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The price impact of CDS trading

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Non technical summary

Credit default swap (CDS) premia are widely used as a market-based indicator for credit risk in research and practice. CDS premia are often compared to credit risk premia of bond markets, because derivatives markets have traditionally been considered less susceptible to frictions. However, new market microstructure research shows that derivatives prices may also deviate significantly from the fundamentally justified prices if real frictions (inventory risks or market power) or informational frictions (asymmetrical distribution of information) exist.

In this study, using a unique dataset provided by the Depository Trust & Clearing Corporation, we show that frictions cause CDS premia to deviate considerably from their fundamental values. CDS traders interpret protection bought by other market participants as a sign of an increase in the underlying reference entity's credit risk, and therefore increase the CDS premia on such transactions (asymmetric information). CDS traders also increase premia to receive compensation for the risks they accumulate through CDS transactions (inventory risk). Last, CDS traders use their market power to charge significantly higher premia in transactions with buy-side investors.

Our findings show that, to a large extent, CDS premia reflect market frictions rather than the credit risk of the underlying reference entity. While premium surcharges can be interpreted as risk compensation for CDS traders on the basis of asymmetric information and inventory risk, the market power that CDS traders enjoy through limited competition between traders leads to price discrimination between different groups of investors. Furthermore, the impact of the order flow direction does not rule out the possibility of CDS premia being strategically affected by large orders. Overall, our results suggest that centralized trading platforms could significantly increase the price efficiency in the CDS market to the extent that they can reduce market frictions.

Nicht-technische Zusammenfassung

Die Nutzung von Credit Default Swap (CDS)-Prämien als marktbasierter Indikator für Kreditrisiko ist in Forschung und Praxis weit verbreitet. Diese Gleichsetzung der CDS-Prämie mit der Kreditrisikoprämie wird häufig damit begründet, dass Derivatemärkte weniger anfällig für Friktionen sind als beispielsweise der Markt für Unternehmensanleihen. Neue Forschungsansätze in der Marktmikrostruktur zeigen jedoch, dass auch die Preise von Derivaten stark von den fundamental gerechtfertigten Preisen abweichen können, wenn reale Friktionen (Inventarrisiken oder Marktmacht) oder Informationsfriktionen (asymmetrische Informationsverteilungen) vorherrschen.

In dieser Arbeit zeigen wir anhand eines einzigartigen Datensatzes der Depository Trust & Clearing Corporation, dass CDS-Prämien aufgrund von Friktionen in erheblichem Umfang von ihrem fundamental gerechtfertigten Wert abweichen. CDS-Händler interpretieren Versicherungskäufe anderer Marktteilnehmer als Signal für ein höheres Kreditrisiko des zugrunde liegenden Referenzunternehmens und erhöhen im Anschluss an solche Transaktionen die CDS-Prämien (asymmetrische Information). Auch das Risiko, das sie durch CDS-Transaktionen eingehen, lassen sich CDS-Händler durch Prämienaufschläge vergüten (Inventarrisiko). Aufgrund ihrer Marktmacht können CDS-Händler bei Transaktionen mit Buyside-Investoren deutlich höhere Prämienaufschläge durchsetzen.

Unsere Ergebnisse zeigen, dass CDS-Prämien zu einem großen Teil nicht das Kreditrisiko des zugrunde liegenden Referenzunternehmens, sondern viel mehr Marktfriktionen widerspiegeln. Während Preisaufschläge aufgrund asymmetrischer Informationen und Inventarrisiken als Risikokompensation für CDS-Händler interpretiert werden können, führt die aus fehlendem Wettbewerb entstehende Marktmacht der CDS-Händler zu einer Preisdiskriminierung zwischen unterschiedlichen Investorengruppen. Darüber hinaus lässt der Einfluss der Richtung des Order Flow nicht ausschließen, dass CDS-Prämien durch große Orders strategisch beeinflusst werden können. Insgesamt legen unsere Resultate den Schluss nahe, dass in dem Maße, wie zentrale Handelsplattformen Marktfriktionen abbauen können, sie die Preiseffizienz im CDS-Markt deutlich steigern könnten.

BUNDESBANK DISCUSSION PAPER NO 20/2013

The Price Impact of CDS Trading*

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Abstract

In this paper we show that informational and real frictions in CDS markets strongly affect CDS premia. We derive this main finding using a proprietary set of individual CDS transactions cleared by the Depository Trust & Clearing Corporation. We first show that CDS traders adjust the CDS premium in response to the observed order flow. Buy orders lead to an increase of the premium and sell orders to a decrease, suggesting that the order flow carries information. Second, we show that traders adjust the premium more for transactions with higher inventory risk. Third, trading with buy-side investors who presumably have less market power increases this effect. Overall, our results imply that CDS premia contain a significant non-default related component which CDS traders charge to protect themselves against informational and real frictions.

Keywords: CDS, frictions, asymmetric information, inventory risk, market power

JEL-Classification: G12, G14

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The Price Impact of CDS Trading

1. Introduction

Are CDS premia a fair measure of the underlying reference entity's default risk? If the market for credit risk were complete and frictionless, CDS premia should only depend on the credit risk of the reference entity. Since CDS are derivatives, many empirical studies claim that the impact of frictions is limited, and therefore use the CDS premium as a credit risk proxy (see, e.g., Norden and Weber 2004, Blanco, Brennan, and Marsh 2005, Longstaff, Mithal, and Neis 2005). Recent theoretical models, however, have shown that even assets in zero net supply, such as CDS, can be materially affected by illiquidity (see, e.g., Bongaerts, De Jong, and Driessen 2011, Garleanu, Pedersen, and Poteshman 2009, Bühler and Trapp 2011). Therefore, real (inventory risk and market power) and informational (asymmetric information) frictions identified in the market microstructure theory (Stoll 2000) may well distort CDS premia.

The contribution of our paper is that we give direct evidence of sizeable premium components in CDS transaction premia caused by these frictions. To do so, we employ a unique dataset of CDS data at the individual transaction level provided by the Depository Trust and Clearing Corporation (DTCC) that spans inter-dealer trades and trades between dealers and buy-side investors. We first analyze how past CDS trades are related to future CDS premia. We determine how the traders adjust their CDS premium in response to whether they act as a net buyer or a net seller of protection, and how their premium relates to the market average premium. We find that a trader who sells (buys) protection increases (decreases) her CDS premium relative to the last trading price by 1.3 bp, or 18% of the average CDS premium change. Compared to the market-average CDS premium, this trader charges (earns) a mark-up of 0.3 bps. These results are consistent with the market microstructure intuition that order flows are informative, and that CDS traders adjust their quotes in line with the direction of the observed order flows (Glosten and Milgrom 1985, Kyle 1985).

Second, we explore how inventory risk affects the impact of order flow on premium adjustments (see, e.g., Ho and Stoll 1983). We use transaction size and the change in the average market-wide CDS premium since the previous transaction as measures of the inventory risk a trader incurs. We find a considerable impact of inventory risk: transactions with higher inventory risk increase the premium by 7.9 bps on average, which equals 113% of the average premium change. The mark-up increases by factor five.

Third, we analyze the impact of market power. We do so by distinguishing between dealer and buy-side investor trades. Duffie, Garleanu and Pedersen (2005, 2008) show that search costs play a role in CDS markets. As Feldhütter (2012) argues for corporate bond markets, search costs can lead to market power of traders with lower search costs. Hence, a CDS buy-side trader could be more likely to trade at less attractive prices because of higher search costs. Consistent with this intuition, we find that asymmetric information and inventory risk only matter for trades with buy-side investors. There, a trader who has sold (bought) protection increases (decreases) their CDS premium by 3.5 bps (as compared to 1 bp for the full sample). If we consider inventory risk, the increase of the CDS premium is 7.8 bps higher than for dealers. Taken together, buy-side investors have to bear the impact of asymmetric information and inventory risk which their trades entail, while dealers face flat price impact functions.

Our study is the first to give direct evidence of such a sizeable premium effect of informational and real frictions. To the best of our knowledge, only two other studies analyze the relation between trades and CDS premia at the transaction level, but are both subject to considerable data restrictions. Tang and Yan (2011) do not detect a significant relation between changes in CDS prices and transaction volume. This finding fits well with our results, since they focus only on inter-dealer trades. Shachar (2012) computes aggregate end-of-day inventory changes for financial firms, also using DTCC data, and explores their impact on end-of-day average CDS Markit quotes. The differences between our studies can be explained by (i) her usage of only financial firms that are also frequently dealers, and (ii) the aggregate data set she uses.

Besides these two studies that directly analyze the impact of frictions, many studies use indirect proxies for frictions. Acharya and Johnson (2007) find evidence for informed trading in CDS markets, but do not detect a price impact. Arora, Gandhi, and Longstaff (2012) show that counterparty risk plays almost no role in CDS premia. A large group of studies (see, e.g., Tang and Yan 2009, Bongaerts, De Jong, and Driessen 2011) measure frictions indirectly via bid-ask spreads, and show a significant relation between these spreads and CDS premium levels. However, these studies cannot reliably quantify the friction-based component in CDS premia since bid-ask spreads are also affected by fundamental risk. Hence, the use of bid-ask spreads is likely to give biased estimates. In contrast, our approach allows us to integrate studies that document the existence of frictions in the CDS market with empirical evidence on significant liquidity premia, and is the first to give direct evidence of their price impact.

In addition to being the first to explicitly study the price impact of informational and real frictions on CDS premia, we contribute to the broader field of market efficiency and derivatives market microstructure as follows. First, we contribute to the growing body of price informativeness in derivatives markets. As argued above, CDS premia are frequently used as a market-implied credit risk measure because the CDS market is believed to be relatively efficient (see, e.g., Norden and Weber 2004, Blanco, Brennan, and Marsh 2005, or Gündüz and Kaya 2013). Our result, however, shows that a significant part of consensus CDS prices[1] might not be due to fundamentals, but to large transactions by the contributing dealers.

Second, several recent studies (Garleanu, Pedersen, and Poteshman 2009, Bongaerts et al. 2011, Duffie 2010a) address the impact of price pressure on derivatives markets, but are (at best) limited to inferring price impact via aggregate net demand or supply. The question of how elastic CDS prices are is part of the broader topic of derivatives market efficiency, and whether traders have the potential to affect prices via demand-based price pressure (Duffie 2010a, 2010b, Stulz 2010). Our data allow us to answer this question at the individual trader level. We show that demand and supply-based price pressure play a significant role in price formation in derivatives markets, and that dealers have considerable market power.[2]

The remainder of the paper is structured as follows. Section 2 describes the DTCC dataset and the computation of the premium changes and order flows. Section 3 develops the hypotheses and presents the results, and Section 4 displays the results of several robustness checks. Section 5 summarizes and concludes.

2. Data

2.1. The DTCC Dataset

Our unique dataset comes from the Depository Trust & Clearing Corporation (DTCC), which provides clearing and settlement services for over-the-counter credit derivatives through its subsidiary DTCC Deriv/SERV LLC.[3] The DTCC estimates that its coverage of credit

[1] Among the most frequently used CDS data providers are CMA and Markit, who base their consensus prices on contributions from dealers.
[2] This is of particular importance as empirical evidence, e.g. Blanco, Brennan, and Marsh (2005), shows that (corporate) bond yield spreads follow CDS premia. This result is consistent with informed trading being more likely in the CDS market where shorting credit risk is cheaper and traders are more short-term oriented.
[3] "DTCC Deriv/SERV provides automated repository and asset servicing for over-the-counter (OTC) credit derivatives trades. It also provides related matching of payment flows and bilateral netting services.

derivatives amounts to 95% of single-name CDS in terms of the number of contracts, and 99% of single-name CDS with respect to notional amounts.

We study CDS transaction premia, instead of quotes. This has the advantage that we use reliable, confirmed prices at which traders buy and sell protection via CDS contracts. The European Central Bank endorses this view in its 2009 CDS report: "As the [DTCC] data are based on actual settlement instructions, this may currently be the most accurate data source available."[4]

The database contains all transactions (new trades, assignments, and terminations[5]) for single-name CDS with German companies as the reference entity from January 2009 to June 2011. Our dataset thus fully covers the CDS activities concerning German reference entities. The transaction types, especially assignments, are described in more detail in the appendix. For each transaction, the DTCC data contain the following information: the legal name of the protection buyer and protection seller, a DTCC-specific classification of the buyer and seller as a dealer[6] or buy-side trader, the submitter of the transaction to the DTCC (both buyer and seller submit the transaction details once), the legal name and Markit RED pair code of the reference entity, an ISIN specifying the standard reference obligation, which allows us to infer the seniority of the CDS, the contract termination date (maturity date), the currency and notional volume of the transaction, the transaction date, and the submission time and date. The DTCC additionally reports a trade-specific conventional CDS premium for new trades, which constitute approximately one-third of all transactions.

Deriv/SERV's customer base, which includes dealers and buy-side firms from more than 52 countries, is the market's largest post-trade service provider for OTC derivatives. In 2009, Deriv/SERV processed a record 11.5 million transactions." (http://www.dtcc.com/about/subs/derivserv/derivserv.php)

[4] See ECB (2009), p. 11.

[5] Amendments are not included in our dataset, as the DTCC is currently unable to indicate which part of the original CDS contract has been amended.

[6] The DTCC defines a dealer as any trader "who is in the business of making markets or dealing in credit derivative products." (http://www.dtcc.com/downloads/products/derivserv/tiw_data_explanation.pdf)

Overall, our dataset contains 432,560 observations where 595 market participants submit information on CDS transactions for 70 German reference entities. According to the DTCC definition, 22 submitters are classified as dealers, and the remaining 573 as buy-side traders. 87% of all transactions have a dealer as buyer or seller, and 75% of transactions are inter-dealer trades. The majority of transactions are undertaken by G14 dealers,[7] who act as protection sellers for 80% and as protection buyers for 76% of all transactions. These proportions imply a large dealer market share, and hence a high potential impact of asymmetric information and, as also pointed out by Gündüz, Lüdecke, and Uhrig-Homburg (2007), of dealer market power.

The most frequently traded reference entities are Daimler, Deutsche Telekom and Volkswagen, with more than 20,000 transactions each. The fourth most frequently traded reference entity, representing 4.5% of all transactions, is the Federal Republic of Germany, our only sovereign reference entity. 26 of the 70 reference entities are members of the DAX, the index of the 30 largest German companies in terms of equity market capitalization. The remaining 43 companies are mostly members of the MDAX, and hence rank immediately below the DAX companies. This distribution, combined with the large market share of German CDS transactions mentioned above, makes us confident that our dataset is representative of the corporate CDS market as a whole.

Around half of the CDS contracts have a five-year maturity on initiation, and 91% of all contracts are senior CDS. 80% of the trades are denominated in EUR, while USD-denominated trades constitute 19% of the sample. New trades of CDS denominated in EUR have an average notional volume of 7.28 million, with a median of 5 million. Our overall

[7] The G14 dealers comprise Bank of America-Merrill Lynch, Barclays Capital, BNP Paribas, Citi, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JP Morgan, Morgan Stanley, RBS, Societe Generale, UBS and Wells Fargo Bank.

transaction volume (new trades, assignments and terminations) adds up to EUR 2.8 trillion, of which EUR 1 trillion are new trades.

The frequency of trades varies across reference entities. We observe a maximum of 348 trades for one reference entity on one day, but an average of 225 trades for all reference entities per day. If we break down the entities into the most actively traded (top 14 entities) and infrequently traded (bottom 28 entities), the most actively traded entities have an average of 9.13 trades, whereas for the infrequently traded entities this value is as low as 0.05. In the next section, we describe how we standardize order flows to ensure that our results are not driven by these differences in trading frequency.

2.2. Order Flow and Transaction Premia

We construct separate submitter-specific time series for each reference entity / ISIN / seniority / currency / maturity combination.[8] This gives us a total of 9,266 time series for 595 submitters. For each of these time series, we assign a positive sign to notional volumes of transactions when the submitter acts as protection seller and a negative sign when the submitter acts as protection buyer.

To facilitate a comparison of the different time series, we standardize the order flows in the same manner as Hansch, Naik, and Viswanathan (1998). First, we add up the signed notional volumes of all transactions between two new trades to construct the aggregate order flow a dealer faces. Second, we subtract the time-series average from the aggregate order flow at each new trade date, and then standardize by dividing this quantity by the standard deviation.

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[8] We might thus over- or understate the submitter-specific order flows because different term structures and currencies for CDS on the same reference entity constitute comparable credit risk exposures. However, since the correct aggregation procedure is by no means apparent, we instead provide a distinct treatment for every individual time series at the lowest possible aggregation level.

In addition to the DTCC transaction level CDS price information reported for each new trade, we collect Credit Market Analysis (CMA) benchmark market prices from Bloomberg for a CDS contract with the same currency, maturity and seniority as the DTCC trade CDS. This allows us to measure the premium change between two new trades in two alternative ways: the premium change (premium of the current trade minus premium of the most recent trade), and the premium mark-up (difference between the current trade premium and the Bloomberg mid CDS premium). We relate these premium changes to the standardized order flow between two new trade dates in Section III, and present the descriptive statistics of our final sample in Table I.

Panel A of Table I shows the descriptive statistics for the DTCC and Bloomberg price information that we use throughout the rest of the study. The mean premium for DTCC trades equals 185 bps, whereas the average market benchmark premium is 204 bps. The negative average changes in the CDS premium (-7 bps for the DTCC data, -6 bp for the Bloomberg data) are consistent with a decrease in credit risk in the aftermath of the financial crisis. Panel B of Table I gives the descriptive statistics for the order flow, which show that the average order flow between two trades equals EUR 80,000 (comparing this quantity to an average trade size of EUR 7.28 million shows that the difference between order flow and new trades is sizeable). We also observe a large dispersion among counterparties, which is reduced when we use normalized order flows.

Table I – Sample Description

The table shows summary statistics for our sample. Premium denotes the DTCC transaction premium in bps, Premium Change the change in the DTCC transaction premium between two new trades. Market Premium (Bloomberg) and Market Premium Change (Bloomberg) denote the corresponding statistics using CMA average mid-quotes downloaded via the Bloomberg system. Abnormal Premium denotes the difference between the DTCC transaction premium and the same-day CMA average mid-quote in bps, Abnormal Premium Change the change in this quantity between two new trades. Relative Abnormal Premium denotes the abnormal premium relative to the same-day CMA average mid-quote, Relative Abnormal Premium Change the change in this quantity between two new trades. Order flow denotes the submitter-specific order flow for a particular reference entity/maturity/currency/seniority combination in EUR million between two new trades. Normalized Order Flow denotes the order flow standardized as in Hansch et al. (1998) by subtracting the time-series average order flow at each date, and then standardizing by dividing the mean-0 order flow by the standard deviation.

	Mean	Median	Minimum	Maximum	Std. Dev.	N
Panel A: Premium Statistics						
Premium	185.41	95.00	0.10	3,334.17	258.67	54087
Premium Change	-6.98	-0.00	-2,589.35	1,255.12	68.79	53000
Market Premium (Bloomberg)	204.51	103.57	16.83	2,410.57	258.15	53503
Market Premium Change (Bloomberg)	-5.86	0.00	-1,798.06	772.27	55.21	52405
Abnormal Premium	-13.19	-1.75	-938.75	947.44	59.62	53503
Abnormal Premium Change	-1.07	0.00	-1,010.21	800.22	32.34	52405
Relative Abnormal Premium	-0.09	-0.01	-1.00	5.56	0.20	53503
Relative Abnormal Premium Change	-0.01	0.00	-5.79	3.99	0.11	52405
Panel B: Order Flow Statistics						
Order Flow	-0.08	0.00	-956.82	950.00	19.78	53000
Normalized Order Flow	0.00	0.00	-5.45	5.33	0.73	53000

3. Hypotheses Development and Empirical Results

3.1. Asymmetric Information - Order Flow Direction

At the core of our analysis is the price impact function. Traders adjust quotes in reaction to the observed order flow for a variety of reasons, including asymmetric information and inventory risk. In general, market microstructure suggests that traders interpret a positive (negative) order flow as a sign of a higher (lower) fundamental value of the reference entity. Translating this to the CDS setting, a positive order flow (a submitter who sells protection) is an indication of higher credit risk. Hence, a CDS trader will increase premia to reflect the updated credit risk estimate. Conversely, a trader will decrease premia in reaction to a negative order flow (a submitter who buys protection). This consideration leads to the following hypothesis.

H1: Transaction Direction

CDS traders increase (decrease) their CDS premium changes when selling (buying) protection.

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + \varepsilon_t \qquad \text{(I)}$$

where Δprem_t is the premium change since the previous CDS trade, or the premium mark-up compared with the average mid-quote, for a representative submitter on a representative reference entity, $1_{\text{submitter=seller}}$ is a dummy variable that takes on the value 1 if the CDS trader sells protection, and $1_{\text{submitter=buyer}}$ is a dummy variable that takes on the value 1 if the CDS trader buys protection.[9] If traders react to the direction of the order flow, as suggested by standard market microstructure theory, we expect $b > 0$.

Our regression equations require that the time series of CDS premium changes and order flows are stationary. Non-stationarity is rejected for all time series using an Augmented Dickey-Fuller test. We use pooled OLS to estimate the regression equations and control for time-invariant differences between the time series by including submitter, underlying, currency and maturity fixed effects separately and simultaneously. The estimation results are presented in Table II.

Consistent with Hypothesis 1, Panel A of Table II documents a significant premium increase when CDS traders sell protection, and a significant premium decrease when CDS traders buy

[9] Equation (I) is well-specified even though we do not use the dummy variables separately, since they are complementary. We use the difference between the two dummy variables to obtain a unique sign of the factor loading.

Table II – Transaction Direction

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (I), the regression of the premium change (Panel A) and the mark-up (Panel B) on the direction of the transaction. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The direction of the transaction is given as +1 if the transaction submitter sells protection in the current transaction and as -1 if the transaction submitter buys protection in the current transaction. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + \varepsilon_t$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-4.3566**	1.6835	5.7657	-0.0320	0.7892	11.1915
	(-17.53)	(0.18)	(1.48)	(-0.03)	(0.25)	(0.95)
b	**1.2890**	**1.2879**	**1.1087**	**1.2613**	**1.2402**	**1.1007**
	(5.19)	**(5.16)**	**(4.50)**	**(5.07)**	**(5.00)**	**(4.46)**
Adj. R^2 [%]	0.0507	0.1954	2.2042	0.0876	0.5891	2.6998
N			53,000			

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-7.6473**	0.4302	1.4766	0.3891	**6.3634**	13.9445
	(-30.52)	(0.05)	(0.38)	(0.38)	**(2.30)**	(1.10)
b	0.3197	0.4061	0.2766	0.2656	0.0424	0.1147
	(1.28)	(1.62)	(1.12)	(1.06)	(0.20)	(0.54)
Adj. R^2 [%]	0.0030	0.4437	3.4137	0.1227	25.7748	28.4546
N			53,503			

protection. Regarding the economic significance of the results, a CDS sale (purchase) transaction increases (decreases) the premium change by between 1.29 bps and 1.10 bps, corresponding to an increase of 16% to 18% compared with the mean change of 7 bp. For the mark-up, the coefficient estimates in Panel B of Table II are also positive, but not statistically significant. Finally, the estimates are unaffected by any fixed effects.

Next, we consider different specifications which allow us to vary the extent to which an order flow is informative, and to pinpoint the effects of inventory risk and asymmetric information.

3.2. Inventory Risk

In Equation (I) we only considered the direction of the order flow. This is consistent with the intuition of simple market-maker models that traders observe order flows of a fixed size, and that they obtain no additional information regarding the fundamental value of the underlying reference entity (see, e.g., Hasbrouck 1991 and Glosten and Milgrom 1985). These simplifying assumptions do not hold for CDS markets. First, CDS quotes usually apply to a given transaction size range, and are not representative for transactions outside this size range. Hence, traders can react to the higher inventory risk they accumulate in larger transactions by adjusting their premia. Second, the time between two transactions varies significantly within and across the time series. The longer the time between two transactions, the more likely it is that the fundamental credit risk of the underlying reference entity changes between the first and the second transaction. If, for example, a CDS trader increases the transaction premium by 10 bps between two transactions, this increase could partially reflect a higher default risk of the underlying reference entity, and the higher associated inventory risk that the trader takes on when selling protection. Data providers such as Markit or CMA publish aggregate market bid and ask quotes which indicate the market consensus premium, thereby providing a publicly available signal of a reference entity's fundamental default risk. Conversely, if the market consensus CDS premium decreases between two transactions, the inventory value of a CDS trader who buys protection decreases, and their inventory risk increases.

We therefore formulate the following hypotheses that allow us to explore the impact of inventory risk on CDS transaction premia.

H2: Order Flow

The higher (lower) the order flow a dealer observes, the higher (lower) the price adjustment to a positive (negative) order flow should be.

$$\Delta prem_t = a + b \cdot OF_t + \varepsilon_t \qquad (\text{II})$$

H3: Fundamental Risk

The higher the recent ***increase*** *in market CDS premia since the last trade, the higher (lower) the price adjustment to a CDS sale (purchase) transaction should be. Correspondingly, the higher the recent* ***decrease*** *in market CDS premia since the last trade, the higher (lower) the price adjustment to a CDS purchase (sale) transaction should be.*

$$\begin{aligned}\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)_t + c \cdot \Delta market_t \\ + d \cdot \Delta market_t \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)_t + \varepsilon_t\end{aligned} \qquad (\text{III})$$

H4: Order Flow and Fundamental Risk

The higher the recent ***increase*** *in market CDS premia since the last trade, the higher (lower) the price adjustment to a higher order flow should be. Correspondingly, the higher the recent* ***decrease*** *in market CDS premia since the last trade, the higher (lower) the price adjustment to a lower order flow should be.*

$$\Delta prem_t = a + b \cdot OF_t + c \cdot \Delta market_t + d \cdot \Delta market_t \cdot OF_t + \varepsilon_t \qquad \text{(IV)}$$

Δprem_t, $1_{\text{submitter=seller}}$, and $1_{\text{submitter=buyer}}$ are defined as in Equation (II), OF_t is the normalized order flow as explained in Section II, and Δmarket_t is the change in the benchmark market CDS premium for the reference entity since the last trade. If traders consider inventory risk when adjusting their premia, and do so more strongly for higher inventory risk, we expect that $b > 0$, $c > 0$, and $d > 0$ in Equations (II) to (IV). The estimation results are presented in Tables III to V.

The results in Table III confirm our findings from Table II. A standard protection sale (purchase) is associated with statistically significant higher premium increases (decreases) of 1.57 bps (Panel A). Regarding the economic significance of the results, this corresponds to a premium change that is 23% higher than the average premium change for a trade with a notional volume of EUR 19.78 million (see Table I). The premium mark-up is again positively, but not significantly, associated with a higher order flow. Again, our results are robust against the use of different fixed effects.

As the results in Table IV show, a higher market premium increase (decrease) is associated with statistically significant higher (lower) CDS premium changes and mark-ups. The estimates for the transaction direction impact remain positive and are significant in almost all specifications in Panels A and B of Table IV. In addition, the estimates for the market premium change and the transaction direction interacted with the market premium change are always positive and significant. Hence, a higher fundamental risk of the underlying reference

Table III – Order Flow Impact

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (II), the regression of the premium change (Panel A) and the mark-up (Panel B) on the order flow. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The order flow is measured as the change in the normalized order flow through the current trade. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\Delta prem_t = a + b \cdot OF_t + \varepsilon_t$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-4.3332**	1.1391	5.8843	0.1108	0.9191	10.7319
	(-17.43)	(0.12)	(1.51)	(0.11)	(0.29)	(0.91)
b	**1.5695**	**1.5987**	**1.5598**	**1.5648**	**1.5869**	**1.5922**
	(2.81)	**(2.87)**	**(2.83)**	**(2.81)**	**(2.85)**	**(2.89)**
Adj. R^2 [%]	0.0149	0.1607	2.1815	0.0539	0.5574	2.6785
N			53,000			

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-8.6011**	0.2387	1.4386	0.4478	6.5258	14.7777
	(-32.86)	(0.03)	(0.38)	(0.44)	(2.44)	(1.19)
b	0.1827	0.1910	0.2302	0.1692	0.3429	0.3868
	(0.33)	(0.35)	(0.42)	(0.31)	(0.73)	(0.84)
Adj. R^2 [%]	0.0002	0.4978	3.5784	0.1443	28.0008	30.6292
N			52,423			

Table IV – Transaction Direction and Inventory Risk (Market Premium)

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (III), the regression of the premium change (Panel A) and the premium mark-up (Panel B) on the direction of the transaction, the market premium change, and the direction of the transaction interacted with the market premium change. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The direction of the transaction is given as +1 if the transaction submitter sells protection in the current transaction and as -1 if the transaction submitter buys protection in the current transaction. The market premium change is measured as the current Bloomberg mid CDS premium minus the Bloomberg mid CDS premium observed on the day of the most recent trade. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)_t + c \cdot \Delta market_t$$
$$+ d \cdot \Delta market_t \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)_t + \varepsilon_t$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	-0.0964	0.0436	-2.7197	-0.0657	0.4219	-2.1275
	(-0.68)	(0.01)	(-1.22)	(-0.11)	(0.23)	(-0.25)
b	**0.6888**	**0.7028**	**0.6892**	**0.6886**	**0.6839**	**0.6988**
	(4.87)	**(4.95)**	**(4.87)**	**(4.87)**	**(4.84)**	**(4.92)**
c	**1.1904**	**1.1903**	**1.1895**	**1.1903**	**1.1897**	**1.1889**
	(336.00)	**(335.52)**	**(330.77)**	**(335.90)**	**(334.71)**	**(329.47)**
d	**0.0366**	**0.0366**	**0.0365**	**0.0366**	**0.0366**	**0.0365**
	(10.33)	**(10.32)**	**(10.30)**	**(10.33)**	**(10.34)**	**(10.30)**
Adj. R^2 [%]	68.6383	68.6405	68.6548	68.6383	68.6509	68.6695
N			52,423			

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
	-7.5550	0.3852	0.3882	0.3786	**6.4677**	13.6025
	(-30.84)	(0.04)	(0.10)	(0.38)	**(2.43)**	(1.10)
b	**0.4773**	**0.5648**	**0.4382**	**0.4230**	0.2205	0.2882
	(1.95)	**(2.30)**	**(1.82)**	**(1.73)**	(1.06)	(1.40)
c	**0.1472**	**0.1461**	**0.1467**	**0.1461**	**0.0946**	**0.1022**
	(23.97)	**(23.82)**	**(23.96)**	**(23.79)**	**(18.04)**	**(19.57)**
d	**0.0392**	**0.0397**	**0.0382**	**0.0391**	**0.0310**	**0.0292**
	(6.38)	**(6.47)**	**(6.33)**	**(6.37)**	**(5.93)**	**(5.68)**
Adj. R^2 [%]	1.1214	1.6041	4.6584	1.2466	28.4697	31.1532
N			52,423			

entity causes traders to adjust their quotes more strongly to the direction of the transaction. Regarding the economic significance, a CDS trader selling protection increases their premium vis-à-vis the previous trade by on average 0.69 bps + 1.19 * 5.86 + 0.04 * 5.86 bps = 7.88 bps, or 2.02 bps *more* than the market premium, for a standard market premium change (see Panel A of Table I for the average market premium change), and charges a mark-up of 0.48 bps + 0.15 * 5.86 bps + 0.04 * 5.86 bps = 1.57 bps.

Finally, we present the results where we simultaneously consider order flow size and the market premium change. Table V shows that a higher (lower) order flow matters more when it coincides with a market premium increase (decrease). Regarding the premium change, we observe statistically significant positive estimates for order flow, the market premium change, and order flow interacted with the market premium change. The economic size of the effect is again substantial with an average increase due to a sale of 1.17 bps + 1.19 * 5.86 + 0.02 * 5.86 bps = 8.28 bps, or 2.42 bps more than the market premium. For the premium mark-up, the positive but statistically insignificant estimates for the order flow itself are consistent with the insignificant estimates of the transaction direction in Panel B of Table II. The interaction term, however, is highly significant, suggesting that a standard order flow is associated with a mark-up of 0.06*5.86 = 0.33 bps on average.

Overall, the results of this section imply that CDS premia strongly reflect the traders' inventory risk. Not only the direction of a trade, but also its size and the fundamental risk reflected in the trade affect CDS traders' transaction premia. The substantial size of the effect suggests that CDS premia, which are often used as an unbiased measure of the fundamental credit risk of the underlying reference entity, can be strongly affected by demand and supply imbalances in the CDS market.

Table V – Order Flow and Inventory Risk

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (IV), the regression of the premium change (Panel A) and the premium mark-up (Panel B) on the order flow, the market premium change, and the order flow interacted with the market premium change. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the current Bloomberg mid CDS premium. The order flow is measured as the normalized order flow through the current trade. The market premium change is measured as the current Bloomberg mid CDS premium minus the Bloomberg mid CDS premium observed on the day of the most recent trade. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\Delta prem_t = a + b \cdot OF_t + c \cdot \Delta market_t + d \cdot \Delta market_t \cdot OF_t + \varepsilon_t$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	-0.0825	-0.2016	-2.6253	0.0151	0.5023	-2.1732
	(-0.58)	(-0.04)	(-1.18)	(0.03)	(0.28)	(-0.25)
b	**1.1709**	**1.1733**	**1.1758**	**1.1707**	**1.1695**	**1.1771**
	(3.66)	**(3.66)**	**(3.67)**	**(3.66)**	**(3.65)**	**(33.67)**
c	**1.1946**	**1.1946**	**1.1936**	**1.1946**	**1.1940**	**1.1931**
	(337.32)	**(336.85)**	**(332.01)**	**(337.22)**	**(336.04)**	**(330.73)**
d	**0.0178**	**0.0179**	**0.0180**	**0.0178**	**0.0175**	**0.0179**
	(2.55)	**(2.57)**	**(2.58)**	**(2.55)**	**(2.52)**	**(2.56)**
Adj. R^2 [%]	68.5649	68.5669	68.5820	68.5649	68.5775	68.5963
N			52,423			

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-7.5427**	0.0658	0.4324	0.4300	**6.5054**	13.5148
	(-30.79)	(0.01)	(0.11)	(0.43)	**(2.44)**	(1.09)
b	0.4366	0.4433	0.4474	0.4237	0.6119	0.6071
	(0.79)	(0.80)	(0.82)	(0.76)	(1.30)	(1.31)
c	**0.1458**	**0.1447**	**0.1452**	**0.1446**	**0.0938**	**0.1013**
	(23.77)	**(23.62)**	**(23.73)**	**(23.59)**	**(17.92)**	**(19.42)**
d	**0.0566**	**0.0570**	**0.0498**	**0.0565**	**0.0555**	**0.0475**
	(4.70)	**(4.73)**	**(4.20)**	**(4.69)**	**(5.41)**	**(4.71)**
Adj. R^2 [%]	1.0826	1.5620	4.6149	1.2092	28.4618	31.1395
N			52,423			

3.3. Market Power

Many empirical studies, e.g. Edwards et al. (2007), document a price wedge between institutional and retail investors. One explanation for this price wedge is market power: price competition in opaque OTC markets is lower, and search costs are high, allowing institutional investors to extract rents from retail investors. Feldhütter (2012) argues that these search costs are a potential explanation for the observed liquidity premia in corporate bonds' yield spreads. Duffie, Garleanu and Pedersen (2005, 2008) show that search costs can also play an important role in CDS markets. Hence, CDS traders with little market power may be more likely to trade at a premium that deviates from the fair price because their outside options are lower than those of a trader with high market power.

We exploit variation in trader type to assess the impact of market power. We assume that CDS dealers have more market power than CDS buy-side traders. This assumption is sensible, since most transactions we observe report one out of a small group of dealers as one counterparty to the trade.[10]

We therefore formulate the following hypothesis.

H5: Market Power

If the counterparty of a trade is a dealer, the submitter changes the premium to a lesser extent than for a trade with a buy-side counterparty.

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t \qquad \text{(V)}$$

[10] Studies on asymmetric information also use the distinction between dealer and buy-side investor to differentiate between uninformed (dealers) and informed (buy-side) investors. However, since dealers in CDS markets are large, financial institutions, we do not believe that they have an informational advantage compared to buy-side investors. In addition, if order flow is informative, dealers should observe more, not less, information than buy-side investors.

where Δprem_t, $1_{\text{submitter=seller}}$, and $1_{\text{submitter=buyer}}$ are defined as in Equation (II), and $1_{\text{counterparty=dealer}}$ is a dummy variable that takes on the value 1 if the submitter's counterparty is a dealer. If market power plays a role, we expect that $c < 0$. The estimation results are presented in Table VI.

As Panels A and B of Table VI show, transactions with CDS dealers lead to statistically significantly lower premium increases and mark-ups than transactions with CDS buy-side investors. While a sale to a buy-side investor increases the premium by 3.5 bps, the sale to a dealer increases the premium by only 3.5 bps – 2.5 bps = 1 bp, and dealers pay no mark-ups compared with the market premium. This is consistent with the economic intuition that CDS dealers have market power, and therefore obtain better conditions when trading in the CDS market than buy-side traders.

To conclude our empirical analysis, we explore the interaction of market power and asymmetric information with the inventory risk measures from Section 3.2. Standard models suggest that market power plays a greater role when fundamental risk is high. We therefore formulate the following hypothesis.

H6: Market Power, Asymmetric Information and Inventory Risk

If the counterparty of a trade is a dealer, the impact of asymmetric information and inventory risk on the transaction premium is smaller than for a trade with a buy-side counterparty.

This holds for all inventory risk measures, i.e. when inventory risk is measured by the fundamental risk change,

Table VI – Dealer vs. Buy-Side Transaction Direction

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (V), the regression of the premium change (Panel A) and the premium mark-up (Panel B) on the transaction direction and the transaction direction interacted with a dummy for whether the transaction is entered into with a dealer. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The direction of the transaction is given as +1 if the transaction submitter sells protection in the current transaction and as -1 if the transaction submitter buys protection in the current transaction. The dummy variable takes on a value of 1 if the submitter entered into a transaction with a dealer, and 0 otherwise. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-4.4020**	1.5562	5.5891	-0.2608	0.6581	11.2491
	(-17.68)	(0.16)	(1.43)	(-0.26)	(0.21)	(0.95)
b	**3.5010**	**3.5512**	**2.3875**	**3.2768**	**3.0045**	**2.1108**
	(4.71)	**(4.77)**	**(3.23)**	**(4.40)**	**(4.05)**	**(2.85)**
c	**-2.4904**	**-2.5497**	**-1.4380**	**-2.2678**	**-1.9861**	-1.1364
	(-3.16)	**(-3.23)**	**(-1.83)**	**(-2.87)**	**(-2.52)**	(-1.45)
Adj. R^2 [%]	0.0695	0.2150	2.2104	0.1031	0.6010	2.7036
N			53,000			

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-7.7357**	0.2301	0.9772	-0.0546	**6.2364**	14.0220
	(-30.82)	(0.02)	(0.25)	(-0.05)	**(2.26)**	(1.10)
b	**4.3579**	**4.4077**	**3.9221**	**3.9271**	**1.6551**	**2.2224**
	(5.80)	**(5.87)**	**(5.28)**	**(5.22)**	**(2.55)**	**(3.47)**
c	**-4.5435**	**-4.5051**	**-4.0965**	**-4.1169**	**-1.8142**	**-2.3698**
	(-5.70)	**(-5.65)**	**(-5.20)**	**(-5.16)**	**(-2.64)**	**(-3.49)**
Adj. R^2 [%]	0.0638	0.5032	3.4626	0.1723	25.7881	28.4709
N			53,503			

(H6 continued)

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}}$$
$$+ d \cdot \Delta market_t + e \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} \cdot \Delta market_t + \varepsilon_t \qquad (\text{VI.a})$$

the size of the order flow,

$$\Delta prem_t = a + b \cdot OF_t + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} + d \cdot OF_t \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t \qquad (\text{VI.b})$$

or the fundamental risk change and the order flow simultaneously:

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}}$$
$$+ d \cdot \Delta market_t + e \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} \cdot \Delta market_t$$
$$+ f \cdot OF_t + g \cdot OF_t \cdot 1_{\text{counterparty=dealer}} + h \cdot OF_t \cdot \Delta market_t$$
$$+ i \cdot OF_t \cdot \Delta market_t \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t \qquad (\text{VI.c})$$

The results of the estimation are presented in Tables VII to IX. From Table VII we observe that the impact of a market premium change on premium changes and mark-ups is significantly smaller for dealers, as the estimates of *c* and *e* in Equation (VI.a) are significantly smaller than 0 in both specifications. Hence, both asymmetric information and inventory risk play a significantly higher role in transactions with buy-side counterparties. Regarding the economic significance, market premia change by 1.99 bps + 0.04 * 5.86 bps = 2.20 bps more for non-dealers, compared to dealers.

Table VIII shows a similar result. The effect of the order flow is statistically and economically significantly smaller when the counterparty is a dealer, both for the premium change between two transactions (non-dealers pay premium changes which are higher by 1.10 bps + 6.69 bps = 7.80 bps) and for the mark-up charged in excess of the average market premium, in almost all specifications.

Table VII – Dealer vs. Buy-Side Transaction Direction and Inventory Risk

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (VI.a), the regression of the premium change (Panel A) and the premium mark-up (Panel B) on the transaction direction, the transaction direction interacted with a dummy for whether the transaction is entered into with a dealer, the market premium change, and the transaction direction interacted with a dummy for whether the transaction is entered into with a dealer and the market premium change. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The direction of the transaction is given as +1 if the transaction submitter sells protection in the current transaction and as -1 if the transaction submitter buys protection in the current transaction. The dummy variable takes on a value of 1 if the submitter entered into a transaction with a dealer, and 0 otherwise. The market premium change is measured as the current Bloomberg mid CDS premium minus the Bloomberg mid CDS premium observed on the day of the most recent trade. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}}$$
$$+ d \cdot \Delta market_t + e \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} \cdot \Delta market_t + \varepsilon_t$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	-0.1396	-0.0490	-3.0630	-0.2821	0.2924	-2.1614
	(-0.99)	(-0.01)	(-1.38)	(-0.49)	(0.16)	(-0.25)
b	**2.4691**	**2.4851**	**2.4894**	**2.4772**	**2.4287**	**2.4836**
	(5.86)	**(5.88)**	**(5.87)**	**(5.86)**	**(5.76)**	**(5.84)**
c	**-1.9915**	**-1.9948**	**-2.0114**	**-1.9995**	**-1.9513**	**-1.9952**
	(-4.45)	**(-4.45)**	**(-4.47)**	**(-4.46)**	**(-4.36)**	**(-4.42)**
d	**1.1890**	**1.1890**	**1.1882**	**1.1890**	**1.1884**	**1.1877**
	(333.95)	**(333.45)**	**(328.82)**	**(333.86)**	**(332.69)**	**(327.53)**
e	**-0.0363**	**-0.0364**	**-0.0362**	**-0.0363**	**-0.0364**	**-0.0363**
	(-9.67)	**(-9.67)**	**(-9.64)**	**(-9.67)**	**(-9.69)**	**(-9.65)**
Adj. R^2 [%]	68.6407	68.6430	68.6573	68.6408	68.6529	68.6719
N			52,423			

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-7.6256**	0.1623	0.0221	-0.0082	**6.3809**	13.7218
	(-31.08)	(0.02)	(0.01)	(-0.01)	**(2.39)**	(1.11)
b	**4.0591**	**4.1090**	**3.6462**	**3.6272**	**1.3872**	**1.9183**
	(5.55)	**(5.63)**	**(5.05)**	**(4.95)**	**(2.23)**	**(3.12)**
c	**-4.0647**	**-4.0243**	**-3.6434**	**-3.6370**	**-1.3406**	**-1.8640**
	(-5.24)	**(-5.19)**	**(-4.76)**	**(-4.68)**	**(-2.03)**	**(-2.86)**
d	**0.1477**	**0.1467**	**0.1473**	**0.1466**	**0.0950**	**0.1026**
	(23.93)	**(23.78)**	**(23.94)**	**(23.76)**	**(18.04)**	**(19.54)**
e	**-0.0333**	**-0.0339**	**-0.0312**	**-0.0333**	**-0.0261**	**-0.0232**
	(-5.12)	**(-5.22)**	**(-4.87)**	**(-5.11)**	**(-4.70)**	**(-4.26)**
Adj. R^2 [%]	1.1491	1.6305	4.6726	1.2637	28.4584	31.1464
N			52,423			

Table VIII – Dealer vs. Buy-Side Transaction and Order Flow

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (VI.b), the regression of the premium change (Panel A) and the premium mark-up (Panel B) on the order flow, the transaction direction interacted with a dummy for whether the transaction is entered into with a dealer, and the order flow interacted with a dummy for whether the transaction is entered into with a dealer. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The order flow is measured as the normalized order flow through the current trade. The direction of the transaction is given as +1 if the transaction submitter sells protection in the current transaction and as -1 if the transaction submitter buys protection in the current transaction. The dummy variable takes on a value of 1 if the submitter entered into a transaction with a dealer, and 0 otherwise. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\Delta prem_t = a + b \cdot OF_t + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} + d \cdot OF_t \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-4.3459**	1.5852	5.6290	0.0856	0.8544	10.8669
	(-17.48)	(0.17)	(1.44)	(0.08)	(0.27)	(0.92)
b	**6.3464**	**6.4329**	**5.1469**	**6.3180**	**5.9163**	**5.0207**
	(3.56)	**(3.60)**	**(2.91)**	**(3.54)**	**(3.32)**	**(2.84)**
c	**-1.1001**	**-1.0783**	**-0.9638**	**-1.0983**	**-1.0867**	**-0.9820**
	(-3.42)	**(-3.33)**	**(-3.03)**	**(-3.42)**	**(-3.39)**	**(-3.07)**
d	**-6.6944**	**-6.7308**	**-5.2023**	**-6.6658**	**-6.1815**	**-5.0503**
	(-3.48)	**(-3.50)**	**(-2.73)**	**(-3.47)**	**(-3.22)**	**(-2.65)**
Adj. R^2 [%]	0.0520	0.1969	2.2068	0.0907	0.5912	2.7035
N	53,000					

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-8.0708**	0.2697	1.2539	0.4284	**6.5162**	14.6942
	(-32.89)	(0.03)	(0.33)	(0.42)	**(2.44)**	(1.19)
b	**3.9638**	**4.0591**	**3.3558**	**3.8792**	2.3554	**2.9243**
	(2.20)	**(2.26)**	**(1.89)**	**(2.16)**	(1.54)	**(1.94)**
c	-0.0378	0.0903	-0.0684	-0.0427	-0.0764	-0.0481
	(-0.12)	(0.28)	(-0.22)	(-0.13)	(-0.28)	(-0.18)
d	**-4.1276**	**-4.3876**	**-3.3648**	**-4.0430**	-2.1250	**-2.7413**
	(-2.13)	**(-2.27)**	**(-1.77)**	**(-2.09)**	(-1.29)	**(-1.70)**
Adj. R^2 [%]	0.0095	0.5077	3.5848	0.1533	28.0035	30.6333
N	52,423					

Table IX confirms these results. When we simultaneously consider the market premium change and the order flow, the coefficient estimates of *c*, *e*, *g*, and *i* are almost always smaller than zero. This indicates that inventory risk has less of an impact on trades with CDS dealers. Regarding the economic significance, we find that CDS buy-side investors pay premia that are on average 1.69 bps + 0.06 * 5.86 bps + 1.16 bps + 0.09 * 5.86 bps = 3.78 bps higher than the fundamental value compared to dealers.

Overall, the results of this section imply that CDS dealers trade against flat price impact functions because they have considerable market power.

4. Robustness

As the results of Tables IV, V, VII, and IX show, the market premium change plays an important role in explaining the premium change and the premium markup. This effect could suggest that we omit a central variable in the regressions where the market premium change is not included: the underlying reference entity's default risk. If this were the case, we might wrongly attribute the impact of a market premium change to the direction of the transaction, the counterparty type, or to the order flow.

To address this issue, we run two robustness checks. First, we include the market premium change as an explanatory variable on the right-hand side in Equation (I), (II), (V) and (VI.b), and re-run the regression. Second, we compute the relative premium change (premium of the current trade divided by the Bloomberg mid premium, minus the premium of the most recent trade, divided by the Bloomberg mid premium during the most recent trade) and the relative mark-up (premium of the current trade minus the Bloomberg mid premium, divided by

Table IX – Dealer vs. Buy-Side Transaction, Order Flow, and Inventory Risk

The table shows coefficient estimates (and t-statistics in parentheses) for Equation (VI.c), the regression of the premium change (Panel A) and the premium mark-up (Panel B) on the order flow, the transaction direction interacted with a dummy for whether the transaction is entered into with a dealer, and the order flow interacted with a dummy for whether the transaction is entered into with a dealer. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The order flow is measured as the normalized order flow through the current trade. The direction of the transaction is given as +1 if the transaction submitter sells protection in the current transaction and as -1 if the transaction submitter buys protection in the current transaction. The dummy variable takes on a value of 1 if the submitter entered into a transaction with a dealer, and 0 otherwise. We use robust standard errors. Bold format indicates significance at the 10% level or less.

$$\begin{aligned}\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} \\ + d \cdot \Delta market_t + e \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} \cdot \Delta market_t \\ + f \cdot OF_t + g \cdot OF_t \cdot 1_{\text{counterparty=dealer}} + h \cdot OF_t \cdot \Delta market_t \\ + i \cdot OF_t \cdot \Delta market_t \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t\end{aligned}$$

Panel A: Dependent Variable Premium Change

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	-0.1237	-0.1503	-2.9471	-0.2447	0.3304	-2.2802
	(-0.87)	(-0.03)	(-1.33)	(-0.42)	(0.18)	(-0.27)
b	**2.0785**	**2.0950**	**2.0837**	**2.0882**	**2.0386**	**2.0794**
	(4.07)	**(4.10)**	**(4.06)**	**(4.08)**	**(3.99)**	**(4.04)**
c	**-1.6871**	**-1.6882**	**-1.6917**	**-1.6968**	**-1.6494**	**-1.6759**
	(-3.11)	**(-3.11)**	**(-3.10)**	**(-3.12)**	**(-3.04)**	**(-3.07)**
d	**1.1906**	**1.1906**	**1.1898**	**1.1906**	**1.1900**	**1.1893**
	(333.70)	**(333.20)**	**(328.55)**	**(333.61)**	**(332.45)**	**(327.27)**
e	**-0.0636**	**-0.0636**	**-0.0634**	**-0.0636**	**-0.0635**	**-0.0634**
	(-13.94)	**(-13.93)**	**(-13.90)**	**(-13.94)**	**(-13.94)**	**(-13.89)**
f	1.5257	1.5166	1.5760	1.5134	1.5201	1.5605
	(1.22)	(1.21)	(1.26)	(1.21)	(1.21)	(1.24)
g	-1.1629	-1.1724	-1.2145	-1.1506	-1.1498	-1.2099
	(-0.88)	(-0.89)	(-0.92)	(-0.87)	(-0.87)	(-0.91)
h	**0.1861**	**0.1861**	**0.1845**	**0.1861**	**0.1867**	**0.1852**
	(5.71)	**(5.71)**	**(5.66)**	**(5.71)**	**(5.73)**	**(5.68)**
i	**-0.0947**	**-0.0947**	**-0.0932**	**-0.0947**	**-0.0955**	**-0.0939**
	(-3.02)	**(-3.02)**	**(-2.97)**	**(-3.02)**	**(-3.04)**	**(-2.99)**
Adj. R^2 [%]	68.7138	68.7161	68.7302	68.7138	68.7257	68.7445
N			52,423			

Table IX – (Cont'd)

Panel B: Dependent Variable Premium Mark-up

Fixed Effects	None	Submitter	Underlying	Currency	Maturity	All
a	**-7.6531**	0.1834	-0.3251	-0.0451	**6.4123**	13.2531
	(-31.19)	(0.02)	(-0.09)	(-0.04)	**(2.41)**	(1.07)
b	**4.5918**	**4.6365**	**4.1344**	**3.9829**	1.1750	**1.7326**
	(5.19)	**(5.24)**	**(4.72)**	**(4.48)**	(1.56)	**(2.32)**
c	**-4.5855**	**-4.4942**	**-4.1390**	**-3.9805**	-1.2269	**-1.7477**
	(-4.88)	**(-4.78)**	**(-4.46)**	**(-4.22)**	(-1.53)	**(-2.21)**
d	**0.1445**	**0.1434**	**0.1441**	**0.1434**	**0.0921**	**0.0995**
	(23.35)	**(23.20)**	**(23.34)**	**(23.17)**	**(17.42)**	**(18.91)**
e	**0.0314**	**0.0321**	**0.0311**	**0.0313**	**0.0207**	**0.0200**
	(3.96)	**(4.06)**	**(4.00)**	**(3.96)**	**(3.07)**	**(3.03)**
f	-1.6692	-1.6406	-1.4891	-0.8956	1.5312	1.3901
	(-0.77)	(-0.76)	(-0.70)	(-0.41)	(0.83)	(0.76)
g	1.6214	1.4158	1.5155	0.8466	-1.1426	-1.1200
	(0.71)	(0.62)	(0.67)	(0.37)	(-0.59)	(-0.58)
h	**0.3737**	**0.3722**	**0.3640**	**0.3756**	**0.3572**	**0.3474**
	(6.86)	**(6.85)**	**(6.8)**	**(6.9)**	**(7.71)**	**(7.63)**
i	**-0.3686**	**-0.3677**	**-0.3654**	**-0.3707**	**-0.3404**	**-0.3381**
	(-6.52)	**(-6.52)**	**(-6.58)**	**(-6.56)**	**(-7.08)**	**(-7.16)**
Adj. R^2 [%]	1.2411	1.7220	4.7594	1.3552	28.5422	31.2240
N			52,423			

Bloomberg mid premium), and use these relative quantities as the dependent variables in Equations (I) to (IV.c).

We re-run the entire estimation procedure, but do not report all results for sake of brevity. First, we only report the results for the model that contains fixed effects for submitter, underlying, currency, and maturity, since this setting is most conservative with respect to our finding a significant impact of the explanatory variables. However, the results are similar for the models with no fixed effects, and only one fixed effect considered at a time. Second, we restrict the presentation to the most important variables in Table X.

Table X – Robustness

The table displays coefficient estimates (and t-statistics in parentheses) for the robustness analyses for Equations (I) to (VI.c). The panel headers give the reference to the table to which the robustness check applies and the corresponding regression equation. For ease of comparison, we again repeat the original results in the first and fourth column where the dependent variable is the premium change (column 1) and the markup (column 4) in Panel A to H. In the second and fifth column, we re-estimate the original regression with the market premium change as an additional explanatory variable for the premium change (column 2) and the premium markup (column 5) if the market premium change is not used as an explanatory variable in the original regression. In the third and sixth column, we re-estimate the original regression and use the relative premium change (column 3) and the relative markup (column 6) as the dependent variable. The explanatory variables are as in the original regression equation s for these columns. The premium change is measured as the premium of the current trade minus the premium of the most recent trade, the mark-up as the difference between the current trade premium and the Bloomberg mid CDS premium. The relative premium change is measured as the premium of the current trade, divided by the Bloomberg mid premium, minus the premium of the most recent trade, divided by the Bloomberg mid premium during the most recent trade. The relative mark-up is measured as the premium of the current trade minus the Bloomberg mid premium, divided by the Bloomberg mid premium. The explanatory variables are defined as in the original regression equations. We use robust standard errors. Bold format indicates significance at the 10% level or less.

	Premium Change			Markup		
	Original Result	+ Explanatory Variable Δ Market Premium	Dependent Variable Relative Premium Change [%]	Original Result	+ Explanatory Variable Δ Market Premium	Dependent Variable Relative Markup [%]
Panel A: Table II, $\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + \varepsilon_t$						
b	**1.1007**	**0.8280**	**0.3133**	0.1147	0.1849	**0.1504**
	(4.46)	**(5.84)**	**(7.92)**	(0.54)	(0.90)	**(3.69)**
Adj. R^2 [%]	2.6998	68.5580	0.2459	28.4546	31.0054	62.7034
N	53,000	52,423	52,423	53,000	52,423	53,503
Panel B: Table III, $\Delta prem_t = a + b \cdot OF_t + \varepsilon_t$						
b	**1.5922**	**1.0772**	**0.4992**	0.3868	0.3421	**0.2367**
	(2.89)	**(3.39)**	**(5.62)**	(0.84)	(0.74)	**(2.58)**
Adj. R^2 [%]	2.6785	68.5444	0.1865	30.6292	31.0051	63.7405
N	53,000	52,423	52,423	52,423	52,423	52,423
Panel C: Table IV, $\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)_t + c \cdot \Delta market_t + d \cdot \Delta market_t \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)_t + \varepsilon_t$						
b	**0.6988**	**-**	**0.3102**	0.2882	**-**	**0.1751**
	(4.92)	**-**	**(7.85)**	(1.40)	**-**	**(4.28)**
d	**0.0365**	-	**0.0055**	**0.0292**	-	**0.0018**
	(10.30)	-	**(5.54)**	**(5.68)**	-	**(1.76)**
Adj. R^2 [%]	68.6695	-	1.0952	31.1532	-	63.6785
N	52,423	-	52,423	52,423	-	52,423

Table X – (Cont'd)

	Premium Change			Markup		
	Original Result	+ Explanatory Variable Δ Market Premium	Dependent Variable Relative Premium Change [%]	Original Result	+ Explanatory Variable Δ Market Premium	Dependent Variable Relative Markup [%]
Panel D: Table V, $\Delta prem_t = a + b \cdot OF_t + c \cdot \Delta market_t + d \cdot \Delta market_t \cdot OF_t + \varepsilon_t$						
b	**1.1771**	-	**0.5060**	0.6071	-	**0.2406**
	(33.67)	-	**(5.6795)**	(1.31)	-	**(2.61)**
d	**0.0179**	-	**0.0029**	**0.0475**	-	0.0007
	(2.56)	-	**(1.69)**	**(4.71)**	-	(0.33)
Adj. R^2 [%]	68.5963	-	1.0412	31.1395	-	63.6692
N	52,423	-	52,423	52,423	-	52,423
Panel E: Table VI, $\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t$						
b	**2.1108**	**2.4805**	**1.3468**	**2.2224**	**1.9203**	**1.5609**
	(2.85)	**(5.83)**	**(11.35)**	**(3.47)**	**(3.12)**	**(12.75)**
c	-1.1364	**-1.8583**	**-1.1622**	**-2.3698**	**-1.9516**	**-1.5858**
	(-1.45)	**(-4.12)**	**(-9.24)**	**(-3.49)**	**(-2.99)**	**(-12.22)**
Adj. R^2 [%]	2.7036	68.5676	0.4063	28.4709	31.0159	62.8066
N	53,000	52,423	52,423	53,503	52,423	52,423
Panel F: Table VII, $\Delta prem_t = a + b \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} + d \cdot \Delta market_t + e \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} \cdot \Delta market_t + \varepsilon_t$						
b	**2.4836**	-	**1.3536**	**1.9183**	-	**1.5294**
	(5.84)	-	**(11.45)**	**(3.12)**	-	**(12.50)**
c	**-1.9952**	-	**-1.1733**	**-1.8640**	-	**-1.5261**
	(-4.42)	-	**(-9.36)**	**(-2.86)**	-	**(-11.76)**
e	**-0.0363**	-	0.0006	**-0.0232**	-	0.0011
	(-9.65)	-	(0.5863)	**(-4.26)**	-	(1.02)
Adj. R^2 [%]	68.6719	-	1.2595	31.1464	-	63.7727
N	52,423	-	52,423	52,423	-	52,423
Panel G: Table VIII, $\Delta prem_t = a + b \cdot OF_t + c \cdot \left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) \cdot 1_{\text{counterparty=dealer}} + d \cdot OF_t \cdot 1_{\text{counterparty=dealer}} + \varepsilon_t$						
b	**5.0207**	**4.6615**	**2.0819**	**2.9243**	**2.8700**	**1.8131**
	(2.84)	**(4.50)**	**(7.20)**	**(1.94)**	**(1.92)**	**(6.08)**
c	**-0.9820**	**-0.6571**	**-0.1467**	-0.0481	-0.0768	-0.0292
	(-3.07)	**(3.58)**	**(2.86)**	(-0.18)	(-0.29)	(-0.55)
d	**-5.0503**	**-4.7978**	**-1.9354**	**-2.7413**	**-2.6941**	**-1.7038**
	(-2.65)	**(-4.31)**	**(-6.23)**	**(-1.70)**	**(-1.67)**	**(-5.31)**
Adj. R^2 [%]	2.7035	68.5588	0.2613	30.6333	31.0067	63.6907
N	53,000	52,423	52,423	52,423	52,423	52,423

Table X – (Cont'd)

	Premium Change			Markup		
	Original Result	+ Explanatory Variable Δ Market Premium	Dependent Variable Relative Premium Change [%]	Original Result	+ Explanatory Variable Δ Market Premium	Dependent Variable Relative Markup [%]

Panel H: Table IX,

$$\Delta prem_t = a + b\cdot\left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right) + c\cdot\left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)\cdot 1_{\text{counterparty=dealer}}$$
$$+ d\cdot\Delta market_t + e\cdot\left(1_{\text{submitter=seller}} - 1_{\text{submitter=buyer}}\right)\cdot 1_{\text{counterparty=dealer}}\cdot\Delta market_t$$
$$+ f\cdot OF_t + g\cdot OF_t\cdot 1_{\text{counterparty=dealer}} + h\cdot OF_t\cdot\Delta market_t$$
$$+ i\cdot OF_t\cdot\Delta market_t\cdot 1_{\text{counterparty=dealer}} + \varepsilon_t$$

b	**2.0794**	-	**1.2815**	**1.7326**	-	**1.6230**
	(4.04)	-	**(8.94)**	**(2.32)**	-	**(10.94)**
c	**-1.6759**	-	**-1.1425**	**-1.7477**	-	**-1.6437**
	(-3.07)	-	**(-7.51)**	**(-2.21)**	-	**(-10.44)**
e	**-0.0634**	-	-0.0002	**0.0200**	-	0.0019
	(-13.89)	-	(-0.14)	**(3.03)**	-	(1.45)
f	1.5605	-	0.3113	1.3901	-	-0.3722
	(1.24)	-	(0.89)	(0.76)	-	(-1.03)
g	-1.2099	-	-0.1505	-1.1200	-	0.4648
	(-0.91)	-	(-0.41)	(-0.58)	-	(1.22)
h	**0.1852**	-	0.0019	**0.3474**	-	**0.0183**
	(5.68)	-	(0.21)	**(7.63)**	-	**(2.03)**
i	**-0.0939**	-	0.0009	**-0.3381**	-	**-0.0210**
	(-2.99)	-	(0.10)	**(-7.16)**	-	**(-2.24)**
Adj. R^2 [%]	68.7445	-	1.2589	31.2240	-	63.7752
N	52,423	-	52,423	52,423	-	52,423

As Table X shows, our main conclusions still hold. Sell (buy) transactions increase (decrease) transaction premia and markups (Panel A, C, E, F, H), and the more so if fundamental risk also increases (decreases) (Panel C), and if the transaction counterparty is not a dealer (Panel E, F, G, H). Large buy (sell) transactions increase (decrease) transaction premia and markups (Panel B, D, G), and the more so if fundamental risk increases (decreases) (Panel H), and if the counterparty is not a dealer (Panel G). Overall, the results of our robustness checks confirm our earlier results.

5. Conclusion

We use a unique, proprietary dataset to test the price impact of trades in CDS markets. We show that CDS traders adjust their quotes to the order flows they observe. This effect is stronger when the inventory risk is higher. To our knowledge, we are the first to provide evidence on such price pressure in CDS markets, as discussed by Duffie (2010a, b). Second, we exploit variation in trader type to examine the effect of market power, and find that buy-side traders pay significantly higher mark-ups than dealers. This finding is consistent with the notion that a lack of competition in CDS markets gives rise to dealer market power with significant price impact.

Our results have the following implications. First, since CDS premia are affected by order flows, we cannot rule out demand-based price manipulation. Whether manipulation strategies are profitable depends on the relative elasticity of purchase versus sale transactions, and is the subject of ongoing research. Second, one reason for proposing a centralized clearing counterparty for CDS is the reduction, or at least disclosure, of large net exposures. We show that this is not a fundamental concern, as CDS traders already exhibit behavior consistent with limiting their aggregate exposures. Third, our results imply that price discrimination is prevalent in the CDS market, and that dealers use their market power to extract monopoly rents from buy-side investors. Hence, introducing a centralized exchange or a reporting system that increases post-trade transparency for CDS could potentially contribute to more efficient risk sharing in CDS markets by increasing competition between CDS dealers, improving trading conditions for non-dealers, and thus contribute to more efficient risk sharing.

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Appendix

Data Matching

First, we identify the submitter of the CDS contract in the DTCC dataset. A typical CDS contract is submitted to the DTCC once by the buyer and once by the seller. Therefore, if we use the submitter information pivotally, we are able to observe each transaction from the buyer and the seller perspective. We treat each counterparty at the parent entity level. For example, we consider the New York and London branches of Deutsche Bank as a single party. Entity names are defined such that they have a unique CDS price time series. We only consider CDS series with a reference entity for which we know the ISIN. We remove all compression trades. These are netting trades, where a new price was not negotiated, and are tied only to the specific administrative process.

Assignments

These types of transactions define three roles for three counterparties. There is a step-out party, who transfers their role to the step-in party, and a remaining party. If the step-out party is a buyer (seller), then the new buyer (seller) for the transactions is the step-in party. Naturally, the role of the remaining party is not affected. We consider assignments where the step-out party is a seller, to decrease the step-out party's credit risk inventory and increase the step-in party's inventory, while the remaining party's inventory remains unaffected.

Time Stamps

The DTCC provides a date, not a time stamp, for each transaction. Therefore, we order our transactions according to three identifiers. (i) First, transactions are ordered by the ”Trade Date” (calendar date on which the transaction took place). (ii) If two transactions occur on the same date, we order them according to the “Submit Date” identifier, the date at which the information is submitted to the DTCC. Naturally, we identify all block trades as a single trade, although they may have differing submit dates (see section ”Block trades”). (iii) If two transactions have the same trade and the same submit date, as a third identifier, we order them according to “Submit Time” (clock time in hh:mm:ss format). For example, we assume that a trade on 1/10/10 that was submitted to the DTCC on 3/10/10 at 12:00:00 happened before a trade on 1/10/10 that was submitted to the DTCC on 3/10/10 at 16:00:00).

Block Trades

The DTCC collects allocated level volumes instead of the original volume of the block transaction. This can be problematic if, for example, a parent fund buys protection with a notional volume of EUR 10 million, and subsequently allocates EUR 1 million to 10 different sub-funds. Since we treat each counterparty at the parent entity level, our initial dataset would show 10 transactions with a notional volume of EUR 1 million under the parent fund’s name. Therefore, we aggregate all the trades with the same submitter (buyer or seller), entity, maturity, trade date, and price into a block trade (under the parent entity), so as not to be misled by the split dataset.