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Credit Default Swap Bond Basis Trading Opportunities in Times of Economic Uncertainty in European Financial Market

A study on positive and negative basis trading strategies during economic events on a period between 2015 and 2020

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ABSTRACT

We investigated CDS-bond basis trading strategies during five different events, which possibly have caused market uncertainty on the European market. Those events include the peak of the Greek debt crisis (2015), Brexit announcement (2016), French presidential elections (2017), Tariffs on European Union (2018) and COVID-19 crisis (2020). Further, using the companies from two different iTraxx indices, the sample consisted of 10 non-investment grade and 42 investment grade companies. We found that the basis trading was more profitable during the "turbulent" market condition than during selected "calm" periods, outside the event periods. Moreover, even though for some companies both positive and negative basis trading opportunity arose, the positive basis trading turned out to be more profitable during the listed events. We also found that the fixed, 1 month holding period outperformed the 2-week fixed and volatility triggered holding period.

Keywords: CDS-bond spread, Basis Trading, Volatility triggered exit, economic uncertainty

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ABBREVIATIONS

ASW	-	Asset Swap
BPS	-	basis points
CDS	-	Credit Default Swap
COVID19	-	Coronavirus Disease 2019
FX	-	Foreign Exchange, *here:* Foreign Exchange Rate
IRS	-	Interest Rate Swap
ISDA	-	International Swaps and Derivatives Association
LIBOR	-	London Interbank Offered Rate
RR	-	Recovery Rate
VIX	-	Chicago Board Options Exchange (CBOE) Volatility Index

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1. INTRODUCTION

The market in equilibrium and the no-arbitrage assumption in the financial market form the basis of financial theory and the pricing of financial instruments. However, market events like crises, unexpected events and economic uncertainty can lead to a violation of this assumed market equilibrium. Thus, anomalies can occur in the financial market. For example, the financial crisis, starting in 2008 caused assumed relationships, which had previously been a guarantor of arbitrage freedom in the financial market, to be no longer true. For instance, there was a violation of the covered interest rate parity for USD related currency pairs (Coffey, Hrung & Sarkar, 2009), the swap spread on the interest rate market and break-even inflation rates on the inflation market reached negative levels (the latter implies arbitrage possibilities with inflation swaps) (Fleckenstein, Longstaff & Lustig, 2014). Moreover, credit spreads across a wide range of asset classes and rating categories reached unprecedented levels. Credit default swap contracts (CDS) are a well-known financial instrument for measuring credit risk (De Wit, 2006). This form of credit derivative makes it possible to transfer the credit risk to another party. It is usually assumed that the credit risk (CDS premium) priced by means of a credit derivative corresponds to the credit risk entered into a bond contract (credit spread of a bond) and therefore in general, there is a prevailing no-arbitrage assumption regarding both the CDS premium and bond credit spread. According to an International Swaps and Derivatives Association (ISDA) study, the market for single-name CDS' has stabilized over the last three and a half years, with a volume of around 600 to 700 billion dollars traded per quarter (ISDA, 2019a).

Much like the financial crisis in 2008, the current economic uncertainty due to the COVID-19 global pandemic has caused the global stock market to experience a shock and thus credit risk premiums for corporate entities have risen (UniCredit, 2020). As CDS spreads in general are more liquid and volatile as opposed to bonds, mispricing sometimes occurs because CDS spreads are quicker to react to the changes in the market, which leads to a spread between a bonds credit risk (e.g. G-Spread) and the traded CDS spread. This difference, the so-called *basis*, can be traded by buying or selling the CDS and the referenced underlying. Thus, arbitrage opportunities can be used in the market to achieve a near risk-free return. We assume that in times of global economic crisis and market events, such as the COVID-19 pandemic in which the credit risk market has become more volatile, these arbitrage opportunities must exist in the European market. Consequently, we want to investigate if the assumption regarding basis trade

opportunities during the COVID-19 crisis and other market events holds and therefore investors could make use of this to gain a better return in times of negative interest rates.

This is particularly interesting to see since previous researches have not been conducted on the different market events, which might affect the market differently. Moreover, there is also not much research done which would investigate different holding periods, or whether the volatility might trigger the exit and thus could lead to higher profits. This might spike the interest since the volatility has been found to be one of the theoretical explanatory variables of the CDS spreads (Hull, 2015; Coro, Dufour & Varotto, 2013) and, for example the VIX index, which measures the anticipated future market volatility level, is followed very closely to determine the option pricing. This might suggest that there should be more research done on the volatility when trading the CDS-bond basis. However, Monika Trapp (2009) in her research investigated the arbitrage basis trading opportunities. She tested three different exit strategies but none of them involved the strategy to hold the position for a certain length (apart from the buy-and-hold until maturity) or see if the volatility might trigger the exit. Her data period was compared with a period of constant increase in the economy to the economic downturn. This research, on the other hand, is more focused on how the different, smaller uncertainties in the economy can affect the basis trading. Therefore, she only investigated one turbulent period of the market. The other previous researches have mainly focused on the determinants of the CDS spreads and the bond spreads as well as their relationships. However, this is not necessarily that helpful on determining the suggested basis trading during different events on the market. Therefore, we conduct a research to full-fill the gap regarding the CDS-bond basis trading during the uncertainty on the market.

The general purpose of this Master Thesis is to analyze how credit default swaps can improve the return on investment strategies through CDS-bond basis trading during uncertainty in the European market. As Marc Cuban, an American entrepreneur and investor has stated: „Wherever there is change, and wherever there is uncertainty, there is opportunity“, there is a well-founded assumption that economic uncertainty not only can lead to anomalies in financial market but also can offer a base for a more profitable arbitrage basis-trading strategy through a widening of the basis. The research is performed on the sample companies selected from the *iTraxx Europe* and *iTraxx Crossover* indices on a period between January 2015 to April 2020, specifically evaluating five events. Thus, the first research question for this paper will be to investigate whether the basis trading is more profitable during the turbulent or the calm period. Our hypotheses for the first research question is that the CDS-bond spreads are higher during the more volatile period and thus, should give arbitrage trading opportunities through trading

the basis. While previous research papers have mainly used the *2008 financial crisis*, namely Trapp (2009), as the turbulent sample period, the same assumption about the turbulence is transferred to the sample period and the events falling in between in this thesis. Therefore, the first hypothesis is, that the basis trading will be more profitable during the uncertainty on the market.

The second research question will be to analyze which basis trading is more profitable during the uncertain market condition – only trading a positive or negative basis. In this part the analysis is based on distinguishing the strategy for the investment grade and non-investment grade companies. Our hypothesis for the second research question states that there will be a clear answer whether negative or positive basis trading will be more profitable during economic uncertainty in the market and, therefore, should be applied. This assumption also includes that the companies with investment grade credit quality will offer a higher return due to the applied basis trading strategy within the given sample period. Therefore, companies with a good credit rating will be represented by the companies included in the *iTraxx Europe* index and non-investment grade companies through the *iTraxx Crossover* index.

Lastly, the third research question will offer an evaluation between the exit strategies – should the trading position be always on a fixed period or can a volatility trigger indicator outperform the fixed holding period. Therefore, the sample companies will be tested on two fixed holding period strategies and a volatility triggered exit strategy. Hypothesis for this one states that the volatility triggered exit strategy outperforms the fixed holding period basis trading strategies.

To derive to the results, this thesis is divided into different subsections. First, the *Theoretical Framework* section covers the basics including definitions of asset swap spread, which is often previously used to measure the bond's risk premium, and bond spreads, which will be followed by an explanation and theoretical background of credit default swaps, a further explanation of arbitrage trading opportunities – how and when – and ends with an overview of relevant previous research done in this field. Second, the *Methodology* section focuses on the specifics of the data, a brief overview of the selected events for the research and an explanation of the approach for testing the research questions stated in the *Introduction* section. Third, the outcomes and the analysis of the results are presented in the *Results* section. Fourth, the discussion on the retrieved results with the assumptions is made together with the critique to the research in hand. Lastly, the main findings and the summary is provided in the *Conclusion* section along with the possible focuses on the further research.

2. THEORETICAL FRAMEWORK

This section is divided into different sub-sections. Firstly, the main components of the CDS and bond basis trading are covered. This includes bond credit spread, asset swap (which is important to define as it is widely used in most of the papers that analyze the CDS bond basis trading, but which in our thesis was replaced by the G-spread as further discussed below) and credit default swap. Secondly, the possible arbitrage opportunities and the two basis trading strategies are discussed. Lastly, this section finishes off with an overview done in this field.

2.1. Bond Credit Spread

Bonds serve as a basic instrument of financing in the financial market (SEC, 2013). There are different types of bonds, the most common are government / treasury bonds and corporate bonds. Government and treasury bonds are assumed to have almost a zero-default risk and therefore are considered to be a risk-free investment. Thus, government and treasury bonds quote close to or equal to the risk-free rate. Corporate bonds, on the other hand, trade at a premium to the risk-free rate because the investors expect a risk-adequate compensation for lending the money to the company that has an associated risk to default. This additional risk premium measures the issuer's credit quality and indicates how likely the borrower is going to default. (SEC, 2013) Therefore, a bond's credit spread is represented as the difference between yield on the corporate bonds and treasury bonds with the same maturity (Cherubini & Della Lunga, 2007).

Manning (2004) discusses in his research that the classical approach to bond valuation to determine the default probability goes back to Black and Scholes (1973) and Merton (1974). Those models consider the liabilities of a company as contingent claims on the goodwill or assets of the company and establish a connection between the valuation of a bond and the option pricing theory. Accordingly, the uncertain enterprise value is the decisive factor in determining the credit risk. As a result, he says that the conclusions can be drawn about default or bankruptcy probabilities from changes in the credit spread.

2.2. Asset Swap

An Asset Swap (ASW) is used to evaluate the credit risk. If an investor holds a credit-risky bond with fixed interest rate payment and wants to avoid the risk of rising interest rates, the cash flow structure can be altered by entering in parallel a plain vanilla Interest Rate Swap (IRS) with the same maturity. The investor in a credit-risky bond receives a fixed payment. By

enclosing an IRS in parallel, the investor becomes a fixed-rate payer and a floating-rate receiver. Therefore, an asset swap enables the investor to convert the fixed-rate credit-risky bond into a floating-rate credit-risky bond (He, 2009). Fabozzi, Davis and Choudhry (2006a) concluded that using an asset swap can save the investor from having to sell fixed-interest securities because of rising interest rates, as the interest payments are swapped into variable interest payments, and vice versa, when interest rates fall. Similarly, they also argued that the yield differences between securities of the same issuer can be exploited by using the swap to create synthetic investments and convert interest and redemption payments of the most favorable security into the structure desired by the investor.

He (2009) claimed that there is a difference between an asset swap and a plain vanilla IRS, since the ASW buyer needs to pay the seller "…the amount of accrued interest from the asset swap floating leg minus the accrued interest from the bond and the difference between the par value and the bond clean price in the par-in-par-out scheme if this difference is positive. Otherwise he receives the net payment" (He, 2009, p. 11).

Although the asset swap is not originally credit derivative, by determining the asset swap spread as a difference between the floating part of the ASW and the risk-free rate (e.g. LIBOR), which represents a compensation of the default risk and is commonly used for quoting and pricing corporate bonds, it also forms the basis for structuring and pricing credit derivatives (Aussenegg, Götz & Jelic, 2014).

2.3. Credit Default Swap

Traditionally, IRS contracts are used to transfer interest rate risks, as discussed in previous section. To enable financial institutions to also transfer credit risks, the credit derivatives were introduced in the early 1990s (Cherubini & Della Lunga, 2007). One form of credit derivatives is the credit default swap, which acts like an insurance against defaults or similar credit events based on fixed-interest securities such as corporate or government bonds (Hull, 2015). The typical CDS structure is very similar to an IRS swap. Generally, a CDS contract directly includes two parties: the debt security buyer and the security seller, which is usually a large bank or insurance company. Additionally, the issuer of the debt security acts as an indirectly involved third party as it represents the underlying entity (UniCredit Bank AG, 2008). *Figure 1* below demonstrates how those three parties are related to each other.

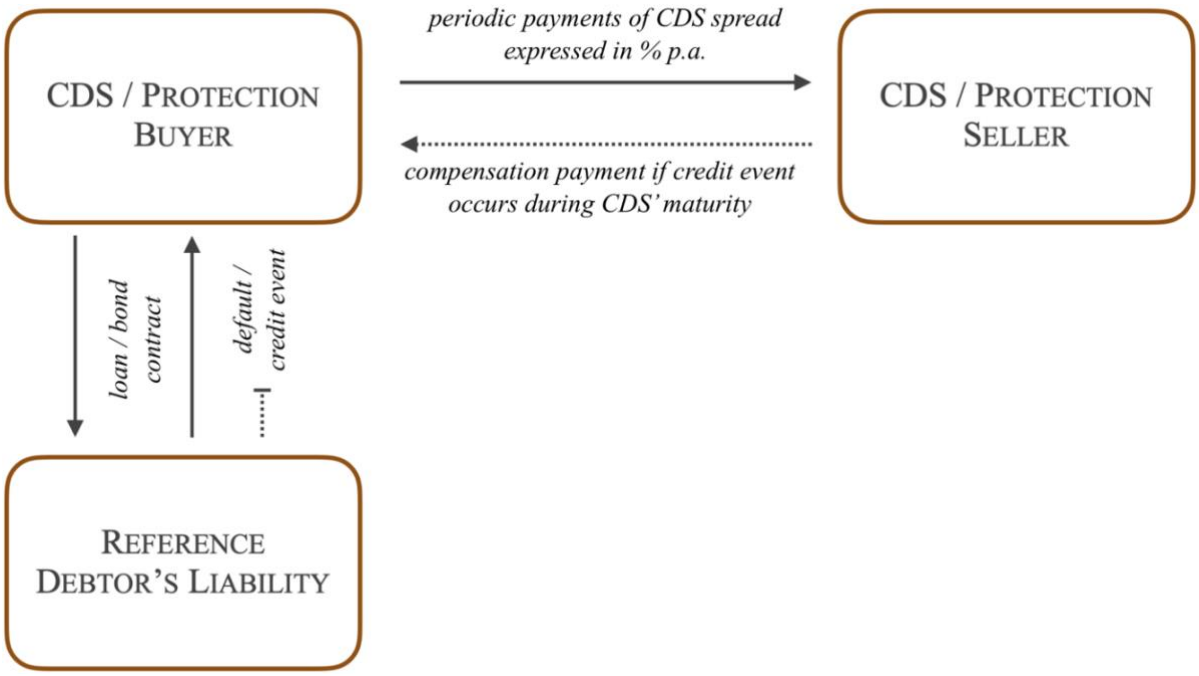


Figure 1: CDS composition and participating entities, adopted from UniCredit Bank AG, 2008

One party buys a protection against a default event during the lifetime of a bond, matching the maturity of the CDS and bond. Therefore, the protection buyer pays a periodic fee – usually quarterly or semi-annually – to the protection seller. These periodic payments are usually expressed in basis points (percentage) of the nominal value of the bond and are referred to as the CDS spread or premium (Augustin, Subrahmanyam, Tang & Wang, 2014). The amount of this premium is determined by the creditworthiness of the reference debtor, the maturity of the CDS, the creditworthiness of the protection seller and the definition of credit events (UniCredit Bank AG, 2008). The premium is paid either until the occurrence of a credit event defined in advance in the contract or until the end of the term of the CDS (Hull, 2015).

In return, the protection seller of the CDS undertakes the risk and makes a compensation payment to the protection buyer if a pre-specified credit event occurs during the CDS' maturity and pre-determined requirements are met. According to ISDA, credit events relating to the reference debtor, or its liabilities, usually include insolvency, default or delinquency and restructuring of the reference debtor's liabilities to the detriment of the creditors (UniCredit Bank AG, 2008).

ISDA is considered as the largest global financial trade association in terms of the number of member firms (ISDA, 2020). Through ISDA, participants of the private negotiated derivatives industry are represented, as well as uniform documentation and international contractual standards for privately negotiated derivative transactions are offered. These contractual

standards are now used by most of the major market participants, including the ISDA *Master Agreement*, as the legal basis for derivatives trading (ISDA, 2019b).

The settlement payment is made either in the percentage of the nominal amount of the CDS by physical settlement, in which case the deliverable liability must be provided in the form of a bond, or in the form of a cash settlement, in which the difference between the original nominal amount of the CDS and the residual value of the reference liability, determined after the credit event has occurred, is paid out (Hull, 2015). Another, less known alternative is to agree a fixed monetary amount when the contract is concluded (UniCredit Bank AG, 2008). Thus, the protection buyer can turn a credit risky bond into a nearly credit risk-free bond due to combining a bond and a CDS contract with same maturity and same underlying. As the investor would still carry the issuer risk, in reality it would never really be a risk-free investment.

Even though, usually the CDS buyer also holds the underlying asset – hedging the risk, it is not an obligation (Mengle, 2007). Hence, by only buying a CDS contract and not holding the underlying asset, a CDS enables the risk to be separated from the underlying debt and the credit risk to be transferred from one party to another. Credit default swaps can therefore be used both for hedging the risk and for speculations. The following *Figure 2* shows the cash flows of the CDS buyer and the CDS seller:

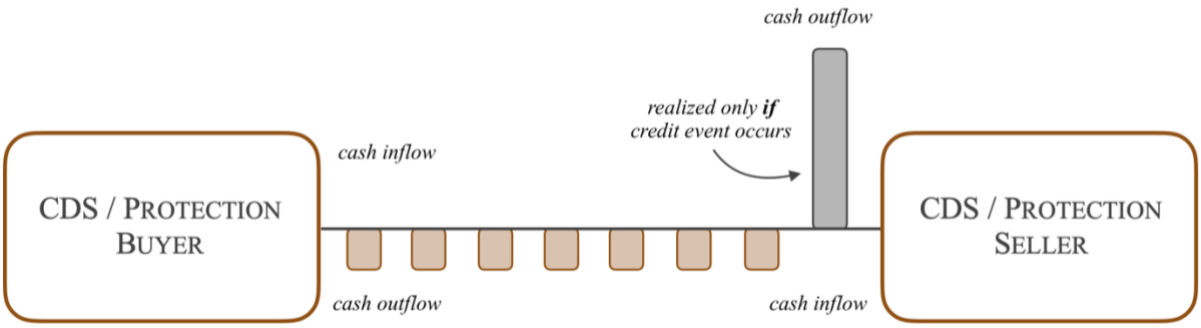


Figure 2: A CDS contract's cash flows from protection seller's and buyer's view

Although this asymmetrical payment and risk structure gives the CDS contract a more optional character, the term of a *swap* is derived from the view that the CDS can be regarded as "a swap of a default-free floating-rate note for a defaultable floating-rate note" (Duffie, 1999, p. 73).

Considering that the CDS spreads are intended to reflect market assessments of the probability of a credit event occurrence and the expected value of the reference security after the credit event, the CDS represents also an alternative market price of the credit risk (Chan-Lau, 2003; Zhu, 2006). The instrument can thus serve as a key indicator for assessing the credit quality of sovereigns, banks and corporates (Dötz, 2007). Therefore, when market is in equilibrium, a

bond's credit spread and CDS spread for the same underlying entity with the same maturity should be approximately equal. However, there may be differences in the credit spread of a bond and CDS spread in the market, which investors can take advantage of every once in a while. This difference, the so-called CDS *bond basis*, can therefore be calculated as follows:

$$\text{CDS } \textit{bond basis} = \text{CDS spread} - \text{bond credit spread}$$

2.4. Basis Trading and Arbitrary Strategies

Essentially the CDS-bond basis trading demonstrates the difference between the price of the bond and the corresponding CDS price. In theory as discussed previously, the bond should trade at the same price as its CDS on the same underlying firm. It should give the investor an opportunity for the risk-free profit trade, supporting the idea why the investor would buy the CDS on the first place. This means that the investor's position is neutral in relation to the default of the bond. This also indicates that the value of the basis trade is zero in this case. Even though these two positions should be offsetting in the case of the default, they are still two different kinds of instruments, which gives the rise in the difference within the price movement. The main reason is, that these instruments have different exposure to the company's credit risk, which creates the attractive arbitrage opportunity for the basis trade investors. This is, according to Elizalde, Doctor and Saltuk (2009) due to the reason that the CDS price is mean reverting and gives an investor the opportunity to make a profit from a short trade horizon. This is, on the other hand, contradicting to some previous research, namely Trapp (2009) who's main findings are covered in *Previous Research* section below. There are two different types of basis trading: negative and positive trading, which are demonstrated on the *Figure 3* below and briefly discussed next (Elizalde, Doctor & Saltuk, 2009).

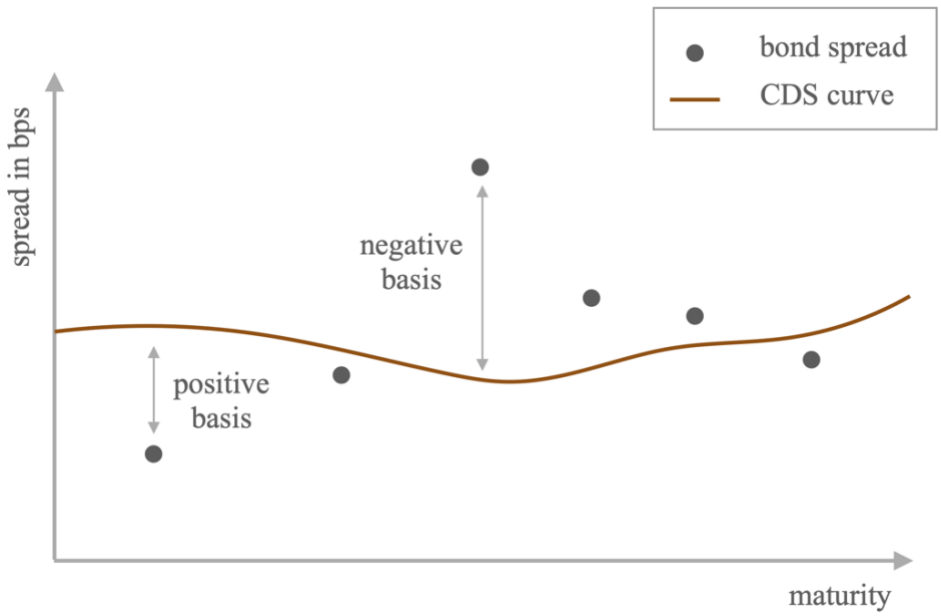


Figure 3: Demonstration of the negative and positive basis trading opportunity, adapted from J.P. Morgan's Bond-CDS Basis Handbook, p. 1, 2009

2.4.1. Negative Basis Trading Strategy

Negative basis trading strategy occurs when the CDS spread is smaller than the bond spread. Therefore, if there is a negative basis, an investor can earn more than the risk-free rate by buying the bond and the CDS contract. This strategy could earn a profit because it indicates that the bond's spread is relatively higher compared to the credit premium represented by the CDS premium and thus the investor can purchase an equal protection relatively cheap, as he has to pay less than theoretically expected. (Choudhry, 2007). Therefore, the bond holder can cover the costs of the CDS contract, giving an investor the opportunity to earn higher profits while being nearly risk-free as the investor has still the issuer risk of the CDS.

Bernhart and Mai (2016) list six reasons in their research why the negative basis even exists. Firstly, *liquidity issues* refer to the fact that the CDS market is generally assumed to be more liquid in terms of trading than the bond market. They say that one reason for this is that bonds are limited in terms of their volume and term, while regarding these parameters, counterparties in the derivatives market have virtually unlimited options, which is also discussed by Felsenheimer and Klopfer (2019) in their research. Therefore, there might be a mismatch on the market, which could lead to a decrease in the bond's price while the CDS spread might remain constant (meaning that the spread increases). Secondly, *funding costs* are high investors might sell the CDS instead of buying the bond, which form the standpoint of credit risk are the same (the associated costs differ). This would result in more CDS contracts sold, which in turn

makes it cheaper in relation to the bond. Third, they say that the negative basis exists because of the *market segmentation*, which defines the different characteristics that affect the CDS market and bond market. They discuss, and agree with Felsenheimer and Klopfer (2019), that these differences in pricing, on both markets, are caused by different investor groups – so-called real money accounts on the bond market (e.g. pension funds and insurance companies) and the CDS market, which is mainly dominated by banks and hedge funds – with different strategic investment approaches and scope for action. Fourth, they state that the *legal risk*, which hints to the risks that are associated with the bond and which cannot be covered with the CDS contract. Fifth, they claim that *counterparty credit risk* indicates the joint default of the bond issuer and the party selling the protection. Hence, entire risk cannot be covered by the CDS contract. Lastly, they add that the *mark-to-market risk* is the reason why the negative basis exist: This risk describes a scenario of a basis that expands to one of the reasons mentioned above, after entering the position. This initially results in a purely arithmetical loss in the position, up to the individual loss limit. In this case, the position must be closed and the loss will be realized. Part of the negative basis could therefore be seen as a risk premium for this possible loss.

2.4.2. Positive Basis Trading Strategy

Positive basis trading strategy occurs when the CDS spread is larger than the bond spread. Therefore, if the basis is positive, an investor takes advantage of the opportunity to sell the bond and also sell the CDS contract. Whereby this leads to a credit financing due to the short position, which is made at a lower interest rate than the risk-free rate. Although, theoretically both of the trades might sound easy to accomplish, the positive basis trade strategy might be harder to apply than the negative basis, mainly for two reasons:

> First, it is hard to borrow the cash bond and then to short sell it, particularly as some illiquid bonds are extremely difficult to obtain. Secondly, even if the investor successfully borrows the cash bond, there are potential haircut costs and possibly a margin deposit with the dealer. During the holding period, if the investor cannot satisfy the possible margin call requirement, he may be forced into interim liquidation (He, 2009, p. 17).

In both cases it is important to clarify the size of the CDS position that should be closed in order to achieve optimal hedging. Conservative investors prefer to minimize the risk of a sudden default and purchase protection on the full face-value of the bond. Meanwhile, market participants usually prefer to buy less protection to improve the carry profile of the trade and

thus pay less insurance premiums. It is assumed that in the event of a bond default, a fraction of the nominal value can be recovered. In order to cover the capital loss, considering the corresponding recovery rate (RR), the hedge would have to be purchased at a nominal time (1-RR). This procedure allows the investor to achieve a lower premium payment, but at the same time assumes a capital loss risk in the event that the expected recovery rate cannot be achieved in case of a defaulting underlying (Bai & Collin-Dufresne, 2018).

2.4.3. Previous Research

The bond market and its related CDS contracts have been an interest for many researches and investors in the financial market due to its indicators of the credit spread and diverse usage in investing through the seemingly complicated combination of the contracts. Even though the US market is much bigger in the size of the bonds and its CDS, the European corporate bond market has seen rapid growth in volume and changes in the composition over the past twenty years. Although, it seems that there is not much recent research done in one study, which would include arbitrage trading opportunities during different economic uncertainties, various exit strategies or comparison between the good credit worthiness and "junk" bonds, there are investigations on the price determinants of the premiums, the relationships between the bond and CDS spreads, and so forth. This section focuses on the previous research done on different bond markets and the related CDS contracts.

The most relevant previous research done to this thesis' topic is *Trading the Bond-CDS Basis – The Role of Credit Risk and Liquidity* by Trapp (2009). The author investigated the arbitrage trading opportunities – both negative and positive basis trading that arose from the difference between the bond and CDS spreads. Trapp also investigated three different exit triggered strategies, which were compared to the buy-and-hold strategy. The strategies were to exit when the CDS contract date changed, when the risk-free interest rate changed or when the ASW and the CDS quote went the opposite directions from the direction they moved previously. Additionally, the author demonstrated that the credit risk of the company, liquidity and the market measures affect the size of the basis. As a result, the author pointed out that the CDS and the bond market trading strategy cannot be reliable only on convergence assumption, but other associated risks – credit risk, liquidity, market conditions – must be counted as well regardless of the strategy. Moreover, 34 firms out of their total sample of 116 firms led the author to conclude that there is no significance cointegration relation between the spreads. Since there is no relation, it suggested that information from the CDS spills over to the bond market. This research conducted their findings on the European sample from June 2001 to June 2007 to

the comparison of mid-2007 to early 2009, which is right after the burst of the Dot-com bubble and right in the beginning of the financial crisis compared to the turbulent period.

Previous papers have also done empirical research on the relationship between the CDS spreads and the bond spreads. Berggren and Mattsson (2008) investigated this relationship over time based on the US and European market. Their main significant finding was that the average CDS spreads, average bond spreads and average credit spreads were higher during the financial turmoil period (end of 2007 and most of 2008). In addition, similar to the research contacted by Trapp (2009), Berggren and Mattsson (2008) also found in their thesis research that there is not enough evidence to conclude that cointegration between CDS and bond spreads exists. This suggests that in theory there might be a lack of arbitrage trading opportunity, instead some other factors affect the difference in given spreads.

Nilsson and Sandahl (2018) also did a similar research paper on the sample data from 2013 to 2017. Their main empirical finding was similar to previous ones – there are no arbitrage trading opportunities in the short-run due to the finding that the CDS contracts might be over- or underestimated compared to the bond market. This finding was supported by the different results regarding the credit rating and the liquidity from the regression. The authors had divided their data into companies that had a credit rating of at least A and companies with credit ratings from BB to A, which, in the case of our specific research, would be considered as one group. Similarly, Alexopoulou, Andersson and Georgescu (2009) in European Central Bank conducted an empirical study comparing the different factors affecting the CDS and corporate bond market prices. Their finding demonstrated that the CDS spreads were more affected by the systematic risk, whereas corporate bonds were more sensitive to the changes in liquidity and idiosyncratic risk. Evidentially, they concluded that while the two markets have a long-term relationship, the CDS spreads were quicker to react to the changes in the market.

Multiple researches demonstrated the variables that affect the CDS and corporate bond markets. Parrado-Martinez, di Pietro, Samaniego-Medina and Trujillo-Ponce (2016) investigated the factors affecting the CDS spread before the financial crisis and during the crisis. The authors used accounting- and market-based data. Evidentially, the market-based variables had a greater effect on the CDS price than the accounting-based data. Moreover, the authors found that the explanatory variables were more dominant during the crisis than in the pre-crisis period. Correspondingly, Galil, Shapir, Amiram and Ben-Zion (2014) also demonstrated the market variables to have the most power over CDS prices. Additionally, the authors find that the structural models could be improved by including the market variables. Similarly, Chodnicka-

Jaworska and Jaworski (2017) and Alexopoulou et al. (2009) found similar results – the market risk factors have explanatory level over CDS spreads.

More specific findings were done by Coro, Dufour and Varotto (2013), who found that the overall market volatility is statistically significant to explain the change in CDS spread. Aunon-Nerin, Cossin, Hricko and Huang (2002) and Krylova (2016) found that the credit rating could determine the CDS premium but in contrast, this variable can be questionable since "First, rating agencies claim that their ratings are a through-the-cycle evaluation, and second, information on a borrower's creditworthiness may be reflected in CDS premia before the rating is adjusted" (Trapp, 2009, p. 5).

In contrast to other previous researches, Gyntelberg, Hördahl, Ters and Urban (2017) from the Monetary and Economic Department of the Bank, International Settlements, investigated when investors prefer trading the CDS-bond basis, which was based on the euro area sovereign debt. It was demonstrated that the CDS-bond basis has to exceed a specific threshold in order to be an attractive investment. Therefore, the different costs must be taken into account. The authors found that during the European debt crisis the transaction costs were much higher than prior to the crisis, 190 basis points vs 80 basis points, respectively. They reasoned this with the fact that the compensation for the increased risk to default had to be higher during the crisis.

Additionally, some researchers have divided their data into two samples: financial and non-financial, such as Alexopoulou, Andersson and Georgescu (2009) and Trapp (2009). It is argued that this is "… relevant since financial firms are the major counterparties in the CDS market" (Trapp, 2009, p.3). As such, suggesting that the banks have more information than the non-financial firms, which would lead to the spread acting differently among the different types of institutions. Moreover, Acharya and Johnson (2007) also showed in their research that informed banks' CDS spreads act different because of the access to non-public information when trading on the CDS market. Those arguments could also somewhat be supported by the *Too Big to Fail* phenomena, which was demonstrated in 2008 when the governments bailed out several banks to avoid even greater meltdowns. According to Onaran (2017) in his Bloomberg article, the banks have saved more money over the years and for that reason they are more protected from these crises. In addition, he states that regulators argue that banks are more aware of the risks since the frequent stress tests conducted. On the other hand, he points out that the critics claim that those banks are still connected to each other through different derivatives – if one fails, it could also bring the others down. Additionally, he says that the Dodd-Frank act has not been tested on many banks at the same time, which could result in different conclusions.

3. METHODOLOGY

3.1. Data Description

The selection of the underlying European companies is made from the European iTraxx indices. Those indices are credit default indices and consist of only the most tradeable, in other words, the most liquid assets. For the purpose of this paper, namely two indices were selected – the iTraxx Europe index and the iTraxx Crossover index. The iTraxx Europe index consists of investment grade companies and the iTraxx Crossover index consists of non-investment grade companies. Only the companies were used that had sufficient data and had unsecured senior bonds with 5-year maturity available through the Bloomberg terminal. As a result, the sample decreased from 125 to 42 remaining companies including 54 bonds from the iTraxx Europe index and from 75 to 10 companies including 13 bonds from the iTraxx Crossover index. See Appendix A for the full list of companies and number of bonds selected for each of the companies. A distinction between the two types is made because of previous research, which suggested that higher rated companies might be more sensitive to market factors (Kim, Park & Park, 2017). Therefore, it might be interesting to see if the trading strategy differs along the credit rating even though the sample in hand for the two data sets is not balanced in terms of number of companies.

Moreover, the five-year CDS daily bid and ask quotes are extracted from the Bloomberg terminal (2020). The five-year maturity contracts are used as CDS contracts with this particular maturity cover the most liquid contracts and are therefore considered to provide the most reliable market data (Dötz, 2007).

The relevant bond data are also retrieved from the Bloomberg terminal (2020) to correspond to the underlying CDS data. Firstly, all the companies' bond ISIN codes are extracted and only the senior, unsecured bonds are chosen. Next, for each bond the G-spread, ask, bid and mid-prices are taken. Instead of using the G-spread, one could argue to use also the ASW spread, which is used in many previous researches, but the problems arise when the bond would trade below its par value. This would result in the ASW to underestimate the credit risk and would therefore "… provide an unreliable measure of the basis" (Choudhry, 2006a, p. 22). Therefore, the G-spread might be a more accurate representation of the bond's credit spread.

The G-spread corresponds to the risk premium, and according to the Bloomberg terminal, it is calculated above the corresponding market's Treasury rate (e.g. it is subject to the market). This means that the G-spread assumes that the Treasury yield is the representation of the risk-free

rate, which could be a problematic assumption (Damodaran, 2008). If the Treasury yields are in some way lower than the actual risk-free rate, then it leads the G-spread to overestimate the credit spread. In contrast, if the Treasury yield is not completely risk-free, then the opposite would be true. However, for the purpose of this paper, it is assumed that the Treasury yield is equal to the risk-free rate. Additionally, even though the mid-price might lead to overestimation, the bid and ask prices for the calculation of the profits and losses are excluded because this would suggest the worst- or best-case scenarios, which would not portray the realistic assumption.

3.2. Time Period

Initially the evaluation period was planned to be from beginning of 2010 up to 2020, but because the lack of data to extract from Bloomberg, the evaluation period ended up falling between 1st of January 2015 and 1st of April 2020. Specifically, the different events were chosen out of this sample period based on the VSTOXX index[1] to evaluate the strategy under the economic uncertainties that have caused the turbulence on the European market.

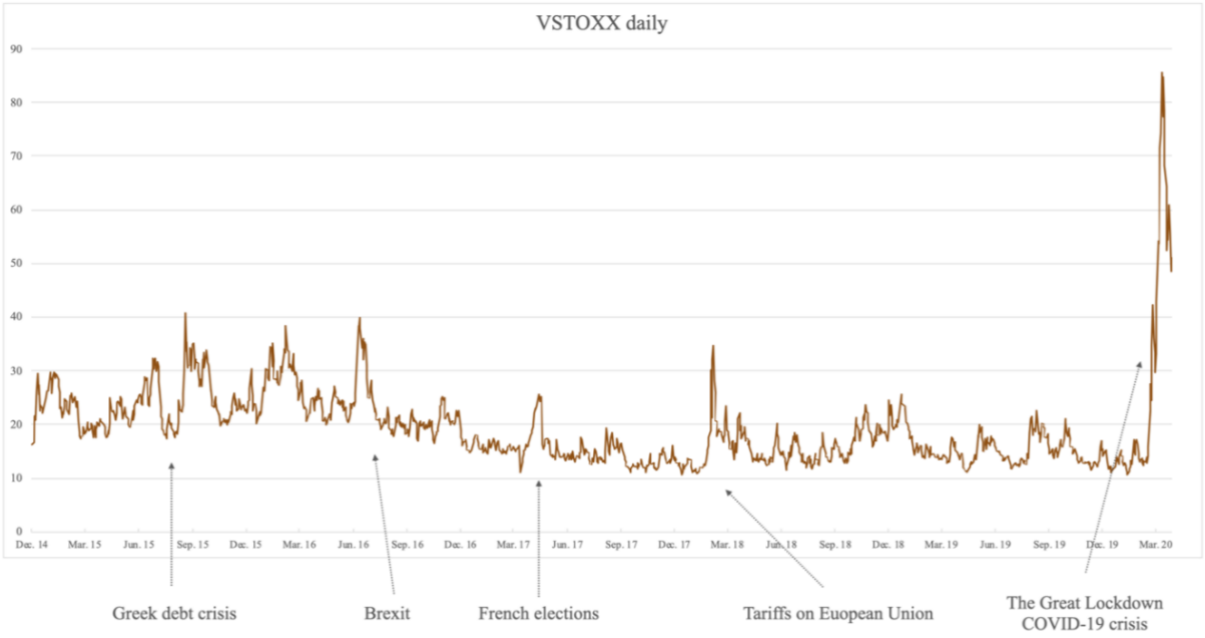


Figure 4: A VSTOXX spot index from beginning of 2015 to end of March 2020 (Data Source: Bloomberg terminal)

[1] "The VSTOXX Indices are based on EURO STOXX 50 realtime options prices and are designed to reflect the market expectations of near-term up to long-term volatility…" (Stoxx, n.d.)

Therefore, the five chosen events are the peak of the Greek debt crisis (2015), Brexit first announcement (2016), French elections (2017), Tariffs on European Union (2018) and COVID-19 (2020). Below is the short description of each of the events selected.

3.2.1. The Peak of the Greek debt crisis (2015)

The Greek debt crisis started in 2008 but the threat to the entire European Union (EU) reaches back to 2010 when the first bailout by the International Monetary Fund (IMF) and EU was provided after the credit-rating agencies decided to downgrade Greece's debt and making their sovereign debt to be equivalent to the *junk* bond. After different actions in between, Greece's debt crisis reached its peak in June 2015, when they missed the pay back of the bailout to the IMF. Additionally, Greece got approved for their third bailout in August 2015, but this time only with the help from the EU but not from the IMF (Council on Foreign Relations, n.d.).

3.2.2. Brexit announcement (2016)

Under the administration of David Cameron, The United Kingdom (UK) wanted to negotiate better terms with rest of the EU. The administration back then even threatened to leave the EU if the negotiations would not be in favor of the UK. Ultimately, the Brexit referendum was conducted on 23rd of June 2016 with 52% of the voters being in favor of and 48% against leaving the EU (BBC News, 2016). The referendum day was followed with the loss of $2 trillion in value on the global stock market and the British pound reached its lowest level in the last 30 years, down to only $1.33 (Quaye, Mu, Abudu, & Agyare, 2016).

3.2.3. French elections (2017)

The 2017 French presidential election was held on 23 April and 7 May 2017. The election marked the first time the history of the Fifth Republic when the runoff did not include a nominee from the traditional left or right party, with the two top candidates being Emmanuel Macron of La République En Marche party and Marine Le Pen of the National Rally party representing the pro-EU liberals and Eurosceptic far-right, respectively (BBC, 2017). Although the election was ultimately won by Macron with 66.1% of the total votes, the popularity of Le Pen and fear of the far-right winning the election still managed to cause uncertainty in the equity markets and elevate the EURO STOXX 50 Volatility Index levels prior to it (Reynolds, 2017).

3.2.4. Tariffs on European Union (2018)

Under the Trump Administration, the United States (U.S.) announced its first round of tariffs in January 2018, which was the beginning of the U.S. and China trade war (Reuters, 2020). On 23rd of March 2018 the Trump Administration imposed "…tariffs of 25% on steel imports and 10% on aluminum imports…" on EU, among the other countries (European Parliament, 2018, n.p.). Even though the possible renegotiations were discussed between the two, the US administration was not in favor with the proposed permits and, ultimately, the tariffs entered into force on 1st of June 2018, which could be seen as the beginning of the global trade war (European Parliament, 2018).

After the USA imposed record customs duties of 7.5 billion dollars on European goods as part of the trade war, the World Trade Organization (WTO) also agreed to a US tariff increase in October 2019 with the aim of recovering damages amounting to 7.5 billion dollars (6.7 billion euros) (Deutsche Welle, 2019).

3.2.5. COVID-19 crisis – The Great Lockdown (2019/2020)

At the end of December 2019, in Wuhan, a Chinese city of 11 million inhabitants, a series of pneumonia cases occurred with initially unclear causes. Already at the beginning of January, the cause could be traced back to a novel corona virus related to the SARS corona virus, which spread rapidly and caused a high death rate. As early as January 2020 it developed into an epidemic in China and eventually spread worldwide. To counteract its spread to countries without efficient health care systems, the World Health Organization (WHO) declared an international health emergency on January 30, 2020 (WHO, 2020a) and finally, on 11 March 2020, the WHO officially declared the previous epidemic to be a pandemic (WHO, 2020b). In many countries, curfews and contact bans have been imposed to prevent further spread of COVID-19. As a result, the stock markets collapsed – on Monday, 9 March 2020, a stock market crash, the so-called corona crash, occurred after the beginning of the price losses in the previous days –, economic output fell worldwide, unemployment rose, and numerous countries asked for international credit assistance (Cohen & Hsu, 2020). On Wall Street, the biggest slump in stock market prices since 1987 was reported (Ehrhardt, 2020). In addition, the volatility indices rose by almost 20% to 86.18 and 88.84 points respectively at the beginning of March. Fears of the economic consequences of the coronavirus pandemic are thus catapulting the VSTOXX to record highs (EUREX, 2020a). To counteract the economic crisis, central banks around the world cut interest rates. Large-scale fiscal and monetary support was also

announced to cushion the severe economic consequences of the lockdown in April (UniCredit, 2020).

The dates above were chosen in combination with the higher volatility during that period (which is the reason why the certain events were chosen) and the specific dates were chosen based on the events in the news. The first event's date was chosen based on the day when Greece did not meet the deadline to pay the bailout received from the IMF back. The Brexit date was chosen based on the announcement of the first referendum results. French president election's date was chosen based on the first elections where the results were that none of the candidates got enough support to win the elections. The 23rd March 2018 was chosen because this is the day when the Trump Administration imposed the tariffs on Europe, among other countries. COVID-19 date was chosen based on when WHO announced the novel coronavirus had become a pandemic and the restrictions all over Europe started to be applied.

3.3. Descriptive Statistics

Table 1 - 3 below demonstrate the average, maximum (Max.) and minimum (Min.) of the CDS-Bond basis, the bond spread and the CDS spread for both non-investment grade and investment grade companies over the course of the five events and for different holding strategies. To see the number of observations recorder for each of the descriptive statistics, please see Appendix B.

As can be seen from all the tables, the CDS spreads have been wider in all cases, which might be explained by the fact that the CDS contracts are quicker to react to the changes in the market and, as discussed, are more liquid in regards to their tradability. In all cases, the CDS spread is also wider for the non-investment grade companies in comparison to the investment grade ones. On the one hand, it might be the case because of the higher risk of the non-investment grade companies' bonds, which in turn suggests higher probability to default. This is reasoned by Weistroffer (2009) in the research, where it is suggested that is due to the higher fees that the investors would charge in order to protect themselves against the default of the company. On the other hand, Kiff, Elliott, Kazarian, Scarlata and Spackman (2009) finds that the CDS are more liquid for the companies with lower credit ratings and, hence should suggest the lower spread. At the same time, it is important to note that there are also many fewer less companies as a sample in hand for the non-investment grade companies than there are for the investment grade companies in this research.

The biggest dispersion in the data seems to be during the COVID-19 pandemic since the maximum and the minimum points are furthest from the average. Although, there is not a big variation among the holding strategies. Tariffs on the European Union is the next one in terms of the data dispersion, which is also very similar throughout the holding time period. The bigger dispersions among those two events could be also explained by the volume of data – those events had more observations in hand than the rest of the events, with the Greek debt crisis having the fewest number of data points. Additionally, while the consequences of the first four events and their effect on the market was grasped more quickly, COVID-19 consequences could almost be compared to the financial crisis in 2008. Moreover, during March and early April, when the data is evaluated, the scope of the economic consequences and what would be following was still uncertain, which makes the market more volatile.

Table 1: Descriptive Statistics of non-investment grade and investment grade companies for the 2 week holding period

2 weeks		iTraxx Crossover (Non-Investment grade)			iTraxx Europe (Investment grade)		
		CDS-Bond basis	**Bond spread**	**CDS spread**	**CDS-Bond basis**	**Bond spread**	**CDS spread**
Greek debt crisis	Average	-16.58	0.65	15.49	-18.99	0.12	5.43
	Max.	56.08	0.88	53.67	73.95	0.26	15.29
	Min.	-53.16	0.25	4.65	-84.45	0.00	2.52
Brexit announce-ment	Average	64.79	0.58	27.65	-2.38	0.46	7.28
	Max.	191.96	1.75	142.49	195.22	2.46	20.73
	Min.	-65.01	0.00	5.43	-105.40	0.00	3.06
French elections	Average	-13.09	0.37	17.14	19.12	0.35	5.46
	Max.	96.48	0.78	73.82	696.56	1.84	12.87
	Min.	-92.31	0.00	4.90	-61.33	0.00	3.08
Tariffs on European Union	Average	-26.13	0.37	12.01	64.30	0.26	4.74
	Max.	64.52	0.91	30.24	1174.20	1.05	7.49
	Min.	-151.31	0.00	4.60	-100.35	-0.08	3.38
COVID-19	Average	-217.40	1.00	120.13	27.69	0.39	17.08
	Max.	468.44	3.20	1130.48	4704.18	6.02	52.92
	Min.	-5809.72	0.00	15.88	-1110.38	-0.52	6.71

Table 2: Descriptive Statistics of non-investment grade and investment grade companies for the 1 month holding period

1 month		iTraxx Crossover (Non-Investment grade)			iTraxx Europe (Investment grade)		
		CDS-Bond basis	Bond spread	CDS spread	CDS-Bond basis	Bond spread	CDS spread
Greek debt crisis	Average	0.21	0.55	15.35	-20.18	0.11	5.26
	Max.	104.00	0.88	53.67	73.95	0.26	15.29
	Min.	-53.55	0.00	4.61	-92.06	0.00	1.89
Brexit announce-ment	Average	65.83	0.63	25.91	-4.40	0.46	6.72
	Max.	191.96	1.75	164.91	195.22	2.46	20.73
	Min.	-65.01	0.00	5.43	-105.40	0.00	0.22
French elections	Average	-0.83	0.39	16.37	14.96	0.34	5.39
	Max.	107.80	0.86	73.82	696.56	1.84	12.87
	Min.	-92.31	0.00	4.65	-61.33	0.00	2.98
Tariffs on European Union	Average	-22.40	0.36	12.02	60.91	0.26	4.72
	Max.	64.52	0.95	33.72	1410.93	1.09	7.49
	Min.	-151.31	0.00	4.60	-100.35	-0.08	3.35
COVID-19	Average	-201.45	1.04	97.37	30.27	0.42	16.51
	Max.	1447.92	4.61	1130.48	4770.24	6.02	56.69
	Min.	-5809.72	0.00	15.88	-1110.38	-0.52	0.00

Table 3: Descriptive Statistics of non-investment grade and investment grade companies for the volatility triggered holding period

Volatility triggered		iTraxx Crossover (Non-Investment grade)			iTraxx Europe (Investment grade)		
		CDS-Bond basis	Bond spread	CDS spread	CDS-Bond basis	Bond spread	CDS spread
Greek debt crisis	Average	-28.58	0.61	15.32	-19.19	0.13	5.51
	Max.	10.10	0.69	53.43	66.03	0.26	15.13
	Min.	-51.90	0.25	4.84	-84.45	0.00	3.00
Brexit announce-ment	Average	62.44	0.59	28.09	-0.08	0.47	7.85
	Max.	175.36	1.75	129.09	195.22	2.46	20.73
	Min.	-50.21	0.00	5.43	-105.40	0.00	3.47
French elections	Average	-22.53	0.39	17.81	25.34	0.35	5.63
	Max.	60.55	0.78	73.82	612.28	1.72	12.87
	Min.	-84.97	0.00	5.00	-61.33	0.00	3.08
Tariffs on European Union	Average	-24.09	0.37	12.20	58.61	0.25	4.72
	Max.	64.52	0.93	30.78	1364.24	1.05	7.49
	Min.	-151.31	0.00	4.60	-100.35	-0.08	3.38
COVID-19	Average	-203.26	1.06	109.13	21.12	0.42	17.00
	Max.	468.44	4.61	1130.48	4758.03	6.02	56.69
	Min.	-5809.72	0.00	15.88	-1110.38	-0.52	6.71

3.4. Approach

This part is divided into four parts. The first part discusses and demonstrates the specific dates chosen for entrance of the trades. The second part focuses on the preliminary calculations, which are essential before the return calculations. The third part demonstrates the return calculations, both negative and positive, for the fixed holding periods and the last part discusses the same for the volatility triggered exit.

3.4.1. Trading Period

The trading period is divided into two parts: one is considered turbulent because of the market uncertainties (the five events discussed above) and then there is the rest of the period, which is referred to in this research as the "calm" period. First, the trading strategies are implemented on the events. The entrance for all the strategies occurs five times (e.g. five different events) on the same dates, which are indicated in *Table 4* below:

Table 4: Holding period dates of the basis trading during turbulent period

	Entrance	2 weeks Exit	1 month Exit
Greek debt crisis	6/30/2015	7/14/2015	7/30/2015
Brexit announcement	6/23/2016	7/7/2016	7/25/2016
French elections	4/24/2017	5/8/2017	5/24/2017
Tariffs on European Union	3/23/2018	4/6/2018	4/23/2018
COVID-19	3/11/2020	3/25/2020	4/14/2020

Second, five periods are chosen to enter the strategy during the calm period to test if the Hypothesis 1 for this research holds. The periods are chosen randomly but under the condition of low volatilities regarding the VSTOXX and EURO STOXX 50. In theory whatever period is chosen out of the calm period should underperform compared to the strategy entered in the beginning of the turbulent period, caused by the events. The trade dates for the chosen five periods are indicated in the *Table 5* below:

Table 5: Holding period dates of the basis trading during calm period

	Entrance	2 weeks Exit	1 month Exit
Calm 1	5/5/2016	5/19/2016	6/5/2016
Calm 2	2/3/2017	2/17/2017	3/3/2017
Calm 3	11/3/2017	11/17/2017	12/1/2017
Calm 4	8/3/2018	8/17/2018	9/4/2018
Calm 5	4/5/2019	4/18/2019	5/3/2019

As stated in the *Introduction* section, one of the purposes of this thesis is to investigate whether the exit strategy should be a fixed period or triggered by a certain factor. Two different fixed holding periods are introduced. The first one is a 2-week period and the other one is a 1-month holding period. The last one is used as a fixed period as this is often the time period used to demonstrate the basis trading strategy. To investigate whether volatility could be used as an exit trigger, two volatility indicators are used. On the one hand, implied volatility represented by the VSTOXX index, as it measures the EURO STOXX 50 1-month implied volatility and therefore acts as an "European volatility benchmark [and reflects] the investor sentiment and overall economic uncertainty" (EUREX, 2020b).

On the other hand, the historical data from EURO STOXX 50 index is used to calculate the annualized historical volatility. Therefore, the calculation of the standard deviation of the daily log returns is conducted and afterwards annualized it by multiplying the square root of 252 business days. Both volatility indicators are used to evaluate the implied volatility, which would indicate the future expectations, and the historical volatility to view the actual movements.

As a contrast to many previous research papers, that discussed the basis trading strategies under the assumption of common buy-and-hold trading which requires long-term investments and thus binds the investors liquidity for a long period, the focus of this thesis is set on short-term trading strategies. Through entering a nearly pure arbitrage basis trade under hold-to-maturity-assumption, the investor has a predictable expected absolute return, which is measured in particular by the amount of the purchased base and the term of the position. This paper investigates whether trading the basis as a short-term investment can be either profitable or not. In practice, there are several reasons why a buy-and-hold negative basis trade is not a pure arbitrage. These risks are discussed in detail in Elizalde, Doctor and Saltuk (2009) (see, in particular, their table 2 on page 23).

3.4.2. Preliminary Calculations

The first step in the approach is the calculation of the mid-price for the CDS, which is derived from the given ask and bid prices. Even though the mid-price might result in a slight overestimation, the error would be smaller than if the ask and bid prices would be matched, which would lead to an even higher underestimation since they form the outer borders, which are usually not traded.

Next the CDS-bond basis is calculated based on the formula below:

$$\text{CDS } \textit{bond basis} = \text{CDS spread} - \text{bond credit spread},$$

where CDS spread is the CDS mid premium and the bond credit spread is the G-spread. Additionally, the data is evaluated and observed to see if the basis is higher for the higher-quality rated companies (iTraxx Europe index) than for the companies from the iTraxx Crossover index, as suggested above. Therefore, the steps and approach described below are implemented on both different company groups the same way.

Following the CDS bond basis calculation, the results are evaluated based on the sign. The sample is divided into two sub-samples throughout the time period depending on the sign of the basis – to distinguish between the suggested positive and negative trading strategy.

This is followed by the calculation of the returns for both the negative and positive basis trading strategy, using the daily CDS bond basis data and the bond's mid prices. The exact formula and approach calculation of the returns for each of the exit strategy is discussed further below.

3.4.3. Return calculation for the fixed period strategies

For positive basis trading both the bond and the CDS contract (full face-value of the bond) will be sold at the mid-price during the day the strategy was entered. After a 2-week and 1-month holding period, the bond and the CDS contract will be bought back at the mid-price, or rather the position will be closed. Additionally, the profit is received from trading the basis pro-rata for the holding period. If there will not be any data available for the particular bond or CDS contract on the day the trade would be exited according to the fixed period, the next available data point will be taken. Therefore, for some trades the holding period might be some days longer if the trade could not be exited on the pre-specified day. The calculation of the return through the applied positive basis trading strategy, expressed in basis points, can be represented as follows:

$$\sum_{n=1}^{N}\left(\mathrm{Bond}_{t_{n,1}}^{\mathrm{mid}}-\mathrm{Bond}_{t_{n,2}}^{\mathrm{mid}}\right)\times 100+\mathrm{Basis}_{t_{n,1}}^{\mathrm{positive}}\times\frac{t_{n,2}-t_{n,1}}{360},$$

where $t_{n,1}$ represents the date the strategy is entered, $t_{n,2}$ the date when the strategy will be exit and n the pairs of corresponding bond prices and CDS premiums included in the examined period's subsample.

For the negative basis trade, the procedure is similar to the positive basis trading. But, unlike in the case of positive basis, the negative basis trade involves buying the bond and the CDS contract (full face-value of the bond) at the mid-price during the day the strategy will be entered and selling or performing and exit when the exit is required to apply. The calculation of the return through the applied negative basis trading strategy, expressed in basis points, can be represented as follows:

$$\sum_{n=1}^{N}\left(-\mathrm{Bond}_{t_{n,1}}^{mid}+\mathrm{Bond}_{t_{n,2}}^{mid}\right)\times 100+\mathrm{Basis}_{t_{n,1}}^{negative}\times\frac{t_{n,2}-t_{n,1}}{360}\times -1$$

As already mentioned in the paper, the CDS represents a more liquid contract than the bond. This liquidity also includes the contracts exit options before expiry and before a credit event occurs. More particularly, there are two exit options: *Unwind* and *Novation*. In the event of an *Unwind*, both contracting parties agree to dissolve the contract against payment of the current market value. However, it might also be the case that only one contracting party want to exit the contract. The investor's position could be neutralized by taking the opposite position, but this entails a certain risk due to price fluctuations in the market or a lack of congruence of terms and premiums. Therefore, taking the opposite position might not be the best solution. The other exit possibility is *Novation*. This means that a party to the CDS will find a third party to take its place in the CDS contract. In most cases, this is regulated through the conclusion of a further CDS contract between the exiting party and the third entering party, whereby the parameters of the new contract match those of the original transaction, so that in conclusion the exiting party has a complete neutralization regarding its positions. A so-called collaboration of the cash flows follows, which means that the exiting party is no longer part of the contract. The *Novation* thus offers the investor an opportunity for a completely cost-neutral exit.

Although we are aware that most of the time in reality it can be complicated and hard to find an entering third party for the position to be taken over, we assume that the exit happens through *Novation* in the case of this research and therefore, the simplified assumption is made.

3.4.4. Return calculation for the volatility triggered exit strategy

To apply volatility triggered exit strategy, the average of VSTOXX and EURO STOXX 50 daily will be taken, and the change will be calculated. The change is calculated for every holding day, compared to the average volatility level of the day entered the strategy, after the trade was entered. The trade is entered the same days as the fixed period trades. The difference will come in the exit day, which for the volatility triggered one will be implemented when the volatility change is at least –5% compared to the level when the trade is entered. In the case that the assumed volatility level triggering the exit would not be reached within a certain period of time, an emergency exit trigger would be implemented for periods longer than three months. The profits and losses of the positive and the negative basis trades will be calculated the same way as demonstrated above in the form of the formulas in the fixed holding period trades.

4. RESULTS AND DISCUSSIONS

This section demonstrates the results of the implementation of the strategies described above. It is divided into different parts. The first part incorporates the analyzation of the results broken down by the three hypothesis stated in the introductory section. The last part builds upon the approach section and the results indicated in this section, to state the assumptions and critical statements.

To compare the results of the applied basis trading strategy, the sub-samples were created for trading the basis with investment grade rated companies and non-investment grade companies as discussed above. Additionally, a separation between implementing the positive or negative trade was made.

4.1. Hypothesis 1: Basis Trading will be more profitable during uncertainty

Table 6 and 7 below demonstrate the returns of the sub-samples among all the events, which are compared to the returns recorded during the calm period. The first two tables indicate the returns of the investment grade companies and the following two indicate the returns of the non-investment grade companies.

Table 6: Return on CDS-Bond Basis Trading Strategies for iTraxx Europe in basis points (fixed holding period)

iTraxx Europe (Investment Grade)	**Fixed**					
	2 weeks			**1 month**		
Events	Positive	Negative	Total	Positive	Negative	Total
Greek debt crisis	1,546.46	91.09	1,637.56	3,334.93	202.44	3,537.38
Brexit announcement	22,582.35	544.95	23,127.30	51,367.36	564.98	51,932.34
French elections	19,507.66	-17.34	19,490.32	43,634.92	284.78	43,919.70
Tarrifs on Europe	23,142.97	207.60	23,350.57	50,075.08	-220.57	49,854.51
COVID-19: The Great Lockdown	49,841.44	-5,047.43	44,794.01	113,667.62	-1,824.27	111,843.35
Total:	116,620.87	-4,221.12	112,399.75	262,079.91	-992.63	261,087.28
Non-Events	Positive	Negative	Total	Positive	Negative	Total
Calm Period 1	0.00	-20.59	-20.59	0.00	-73.61	-73.61
Calm Period 2	20,757.56	292.84	21,050.40	41,219.02	130.19	41,349.21
Calm Period 3	22,867.00	-324.04	22,542.96	44,451.81	-487.71	43,964.10
Calm Period 4	5,125.52	85.13	5,210.65	11,874.94	4.74	11,879.68
Calm Period 5	9,529.83	86.95	9,616.78	18,925.60	199.16	19,124.76
Total:	58,279.91	120.30	58,400.20	116,471.37	-227.23	116,244.13

Comparing the results of both periods, it becomes clear that the positive basis trading strategy outperforms the negative basis trading strategy during the calm period as well as during the turbulent period. A closer look at the 2-week strategy reveals that the overall return for trading during the events, when both basis trading strategies – positive and negative – were applied was almost twice as high as during the calm period. The investment grade companies achieved a total return of 112,399.75 basis points (bps)[2] for the turbulent period (compared with 58,400.20 bps for the calm periods) and the non-investment grade companies achieved a total return of 114,359.82 bps (vs. 68,892.92 bps for the calm period). If the less profitable positive basis trading strategy is excluded, and only the negative basis 2-week fixed holding period strategy for events and non-events is compared, it can be retrieved clearly that the doubled result achieved during the events is mainly due to the negative trading strategy. However, it should be mentioned that the majority of the result is influenced by a very high basis during the last event, the COVID-19 crisis.

Table 7: Return on CDS-Bond Basis Trading Strategies for iTraxx Crossover in basis points (fixed holding period)

iTraxx Crossover (Non-Investment Grade)	**Fixed**					
	2 weeks			**1 month**		
Events	Positive	Negative	Total	Positive	Negative	Total
Greek debt crisis	0.00	116.56	116.56	0.00	332.60	332.60
Brexit announcement	-76.72	15.52	-61.19	-282.60	237.09	-45.52
French elections	0.38	144.30	144.68	64.34	47.13	111.48
Tarrifs on Europe	19,527.29	54.95	19,582.24	43,274.83	87.66	43,362.49
COVID-19: The Great Lockdown	97,638.88	-3,061.34	94,577.54	228,303.65	-721.77	227,581.89
Total:	117,089.82	-2,730.00	114,359.82	271,360.23	-17.29	271,342.94
Non-Events	Positive	Negative	Total	Positive	Negative	Total
Calm Period 1	0.00	-62.46	-62.46	0.00	-134.66	-134.66
Calm Period 2	-40.54	113.83	73.29	-92.88	182.95	90.08
Calm Period 3	12,571.78	-325.82	12,245.97	24,963.56	-259.23	24,704.33
Calm Period 4	27,928.19	32.89	27,961.07	63,165.49	33.31	63,198.80
Calm Period 5	28,285.25	389.80	28,675.05	61,236.99	241.34	61,478.33
Total:	68,744.68	148.24	68,892.92	149,273.17	63.71	149,336.87

[2] This presentation of the results achieved in basis points can be seen as a return per EUR 1 invested. Thus, a result of 112,399.75 bps equals a return of EUR 11.24 per EUR 1 invested or 1,123.99%.

A similar result was also achieved for the 1-month strategy, with the difference that the returns were more than twice as high as for the 2-week strategy. For both strategies a total return of 261,087.28 bps (+132%) was achieved for the investment grade companies during the turbulent period and 271,342.94 bps (+137%) for the non-investment grade companies. But even during the calm period the 1-month strategy outperformed the 2-week strategy with a result of 116,244.13 bps (+99%) for the investment grade companies and 149,336.87 bps (+116%) for non-investment grade companies. Thus, the difference between the turbulent period and the calm period remains over both strategies applied, which allows the conclusion that the positive basis trading was profitable during uncertainty and thus the first hypothesis is confirmed. Those clear results are in contrast to Trapp's (2009) findings during her research. She found that there were big losses among financial institutions during the financial crisis. She explained that those results might have been caused by the changed risk profile, which were not taken into account in this thesis. On the other hand, it is important to note that her findings were only based on the financial institutions' data, and thus are not applicable to this thesis.

4.2. Hypothesis 2: There will be a clear answer whether negative or positive basis trading should be applied during economic uncertainty

Analysis and inspection of all the companies with their different bonds led to the conclusion that neither the positive nor negative basis trading was clearly preferred to enter at the beginning of economic uncertainty caused by the different events in the market. The three graphs below, *Figure 5*: Credit Suisse Group AG, *Figure 6*: HSBC Holdings PLC and *Figure 7*: Daimler AG are examples of the total of 12 companies, which indicated similar results. For the rest of the graphs please see Appendix B.

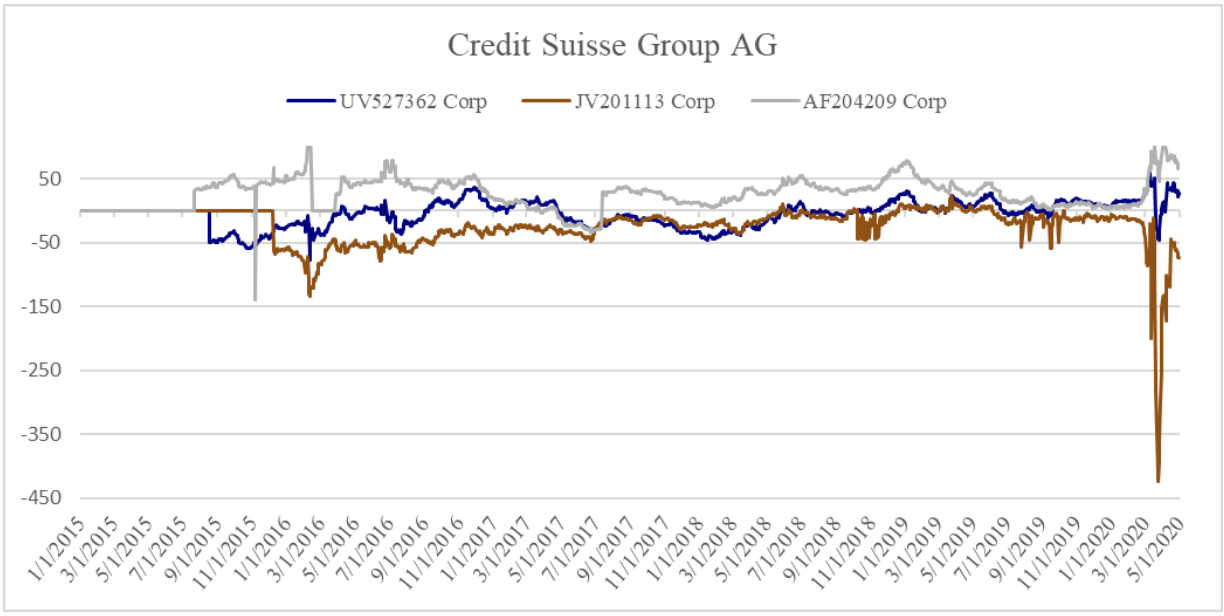


Figure 5: Credit Suisse Group AG CDS-bond basis

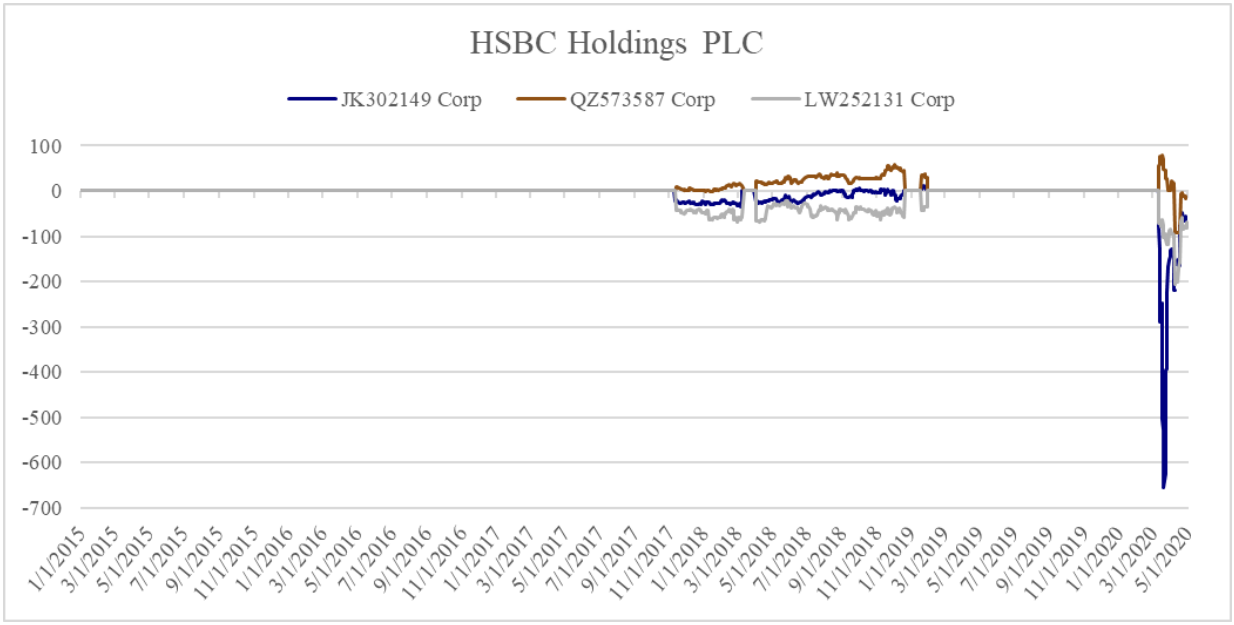


Figure 6: HSBC Holdings PLC CDS-bond basis

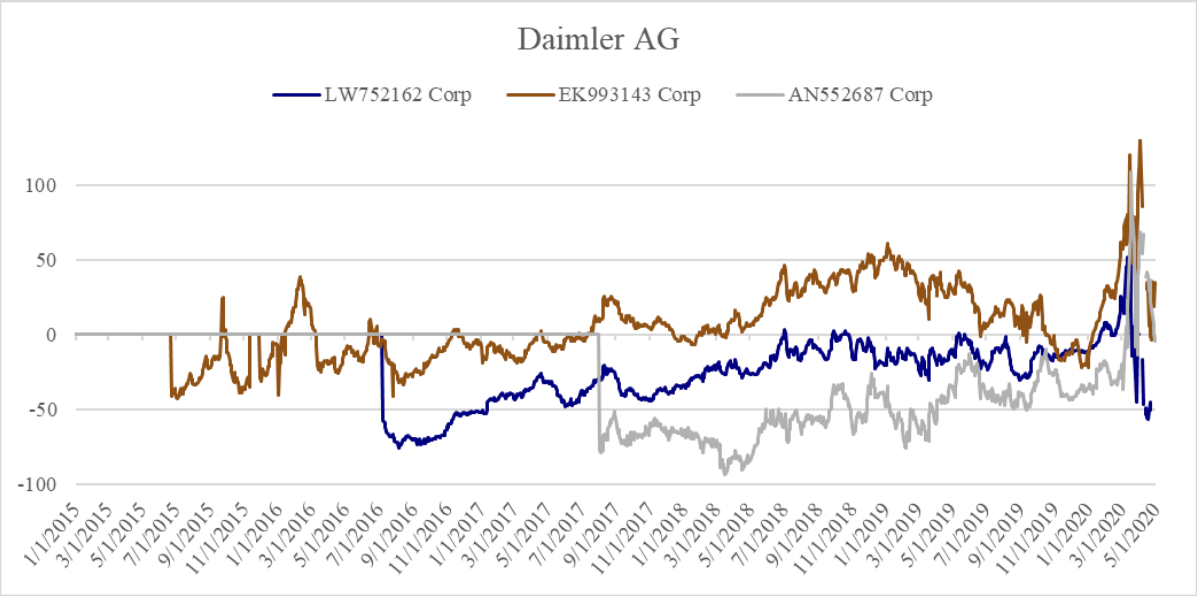


Figure 7: Daimler AG CDS-bond basis

As seen, the bonds from the same company did not move the same direction and did not follow the same pattern. For example, while HSBC Holdings PLC one bond (LW252131) had a wider negative basis during 2018 than the rest of the bonds, during the COVID-19 JK302149 had about three times wider negative basis than LW25213 had, which previously was another way around.

Another interesting finding is, that for example Daimler AG's CDS-bond basis' do not follow the same direction – on all those bonds, both negative and positive basis trading strategy could be applied during the different times.

Therefore, there is not a clear answer whether only positive or negative basis would occur during the uncertainties as even the same company's CDS-bond basis suggests different directional movement during the same event. On the other hand, profitability of the two trading strategies propose something different.

The tables below demonstrate the average, maximum (Max.), minimum (Min.) and total profit or loss in basis points for the three different exit strategies of both positive and negative trade among non-investment grade and investment grade companies. In terms of the average and the total, the positive basis trading with investment grade companies outperformed the negative basis trading with the investment grade companies in each case (in terms of the events and the exit strategy). In some cases, the negative basis trading on average also resulted in a loss (French elections, 2-week holding and volatility triggered; COVID-19, for all the holding periods and Tariffs on European Union, 1 month holding period) or very small profit, which in a high chance would result in a loss if the trading costs were taken into account.

Table 8: Descriptive statistics of the profit/loss for the 2 week holding period

2 weeks		iTraxx Crossover (Non-Investment grade)		iTraxx Europe (Investment grade)	
		Positive Basis Trading	**Negative Basis Trading**	**Positive Basis Trading**	**Negative Basis Trading**
Greek debt crisis	Average	**No data**	58.28	773.23	30.36
	Max.		125.50	1547.07	50.71
	Min.		-8.94	-0.61	18.48
	Total		116.56	1546.46	91.09
Brexit announce-ment	Average	-38.36	15.52	1881.86	60.55
	Max.	43.83	15.52	5126.37	139.62
	Min.	-120.55	15.52	-126.56	-80.73
	Total	-76.72	15.52	22582.35	544.95
French elections	Average	0.19	28.86	1625.64	-1.73
	Max.	0.38	81.94	3419.46	19.88
	Min.	0.00	-0.38	-1251.26	-27.15
	Total	0.38	144.30	19507.66	-17.34
Tariffs on European Union	Average	3905.46	13.74	1218.05	10.93
	Max.	19687.35	66.77	3196.83	27.42
	Min.	-138.72	-8.97	-1670.00	-2.51
	Total	19527.29	54.95	23142.97	207.60
COVID-19	Average	12204.86	-612.27	1557.54	-229.43
	Max.	84960.94	-82.93	7836.31	13.42
	Min.	61.11	-1104.73	-3174.77	-695.87
	Total	97638.88	-3061.34	49841.44	-5047.43

Table 9: Descriptive statistics of the profit/loss for the 1 month holding period

1 month		iTraxx Crossover (Non-Investment grade)		iTraxx Europe (Investment grade)	
		Positive Basis Trading	**Negative Basis Trading**	**Positive Basis Trading**	**Negative Basis Trading**
Greek debt crisis	Average	**No data**	166.30	1667.47	67.48
	Max.		208.07	3347.12	136.74
	Min.		124.54	-12.19	22.24
	Total		332.60	3334.93	202.44
Brexit announce-ment	Average	-141.30	237.09	4280.61	62.78
	Max.	-17.54	237.09	11961.89	207.43
	Min.	-265.06	237.09	-212.87	-86.72
	Total	-282.60	237.09	51367.36	564.98
French elections	Average	32.17	9.43	3636.24	28.48
	Max.	58.59	43.54	7262.45	65.24
	Min.	5.76	-58.59	-697.99	0.03
	Total	64.34	47.13	43634.92	284.78
Tariffs on European Union	Average	8654.97	21.91	2635.53	-11.61
	Max.	43352.47	83.89	7054.55	62.13
	Min.	-86.10	-23.75	-3809.63	-67.39
	Total	43274.83	87.66	50075.08	-220.57
COVID-19	Average	28537.96	-144.35	3552.11	-82.92
	Max.	204081.02	401.65	18828.10	496.62
	Min.	-758.82	-965.03	-1977.09	-505.59
	Total	228303.65	-721.77	113667.62	-1824.27

Table 10: Descriptive statistics of the profit/loss for the volatility triggered holding period

Volatility triggered		iTraxx Crossover (Non-Investment grade)		iTraxx Europe (Investment grade)	
		Positive Basis Trading	Negative Basis Trading	Positive Basis Trading	Negative Basis Trading
Greek debt crisis	Average	No data	33.71	311.22	36.51
	Max.		43.91	607.24	46.11
	Min.		23.52	15.19	19.32
	Total		67.43	622.44	109.54
Brexit announce-ment	Average	96.05	-73.85	833.50	21.82
	Max.	165.24	-73.85	2147.87	78.67
	Min.	26.86	-73.85	3.45	-70.43
	Total	192.11	-73.85	10002.04	196.34
French elections	Average	1.79	6.57	192.65	-0.35
	Max.	12.28	21.28	496.02	7.85
	Min.	-8.70	-12.28	-682.27	-8.42
	Total	3.58	32.84	2311.77	-3.55
Tariffs on European Union	Average	6646.54	37.98	1987.63	1.45
	Max.	33393.99	132.85	5453.04	31.68
	Min.	-125.94	-7.08	-3564.08	-21.62
	Total	33232.69	151.93	37764.90	27.54
COVID-19	Average	17105.82	-401.21	2214.71	-155.63
	Max.	120744.78	-2.98	11092.09	21.31
	Min.	-125.42	-964.20	-568.32	-591.23
	Total	136846.58	-2006.03	70870.85	-3423.93

Moving over to the non-investment grade companies, on average and in terms of the total, the positive basis trading outperformed the negative basis trading with some exceptions. For the first two events, Greek debt crisis and Brexit announcement, there were not enough data points to come to a conclusion. During the French elections, the negative basis trading on average resulted in slightly higher profits for the 2 weeks and volatility triggered holding period than the positive basis trading. But for the last two events, the positive basis trading clearly outperformed the negative basis. Therefore, even though there is not only one basis trading strategy occurring during the events that might cause the uncertainty in the market, the positive basis trading on average is more profitable than the negative basis trading strategy. This finding is also similar to Trapp's (2009), where she concluded that on average the positive basis trading is more profitable and more frequent than the negative basis trading during the financial crisis, which in our case would be considered as an event. However, she also found that the negative basis trading is more profitable when the trade has to be dissolved, depending on the different triggers, before the anticipated date, which did not happen in the case of this research.

Another part of the second hypothesis also investigated whether the basis trading is more profitable among trading the non-investment grade companies. As it turned out, during the

second and third event the investment grade companies outperformed the non-investment grade companies on average in all periods with the positive basis trade. On the other hand, in some cases, the non-investment grade companies outperformed the investment grade companies through the applied negative basis trading strategy. During the last two events, non-investment grade companies outperformed the investment grade companies on average with both trades, apart from COVID-19, where neither the groups resulted in a positive return with the negative basis. However, it is important to note that due to the major difference in the sample size among the two groups and the fact that those groups outperformed each other during different events, the conclusions cannot be drawn in the matter of this hypothesis part.

4.3. Hypothesis 3: Indicator triggered exit strategy outperforms the fixed holding period basis trading strategy

Comparing *Table 11* to *Tables 6-10* above and comparing only the profitability among both, the investment grade and non-investment grade companies, the 1 month holding period turned out to be the most profitable for the positive basis trading. The similar results were also retrieved for the negative basis trading apart from the fourth event, Tariffs on the European Union, where the 1 month holding period resulted in a loss.

Table 11: Return on CDS-Bond Basis Trading Strategies for iTraxx Europe and iTraxx Crossover in basis points (volatility triggered holding period)

Volatility triggered	**iTraxx Europe (Investment Grade)**			**iTraxx Crossover (Non-Investment Grade)**		
Events	Positive	Negative	Total	Positive	Negative	Total
Greek debt crisis	622.44	109.54	731.98	0.00	67.43	67.43
Brexit announcement	10,002.04	196.34	10,198.38	192.11	-73.85	118.26
French elections	2,311.77	-3.55	2,308.22	3.58	32.84	36.43
Tarrifs on Europe	37,764.90	27.54	37,792.44	33,232.69	151.93	33,384.62
COVID-19: The Great Lockdown	70,870.85	-3,423.93	67,446.92	136,846.58	-2,006.03	134,840.55
Total:	121,571.99	-3,094.05	118,477.94	170,274.96	-1,827.67	168,447.29

Conversely, for 2 weeks and volatility triggered exit, the profits turned out to be so low, that if the costs would have been considered, the trades would have also resulted in a loss. It is also important to note that the volatility triggered exit period was shorter in each case than a month holding period. This also indicates that the emergency exit was not used on any of the volatility triggered trades since the exit was achieved within the time frame. Moreover, since in

theoretical aspect, the investor would want to close down the width of the basis as much as possible after entering the trade, it would support the idea that the 1 month holding period turned out to be the most profitable one. Therefore, the volatility triggered exit did not outperform the fixed holding period basis trading strategy. The research suggests that the longer holding periods might generate higher profits for the investor than the short period strategies.

4.4. Discussion on retrieved results and critical statements

The results described above allow some conclusions to be drawn, but must be correctly put in perspective with regard to the assumptions made, occurred inaccuracies and problems.

4.4.1. Assumptions

Certain assumptions were made to ensure that the calculations were in line with the scope of this paper. One of these assumptions concerns the use of the mid-prices of the bonds instead of the customary bid and ask prices. Since the exact price at which a bond is purchased and sold cannot be determined retrospectively, it is possible to use historical bid and ask prices for the calculations. In reality, however, an investor will not trade at these external boundaries, which means that using these prices as a basis for calculation will automatically lead to a poorer result by underestimating the possible profits/losses. Therefore, in this paper it was decided to use mid-prices as a basis for return calculations, even though we are aware that an investor will not trade at mid-prices either and the calculated returns must be questioned with regard to a possible better position. Since this paper compares relative profits and the present overestimation of the retrieved results biases all profits, this should not significantly affect the comparison itself. In addition, no transaction or custody costs were taken into account in the calculations, which means that the returns shown in this paper are subjects to additional costs. Moreover, over the years the transaction costs have reduced due to the hyphened competition and liquidity on the market. This would suggest that for example, even though the profits or losses might turn out to be similar within different events, the actual realized profits/losses in reality might be different due to the decrease in the profits. The assumption of no transaction costs is important to note because if the profits are very low, then the transaction costs in reality might eliminate those minimal profits completely.

4.4.2. Problems

A further problem is the tradability of the products on the market. While bonds can usually be traded at quoted market prices depending on their trading volume, there are several options for

the exit from a CDS contract. As already mentioned above the most common method is to terminate the contract by agreement of both parties associated with a payment of the position's current market value. The assumption made that there is a corresponding third party for every transaction, who is willing to take over the CDS contract at the traded conditions (called *Novation*) serves the purpose of simplification, because the purpose of this paper is to examine whether trading opportunities arise at all on the market during uncertain market conditions. This assumption made in this thesis certainly carries a risk for the investor, since in reality it may not always be possible to find a suitable third counterpart and the return of the strategy may be reduced, or even destroyed, by certain liquidation prices of the contract. An examination of whether the profits achieved by the trading strategies presented here can be increased, reduced or even converted into a loss by the accruing dissolution prices of the contracts at the respective current cash value provides a starting point for further investigations.

The reported return consists of two income components: firstly, the gain or loss achieved by buying and selling the bond at different prices and, secondly, the result of trading the basis pro rata for the holding period. A profit as a result of a trade is therefore not only caused by the traded basis but can also be significantly influenced by price gains and losses due to trading the underlying bond. Since the correct trading strategy was selected depending on the available basis (whether negative or positive), a profit is always generated by the basis trade component – but this can fluctuate considerably in amount, as this depends on the absolute amount of the basis and the holding period. If a negative result is shown for a trade, this is due to a price loss caused by trading the bond, which is higher than the profit made by the basis trade. Thus, in conclusion, within the applied strategy the investor takes a risk of a negative movement in the bond prices which will reduce his income and – in worst case – could lead to losses.

Other problems in reality result through financing the basis trading strategy. The simplest way to finance the basis trade is to use the investor's free liquidity to buy the assets (negative basis trade) and sell them again after the trade is completed. However, in a strategy with a long-term horizon, this option ties up the investor's liquidity for a long time. In general, however, investors prefer short maturities with maximum profit. In addition, the use of as little liquidity as possible allows a high scalability of the profit in relation to the invested capital. Thus, investors often draw on repurchase agreements, so-called *repos*, to finance trading strategies. In the case of a negative basis trade, the repo transaction can result in additional income or loss, depending on whether the repo rate is positive or negative. However, if a positive basis trade is made, the bond is short sold, and a reverse repo is used for the funding to save liquidity. If the repo rate is positive, this represents an additional expense within the strategy. However, if the repo rate

is negative, as in the current market, this represents an additional income for the investor, which can positively influence the outcome of the strategy (Choudhry, 2006b). However, this paper assumes the use of liquidity due to the short maturities of 2 weeks and 1 month – or a maximum of three months in the event of the actual occurrence of an emergency exit – and neglects the possibility of financing the trades via repo rates.

5. SUMMARY AND FURTHER RESEARCH

The general purpose of this Master Thesis was to analyze how CDS-bond basis trading strategies can improve the return during uncertainty in the European market. Therefore, five economic events and five calm periods – which were represented as periods with relatively low volatility in the market and outside of the events range – during the period from 2015 until April 2020 were chosen. In order to be able to answer the question of whether basis trading strategies are more profitable in times of economic uncertainty in a more granular way, three hypotheses were put forward.

5.1. Conclusion

The first research question seeks an answer to whether the basis trading is more profitable during economically turbulent period than during the calm period. Since the previous research already shows that a hold-to-maturity strategy can lead to an almost guaranteed profit if there is a basis, even though this strategy ties up the investor's liquidity for a long holding period, various short-term strategies were tested in this thesis in order to be able to make a statement as to whether these strategies can also be profitable. The result was a clear outperformance for both subsamples – investment grade and non-investment grade – of the basis trading strategy during the selected turbulent periods compared to the calm periods chosen for comparison for both maturities applied, two-week and one-month basis trading strategy.

The second hypothesis stated that there will be a clear answer whether negative or positive basis trading should be applied during the economic uncertainty. As it turned out, it did not have a clear concrete answer right away. One finding was, that the basis does not move in the same direction during the economic uncertainty – not even for bonds of the same company. Therefore, pursuing only one basis trading strategy, positive or negative, could lead to a negative outcome on an individual basis. However, when looking at the overall result for all bonds examined, both the outperformance in the overall return and the mean, min and max values of the results obtained indicate a clear preference for the positive basis trading strategy. Therefore, even though there is not only one basis trading strategy occurring during the events that might cause the uncertainty on the market, the positive basis trading on average is more profitable than the negative basis trading strategy.

In order to make a statement related to hypothesis three, indicator triggered exit strategy outperforms the fixed holding period basis trading strategy, a volatility trigger, which caused the exit of the basis trading strategy, when a certain volatility level was reached again, was

developed and implemented. In conclusion, the volatility triggered exit periods on average were shorter than the other implemented strategies and did outperform the 2 week fixed holding period basis trading strategy in all samples. Thus, the research suggests that the longer holding period might generate higher profits for the investor than the short period strategies. However, the results obtained provide a sufficient basis for further investigations and research.

5.2. Further research

There are several ways to develop and continue with this research. As demonstrated, this research was conducted on the companies from the two different iTraxx portfolios on the period from January 2015 to April 2020. It would be beneficial and interesting to expand the strategies to a longer time period and broader range of companies, from different industries, regions and distinction between the credit rating. Moreover, as this research included only senior unsecured bonds, potentially different types of bonds could be evaluated.

For the time constrain of this thesis, there were only three different exit strategies implemented. Therefore, based on the results of this thesis it could be concluded that the further research should be done including more exit strategies. Those strategies could potentially be implemented for 2 months, 3 months, 6 months and holding the position until maturity. By applying those incremental holding periods on a large data sample, it could possibly be found out the range of the holding period that is possibly the most likely to generate the highest returns to the investor. Additionally, other volatility levels or types of exit triggers could also be evaluated. This could include for example the exchange rate movements of the main currencies that the selected companies operate in. This can be reasoned for example with the events depreciating against other currencies. One of those examples is Brexit, when the FX EURGBP strengthened, meaning that the value of the GBP decreased. Thus, there could be other indicators that could be gathered into one complex trigger that would possibly make the investor confident to exit the CDS-bond basis trading strategy best.

REFERENCES

Acharya, V., & Johnson, T. C. (2007). Insider Trading in Credit Derivatives, Journal of Financial Econometrics, vol. 84, no. 1, pp. 110–141, Abstract only, Available online: https://www.sciencedirect.com/science/article/abs/pii/S0304405X06002236 [Accessed 14 April 2020]

Alexopoulou, I., Andersson, M. & Georgescu, O.M. (2009). An Empirical Study on the Decoupling Movements Between Corporate Bond and CDS spreads, working paper, no. 1085, European Central Bank, Available online: https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1085.pdf [Accessed 6 April 2020]

Augustin, P, Subrahmanyam, M.G., Tang, D.Y., & Wang, S.Q. (2014). Credit Default Swaps – A Survey, *Foundations and Trends in Finance*, pp. 9-11, Available online: https://www.mcgill.ca/desautels/files/desautels/cds_survey_final.pdf [Accessed 13 April 2020]

Aunon-Nerin, D., Cossin, D., Hricko, T., & Huang, Z. (2002). Exploring for the Determinants of Credit Risk in Credit Default Swap Transaction Data: Is Fixed-Income Markets' Information Sufficient to Evaluate Credit Risk?, Fame Research Paper, no. 65, Abstract only, Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=375563 [Accessed 13 April 2020]

Aussenegg, W., Götz, L. & Jelic, R. (2014). European Asset Swap Spreads and the Credit Crisis, *The European Journal of Finance*, vol. 22, no. 7, pp. 572-600, Available online: https://www.tandfonline.com/doi/full/10.1080/1351847X.2014.935869 [Accessed 13 April 2020]

Bai, J., & Collin-Dufresne, P. (2018). The CDS-bond basis. *Financial Management*. 2018, Wiley, pp. 1–23. Available through: https://onlinelibrary.wiley.com/doi/abs/10.1111/fima.12252 [Accessed 13 April 2020]

BBC (2016). UK Votes to Leave the EU, BBC News, Available Online: https://www.bbc.com/news/politics/eu_referendum/results [Accessed 14 April 2020]

BBC (2017). French Election 2017: Why Is It Important?, BBC News, Available Online: https://www.bbc.com/news/world-europe-39130072 [Accessed 14 April 2020]

Berggren, C.-J., & Mattson, N. (2008). The Relationship Between CDS Spreads and Bond Spreads - An Emirical Comparison, Master Thesis, Department of Economics, Lund University, Available online: https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=1351304&fileOId=2435272 [Accessed 7 April 2020]

Bernhart & Mai (2016). Negative Basis Measurement: Finding the Holy Scale, vol. 165, pp. 385-403, Available online: https://www.researchgate.net/publication/311364731_Negative_Basis_Measurement_Finding_the_Holy_Scale#pf12 [Accessed 20 April 2020]

Chan-Lau, Jorge A (2003). Anticipating Credit Events Using Credit Default Swaps, with an Application to Sovereign Debt Crises, IMF Working Paper, no. 03-106, Available

online: https://www.imf.org/external/pubs/ft/wp/2003/wp03106.pdf [Accessed 01 May 2020]

Cherubini, U., & Della Lunga, G. (2007). Structured Finance: The Object Orientated Approach, Chichester: John Wiley & Sons

Chodnicka-Jaworska, P. & Jaworski, P. (2017). Fundamental Determinants of Credit Default Risk for European and American Banks, *Journal of International Studies*, vol. 10, no. 3, pp. 51-63, Available online: https://www.jois.eu/files/2_331_Chodnicka-Jaworska_Jaworski.pdf [Accessed 20 April 2020]

Choudhry, M., (2007). Trading the CDS Basis: Illustrating Positive and Negative Basis Arbitrage Trades. *The Journal of Trading*, vol. 2, no. 1, pp. 79-94, Available online: https://www.researchgate.net/publication/240315832_Trading_the_CDS_Basis_Illustrating_Positive_and_Negative_Basis_Arbitrage_Trades [Accessed 14 April 2020]

Choudhry, M. (2006a). Revisiting the Credit Default Swap Basis: Further analysis of the cash and synthetic credit market differential, *The Journal of Structured Finance*, vol. 11, no. 4, pp. 21-32, Available online: https://www.researchgate.net/publication/247908019_Revisiting_the_Credit_Default_Swap_Basis_Further_Analysis_of_the_Cash_and_Synthetic_Credit_Market_Differential [Accessed 14 April 2020]

Choudhry, M. (2006b). The credit default swap basis: illustrating positive and negative basis arbitrage trades, *The Journal of Trading*, vol. 2, pp. 79-94, Available online: https://www.researchgate.net/publication/240315832_Trading_the_CDS_Basis_Illustrating_Positive_and_Negative_Basis_Arbitrage_Trades [Accessed 14 April 2020]

Cohen, P. & Hsu, T. (2020). 'Sudden Black Hole' for the Economy with Millions More Unemployed, *Jobless claims now exceed 16 million as shutdowns from the coronavirus pandemic widen and problems with getting benefits persist*, Available online: https://www.nytimes.com/2020/04/09/business/economy/unemployment-claim-numbers-coronavirus.html [Accessed 15 April 2020]

Coffey, N., Hrung, W. B., & Sarkar, A. (2009). Capital constraints, counterparty risk, and deviations from covered interest rate parity, Federal Reserve Bank of New York, Staff Report no. 393, Available online: https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr393.pdf [Accessed 19 April 2020]

Corò, F., Dufour, A., & Varotto, S. (2013). Credit and Liquidity Components of Corporate CDS Spreads, Journal of Banking & Finance, vol. 38. no. 12, pp. 5511-5525. Available online: https://doi.org/10.1016/j.jbankfin.2013.07.010 [Accessed 19 April 2020]

Council on Foreign Relations (n.p.). Greece's Debt, Available Online: https://www.cfr.org/timeline/greeces-debt-crisis-timeline [14 April 2020]

Damodaran, A. (2008). What is the Risk free Rate? A Search for the Basic Building Block, Available Online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1317436 [Accessed 14 April 2020]

De Wit, J. (2206). Exploring, the CDS-Bond Basis, National Bank of Belgium, working paper no. 104, Available online: https://www.nbb.be/doc/ts/publications/wp/wp104en.pdf [Accessed 19 April 2020]

Deutsche Welle (2019). US imposes record $7.5 billion tariffs on European goods, News, Available online: https://www.dw.com/en/us-imposes-record-75-billion-tariffs-on-european-goods/a-50880622 [Accessed 15 April 2020]

Dötz, N. (2007). Time-Varying Contributions by the Corporate Bond and CDS Markets To Credit Risk Price Discovery, Discussion Paper: series 2: Banking and Financial Studies, no. 08-2007, Available through: http://www.bundesbank.de [Accessed 13 April 2020]

Duffie, D. (1999). Credit Swap Valuation, *Financial Analysts Journal*, vol. 55, no. 1, p.73, Available online: https://www.darrellduffie.com/uploads/pubs/DuffieCreditSwapValuation1999.pdf [Accessed 2 April 2020]

Ehrhardt, M. (2020). Corona-Crash: Wie tief geht es an der Börse noch?, Available online: https://www.dw.com/de/corona-crash-wie-tief-geht-es-an-der-b%C3%B6rse-noch/a-52805957 [Accessed 15 April 2020]

Elizalde, A., Doctor, S., & Saltuk, Y. (2009). Europe Credit Derivative Research, Bond-CDS Basis Handbook: Measuring, trading and analyzing basis trades, J.P. Morgan, Available through: https://www.scribd.com/doc/62196478/Bond-CDS-Basis-Trading-Handbook [Accessed 14 April 2020]

EUREX (2020a). VSTOXX® Futures (FVS) April Update, Available online: https://www.eurexgroup.com/resource/blob/1908630/49aef66303f121dadcf6d9c383968aa7/data/VSTOXX-Monthly-Newsletter-2020-04-Download.pdf [Accessed 15 April 2020]

EUREX (2020b). Volatility Derivatives on Eurex Exchange: VSTOXX®, Available online: https://www.eurexchange.com/exchange-en/products/vol/vstoxx [Accessed 15 April 2020]

European Parliament (2018). US Tariffs: EU Response and Fears of a Trade War, Available Online: https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/623554/EPRS_ATA(2018)623554_EN.pdf [Accessed 14 April 2020]

Fabozzi J. F., Davis A., H. & Choudhry M. (2006). Introduction to Structured Finance pp. 54-56, Hoboken: John Wiley & Sons

Felsenheimer, J. , Klopfer, W. & Von Altenstadt, U. (2019). Credit Default Swaps. Handelsstrategien, Bewertung und Regulierung, Weinheim: John Wiley & Sons

Fleckenstein, M., Longstaff, F., & Lustig, H. (2014). The Tips-Treasury Bond Puzzle. *Journal of Finance*, [e-journal] vol. *69*, pp. 2151–2197. Available through: https://doi.org/10.1111/jofi.12032 [Accessed 19 April 2020]

Galil, K., Shapir, O.M., Amiram, D., & Ben-Zion, U. (2014). The Determinants of CDS Spreads, *Journal of Banking & Finance*, [e-journal] vol. 41, pp. 271-282, Abstract

only, Available through: https://www.sciencedirect.com/science/article/abs/pii/S0378426613004676 [Accessed 7 April 2020]

Gyntelberg, J., Hördahl, P., Ters, K., & Urban, J. (2017). Arbitrage Costs and the Persisten Non-Zero CDS-Bond basis: Evidence from intraday euro area sovereign debt market, BIS Working Papers, no 631, Available Online: https://www.bis.org/publ/work631.pdf [Accessed 7 April 2020]

He, X. (2009), Essays on Credit Default Swap, PhD thesis, University of Mannheim, Available online: https://madoc.bib.uni-mannheim.de/2763/1/xhe_dissertation.pdf [Accessed 9 April 2020]

Hull, J. C. (2015). Options, Futures, & Other Derivatives, 9th edn, Upper Saddle River, N.J: Pearson

International Swaps and Derivatives Association (ISDA) (2020). About ISDA, Available online: https://www.isda.org/about-isda/ [Accessed 13 April 2020]

International Swaps and Derivatives Association (ISDA) (2019b). Legal Guidelines for Smart Derivatives Contracts: The ISDA Master Agreement, Available online: https://www.isda.org/a/23iME/Legal-Guidelines-for-Smart-Derivatives-Contracts-ISDA-Master-Agreement.pdf [Accessed 13 April 2020]

International Swaps and Derivatives Association (ISDA) (2019a). Global Credit Default Swaps Market Study, Available online: https://www.isda.org/a/JUPTE/Global-CDS-Market-Study.pdf [Accessed 13 April 2020]

Kiff, J., Elliott, J., Kazarian, E., Scarlata, J. & Spackman, C. (2009). Credit Derivative: Systematic Risks and Policy Options. *IMF Working Paper*, No. 09/254. Available Online: https://www.imf.org/external/pubs/ft/wp/2009/wp09254.pdf [Accessed 10 May 2020]

Kim, T.S., Park, Y.J. & Park, J. (2017). Macroeconomic Conditions and Credit Default Swap Spread Changes, *Journal of Future Markets*, [e-journal] vol. 37, no. 7, pp. 660-688, Abstract only, Available online: https://onlinelibrary.wiley.com/doi/abs/10.1002/fut.21836 [Accessed 10 April 2020]

Krylova, E. (2016). Determinants of Euro Denominated Corporate Bond Spreads, Working paper series, no. 1912, European Central Bank, Available online: https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1912.en.pdf [Accessed 14 April 2020]

Manning, M.J. (2004). Exploring the Relationship between Credit Spreads and Default Probabilities, Bank of England Working Paper, no. 225, Available through: https://www.bankofengland.co.uk/working-paper/2004/exploring-the-relationship-between-credit-spreads-and-default-probabilities [Accessed 9 April]

Mengle, D. (2007). Credit Derivatives: An Overview. Federal Reserve Bank of Atlanta. Available online: https://pdfs.semanticscholar.org/41c7/6b5d112daf7701afad150d504bd9693ebf02.pdf [Accessed 13 April 2020]

Nilsson, S., & Sandahl, I., (2018). The Relation Between the Credit Default Swap and Corporate Bond Market, A study of European companies with different credit ratings, Master thesis, Department of Economics, Lund University, Available online: http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8946270&fileOId=8946278 [Accessed 6 April 2020]

Onaran, Y. (2017). Too Big to Fail, Bloomberg, 8 December, Available Online: https://www.bloomberg.com/quicktake/big-fail [Accessed 14 April 2020]

Parrado-Martínez, P., di Pietro, F., Samaniego-Medina, R. & Trujillo-Ponce, A. (2016). Determinants of Bank CDS Spreads in Europe, *Journal of Economics and Business*, [e-journal] vol. 86, pp. 1-15, Abstract only, Available through: https://ideas.repec.org/a/eee/jebusi/v86y2016icp1-15.html [Accessed 13 April 2020]

Quaye, I., Mu, Y., Abudu, B., & Agyare, R. (2016). Review of Stock Markets' Reaction to New Events: Evidence from Brexit, *Journal of Financial Risk Management*, vol. 5, no. 4, pp. 281-314, Available Online: http://dx.doi.org/10.4236/jfrm.2016.54025 [Accessed 14 April 2020]

Reuters (2020). Timeline: Key Dates in the U.S.-China Trade War, Available Online: https://www.reuters.com/article/us-usa-trade-china-timeline-idUSKBN1ZE1AA [Accessed 14 April 2020]

Reynolds, G. (2017), EQDerivatives: VSTOXX French Election Risk Opens Risk Premia Trade, Eurex Exchange, Eurex Group, Available Online: https://www.eurexgroup.com/exchange-en/products/vol/vstoxx-outlook/VSTOXX-french-election-risk-355600 [Accessed 14 April 2020]

Securities and Exchange Comissions (SEC) Office of Investor Education and Advocacy. (2013). Investor Bulletion: What Are Corporate Bonds? no. 149, Available online: https://www.sec.gov/files/ib_corporatebonds.pdf [Accessed 19 April 2020]

Trapp, M., (2009). Trading the Bond-CDS Basis – The Role of Credit Risk and Liquidity, Department of Finance, University of Cologne, Available Online: https://micro.econ.kit.edu/downloads/Trapp_Vortragspaper.pdf [Accessed 6 April 2020]

UniCredit Bank AG (2020). The UniCredit Economics Chartbook Quarterly: *The mother of all recessions has arrived*, pp. 3-13, Available online: https://www.research.unicredit.eu/DocsKey/economics_docs_2020_176448.ashx?EXT=pdf&KEY=C814QI31EjqIm_1zIJDBJFQWHqiVh6iWv-rRmfm0wlw=&T=1 [Accessed 19 April 2020]

UniCredit Bank AG. (2008). Basisinformationen über Finanzderivate: Grundlagen, wirtschaftliche Zusammenhänge, Anwendungsmöglichkeiten und Risiken. bank-verlag medien. Cologne, pp. 113-120

Weistroffer, C. (2009). Credit Default Swaps: Heading towards a more stable system, Deutsche Bank Research, Available Online: https://www.ssc.wisc.edu/~mchinn/cds_example_DB.pdf [Accessed 10 May 2020]

World Health Organization (WHO) (2020a). Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak

of novel coronavirus (2019-nCoV), Available online: https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov) [Accessed 15 April 2020]

World Health Organization (WHO) (2020b). WHO Timeline – COVID19, Available online: https://www.who.int/news-room/detail/08-04-2020-who-timeline---covid-19 [Accessed 15 April 2020]

Zhu, Haibin (2006). An Empirical Comparison of Credit Spreads between the Bond Market and the Credit Default Swap Market, *Journal of Financial Services Research*, [e-journal] vol 29, pp. 211-235, Available through: https://doi.org/10.1007/s10693-006-7626-x [Accessed 15 April 2020]

APPENDICES

Appendix A: Companies from iTraxx Europe and iTraxx Crossover index

Companies from the iTraxx Europe Index

Company	Equity Ticker	Number of Bonds
Credit Suisse Group AG	CSGN SW Equity	3
HSBC Holdings PLC	HSBA LN Equity	3
ING Groep NV	INGA NA Equity	2
Intesa Sanpaolo SpA	ISP IM Equity	2
Standard Chartered PLC	STAN LN Equity	2
Bayerische Motoren Werke AG	BMW GR Equity	1
Cie Financiere Michelin SCmA	ML FP Equity	1
Continental AG	CON GR Equity	1
Daimler AG	DAI GR Equity	3
Deutsche Lufthansa AG	LHA GR Equity	1
LVMH Moet Hennessy Louis Vuitton SE	MC FP Equity	2
Volkswagen AG	VOW GR Equity	1
British American Tobacco PLC	BATS LN Equity	2
Danone SA	BN FP Equity	1
Diageo PLC	DGE LN Equity	1
Henkel AG & Co KGaA	HEN3 GR Equity	1
Unilever NV	UNA NA Equity	1
AstraZeneca PLC	AZN LN Equity	2
Sanofi	SAN FP Equity	1
STMicroelectronics NV	STM IM Equity	1
Air Liquide SA	AI FP Equity	1
BASF SE	BAS GR Equity	1
Cie de Saint-Gobain	SGO FP Equity	1
LANXESS AG	LXS GR Equity	1
LafargeHolcim Ltd	LHN SW Equity	1
BP PLC	BP/ LN Equity	1
Eni SpA	ENI IM Equity	1
Repsol SA	REP SM Equity	1
CNH Industrial NV	CNHI US Equity	1
Rolls-Royce PLC	3631515Z LN Equity	1
Siemens AG	SIE GR Equity	1
Vinci SA	DG FP Equity	1
E.ON SE	EOAN GR Equity	1
Electricite de France SA	EDF FP Equity	1
National Grid PLC	NG/ LN Equity	1
Veolia Environnement SA	VIE FP Equity	1
British Telecommunications PLC	58742Z LN Equity	1
Deutsche Telekom AG	DTE GR Equity	1
Orange SA	ORA FP Equity	1
Telefonica SA	TEF SM Equity	1
Vivendi SA	VIV FP Equity	1
Vodafone Group PLC	VOD LN Equity	1

Companies from the iTraxx Crossover Index

Company	Equity Ticker	Number of Bonds
Fiat Chrysler Automobiles NV	FCAU US Equity	1
Renault SA	RNO FP Equity	1
Auchan Holding SA	211642Z FP Equity	2
Casino Guichard Perrachon SA	CO FP Equity	1
Louis Dreyfus Co BV	0308213D NA Equity	1
Nokia Oyj	NOKIA FH Equity	1
ArcelorMittal SA	MT NA Equity	2
Thyssenkrupp AG	TKA GR Equity	2
CMA CGM SA	144898Z FP Equity	1
Telecom Italia SpA/Milano	TIT IM Equity	1

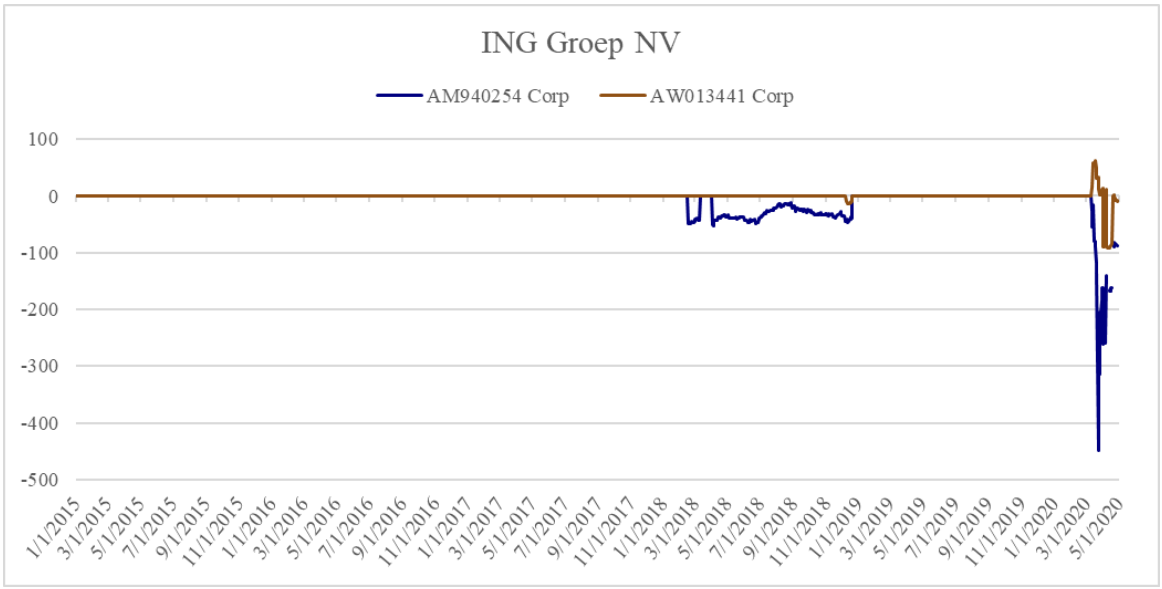
Appendix B: Number of Observations Recorded for the Data Descriptive Calculations

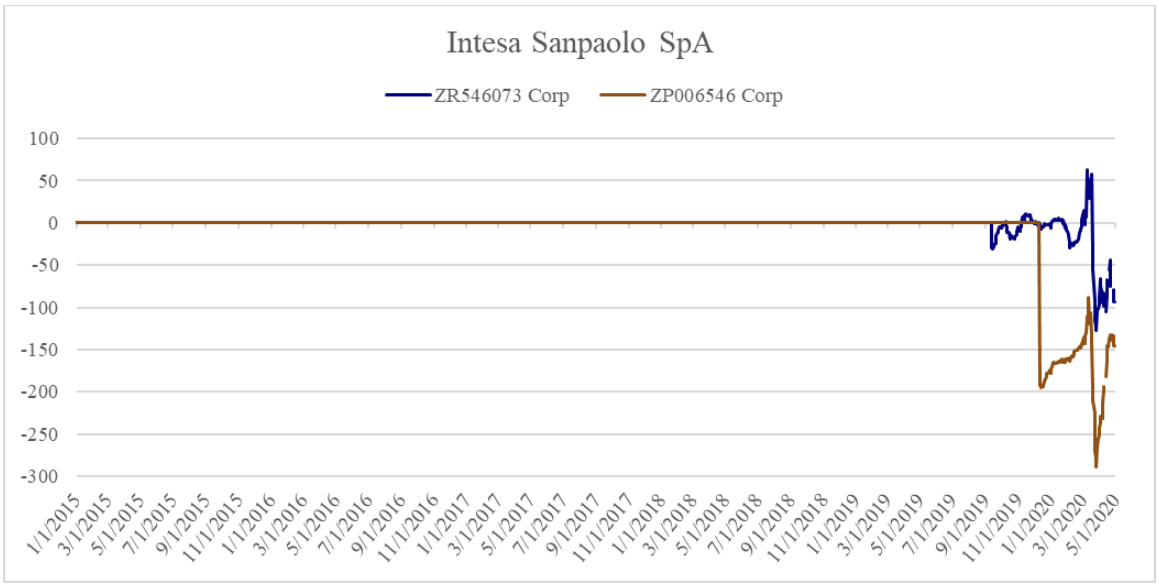
2 weeks	iTraxx Crossover (Non-Investment grade)			iTraxx Europe (Investment grade)		
	CDS-Bond basis	Bond spread	CDS spread	CDS-Bond basis	Bond spread	CDS spread
Greek debt crisis	22	22	99	52	49	428
Brexit announcement	32	32	110	210	228	420
French elections	41	51	100	206	324	384
Tariffs on European Union	85	85	110	319	370	437
COVID-19	142	137	110	542	565	451

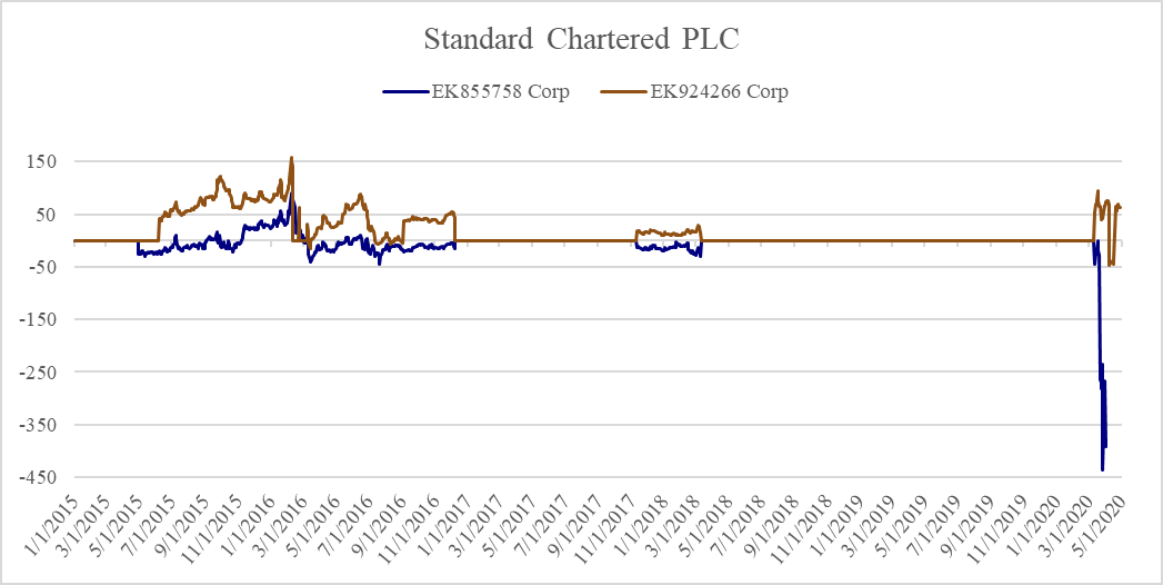
1 month	iTraxx Crossover (Non-Investment grade)			iTraxx Europe (Investment grade)		
	CDS-Bond basis	Bond spread	CDS spread	CDS-Bond basis	Bond spread	CDS spread
Greek debt crisis	46	51	202	120	116	892
Brexit announcement	62	68	220	447	506	846
French elections	98	110	217	440	698	801
Tariffs on European Union	178	184	212	675	802	840
COVID-19	281	285	229	1147	1200	1006

Volatility triggered	iTraxx Crossover (Non-Investment grade)			iTraxx Europe (Investment grade)		
	CDS-Bond basis	Bond spread	CDS spread	CDS-Bond basis	Bond spread	CDS spread
Greek debt crisis	10	10	45	22	19	195
Brexit announcement	15	15	50	100	106	194
French elections	12	15	27	60	96	105
Tariffs on European Union	133	139	162	493	606	635
COVID-19	191	189	150	740	769	597

Appendix C: CDS-Bond basis



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EK924266 Corp
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50
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-150
-250
-350
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3/1/2015
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7/1/2015
9/1/2015
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1/1/2016
3/1/2016
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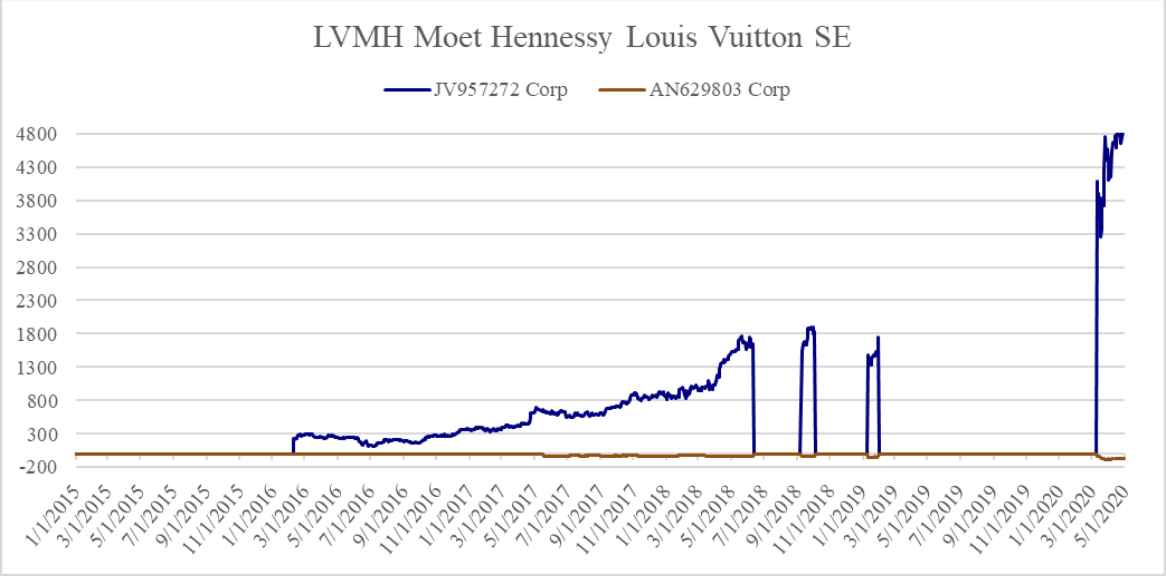
3/1/2020
5/1/2020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JV957272 Corp
AN629803 Corp
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4300
3800
3300
2800
2300
1800
1300
800
300
-200
1/1/2015
3/1/2015
5/1/2015
7/1/2015
9/1/2015
11/1/2015
1/1/2016
3/1/2016
5/1/2016
7/1/2016
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11/1/2016
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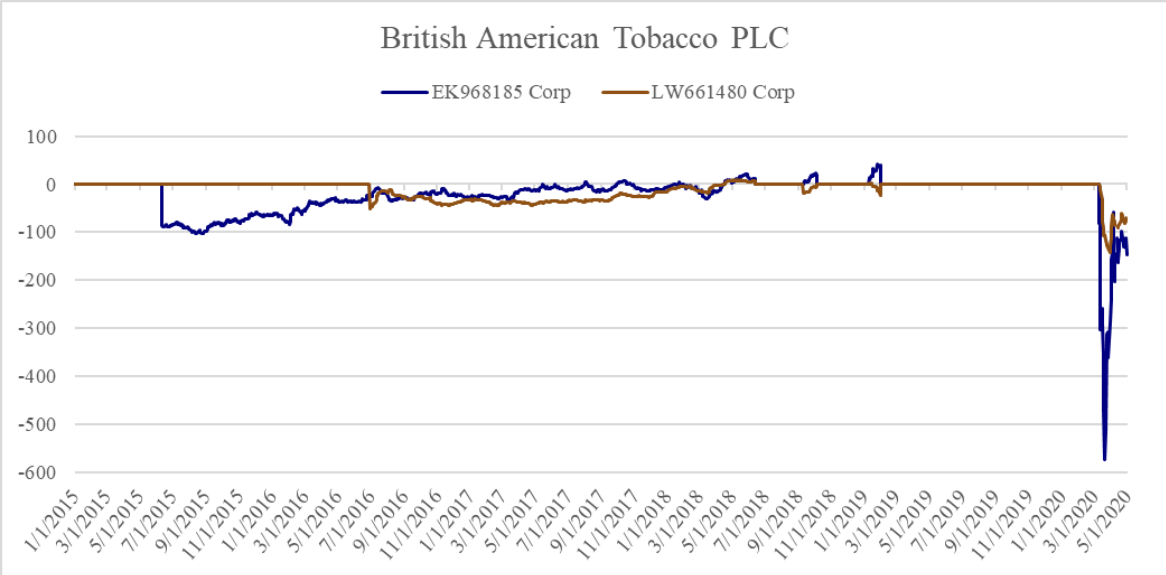
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LW661480 Corp
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-300
-400
-500
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5/1/2015
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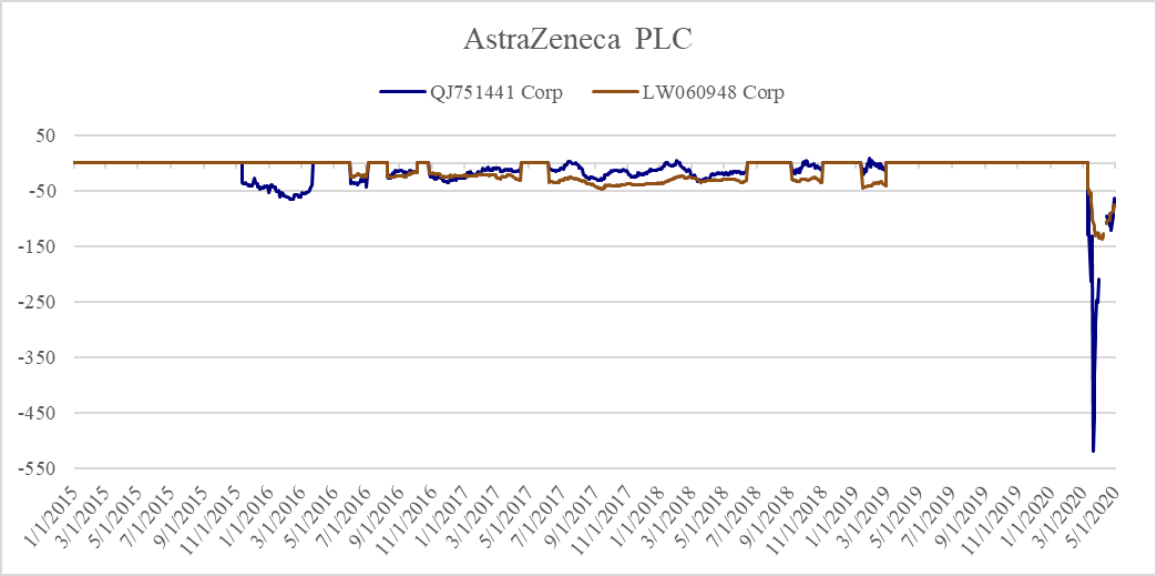
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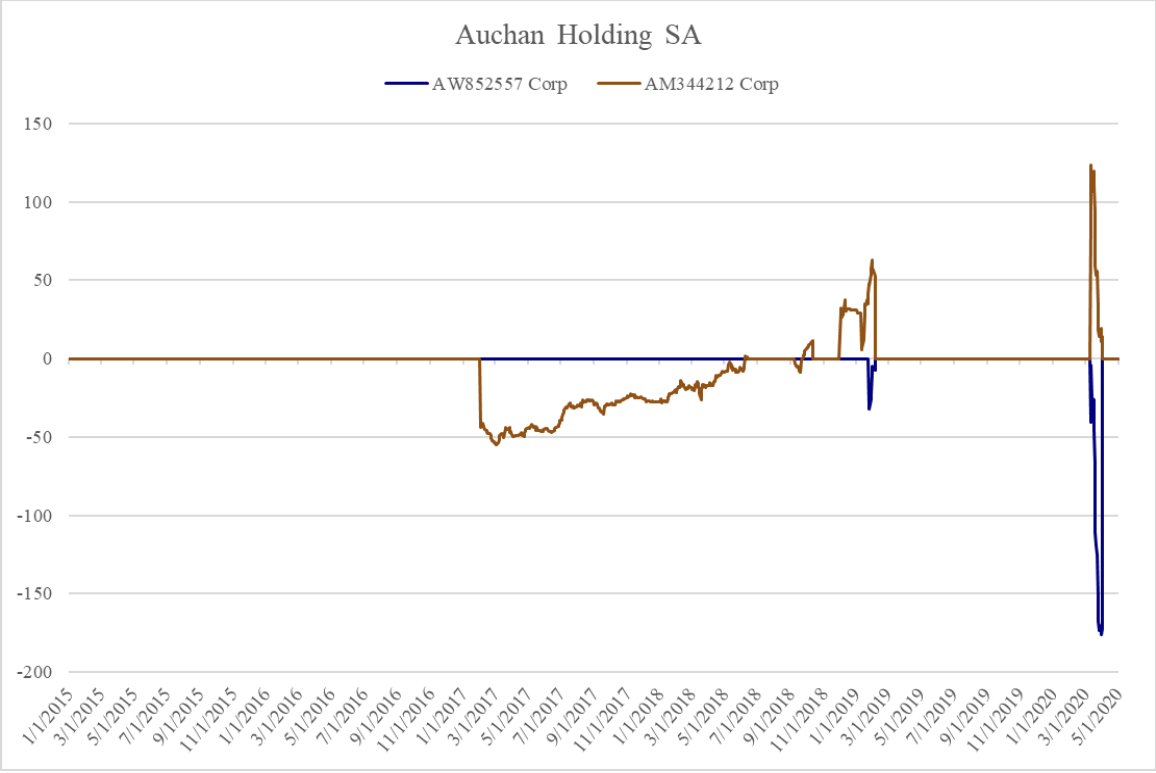
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ArcelorMittal SA
AW637524 Corp
AF114752 Corp
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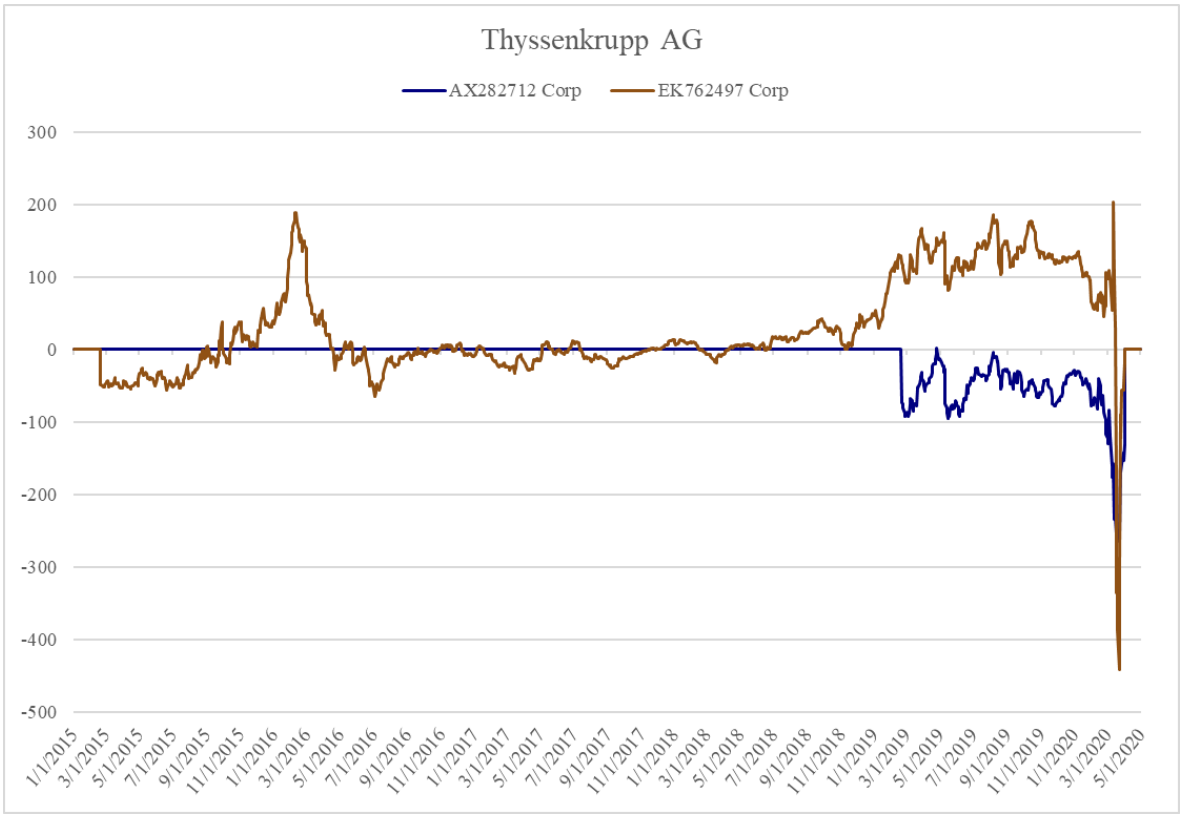
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