);
- ✓ In this case, concerning the index Spread and how this measure can be computed, it is only used **Senior Debt** of the different 25 entities (thus, subordinated debt is excluded);
- ✓ All of the data on this chapter is on a **daily** basis, collected with the help of the index designer: Markit. The time frame present in this chapter is the entire publicly available data since this index creation (24th June, 2004), till 20th March, 2015;
- ✓ As previously seen in Chapter 2 (specifically in 2.1 – Trading Overview), Spread evolution is crucial to measure the credit quality of

an entity. In this case, just like in many other CDS indices, it is possible to observe that a Spread increase is perceived as a deterioration of the credit quality, i.e., the higher the Spread, the higher the default risk;

- ✓ The main reason behind the usage of this particular index (Financials Senior) is simply because this one reveals the largest difficulties that financial intstitutions faced during the whole time frame (with special attention to the financial crisis that was strongly felt in 2007/2008 and the recent Eurozone sovereign debt crisis);
- ✓ Another reason behind this choice was that Regulatory measures have far less impact on the evolution of this kind of index (corporate) than in sovereign indices. One of the most controversial and critical regulation was the banning of naked CDS transaction, which was introduced for the Eurozone in November 2012. "The regulation prohibits trade of sovereign CDS contracts if the market participants do not hold the underlying government bond as well"(Vogel et al., 2013). Thus, the index that is used in this chapter was not affected by one of the most impactfull regulatory measure so far taken.

3.2 Preliminary Analysis

Figure 10 – **Preliminary Analysis**



Source: Own diagram, with data from Markit. Top panel is the index series since its inception (2004). Bottom panel represents the returns of multi-name CDS (iTraxx). (This bottom panel can be used to understand the volatility of these returns too).

Before starting with the analysis of both panels, it is compulsory to understand some terminology behind this complex subject (that is common in financial time series):

Let's start with the expression *Volatility Clustering*. This concept consists on the following idea: in financial markets "large [volatility] changes tend to be followed large changes – of either sign – and small changes tend to be followed by small changes" (Mandelbrot, 1963).

A process with Long Memory is one in which current conditional volatility is correlated with a very large number of lagged conditional volatilities (asymptotically, with and infinite number of these).

Regarding the *Excess Kurtosis*, it is said that "Kurtosis measures the 'fatness' of the tails of a distribution. Positive excess Kurtosis means that distribution has fatter tails than a normal distribution. Fat tails means there is a higher than normal probability of big positive and negative returns realizations." (in Nasdaq financial glossary)

Finally, *Leverage Effects* means that volatility will increase in higher values when we are faced with a strong decrease in prices, rather than with an increase in prices (with the same amplitude).

After listing some important concepts and taking a close look to Figure 10, it is possible to extract some evident results. From the **top** panel it is clear that:

- ✓ Until the first semester of 2007, the perceived credit risk was stable and at low levels, since the index creation. As seen before, 2007 is a very special year because it is the onset of the sub-prime financial crisis that took place in the United States of America (USA);
- ✓ Between 2007 and 2009 the rising tendency is closely related to the USA financial crsis, particularly with the bankruptcy of important market players such as Fannie Mae, Freddy Mac, Bear Stearns and Lehman Brothers. This collapses were not only felt in the USA, but also in some countries around Europe (the ones that its monetary system was closely related to the American one);
- ✓ Later on 2009 and until 2012, the rising levels of the credit risk were closely associated with the interdependence between European banks and European sovereign debt of different countries. This was aggravated by successive banking bail-outs during this period (for example, in June 2012 Europe bail-out the Spanish banking system, with values around 100.000 M€);

- ✓ From 2013 on there is a short decline in perceived credit risk (probably linked with the first bail-in experience in Cyprus).

From the bottom panel it is possible to extract some considerations too. First of all, when comparing to the top panel, it is possible to see that returns and volatility are closely related to the processes described earlier:

- ✓ Until 2007 volatility levels are low;
- ✓ Between 2007 and 2009 high returns are followed by high volatility (this period, as previously seen, was identified as the first one that had a rising trend of the index);
- ✓ It is possible to point out two more important periods, where we can observe a high level of volatility: in the middle of 2010 and early 2012, which corresponds to the second financial rescue of Greece.

After a preliminary analysis it is possible to conclude that the volatility of the iTraxx Financials Europe returns has the following properties: Volatility Clustering, Long Memory and possibly Excess Kurtosis. These are usually observed in financial time series.

However these properties are not enough and must be tested by modelling the returns, with the help of a GARCH model. Afterwards this model will suffer a slight adjustment, in order to measure other two distinct effects, such as *risk aversion* and *leverage effects*.

In fact, the most commonly used model to measure Leverage Effects is the Threshold GARCH (or TGARCH).

"A TGARCH model assumes the form:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{s}(\alpha_i + \gamma_i N_{t-i})a_{t-i}^2 + \sum_{j=1}^{m}\beta_j \sigma_{t-j}^2, \quad (2)$$

Where N_{t-i} is an indicator for negative a_{t-i}, that is,

$$N_{t-i} = \begin{cases} 1 & \text{if } a_{t-i} < 0, \\ 0 & \text{if } a_{t-i} \geq 0, \end{cases}$$

and α_i, γ_i and β_j are non-negative parameters satisfying conditions similar to those of GARCH models. From the model, it is seen that a positive a_{t-i} contributes $\alpha_i a^2_{t-i}$ to σ^2_t, whereas a negative a_{t-i} has a larger impact $(\alpha_i + \gamma_i)a^2_{t-i}$ with $\gamma_i > 0$. The model uses zero as its threshold to separate the impacts of past shocks" (Tsay, 2005).

3.3 Econometric Analysis

After what was analysed in the previous section, it is now necessary to estimate a GARCH model and, in this case, it will be used a TGARCH (1,1_t)-M. This will be estimated in order to measure if different effects, such as *Risk Aversion* and *Leverage Effects*, are implied in the volatility of the index returns.

Table 3 – **Estimation Results**

	Coefficient	**Standard Error**	**Robust Std Error**	**t-value**	**t-prob**
Constant (X)	-0.00219155	0.0004357	0.0004159	5.27	0.000
Alpha_0 (H)	6.70702e-006	2.421e-006	2.797e-006	2.40	0.017
Alpha_1 (H)	0.186977	0.00234	0.00524	3.57	0.000
Beta_1 (H)	0.813023	0.01977	0.02390	34.0	0.000
Student-t df	4.27211	0.3495	0.3379	12.6	0.000
Threshold (H)	0.0436587	0.02769	0.02820	1.55	0.122
h_t (X)	0.748063	0.9302	0.8677	0.862	0.389

Source: Own table. X represents Return measures and H Volatility ones.

After a closer look to the table above, it is possible to extract some considerations:

- ✓ The effect of Volatility Clustering is measured by Alpha_1, which is statistically different from 0, with 1% significance. Thus, as previously seen, it is possible to conclude that Volatility Clusterung is in fact present on the model;
- ✓ Regarding Long Memory volatility, since the observed test statistics for Beta_1 is 34.0, it is possible to say that this effect is indeed present on the model, as previously seen;

- ✓ With the implementation of this model it is now possible to confirm the effect of Excess Kurtosis (on the previous chapter we only point out the possibility of the existence of this effect). This is confirmed by not rejecting the null hypothesis that the degrees of freedom of the t-student distribution are in fact 4 (the observed value in this model is 4.27);

So far it is possible to confirm the three effects presented on the preliminary analysis. Now let's take a closer look to the new effects that could not be tested previously:

- ✓ In order to measure Leverage Effects it is imperative to look to the threshold test statistic. The observed value is only 1.55, which force us not to reject the null hypothesis, that claims the absence of Leverage Effects;
- ✓ Finally, the effect of Risk Aversion is measured by the last parameter on the table (h_t). Here we also do not reject the hypothesis of neutrality towards risk given that the relevant observed test statistic assumes the value of 0.862.

3.4 Empirical Findings

In order to summarise this whole chapter it is possible to highlight two major findings:

- ✓ First of all, the index behaviour (and its implied volatility) appears to be in compliance with the well-known episodes that occurred in this time period – the financial American turmoil, the Eurozone sovereign debt crisis, some important players' bankruptcy and even some bail-out experiences (and possible bail-ins) . In the scope of this analysis this index appears to be an efficient vehicle for revealing expectations, allowing better informed investors to obtain higher returns;
- ✓ The second and final highlight to be made is linked with the usage of a T-GARCH model. As previously seen, this model was used in order to address Risk Aversion and Leverage Effects. The Credit Derivatives market is therefore completely different from the stock market, for example. In the first one market participants are not risk averse as well as they don't have the traditional concern with "bad news". In fact, the absence of Leverage Effect is consistent with the fact that market participants tend to win (rising spreads) with "bad news" regarding the financial system.

Conclusion and Discussion

This document provides an extended overview of the Credit Derivatives Market, with special attention to a multi-name European index: iTraxx Financials (Senior). So far, most of the literature is about single-name contracts but, as time progresses, the usage of multi-name contracts is rising in popularity, due to hedging and trading activities.

The main findings of this paper contribute to fully understand how index information can be used to valuate the credit quality of an institution and therefore, to valuate their default risk. It is also a contribution to understand which financial time series properties are present on the Credit Indices Market.

The time scope of this document was the financial turmoil felt all around the world (since 2007), which enabled a more complex anaysis of how can index returns change throughout time. As stated before, well informed investors can gain huge advantages by trading CDS indices, particularly in times of financial distress.

Future work can be made about sovereign European contracts, but here the regulation is stricter as a result of the European debt crisis of 2009.

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Appendix

Synthetic Indices

Synthetic Indices can be backed by single name **bonds** CDS (senior unsecured) and single name **loans** CDS (senior secured). Markit CDX, iTraxx and SovX for bonds. LevX and LCDX for loans.

- ✓ Markit CDX – Markit credit indices focused on the Americas. Investment Grade, High Yield and Emerging Markets are the three major sub-indices.
- ✓ Markit iTraxx – European and Asian CDS indices owned by Markit. The iTraxx represents the most liquid part of the CDS market for Asia and Europe.
- ✓ Markit iTraxx LevX – These are based on European Loan credit derivatives – they are constructed from the universe of European corporates.
- ✓ Markit iTraxx SovX – These are a family of sovereign CDS indices covering countries across the globe. The indices have 5-year and 10-year maturities and the underlying currency is USD.
- ✓ Markit LCDX – This is the North American benchmark for first lien leverage loans CDS.
- ✓ Markit MCDX – Markit MCDX index references US municipal credits covering revenue and general obligations.
- ✓ Markit VolX – These are the benchmark family of indices that track the realized volatility in the European and North American credit derivatives markets.

Figure 1A- Trading Conventions