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Credit default swaps

and

the impact on corporate bonds

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List of abbreviations

BIS	Bank of International Settlement
CEO	Chief Executive Officer
CDS	Credit Default Swap
CMA	Credit Management Association
CRSP	Center for Research in Security Prices
CTD	Cheapest-to-Deliver
DTCC	Depository Trust and Clearing Corporation
FED	Federal Reserve System
ISDA	International Swap and Derivatives Association
OLS	Ordinary least squares
OTC	Over-the-Counter
NASD	National Association of Securities Dealers
ROA	Return on assets
S&P 500	Standard & Poor's 500
TRACE	Trade Reporting and Compliance Engine
USD	US Dollar

1. Introduction

Since the upcoming of credit derivatives in the 1990s, the financial instrument and the corresponding market of credit default swaps have been viewed ambivalently. Initially credit default swap (CDS) have been celebrated by regulators, bankers and financial market participants as a financial instrument enabling more efficient and effective credit risk management, especially for financial institutions. Ultimately, it has been believed that the financial innovation of credit default swaps is leading to a more complete financial market. It has also been believed that such a financial instrument would enhance the stability of the financial system in general. By providing the means to perform an efficient risk allocation among market participants, financial institutions, non-financial firms and the economy in general could benefit from credit derivatives. Among others, Alan Greenspan, former Chairman of the Federal Reserve of the United States, said at a conference at the Federal Reserve Bank of Chicago in 2005 that “[...] derivatives have permitted the unbundling of financial risks. Because risks can be unbundled, individual instruments now can be analyzed in terms of their common underlying risk factors, and risks can be managed on a portfolio basis. [...]”¹. As a consequence “[it] is generally acknowledged, the development of credit derivatives have contributed to the stability of the banking system by allowing banks, especially large, systematically important banks, to measure and manage their credit risks more effectively”².

As the CDS market grew rapidly and tremendously from USD 6.4 trillion in 2004 to USD 58.2 trillion in 2008 measured in terms of notional amount outstanding, the understanding of CDSs had changed and the perception of possible adverse effects had amplified as well.³ At the wake of the financial crisis in 2007-2008, CDSs were among the financial instruments which were blamed to have fueled conditions leading to the disastrous credit bubble that triggered the financial meltdown. Alan Greenspan admitted at a congressional testimony in 2008 that “credit default swaps [...] have serious problems associated with them”⁴. Subsequently, the market for credit default swaps has been kept down by financial institutions and regulators, because of the unclear detrimental effects.

¹ (Greenspan 2005), p.1.

² (Greenspan 2005), p.4.

³ Cf. (Morgan Stanley 2011), p.8.; Cf. (Smithson & Mengle 2006), p.55.

⁴ (Barr 2008), p.1.

But just recently, in May 2015, financial market participants have undertaken efforts to revive the credit derivatives market.⁵ The financial community had gotten used to and is now missing the most striking feature of derivatives: the ability to unbundle risk factors, in particular the separation of credit and interest-rate risk. As monetary policies are shifting and changing around the world, especially with an anticipated large effect from the FED policy change, market participants seek ways to trade credit risk without being exposed to interest-rate risk, which is simultaneously present when trading fixed-income instruments. The positive features of credit derivative trading are now being pronounced again.

Thus, it is obvious that the consequences, merits and faults, of CDS trading are at best ambivalent and at worst unclear.

One particular question of interest regarding the consequences of CDS trading is the effect of CDSs on corporate bonds. For investors one major factor to assess when investing in corporate bonds is the issuer's credit risk. It is a main driver of yield spreads, thus of issuers financing costs, and also influences the liquidity of corporate bonds. It is claimed that CDSs are a market-based proxy for credit risk that improved the trading of credit risk. Hedging has become easier since no investment into bonds is necessary. Especially single-named CDSs are often referenced to corporate issuers of bonds and thus create a strong economic and financial link between the CDS and corporate bond market. Academic work about the theoretical interdependence of the CDS and corporate bond market highlight that the ability to solely transfer credit risk through CDS trading has potential positive as well as negative effects on corporate bonds yield spreads and liquidity. Given the size of both markets, a potential effect could have meaningful insight and consequences for financial market participants, corporate issuers and policy makers.

⁵ Cf. (Rennison 2015).

Therefore, the research question of this study is:

How does the trading of CDSs affects corporate bonds in terms of yield spreads and liquidity?

Corresponding to this research question, three main research objectives are put forth.

First, to estimate whether the trading of CDS affects yield spreads of corresponding corporate bonds.

Second, to estimate whether the trading of CDS affects the liquidity of corresponding corporate bonds.

Third, to estimate whether the effect of CDS trading on yield spreads and liquidity is different before and after the financial crisis in 2007-2008.

In order to provide a comprehensive analysis of the matter, in chapter two of this study an overview of the financial instruments and markets of CDS and corporate bonds, respectively, is provided. Definitions, the evolution and the fundamental relationship will be presented. Chapter three is dedicated to a comprehensive literature review pointing out the channels through which the trading of CDS theoretically affects, both positively and negatively, yield spreads and liquidity of corporate bonds. Additionally, a literature review covering empirical work about the relationship of the two financial instruments is provided. In chapter four an empirical analysis of the research question is presented. First, based on the theoretical part of the literature review, hypotheses about the effect of CDSs on corporate bonds are formulated. Second, the data set used to deduct the empirical analysis is described, including a description of the sample selection approach. Third, the applied methodology to test the hypotheses, as set out above, is presented. Fourth, the main part of interest presents the findings of the empirical analysis including a description of the regression results as well as an interpretation of the former. Fifth, limitations of the empirical work are addressed. The study closes with a conclusion, connecting the theoretical part with the empirical results while drawing conclusions for financial market participants, such as traders, corporate issuers and policy makers.

2. The financial instruments and markets of corporate bonds and credit default swaps

This section serves the purpose of providing an overview of the market for corporate bonds and the market for credit default swaps. Since the relationship between these financial instruments, in particular, and the markets, in general, will be investigated later on, it is important to have an understanding about the two financial instruments and their markets, respectively. Especially the market for credit default swap is a relatively new market that evolves rather quickly and therefore a comprehensive understanding is necessary. In the following, definitions of the financial instruments and their specifications will be provided. Additionally, the evolution of the market with regard to size and usage of the financial instrument will be addressed. Lastly, a first fundamental relationship between these two financial instruments will be shown.

Corporate bonds and its market

A corporate bond is a debt instrument issued by a firm to borrow debt capital and requires the issuer to make period coupon/interest payments over a specified time period and to repay the notional amount at maturity.⁶

There are three fundamental features of corporate bonds. First, the term to maturity specifies the time period in which the corporate issuer has to make periodic coupon payments and has to meet other obligations specified in the bond contract. Second, the notional value is the amount which the corporate issuer is required to repay at maturity. And third, the coupon rate specifies the interest on the notional value which the corporate issuer is required to pay periodically.⁷ There are several embedded options occasionally used in corporate bond issuances, such as put and call provisions which grant the investor or issuer certain rights, respectively. A detailed description is omitted, since the later analysis will focus on straight bonds which have no such embedded options.

Corporate bonds are broadly distinguished by term to maturity and credit risk. Bond issuances with a term to maturity of less than five years are referred to as short-term, maturities of five to 12 years are called intermediate-term and bonds with maturities exceeding 12

⁶ Cf. (Fabozzi 2010), p. 1.

⁷ Cf. (Fabozzi 2010), p. 3-4.

years are viewed as long-term bonds. Regarding credit risk, bonds with a credit rating of BBB or higher are referred to as investment grade bonds while bonds with credit ratings of BB or lower are termed non-investment grade or high-yield or junk bonds.⁸

Investing in corporate bonds does not come without risks. There are many kinds of risks, but for the later analysis credit and liquidity risk are of main interest. Credit risk commonly refers to the uncertainty about the issuer's ability and willingness to make timely periodic coupon payments and to repay the notional value at maturity. Liquidity risk refers to the uncertainty about the ease at which a bond can be sold at or near its value.⁹ The degree of credit and liquidity risk of a particular bond will be reflected in the coupon rate and especially in the yield spread, which will be addressed in more detail later.

The size of the corporate bond market, which is an over-the-counter (OTC) market, is driven by corporate demand for external financing. Especially in the US, corporations use corporate bonds as their main source of external financing. (Tendulkar & Hancock 2014) estimate the global corporate bond market at USD 19 trillion in 2000. By 2007, the global corporate bond market had reached a size of USD 44 trillion and continued to grow to reach a size of USD 49 trillion in 2013 measured by notional amount outstanding. The US market accounts for a large part of global corporate bond market with USD 21 trillion or 44 per cent of outstanding debt in 2013.¹⁰ Despite its tremendous market size, corporate bond markets tend to be illiquid. (Edwards et al. 2007) report that bonds only trade on 48% of all days in their data sample.¹¹ (Bessembinder & Maxwell 2008) stress this argument by stating that the illiquidity of corporate bonds is higher than for other bond classes; corporate bonds only accounting for about 3 per cent of all US bond trading activity between 2001 and 2006.¹² Regulators have tried to counteract the illiquidity issue by raising transparency in the OTC market through the introduction of TRACE (Transaction Reporting and Compliance Engine). Introduced in July 2002 by the National Association of Securities Dealers (NASD), TRACE requires dealers to report all transactions in corporate bonds and the

⁸ Cf. (Fabozzi 2010), p. 2-3.

⁹ Cf. (Fabozzi 2010), p. 9-10.

¹⁰ Cf. (Tendulkar & Hancock 2014), p. 13-18.

¹¹ Cf. (Edwards et al. 2007), p. 1427-1428.

¹² Cf. (Bessembinder & Maxwell 2008), p. 221.

NASD then publishes aggregate statistics about corporate bond market activity at the end of each day.¹³

Three common measures of corporate bonds are the price of a corporate bond, its yield-to-maturity and the yield spread. The price of a corporate bond, determined by demand and supply, should theoretically equal the value of a corporate bond which is derived by discounting expected cash flows from the corporate bond considering several risk factors as mentioned above.¹⁴ The yield-to-maturity is the yield that an investor will earn when holding the bond until maturity; thus, discounting the expected cash flows at the yield-to-maturity will result in a value equal to the price of the bond.¹⁵ The yield spread is the difference between the yield-to-maturity of a corporate bond and the yield-to-maturity of a riskless investment, for which government bonds or swap rates are frequently used as proxies.¹⁶ The yield spread is reflecting different factors related to risk and taxes. (Elton et al. 2001) find that for 10-year A-rated bond up to 17.8 per cent of the yield spread can be explained by credit risk, measured by expected default loss. Another 36.1 per cent account for tax accounting, while most of the remaining yield spread can be explained by systematic risk factors such as the Fama-French factors.¹⁷ Despite the findings of (Elton et al. 2001), market participants often treat yield spreads on corporate bonds as if yield spreads mainly account for credit risk, resulting for example in the distinction between investment grade and high-yield bonds. Additionally, this leads to the simplifying language in which yield spreads are often referred to as credit spreads. The perception of credit risk, being one of the most important determinants of yield spreads and factors when assessing corporate bonds, also led to the emerge of the credit derivatives market.

Credit Default Swaps and its market

The market of derivative financial instruments can be tracked back centuries, but the linkage between credit risk and financial derivatives, resulting in credit derivatives, became popular only in the mid-1990s when bankers first started to trade these innovative financial instruments.¹⁸ The initial intention for banks to create and trade credit derivatives was to

¹³ Cf. (Fabozzi 2010), p. 164-165.

¹⁴ Cf. (Fabozzi 2010), p. 21.

¹⁵ Cf. (Fabozzi 2010), p. 39.

¹⁶ Cf. (Elton et al. 2001), p. 251.

¹⁷ Cf. (Elton et al. 2001), p. 273.

¹⁸ Cf. (Tett 2006).

lay off excess credit risk resulting from their lending activities. By laying off credit risk, banks were able to reduce their need to hold capital for regulatory requirements regarding their exposure to credit risk. This, in consequence, made lending activities a more capital light business and freed up capital to employ for other business purposes. Thus, credit derivatives enabled banks to enhance business activity and profitability.

The primary financial derivative instrument to trade credit risk evolved to be credit default swaps. A CDS is “contract between the seller and the buyer of protection against the risk of default on a set of debt obligations issued by a specified reference entity”¹⁹. The buyer of a CDS pays a periodic premium to the seller until maturity of the CDS contract or until a credit event occurs. In case the CDS reaches maturity, the contract is terminated and no further cash flows are exchanged. In case a credit event occurs during the lifetime of the CDS, the CDS seller is obliged to offset missing cash flows in a way specified in the CDS contract.

There are two ways in which cash flows can be settled in case of a credit event. First, there is physical settlement in which the CDS seller transfers the par value of the debt obligation to the CDS buyer, who in return transfers a deliverable obligation to the CDS seller. Second, there is cash settlement in which the CDS seller transfers the par value minus the recovery value of the debt obligation to the CDS buyer.²⁰

Circumstances that are defined as credit events differ from contract to contract. Three common credit events used in practice are bankruptcy, failure-to-pay and restructuring. Restructuring, which can broadly be defined as any change in the contractual terms of a debt obligation, is a credit event more commonly used in Europe due to its different interpretation of bankruptcy law. For corporate CDS contracts, restructuring is not a credit event in North America.²¹ Detailed definitions of credit events are provided by the International Swap and Derivatives Association (ISDA).²²

Besides the definition of credit events, the definition of deliverable obligation is crucial for the valuation and usage of CDSs. When it comes to a credit event, it needs to be determined, in case of physical settlement, which obligations can be delivered or, in case of cash

¹⁹ (Morgan Stanley 2011), p. 6.

²⁰ Cf. (Morgan Stanley 2011), p. 6-7.

²¹ Cf. (Morgan Stanley 2011), p. 9.

²² For further details see: 2014 ISDA Credit Derivatives Definitions.

settlement, what the recovery value of the deliverable obligation is. The most common factors influencing the deliverability of obligations are the currency, maturity, subordination, governing law and market of issuance. By mutually assessing all these factors, including the type of debt and language of the bond contracts, market participants will determine the “cheapest-to-deliver bond” (CTD) which is used in the physical settlement.²³

In order to determine the recovery value/recovery rate of a debt obligation, market participants have developed an auction process in which the recovery rate is determined. The ISDA, together with administrating partners, conduct such auctions with market participants following a certain methodology, in which bids and asks for deliverable obligations are exchanged, to determine the recovery rate which is then used in cash settlement of CDS contracts.²⁴

The market for CDS has undergone some significant evolution since its onset of trading in the mid-1990s with regard to size, usage and market participants.

CDSs are traded OTC and are mostly traded as single-name CDSs. Corporate CDS indices have been around since 2002 and gain in importance as the CDS market matures.²⁵ The ISDA reports that the market for CDSs, measured by the notional amount outstanding, was at USD 6.4 trillion in 2004. By 2005, the CDS market surpassed the size of the corporate bond and loans market for the first time, which underlines the economic importance of this credit derivatives market.²⁶ By 2007, the CDS market had grown to USD 58.2 trillion and reached its high point so far. After the recent financial crisis the CDS market shrank to USD 25.1 trillion in 2012 mainly due to portfolio compression or trade tear-ups, which can be describes as a process of eliminating offsetting CDS positions.²⁷ Most recent data from the Bank of International Settlement (BIS) measures the CDS market at USD 19.4 trillion in June 2014 by notional amount outstanding.²⁸ The significant compression of the CDS market starting from 2007 can be attributed to the efforts of market participants and regulator to erase offsetting positions and can be interpreted as an evolution towards a more effi-

²³ Cf. (Morgan Stanley 2011), p. 12.

²⁴ Cf. (Morgan Stanley 2011), p. 17. For further details on the auction process, see: www.isda.org.

²⁵ Cf. (Morgan Stanley 2011), p. 8.

²⁶ Cf. (Smithson & Mengle 2006), p. 55.

²⁷ Cf. (International Swap and Derivatives Association 2013), p. 2.

²⁸ Cf. (Bank of International Settlement 2014).

cient market. Furthermore, the ISDA and other market participants²⁹ argue that the notional amount outstanding does not clearly mirror the market dynamics anymore, because of portfolio compression, and therefore suggest to measure market size by “market risk transaction activity”, which is related to the volume of new contract traded that affect market risk. Looking at this measure of market size, the CDS market has increased by 15% from 2012 to 2013 at hit level of USD 17.3 trillion in July 2013.³⁰

Regarding the usage of CDSs, three main intentions to trade in CDSs can be identified. (Smithson & Mingle 2006) point out that banks used CDSs initially to lay off credit risk. (Oehmke & Zawadowski 2014) tested this assumption and find support for the claim that market participants use CDSs for hedging purposes. (Hirtle 2008), on the contrary, shows that only very few US banks hold credit derivatives for hedging purposes by 2006; credit derivatives represent only 5 per cent of aggregate commercial and industrial loans.³¹ Furthermore, (Oehmke & Zawadowski 2014) provide evidence that market participants also use the CDS market to speculate and pursue arbitrage strategies.³²

Participants in the CDS market are mainly investment banks, hedge funds, asset managers and insurance companies with the latter mainly being active as sellers of CDS, while non-financial corporations make up only 1-2 per cent of market participants.³³

To complete the picture on CDSs, the pricing of this financial instrument needs to be addressed briefly. As mentioned above, the buyer of a CDS makes periodic premium payments to the seller and in return receives protection against the loss on an obligation by a reference entity in the case of a credit event, mainly default. Following this reasoning, the present value of the premium payments should equal the present value of expected default loss. The expected default loss is determined by the product of loss given default and the default probability. The loss given default, in turn, is given the product of the obligations notional value and (1- Recovery Rate).³⁴ In summary, the following pricing approach should hold:

²⁹ Especially the Clearinghouse “Depository Trust and Clearing Corporation” (DTCC).

³⁰ Cf. (International Swap and Derivatives Association 2013), p. 3.

³¹ Cf. (Hirtle 2008), p. 6-7.

³² Cf. (Oehmke & Zawadowski 2014), p. 3-4.

³³ Cf. (Smithson & Mingle 2006), p.57; (Morgan Stanley 2011), p. 2.

³⁴ Cf. (Morgan Stanley 2011), p. 7.

$$PV(CDS\ Premium) = PV(Notional * (1 - Recovery\ Rate) * Default\ Probability)$$

Arbitrage Relationship between CDSs and corporate bonds

As pointed out above, credit risk is the factor linking corporate bonds and credit default swaps. It is broadly perceived that the yield spread is entirely reflecting the credit risk of a bond investment. Obviously other risks, such as counterparty risk, interest rate risk or liquidity risk, are present when investing in corporate bonds as well as credit default swaps. Additionally, it might be the case that short-selling constraints exist when trading in corporate bonds or CDS. Abstracting from other risks, short-selling constraints and assuming that yields spreads entirely reflect credit risk, there exists an arbitrage relationship between these two financial instruments. Thus, the CDS premium should equal the yield spread on a corporate bond. If this relationship does not hold, arbitrage strategies can be applied which puts pressure on prices and yields, so that the equation eventually holds.

In case that the yield spread on a particular corporate bond exceeds the CDS premium, a market participant can exploit arbitrage opportunity by purchasing the bond and taking a synthetic short position in the bond by buying a CDS and selling a riskless bond. (Oehmke & Zawadowski 2014) refer to this strategy as a negative basis trade.³⁵ In the opposite case, when the CDS premium exceeds the yield spread on a particular corporate bond, a market participant should take a short position in the bond and a synthetic long position by selling a CDS and buying a riskless bond to exploit this arbitrage opportunity.

This arbitrage relationship between CDSs and corporate bonds illustrate the interconnect-edness of these financial instruments. In the presence of arbitrageurs, the existence of a CDS market can be beneficial for corporate debt issuers through compressing yield spread on corporate bonds.³⁶ A variety of in-depth analysis of the theoretical and empirical relationship of the two financial instruments has been conducted by researchers, of which a literature review is provided in the following section.

³⁵ Cf. (Oehmke & Zawadowski 2014), p. 4, 7.

³⁶ Cf. (Oehmke & Zawadowski 2014), p. 2.

3. Literature review

In the previous section, the financial instruments and markets of CDSs and corporate bonds have been presented separately, including a first illustration of interdependence. In this section, a closer look is taken at the relationship between CDSs and corporate bonds by reviewing academic literature. At the center of this review is the impact of CDSs on corporate bonds with regard to yield spread and liquidity. First, the theoretical relationship between CDSs and corporate bonds is addressed by highlighting possible positive and negative channels of impact. Second, academic work on the empirical relationship is presented.

3.1. Theoretical relationship between corporate bonds and credit default swaps

Effects' leading to lower yield spreads on corporate bonds

Previous academic work about the interdependence of CDSs and corporate bonds highlights several channels through which CDSs might have a beneficial impact on corporate bonds' leading to lower yield spreads.

First, (Ashcraft & Santos 2009) point out the informational advantages which come along with the CDS market.³⁷ When corporations issue a new bond, investors face the challenge to assess the corporates' credit risk in order to fairly price the bond. This problem arises from asymmetric distribution of information between corporates and investors. It is costly for investors to gather information and assess credit risk, which results in an information premium charged by investors. Investors' ability to assess credit risk has been limited before the onset of CDS trading. The yield spread of corporate bonds, as discovered by (Elton et al. 2001), contains other risks than credit risk and therefore cannot not be referred to as a clean measure of credit risk. Credit ratings, provided by private institution such as Moody's, Fitch or Standard & Poor's, have historically proven to have some shortcoming as mentioned by (Dilly & Mählmann 2014). Adverse incentive schemes have led rating agencies to assign overly optimistic ratings and consequently lowering the quality of ratings.³⁸ Thus, credit ratings provide investors with information about the credit risk of corporations, but entail some fundamental shortcoming, which compromises the quality of credit risk assessment. The onset of CDS trading has created a new source of information

³⁷ Cf. (Ashcraft & Santos 2009), p. 2-3.

³⁸ Cf. (Dilly & Mählmann 2014), p. 2.

about credit risk. Since CDSs prices solely reflect credit risk, market participants have access to a relatively clean measure of credit risk of a specific reference entity as soon as a CDS is traded for this reference entity. The availability of new decision-relevant information reduces the severity of asymmetric distribution of information and could therefore lead to a reduction in information premium, which ultimately leads to lower yield spreads.³⁹

Second, (Ashcraft & Santos 2009) point to new diversification opportunities for investors created by CDSs trading. Before the onset of CDS trading, it was difficult and costly to trade credit risk of corporate bonds. An investor wishing to increase or decrease exposure to a corporates credit risk was limited to trade in the cash market and faced the problem of low liquidity in this market.⁴⁰ Additionally, trading corporate bonds cannot be considered pure trading of credit risk as it involves other risks as mentioned by (Elton et al. 2001). As a result of the onset of CDS trading, investors can easily lay off credit risk or increase their credit exposure to certain corporates, thus a diversification channels has been created.⁴¹ (Minton et al. 2006) underline the importance of this opportunity for banks. By buying CDS protection on corporation with which they have lending relationships, banks can manage their credit portfolios more efficiently and reach an optimal use of the banks' capital.^{42,43} A more efficient management of credit risk will enable investors to generate higher returns on their business activities. Thereby, the diversification benefits enjoyed by investors may be passed on to corporates by a reduction in yield spreads.

Third, (Duffee & Zhou 2001) highlight banks' potential benefits of CDS trading with regard to adverse selection problems when transferring credit risk. The argumentation of (Duffee & Zhou 2001) is that banks possess private information about the credit quality of corporations with which they have lending relationships. When banks want to transfer credit risk to other investors, they face a "market for lemons" problem. This is because investors will assume that banks just want to lay off low-quality credit risk; hence banks willing to transfer high-quality credit risk will be forced to sell at lower prices. This problem might keep banks from transferring credit risk which inevitable creates inefficiencies. (Duffee & Zhou 2001) further argue that banks' private information varies over time and are more

³⁹ Cf. (Ashcraft & Santos 2009), p. 2-3.

⁴⁰ Cf. (Ashcraft & Santos 2009), p. 2.

⁴¹ Cf. (Ashcraft & Santos 2009), p. 3.

⁴² Cf. (Minton et al. 2006), p. 1.

⁴³ Cf. (Hirtle 2008), p. 4.

valuable for long-term maturities. The reason for this argument is that revenues of new project financed with debt provided by banks will only realize in the distant future, whereas short-term revenues depend on existing projects which are more easily observable by all investors. Thus, banks' private information about short-term credit risk is not as valuable. By creating a way to solely transfer short-term credit risk, the "market for lemons" problem would be diminish and an efficient transfer of credit risk could be established.⁴⁴ CDSs, which can be traded with different maturities, open up such a way. In consequence, banks enjoy benefits from CDS trading, which again might be passed on to corporate bonds resulting in lower yield spreads.

Fourth, it is argued that the introduction of the CDS market will increase credit supply. (Hirtle 2008) highlights that CDSs provide a way to separate funding of debt capital from taking on credit risk. Banks' ability to provide debt capital depends mainly on their capitalization and their ability absorb risk. By engaging in lending activities banks will assume credit risk for which they need to hold costly regulatory capital which consequently limits their ability to supply credit. CDSs open up a way for banks to divest themselves of credit risk, reducing the need to hold regulatory capital and thus freeing up capacity to supply credit to firms. The ability to do so crucially depends on whether a CDS is traded on a specific reference entity or not. If a CDS is traded, banks can supply credit at lower cost, since they can avoid holding costly regulatory capital. (Hirtle 2008) argues that these factors might lead to greater supply of credit in the market.⁴⁵ (Saretto & Tookes 2013) stress this point by stating that if a market fragmentation exists between those who want to assume credit risk and those who want to provide debt capital, credit supply should increase following the introduction of CDSs. Furthermore, (Saretto & Tookes 2013) add that banks are able to maintain client relationships in the form of continuing credit supply even if this means taking on more credit risk initially, because by purchasing CDSs those banks can reduce their credit risk exposure.⁴⁶ Thus, (Hirtle 2008) and (Saretto & Tookes 2013) argue that the onset of CDS trading will lead to higher credit supply. Assuming that credit demand is not affected by the onset of CDS trading, credit should be available at lower prices. Put differently, higher supply of credit will result in lower yield spreads on corporate bonds.

⁴⁴ Cf. (Duffee & Zhou 2001), p. 31-32.

⁴⁵ Cf. (Hirtle 2008), p. 3.

⁴⁶ Cf. (Saretto & Tookes 2013), p. 1-2.

Fifth, (Bolton & Oehmke 2010) point out the empty creditor problem and the effect on strategic default and commitment of borrowers. (Bolton & Oehmke 2010) argue that the financial innovation of CDSs has altered the debtor-creditor relation. Investors who hold corporate bonds provide credit to firms and obtain cash-flow rights. Since this creates an economic interest in the firm, investors also obtain control rights. Control rights are defined by the right to renegotiate debt contracts or to force a corporation into default in case of financial distress. Cash flow rights are defined by claims for coupon and notional payments. CDSs have created a way to separate cash-flow rights from control rights. By buying CDSs, a creditor secures safe cash-flows, either receiving those cash-flows from the corporation or from the CDS seller in case of default. At the same time, the creditor remains to hold control rights by holdings corporate bonds. This results in a situation where creditors do not have any economic interest in a corporation while still having control rights. (Bolton & Oehmke 2010) phrase creditors with CDS protection “empty creditors”.⁴⁷ In case of financial distress, empty creditors have an incentive to force corporations into bankruptcy, which will trigger CDS payments, rather than to renegotiate credit contract terms.⁴⁸ This, in consequence has an effect on borrowers’ incentives to strategically default. (Kim 2013) highlights that in the presence of incomplete corporate credit contracts, cash flows are observable, but not verifiable. In such a situation, borrowers with sufficient funds to serve their debt obligations may choose to default strategically which enables them to renegotiate credit contract terms in their own favor. However, given the empty creditor problem, borrowers will be reluctant to default strategically, because creditors are unlikely to agree to renegotiate, but rather force them into bankruptcy.⁴⁹ Thus, the onset of CDS trading has altered the debtor-creditor relation ex-ante in such a way that borrowers are committed to exercise more effort to meet their debt obligations.⁵⁰

It is stressed by (Kim 2013) that borrowers’ ability to strategically default leads to higher funding costs for corporations.⁵¹ As the incentive to strategically default has been reduced by availability of CDSs, the cost of debt should also be reduced. Thus, the onset of CDSs trading may lead to lower yield spreads.

⁴⁷ Cf. (Bolton & Oehmke 2010), p. 1ff.

⁴⁸ Cf. (Bolton & Oehmke 2010), p. 2.

⁴⁹ Cf. (Kim 2013), p. 2-3.

⁵⁰ Cf. (Arping 2014), p. 2.

⁵¹ Cf. (Kim 2013), p. 3.

So far, literature has been reviewed that stressed five channels through which the onset of CDS trading might lead to lower yield spreads. However, there are also arguments that the onset of CDS trading has an adverse effect on yield spreads of corporate bonds.

Effects' leading to higher yield spreads on corporate bonds

First, in the context of the empty creditor problem, (Bolton & Oehmke 2010) not only show the upside of credit protection via CDS, but also shed light on the downside. Creditors with CDS holdings basically have two options. Those creditors either force firms into bankruptcy in order to capture the payoff of CDS contract or they agree to restructure in order to receive future cash flows from the restructured debt obligations. Nevertheless, (Bolton & Oehmke 2010) show in their analytical model that creditors will “over-insure” by buying CDSs excessively. Thus, ex-post over-insured creditors will never choose to renegotiate with borrowers and will always force firms into bankruptcy in order to trigger CDS payments, which are more valuable for them, although it is not a social optimum.⁵² Given these ex-post results, the onset of CDS trading might have an adverse effect on the cost of debt, because the risk of being forced into bankruptcy has increased. This might even lead to excessive risk-taking which again increases default risk. In consequence, yield spreads might increase after the onset of CDS trading.

Second, (Ashcraft & Santos 2009) highlight the adverse effect of creditors' ability to lay off credit risk with regard to monitoring. Banks or other credit suppliers who have exposure to a borrower's credit risk have an incentive to monitor borrowers by reviewing information about borrowers' business results on a frequent basis. By doing so, the creditor has some control over repayment risk and can mitigate the probability of default. (Ashcraft & Santos 2009) point out that creditors' ability to lay off credit risk by buying CDSs and the subsequent reduced exposure to the borrower obliterates the incentive to monitor.⁵³ A reduced level of monitoring will increase the likelihood of borrowers' financial distress. The problem might become even more severe when borrowers anticipate the reduced monitoring efforts, which can lead to moral hazard and elevate the default probability. Thus, through this monitoring channel, the onset of CDS trading might have a negative effect on the cost of debt, leading to higher yield spreads.

⁵² Cf. (Bolton & Oehmke 2010), p. 4.

⁵³ Cf. (Ashcraft & Santos 2009), p. 3-4.

Third, (Brancati & Macchiavelli 2014) indicate that new and more precise information about credit risk delivered by CDSs could trigger adverse effects. The authors argue that financial crisis occur through coordinated behavior of market participants. By coordinating their behavior, agents mutually attack an entity, may it be a corporation or any other market participant. If there is broad agreement about certain fundamental information, hence more precise information, agents are able to coordinate their behavior by anticipating each other's actions. In contrast, if information is dispersed, agents cannot clearly anticipate behavior of others which puts limit on their ability to coordinate.⁵⁴ Thus, in a market with precise, consensual information, large scale attacks are more likely than in a market with dispersed information. (Ashcraft & Santos 2009) have highlighted that CDSs deliver new and more precise information about an entities default risk; thus CDSs serve as an instrument to reduce information dispersion, which increases agents' ability to coordinate. Following (Brancati & Macchiavelli 2014) reasoning, the onset of CDS trading might lead to more broad scale attacks on corporations, which increases the likelihood of default. Thus, another channel through which the onset of CDS trading might lead to higher yield spreads has been detected.

Effects on liquidity of corporate bonds

Thus far channels through which the onset of CDS trading might affect yield spreads of corporate bonds have been illustrated. Besides the effect on yield spreads, there are some rationales illustrating that the onset of CDS trading also impacts liquidity in the corporate bond market.

First, (Das et al. 2014) highlight that the financial innovation of CDSs has led to a more complete market for credit risk, which generally has a positive impact on liquidity.⁵⁵ One way through which markets became more complete is through a higher level of available information. (Ashcraft & Santos 2009) point out that the onset of CDS trading has led to a higher degree of availability and substance of information. A higher level of information will lead to a reduction of information asymmetry, which will in consequence lessen problems related to asymmetric distribution of information such as adverse selection. (Alexander et al. 2000) adopt this rationale and argue that bonds issued by private corpora-

⁵⁴ Cf. (Brancati & Macchiavelli 2014), p. 1.

⁵⁵ Cf. (Das et al. 2014), p. 1.

tions with less available information will have lower trading volumes, a measure of liquidity.⁵⁶ Another way, through which the onset of CDS trading has led to a more complete market, is by offering a way to uniquely trade credit risk. (Ashcraft & Santos 2009) underline the diversification opportunities for investors offered by CDSs and its potential positive effect on yield spreads.⁵⁷ Given the opportunity to diversify or lay off credit risk, investors might be more inclined to trade in corporate bonds as the exposure to a corporate credit risk is reduced. (Massa & Zhang 2012) argue that especially insurance companies will be attracted to hold CDSs to lay off credit and reduce regulatory capital requirements. In consequence, (Massa & Zhang 2012) state that the need for fire sales of bonds, in case of rating downgrades, is reduced, because insurance companies will not face higher regulatory capital requirements anymore. The reduced need for fire sales will have a positive effect on bond market liquidity.⁵⁸ Additionally, market participants pursuing speculation and arbitrage strategies, as pointed out by (Oehmke & Zawadowski 2014), involving CDS and corporate bonds, will increase trading volumes in both markets and thus improve liquidity provision.⁵⁹ Hence, by enriching the completeness of the market through reducing information asymmetry and offering separate credit risk trading, the onset of CDSs trading might have a positive impact on liquidity in the corporate bond market.

Second, (Das et al. 2014) stress the point that the CDSs market can be seen as a substitute to the corporate bond market. Market participants might not need to use the cash market to trade credit risk anymore, but instead use CDSs to do so. (Das et al. 2014) state that large institutional investors have migrated from the bond market to the credit derivative market to pursue their investment strategies.⁶⁰ (Stulz 2010) provides three reasons why investors might prefer to trade in the CDS market rather than in the bond market. First, CDSs trading is pure credit trading because it does not include lending. Second, corporate bonds might have many different specifications, differing from issue to issue and from corporation to corporation. This makes it difficult and costly to assess pricing and credit risk. Lastly, creating a short position in credit risk is more difficult and inconvenient in the cash market than in the derivatives market.⁶¹ As a result, the emerge of a substitute to the corporate

⁵⁶ Cf. (Alexander et al. 2000), p. 181.

⁵⁷ Cf. (Ashcraft & Santos 2009), p.2.

⁵⁸ Cf. (Massa & Zhang 2012), p. 2-3.

⁵⁹ Cf. (Oehmke & Zawadowski 2014), p.2-6.

⁶⁰ Cf. (Das et al. 2014), p. 29-32.

⁶¹ Cf. (Stulz 2010), p. 6-7.

bond market to trade credit risk and the subsequent migration of traders to the credit derivatives market, might have negative effects on liquidity in the corporate bond market.

All in all, there are arguments that the onset of CDS trading might have positive as well as negative effects on yield spreads and liquidity. Which effect is dominating remains an empirical question.

3.2. Empirical relationship between corporate bonds and credit default swaps

In the previous section, academic literature focusing on the theoretical relation between CDS and yield spreads as well as liquidity of corporate bonds has been reviewed. In order to provide reason to substantiate or doubt these arguments, empirical work on these matters will be reviewed in this section. First, academic literature providing empirical insight on intermediate arguments on the relationship between CDS and corporate bonds, such as the arbitrage relationship, effect on ratings, information provision, price discovery, credit supply and the empty creditor problem, are introduced. Second, empirical work on the direct effect of CDS trading on yield spreads and liquidity of corporate bonds are presented.

(Blanco et al. 2005) address the arbitrage relation between CDS and corporate bonds. The authors measure the CDS-bond basis which they define as the difference between the CDS price and the credit spread. A CDS-bond basis of zero would indicate a perfect arbitrage relation between the two financial instruments. To measure CDS prices, (Blanco et al. 2005) use daily mid-market quotes while the yield to maturity for corporate bonds is derived by linear interpolation. The risk-free rate is approximated by two measures, 5-year government mid-market yields and swap rates. The data investigated consists of 33 US and European reference entities and spans from January 2001 to June 2002.⁶² (Blanco et al. 2005) are able to show that the arbitrage relation holds fairly well, with a mean basis of -41 basis points and +6 basis points using government yields and swap rates to approximate the risk-free rate, respectively. Two deviations from parity are detected. First, for a few European firms the CDS price is substantially higher than the credit spread. The authors suggest that this deviation is due to the CTD option, which makes holding a CDS more valuable and thus increases its price. Alternatively, this deviation may also be due to costs when short selling bonds, such as repo costs, which will lead to lower computed credit spreads

⁶² Cf. (Blanco et al. 2005), p. 2260-2262.

compared to the real credit spread.⁶³ Second, (Blanco et al. 2005) present short-lived deviations from parity for all reference entities. These deviations are ascribed to CDSs' leading role in the price discovery process of credit risk. The authors are able to measure an average contribution of CDSs to the price discovery of credit risk of 80 per cent.⁶⁴ Overall, (Blanco et al. 2005) conclude that the arbitrage relation holds fairly well, CDS prices are upper bounds while credit spreads are lower bounds to measure credit risk, and CDSs have a significant role in the price discovery process of credit risk.⁶⁵

(Norden & Weber 2009) investigate the price discovery role of the CDS market in further detail by testing the hypothesis that price discovery mainly takes place in the CDS market. The authors analyze a data set covering 70 per cent of the 20 most traded corporate reference entities for the time period from January 2000 to December 2002 using mean mid-market CDS quotes, linearly interpolated mid-market yield to maturities and government bond yields as well as swap rates.⁶⁶ The results indicate that price discovery mainly takes place in the CDS market with a pronounced effect for US firms. (Norden & Weber 2009) find that for 67 per cent of US firms and for 40 per cent of European firms contribution to price discovery exclusively takes place in the CDS market.⁶⁷

The role of CDSs with regard to credit ratings is investigated by (Hull et al. 2004) who test whether CDS spreads widen before and after rating events and whether the probability of a rating event depends on CDS spread changes. The authors analyse a time period from October 1998 to May 2002 covering corporations, sovereigns and quasi-sovereigns globally and control for macroeconomic effects.⁶⁸ (Hull et al. 2004) find that CDS spreads significantly increase well before a downgrade credit rating event. They are able to measure that CDS spreads approximately increase by 38 basis point 90 days before a downgrade and by 29 basis points 90 days before a negative outlook.⁶⁹ When assessing the information content of CDS spread changes for the prediction of the probability of rating events, (Hull et al. 2004) are able to present results indicating that spread changes do contain information to predict the probability of rating events. For 42.6 per cent of downgrades and 50.9 per cent

⁶³ Cf. (Blanco et al. 2005), p. 2265-2267.

⁶⁴ Cf. (Blanco et al. 2005), p. 2256.

⁶⁵ Cf. (Blanco et al. 2005), p. 2278f.

⁶⁶ Cf. (Norden & Weber 2009), p. 533f.

⁶⁷ Cf. (Norden & Weber 2009), p. 550-552.

⁶⁸ Cf. (Hull et al. 2004), p. 2793.

⁶⁹ Cf. (Hull et al. 2004), p. 2802.

of negative outlooks CDS spread changes have been within the top quantile of CDS spread changes.⁷⁰

A different perspective on the role of CDSs with regard to credit ratings is taken by (Dilly & Mählmann 2014). The authors assess the question whether the onset of CDS trading, viewed as an external monitoring device of conventional credit ratings, has increased the quality of credit ratings. The authors use a data set covering the period between January 2002 and December 2010. (Dilly & Mählmann 2014) observe a significantly increased correlation between ratings and bond spreads at issuance when a CDS is traded on the reference entity compared to the situation when no CDS is traded. From this, the authors conclude that the presence of CDSs has a positive effect on the quality of credit ratings.⁷¹ Furthermore, (Dilly & Mählmann 2014) are able to show that the timeliness of credit rating corrections increases when a CDS is traded. The time between the first downgrade and default increases for bonds with traded CDS, suggesting that defaults are earlier anticipated, which indicates a higher quality of ratings also after issuance.⁷²

Taken together, the results of (Blanco et al. 2005) and (Norden & Weber 2009) about the price discovery role of the CDS market and (Hull et al. 2004) as well as (Dilly & Mählmann 2014) findings about the information content and quality effects of CDSs on credit ratings establish reason to believe that new information provided by the onset of CDS trading can benefit investors and corporations through the information channel described above.

Based on more precise information, as argued by (Brancati & Macchiavelli 2014), investors might be able to coordinate their actions, which might lead to more coordinated attacks on corporations. This in consequence would lead to a higher probability of default. Besides the theoretical rationale, the authors also provide an empirical investigation by analyzing the effect on banks' default risk if information is more precise. The authors approximate information precision with data on analysts' earnings forecasts and balance sheet items, using data covering 190 banks worldwide between 2005 and 2012. (Brancati & Macchiavelli 2014) find that more precise information about a bank's future profitability greatly increases the bank's default risk, if information reveal bad news about firms. More precisely, if

⁷⁰ Cf. (Hull et al. 2004), p. 2807, 2809.

⁷¹ Cf. (Dilly & Mählmann 2014), p. 17f.

⁷² Cf. (Dilly & Mählmann 2014), p. 19f.

information precision increases by one standard deviation, bank's default risk measured by CDS spreads increase by 120 basis points.⁷³ Moreover, and shedding some positive light on the precision of information, a one per cent increase in a bank's expected ROA reduces the CDS spread by 11 basis points in case of an imprecise signal, but if the signal is precise it reduces the CDS spread by 26 basis points.⁷⁴ Finally, the authors find a three times larger sensitivity of default risk to market expectation for precise information compared to imprecise information.⁷⁵ These findings support the argument that new information provided by the onset of CDS trading helps market participants to coordinate investment decisions which eventually has an effect on bond's credit spreads.

(Hirtle 2008) addresses the relation between the usage of credit derivatives and banks credit supply. Using a data set on US commercial banks, the author finds that banks' increased usage of credit derivatives for hedging purposes predominantly decreases the volume of loans paid out to borrowers.⁷⁶ Nevertheless, when looking at increased credit supply in terms of longer maturities and lower spreads, (Hirtle 2008) is able to detect evidence that the increased usage of credit derivatives increases credit supply for large term loans. Put numerically, a one standard deviation increase in the usage of credit derivatives leads to an increase of average loan maturity of six month and to a 21 basis point drop of loan spreads. The author highlights that evidence for increased credit supply is limited to large term loans might arise from the fact that mainly large corporations, who take large term loans, are "named credits" in the credit derivatives market.⁷⁷

(Saretto & Tookes 2013) add to the findings of (Hirtle 2008) by investigating the effect of single-named CDSs on firm's leverage and debt maturity using a data set covering US non-financial firms between the years 2002 and 2010.⁷⁸ They find that the onset of CDS trading leads to a statistically and economically significant increase of firm's leverage and debt maturities, an indication for higher credit supply.⁷⁹ Firms' mean book leverage increases by 20 per cent and mean debt maturity increases by between 1.09 and 1.79 years when CDSs are introduced. By decomposing debt data, (Saretto & Tookes 2013) also stress that the intro-

⁷³ Cf. (Brancati & Macchiavelli 2014), p. 2.

⁷⁴ Cf. (Brancati & Macchiavelli 2014), p. 12.

⁷⁵ Cf. (Brancati & Macchiavelli 2014), p. 15.

⁷⁶ Cf. (Hirtle 2008), p. 19-20.

⁷⁷ Cf. (Hirtle 2008), p. 2.

⁷⁸ Cf. (Saretto & Tookes 2013), p. 11-13.

⁷⁹ Cf. (Saretto & Tookes 2013), p. 3-4.

duction of CDSs allows firm's to hold more bond debt capital compared to loan debt capital.⁸⁰

Comprising, the findings of (Hirtle 2008) and (Saretto & Tookes 2013) provide some support that the onset of CDSs trading has increased credit supply. An increased credit supply could thus impact credit spreads of corporate bonds.

An empirical investigation of the empty creditor problem is provided by (Subrahmanyam et al. 2014). Using a dataset on North American corporations between the years 1997 and 2009, the authors investigate whether the onset of CDS trading adversely impacts corporate credit risk against the backdrop of the empty creditor problem. (Subrahmanyam et al. 2014) find that the introduction of CDSs significantly increases the probability of credit downgrades and bankruptcy. Numerical, two years after the onset of CDS trading, corporations' credit ratings have decreased by half a notch. Regarding the likelihood of bankruptcy, an average firm has a 2.4 times higher probability of default after the onset of CDS trading than before. (Subrahmanyam et al. 2014) are able to highlight that these results are due to the empty creditor problem. The impact of CDS trading on credit ratings and bankruptcy is more pronounced for those firms with larger notional amounts of CDS outstanding relative to total debt outstanding indicating that creditor are over-insured.⁸¹ A marginal increase in the ratio of notional amount of CDS outstanding to total debt outstanding increases the likelihood of bankruptcy by 0.01 per cent, compared to an average probability of bankruptcy of 0.14 per cent.⁸²

Another characteristic of the empty creditor problem is the effect on the probability of strategic default. (Kim 2013) empirically analyses the commitment device, established by CDS trading, for borrowers not to default strategically. The author investigates the impact of the onset of CDS trading on the cost of debt and relates this impact to the commitment ability of firms.⁸³ Using a data set on 134 corporate bond issuances and CDSs between 2001 and 2006, (Kim 2013) applies an ordinary least squares (OLS) regression with proxies for the likelihood of strategic default such as CEO equity ownership to capture shareholders bargaining power, asset intangibility to capture liquidation costs and dispersion of bondholders

⁸⁰ Cf. (Saretto & Tookes 2013), p. 18-22.

⁸¹ Cf. (Subrahmanyam et al. 2014), p. 4-5.

⁸² Cf. (Subrahmanyam et al. 2014), p. 29.

⁸³ Cf. (Kim 2013), p. 2-3.

to capture renegotiation frictions.⁸⁴ (Kim 2013) finds for firms with traded CDSs that a one standard deviation increase in CEO shareholding reduces average credit spreads by 16 basis points, a one standard deviation increase in the intangibility reduces average credit spreads by 14 basis points and a one standard deviation decrease in the dispersion of bondholders leads to a reduction of average credit spreads by 12 basis points.⁸⁵ The findings indicate that firms with a higher likelihood of strategic default benefit from the presence of CDSs.

Thus, (Subrahmanyam et al. 2014) and (Kim 2013) are able to find reasons to believe that the empty creditor problem, through over-insured creditors and commitment of borrowers not to default strategically seems to have an impact on credit risk, which should as well impact yield spreads.

So far literature has been reviewed with focus on empirical investigation of the intermediate arguments through which the onset of CDS trading might impact corporate bonds. Next, literature will be presented which study the direct effect of CDS trading on corporate bonds.

(Das et al. 2014) provide an empirical investigation of whether the onset of CDS trading has affected the secondary corporate bond market in terms of efficiency, quality and liquidity. By comparing corporate bonds' ability to absorb new information about the corporation relative to other securities in order to measure market efficiency, (Das et al. 2014) find that the corporate bond market has become less efficient after the introduction of CDSs.⁸⁶ To assess the impact of CDSs on the market quality of corporate bonds, the authors compare the difference between efficient prices and transaction prices, a Hasbrouck's measure of pricing error, before and after the onset of CDS trading. They find that the introduction of CDSs does not significantly affect the market quality of named-CDS corporation, but that bond market quality increases during the same periods for corporates with no CDS outstanding. From this (Das et al. 2014) conclude that, on a comparative basis, the onset of CDS trading has an adverse effect on bond market quality.⁸⁷ Lastly, the authors use six different liquidity measures, such as number of trades, dollar volume of trading, trading volume as a percentage of outstanding amount of debt, LOT measure, Amihud illiquidity

⁸⁴ Cf. (Kim 2013), p. 15-16.

⁸⁵ Cf. (Kim 2013), p. 19-20.

⁸⁶ Cf. (Das et al. 2014), p. 3, 14-15.

⁸⁷ Cf. (Das et al. 2014), p. 3, 27-29.

measure and Roll's liquidity measure in order to detect a differential impact pre and post CDS trading. As some of these measures indicate an deteriorating effect of CDSs on corporate bonds liquidity and others suggest a positive effect, (Das et al. 2014) conclude that there is no persuasive evidence that the onset of CDS trading improves the liquidity of corporate bonds.⁸⁸

(Ashcraft & Santos 2009) compare credit spreads on corporate bonds after CDSs start to trade to credit spreads on corporate bonds before the introduction of CDSs.⁸⁹ They investigate a sample of 434 firms for a time period between 2001 and 2005 using various OLS regression models controlling for firm-specific, bond-specific and macroeconomic factors.⁹⁰ First, (Ashcraft & Santos 2009) results indicate that, on average, firms do not experience a statistically significant decrease in credit spreads after the onset of CDS trading.⁹¹ Second, (Ashcraft & Santos 2009) analyse the influence of firm's riskiness and opacity on the impact of CDS trading on credit spreads. They find that credit spreads of bonds issued by risky and opaque firms increase after the introduction of CDSs relative to safe and transparent firms, which they see in line with the monitoring channel described above. Moreover, the authors show that the most safe and transparent firms experience a small reduction in credit spreads once the CDS market becomes liquid.⁹² Taken together, (Ashcraft & Santos 2009) only find limited support for the assumption that the onset of CDS trading has impacted yield spreads.

(Massa & Zhang 2012) claim that the presence of CDSs reduces the need for fire sales, if corporations, such as insurance companies, have to comply with regulations regarding credit quality. The reduced need for fire sales should impact liquidity and yield spreads especially for investment grade corporate bonds. The authors investigate this matter empirically with a data set containing US corporate bonds and CDSs during the years 2001 to 2009.⁹³ (Massa & Zhang 2012) find that the existence of CDSs results in a 22 basis point lower yield spread of investment grade bonds, which is a 14 per cent reduction compared to the unconditional mean. When investigating periods of financial crisis, the authors are able to

⁸⁸ Cf. (Das et al. 2014), p. 3-4, 29-32.

⁸⁹ Cf. (Ashcraft & Santos 2009), p. 5.

⁹⁰ Cf. (Ashcraft & Santos 2009), p. 7-8.

⁹¹ Cf. (Ashcraft & Santos 2009), p. 13-14.

⁹² Cf. (Ashcraft & Santos 2009), p. 19, 21-22.

⁹³ Cf. (Massa & Zhang 2012), p. 2-3.

unfold an even stronger tie between the presence of CDSs and yield spreads on corporate bonds. No significant relation is detected for high yield bonds.⁹⁴ When addressing bond liquidity, (Massa & Zhang 2012) define bond liquidity by the implied bid-ask spread. They find that the existence of CDSs increases liquidity by 9 per cent compared to the unconditional mean for investment grade bonds. The impact is again pronounced during periods of crisis. The impact on high yield bonds is reversed; liquidity decrease by 8 per cent when CDSs are traded.⁹⁵ Thus, (Massa & Zhang 2012) are able to show that yield spreads and liquidity are impacted by the onset of CDS trading.

An investigation of the linkage of the Asian corporate bond and CDS market in terms of yield spreads and liquidity is conducted by (Shim & Zhu 2010). This study is different from those focusing on the US market, because the Asian corporate bond market was underdeveloped when CDS started to trade, thus establishing a ‘jump-start effect’ of CDSs on the Asian bond market.⁹⁶ The authors use a dataset covering 10 Asian economies over the period from 2003 to 2009. (Shim & Zhu 2010) find a statistically and economically significant impact of CDS trading on yield spreads and liquidity. On average, the presence of CDSs lowers yield spreads by 18 basis points and bid-ask spreads by 2.1 basis points at issuance. The authors recognize that these results contradict findings of (Ashcraft & Santos 2009) and assume that the jump-start effect might cause this antagonism. The information revelation content of CDS might be more pronounced in the Asian market than the US market and thus the positive impact of the information channel dominates the negative impact of the monitoring channel.⁹⁷ This argument is supported by the finding that smaller firms, which can be assumed to be more opaque, benefit more from the onset of CDS trading than larger firms.⁹⁸ Additionally, (Shim & Zhu 2010) analyze the effect during periods of crisis and find that yield spreads for bonds included in CDS indices experience an above average increase of approximately 100 basis points on average, while no significant effect is detected on bond market liquidity.⁹⁹ These findings suggest that CDSs benefit firms in normal periods, but have adverse effects during periods of crisis.

⁹⁴ Cf. (Massa & Zhang 2012), p. 10-11.

⁹⁵ Cf. (Massa & Zhang 2012), p. 12.

⁹⁶ Cf. (Shim & Zhu 2010), p. 2.

⁹⁷ Cf. (Shim & Zhu 2010), p. 18-19.

⁹⁸ Cf. (Shim & Zhu 2010), p. 21.

⁹⁹ Cf. (Shim & Zhu 2010), p. 24-25.

All in all, the review of empirical evidence suggests that the onset of CDS has an impact on the market for corporate bonds. Empirical studies on the direct effect of CDS trading on corporate bonds are mixed, but are able to detect some significant relation. The channels through which such an impact can be explained theoretically, as described above, find some empirical support. Nevertheless, whether the onset of CDS trading has a positive or negative impact on yield spreads and liquidity of corporate bonds is not clear. The answer to this question remains an empirical one.

4. Empirical analysis

The previous section has shown that theoretical concepts and empirical work exist which create reason to believe that there is a relation between the trading of CDS and the yield spread as well as the liquidity of corporate bonds. In order to be able to support or object these arguments, this section will focus on an empirical investigation of this matter. First, deriving from the theoretical arguments presented above, hypotheses are formulated which will later be tested using a comprehensive data set. Second, the sample selection approach as well as a description of the final sample is presented. Third, the methodology used to test the hypothesis is introduced, followed by a description and interpretation of the findings. Lastly, the limitations of the empirical investigation are addressed.

4.1. Hypothesis

Several researchers have addressed credit default swaps in light of its impact on corporate bonds. The arguments put forth do not unambiguously suggest a positive or negative impact on yield spreads or liquidity respectively, but taken together suggest that CDSs have an effect on corporate bonds. The answer to the question whether CDSs are beneficial for corporations, in terms of lower yield spreads, and for bond market participants, in terms of higher liquidity, is an empirical one. Because of the ambiguous nature of the empirical question investigated, a main hypothesis will be followed by several sub-hypothesis to address the different channels through which CDSs may impact corporate bonds.

Regarding the effect of CDSs on yield spreads of corporate bonds the main hypothesis reads as follows:

Main hypothesis I: The presence of CDSs affects yield spreads of corporate bonds compared to yield spreads before the onset of CDS trading.

As stated before, scholars have put forth arguments that claim the onset of CDS trading either reduces or increases yield spreads on corporate bonds. An overview of these arguments is presented in table 1.

Table 1: Overview of channels through which CDSs affect yield spreads of corporate bonds

Channel	Description	Effect
Information Channel (Ashcraft & Santos 2009)	CDSs provide investors with new information about corporations' credit quality, lessening asymmetric distribution of information. In consequence, information premium charged by investors will be lower, resulting in lower yield spreads.	- (Lower Yield Spread)
Diversification Channel (Ashcraft & Santos 2009)	CDSs allow for more efficient management of credit risk, which enables investors to generate higher returns on business activities. Diversification benefits may partly be passed on to corporation, resulting in lower yield spreads.	-
Adverse Selection Channel (Duffee & Zhou 2001)	CDSs enable banks to transfer short-term credit risk for which private information is not as valuable, which in consequence mitigates the adverse selection problem in the market for credit transfer. Banks increased ability to transfer credit risk will result in lower yield spreads.	-
Credit Supply Channel (Hirtle 2008; Saretto & Tookes 2013)	The presence of CDSs increases banks' risk management abilities, lowers costs of lending and frees up capital for lending activities. Given a constant level of credit demand, a higher credit supply leads to lower yield spreads.	-
Commitment Channel (Kim 2013)	Corporations anticipate that corporate creditors, holding CDSs, are less inclined to renegotiate in case of default, which in consequence reduced the incentive to strategically default. Thus, the probability of default is reduced.	-
Monitoring Channel (Ashcraft & Santos 2009)	By holding CDSs, corporate creditors' incentive to monitor corporations is reduced, because credit risk is hedged, which leads to a higher probability of default.	+
Empty Creditor Channel (Bolton & Oehmke 2010)	Corporate creditors excessively hold CDSs ("over-insure"), which increases their incentive to force corporations into bankruptcy rather than to renegotiate credit terms. This leads to a higher probability of bankruptcy.	+
Coordination Channel (Brancati & Macchiavelli 2014)	CDSs provide new and more precise information about corporations which helps market participants to coordinate their behavior. Better coordination increases the likelihood of broad scale attack and in consequence increases probability of default.	+

Depending on whether the channels advocating a positive effect or a negative effect dominate, yield spreads will either decrease or increase following the onset of CDS trading. These leads to two sub-hypotheses regarding yield spreads:

Sub-Hypothesis 1 (H1): The information, diversification, credit supply and commitment channel dominate, thus the onset of CDS trading leads to lower yield spreads of corporate bonds.

Sub-Hypothesis 2 (H2): The monitoring, empty creditor and coordination channel dominate, thus the onset of CDS trading leads to higher yield spreads of corporate bonds.

By finding evidence that support either H1 or H2, the main hypothesis is also supported. In the case that neither H1 nor H2 finds significant results that establish reason to believe that the hypotheses hold, the main hypothesis also needs to be rejected.

The effect of the onset of CDS trading on the liquidity of corporate bonds is again ambiguous in theory and therefore a main hypothesis will be followed by two sub-hypothesis. The main hypothesis regarding the effect on liquidity reads as follows:

Main hypothesis II: The presence of CDSs affects liquidity of corporate bonds compared to liquidity before the onset of CDS trading.

The arguments established by researchers regarding the effect of CDSs on liquidity of corporate bonds, which create the ambiguous nature of the empirical investigation, are presented in table 2.

Table 2: Overview of channels through which CDSs affect liquidity of corporate bonds

Channel	Description	Effect
Information Channel (Ashcraft & Santos 2009; Alexander et al. 2000; Das et al. 2014)	CDS' enrich the completeness of financial markets through reducing information asymmetry and offering separate credit risk trading means, which are complementary for bond trading activities, thus leading to higher liquidity in corporate bonds.	+
Substitution Channel (Das et al. 2014; Stulz 2010)	CDS' allow for pure credit trading compared to the cash market, which incentivizes market participants to diverge from trading in the cash market to trading in the derivatives market. This mi-	-

	gration leads to lower liquidity in corporate bonds.	
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Depending on which effect is dominating, liquidity of corporate bonds will either increase or decrease following the onset of CDS trading. Therefore, the sub-hypotheses are:

Sub-Hypothesis 3 (H3): The information channel dominates, thus the onset of CDS trading leads to higher liquidity of corporate bonds.

Sub-Hypothesis 4 (H4): The substitution channel dominates, thus the onset of CDS trading leads to lower liquidity of corporate bonds.

Again, any evidence that supports either H3 or H4 will implicitly also supports the main hypothesis. If the empirical investigation fails to find any evidence for H3 or H4, the main hypothesis will also need to be rejected.

4.2. Data set

The previous section has put forth hypothesis, which are based on theoretical concepts and previous empirical investigations. This section will introduce and describe the data set which is used to test the hypothesis. First, the sample selection approach is described and second, the properties of the final sample are outlined.

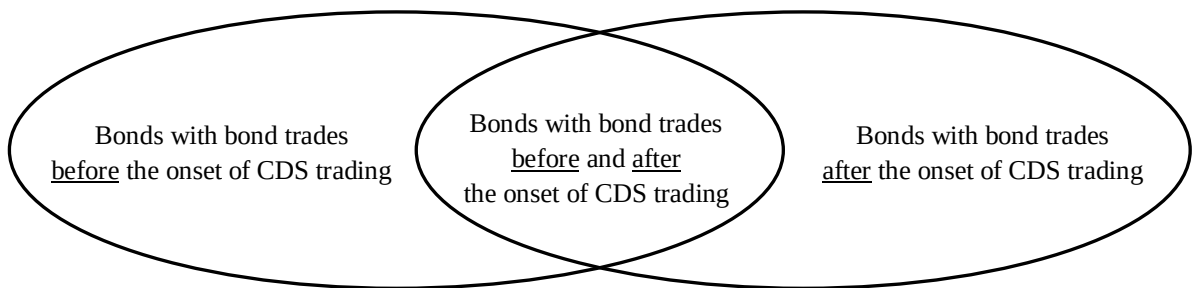
The initial data set contains data retrieved from different data sources. Data about bonds, such as trade dates, prices, yields, volumes and ratings, has been retrieved from TRACE (Trade Reporting and Compliance Engine). To have insight about corporates' shares, CRSP (Center for Research in Security Prices) data was used. COMPUSTAT data has been retrieved to display firms' financial data, such as income statement and balance sheet items, while data about CDSs has been retrieved from Thomson Reuters. The initial data set covers firms included in the S&P 500 between July 01, 2002 and December 28, 2012 and contains 1,510,026 bond trades, 2,455 different bonds and 776 different firms.

First, an initial examination of the data set shows that for 73.5 per cent of bond trades, the onset of CDS trading is on January 05, 2004, which is the first Monday of the year 2004. A further investigation of this matter reveals that Thomson Reuters began sourcing CDS data from CMA (Credit Management Association) in 2004. As it is not possible to distinguish

whether a CDS actually started to trade or whether Thomson Reuters started to document CDS trading in its database on this date, any observations for which January 05, 2004 is the date of the onset of CDS trading is excluded from the sample. This procedure reduces the sample size by a large amount, as a matter of fact by 1,109,938 observations. Nevertheless, in order to receive valid results and in light of academic rigor it is necessary to follow this procedure.

Second, as the goal of the empirical investigation is to test whether the onset of CDS trading has an impact on bonds, only bonds for which CDSs start to trade during the lifetime of the bond are of interest. Therefore, any bonds for which only bond trades before the onset of CDS trading are documented are dropped from the sample. Additionally, all bonds for which only bond trade after the onset of CDS are document are excluded from the sample. This procedure reduces the sample by 337,400 observations. It leads to a final sample that includes only those bonds for which bond trades before and after a CDS begins to trade are documented. An illustration of this procedure and the sample set is provided in figure 1.

Figure 1: Sample Construction



The final sample contains 62,643 observations. This represents 4.1 per cent of the initial data set. Although this is a tremendous reduction of the sample size, it underlines the priority given to academic rigor and any conclusion drawn from the analysis has accented validity. The final sample covers 113 bonds issued by 55 firms over a time period from July 01, 2002 to December 28, 2012. The first observation for a CDS issuance is January 13th, 2004, while the last observed CDS issuance is November 07th, 2006. Since the data set contains information about S&P 500 firms, these CDS issuances dates seem reasonable, because CDS trading has initially started to trade on larger firms, such as companies included in the S&P 500. There are 35,421 observations for bond trades with outstanding CDSs while bond trades without outstanding CDSs amount to 27,222 observations.

In order to describe the characteristics of the final sample, mean values for firm, bond and financial market characteristics are computed. The results are illustrated in table 3. This procedure is conducted for the whole sample, shown in the first column, as well as for observations before and after the onset of CDS trading, which are illustrated in column two and three, respectively. The change in variables is also computed and is shown in the fourth column.

Table 3: Sample Characteristics

Sample Characteristics		CDS Issuance			
	Whole Sample	Pre	Post	Difference	Difference in %
<u>Firm Characteristics</u>					
Market capitalization (mn)	14,460.06	14,474.14	14,450.41	-23.73	-0.16
Sales (mn)	16,330.24	12,819.68	19,027.36	6,207.68	48.42
Profit margin (%)	3.32	3.45	3.22	-0.23	-6.67
Leverage	0.37	0.37	0.37	0.00	-0.54
Rating	10.46	10.32	10.57	0.25	2.42
Rating per rating class (%)					
AAA	0.37	0.00	0.66	0.66	-
AA	2.43	0.00	4.29	4.29	-
A	25.79	24.53	16.15	-8.38	-34.15
BBB	30.19	18.90	36.24	17.35	91.81
BB	14.90	18.36	17.15	-1.21	-6.58
B	14.88	22.24	14.12	-8.11	-36.48
CCC & lower	11.44	15.98	11.39	-4.59	-28.75
<u>Bond Characteristics</u>					
Amount issued (mn)	529.44	645.76	440.04	-205.72	-31.86
Time to maturity (years)	5.39	5.34	5.43	0.09	1.74
Weighted yield (bp)	720.98	742.78	704.22	-38.56	-5.19
Weighted yield spread (SWAP) (bp)	401.89	466.85	351.96	-114.89	-24.61
Weighted yield spread (Treasury) (bp)	440.15	498.27	395.49	-102.78	-20.63
Roll measure	1.696	1.8661	1.5683	-0.30	-15.96
<u>Financial Market characteristics</u>					
Treasury rate (bp)	280.8243	244.5073	308.735	64.23	26.27
Swap rate (bp)	319.088	275.9247	352.2601	76.34	27.67

The illustrated figures give a first picture on how firm characteristics change before and after CDS start to trade. Firms' average market capitalization stays relatively constant. Average sales increase noticeably by 48 per cent from average sales of USD 12.8 billion before CDS trading to USD 19.0 billion after CDSs start to trade. This increase can, on the one hand, be attributed to a general aging effect and, on the other hand, to the fact that many CDSs start to trade between 2004 and 2005, so that the figures incorporate the boom years before the financial crisis starting in 2008. An alternative interpretation is that after CDSs start to trade on particular firms, those firms are able to generate higher revenues. Nevertheless, these indicative figures are not suitable to draw any conclusion on this hypothesis. Profit margins deteriorate from 3.45 per cent to 3.22 per cent. Average leverage

levels are constant at 0.37, indicating that firms do not increase their leverage after CDSs are traded. Nevertheless, firms' average ratings slightly worsen after the onset of CDS trading. This observation might be a first indication that rating agencies incorporate new information into rating assessments or that negative effects of CDS trading materialize. By taking a look at the change in different rating classes, the increase in the share of bonds traded with triple B rating is remarkable. Before the issuance of CDSs, 18.9 per cent of bonds traded had a triple B rating while after CDSs start to trade, 36.2 per cent carry a triple B rating, which is a 91.8 per cent increase. Furthermore, after the onset of CDS trading, bonds with A and B ratings decrease by 34 and 36 per cent respectively. Remarkable is also that there are no bonds traded with a rating higher than single A before CDSs start to trade. The figures suggest that credit ratings are drawn towards a triple B rating with the onset of CDS trading.

Regarding bond characteristics, it is noticeable that the average amount issued per bond decreases from USD 646 million to USD 440 million after CDSs start to trade. The reasons for this deterioration can be manifold, such as a reduced demand for debt capital, a weaker supply of debt capital or a splitting of bond issues into multiple smaller bond issuances. Average bond time to maturity increases by 1.7 per cent, which indicates that firms are able to borrow capital for longer periods of time. Closely related to the hypothesis put forth above, yields and yield spreads appear to decrease following the onset of CDS trading. Weighted average bond yields decline from 743 basis points to 704 basis points, which is a 5 per cent decrease. Yield spreads experience a more pronounced deterioration from 467 to 351 basis points, which is a 25 per cent decrease, when looking at the yield spread over the swap rate. Roll's liquidity measure, a measure of implicit effective bid-ask spread, indicates higher liquidity in the bond market after the onset of CDS trading as Roll's measure decreases.

Financial market characteristics show higher interest rate regimes after the onset of CDS trading, signaled by increased treasury and swap rates. The reasons for the increased treasury and swap rates are manifold again. Since many CDSs start to trade between 2004 and

2005, the increase of the federal fund rate by the FED from 1 per cent in January 2004 to 4.16 per cent in December 2005 is certainly one reason.¹⁰⁰

4.3. Methodology

The sample which is used to test the hypotheses has been described in the previous section. Next, the methodology used to analyse and investigate the posed hypotheses is presented. First, the basic regression model deployed to investigate the relationship between CDSs and bonds is introduced. Second, variables used in the regression model are described. Third, the regression model specifications are presented. And finally, regression model extensions, which test specific circumstances, are illustrated.

The main conception of the regression analysis has been adapted from (Ashcraft & Santos 2009). In order to investigate the relationship between the onset of CDS trading and yield spreads on corporate bonds and to test the presented hypotheses, the following basic regression model has been used:

$$\begin{aligned} \text{Yield Spread}_{i,t} &= \alpha + \beta_1 * \text{TRADING}_{i,t} + \beta_2 * \text{LNSALES}_{i,t} + \beta_3 * \text{PROFMARGIN}_{i,t} + \beta_4 \\ &* \text{LEVERAGE}_{i,t} + \beta_5 * \text{RATING}_{i,t} + \beta_6 * \text{LNBONDAMT}_{i,t} + \beta_7 \\ &* \text{LNBONDMAT}_{i,t} + \varepsilon_{i,t} \end{aligned}$$

The regression model used to investigate the relationship between the onset of CDS trading and liquidity of corporate bonds reads as follows:

$$\begin{aligned} \text{Roll Measure}_{i,t} &= \alpha + \beta_1 * \text{TRADING}_{i,t} + \beta_2 * \text{LNSALES}_{i,t} + \beta_3 * \text{PROFMARGIN}_{i,t} + \beta_4 \\ &* \text{LEVERAGE}_{i,t} + \beta_5 * \text{RATING}_{i,t} + \beta_6 * \text{LNBONDAMT}_{i,t} + \beta_7 \\ &* \text{LNBONDMAT}_{i,t} + \varepsilon_{i,t} \end{aligned}$$

$\text{Yield Spread}_{i,t}$ represents the weighted average spread over the treasury rate with the same maturity of bond i at the time of the bond trade t , measured in basis points. $\text{Roll Measure}_{i,t}$ measures the implicit effective bid-ask spread of corporate bond i at the time of the bond trade t . TRADING is a dummy variable which takes the value of 1 if the

¹⁰⁰ Cf. Federal funds (effective) – Monthly: <http://www.federalreserve.gov/releases/h15/data.htm>.

issuer of the corporate bond has a CDS outstanding at the time of the bond trade. Otherwise, the dummy equals 0. This is the main variable of interest for the regression analysis as it allows to test the hypotheses. Significant values for this dummy variable would indicate that the onset of CDS trading has an effect on corporate bonds.

The next four independent variables are firm-specific which are used to control for firm characteristics. *LNSALES*, the logarithm of sales, controls on the one hand for firm size and on the other hand for firms' overall risk. It can reasonably be assumed that larger firms, with higher sales, are better diversified and thus have lower credit risk. Therefore, a negative effect on yield spreads and a positive effect on liquidity are predicted. *PROFMARGIN* represents a firms net income-to-sales ratio, a measure of profitability. More profitable firms are more likely to meet debt obligations, thus lowering credit risk. Thus, the predicted effect on yield spreads is negative and positive on liquidity. *LEVERAGE*, sized by firms' debt-to-asset ratio, is a measure of firms' financial riskiness. Higher leverage indicates more financial risk, as it becomes more difficult for a firm to meet its debt obligations. Hence, the forespoken effect is positive on yield spreads and negative on liquidity. *RATING*, which represents a firms' external credit rating by Standard and Poor's, is a more holistic measure of firms' credit worthiness than the leverage ratio as its assessment takes more parameters into account. *RATING*, is measured numerically, 1 expressing a triple A (AAA) rating, the highest expression of creditworthiness, and 21 a single C (C) rating. The predicted effect of a deteriorating credit rating, represented by an increasing rating number, on yield spreads is positive and negative on liquidity.

The regression model also incorporates two bond-specific control variables. *LNBONDAMT* is the logarithm of the bond issue amount. The effect of the bond issue size on yield spreads is theoretically ambiguous. On the one hand, larger bond issues establish higher default risk for firms as it gets more difficult to repay the bond issue. On the other hand, larger bond issues may benefit from economies of scale during the issuing process and are more likely to be issued by larger, better diversified firms. The effect on the amount issued on bonds' liquidity is predicted to be positive as a higher supply of bonds enables to more frictionless trading. *LNBONDMAT* is the logarithm of bonds' time to maturity. On the one hand, bonds with repayment dates in the more distant future, thus with a longer time to maturity, may be exposed to higher credit risk as future events and cash flow profiles are harder to predict.

On the other hand, bonds with longer time to maturity are more likely to be issued by larger and financially more stable firms, thus may endogenously have lower credit risk. The overall effect of time to maturity on yield spreads and liquidity is therefore ambiguous.

The regression models apply the OLS method. To conduct a comprehensive and thorough analysis of the matter, four different model specifications are applied. By estimating several different regression models, it can be ruled out that false model assumptions lead to biased or inefficient regression results. The first regression model is a pooled regression which assumes that the OLS assumptions are fulfilled. Second, fixed effects are introduced to control for unique attributes of bond issues that are not the result of random variation and are constant over time. Incorporating fixed effects helps to control for possible heterogeneity. Third, robust standard errors are used to estimate the regression. This is done to control for possible heteroscedasticity. Lastly, one regression specification is deployed that uses fixed effects and robust standard errors. In the later description and interpretation of the regression results, the main focus will be on second regression specification.

Additionally, some model extensions are made to capture the impact of CDS trading for different firm characteristics by introducing additional explanatory variables. First, a model extension is used to capture the effect of CDS trading on riskier firms. The interaction term *TRADING_LEVERAGE*, which takes a value of 0 if no CDS is traded and equals the leverage ratio otherwise, gives some indication of the effect CDS trading has on leveraged, riskier firms. An alternative interaction term *TRADING_NIGRADE* takes a value of 1 for non-investment grade rated firm with outstanding CDS. Thus, it captures the effect of CDS trading only on non-investment grade rated firms. Second, it is of interest whether the impact of CDS trading has changed after the recent financial crisis with Lehman Brothers bankruptcy on September 15th, 2008. Since the financial crisis, the CDS market has gone through structural changes as pointed out before and therefore a change of impact is reasonable. Also, the time period before the financial crisis corresponds to the time period of the emerge of CDS trading, and therefore the effect CDS trading has on the corporate bond market might have changed since the CDS market has become more mature. To capture this effect, the interaction term *TRADING_PRECRISIS* has been used, which takes a value of 1 if the bond trade occurs prior to Lehman's' bankruptcy filing and a CDS' is traded on the corresponding bond. The third model extension is used to capture time-lagged, long-run

effects of the onset of CDS trading. The basic regression model uses a dummy variable which captures the impact of CDS' on corporate bonds at the first day of CDS trading. Nevertheless, it is reasonable to assume that some time has to pass until all potential effects unleash through which CDSs might impact corporate bonds. CDSs have to become sufficiently liquid and need to be allocated to market participants who pursue different objectives. Thus, the effect of CDSs on corporate bonds in the long-run might diverge from short-run effects. In order to account for long-run effects, 4 different dummy variables are deployed, which capture the effect of the onset of CDS trading after 3, 6, 9 and 12 month. The variables *TRADING3M*, *TRADING6M*, *TRADING9M* and *TRADING12M* take a value of 1 for bond trades, 3, 6, 9 and 12 month after the onset of CDS trading, respectively.

The computer program STATA is used to generate the regression results.

4.4. Findings: Description and interpretation

After having presented the methodology of the empirical analysis, this chapter contains the presentation and interpretation of the empirical findings. First, the regression output regarding the impact of CDSs on yield spreads of corporate bonds is presented. Second, the empirical findings regarding the effect of CDSs on liquidity of corporate bonds is illustrated. Lastly, the implications of the empirical results of the investigations are stressed in light of the existing theory.

Empirical result for the effect of CDSs on yield spreads

The presentation of the empirical results address the first research objective of this study which is to estimate whether the trading of CDSs affects yield spreads of corresponding corporate bonds.

An overview of the empirical results regarding the effect of CDSs on yield spreads is illustrated in table 4. The table includes five regression models with different model specifications. In model (1) random effects are used, not controlling for possible non-random variation within firms or heteroscedasticity. Model (2) uses firm fixed effects to control for non-random variation within a given firm. Model (3) and (4) applies with robust standard errors which control for possible heteroelasticity. Model (4) drops bond control variables to elim-

inate the possibility that bond controls are jointly determined with bond spreads. Model (5) includes firm fixed effects and robust standard errors. In Model (2) and (5) the independent variable LNBONDAMT was dropped because of collinearity. The dependent variable is W_YS_T: Weighted average bond spread over the treasury rate of the same maturity. The regression model of main interest for the latter interpretation is model (2) as it incorporates firm fixed effects and leaves out robust standard errors because heteroelasticity does not seem to be an influencing factor.

Table 4: Effect of CDS trading on yield spreads of corporate bonds

Independent Variables	(1)	(2)	(3)	(4)	(5)
TRADING	-42.14 *** 0.000	-40.75 *** 0.000	-42.14 0.246	-66.2 0.132	-40.76 0.263
<u>FIRM CONTROLS</u>					
LNSALES	100.39 *** 0.000	101.16 *** 0.000	100.39 0.019	57.91 0.102	101.17 0.040
PROFMARGIN	-652.01 *** 0.000	-641.91 *** 0.000	-652.01 *** 0.000	-628.45 *** 0.000	-641.91 *** 0.000
LEVERAGE	1163.74 *** 0.000	1163.11 *** 0.000	1163.74 *** 0.000	1181.93 *** 0.000	1163.11 *** 0.000
RATING	8.6 *** 0.000	6.34 *** 0.000	8.60 0.745	-8.05 0.757	6.34 0.829
<u>BOND CONTROL</u>					
LNBONDAMT	28.68 0.274	dropped	28.68 0.300		dropped
LNBONDAMT	100.46 *** 0.000	100.66 *** 0.000	100.46 *** 0.000		100.66 *** 0.000
Oberservations	51277	51277	51277	51277	51277
R-squared	0.3691	0.3640	0.3691	0.3528	0.3640

The table reports the coefficients and p-values of independent variables as well as an indication of significance level. ***, **, * corresponds to 1, 5 and 10 per cent significane level respectively.

Model (1) is estimated with random effects. Model (2) uses firm fixed effects to control for nonrandom variation within a given firm. Model (3) and (4) is estimated with robust standard errors which control for possible heteroelasticity. Model (4) drops bond control variables to eliminate the possible that bond controls are jointly determined with bond spreads. Model (5) includes firm fixed effects and robust standard errors. In Model (2) and (5) the independent variable LNBONDAMT was dropped because of collinearity. The dependent variable is W_YS_T: Weighted average bond spread over the treasury rate of the same maturity in basis points. TRADING: Dummy variable that equals 1 for bonds that have a traded CDS. LNSALES: Log of sales. PROFMARGIN: Net Income over Sales. LEVERAGE: Debt-to-Asset ratio. RATING: Equals the number of the firms credit rating. LNBONDAMT: Log of bond amount issued. LNBONDAMT: Log of bond time-to-maturity.

The result of the empirical investigation indicates that the onset of CDS trading does have a highly significant effect on yield spreads of corporate bonds. On average, the yield spread of corporate bonds is 41 basis points lower for firms with a traded CDS than for firms without a traded CDS. The significance and direction of the result does not change whether the yield spread over treasury or swap rate is considered. Thus, this result supports sub-hypothesis H1 which claims that the information, diversification, credit supply and com-

mitment channel dominate and therefore the onset of CDS trading leads to lower yield spreads of corporate bonds. All of the four firm control variables are statically significant. The firm control variable for size and overall risk, LNSALES, indicates that larger firms have on average higher yield spreads, which stands in contrast to an expected negative effect. A one percent increase in LNSALES leads to a yield spread increase of 1.01 basis points. Although statistical significance is given, economic significance is weak. The effect of firms' profit margin on yield spreads is negative, as expected. A one standard deviation increase of a firms' profit margin leads to a yield spread reduction of 104 basis points, which signals not only statistical, but also economic significance. LEVERAGE measures firms' financial risk and its effect on yield spreads is, as expected, positive. A one standard deviation increase in firms' debt-to-asset ratio leads to a yield spread increase of 262 basis points, which is again economically significant. RATING, which is a more holistic measure of firms' risk, indicates that firms with a lower credit rating have higher yield spreads. A one notch drop in credit rating leads to a yield spread increase of 6.3 basis points. Compared to the effect of LEVERAGE and PROFITMARGIN on yield spreads, the effect of RATING is weak. As expected, the bond control variable LNBONDMAT, measuring the time to maturity of firms' bond, has a positive impact on yield spreads. A one per cent increase of time to maturity leads to an increase in yield spread of 1 basis point, thus its economic significance is rather neglectable despite its statistical significance. Hence, these regression results have some explanatory power with all of the independent variables being statistically significant and most also economically significant. The regression model can explain 36 per cent of the variation in yield spreads, as measured by R-squared, which is fairly high. Therefore, the empirical investigation is consistent with sub-hypothesis H1 and furthermore reveals that the onset of CDS trading has a meaningful impact on corporate bond yield spreads.

Some of the academic work on the topic of CDSs and corporate bonds point out that the impact of CDSs on yield spreads may vary with the riskiness of firms, as the need to address credit risk is greatest for this kind of firms.¹⁰¹ To address this topic, a regression model is set up using dummy variables to measure the effect of CDSs for more risky firms. The results of these regressions are illustrated in column one and two of table 5. The interaction term TRADING_LEVERAGE is highly statistically significant and indicates a negative

¹⁰¹ Cf. (Ashcraft & Santos 2009),p. 19-22.

effect of CDSs on yield spreads for riskier firms. If a CDS is traded, a one standard deviation increase in the debt-to-asset ratio leads to a 191 basis point reduction in yield spreads compared to firms with no outstanding CDS.

Table 5: Effect of CDS trading on yield spreads of corporate bonds for riskier firms and pre-crisis

Independent Variables	(6)		(7)		(8)	
TRADING	131.65 *** 0.000		13.86 ** 0.018		236.29 *** 0.000	
TRADING_LEVERAGE	-516.83 *** 0.000					
TRADING_NIGRADE			-135.19 *** 0.000			
TRADING_PRECRISIS					-348.33 *** 0.000	
<u>FIRM CONTROLS</u>						
LNSALES	100.78 *** 0.000		94.99 *** 0.000		25.98 *** 0.000	
PROFMARGIN	-682.24 *** 0.000		-662.48 *** 0.000		-633.42 *** 0.000	
LEVERAGE	1548.28 *** 0.000		1088.11 *** 0.000		795.46 *** 0.000	
RATING	15.04 *** 0.000		14.22 *** 0.000		-2.12 0.210	
<u>BOND CONTROL</u>						
LNBONDAMT	dropped		dropped		dropped	
LNBONDMAT	88.27 *** 0.000		90.62 *** 0.000		146.89 *** 0.000	
Observations	51277		51277		51277	
R-squared	0.4113		0.3754		0.2944	

The table reports the coefficients and p-values of independent variables as well as an indication of significance level. ***, **, * corresponds to 1, 5 and 10 per cent significance level respectively. Model (6), (7) and (8) are estimated with fixed effects. In all models, the independent variable LNBONDAMT was dropped because of collinearity. The dependent variable is W_YS_T: Weighted average bond spread over the treasury rate of the same maturity in basis points. TRADING: Dummy variable that equals 1 for bonds that have a traded CDS. TRADING_LEVERAGE: Interaction term of TRADING and LEVERAGE. TRADING_NIGRADE: Interaction terms that equals 1 if firm has a traded CDS and a non-investment grade rating. TRADING_PRECRISIS: Interaction term that equals 1 if a firm has a traded CDS and the bond traded occurred before September 17th, 2008. LNSALES: Log of sales. PROFMARGIN: Net Income over Sales. LEVERAGE: Debt-to-Asset ratio. RATING: Equals the number of the firm's credit rating. LNBONDAMT: Log of bond amount issued. LNBONDMAT: Log of bond time-to-maturity.

This regression result supports the reasoning of the information, diversification, credit supply and commitment channel and supports the previous regression results which indicate

that the onset of CDS trading leads to lower yield spreads for an average firm. Since the effect for riskier firms is more pronounced than for an average firm, one can infer that the economic benefits of CDS trading are amplified for firms with higher financial leverage and thus higher default risk, which is in line with theory.

An alternative interaction term, `TRADING_NIGRADE`, is introduced in regression model (7). The results support the results of regression model (6). The effect is not only statistically significant, but also economically. If a firm has a non-investment grade rating, the onset of CDS trading has a negative effect on yield spreads; namely yield spreads decrease by 135 basis points or 31 per cent compared to the average yield spread.

Taken together, two measures, capturing the riskiness of firms, indicate that there is a statistically and economically significant effect of CDS trading on yield spreads for riskier firms. The information, diversification, credit supply and commitment channel seem to have greater effect on more risky than on average firms.

Next, the goal is to test whether the effect of CDS trading on corporate bonds is different for the time period before the financial crisis of 2008 compared to the whole sample period from 2002 to 2012. The results of regression model (8), which incorporates the interaction term `TRADING_PRECRISIS`, are presented in column three of table 5. The empirical investigation shows that the onset of CDS has a significant negative effect on corporate yield spreads before the collapse of Lehman Brothers in 2008. For an average firm, yield spreads decrease 348 basis points if the bond trade occurred before September 2008. Comparing this result to the 41 basis point decrease indicated by model (2), the effect of CDSs on corporate bonds is more pronounced pre-Lehman. Nevertheless, attributing this strong negative effect to the occurrence of the financial crisis would be premature. One needs to take into account that the period between 2002 and 2008 is also the time period during which the CDS market has become more mature and had tremendous growth. Therefore, this effect can either be attributed to the development of the CDS market or to the occurrence of the financial crisis, or both.

The last set of regression models tries to shed light on the long-run effect of CDS trading on yield spreads. For this purpose, four different time-lagged dummy variables for the onset of CDS trading are used. The results of these regressions are presented in table 6. First, all

of the time-lagged variables are statistically significant. This indicates that CDS trading not only has an impact on corporate bonds right at the time when CDSs start to trade, but also in the period three to 12 month afterwards. Second and most striking, the long-run effect is positive and thus opposing the immediate effect of the onset of CDS trading. For example, the results of model (12) show that on the day of the onset of CDS trading, yield spreads decrease by 191 basis points for an average firm. But 12 month after the onset of CDS trading, yield spreads increase by 237 basis points because of the onset of CDS trading. A possible interpretation is that when CDS start to trade, the revelation of new information about firms' credit quality leads to more efficient prices and decreases yield spreads by compressing information premia. Nevertheless, after some time has passed other condition such as the reduced level of monitoring, the increasing importance of the empty creditor problem and a better coordination of market participants lead to higher default risk, so that yield spreads increase in the long run. Thus, the effect of CDS trading is ambiguous and depends on the considered time span. Lastly, the magnitude of the long-run effect increases with time. Three month after the onset of CDS trading yield spreads increase by 147 basis points. This effect increases to a 237 basis points 12 month after the onset of CDS trading. Interpreting this occurrence, one can assume that underlying conditions which create the prerequisites for the positive effect of CDSs on yield spreads reinforce and harden with time or just come through after CDSs have traded for some period of time. The effect of the reduced level of monitoring is certainly amplifying over time, leading to increased default risk and could therefore be an example explaining this phenomenon. Additionally, the empty creditor problem might unleash continuously over time. Market participants might only recognize over time that bondholders increasingly buy CDSs to overinsure themselves against a possible default, which in consequence reinforces default risk.¹⁰²

¹⁰²(Bolton & Oehmke 2010) highlight that transparency in the CDS market is rather weak with regard to who holds which CDSs positions.

Table 6: Long-run effect of CDS trading on yield spreads of corporate bonds

Independent Variables	(9)		(10)		(11)		(12)	
TRADING	-172.03 0.000	***	-159.48 0.000	***	-165.86 0.000	***	-191.23 0.000	***
TRADING3M	147.21 0.000	***						
TRADING6M			148.59 0.000	***				
TRADING9M					174.18 0.000	***		
TRADING12M							237.28 0.000	***
<u>FIRM CONTROLS</u>								
LNSALES	97.73 0.000	***	94.02 0.000	***	87.56 0.000	***	78.89 0.000	***
PROFMARGIN	-625.04 0.000	***	-609.27 0.000	***	-586.69 0.000	***	-587.64 0.000	***
LEVERAGE	1162.15 0.000	***	1158.04 0.000	***	1155.74 0.000	***	1149.78 0.000	***
RATING	6.17 0.000	***	6.21 0.000	***	5.17 0.003	***	3.68 0.033	***
<u>BOND CONTROL</u>								
LNBONDAMT	dropped		dropped		dropped		dropped	
LNBONDMAT	103.73 0.000	***	106.41 0.000	***	108.89 0.000	***	117.41	
Observations	51277		51277		51277		51277	
R-squared	0.3594		0.3556		0.3486		0.3397	

The table reports the coefficients and p-values of independent variables as well as an indication of significance level. ***, **, * corresponds to 1, 5 and 10 per cent significance level respectively.

Model (9), (10), (11) and (12) are estimated with fixed effects. In all models, the independent variable LNBONDAMT was dropped because of collinearity. The dependent variable is W_YS_T: Weighted average bond spread over the treasury rate of the same maturity in basis points. TRADING: Dummy variables that equals 1 for bonds that have a traded CDS. TRADING3M: Dummy variable equals 1 for bonds 90 days after the inception of CDS trading. TRADING6M: Dummy variable equals 1 for bonds 180 days after the inception of CDS trading. TRADING9M: Dummy variable equals 1 for bonds 270 days after the inception of CDS trading. TRADING12M: Dummy variable equals 1 for bonds 360 days after the inception of CDS trading. LNSALES: Log of sales. PROFMARGIN: Net Income over Sales. LEVERAGE: Debt-to-Asset ratio. RATING: Equals the number of the firms credit rating. LNBONDAMT: Log of bond amount issued. LNBONDMAT: Log of bond time-to-maturity.

At this point, an interim conclusion serves the purpose of summing up the results of the empirical analysis regarding the effect on corporate bond yield spreads. First, the onset of CDS trading leads initially to a decrease of yield spreads of 41 basis points for an average firm. Second, the analysis reveals that the negative effect of CDSs trading is more pronounced for riskier firms. Third, for the period before the financial crisis of 2008, the analysis reveals that the effect of CDS was much larger than for the whole sample period from

2002 to 2012. Fourth, the investigation of the long-run effect of CDSs trading indicates that the initial negative effect on yield spreads go into reverse after some period of time. Not only does the effect reverse, but it also increases in magnitude. All in all, the regression analysis provides results which support sub-hypothesis H1, the onset of CDS trading leads to lower yield spreads, for the initial effect of CDS trading. The analysis for the long-run produces results that are consistent with sub-hypothesis H2. Consolidated, it can be concluded that the findings are supporting main hypothesis I which reads as follows: The presence of CDSs affects yield spreads of corporate bonds compared to yield spreads before the onset of CDS trading.

Empirical result for the effect of CDSs on liquidity

The second research objective of this study is to estimate whether the trading of CDSs affects liquidity of corporate bonds.

In order to estimate the effect of CDSs on liquidity, a measure of liquidity needs to be determined. There exist multiple alternatives to measure liquidity and among these alternatives there is no obvious best choice. Therefore, the effect of CDSs on liquidity is estimated with different measures of liquidity, namely Roll's measure of implicit effective bid-ask spread, total trading volume, mean trading volume and the interquartile range of bid quotes. As already pointed out in the methodology part of this study, the main focus regarding liquidity measures is on Roll's measure of effective bid-ask spread. The reason to focus on Roll measure of liquidity is that it is among one of the most popular liquidity indicators and is used by several authors who have investigated the effect of CDSs on corporate bonds liquidity which underlines its legitimacy. Nevertheless, the results for the alternative liquidity measures are presented in table 7.

Table 7: Regression results for alternative liquidity measures

Regression Model & Independent Variables	Dependent Variable: Alternative Liquidity Measures			
	I Roll's Measure	II Trading Volume	III Mean Trading Volume	IV Interquartil Range
(1) TRADING	-0.258 *** 0.000	-161,120 0.345	29013.95 0.332	-0.0004451 ** 0.034
(2) TRADING	-0.253 *** 0.000	-77,626 0.661	27224.18 0.358	-0.0003061 0.153
(3) TRADING	-0.258 ** 0.026	-161,120 0.505	29013.95 0.698	-0.0003061 0.153
(4) TRADING	-0.351 *** 0.009	-375,306 0.141	-29256.42 0.687	-0.000186 0.895
(5) TRADING	-0.253 ** 0.034	-77,626 0.759	27224.18 0.724	0.0003061 0.723
(6) TRADING_LEVERAGE	0.927 *** 0.000	-868,226 0.304	-556482.4 *** 0.000	-0.00561 *** 0.000
(7) TRADING_NIGRADE	0.117 *** 0.002	516,753 0.137	29592.43 0.612	-0.003074 *** 0.000
(8) TRADING_PRECRISIS	-0.776 *** 0.000	43,438 0.852	454809.7 *** 0.000	-0.006377 *** 0.000
(9) TRADING3M	0.188 *** 0.000	-1,896,880 *** 0.000	-388907 *** 0.000	0.0019689 *** 0.000
(10) TRADING6M	0.193 *** 0.000	-1,630,099 *** 0.000	-419061.6 *** 0.000	0.0020658 *** 0.000
(11) TRADING9M	0.189 *** 0.000	-1,649,926 *** 0.000	-390269.2 *** 0.000	0.002547 *** 0.000
(12) TRADING12M	0.314 *** 0.000	-1,289,665 *** 0.000	-359737.5 *** 0.000	0.0036577 *** 0.000

The table reports the coefficients and p-values of independent variables as well as an indication of significance level. ***, **, * corresponds to 1, 5 and 10 per cent significance level respectively.

Models (2) and (6) to (12) are estimated with firm fixed effects. Model (1) estimated with random effects. Model (3) and (4) is estimated with robust standard errors which control for possible heteroskedasticity. Model (4) drops bond control variables to eliminate the possibility that bond controls are jointly determined with bond spreads. Model (5) includes firm fixed effects and robust standard errors.

The regression results reported in column I are estimated in a model using Roll's measure as a dependent variable. The regression results reported in column II are estimated in a model using the sum of bond trading volume as a dependent variable. The regression results reported in column III are estimated in a model using mean bond trading volume as a dependent variable. The regression results reported in column IV are estimated in a model using the interquartile range of bond bid quotes as a dependent variable.

TRADING: Dummy variable that equals 1 for bonds that have a traded CDS. TRADING_LEVERAGE: Interaction term of TRADING and LEVERAGE. TRADING_NIGRADE: Interaction term that equals 1 if firm has a traded CDS and a non-investment grade rating. TRADING_PRECRISIS: Interaction term that equals 1 if a firm has a traded CDS and the bond traded occurred before September 17th, 2008. TRADING3M: Dummy variable equals 1 for bonds 90 days after the inception of CDS trading. TRADING6M: Dummy variable equals 1 for bonds 180 days after the inception of CDS trading. TRADING9M: Dummy variable equals 1 for bonds 270 days after the inception of CDS trading. TRADING12M: Dummy variable equals 1 for bonds 360 days after the inception of CDS trading. All models include control variables which are not reported in the table, but can be delivered upon request.

When considering Roll's liquidity measure, the regressions for four out of five model specifications yield statistically significant results for the effect of CDS trading on liquidity. An overview of the regression results for the five model specification is presented in table 8.

From regression model (2) it can be deduced that the presence of CDSs reduces Roll's liquidity measure by 0.253. When comparing this result to the average Roll measure for the whole sample size of 1.696, the effect of CDS trading is not only statistically significant but also economically as Roll's measure decreases by almost 15 per cent. A reduction of Roll's measure indicates that the effective bid-ask spread decreases, which is in consequence in indication for higher liquidity.

Table 8: Effect of CDS trading on liquidity of corporate bond

Independent Variables	(1)	(2)	(3)	(4)	(5)
TRADING	-0.258 *** 0.000	-0.253 *** 0.000	-0.258 ** 0.026	-0.351 *** 0.009	-0.253 ** 0.034
<u>FIRM CONTROLS</u>					
LNSALES	0.050 *** 0.007	0.040 ** 0.042	0.050 0.560	0.153 0.105	0.04 0.687
PROFMARGIN	-0.219 *** 0.000	-0.202 *** 0.001	-0.219 0.300	-0.078 0.746	-0.202 0.348
LEVERAGE	0.370 *** 0.000	0.364 *** 0.000	0.37 0.476	0.427 0.457	0.364 0.493
RATING	-0.014 0.042	-0.018 0.016	-0.01 0.798	-0.093 0.126	-0.018 0.777
<u>BOND CONTROL</u>					
LNBONDAMT	0.471 *** 0.000	dropped	-0.471 *** 0.000		dropped
LNBONDMAT	0.455 *** 0.000	0.453 *** 0.000	0.455 *** 0.000		0.453 *** 0.000
Observations	49211	49211	49211	49211	49211
R-squared	0.1178	0.0651	0.1178	0.0005	0.0651

The table reports the coefficients and p-values of independent variables as well as an indication of significance level. ***, **, * corresponds to 1, 5 and 10 per cent significance level respectively.

Model (1) estimated with random effects. Model (2) uses firm fixed effects to control for nonrandom variation within a given firm. Model (3) and (4) is estimated with robust standard errors which control for possible heteroelasticity. Model (4) drops bond control variables to eliminate the possible that bond controls are jointly determined with bond spreads. Model (5) includes firm fixed effects and robust standard errors. In Model (2) and (5) the independent variable LNBONDAMT was dropped because of collinearity. The dependent variable is ROLL_MEASURE: A measure of implied effective bid-ask spread. TRADING: Dummy variable that equals 1 for bonds that have a traded CDS. LNSALES: Log of sales. PROFMARGIN: Net Income over Sales. LEVERAGE: Debt-to-Asset ratio. RATING: Equals the number of the firms credit rating. LNBONDAMT: Log of bond amount issued. LNBONDMAT: Log of bond time-to-maturity.

These regression results are consistent with sub-hypothesis H3. CDSs seem to have a positive effect on liquidity in the corporate bond market by enriching the completeness of financial markets through reducing information asymmetry and offering a separate instrument to trade credit risk, which is complementary for bond trading activities. Nevertheless, it needs to be noted that when using alternative liquidity measures, the regressions do not yield significant results, which weakens the validity of this statement.

Regarding the control variables with a statistically significant effect, it should be noted that coefficients are in line with predictions. Bonds of firms with higher leverage, thus higher default risk, are less liquid. Nevertheless, the economic significance is rather weak as a one per cent increase in the debt-to-asset ratio leads only to a 0.21 per cent increase of Roll's measure. For bonds with longer maturity, for which cash flows are received in the more distant future and are thus exposed to higher default risk, there is also less liquidity as measured by LNBONDMAT. On the contrary, bonds of firms which are more profitable, as measured by PROFMARGIN, are more liquid. Despite the statistical significance, the economic significance is questionable, with a 0.12 per cent decrease of Roll's measure given a one per cent increase in profit margin.

The underlying conditions that establish the reason for the impact of CDSs on bond liquidity should be more severe for riskier firms. Information and adverse selection problem as well as the need for the provision of a separate instrument to trade credit risk are most likely to be amplified if firms face higher default risk. Therefore, it should be tested whether the effect on liquidity is more pronounced for riskier firms. The results of the empirical analysis for riskier firms are presented in table 9. The independent variable TRADING_LEVERAGE, which measures the effect of CDSs on the liquidity for riskier firms in terms of higher financial leverage, is statistically significant. If a CDS is traded, a one per cent increase in the debt-to-asset ratio leads to an increase of the effective bid-ask spread of 0.00927, which is a 0.55 per cent increase of the average bid-ask spread. Although statistical significance is given, economic significance is rather weak. It should also be noted that when different liquidity measures are applied, namely mean trading volume and the inter-quartile range, the regression results indicate that liquidity increases following the onset of CDS trading. The second measure to capture the effect on riskier firms, TRADING_NIGRADE, is supporting the deteriorating effect of CDSs on liquidity for riskier firms. If a firm has a non-investment grade rating and CDSs start to trade, liquidity of those bonds decreases, as indicated by an increase of Roll's measure by 0.117 or 6.89 per cent.

Thus, the empirical analysis for the effect of CDS trading on the liquidity for more risky firms yield statistically significant results, are not unambiguous, but predominantly indicate that liquidity is negatively affected. Despite the weak economic significance, it seems as if the availability of a new instrument to trade credit risk on riskier firms incentivizes credit

traders to migrate from the cash market to the derivatives market to pursue their trading strategies, thus leading to less liquidity in the corporate bond market. The effect for riskier firms stands in contrast to the effect of CDSs trading on bond liquidity of average firms. Next, it is tested whether the effect of CDS trading on liquidity is different for the period before the financial crisis 2007-2008. Before the collapse of Lehman Brothers, the CDS market was at its high point, providing substantial information about credit risk and a separate instrument to trade credit risk. Model specification (8) incorporates the interaction term `TRADING_PRECRISIS` which measures the effect CDSs have on liquidity for bond trades before the Lehman bankruptcy.

The variable is statistically significant and indicates a strong positive effect on liquidity. For bond trades before the financial crisis, the presence of a CDS reduces the effective bid-ask spread by 0.776. The average bid-ask spread, as measured by Roll's measure, for the period before the financial crisis is 1.866 and thus the presence of a CDS reduces the average bid-ask spread by about 46 per cent. Additionally, the regressions using alternative liquidity measures indicate the same effect and are also yield statistical significance. Thus, the regression results support the assumption that the effect of CDS trading on the liquidity of corporate bonds is more pronounced before the financial crisis.

Table 9: Effect of CDS trading on liquidity of corporate bonds for riskier firms and pre-crisis

Independent Variables	(6)		(7)		(8)	
TRADING	-0.564 ***		-0.301 ***		0.362 ***	
	0.000		0.000		0.000	
TRADING_LEVERAGE	0.927 ***					
	0.000					
TRADING_NIGRADE			0.117 ***			
			0.002			
TRADING_PRECRISIS					-0.776 ***	
					0.000	
<u>FIRM CONTROLS</u>						
LNSALES	0.041 **		0.045 **		-0.13 ***	
	0.038		0.022		0.000	
PROFMARGIN	-0.127 **		-0.185 ***		-0.183 ***	
	0.038		0.002		0.002	
LEVERAGE	-0.333 ***		0.429 ***		-0.464 ***	
	0.007		0.000		0.000	
RATING	-0.033 ***		-0.024 ***		-0.038 ***	
	0.000		0.001		0.000	
<u>BOND CONTROL</u>						
LNbondamt	dropped		dropped		dropped	
LNbondmat	0.477 ***		0.462 ***		0.558 ***	
	0.000		0.000		0.000	
Observations	49211		49211		49211	
R-squared	0.0526		0.0665		0.0728	

The table reports the coefficients and p-values of independent variables as well as an indication of significance level. ***, **, * corresponds to 1, 5 and 10 per cent significance level respectively. Model (6), (7), and (8) are estimated with fixed effects. In all models, the independent variable LNbondamt was dropped because of collinearity. The dependent variable is ROLL_MEASURE: A measure of implied effective bid-ask spread. TRADING: Dummy variable that equals 1 for bonds that have a traded CDS. TRADING_LEVERAGE: Interaction term of TRADING and LEVERAGE. TRADING_NIGRADE: Interaction terms that equals 1 if firm has a traded CDS and a non-investment grade rating. TRADING_PRECRISIS: Interaction term that equals 1 if a firm has a traded CDS and the bond traded occurred before September 17th, 2008. LNSALES: Log of sales. PROFMARGIN: Net Income over Sales. LEVERAGE: Debt-to-Asset ratio. RATING: Equals the number of the firms credit rating. LNbondamt: Log of bond amount issued. LNbondmat: Log of bond time-to-maturity.

Finally and as already investigated for the effect on yield spreads, it is interesting to know whether the effect on liquidity changes after some period of time. The final set of regression models test the long-run effect of CDSs on liquidity. The corresponding regression results are presented in table 10. The analysis of the long-run effect of CDSs on liquidity

yield interesting results, which are unambiguous with regard to alternative liquidity measures.

First, all of the independent variables measuring the long-run effect are statistically significant. In addition, the long-run effect is also economically significant. The change in effective bid-ask spread is within the range of 11 and 19 per cent of the average effective bid-ask spread.

Second, the impact of CDSs on liquidity seems to increase within the timeframe of three to 12 month after the onset of CDS trading. Three month after the onset of CDS trading, Roll's liquidity measure increases by 0.188, but 12 months after CDS started to trade the effect of CDS trading on liquidity increases to 0.314. Interpreting this phenomenon, one can assume, on the one hand, that it takes some time until the underlying conditions through which CDSs affect liquidity unravel. On the other hand, it might be the case that the CDS itself needs to become sufficiently liquid until the effect on corporate bonds' liquidity come through.

Third and deeply interesting, the long-run effect on liquidity is reversing the initial effect at the onset of CDS trading. While initially, the presence of CDSs seems to positively affect liquidity in the corporate bond market, as indicated by compressed bid-ask spreads, the long-run effect of CDSs seems to deteriorate liquidity in the bond market. A possible explanation for this appearance is that initially the presence of CDSs reduces information asymmetry and adverse selection problems as well as complements the bond market by offering a hedging instrument, which leads to higher liquidity.

Table 10: Long-run effect of CDS trading on liquidity of corporate bonds

Independent Variables	(9)		(10)		(11)		(12)	
TRADING	-0.420	***	-0.407	***	-0.389	***	-0.452	***
	0.000		0.000		0.000		0.000	
TRADING3M	0.188	***						
	0.000							
TRADING6M			0.193	***				
			0.000					
TRADING9M					0.189	***		
					0.000			
TRADING12M							0.314	***
							0.000	
<u>FIRM CONTROLS</u>								
LNSALES	0.036		0.031		0.025		0.009	
	0.073		0.121		0.214		0.633	
PROFMARGIN	-0.179	***	-0.158	**	-0.139	**	-0.126	**
	0.003		0.010		0.024		0.039	
LEVERAGE	0.363	***	0.358	***	0.356	***	0.347	***
	0.000		0.001		0.001		0.001	
RATING	-0.018	**	-0.018	**	-0.019	***	-0.022	***
	0.014		0.014		0.008		0.003	
<u>BOND CONTROL</u>								
LNBONDAMT	dropped		dropped		dropped		dropped	
LNBONDMAT	0.457	***	0.460	***	0.462	***	0.474	***
	0.000		0.000		0.000		0.000	
Observations	49211		49211		49211		49211	
R-squared	0.0647		0.0646		0.0643		0.0650	

The table reports the coefficients and p-values of independent variables as well as an indication of significance level. ***, **, * corresponds to 1, 5 and 10 per cent significance level respectively.

Model (9), (10), (11) and (12) are estimated with fixed effects. In all models, the independent variable LNBONDAMT was dropped because of collinearity. The dependent variable is ROLL_MEASURE: A measure of implied effective bid-ask spread. TRADING: Dummy variable that equals 1 for bonds that have a traded CDS. TRADING3M: Dummy variable equals 1 for bonds 90 days after the inception of CDS trading. TRADING6M: Dummy variable equals 1 for bonds 180 days after the inception of CDS trading. TRADING9M: Dummy variable equals 1 for bonds 270 days after the inception of CDS trading. TRADING12M: Dummy variable equals 1 for bonds 360 days after the inception of CDS trading. LNSALES: Log of sales. PROFMARGIN: Net Income over Sales. LEVERAGE: Debt-to-Asset ratio. RATING: Equals the number of the firms credit rating. LNBONDAMT: Log of bond amount issued. LNBONDMAT: Log of bond time-to-maturity.

After this initial effect has passed, the deteriorating effect on liquidity comes through over time. Traders leave the corporate bond market to trade credit risk and migrate to the credit derivative market, as it offers a cleaner and less capital-intensive way to trade credit risk. As a result, liquidity in the bond market decreases over time.

The empirical analysis of the effect of CDS trading on liquidity of corporate bonds offers some interesting insights. Initially, the presence of CDSs has a positive effect on liquidity

which supports sub-hypothesis H3; the availability of new information and complementing hedging instruments enhance the corporate bond market leading to higher liquidity. The prediction that this effect should be more pronounced for riskier firms can be backed by regression results incorporating variables to measure the effect for riskier firms. Interestingly, the impact of CDSs on liquidity not only reverses but also amplifies over time. 12 month after the onset of CDS trading, the presence of credit derivatives decreases liquidity in corporate bonds. Hence, in the empirical results regarding the long-run effect of CDSs support sub-hypothesis H4. This phenomenon can be attributed to the migration of credit traders from the capital-intensive and unclean bond market with regard to other risks, such as interest-rate risk, to the credit derivatives market in which credit trading is less capital-intensive and cleaner. It can be said that the empirical investigation puts forth results which are consistent with main hypothesis II which reads as follows: The presence of CDSs affects liquidity of corporate bonds compared to liquidity before the onset of CDS trading.

Taken together, the empirical analysis reveals that CDSs do impact the corporate bond market in terms of yield spreads and liquidity. At the onset of CDS trading, yield spreads decrease by 41 basis points for an average firm. This result contradicts the results of (Ashcraft & Santos 2009) who show that on average firms do not experience a statistically significant change in credit spreads after the onset of CDS trading. Nevertheless, this result is in line with findings by (Massa & Zhang 2012) for investment grade bonds and (Shim & Zhu 2010) for Asian bonds, who both show that yield spreads decrease after the onset of CDS trading. The analysis for more risky firms yields unambiguous results indicating that the effect is more pronounced for riskier firms. These empirical results support the findings of (Ashcraft & Santos 2009) who show that CDS trading especially affects riskier firms. Interestingly, the effect of CDS trading on yield spreads reverses and amplifies over time, which has been, to the best of my knowledge, not tested by other authors so far.

With regard to liquidity in the corporate bond market, the empirical results show that liquidity economically significantly increases at the onset of CDS trading. This result is supporting the findings of (Massa & Zhang 2012) for investment grade bonds and (Shim & Zhu 2010) for Asian bonds who also investigate the effect of CDS trading on bid-ask spreads. On the other hand, (Massa & Zhang 2012) also find that liquidity is negatively affected by CDS trading for high yield bonds. This is again in line with empirical results of

this study, which show that bonds of firms with higher leverage or non-investment grade ratings have lower liquidity once CDSs start to trade. Interestingly again is that the long-run effect of CDS trading on liquidity for an average firm opposes the short-run effect. Over time liquidity in the corporate bond market decreases through CDS trading and this effect is amplifying.

4.5. Limitations

The empirical results as presented above are carried out with a high degree of academic rigor to emphasize empirical robustness. Nevertheless, there are some limitations which need to be addressed.

In the foreground of these limitations is the issue of endogeneity. Technically speaking, endogeneity occurs if an independent variable is correlated with the error term in an OLS regression model. If this is the case, the regression results might be biased. There are several reasons for endogeneity, but for this empirical study the main reason of interest is simultaneous causality. The claim in this study is that the onset of CDS trading might or might not lead to changes in yield spreads and liquidity of corporate bonds. Nevertheless, it could also be the case that changes in yield spreads and liquidity lead to the onset of CDS trading. Thus, it would be a case of reversed causality. If this is the case, then the conclusion that the onset of CDS trading leads to changes in the corporate bond market is incorrect.

To detect endogeneity is not banal, but researchers, such as (Ashcraft & Santos 2009) and (Das et al. 2014) address the issue of endogeneity in this context and come up with a possible treatment. (Ashcraft & Santos 2009) are using a matched sample approach in their study. This approach requires four steps in order to assess endogeneity problems. First, a sample needs to be created containing all CDS-traded firms with observations until the onset of CDS trading and observations of all firms that remain untraded in the CDS market. Second, a probit model needs to be applied to predict the onset of CDS trading based on time-lagged independent control variables. Third, for those firms which remain untraded, but which have high probability to be traded in the CDS market at some point in time, a fictional date is assigned to simulate the onset of CDS trading. The observations of these firms are included in a separate (“matched”) sample for which the identical analysis are conducted as for the sample with firm which are actually traded in the CDS market. Lastly,

the difference between the measured effects for the matched and traded sample needs to be assessed. If there is no significant difference, then endogeneity is not a problem.

It is possible to apply this treatment to the given data set, but conducting a matched sample approach is beyond the scope of this analysis.

Another limitation to this study is evoked by the nature of the data. The sample investigated in this study only contains firms listed in the S&P 500. Bonds and CDSs of those firms are traded in the most developed and efficient market in the world which justifies the sample selection. Nevertheless, the results drawn from this study only apply to a specific set of firms and might not be representative for firms which are fundamentally different or are traded in markets which have considerable different characteristics.

An investigation of the impact of CDSs on corporate bonds which addresses the endogeneity problem and uses a sample containing firms from all over the world would reduce the limitations of this study.

5. Conclusion

The general purpose of this paper is to investigate the relation between CDS trading and corporate bonds. In particular, three research objectives are pursued to shed more light on the linkage of these two financial instruments and markets.

The first research objective is to estimate whether the trading of CDS affects yield spreads of corresponding corporate bonds. The conducted empirical analysis shows that CDS trading does affect yield spreads on corporate bonds for an average firm. Initially, at the onset of CDS trading yield spreads show a statistically and economically significant decrease. These results are consistent with sub-hypothesis H1 which reads as follows: The information, diversification, credit supply and commitment channel dominate, thus the onset of CDS trading leads to lower yield spreads of corporate bonds. The effect on riskier firms is more pronounced which is in line with theory and other empirical investigations. Interestingly, over the course of time the presence of CDSs affect yield spreads of an average firm positively. Using time-lagged dummy variables to capture the long-run effect of CDS trading, the regression results reveal that the effect of CDSs on yield spreads reverses and amplifies over time. In contrast to the short-run effect, the investigation of the long-run effect is consistent with sub-hypothesis H2 claims that the monitoring, empty creditor and coordination channel dominate and thus the onset of CDS trading leads to higher yield spreads of corporate bonds. Accordingly, the empirical results regarding the effect on yield spreads are consistent with main hypothesis I: The presence of CDSs affects yield spreads of corporate bonds compared to yield spreads before the onset of CDS trading.

The second research objective is to estimate whether the trading of CDSs affects the liquidity of corresponding corporate bonds. Using Roll's liquidity measure to define and measure liquidity, the empirical analysis reveals that CDS trading does affect liquidity of corporate bonds. Liquidity of an average firm statistically and economically increases at the onset of CDS trading. For the short-run, the results support sub-hypothesis H3 which claims that the information channel dominates, thus the onset of CDS trading leads to higher liquidity of corporate bonds. The analysis for riskier firms shows that liquidity is negatively affected and therefore decreases at the onset of CDS trading. Over the course of time, the effect of CDSs on liquidity reverses, just like it does with yield spreads. The analysis for the period of three to 12 month after CDSs start to trade reveals that liquidity decreases

the more time has passed since the onset of trading. This finding for the long-run effect is consistent with sub-hypothesis H4; the substitution channel dominates, thus the onset of CDS trading leads to lower liquidity of corporate bonds. Hence, the empirical investigation yields results which support main hypothesis II that the presence of CDSs affects liquidity of corporate bonds compared to liquidity before the onset of CDS trading.

The last research objective aims at estimating whether the effect of CDS trading on yield spreads and liquidity is different before the financial crisis in 2007-2008. The empirical investigation brings forth results showing that the effect is more pronounced before the financial crisis for both yield spreads and liquidity. Before the bankruptcy of Lehman Brothers in September 2008, the presence of CDSs has a stronger negative effect on yield spreads of an average firm. Liquidity also increases by a greater extend at the onset of CDS trading before the financial crisis compared to the effect for the whole sample period spanning from 2002 to 2012.

The results of this study have some non-negligible implications for participants in the financial market, such as traders, corporate treasurers and regulators.

For traders in the corporate bond and derivatives market, this study reveals that there is not only a theoretical linkage between CDSs and corporate bonds, but that this relation materializes in changes in yield spreads and liquidity. By being aware of the nexus of the two financial instruments, traders can form predications about the evolution of yield spreads and liquidity in case a CDS starts to trade and adjust their trading strategies accordingly. Thus, the better understanding of the interrelation of CDS and corporate bonds can lead to less volatility in the corporate bond market and towards a more efficient market.

Corporate treasures might assess the benefits and detriments of CDS trading for their financing needs and costs. The study shows that yield spreads decrease and liquidity increases at the onset of CDS trading, which is positive news for corporate treasurers. Thus, corporates might exert effort to prompt financial institutions to issue CDSs on their corporation in order to lower refinancing costs in the short-run. Nevertheless, corporates should also be aware of the long-run effects revealed by the empirical investigation. Over the course of time, yield spreads increase and liquidity decreases. Therefore, the effect on refinancing costs might just be a short-lived effect and possibly turns out to effect refinancing condi-

tions negatively in the long-run. Lower levels of monitoring after the onset of CDS trading are in theory one reason for the increase in yield spreads. From this it follows that it might be possible for corporates to mitigate the detrimental effect on refinancing costs if they voluntarily exert effort to maintain monitoring levels by creditors.

For regulators it should be of interest to investigate the long-run positive effect on yield spreads in further depth which can partly be attributed to the empty creditor problem. As the empty creditor problem results from specification in CDS contracts, regulators might conclude that changes to these contract specifications might mitigate the perils of having empty creditors. One possibility is that creditors who hold sufficient amount of CDSs to offset their credit exposure are stripped of their voting right in debt renegotiations. Nevertheless, this would also mitigate beneficial commitment effect as pointed out by (Bolton & Oehmke 2010). Alternatively, regulators could enhance the market structure of derivatives. By making disclosure of CDS holdings mandatory, the impact of the empty creditor problem could be extenuated. In the case of disclosure, market participants would be aware of the extent of empty creditors and could thus adjust their expectations.

All in all, the study reveals interesting and important linkages between corporate bonds and CDSs and indicates some implications for financial market participants. Further research should be dedicated to pin down the impact of particular channels in order to draw more detailed conclusions for market participants, which enables to establish a more complete and efficient market.

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Supplements to meet guidelines of the University of Cologne

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