BANK OF ENGLAND

Financial Stability Paper No. 25 – November 2013

The structure and dynamics of the UK credit default swap market

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The authors would like to thank Darrell Duffie, John Jackson, David Murphy, Edwin Schooling Latter and Nick Vause for helpful comments and suggestions that significantly improved the paper. They would also like to thank Paul Sedgwick of the Depository Trust & Clearing Corporation (DTCC) for his help with understanding the DTCC transaction reports and Al Firrell and Che Sidanius for helping us manage the DTCC data. Gayathri Sundar provided excellent research assistance. Any remaining errors are our own.

evangelos.benos@bankofengland.co.uk
Financial Stability, Bank of England, Threadneedle Street, London, EC2R 8AH

anne.wetherilt@bankofengland.co.uk
Financial Stability, Bank of England, Threadneedle Street, London, EC2R 8AH

filip.zikes@bankofengland.co.uk
Financial Stability, Bank of England, Threadneedle Street, London, EC2R 8AH

Except where otherwise stated, the source of the data used in charts and tables is the Bank of England or the DTCC.

The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Bank of England, the Financial Policy Committee or the DTCC. This paper was finalised on 8 November 2013.

ISSN 1754–4262

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Over-the-counter derivatives (OTCDs) have been at the centre of regulators' and policymakers' attention owing to widespread concerns that these markets contributed to the build-up of systemic risk in the 2007/08 financial crisis. In 2009 the G20 initiated a reform programme that aims to increase transparency and reduce systemic risk in these markets. This paper analyses the structure and dynamics in one segment of the OTCD market, namely the UK single-name credit default swap (CDS) market. For our analysis, we use transaction reports warehoused in the trade repository operated by the Depository Trust & Clearing Corporation (DTCC). The data span the time between January 2007 and December 2011 which enables us to take a close look at market activity during the financial crisis.

The data show that the UK CDS market is relatively small (in terms of values traded) and that trading is infrequent. Furthermore, activity is highly concentrated around the main dealers who provide liquidity by intermediating between ultimate CDS buyers and sellers. Importantly, the data also show that dealers continued to provide liquidity throughout and during the peak of the financial crisis. Thus, concerns about counterparty risk, which are inherently present in all OTCDs, did not seem to have impaired market functioning in the UK CDS market. Corroborating this, counterparty risk did not affect CDS trade execution prices, in the sense that dealer credit risk did not correlate with the prices at which dealers were able to sell protection. Finally, the data also show that there are no substantial differences in the execution prices of the various types of counterparties: most market end-users trade at approximately the same prices at which dealers trade with one another. This is an interesting finding given the opacity of this OTCD market.

From a more general point of view, this paper demonstrates the usefulness of trade repository data to regulators. Such data allow regulators to understand better the dynamics of these hitherto opaque OTCD markets and also to estimate derivatives exposures arising between the various counterparties, which is essential for supervision and prudential policy. On-going work with trade repository data at the Bank of England aims to examine these interconnections in more detail.

1 Introduction

It has been a common concern, among regulators and policymakers, that the opacity and insufficient collateralisation in global over-the-counter derivatives (OTCDs) markets contributed to the build-up of systemic risk ahead of the 2007/08 financial crisis (Financial Stability Board (FSB) (2010)). While the OTCD markets continued to function during periods of elevated market stress, and were able to cope with the default of Lehman Brothers in September 2008, at times there was significant uncertainty about the size and nature of exposures between counterparties.

In response to the perceived systemic risk emanating from OTCDs, the G20 sponsored a reform programme which will result in significant changes in the way these contracts are traded. Standardised OTCDs will be centrally cleared and, in some cases, traded on organised platforms. Requirements for reporting to trade repositories (and via them to regulators) will be in place for all trades. Capital and margin requirements for both centrally and bilaterally cleared derivatives transactions will be modified as well. These reforms aim to increase transparency and reduce systemic risk.

Against this background, this paper uses newly available transactions data to describe the overall activity of the UK credit default swap (CDS) market, an OTCD market that is being impacted by the derivatives reforms. Our data span the period between 2007 and 2011 which allows us to focus on the events associated with the financial crisis. The paper first sheds light on the structure of the CDS market by describing the role of the major dealers and the relative participation of asset managers, hedge funds and other end-users of CDS contracts. The richness of the transaction reports captured by trade repositories (TRs) also allows us to explain in detail the mechanics of CDS transactions and characterise the life cycle of CDS positions. The paper then provides some first empirical evidence on the degree of transparency and the pricing of counterparty risk in the UK CDS market. Finally, it discusses the impact of regulatory initiatives that took place over our sample period and provides some thoughts on forthcoming initiatives.

The key findings of our paper can be summarised as follows: First, the UK CDS market is relatively small (in terms of values traded) and trading is fairly infrequent. Second, dealers play a central role in this market by acting as intermediaries between counterparties and as sources of liquidity. Thus, dealers constitute the inner core of a two-tiered trading network whose periphery is populated by the end-users. Third, the market continued to operate undisrupted throughout (and at the peak of) the 2007/08 financial crisis and the major dealers accommodated the increased demand for CDS protection from end-users. Fourth, dealer counterparty risk does not seem to be priced directly, in the sense that the prices at which dealer counterparties (end-users and other dealers) are willing to buy protection are not related to the CDS spread of the selling dealer. Fifth, there do not seem to be any significant and systematic differences in the execution prices available to different market participants. In particular, end-users appear to be trading at prices very near those at which dealers trade with one another.

These findings have direct policy implications. For example, the fact that trading is infrequent suggests that, despite the UK single-name CDS market being highly standardised, a large fraction of traded contracts may not yet be ready for mandatory central clearing. This is because infrequently traded contracts may not be sufficiently liquid for central counterparties to be able to rely on their usual margining and default practices. Also, the fact that CDS market end-users do not appear to be trading at inferior prices suggests that any changes to the transparency framework need to take into account the complex information dynamics present in over-the counter (OTC) markets. Of course, these findings may only apply to the UK single-name CDS market and may not necessarily reflect conditions prevailing in other OTC derivatives markets.

From a broader perspective, our paper also demonstrates how TR data can be used by authorities to develop a deeper understanding of trading activity, risk management and network configurations in the hitherto opaque OTCD markets. Although detailed data on the global OTCD markets will not be fully available until data access and aggregation issues are fully resolved (FSB (2013)), authorities can, in the meantime, start using partial data sets which shed light on a segment of the overall market.

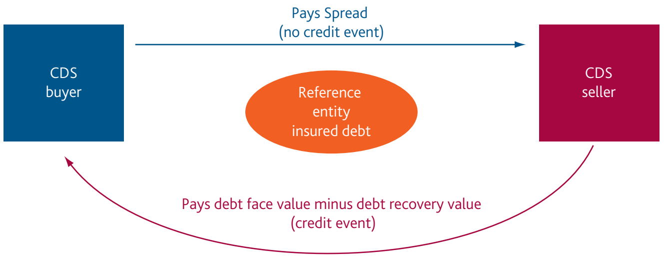
The rest of the paper is organised as follows: In Section 2, we describe the basic mechanics of CDS contracts along with the risks that arise in this market and the tools used to mitigate them. Section 3 introduces the data set, and Section 4 gives some aggregate activity statistics about the UK single-name CDS market. In Section 5, we describe in detail the structure and the main participants of the CDS market and in Section 6 we take a closer look at the behaviour of these participants over time and during the financial crisis. We especially focus on the role of dealers as liquidity providers. In Section 7 we provide empirical evidence related to the pricing of counterparty risk in the CDS market and in Section 8 we examine the issue of transparency and trade execution costs. In Section 9, we describe standardisation and central clearing initiatives as they relate to the UK CDS market. Finally, Section 10 concludes by considering issues related to transaction reporting and prudential policy.

2 CDS contract characteristics, sources of risk and risk management

What is a CDS?

CDS is a contract intended to mitigate losses incurred by a creditor should the debtor fail to meet their obligations. Thus, buying a CDS contract is akin to buying protection on outstanding debt obligations. As such, the contract buyer has to pay the contract seller a regular, pre-determined premium (or 'spread') in exchange for a payment by the protection seller that will cover the buyer's losses in case of debtor default or another credit event (**Figure 1**).

Figure 1 Illustration of a CDS contract



Although a CDS is essentially an insurance contract, it differs from traditional insurance contracts in that the buyer does not need to be a holder of the referenced debt (ie the buyer can have a 'naked position'). Additionally, CDS contracts can be traded whereas traditional insurance contracts cannot. CDS contracts may be written on various types of debt such as corporate, sovereign and consumer debt. More complex CDS products can be written on portfolios of mortgages or other securitised products.

CDS contracts are used to hedge the credit risk of the underlying bonds, to (imperfectly) hedge counterparty credit risk that arises from derivatives or other exposures with the reference entity, or to take a speculative position. In the event of a default or a related credit event (such as a corporate restructuring), the contract seller (ie the protection seller) pays a lump sum equal to the difference between the value of the underlying asset at par and the value following the default (recovery). This typically involves an auction to determine the value of the asset at default.(1)

The global CDS market has grown from US$6.4 trillion in 2004 to US$25.9 trillion at the end of 2011 (as measured by gross notional amounts outstanding), reaching a peak at US$58 trillion in the second half of 2007. A large part of the reduction in notional amounts outstanding between 2007 and 2011 is due to the elimination of offsetting positions via trade compressions.(2) Corporate single-name contracts accounted for the largest share of the market, at 45% as of end-2011 (or US$11.6 trillion). In comparison, gross notional amounts of sovereign CDS contracts stood at US$2.9 trillion (11%) at end-2011, while CDS index contracts stood at US$9 trillion and comprised 35% of the market.(3)

Risks

A position in a CDS contract involves *reference entity credit risk* and *counterparty credit risk*. The first arises when the reference entity experiences a credit event and the protection seller must compensate the protection buyer for the loss associated with the defaulted bond. Thus, the risk here accrues to the protection seller who must make good on the insurance sold. The second arises when a counterparty to a CDS contract experiences a credit event and can no longer honour the contract terms. Typically, counterparty risk is more material when it is the protection seller who experiences a credit event, especially when this happens jointly with a credit event of the reference entity. In fact, the obligations arising from a reference entity credit event may well be the very reason for the CDS seller's default. In this extreme scenario, the protection buyer is then exposed to the risk of not receiving protection precisely when they need it most. But even if a CDS counterparty defaults independently of the contract reference entity, the surviving counterparty still bears the risk of being forced to replace the CDS contract at a potentially unfavourable price (eg when the credit spread widens before the protection buyer manages to find a new seller in order to replace the CDS contract). In the annex, we give additional details and examples of the reference and counterparty risks in the CDS market.

Risk management

In practice, CDS market participants mitigate the reference and counterparty credit risks on a bilateral basis, by putting in place 'close-out netting' agreements and by paying and receiving variation margin while sometimes additional collateral may be exchanged. 'Close-out netting' of derivatives exposures (such as CDS exposures), in the case of a counterparty default, is enabled by automatic stay exemptions. Automatic stay prevents a defaulted party's assets from being seized by the creditors. Exempting derivatives from automatic stay effectively renders derivatives exposures senior to all other claims to the extent that there are derivatives payables to the defaulter that can be netted with derivatives claims on the defaulter. The implications of this exemption are the subject of much debate among policymakers and academics; see Bolton and Oehmke (2013) and the references therein.

(1) The mechanism used in these auctions has been recently criticised by some academic studies as being prone to biases and susceptible to manipulation. See Du and Zhu (2012).
(2) We discuss trade compressions in more detail later on.
(3) Source: Bank for International Settlements (BIS) semi-annual OTC derivatives statistics; updated figures available at: www.bis.org/statistics/derdetailed.htm.

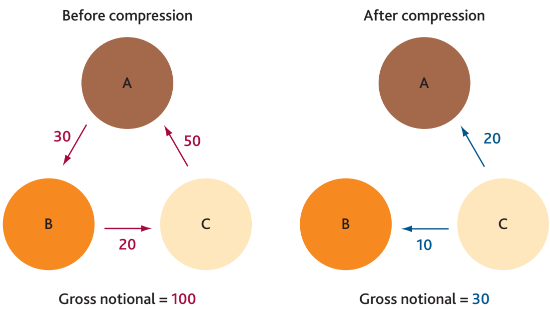
These bilateral risk-mitigating arrangements do not give rise to observable market activity (eg new CDS trades or terminations of old CDS contracts) and as such, this activity is not captured in the TR data. However, the industry has also developed risk-mitigating tools which do give rise to observable market activity. Such tools include: market-wide trade compressions, central clearing and delta-neutral auctions. The transactions resulting from these activities are captured in the TR data and for this reason we describe them below.

Market-wide trade compressions

The purpose of market-wide compressions is to reduce counterparty credit risk arising from bilateral contractual obligations without affecting the market participants' exposure to reference entity credit risk. This is achieved by multilaterally netting the exposures of a group of market participants, separately for each reference entity. The multilateral nature of compressions requires some co-ordination across market participants and this is facilitated by commercial providers.

To illustrate how compressions work, **Figure 2** shows a set of hypothetical exposures of three CDS market participants before (left panel) and after (right panel) a compression cycle is run. All three market participants have bilateral exposures and hence face counterparty credit risk (as explained in the annex). However, these exposures can be reduced by exploiting the benefits of netting across counterparties. Compressions achieve exactly that: trades that can be eliminated through multilateral netting are terminated and are replaced by a smaller number of new trades in a way that preserves market participants' net exposures to the reference credit.

Figure 2 Illustration of a hypothetical compression cycle in the CDS market

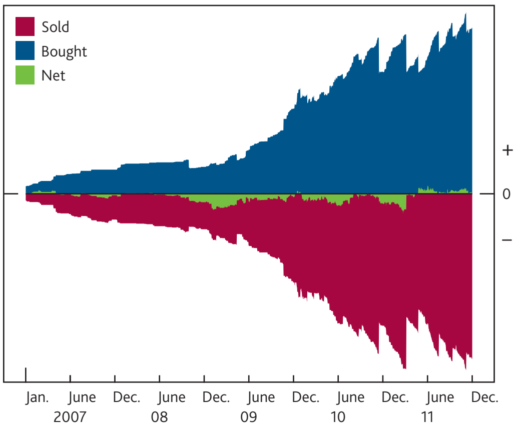


Note: The arrows denote the direction of CDS exposures and the numbers denote the notional amounts insured.

As the example in **Figure 2** makes clear, compression cycles can result in large drops in the gross notional amounts outstanding. For example, Tri-Optima, a provider of post-trade risk management services for OTC derivatives, reports that it facilitated the elimination of around US$77 trillion worth of gross notional outstanding through compression cycles in the global CDS market by 2012.(1)

To illustrate the frequency and impact of compressions on a dealer's CDS inventory, **Chart 1** shows (unscaled) long and short gross and net notional positions of a randomly selected major dealer on a representative UK single-name CDS contract. The large symmetric drops in the gross notional amount bought and sold, on days when compression cycles were run, are clearly visible.

Chart 1 Long and short gross notional positions on a CDS contract by a major dealer



Note: the scale is omitted for confidentiality reasons. The whipsaw pattern in the long and short gross positions is indicative of compression cycles.

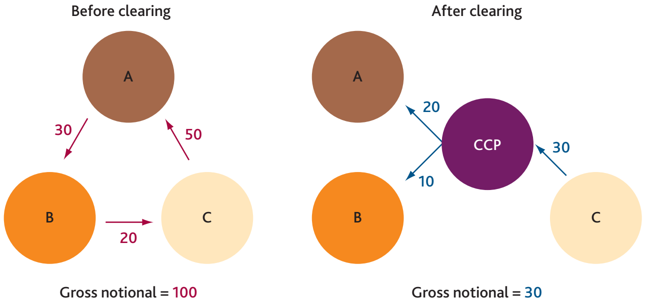
Central clearing

Another way of reducing counterparty credit risk in OTCD markets is through central clearing, whereby an existing contract between two counterparties is novated to a clearing house (also known as a 'central counterparty' or 'CCP'). The original bilateral contract is terminated and is replaced by two new contracts, each between the clearing house and the two counterparties of the original contract. This facilitates multilateral netting in a similar fashion to trade compressions, as illustrated in **Figure 3**. Notice, in **Figure 3**, that after clearing the gross notional amount outstanding is 30 and not 60. This is because of the underlying assumption that a CCP cannot fail unless one of the clearing members fails (in this case counterparty C). So, given that the CCP always has a flat position, the amount of money at risk is 30. In all cases however, each individual counterparty's net exposure to the reference entity remains the same.

There are, however, two important differences between central clearing and trade compressions. First, in central clearing, all bilateral exposures are replaced by exposures to a single counterparty, namely the clearing house, whereas a compression cycle will result into a number of bilateral, but significantly smaller, exposures. Second, central clearing involves additional risk mitigating measures such as initial margin requirements and mutualisation of losses, which are not typically present in the bilateral space.

(1) www.trioptima.co.uk/services/triReduce/triReduce-credit.html.

Figure 3 Illustration of a hypothetical central clearing arrangement in the CDS market



Note: The arrows denote the direction of CDS exposures and the numbers denote the notional amounts insured.

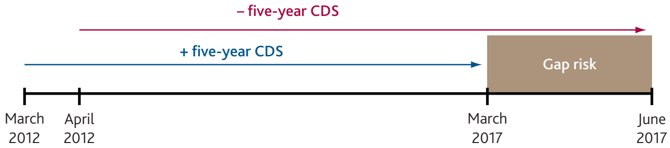
As will be explained in more detail in Section 9, the CDS contract standardisation that was brought about by the Big and Small Bang Protocols in the United States and Europe, respectively, made it easier and more beneficial to centrally clear CDS contracts.

Delta-neutral auctions

In addition to credit risk, CDS traders often face so-called gap risk. Since CDS contracts have quarterly expiration cycles (they expire on the 20th of March, June, September and December), it is often difficult for traders to run books whose long and short positions are perfectly balanced in terms of their tenors. For example, while a five-year CDS contract bought in March of 2012 will expire in March of 2017, a five-year CDS contract sold in April of 2012 will expire in June of 2017. Thus, a dealer who did these trades will have an imbalanced book between March and June of 2017. This is referred to as gap risk and is illustrated in **Figure 4**.

In the above example, to eliminate this book imbalance sometime in April 2012, the dealer would have to sell a five-year March contract and purchase a contract that expires in June 2017. However, following a given expiration cycle, no new contracts of that date can be traded, so the dealer would

Figure 4 Illustration of gap risk



not be able to sell a five-year March contract in April 2012 to offset their position. For this reason, various commercial providers facilitate electronic auctions whereby dealers submit their imbalances for every contract maturity (the ‘curve’) and also the prices at which they are willing to trade in order to balance their books and reduce gap risk. A sophisticated algorithm then matches the dealers’ bids and generates trades that allow them to reduce the imbalances in their books.

3 The CDS trade repository data

In this paper we use CDS contract transaction reports obtained from the Depository Trust & Clearing Corporation (DTCC), a post-trade financial services company that also operates a TR. For every CDS transaction there are usually multiple reports being filed with DTCC by the counterparties involved. Thus, in order to prevent double-counting of trades and volumes we use, for our analysis, only a selected subset of the available reports.

Our data include all transactions on single-name CDS contracts on the 126 most heavily traded UK reference entities from the beginning of January 2007 to the end of December 2011. These are the reference entities for which we observe at least ten trades during our sample period. Our data capture the transactions executed by all counterparties and therefore the global CDS market for these reference entities.

Activity in the CDS market is characterised by different types of transactions (see Box 1). For each transaction type, our

Box 1
CDS market transaction types

In the CDS market there are four types of transactions:

- **New trades**: Two counterparties mutually agree to initiate a position in a CDS contract.
- **Terminations**: Two counterparties mutually agree to terminate an outstanding position in a CDS contract. The termination may be full (ie it covers the full notional amount of the CDS contract) or partial (ie it covers a fraction of the notional amount of the CDS contract).
- **Amendments**: The two counterparties to a CDS contract mutually agree to change one or more of the contract parameters (ie to amend the contract). This could involve for example increasing the notional amount or extending the maturity of the contract.
- **Assignments**: One of the two counterparties to a CDS contract steps out of the contract and is replaced by another counterparty. As with terminations, assignments can also be full or partial.

Box 2
The life cycle of CDS positions

Given that the typical position in a CDS contract experiences multiple events throughout its lifetime such as assignments, amendments and partial or full terminations, only a few contracts mature to their original scheduled expiry date. To illustrate, the charts below show some 'life cycle statistics' of CDS positions in a randomly selected five-year CDS contract. The charts are based on transactions data for the years 2007–11.

Chart A shows the lifespan distribution of positions on the five-year CDS contract. The chart shows that the vast majority of positions are terminated within a year from their initiation and less than 5% of them last until contract maturity. **Chart B** shows the survival function of the same CDS positions, ie the probability that a position will exist beyond a specified time, conditional on the position still being in existence until that time. The chart shows for instance that positions on this five-year CDS contract have a 20% chance of 'surviving' beyond one year and only a 10% chance of 'surviving' beyond two years.

Chart A Lifespan distribution

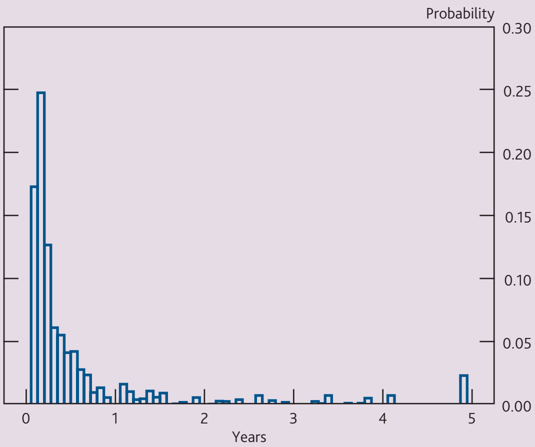
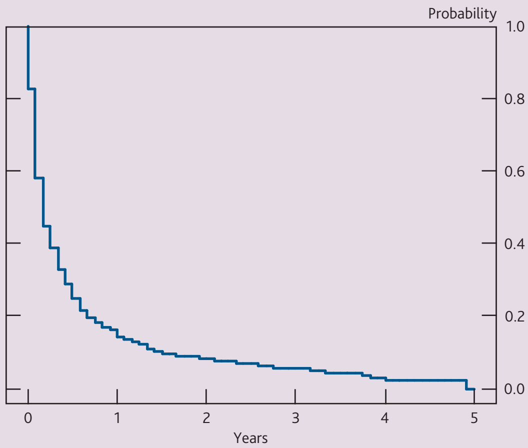


Chart B Survival function

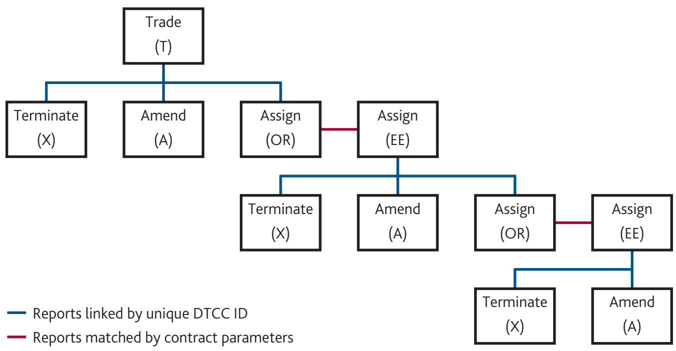


data include all the economically relevant fields, such as the transaction price (premium to be paid), the affected notional amount, the time and date of each transaction, the effective date (the day on which protection begins) and the name of the reference entity. Importantly, it also identifies the counterparties to each transaction which allows us to describe the behaviour of particular types of market participants such as dealers, hedge funds, etc.

After having been initiated, the typical CDS position experiences multiple events: amendments, partial or full assignments and ultimately partial or full terminations. Each of these events is captured by different transaction reports; this means that in order to reconstruct the history of a given CDS position, one has to match, with one another, the associated reports. Some of the reports can be matched by a common unique identifier (the unique DTCC ID) while matching other reports requires the use of an algorithm which compares contract parameters. **Figure 5** summarises the types of transaction reports in the CDS TR data and the method employed in order to link them.

Reconstructing the history of CDS positions, by matching the associated transaction reports, is necessary in order to reconstruct the overall CDS positions and exposures of the

Figure 5 Types of transaction reports in the CDS DTCC database and the associated matching methodology



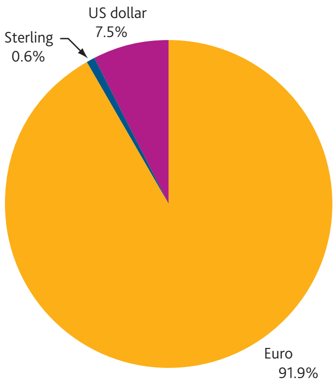
various market participants. Reconstructing the history of CDS positions allows one to calculate their 'life cycle statistics'. Box 2 illustrates this for a five-year CDS contract on a randomly selected reference entity.

4 The UK CDS market: a bird's-eye view

We start our analysis by casting a bird's-eye view on the CDS market for UK corporates over our sample period from January 2007 to December 2011. CDS contracts on the

UK reference entities are mainly traded in three currencies: euro, US dollar and pound sterling (**Chart 2**).[1] The sterling-denominated segment of the market is negligible, while the euro segment is the largest, followed by the US dollar segment. The dominance of euro-denominated volumes may be because many of the UK reference entities also belong to the iTraxx index of European corporates, which is traded in euro. This currency commonality facilitates hedging between the index and its components. For the rest of our analysis we aggregate CDS volumes by converting US dollar and pound sterling-denominated values into euro denominated ones.

Chart 2 Breakdown by currency of the traded volume in single-name CDS contracts written on the UK reference entities in our sample; Jan. 2007–Dec. 2011



Using the euro as the reference currency, **Table A** summarises the main statistics of the UK CDS market. Throughout our sample period there were 672 distinct counterparties who collectively executed about 625,000 new trades, with a total notional amount of €3.57 trillion. Terminations amounted to €2.41 trillion suggesting a net increase in gross notional amounts outstanding of at most €1.16 trillion. Finally, assignments amounted to €0.37 trillion.

Table A Summary statistics for CDS transactions

Time period	Jan. 2007–Dec. 2011
Number of reference entities	126
Number of counterparties	672
Number of new trades	625,032
New trade volume	€3.57 trillion
Assignment volume	€0.37 trillion
Termination volume	€2.41 trillion

The rest of the analysis is based exclusively on transaction reports on new trades. The following charts provide information on the distribution of CDS trading volume across reference entities. **Chart 3** shows the ten most heavily traded (in volume terms) UK reference entities over our sample period. Barclays plc is the most heavily traded reference entity with contracts of about €52 billion being initiated over our sample time. It is followed by BT plc and RBS plc.

Chart 3 The ten most actively traded UK reference entities (€ billions); Jan. 2007–Dec. 2011

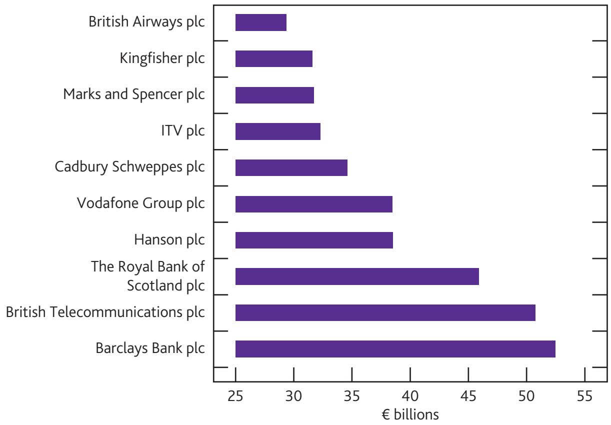
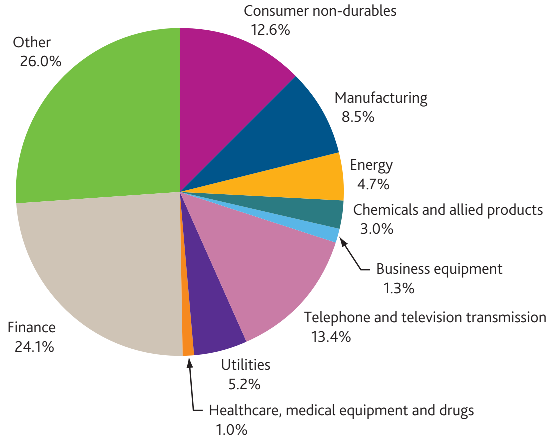


Chart 4 shows the volume breakdown of CDS contracts across reference entity industries. Financial institutions are the single largest corporate sector with 24% of all new CDS volume and Telecoms is the second largest with 13.4%. The prevalence of the financial sector is perhaps not surprising, since CDS contracts are also used to hedge exposures to the financial institutions being referenced.

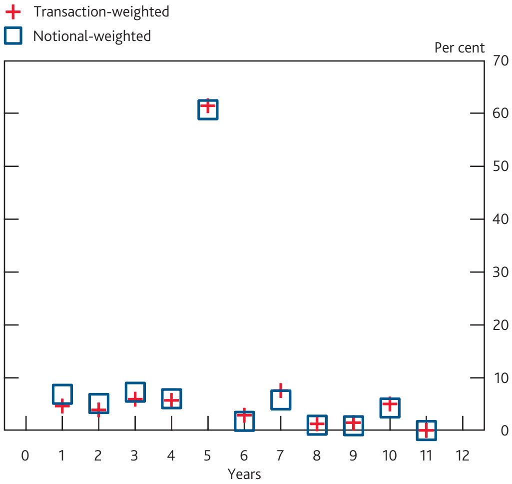
Chart 4 Volume breakdown, by industry, of trades in euro-denominated, UK single-name CDS contracts; Jan. 2007–Dec. 2011



Although our sample includes transactions on CDS contracts of various maturities, the bulk of the trades and of the volume is in the five-year contracts. **Chart 5** shows that the five-year contracts represent around 60% of all activity with no other maturity exceeding 10%. The fact that CDS volume is concentrated around specific maturities eases the process of netting by enabling a wider range of contracts and of positions to be offset against each other. This, in turn, facilitates central clearing. Trade size is also concentrated around specific values; for instance, for euro-denominated contracts, the €5 million notional size is by far the most common, followed

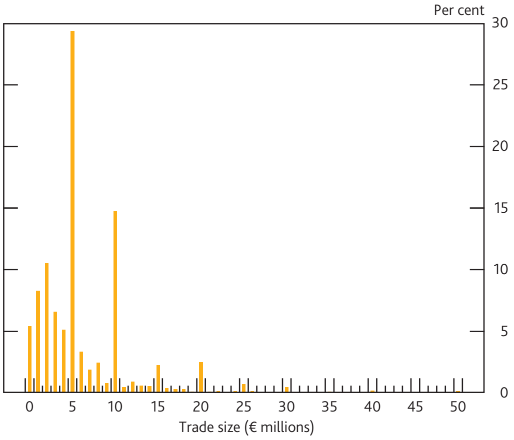
(1) Some trading also occurs in other currencies such as the Japanese yen, the Swiss franc and the Canadian dollar but the associated volumes are negligible.

Chart 5 Maturity distribution of UK single-name CDS contracts; Jan. 2007–Dec. 2011



by the €10 million notional (**Chart 6**). As we will see later, trade sizes concentrated even more around the €5 million and €10 million notionals after the European CDS market 'Small Bang' in June 2009.

Chart 6 Trade size distribution of euro-denominated UK single-name CDS contracts; Jan. 2007–Dec. 2011



We next look at the cross-sectional distribution (over reference entities) of the number of trades (**Chart 7**) and of trade volumes (**Chart 8**). The most actively traded reference entity recorded an average of six trades per day while the ten most frequently traded reference entities had an average of between four and six trades per day. The overall average number of daily trades, across all reference entities in our sample, is 1.51 with a standard deviation of about 1.5.

Thus, contrary to liquid products traded on exchanges, trading in UK CDS contracts is much less frequent. This sets the benchmark of what constitutes a liquid contract in the UK CDS market. While an exchange-traded derivative with an average of six trades per day would probably be considered illiquid, a single-name CDS contract with the same number of average trades is one of the most liquid ones. We will revisit this issue when discussing eligibility for central clearing in Section 9.

Chart 7 Average daily number of trades for each of the UK reference entities in our sample; Jan. 2007–Dec. 2011

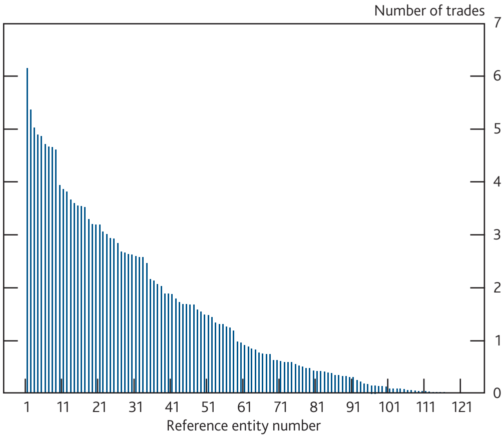


Chart 8 Average daily trading volume (€ millions) for each of the UK reference entities in our sample; Jan. 2007–Dec. 2011

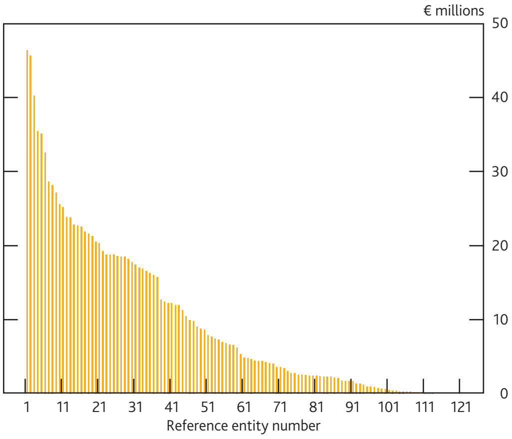


Chart 7 also highlights the large cross-sectional variability in trading frequencies. While the least frequently traded entities in our sample have a total of ten trades between 2007 and 2011 (the cut-off criterion for selecting our reference entities), the most frequently traded ones have more than 7,000 trades over the same period. The daily trading volumes are equally dispersed in the cross-section (**Chart 8**). The average daily traded volume across reference entities is €9.8 million with a standard deviation of €10 million and a maximum of about €45 million. Again, these numbers seem small relative to the traded volumes of some exchange-traded contracts and, as with the average number of daily trades, they suggest that liquidity varies substantially across names in the UK CDS market.

To conclude, most UK single-name CDS contracts are infrequently traded, while trading values vary significantly across reference entities. Similar findings are reported in Chen *et al* (2011) who analyse a set of global CDS transactions over a three-month period.

5 The structure of the UK CDS market

In common with most other derivatives, CDS contracts are traded in OTC markets where clients (or end-users) interact with dealers on a bilateral basis. Dealers act as market makers and in doing so may build up significant inventories. These inventories are managed by trading in the inter-dealer market, where dealers trade with each other. Hence, the CDS market is organised into two distinct segments: the dealer-to-client segment and the inter-dealer (or dealer-to-dealer) segment.(1) Box 3 in Section 8 provides a more detailed description of the different ways in which CDS contracts are traded in these two segments and the associated transparency regimes. In this section we use our transactions data to provide more detail on the UK CDS market trading network.

Structure of the trading network

To shed light on the structure of the trading network, we group market participants into six broad categories: dealers, banks, asset managers, hedge funds, insurance companies and other counterparties (including non-financials). The 'dealers' category includes the so-called 'G16' dealers(2) plus the defaulted Bear Stearns and Lehman Brothers. The 'banks' category includes any non-dealer bank. There are a total of 133 banks in our sample, 241 asset managers, 247 hedge funds, four insurers and 33 other participants.

Table B shows the bilateral trading volumes as a percentage of the total volume, for each pair of counterparty types. The numbers on the main diagonal show the amount of intragroup trading. The figures in **Table B** confirm the dominant role of dealers in the UK CDS market. There are two distinct dimensions to this. The first is the large participation of dealers in the overall volume, with only about 1% of all CDS trading volume not involving a dealer. The second is the large size of the inter-dealer segment of the UK CDS market, which accounts for about 64% of all volume.

Table B Trading network in UK single-name CDS market; Jan. 2007–Dec. 2011

Buyer\seller	Dealers	Banks	Asset managers	Hedge funds	Insurers	Others	Total
Dealers	63.8%	10.5%	1.9%	2%	0.1%	0.4%	78.7%
Banks	11.2%	0.8%	–	0.1%	–	–	12.2%
Asset managers	3.4%	0.1%	–	–	–	–	3.5%
Hedge funds	4.6%	0.2%	–	–	–	–	4.8%
Insurers	0.3%	–	–	–	–	–	0.3%
Others	0.5%	–	–	–	–	–	0.5%
Total	83.8%	11.7%	1.9%	2.1%	0.1%	0.4%	100%

Note: The table shows the percentages of bilateral traded volume, between the various types of counterparties, over total trading volume.

The large size of the inter-dealer segment of the CDS market is indicative of the way dealers operate. Since dealer-to-client transactions are usually initiated by the latter, dealers frequently find themselves with exposures that they may not necessarily wish to bear. For this reason, they usually engage in a series of offsetting transactions with other dealers, until their inventory reaches a desired point of balance. Although (as we will see later) dealers do on average maintain a net short position in the UK CDS market, for the vast majority of contracts they act as intermediaries between non-dealer buyers and sellers. In other words, each dealer-to-client trade triggers a sequence of additional and offsetting inter-dealer transactions until one or more of the dealers find an end-user willing to take the opposite side of the original trade. This explains the magnitude of inter-dealer activity.(3)

Nevertheless, the overall high concentration of trading activity around the 16 main dealers is somewhat puzzling given that there are other market participants that could potentially act as intermediaries. This raises two questions: First, why do we observe this concentration? And second, how does this concentration affect liquidity provision and transaction costs?

The academic literature offers a number of explanations for the first question. One, as articulated in recent academic work by Atkeson, Eisfeldt and Weill (2012), is that because of netting arrangements, CDS trading exhibits *increasing returns to scale*. In their theoretical model, the authors show that large banks can diversify more risk internally by holding portfolios of both long and short positions with a wide range of clients. Thus, the larger the amount of trading, the greater the netting opportunities and the more efficient trading becomes. As a result, trading activity tends to concentrate around a few institutions with large balance sheets.

An alternative, yet non-exclusive, explanation put forward in the academic literature is that large institutions have access to superior information about the reference entities, which allows them to provide liquidity more profitably.(4) Hence, in these models, dealer concentration arises endogenously, with activity concentrated amongst the larger and/or better informed institutions. Large dealers may have superior information about a reference entity either because they are uniquely positioned to observe order flow and are thus able to infer other market participants' beliefs about reference entities, or they may have their own commercial relationships with reference entities and thus be in a position to extract information that other market participants do not have access to.

(1) For more detail, see Smyth and Wetherilt (2011).
(2) The 16 dealers are (in alphabetical order): Bank of America, Barclays, BNP Paribas, Citibank, Commerzbank, Credit Agricole, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JP Morgan, Merrill Lynch, Morgan Stanley, Nomura, Societe Generale, Royal Bank of Scotland, UBS and Wells Fargo.
(3) For instance, Shachar (2012) finds that in a set of CDS contracts written on US reference entities, the average dealer-to-client trade is passed between three dealers before a suitable ultimate counterparty is found.
(4) See for example Boulatov and George (2013).

Recent empirical research has provided evidence in support of the existence of the latter information channel. In their study of the US CDS market, Qiu and Yu (2012) find that the number of dealers providing quotes on reference entities increases with the number of commercial relationships between dealers and reference entities. Also, Acharya and Johnson (2007) find that in the presence of such links, CDS prices capture information, prior to credit events, that the stock prices of the same reference entities do not. Overall, the literature suggests that when dealers have greater direct access to firm information, they are more inclined to act as liquidity providers.

Although in our sample dealers in aggregate largely maintain balanced positions, they are ultimately net sellers of protection and all other counterparty types are net buyers of protection. **Table C** shows the absolute and relative amounts of net traded volumes in UK CDS contracts by each counterparty category, over our sample period. Dealers sold a net total of about €76 billion of protection which was mostly bought by hedge funds (52%), asset managers (31%) and other, non-dealer banks (10%). One thing to notice here is that the net amount of CDS contracts sold, by all dealers collectively, is economically small relative to the collective amount of assets (and capital) of these dealers.(1) Of course, our analysis only covers the UK segment of the CDS market and we do not calculate here dealer exposures across the entire CDS market.

Table C Net trading volume (€ billions) by the various types of market participants and percentage of their net CDS volume over total dealer net volume; Jan. 2007–Dec. 2011

	Dealers	Banks	Asset managers	Hedge funds	Insurers	Others
Net volume	-75.70	7.76	23.84	39.47	2.80	1.82
Percentage of net dealer volume	100%	10%	31%	52%	4%	2%

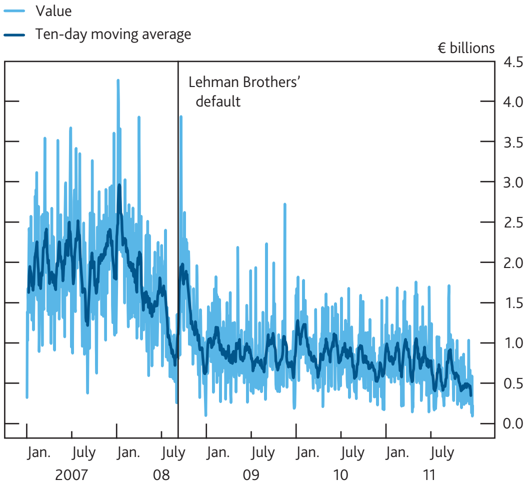
6 Activity in the UK CDS market over time and during the financial crisis

We now look at activity and liquidity provision in the UK CDS market, over time, with a special focus on the 2007/08 financial crisis. Of particular interest is the activity following the Lehman Brothers' default on 15 September 2008 and the uncertainty in UK financial markets preceding the announcement of 8 October 2008 of a support package for UK banks.(2)

Aggregate activity

Chart 9 shows the daily aggregate trading volume (along with its ten-day moving average) in the UK single-name CDS market over our sample period. As before, the chart shows trading activity associated with new contracts only; ie it excludes contract assignments, terminations and activity resulting from compression trades and delta neutral auctions. The chart also marks the date of Lehman Brothers' default, viewed by many as the peak of the financial crisis.

Chart 9 Daily aggregate trading volume (€ billions) in the UK single-name, corporate, CDS market; Jan. 2007–Dec. 2011



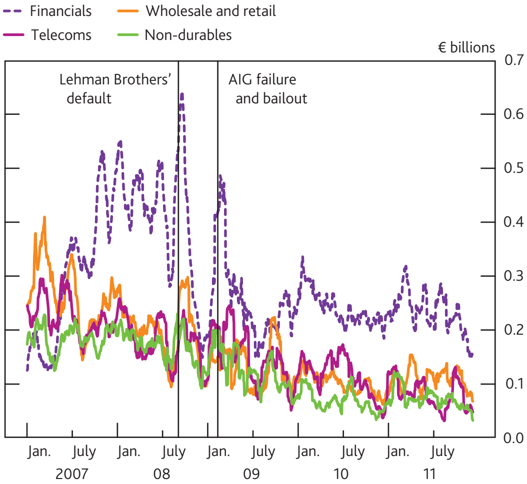
Note: The bold dark blue line denotes the ten-day moving average; the vertical line marks the date of Lehman Brothers' default.

Daily trading volumes hovered around €2 billion in 2007 then dropped throughout 2008 to reach a new lower level, between €500 million and €1 billion daily from 2009 onward. The number of trades (not shown here) also fell from about 300 per day to between 100 and 200 daily over the same period. The overall fall in volumes (and number of trades) after the crisis is consistent with the general reduction in trading activity across a broad spectrum of financial contracts and securities (BIS (2012)). Interestingly, activity in the CDS market spiked in the weeks following the Lehman Brothers' default in September 2008.

In **Chart 10** we break down the CDS traded volumes by reference entity industry. In particular, we plot the 30-day moving average of aggregate daily volumes for the four most heavily traded reference entity industries: financials, wholesale/retail, telecoms and non-durables. The chart shows that most of the variability in volumes, over our sample period, is associated with CDS contracts written on financial institutions. In fact, the post-Lehman Brothers' volume spike is almost entirely driven by activity on financials. Additionally, the industry breakdown reveals another spike in the CDS volume of financials around the failure and subsequent bailout of American International Group (AIG). Overall, increased CDS volumes on financial reference entities

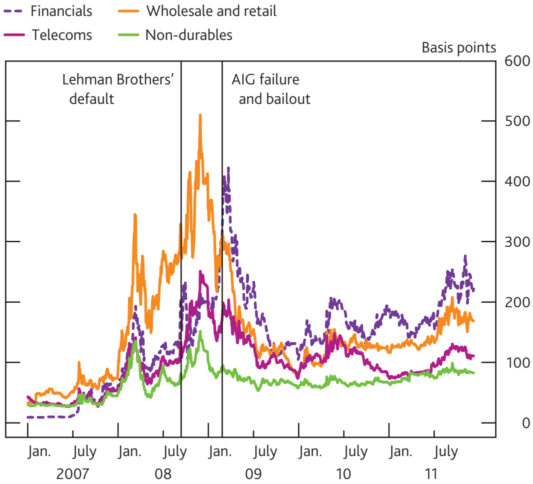
(1) From 2008 to 2011 the collective book value of equity of the G16 dealers was more than US$1 trillion (Source: SNL Financial)
(2) For a detailed timeline of the events during 2007/08, see Bank of England (2009).

Chart 10 30-day moving average of the daily aggregate CDS trading volumes (€ billions) of the four most heavily traded reference entity industries; Jan. 2007–Dec. 2011



Note: Industries include financials, wholesale/retail, shops, telecoms and non-durables. The vertical lines mark the dates of Lehman Brothers' default and AIG's failure and bailout.

Chart 11 Median end-of-day spread (basis points) across all UK reference entities of new CDS trades for the four most heavily traded reference entity industries; Jan. 2007–Dec. 2011



Note: Industries include financials, wholesale/retail, telecoms and non-durables. The vertical lines mark the dates of Lehman Brothers' default and AIG's failure and bailout.

seem to coincide with periods of increased stress in both the global and UK financial markets.(1)

Such spikes in volumes could arise for a number of non-exclusive reasons. First, they could arise because hedgers are becoming more risk-averse and therefore may be seeking additional protection against losses on the underlying bonds. Second, they could arise because hedgers seek protection against counterparty credit risk: market participants with exposures (other than bond holdings) to the financials being referenced in the CDS contracts, may be purchasing these CDS contracts to hedge exposures arising from bilateral loans or other derivatives. Third, when CDS contracts are used for speculative purposes, a rise in trading activity could reflect increased uncertainty about valuations. The academic literature has found evidence in support of all three of these explanations in other CDS markets. For example, Chen *et al* (2011) report similar surges in CDS trading activity around credit events and Oehmke and Zawadowski (2013) show in their study of US CDS contracts that firms which recently experienced a ratings downgrade see an increase in CDS activity. Oehmke and Zawadowski (2013) also show that CDS market activity increases with the degree of disagreement about the credit risk of the reference entity.

Chart 11 shows the median CDS quoted spreads in the four most heavily traded industries for the five-year CDS contracts written on senior debt. Up until the Lehman Brothers' default, we observe a close comovement between the CDS spreads across industries. All spreads increased in the summer of 2007 when the first signs of stress in credit markets became apparent and exhibit a significant spike around the demise of Bear Stearns in the spring of 2008.

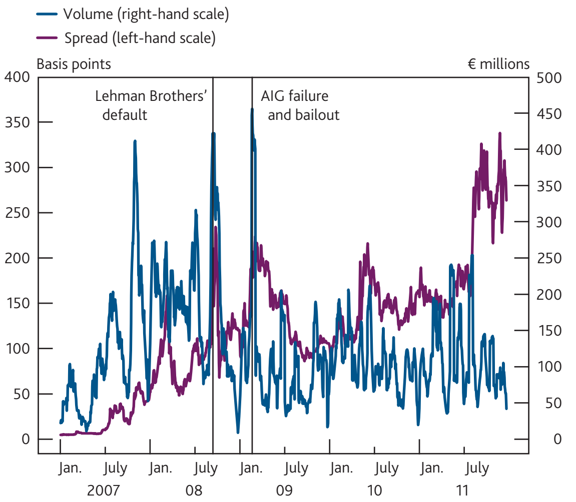
However, after the default of Lehman Brothers, the CDS spreads of financial firms seem to decouple from the other industries. Whereas the spreads of financials gradually rise reaching a peak in the spring of 2009 (at the time of the AIG failure), the spreads of non-financials peak in the beginning of 2009. Interestingly, the spikes in the CDS spread of financials occur concurrently with the spikes in trading volumes, a pattern that is not observed for the non-financial industries. The spike in the CDS prices of the wholesale/retail sector in early 2009 could reflect the impact of the ensuing economic recession on this industry, whose products are characterised by a high income elasticity of demand.(2)

Since the UK financial sector is heavily dominated by the four largest banks (Barclays, HSBC, Lloyds TSB and RBS), we next take a closer look at the behaviour of spreads and trading volumes in these reference entities (**Chart 12**). Trading in the CDS contracts of these four banks accounts for about one half of the total trading volume in financial reference entities. Thus, the volume spike in financials shortly after Lehman Brothers' default is largely driven by these four banks. Similarly to other financials, these banks also experience concurrent spikes in spreads and volumes in the fall of 2008 and spring of 2009.(3)

Overall, the observed increased volumes in the UK CDS market for financial reference entities, at times of stress, suggest that the CDS market facilitated, at those times, the

(1) See, for example, Bank of England (2008) and Bank of England (2009).
(2) In some markets for corporate CDS contracts (eg the US CDS market), CDS spreads also decoupled, over the same period, from the underlying reference entity bond spreads in the period following Lehman Brothers' default. This caused the CDS basis to substantially deviate from zero. Bai and Collin-Dufresne (2013) show that the deviation from zero in the CDS basis was primarily caused by bond market participants' higher funding risk and aggregate bond market illiquidity.
(3) However, contrary to the broader financials category, the four banks experience a much milder rise in spreads in the spring of 2009. This is mainly because a number of other, smaller financial firms underwent serious stress during the latter period, driving the median spread for the broad financials category (see, for example, Bank of England (2008) and Bank of England (2009).

Chart 12 Median spread (basis points) and aggregate trading volume (€ millions) for the four largest UK banks by total assets: Barclays, HSBC, Lloyds and Royal Bank of Scotland; Jan. 2007–Dec. 2011



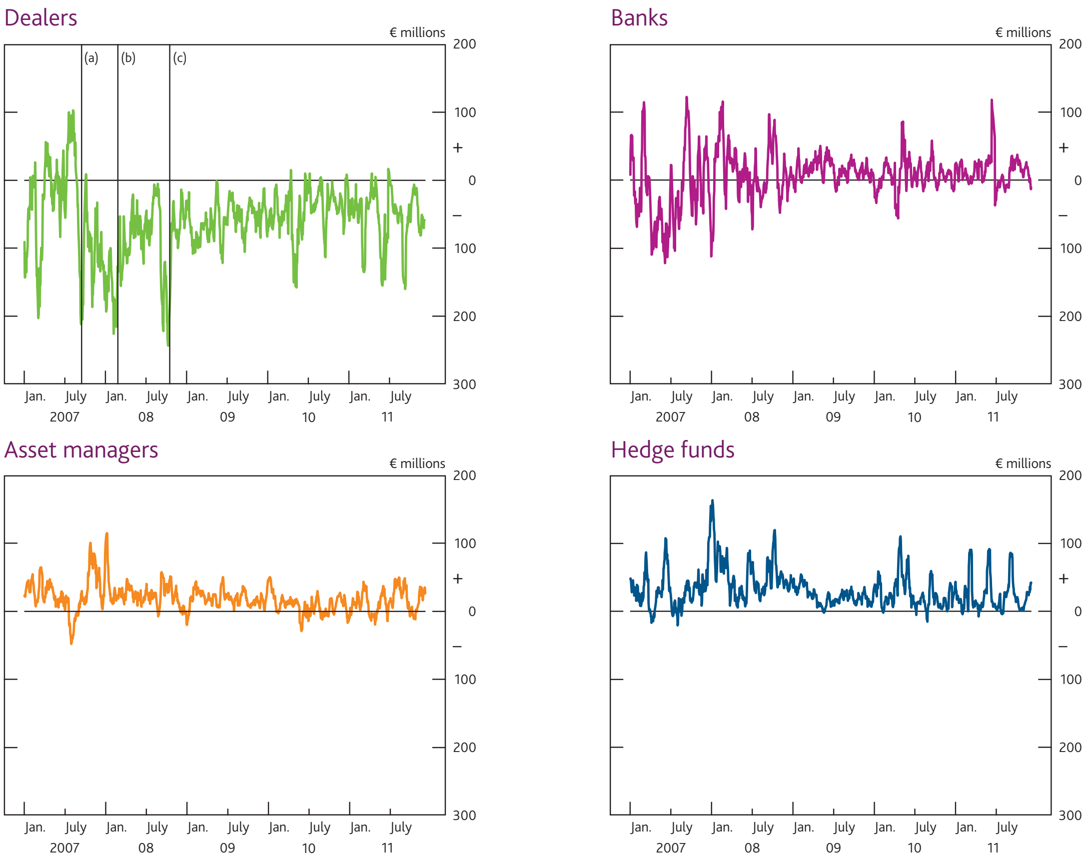
Note: The vertical lines mark the dates of Lehman Brothers' default and AIG's crash and bailout.
Source of banks' total asset value: Bloomberg.

transfer of risk. The counterparty credit risk concerns that one might have expected to emerge after Lehman Brothers' default did not adversely affect the UK single-name CDS market in a visible way. It is worth noting that central clearing of UK single names did not start until December 2009 (see Section 9).

Liquidity provision

Given the relatively high concentration of the UK CDS market around the G16 dealers, we next examine how dealers provide liquidity over time and especially how they performed this role during the financial crisis. **Chart 13** plots the aggregate net trading volume of each counterparty category over time. These time-series plots show that asset managers and hedge funds consistently buy protection whereas non-dealer banks generate smaller exposures as they tend to switch between being net buyers and net sellers.[1] The chart also shows that dealers are consistent providers of liquidity by being net sellers of protection.

Chart 13 Ten-day moving average of net trading volume (€ millions) in CDS contracts written on UK reference entities for each counterparty type; Jan. 2007–Dec. 2011



Note: The vertical lines in the dealer chart mark the three dates when dealers collectively sold the largest volumes. Below, we also provide a description of the events on these days (Source of event description: Guillén (2012) and Bank of England (2009))

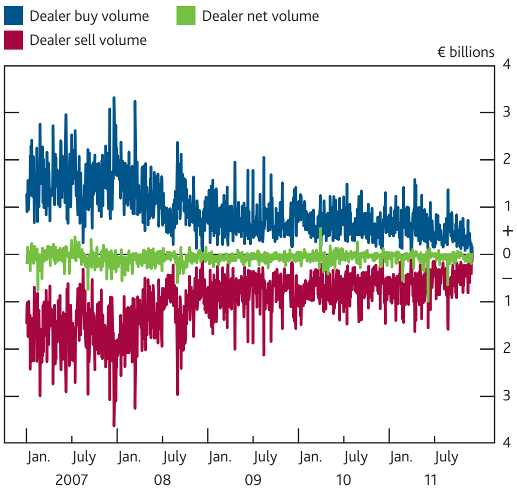
(a) **14–19 September 2007**: The Bank of England announces it has provided a liquidity support facility to Northern Rock (14/9); The Bank of England announces plans to undertake a series of three-month auctions against a broader range of collateral, including mortgage collateral (19/9).
(b) **11 February 2008**: American International Group (AIG) announces its auditors have found a 'material weakness' in its internal controls over the valuation of the AIGFP super senior credit default swap portfolio.
(c) **15 September 2008**: Lehman Brothers files for bankruptcy. Bank of America announces purchase of Merrill Lynch. FTSE 100 closes almost 4% lower at 5,202.4, a 210 point drop.

(1) This of course does not preclude that within each counterparty category there are end-users who also accumulate large short positions.

Chart 13 further illustrates that at times of stress, when demand for protection surges, dealers accommodate this demand by taking larger short positions. The upper left panel of **Chart 13** shows the net trading volume of the major dealers and marks the three dates when dealers collectively sell the largest amounts of protection during our sample period. However, as mentioned earlier, the net amount of protection that dealers sell on UK reference entities, in our sample time, is relatively small. Throughout the financial crisis, when there were spikes in demand for protection, the ten-day moving average of net selling volume never exceeded €250 million and the actual amount never exceeded €750 million for all dealers collectively.

Although end-users are collectively net buyers of credit protection as implied by **Chart 14**, their net CDS positions *vis-a-vis* the dealers are not acquired solely through buy trades. If this were the case, the net short positions of dealers would be generated by selling protection to end-users. But **Chart 14** clearly shows that end-users both buy from and sell to the dealers a significant amount of CDS contracts.

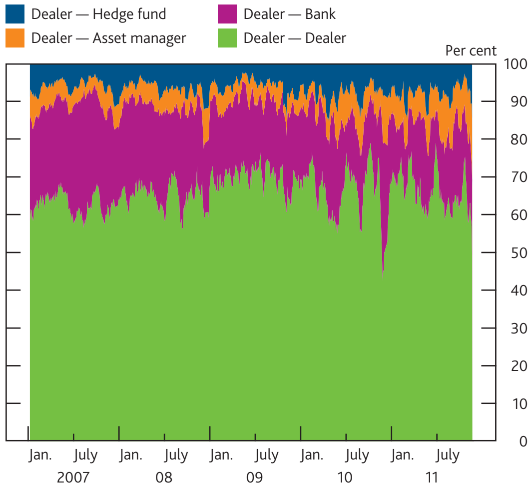
Chart 14 Total dealer buy, sell and net volume (€ billions) traded with CDS market end-users on single-name CDS contracts written on UK reference entities; Jan. 2007–Dec. 2011



This highlights the important intermediation role of dealers in the UK CDS market. The large gross buy and sell volumes that the dealers trade (relative to their net traded volume), suggest that the bulk of their activity is about intermediating between ultimate end-user buyers and sellers. This intermediation role continued undisrupted throughout the financial crisis as **Chart 14** shows.

This is also confirmed by the fact that the trading network remained remarkably stable over the same period. **Chart 15** shows the proportions of volume that dealers traded with each of the counterparty types amongst themselves. It is evident that these proportions are stable even though aggregate CDS trading volume fluctuated substantially over our sample period. The stability of these proportions suggests that when demand for protection by end-users surged, dealers responded by selling protection and subsequently engaging in hedges and offsetting trades in the inter-dealer market. This seems to indicate that the UK single-name CDS market had the capacity to absorb large directional volumes and thus appeared to be liquidity resilient during our sample period.

Chart 15 Breakdown, by counterparty, of dealer CDS trading volume on UK reference entities; Jan. 2007–Dec. 2011

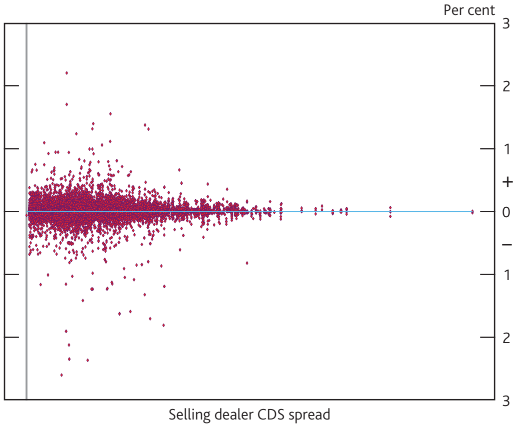


7 Counterparty risk and its pricing in the UK CDS market

Given that aggregate trading activity in the UK CDS market does not appear to have been impacted by concerns about counterparty credit risk during the financial crisis, we next examine if counterparty risk credit is reflected in execution prices. As explained in the annex, counterparty risk credit is primarily borne by protection buyers. For this reason, we look at all the transactions in our sample where a G16 dealer is on the selling side. This includes transactions where dealers sell CDS contracts both to other dealers and to end-users. For these transactions, we plot in **Chart 16** the distance between the transaction spread and the end-of-day par spread against the selling dealer's own CDS spread.

If counterparty risk were reflected in execution prices, then riskier dealers would be forced to sell protection at lower prices relative to less risky dealers. This means that the relationship between the distance of the transaction and par spreads on one hand and the dealer CDS spread on the other would be a negative one, and the linear fit of the observations in **Chart 16** would be downward sloping. However, the linear fit in **Chart 16** is almost indistinguishable from zero. This is consistent with earlier findings in the academic literature (eg Arora, Gandhi and Longstaff (2012)) and also with the fact that there was no disruption in the UK CDS market during the financial crisis. It appears that the collateral and netting arrangements in place, by and large, mitigated counterparty credit risk concerns.

Chart 16 Scatter-plot of the unconditional relationship between the relative spreads (per cent) at which the G16 dealers sell UK CDS contracts and the selling dealer CDS spread; Jan. 2007–June 2009



Note: The relative spread is the difference between the actual transaction spread and the end-of-day par spread. The selling dealer CDS spread axis label has been omitted for confidentiality reasons. The sample includes all sells by dealers to other dealers and to end-users. The blue line denotes the linear fit.

The lack of a counterparty credit risk effect on prices does not preclude the possibility that counterparty credit risk may be priced through volume or collateral channels. For instance, it could be that riskier dealers are shunned by their counterparties and as such have reduced participation in the UK CDS market. Unfortunately, this cannot be easily tested empirically. Although a reduced participation by riskier dealers could be the result of market participants consciously avoiding to trade with them, it could also be the result of the dealers themselves scaling down their activity owing to balance sheet constraints. Additionally, riskier counterparties could be required to post more collateral, eg in the form of initial margin. Since our transactional data do not include information on the collateral arrangements associated with the CDS contracts, we are not able to study if and to what extent counterparty risk is priced through the collateral channel.

8 Transparency and trading costs in the UK CDS market

As we saw in Sections 5 and 6, dealers play a key role in providing liquidity in the UK CDS market and about 64% of all trading volume in UK CDS contracts takes place in the inter-dealer market. While the inter-dealer market is highly competitive and transparent to participating dealers (see Avellaneda and Cont (2010)), asset managers, hedge funds and other end-users of CDS contracts do not have access to this segment of the market. Hence, they cannot observe the prices at which the dealers trade, or are willing to trade, among themselves. Instead, end-users have to rely on 'dealer runs' which are sets of prospective prices at which a particular dealer is willing to trade, or on individual requests for quotes.

Another important feature of OTCD markets is that dealers do not observe each other's quoted prices to end-users. Additionally, throughout our sample time there is no publicly available record of CDS transactions that would allow end-users to infer the prevailing CDS valuations from recently concluded transactions (regulatory changes in the transparency regime of global CDS markets fall outside our sample period — Box 3 provides additional detail on the transparency regime in the CDS market).

This opacity of the CDS market could in principle lead to considerable costs for end-users, who need to search for the best execution price available from a relatively small group of dealers (Duffie (2012) and the references therein). To see whether this manifests itself in the UK CDS market, we use our transactions data to take a closer look at the trading costs incurred by various market participants.

For that, we compare the transaction spreads with end-of-day par spreads provided by Markit. The par spreads are based on fair valuations submitted by the major dealers to Markit at the end of each day (see Markit (2011)). For each transaction in a CDS contract in our sample, we calculate the distance between the transaction spread and the corresponding par spread, and normalise by the par spread. This relative distance measure captures the cost of trading a CDS contract. Thus, a relative distance of 1% on a contract with a par spread of 200 basis points and a notional amount of €5 million would correspond to a trading cost of €1,000 per annum.(1) By calculating the average cost separately for inter-dealer and dealer to end-user transactions, we can infer the impact of the CDS market transparency regime on end-users' trading costs. In other words, if, under the prevailing levels of transparency, end-users face higher execution costs, then we would expect end-users' relative distance measure to be substantially higher than that of dealers.

In **Chart 17**, we plot the median of the relative distance between transaction spreads and par spreads, separately for dealer-to-dealer, dealer-bank, dealer-asset manager and dealer-hedge fund trades, focusing on the most heavily traded five-year tenor. The data period is from January 2007 to June 2009.(2) In addition to the counterparty breakdown, we report the median trading cost measures separately by size ('small trades' (<= 5 million) and 'large trades' (> 5 million notional amount)) and seniority (senior vs subordinated). We also augment the median by the interquartile range in order to facilitate comparison across the different break-downs.

Chart 17 shows that there are relatively small variations in our trading cost measure across inter-dealer and dealer to

(1) 1% x 200 basis points (or 2%) x €5 million = €1,000.
(2) We use this sample period because up until 22 June 2009 (the date of the 'Small Bang'), CDS prices were quoted in terms of par spreads. This makes it easier to calculate the relative trading costs.

Box 3
The CDS market transparency regime

This box gives some detail on the transparency regime of the CDS market in place during our sample period. **Pre-trade transparency** reflects the amount of information that is disclosed as well as the extent of the disclosure prior to a trade being agreed. Thus, pre-trade transparency involves information about a market participant's intention to trade, the participant's identity as well as the prices and quantities at which they are willing to trade. **Post-trade transparency** involves information about the quantities as well as the prices at which contracts were traded. The extent of disclosure refers to the number and types of market participants who have access to this information.

Pre-trade transparency

The dealer to end-user market: End-users typically initiate trades with dealers after the latter have provided to the end-users the prices (quotes) at which they are willing to trade. There are two ways for end-users to obtain dealer quotes: they can either request them or have access to a constant stream of dealer quotes. In the first, 'request for quote' model, dealers respond to the end-user's request for a price quote. As such, both the end-user's intention to trade, as well as their identity, are revealed to the dealer(s). In the second, end-users have access to a constant stream of dealer quotes. For this, end-users may use platforms that aggregate the quotes from a number of dealers which reduces their search costs. End-users can then initiate a trade by clicking on the desired quote ('click-to-trade' model). In this case, end-users' intention to trade is not revealed prior to trade execution. A crucial feature of the dealer to end-user market is that in both the 'request for quote' and 'click-to-trade' models, the quotes that dealers provide are not visible to other dealers. Likewise, such quotes are not available when trades are conducted via voice (ie over the phone).

The inter-dealer market: Most inter-dealer trading happens directly over the phone. This means that both a dealer's intention to trade and their identity are revealed to their counterparty before (and regardless of whether) a trade is concluded. Inter-dealer trading also happens through brokers. In brokered trades, dealers learn who their counterparty is after the trade has been concluded. As such, broking preserves dealer anonymity. There are two kinds of brokerage in the CDS inter-dealer market:

- **Voice**: This is typically used for larger and more complex trades because it maximises the probability of execution. In voice broking, it is optional for the dealer to reveal their identity prior to a trade.

- **Electronic**: This is effectively an inter-dealer electronic trading platform. It may be used for smaller and simpler trades and is often a cheaper option than voice broking. Pre-trade, it reveals to other dealers a dealer's quote but not their identity. **Table 1** summarises the pre-trade transparency attributes of the various inter-dealer trading mechanisms.

Table 1 Pre-trade transparency attributes of the various inter-dealer trading mechanisms

Inter-dealer trading mechanism	Anonymity	Intention to trade	Disclosure
Direct phone contact	No	Revealed	One dealer
Voice brokerage	Yes	Not revealed	n/a
Electronic brokerage	Yes	Revealed	All dealers

As part of the G20-sponsored reforms of the OTCD markets, trading of standardised contracts will move to electronic trading platforms (or exchanges). Although the precise details of the regulations are still being developed in most jurisdictions, this move is likely to be accompanied by an increase in pre-trade transparency.

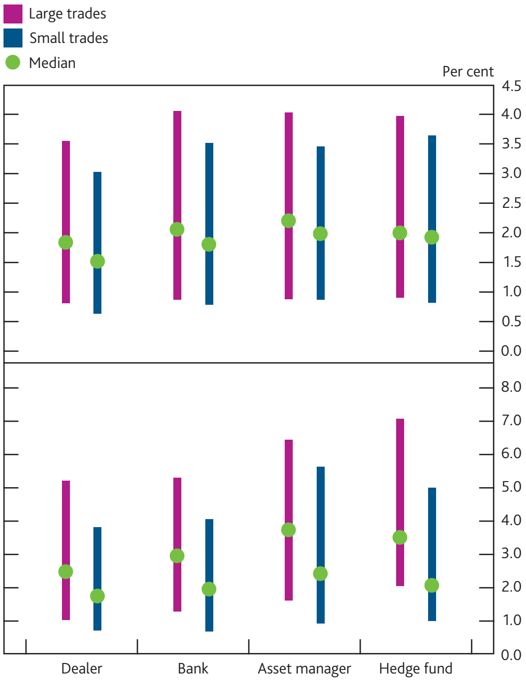
Post-trade transparency

Aggregate trade statistics are published on a weekly basis by DTCC. This includes the number of trades and the total notional amounts traded. Additionally, several data vendors provide daily pricing information based on dealer quotes. However, during our sample period there was no information on volumes or prices of individual transactions, and the CDS market was relatively post-trade opaque.

Forthcoming regulatory changes in Europe will greatly increase post-trade transparency in OTCD markets, including the CDS market. In the United States, the Commodity Futures Trading Commission implemented new post-trade transparency rules at the end of 2012, whereby price and volume information on individual CDS transactions are disseminated to the public in near real time.

end-user trades. While the dispersion of transaction prices around par spreads is generally lower for inter-dealer trades, the differences are not economically significant. Consistent with intuition, we also find that transaction spreads associated with large trades tend to deviate more from the par spreads than those for small trades. The discount on large trades could be either because of inventory risk concerns on behalf of the dealers or because of adverse selection concerns that arise whenever the dealers believe they are trading with a better informed counterparty. Finally, CDS contracts written on subordinated debt tend to exhibit higher dispersion than those written on senior debt and the differences across

Chart 17 Medians and interquartile ranges of the relative (to the par spread) distance between transaction spreads and end-of-day par spreads for five-year senior (top panel) and subordinated (bottom panel) CDS contracts; Jan. 2007–June 2009



counterparties are also more pronounced. This perhaps reflects the relatively lower liquidity of the subordinated contracts.

Overall, despite the concerns about the lack of transparency in the CDS market, our findings suggest that the relative opacity of the UK CDS market does not seem to cause end-users to trade at much inferior prices relative to the dealers. This may seem puzzling given that dealer quotes are not publicly disclosed and, as such, the quotes provided by a dealer to an end-user are not visible to other dealers or other end-users.

One explanation for this may be that most CDS market participants are sophisticated and presumably well informed; there are no retail investors in this market. Also the academic literature on the impact of transparency on trading costs may not be directly applicable to the case of the CDS market. In the context of equity or bond markets, the literature has associated higher transparency with increased competition between dealers, lower search costs and ultimately lower execution costs for end-users.(1) However, the CDS market, like most OTC derivatives markets, differs from securities and exchange traded derivatives markets: for example, contrary to cash securities markets, dealers in OTCD markets are considered to be informed and market making is concentrated around fewer dealers than in other markets. Thus, the transparency issue in the CDS market (and the OTCD markets in general) needs to be approached using a suitable analytical framework.

One such framework might be to view the quote submission process as an auction. For instance, the lack of pre-trade transparency on one hand and the fact that dealers seem to offer competitive prices on the other, is reminiscent of a first-price sealed-bid auction. In this type of auction, bidders are unaware of each other's bids, the highest bidder wins the prize and the winner pays the amount they bid. As such, bidders' prices, in these auctions, are near their 'reservation values' (Klemperer (2004)), which in our case would translate into the best quote being offered by the lowest cost dealer. If this conceptual description of the CDS market transparency regime is accurate, it could imply that increased pre-trade transparency might not necessarily increase end-users' welfare. If, for example, dealers could observe each others' quotes in the dealer to end-user segment of the market, the best price might no longer reflect the lowest cost among dealers but instead the second lowest one. That would be because the lowest cost dealer would have the incentive to improve only marginally the now observable quote of the runner-up dealer. Thus, in effect, publicly disseminated dealer quotes could render the CDS dealer end-user market more like an ascending auction where bidders are aware of each others' bids, the highest bidder wins the prize, but effectively only pays the second highest bid (Klemperer (2004)). However, further research is needed in order to determine if this is an appropriate theoretical framework given the complexity of the information structure of the CDS market.

9 Standardisation and clearing in the CDS market

The G20-mandated OTCD reforms will result in a significant increase in the use of central clearing (FSB (2013)). Central clearing is also being facilitated by an industry and regulator-led increase in the level of contract standardisation. In most jurisdictions, central clearing will not become mandatory until late 2013 or 2014, so it is too early to assess the full impact of central clearing on the CDS market. Nevertheless, some evidence is available from earlier regulatory and industry efforts to increase standardisation and from the introduction of voluntary central clearing in 2009.

Standardisation

CDS contracts are relatively complex instruments owing to the multitude of parameters that are part of the contractual arrangement. These parameters include: the contract reference entity, the notional amount of insurance, the size of the protection premium, the contract effective date (ie the date from which any credit event is covered by the contract), the contract duration, the definition of a credit event, the mechanism for determining the reference entity debt value in a credit event, etc.

(1) For instance, improvements in transparency in the OTC corporate bond markets have been shown to reduce spreads and to benefit public traders. See Goldstein, Hotchkiss and Sirri (2007) and Edwards, Harris and Piwowar (2007).

As CDS markets grew, concerns arose about the robustness of operational processes and uncertainty around what constituted a credit event. In particular, regulators became worried about the backlog of unconfirmed trades, and the impact this would have on market participants' ability to manage the risks associated with their CDS holdings (Bank of England (2005), and BIS (2007)). Authorities also led a push for greater standardisation, which would in turn enable increased use of central clearing and increased execution of trades on electronic platforms (Duffie, Li and Lubke (2010)).

A first set of changes occurred in early 2009 as part of the so-called Big Bang (Markit (2009a)), which introduced a new protocol for market participants. First, this introduced Determination Committees (DC), which would decide whether a credit event had indeed occurred (eg some restructurings may not qualify as credit events). The DCs were also tasked with organising the auctions. As part of the Big Bang, CDS participants signing up to the new protocols were required to participate in the auction process.

The Big Bang also introduced standardised coupon sizes, maturities and payment dates for North American CDS. A little later, the Small Bang led to similar terms for European contracts. The Big Bank Protocol of April 2009 and the subsequent Small Bang Protocol in Europe (Markit (2009b)), in June 2009, significantly increased the standardisation of the various CDS contract parameters.

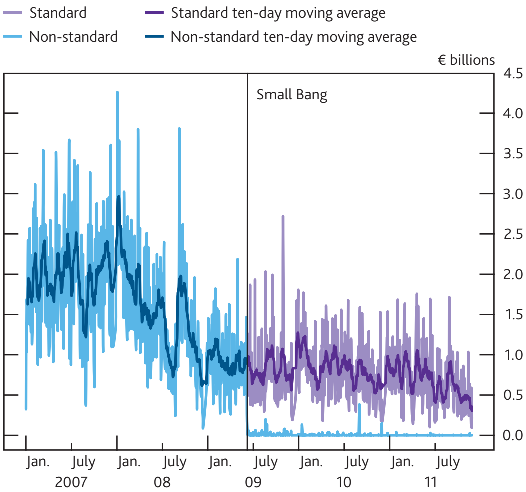
Contract standardisation and the associated increase in contract fungibility have helped reduce inefficiencies in trade and operational processing and they have made it possible to run trade compressions and to centrally clear CDS contracts. As such, standardisation has contributed to the overall reduction of risk arising from exposures in the CDS market. Central clearing of North American and European index contracts started in early 2009. Central clearing for single-name CDS followed in late 2009. FSB (2013) estimates that around 12% the global CDS market is centrally cleared as of end 2012.

Standardisation and the UK CDS market

Chart 18 plots the total trading volumes over time of the non-standard and standard CDS contracts in our sample and also marks the date of the Small Bang (22 June 2009). As is evident, the UK CDS market switched immediately and almost entirely to standard contracts upon their introduction. Although some trading still took place in non-standard contracts post Small Bang, it was economically insignificant and gradually died out.

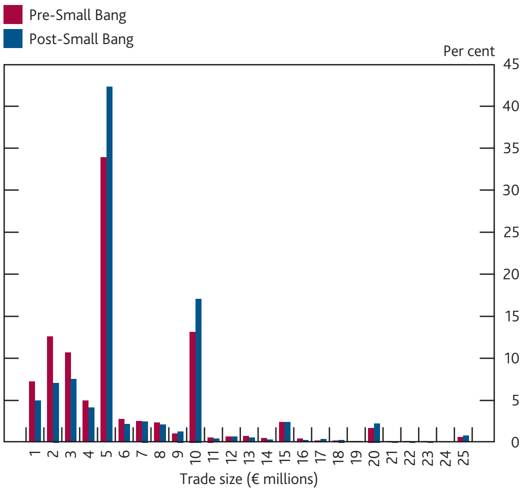
Interestingly, the contract standardisation brought about by the Small Bang also resulted in a higher degree of standardisation in trade sizes. **Chart 19** shows that post-Small Bang, trade sizes of €5 million and €10 million became more frequent than they had been previously. This was

Chart 18 Daily traded volume (€ billions) in standard and non-standard UK single-name CDS contracts; Jan. 2007–Dec. 2011



Note: The vertical line denotes the date of the Small Bang Protocol (22 June 2009).

Chart 19 Frequency distributions of trade sizes (€ millions) of UK single-name CDS contracts before and after the 'Small Bang' (22 June 2009)



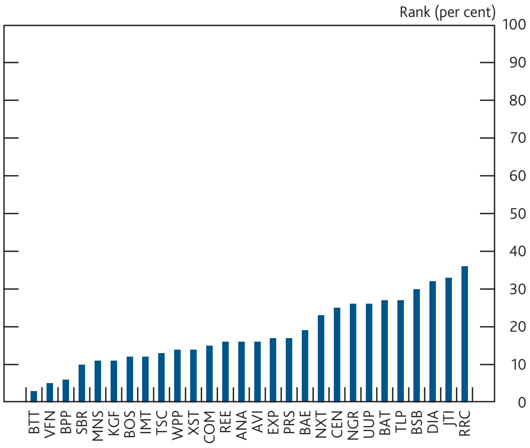
accompanied by a reduction in the frequency of trades of value less than €5 million. We conjecture that this happened because standard trade sizes of standard contracts allow greater degree of overall fungibility between trades.

Central clearing

Central clearing requires a certain degree of standardisation. Thus, following the Small Bang Protocol, ICE Clear Europe started offering central clearing services for selected standard European corporate CDS contracts. These were euro-denominated contracts with a tenor of up to ten years. The first UK-based reference entity admitted for clearing by ICE was Centrica plc on 14 December 2009. Of the 126 UK single-name CDS contracts covered in this paper, 28 were centrally cleared at some point between December 2009 and December 2011. The total volume of cleared trades in these 28 reference entities equals about 18% of the total new trading volume in all UK single names during this period.

Chart 20 shows that most of the contracts selected for central clearing belonged to the most frequently traded ones. Twenty-one of the 28 contracts were in the top 30% of most traded ones and three contracts were in the top 10%. However, some contracts admitted to central clearing had trading volumes that were near the median volume (across all 126 reference entities in our sample) while some other more heavily traded contracts were not admitted to central clearing.

Chart 20 Trading volume ranking percentile to which each of the 28 currently centrally cleared contracts belonged at the time of their admission to central clearing[(a)]



Note: The ranking percentile is based on the contracts' volume over a period of six months prior to their central clearing admission.

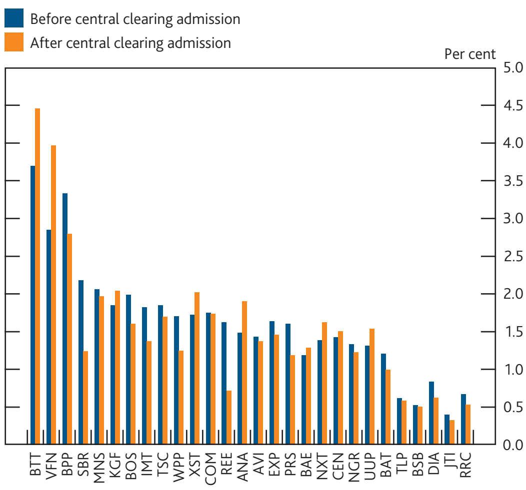
(a) The 28 currently centrally cleared contracts are (in order of appearance):
BTT — British Telecommunications plc; **VFN** — Vodafone Group plc; **BPP** — BP plc;
SBR — J Sainsbury plc; **MNS** — Marks and Spencer plc; **KGF** — Kingfisher plc;
BOS — Bank of Scotland plc; **IMT** — Imperial Tobacco Group plc; **TSC** — Tesco plc;
WPP — WPP 2005 Ltd; **XST** — Xstrata plc; **COM** — Compass Group plc;
REE — Reed Elsevier plc; **ANA** — Anglo American plc; **AVI** — Aviva plc;
EXP — Experian Finance plc; **PRS** — Pearson plc; **BAE** — BAE Systems plc; **NXT** — Next plc;
CEN — Centrica plc; **NGR** — National Grid plc; **UUP** — United Utilities plc;
BAT — British American Tobacco plc; **TLP** — Tate & Lyle plc;
BSB — British Sky Broadcasting Group plc; **DIA** — Diageo plc; **JTI** — JTI (UK) Finance plc;
RRC — Rolls-Royce plc.

The decision to centrally clear contracts with lower trading volumes may have been influenced by whether a given reference entity belongs to the iTraxx index, whose CDS contracts are also centrally cleared. This would have been done to minimise potential pricing discrepancies between contracts written on the index and its components. Such price discrepancies could in turn arise because of the potential difference in the level of counterparty credit risk between the centrally cleared index and its non-centrally cleared components. Thus, a contract that belongs to the iTraxx index may be admitted to central clearing even if it is traded relatively less heavily. On the other hand, some more heavily traded contracts may have been excluded from central clearing because the contract reference entities happen to be CCP clearing members. In order to avoid wrong-way risk, a CCP may not clear contracts written on its clearing members. This includes some big financial institutions whose CDS contracts are among the most heavily traded.

Similar findings are reported for other CDS markets. Chen *et al* (2011) find that, on a set of global CDS transactions, contracts eligible for central clearing trade more frequently. This is confirmed by Slive, Witmer and Woodman (2012) who analyse the characteristics of contracts that are clearing eligible, and find these to have lower bid-ask spreads, larger notionals outstanding and smaller CDS spreads.

A related question is whether the decision to clear influences the liquidity characteristics of cleared contracts. Slive, Witmer and Woodman (2012) conduct an event study and find that the introduction of central clearing is associated with a small decline in bid-ask spreads and a small increase in the number of dealers providing quotes. We do not repeat this exercise here. However, in our sample, the decision to centrally clear did not have a visible impact on the trading volumes of the cleared contracts. **Chart 21** plots the scaled volumes of each of the 28 centrally cleared CDS contracts over a six-month period before and after their admission to central clearing. While for some contracts volumes increased after their admission to central clearing, for other contracts volumes decreased. Overall, there is no clear pattern in the relationship between pre and post-admission volumes.

Chart 21 Average trading volume as a fraction of total market volume of the 28 centrally cleared reference entities six months before and after their admission to central clearing[(a)]



(a) See footnote (a) to **Chart 20**.

10 Conclusion

This paper has used granular transactional data from the DTCC Trade Information Warehouse to document patterns in trading activity, market structure and transparency in the UK single-name CDS market between 2007 and 2011. Overall, we find that the market is relatively small, and trading is fairly infrequent and heavily concentrated in the inter-dealer market. Importantly, we observe that the market continued to operate at the height of the 2007/08 financial crisis, and the major dealers seemed to accommodate the increased demand for CDS protection from end-users. Our transparency analysis does not indicate any economically significant differences in the execution prices across different market participants.

While the analysis of trade reports adds to our knowledge of the microstructure of OTCD markets, the data can also be used to address broader prudential policy questions. On the *microprudential* side, transaction reports can be used to reconstruct the derivative positions and exposures of systemically important financial institutions. With granular TR data, authorities may be able to detect large exposures that would pose a risk to a bank's balance sheet.

On the *macroprudential* side, derivative positions and exposures of individual institutions can be combined to produce a map of the exposure network. This will allow supervising authorities to assess the level of interconnectedness and the associated risk of contagion in OTCD markets. Among other things, regulators will be better placed to assess the impact of the failure of one or more financial institutions on their counterparties and on the market as a whole.(1) A detailed analysis of the direct and indirect linkages created by trading CDS, and their implications for financial stability in the United Kingdom, is the subject of on-going work at the Bank of England.

(1) As an example, see Brunnermeier, Cler and Scheicher (2013).

Annex
Sources of risk in a CDS contract

Here we describe in more detail the reference and counterparty credit risks associated with CDS contracts. **Figure A1** illustrates, in a stylised fashion, these two types of risk by showing the long and short positions of a hypothetical trader in a specific CDS contract.

In the first, symmetric, case ('no risk') the trader has bought and sold the same total amount of CDS contracts (on the same reference entity) so that there is no reference credit risk. Furthermore, the trader has bought and sold equal amounts from the same counterparties (A and B) so that in the presence of bilateral close-out netting agreements no counterparty risk arises as the exposures can be fully netted in case of counterparty default. Thus, these CDS positions pose no risk for the trader.

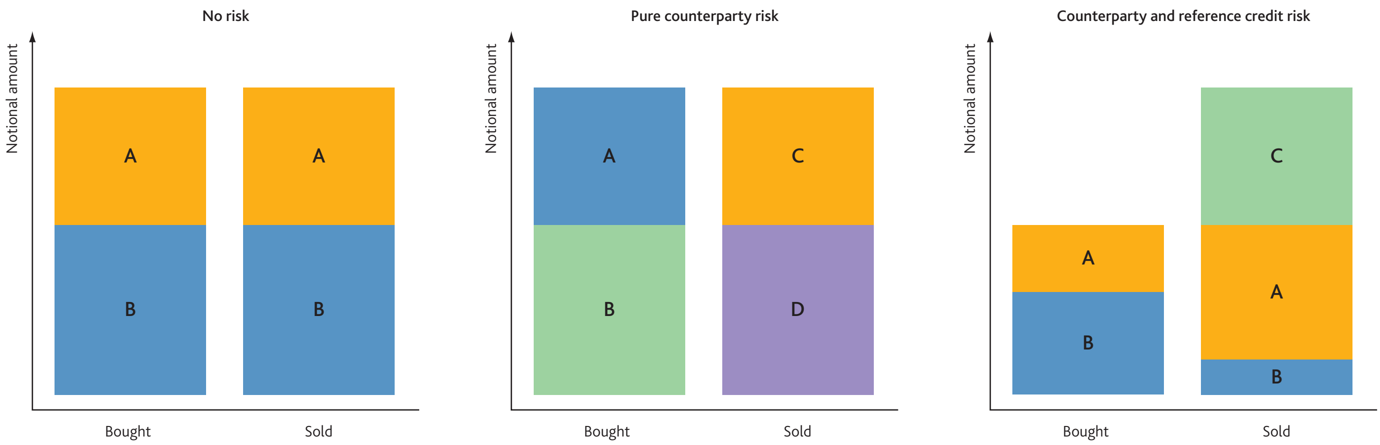
In the second case ('pure counterparty risk') the total amounts of CDS bought and sold remain the same and hence there is still no reference credit risk. However, the counterparties from which the contracts were bought are now different from those to which they were sold (A vs C and B vs D). Consequently, counterparty risk arises. The trader can no longer bilaterally net these exposures in case of counterparty default. If, for example, counterparty B fails, the trader will have to replace the long position with B. That, however, may be costly to do even if the counterparties regularly pay and receive variation margin. Following a counterparty default, it may take the trader a considerable amount of time to replace the contract with another counterparty, and in the meantime the credit spread may widen, forcing the trader to incur significant replacement cost.

The last case ('counterparty and reference credit risk') shows an example where the trader faces both counterparty credit risk and reference credit risk. Being a net seller of protection, the trader incurs losses when the reference credit defaults, and these losses may be exacerbated by counterparty B defaulting, since the trader cannot net the net long position with this counterparty against the net short position with counterparty A. But even if the reference credit does not default, the trader still faces counterparty credit risk since he may incur significant replacement costs associated with their net bilateral positions as explained in the previous paragraph.

In this stylised setting, it is interesting to think about the maximum potential losses of a CDS trader in a worst-case scenario where both the reference entity and all of the trader's counterparties simultaneously default, recovery rates are equal to zero and no collateral is exchanged. **Figure A2** illustrates this for the case when bilateral close-out netting agreements are in place (left-hand panel) and when they are not (right-hand panel). In the former case, because the trader is a net seller of protection, he has to compensate the protection buyers for the losses arising from the default of the reference credit. With zero recovery, reference risk equals the net notional amount of protection sold. In the latter case, the trader incurs a loss due to counterparty B defaulting because they have a net long position with B. No loss occurs due to counterparty A defaulting since the trader can net its long position with A against the larger short position with A. In the absence of bilateral netting arrangements, the resulting exposure equals the total amount of protection sold.

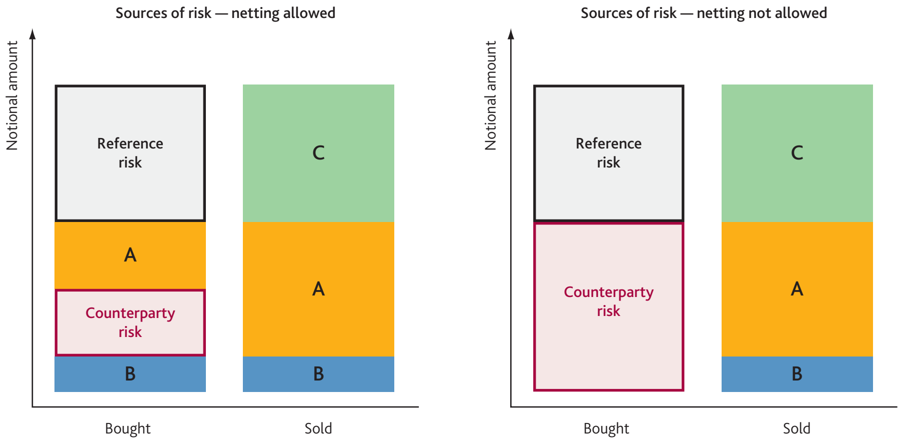
The examples above illustrate the inadequacy of relying on the net amount of protection sold by a trader on a given reference entity as a measure of risk. In the absence of collateral held, what matters are bilateral net notional amounts traded and, if close-out netting is not permitted, the bilateral gross notional amounts sold. These determine the maximum losses that can be incurred in the worst-case scenario depicted above. Even with regular exchange of collateral and close-out netting agreements, counterparty credit risk is not completely eliminated; significant replacement costs may materialise due

Figure A1 Illustration of scenarios where 'reference' and 'counterparty' risk in a CDS contract may arise



Note: Each schematic shows the hypothetical positions of a trader in a specific CDS contract. The 'bought' columns represent long positions in the CDS contract and the 'sold' columns represent short positions. The block capital letters represent the trader's counterparties to its CDS positions.

Figure A2 Illustration of 'reference' and 'counterparty' risks in a worst-case scenario where the CDS reference entity and the CDS seller default simultaneously



to increased volatility and reduced liquidity that characterise market conditions following the default of a major market participant, especially when the size of the position being replaced is large. To properly assess the risk arising from CDS contracts, regulators therefore need to have a full view of the map of bilateral positions, together with a detailed picture of the bilateral risk-mitigating agreements in place, and an estimate of the likely market impact of replacing these positions in stressed markets.

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