

Financial Stability Paper No. 18 – October 2012

# OTC derivatives reform and collateral demand impact

Che Sidanius and Filip Zikes



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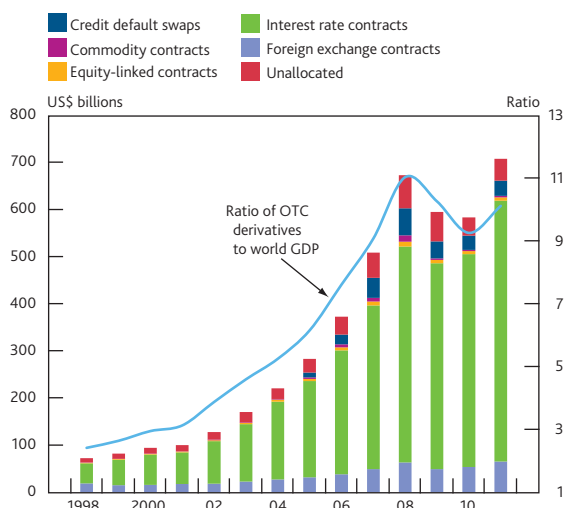
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In an effort to strengthen the over-the-counter (OTC) derivatives market, regulators have mandated central clearing of standardised OTC derivatives and work is ongoing on prospective margin requirements for transactions that are not centrally cleared. These reforms are widely expected to increase demand for high-quality assets to use as collateral. This paper expands on our methodology as presented in the Bank of England's June 2012 *Financial Stability Report* in order to estimate the potential magnitude of the demand for collateral. Recognising that there is considerable uncertainty around how market participants will adapt, we constructed a model that provides a range of quantitative estimates of the total initial margin associated with both centrally cleared and non-cleared (bilateral) OTC derivatives transactions. Our approach allows for factors such as netting assumptions, the impact of restricting rehypothecation, and different market conditions. We limit the product scope to interest rate swaps (IRS) and credit default swaps (CDS) as they account for over 80% of the OTC derivatives market and are particularly suitable to central clearing due to their high degree of standardisation. Our baseline estimates indicate that under normal market conditions and holding the current gross notional amount outstanding fixed, the total initial margin for cleared and non-cleared trades in the IRS and CDS markets may reach between US\$200 billion and US\$800 billion if 80% of trades are subject to central clearing. The wide range reflects the sensitivity to assumptions around netting efficiency. The demand for collateral, however, will rise only gradually as the OTC reforms will only affect new contracts.

## 1 Introduction

The 2007–09 financial crisis sparked a global discussion about the risks and transparency of the over-the-counter (OTC) derivatives market. While the OTC derivatives market did not cause the financial crisis, large bilateral exposures, many not sufficiently collateralised, and proliferation of redundant overlapping contracts exacerbated counterparty credit risk. The US\$650 trillion in notional amount outstanding in OTC derivatives market is more than ten times annual global GDP (Chart 1). The gross market value, or the total value of all derivatives contracts if they had to be closed out and settled at market value on a specific date, was around US\$27 trillion in December 2011.<sup>(1)</sup>

**Chart 1** Notional amounts outstanding of OTC derivatives and ratio to world GDP



Sources: Bank for International Settlements (BIS), European Central Bank (ECB), IMF and Bank calculations.

In April 2009, the G20 group of nations agreed to promote the standardisation of OTC derivatives markets. The commitment was underscored with a declaration that all 'standardised' OTC derivatives should be cleared through central counterparties (CCP). The intent is to achieve greater transparency and reduce counterparty credit risk by eliminating the need for multiple bilateral credit relationships. In 2011, it was further agreed to add margin requirements on non-centrally cleared derivatives and the Basel Committee on Banking Supervision (BCBS) and International Organization of Securities Commissions (IOSCO) was called upon to develop consistent global standards for these requirements.<sup>(2)</sup> The rationale for introducing margin requirements is to incentivise central clearing and reduce the risk of contagion.

This paper expands on our methodology presented in the June 2012 *Financial Stability Report* that focuses on the expected increase in demand for high-quality collateral (or initial margin) to support both centrally cleared and non-centrally cleared OTC derivatives.<sup>(3)</sup> While a proportion of

the OTC derivatives market is already being cleared, the pace of transition to more widespread clearing is expected to be gradual. In the United States and Europe, the central clearing obligation will only affect new contracts entered into as of the date of the clearing notification.<sup>(4)</sup> The increase in the demand for collateral is therefore likely to occur over a period of time as the new requirements are applied to new trades only.

Demand for high-quality assets will not only be driven by central clearing mandates and margining requirements but also by other regulatory reform underway. Under Basel III, banks will be required to hold an amount of highly liquid assets, equal to or greater than a stressed net cash outflow over a 30-day period, known as the liquidity coverage ratio.

The expected increase in demand for collateral should be considered in the context of the total pool of safe assets. For example, the International Monetary Fund (IMF) estimates the total amount of outstanding AAA/AA-rated OECD<sup>(5)</sup>-government securities at US\$33.2 trillion. However, a significant amount of these securities are held by central banks, long-term investors, or already deployed in repo transactions.<sup>(6)</sup> These securities cannot count towards the total pool of usable collateral. In addition, the growing demand for collateral is set against a shrinking range of assets that is perceived as safe, mainly as a result of market uncertainty and heightened awareness of risk. For instance, the number of sovereigns whose debt is considered safe has fallen and could remove some US\$9 trillion from the supply of safe assets by 2016 (IMF (2012)).

The paper is organised as follows. In Section 2 we explain the differences in collateralisation in central and bilateral clearing. Section 3 describes our data and methodology. Section 4 provides a full description of the results. Section 5 concludes. Technical details regarding our models for initial margin rates can be found in the Appendix.

## 2 Collateralisation in central and non-central (bilateral) clearing

Mandating central clearing through a CCP and imposing higher margin requirements for non-centrally cleared contracts is expected to increase demand for margin collateral. This Section explains how collateralisation works in central clearing (Section 2.1) and for non-cleared or bilateral transactions (2.2).

(1) BIS (2011).

(2) G20 (2011).

(3) Bank of England (2012).

(4) United States: [www.sec.gov/news/studies/2012/sec-cftc-intlswapreg.pdf](http://www.sec.gov/news/studies/2012/sec-cftc-intlswapreg.pdf).  
Europe: [www.esma.europa.eu/system/files/2012-379.pdf](http://www.esma.europa.eu/system/files/2012-379.pdf).

(5) Organisation for Economic Co-Operation and Development.

(6) IMF (2012).

## 2.1 Central clearing

Initial margin, in the form of cash or highly liquid securities collected from counterparties, is one of the key controls CCPs use to manage their counterparty risk. It is intended to cover losses in the value of open positions with a defaulted counterparty that might accrue before the position can be replaced at prevailing market prices. These margin requirements should be commensurate with the risks and attributes of the product characteristics such as price volatility, jump-to-default risk, and possible liquidation procedures.

The initial margin methodology adopted by a CCP should, according to current CPSS<sup>(1)</sup>-IOSCO standards, meet an established single-tailed confidence level of at least 99% of the estimated distribution of future exposures. In addition, it needs to maintain sufficient resources to cover its potential future exposure to participants in the interval between the last margin collection and the close out of positions following a participant default. A CCP with a more complex risk profile or that is systemically important in multiple jurisdictions should maintain sufficient resources to cover the default of the two participants and their affiliates that pose the largest aggregate credit exposure in extreme but plausible market conditions. All other CCPs should maintain sufficient financial resources to cover the default of a participant and its affiliates that pose the largest aggregate credit exposure.<sup>(2)</sup>

It is important to note that a clearing house collects and holds the initial margin for the life of the trade to reflect the riskiness of the underlying transaction. In contrast, variation margin is called upon to offset changes in value of a contract on a mark-to-market basis. A CCP is simply the conduit, collecting it from one party and passing it on to the other party.<sup>(3)</sup>

Collateral eligibility criteria differ according to regulatory jurisdictions and clearing house rules. CPSS-IOSCO standards require financial market infrastructures, such as CCPs, to limit the assets they accept as collateral to those with low credit, liquidity, and market risks.<sup>(4)</sup> For initial margin, they generally accept cash and assets considered high-quality such as government securities, and, in some CCPs, corporate bonds, equities included in major stock indices, and gold. Variation margin is exclusively cash.

The amount of collateral posted as initial margin will be driven in part by which OTC derivatives have to be centrally cleared and which counterparties are subject to the central clearing obligation. In the United States, this determination will be made by the Commodity Futures Trading Commission (CFTC) and the Securities and Exchange Commission (SEC), either at the request of a clearing house or by the authorities. An end-user clearing exemption is available for certain non-financial counterparties that use these instruments for hedging or other commercial risk mitigating purposes. Small banks and credit co-operatives with assets of US\$10 billion or

less have also been exempted.<sup>(5)</sup> In Europe, the clearing mandate will be determined by the European Securities and Markets Authority (ESMA) under European Market Infrastructure Regulation (EMIR). The clearing exemption extends to all non-financial counterparties with volumes below a 'clearing threshold' or contracts entered into for hedging purposes.<sup>(6)</sup>

## 2.2 Non-centrally (bilateral) cleared trades

Collateralising OTC derivatives in the bilateral (non-centrally cleared) market has historically been discretionary. Since the financial crisis, however, market participants have significantly increased their reliance on collateral which is now a widely used method to mitigate counterparty credit risk in this market. From 2001 to 2011 the compounded annual growth rate of collateral in circulation (or total collateral received and delivered against non-centrally cleared transactions) was 24% while gross credit exposure has grown at a 14% compounded annual rate.<sup>(7)</sup>

Margin (or commonly referred to as an 'independent amount') in the bilateral market provides protections against default loss partly in conjunction with regulatory capital. Capital held against bilateral exposures is expected to increase as Basel III requires banks to add a credit valuation capital charge to cover risks of mark-to-market losses due to changes in counterparty creditworthiness on OTC derivatives.<sup>(8)</sup> The type of collateral used in the bilateral market is predominantly cash, currently around 80%.<sup>(9)</sup> The benefit associated with cash collateral is operational simplicity in the widely adopted practice of re-using (ie rehypothecating) collateral for other transactions. The independent amount and variation margin in the bilateral market also tends to be combined. Market practice in the bilateral market is to align collateral flows with that of the cleared market which incentivises the use of cash as collateral when posting variation margin.

A Working Group on Margining Requirements (WGMR) established by the BCBS and IOSCO is currently considering standards for which types of collateral should be deemed eligible for meeting margin requirements. The favoured approach being considered by the WGMR would permit a broad set of eligible collateral and apply haircuts to address the potential volatility of such assets.<sup>(10)</sup> The Group also establishes minimum standards for margin requirements for non-centrally cleared trades. The aim of these standards is to reflect the generally higher risk associated with bilateral

(1) Committee on Payment and Settlement Systems.

(2) BIS (2012b).

(3) This does not apply to intraday margin however. A CCP may make intraday variation margin calls without making concurrent pay-outs.

(4) BIS (2012b).

(5) [www.cftc.gov/LawRegulation/DoddFrankAct/Dodd-FrankProposedRules/index.htm](http://www.cftc.gov/LawRegulation/DoddFrankAct/Dodd-FrankProposedRules/index.htm).

(6) [www.esma.europa.eu/consultations/overview/10](http://www.esma.europa.eu/consultations/overview/10).

(7) ISDA (2012). Gross credit exposure, as defined by BIS, is the sum of positive (or negative) market values after bilateral netting.

(8) [www.bis.org/publ/bcbs189.pdf](http://www.bis.org/publ/bcbs189.pdf).

(9) ISDA (2012).

(10) [www.bis.org/publ/bcbs226.pdf](http://www.bis.org/publ/bcbs226.pdf).

contracts and to promote central clearing. The margin requirement being proposed in the Group's consultation report (July 2012) reflects an extreme but plausible increase in potential future exposure that is consistent with a one-tailed 99% confidence interval over a ten-day period.<sup>(1)</sup>

Global regulators are also considering whether rehypothecation of this collateral should be allowed. The WGMR report mentions that some authorities are considering whether rehypothecation may be allowed under certain circumstances and whether clients might be given certain protections. These proposed protections include segregating customer assets from a firm's proprietary assets and ensuring that the counterparty to the failed firm gets first priority claim on the initial margin.<sup>(2)</sup>

### 3 Methodology

Ours is not the first study that tries to gauge the impact of the new regulation of the OTC derivatives market on the demand for collateral (see **Table A**). However, there are significant differences in the various estimates of the demand for collateral. This reflects differences in scope, the opacity of the OTC derivatives markets and the lack of comprehensive data associated with it, and various assumptions made, in particular those regarding trading volumes, and bilateral and multilateral netting benefits.

**Table A** Alternative estimates of collateral demand in OTC derivatives markets

	Products	Resources	Collateral demand (US\$ billions)
MS (2012)	IRS	Additional initial margin	480
IMF (2012)	All OTC	Additional initial margin and default fund contribution	100–200
ISDA (2011)	IRS	Additional initial and variation margin	1,000
BIS (2012a)	IRS and CDS	Total initial margin	718

Sources: BIS (2012a), IMF (2012), ISDA (2011a) and Morgan Stanley (2012).

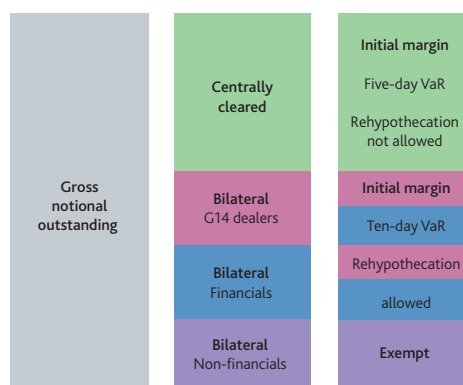
The IMF estimates that the incremental initial margin and default fund contributions associated with moving bilateral OTC derivatives contracts to central counterparties would amount to US\$100 billion–US\$200 billion (IMF (2012)). The International Swap and Derivatives Association (ISDA) estimates that an additional US\$1 trillion in initial and variation margin will have to be posted in the interest rate swaps (IRS) market alone (ISDA (2011a)). The Bank for International Settlements (BIS) calculates that, under 'normal' market conditions and assuming one CCP for each of the two asset classes, the total initial margin could reach US\$718 billion (BIS (2012a)).

We constructed a model that provides a range of quantitative estimates, based on varying netting assumptions, restrictions

on rehypothecation, and different market conditions. We focus on the impact of regulatory changes on the total initial margin that will have to be posted in order to sustain the current level of OTC derivatives trading. The product scope is limited to IRS and credit default swaps (CDS) as they account for over 80% of the OTC market (a majority of which are plain vanilla IRS)<sup>(3)</sup> and are particularly suitable to central clearing due to their high degree of standardisation.<sup>(4)</sup> Currently, around 50% of IRS and about 10% of CDS transactions are centrally cleared (BIS (2011)). Rigorous estimates in this area are difficult and the proportion of derivatives that will remain bilaterally cleared will vary across markets. For the purposes of our modelling approach and consistent with some industry estimates, we assume that around 20% of the OTC derivatives market will not be centrally cleared.<sup>(5)</sup>

Since we are interested in the aggregate increase in the demand for collateral associated with the new regulation, we have not estimated variation margin demands. In bilateral transactions, the variation margin is simply a transfer of the change in the value of the derivatives contract from one counterparty to the other, while for centrally cleared trades the CCP acts as an intermediary and passes the variation margin between the original counterparties to the transaction. Thus for the purposes of our exercise, there is no net aggregate impact from changes in mandatory variation margin on the demand for collateral.

**Chart 2** Gross notional breakdown and initial margins



For each of the two derivatives markets, IRS and CDS, our approach for estimating the total initial margin proceeds in four steps:

- 1 taking the gross notional amounts in the IRS and CDS markets as given and dividing these up by types of counterparties;

(1) BCBS and IOSCO (2012).

(2) BCBS and IOSCO (2012).

(3) Plain vanilla swaps refers to a fixed for floating rate swap calculated on a pre-agreed and fixed notional amount, in a single currency, and over a mutually agreed maturity.

(4) Sidanius and Wetherilt (2012).

(5) This is consistent with industry estimates, eg JPMorgan (2010).

- 2 choosing a netting ratio to estimate the net notional amounts;
- 3 estimating the proportion of centrally cleared and bilateral notional amounts; and
- 4 applying initial margin requirements based on a Value-at-Risk (VaR) methodology to estimate the total initial margin in the IRS and CDS markets.

Each step involves a number of assumptions and calibration of parameters. While we base these on current market data, for transparency we report our results for a range of realistic values of these parameters rather than a single number. Below we describe the four steps in detail.

### 3.1 Gross notional breakdown

The current gross notional amount outstanding in the derivatives markets is taken as a given. Any impact the new regulation and expansion of mandatory central clearing may have on the trading activity in these markets is not considered for modelling purposes. This is a strong assumption, however incorporating the response of market participants to the new regulation is beyond the scope of this work.

Since centrally cleared and non-cleared transactions will receive different treatment under the new margin rules, the gross notional amount is split in two parts: centrally cleared and bilateral. The bilateral notional amount is further divided by counterparty into 'G14 dealers', 'financials' and 'non-financials'. Given that some non-financial institutions (end-users) are exempt from margin requirements for their derivatives transactions, the gross notional amount attributable to their trades is subtracted from the total bilateral gross notional when calculating the total initial margin.<sup>(1)</sup> **Table B** summarises the gross notional breakdown for this approach.

**Table B** Gross notional breakdown (4 November 2011)

US\$ billions	IRS	CDS
<b>Gross notional total</b>	<b>272,793</b>	<b>25,531</b>
CCP	129,705	2,553
Bilateral	143,088	22,978
G14	39,799	18,893
Financials	61,973	3,962
Non-financials	41,316	123
Others	103,289	4,085

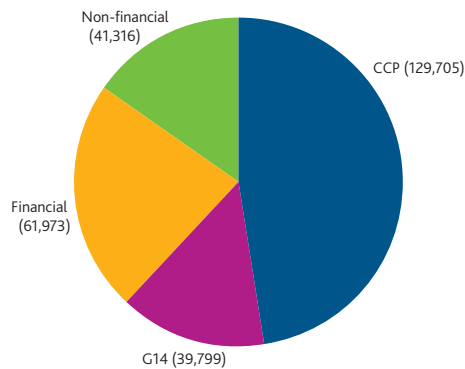
Sources: ISDA, DTCC, TriOptima, and Bank calculations.

The main sources of data on the gross notional amount outstanding in the IRS and CDS markets are the TriOptima Interest Rate Trade Repository and the Depository Trust and Clearing Corporation (DTCC) Credit Trade Repository, respectively. Unlike the BIS which obtain data for the OTC derivatives markets by means of a survey, the trade

repositories collect data on actual transactions taking place in the markets. Although they do not yet capture 100% of the market, the trade repositories provide the most detailed and up-to-date picture of the respective OTC derivatives markets.<sup>(2)</sup>

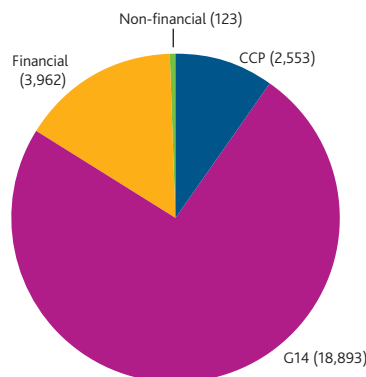
**Table B** summarises the gross notional breakdown for interest rates and credit default swaps based on current market data and Bank of England calculations and assumptions. The IRS notional data are extracted from TriOptima's *Interest Rate Trade Repository Report* of 4 November 2011 (TriOptima (2011)), and include plain-vanilla swaps, overnight index swaps and basis swaps. The remaining interest rate derivatives are excluded from the analysis. After eliminating double counting, the total gross notional amount outstanding in the IRS market stood at almost US\$273 trillion at the beginning of November 2011.<sup>(3)</sup> Out of this amount, US\$130 trillion was centrally cleared and US\$143 trillion bilateral.

**Chart 3** Breakdown of gross notional outstanding in IRS



Sources: TriOptima and Bank calculations.

**Chart 4** Breakdown of gross notional outstanding in CDS



Sources: DTCC and Bank calculations.

(1) In Europe, non-financial counterparties will only be exempt if volumes fall below a threshold and if the trades are for hedging purposes. In the United States, smaller financial entities will also be exempted from the clearing obligation. For this paper, we assume that all financial counterparties and their derivatives activity is not related to hedging and are subject to the clearing obligation and all non-financial counterparties are exempt.

(2) Publicly available weekly reports published by TriOptima and DTCC are used with the aim of making our methodology and results transparent.

(3) This monthly notional amount is comparable the 2011 monthly average.



TriOptima reports a breakdown of the bilateral notional amount into G14 dealers and non-G14 dealers, but they provide no further breakdown of the non-G14 notional into financials and non-financials. We split the non-G14 notional by assuming that 40% of the non-G14 notional is attributable to non-financial institutions and the remaining 60% to financials, which is consistent with the breakdown used by ISDA (2011b). Based on this assumption, we attribute US\$62 trillion to financials, US\$41 trillion to non-financials and US\$40 trillion of the bilateral notional to the G14 dealers. Since TriOptima captures about 80% of the IRS market, we scale up the IRS notionals by a factor of 1.25 when calculating the total initial margin in the next section.

In the case of credit default swaps, our main data source is the DTCC's *Standard Report* of 4 November 2011 (DTCC (2011)). The DTCC reports that the gross notional outstanding in the CDS market at the beginning of November 2011 was almost US\$26 trillion. DTCC provides a breakdown of the total gross notional by counterparty into dealer and non-dealer/customer notional, but there is no information about the proportion of the total notional that is centrally cleared. Following BIS (2012), we assume that 10% of the gross notional is currently subject to central clearing (US\$2.6 trillion) and the remaining 90% of the notional relates to bilateral transactions (US\$23 trillion).<sup>(1)</sup>

We use the ratio of dealer notional to non-dealer notional reported by DTCC to split the bilateral notional into G14 and others. Consistent with BIS (2012a), we assume that 3% of the bilateral notional not involving dealers is attributable to non-financial institutions. Based on these assumptions, the bilateral notional related to G14 dealers was US\$18.9 trillion in the beginning of November 2011, while for financials and non-financials this figure was US\$3.96 trillion and US\$0.12 trillion, respectively.

### 3.2 Margin rates

Initial margins are set to cover potential losses on in-the-money derivative contracts in the event of counterparty default. Sound initial margin requirements have to be based on accurate assessment of the underlying risks and must reflect current market conditions, such as volatility and liquidity. Despite the short-comings of VaR we employ this methodology in order to be consistent with methods used by major clearing houses. See Box 1 for a simple example of how VaR-based initial margin works.

We use standard valuation models together with financial time-series models to estimate the VaR for IRS, and separately for CDS. The VaR estimates are based on daily data for the period October 2006 to October 2011 and are calculated for gross-notional valued portfolios. In case of IRS this is a portfolio of different tenors and currencies, while in the case of CDS it is a portfolio of single-name and index CDS contracts denominated in US dollars. The weights are based on the gross

notional breakdown reported by TriOptima (2011) and DTCC (2011), respectively. A detailed description of the methodology is provided in the Appendix.

We estimate the VaRs separately for long and short positions and under different market conditions (see Table C). Three scenarios are considered depending on the level of volatility in the IRS and CDS markets over the five-year period we use for estimation of the VaR models.<sup>(2)</sup> The 'normal' regime corresponds to average volatility during 2006–11. The 'tranquil' regime assumes volatility equal to around two thirds of the average volatility, as was observed, eg in January 2006.<sup>(3)</sup> Finally, the 'stress' scenario entails volatility elevated to around twice the average volatility, which corresponds to the volatility levels observed during the turbulent month of October 2008.

**Table C** Five-day 99.7% VaR (percentage of notional)

Market conditions	IRS		CDS	
	Short	Long	Short	Long
Tranquil	1.30	1.47	2.52	1.26
Normal	2.03	2.10	3.78	1.89
Stress	4.06	4.21	7.56	3.77

Source: Bank calculations based on data from Bloomberg.

Consistent with the margin models of some major clearing houses, we set the initial margin for cleared IRS and CDS transactions to the five-day VaR at the 99.7% confidence level.<sup>(4)</sup> Since the downside risks to the short and long positions in IRS are fairly symmetric, the initial margin rates for payers and receivers are about the same. Contrary to the IRS, CDS risks are highly asymmetric in that the protection seller faces potentially much higher losses than the protection buyer. Our estimates of the initial margin rates show that the protection seller should post more than twice the amount in initial margin than the protection buyer.

Non-cleared transactions are not currently subject to mandatory initial margin, but as discussed in the introduction, the ongoing regulatory debate envisages that this changes. While the precise rules for setting initial margins for bilateral OTC transactions have yet to be fully determined, we assume an initial margin equal to the ten-day VaR at the 99.7% confidence level for bilateral transactions in our analysis. Assuming a longer close-out period for bilateral as opposed to centrally cleared transactions is justified by the generally lower liquidity and higher complexity of the derivatives contracts that are not eligible for central clearing.

(1) Financial Stability Board (2012a) updated the percentage of CDS contracts cleared on a CCP to 12%.

(2) Using five-year historical data is consistent with how LCH determines a maximum adverse price movement for IRS when calculating the initial margin. [www.lchclearnet.com/risk\\_management/lt/margining/swapclear.asp](http://www.lchclearnet.com/risk_management/lt/margining/swapclear.asp).

(3) Measured by the volatility of the daily changes in one-year swap spreads, the volatility in the 'normal' period was similar to the average volatility between 2000–06.

(4) [www.esma.europa.eu/system/files/eurex\\_clearing\\_ag\\_response\\_to\\_esma\\_discussion\\_paper\\_final.pdf](http://www.esma.europa.eu/system/files/eurex_clearing_ag_response_to_esma_discussion_paper_final.pdf).

## Box 1

### How initial margin works

To illustrate how initial margin helps protect against losses arising from counterparty default, consider two dealers, A and B. Dealer A goes long an equity index futures contract that dealer B shorts. Suppose that the futures price is US\$100 and interest rates are zero. One day later the futures price rises to US\$101 and dealer B is due to pay US\$1 in variation margin to dealer A. Should dealer B default, dealer A can re-establish a long position in the futures contract at the new futures price of US\$101. But the value of this contract is zero and hence the replacement cost for dealer A is US\$1, precisely

the amount dealer B failed to pay to dealer A in variation margin.

Due to fluctuations in market liquidity it won't be always possible to replace the contract immediately following default. Suppose that it may take up to five days to find a new counterparty to the futures contract and that under normal market conditions the futures price would not be expected to move by more than US\$5 within five days with probability 99%. Then if the initial margin is set at US\$5, dealer A will be fully protected against the default of dealer B with 99% confidence. In technical terms, this initial margin equals the five-day VaR at the 99% confidence level.

### 3.3 Netting

The gross notional amount vastly overestimates the total exposures in the derivatives markets, as most market participants hold a large number of positions with offsetting risks. Some of these risks cancel out directly, for example, when a dealer holds both long and short positions in a given contract. Further reduction in the net exposure occurs due to correlated risks. For example, a dealer may be net long a one-year swap and short a two-year swap but since these swap rates move together quite closely, its overall risk exposure is considerably smaller than the sum of the individual net exposures.

Estimating the net risk exposures for the purposes of calculating the total initial margin requires detailed knowledge of all mutual exposures of participants in the derivatives markets. Such an exercise is beyond the scope of our paper. We simply divide the gross notional amount outstanding by a single net position that captures the average offset of risks in the respective markets.

One of the benefits of central clearing is that it allows for multilateral netting which can significantly reduce credit risk. For example, multilateral netting of CDS can reduce the notional amount outstanding by about 90%.<sup>(1)</sup> Experience in the foreign exchange market could also be a useful comparison.<sup>(2)</sup> Our model shows that the netting benefits will increase (see **Table E** in the following section) with increased product standardisation and as more OTC derivatives contracts move to central clearing.

However, it is difficult to predict the precise impact on netting. We therefore report the initial margin estimates for a range of different netting values. If up to 80% of the OTC derivatives are centrally cleared, we use a multilateral netting range of 95%–99% in the IRS market and 90%–95% in the CDS market. The higher netting range for IRS takes into account a greater degree of standardisation compared to the CDS market.

## 4 Modelling the demand for collateral: results

Our baseline estimates indicate that under normal market conditions and holding the current gross notional amount outstanding fixed, the *total* initial margin for cleared and non-cleared trades ranges between US\$200 billion–US\$800 billion (**Charts 5 and 6**, and **Table D**). This translates into an incremental increase of around US\$130 billion–US\$450 billion when comparing current clearing of IRS and CDS (56% and 10% centrally cleared, respectively) with potential future demand (80% centrally cleared for both product classes). According to our model, only 25% of this collateral demand would be driven by bilateral margin requirements (**Table D**). The wide interval estimate reflects the sensitivity of the total initial margin to the degree of multilateral netting.

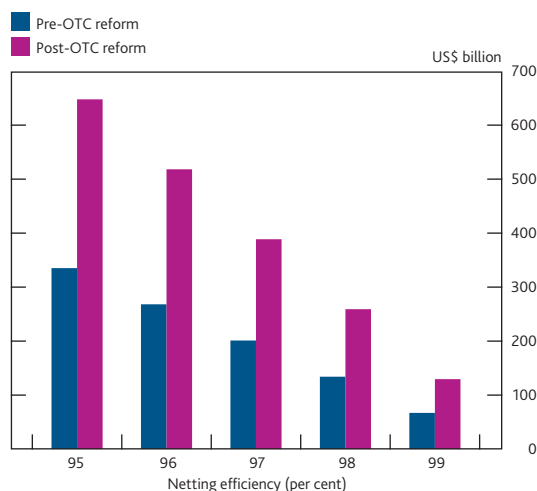
In the IRS market total initial margin is estimated to be between US\$130 billion and US\$650 billion while in the CDS market it is around US\$80 billion–US\$156 billion. The benefits of novating trades into a clearing house are larger for CDS in terms of the total margin, since the proportion of cleared trades is currently around 10%.<sup>(3)</sup> Imposing new margin rules for bilateral transactions will, however, imply a significant increase in margin requirements for CDS contracts. In addition, our model shows that, within a multilateral netting set, increasing the proportion of centrally cleared transactions results in a decrease in the initial margin (**Table F**). This is due to more stringent margin requirements for bilateral transactions together with zero rehypothecation of collateral, and hence an advantage to central clearing in terms of the required initial margin. **Table F** shows that total initial margin estimates fall from US\$198 billion–US\$156 billion as the

(1) IMF (2010).

(2) CLS (2011), an FX settlement service in operation since 2002 with a global market share of 58%, reports a multilateral netting benefit of 95.9%.

(3) Novation refers to a clearing house interposing itself as a counterparty to every trade and extending a guarantee that the trade will be settled as originally intended.

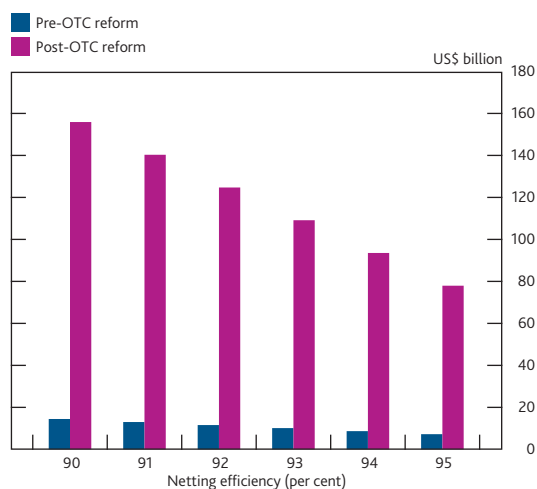
**Chart 5 Total initial margin for IRS under 'normal' market conditions**



Note: Charts 5 and 6 show the total initial margin requirements in the IRS and CDS markets as a function of netting efficiency. The figures include margin for both cleared and non-cleared transactions under normal market conditions. 'Pre-OTC reform' assumes 56% and 10% currently being centrally cleared for IRS and CDS, respectively. 'Post OTC reform' assumes 80% central clearing for respective asset class.

Source: Bank calculations.

**Chart 6 Total initial margin for CDS under 'normal' market conditions**



Note: See note to Chart 5.

Source: Bank calculations.

**Table D Baseline estimates ('normal' market conditions) total initial margin**

	Cleared (per cent)	Netting (per cent)	Initial margin		Total (US\$ billion)
			Cleared (US\$ billion)	Non-cleared (US\$ billion)	
IRS	80	99–95	96–479	34–169	130–648
CDS	80	95–90	58–115	20–41	78–156
<b>Total</b>			<b>154–594</b>	<b>54–210</b>	<b>208–804</b>

Source: Bank calculations.

percentage of centrally cleared trades rises from the current 10% to 80%, assuming 90% netting. A higher netting ratio further reduces total collateral needs. However, the relative collateral efficiency of central clearing may disappear if rehypothecation is allowed as we demonstrate later.

In Tables E and F, we provide a more detailed picture of the impact of netting. In the case of the IRS market, we vary the netting benefits from 90% to 99% and the proportion of central cleared transactions from the current 56% up to 100%. Again, we assume zero rehypothecation of collateral in bilateral transactions, no haircuts and normal market conditions. Clearly, netting is the main driver of our results. According to our model and assuming 80% central clearing, if the netting benefit falls to 90% in the IRS market, the increase in initial margin would reach US\$1.3 trillion in total, or an incremental increase of US\$625 billion.

**Table E Total initial margin estimates for IRS under normal market conditions**

US\$ billions	Netting					
	90%	95%	96%	97%	98%	99%
Proportion cleared						
56%	1,414	707	566	424	283	141
60%	1,395	697	558	418	279	139
70%	1,345	673	538	404	269	135
80%	1,296	648	518	389	259	130
90%	1,246	623	498	374	249	125
100%	1,196	598	479	359	239	120

Source: Bank calculations.

**Table F Total initial margin estimates for CDS under normal market conditions**

US\$ billions	Netting					
	90%	91%	92%	93%	94%	95%
Proportion cleared						
10%	198	178	158	138	119	99
20%	192	173	153	134	115	96
40%	180	162	144	126	108	90
60%	168	151	134	118	101	84
80%	156	140	125	109	94	78
100%	144	130	115	101	86	72

Source: Bank calculations.

#### 4.1 Rehypothecation

Currently, there is broad consensus within the BCBS and IOSCO that initial margin should not be rehypothecated in order to ensure that assets would be readily available to counterparties if the receiving firm failed.<sup>(1)</sup> Rehypothecation refers to a situation when the collateral pledged by one counterparty of a transaction to another is used by the receiving counterparty as collateral in another transaction. For the purposes of our exercise, we considered the trade-off

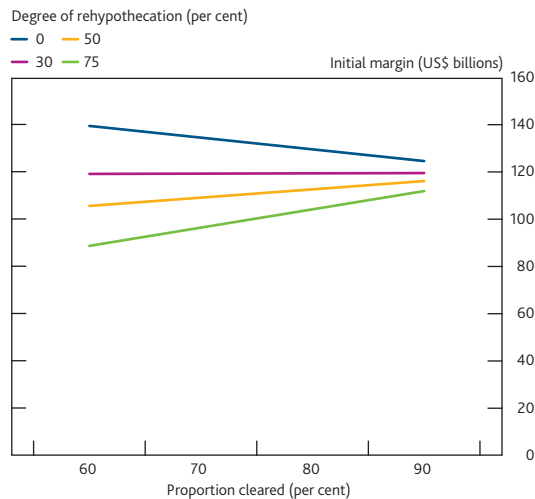
(1) BCBS and IOSCO (2012).

between rehypothecation and higher initial margin rates in the bilateral market.

The baseline results assume more stringent margin requirements for bilateral transactions together with zero rehypothecation of collateral, and hence there is an advantage to central clearing in terms of the required initial margin. However, this effect may be reversed when rehypothecation is allowed. While central counterparties do not allow for rehypothecation of collateral, and so the collateral remains with the CCP for the entire life of the contract, in the bilateral space rehypothecation is currently allowed.<sup>(1)</sup>

The demand for collateral may be lower in the bilateral space as collateral may be recycled and the same amount of collateral may therefore support a larger number of transactions (and imply a higher velocity of collateral). This is facilitated by the fact that the collateral composition is over 80% cash. However, we assume higher initial margin rates for the bilateral transactions, and this exerts the opposite pressure on the demand for collateral for bilateral trades. To see how this trade-off plays out in our quantitative estimates, we now repeat the calculation, allowing for partial rehypothecation of the collateral received in bilateral transactions.

**Chart 7 Collateral demand — effect of rehypothecation — IRS market**



Source: Bank calculations.

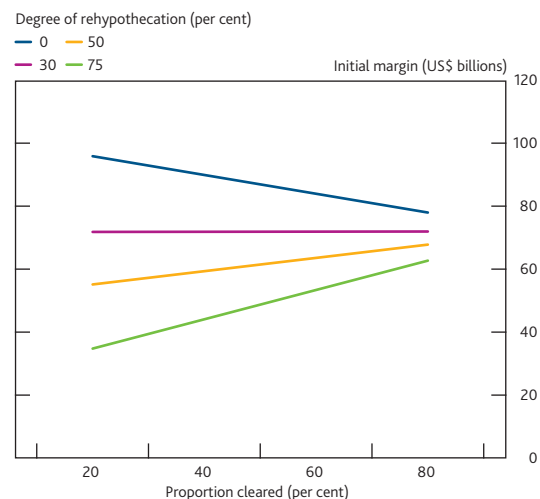
**Table G Total initial margin estimates with 75% rehypothecation**

US\$ billions	Netting					
	90%	95%	96%	97%	98%	99%
Proportion cleared						
56%	856	428	343	257	171	86
60%	887	444	355	266	177	89
70%	964	482	386	289	193	96
80%	1,042	521	417	313	208	104
90%	1,119	560	448	336	224	112
100%	1,196	598	479	359	239	120

Source: Bank calculations.

**Chart 7** summarises the results for IRS. In **Table G** we assume that 75% of the received total collateral for bilateral transactions is rehypothecated and calculate the total initial margin under different assumptions about netting and extent of central clearing akin to **Table E**. This assumption is broadly consistent with some industry surveys which show 74% of collateral posted against interdealer OTC derivative transactions is rehypothecated.<sup>(2)</sup> Unlike in the case of no rehypothecation, the total initial margin now increases with the proportion of cleared notional. In terms of amount of collateral needed, the effect of rehypothecation therefore outweighs the more stringent margin requirements in bilateral transactions. As shown in **Chart 7** this is not always the case: given our estimates for IRS, the ‘break-even’ rehypothecation percentage at which the effect of rehypothecation exactly offsets the higher margin requirements is about 30%. Similar results are obtained for the CDS as shown in **Table H** and **Chart 8**.

**Chart 8 Collateral demand — effect of rehypothecation — CDS market**



Source: Bank calculations.

**Table H Initial margin estimates for CDS with 75% rehypothecation**

US\$ billions	Netting					
	90%	91%	92%	93%	94%	95%
Proportion cleared						
10%	60	54	48	42	36	30
20%	70	63	56	49	42	35
40%	88	79	71	62	53	44
60%	107	96	85	75	64	53
80%	125	113	100	88	75	63
100%	144	130	115	101	86	72

Source: Bank calculations.

(1) Singh and Aitken (2010) show that the role of rehypothecation in the shadow banking system is significant. They estimate the churning, or re-use, of collateral was around a factor of four globally at the end of 2007. ISDA (2011b) shows that large dealers in the OTC derivatives markets re-use around 74% of the collateral received, while small and medium dealers re-use around 28%.

(2) ISDA (2011b).

## 4.2 Market conditions

In addition to the initial margin estimates under normal market conditions, we also include estimates under tranquil and stressed market conditions, where we vary the margin rates with market volatility. As previously stated, the 'tranquil' market condition corresponds to two thirds of the 'normal' market volatility between 2006 and 2011, while the 'stressed' market condition corresponds to twice the 'normal' market volatility.

Applying the tranquil or stressed initial margin rates to the total stock of outstanding notional amount may seem to be inappropriate, since only new OTC derivative transactions will be subject to central clearing requirements and it will take a number of years for the current outstanding notional to be fully replaced (see Section 4.3 for details). However, once the transition is complete, the entire stock will be subject to stressed margin rates should stress hit the market, as it is common practice by major clearing houses to constantly update their initial margins in response to changing market conditions.

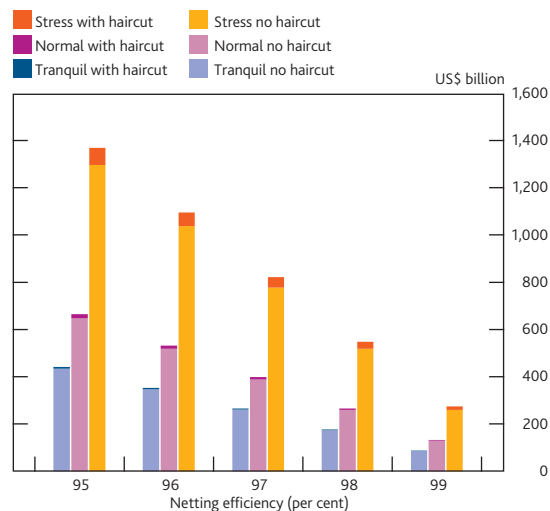
In addition, we consider how haircuts on non-cash collateral impact the total initial margin. The value of non-cash collateral fluctuates with interest rates, liquidity and other market variables, and are thus vary with market conditions. This imposes an additional risk arising in the event of counterparty default: the risk of an adverse change in the collateral value before it can be liquidated to provide for the losses on the in-the-money derivatives position. Haircuts are simply a discount deducted from the current market value of the collateral posted as initial margin. For example, a haircut of 5% means that to satisfy an initial margin of US\$95 in cash, the market participant has to post US\$100 in non-cash collateral.

The split between cash and non-cash collateral to which the haircuts are applied is approximately 50-50, reflecting the current composition of the initial margin held by some CCPs according to market intelligence. The haircut rates are assumed to be 3.35%, 5% and 10% of the market value of non-cash collateral in the 'tranquil', 'normal' and 'stress' regimes, respectively. Normal market conditions correspond to average volatility during 2006–11. The 5% haircut for normal market conditions is similar to the haircuts currently applied by LCH and ICE to eligible high-quality collateral, while the haircuts for tranquil and stressed market conditions equal two thirds and twice the haircut for normal market conditions, respectively.

Charts 9 and 10 show that under stressed market conditions and holding the current gross notional amount outstanding fixed, the *total* initial margin for cleared and non-cleared trades may reach up to US\$1.7 trillion including haircuts on non-cash collateral, and about US\$1.6 trillion without taking

into account haircuts. This translates into an *incremental* increase over US\$1 trillion and US\$900 billion, respectively, when comparing current clearing of IRS and CDS with potential future demand (if 80% of trades are subject to central clearing).

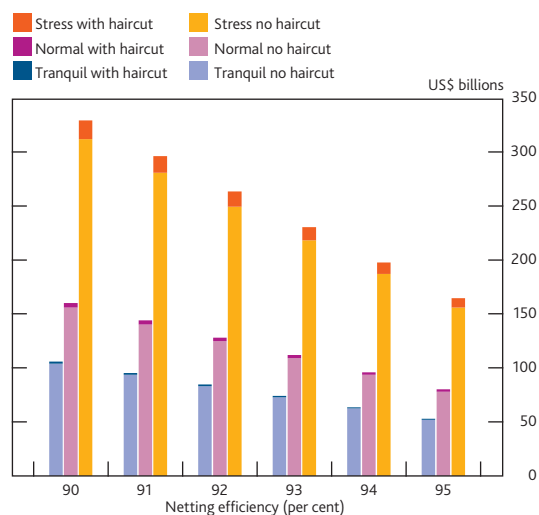
**Chart 9** IRS initial margins under different market conditions



Note: The chart shows the total initial margin requirement in the IRS market as a function of netting efficiency. The figures include margin for both cleared and non-cleared transactions under 'tranquil', 'normal', and 'stressed' market conditions.

Source: Bank calculations.

**Chart 10** CDS initial margins under different market conditions



Note: The chart shows the total initial margin requirement in the CDS market as a function of netting efficiency. The figures include margin for both cleared and non-cleared transactions under 'tranquil', 'normal', and 'stressed' market conditions.

Source: Bank calculations.

## 4.3 Pace of transition

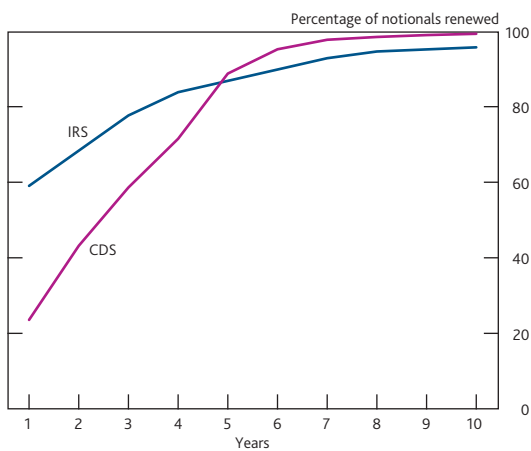
As mentioned previously, the clearing obligation will affect new contracts entered into as of the date of the clearing notification.<sup>(1)</sup> Similarly, the new margin rules for bilateral trades, if mandated, are also expected to apply to new

(1) Europe: [www.esma.europa.eu/system/files/2012-379.pdf](http://www.esma.europa.eu/system/files/2012-379.pdf).  
United States: [www.sec.gov/news/studies/2012/sec-cftc-intlswapreg.pdf](http://www.sec.gov/news/studies/2012/sec-cftc-intlswapreg.pdf).

transactions.<sup>(1)</sup> Thus the increase in the demand for collateral associated with these OTC reforms will occur gradually as we move from a world where OTC derivatives are centrally cleared on a voluntary basis and not all bilateral transactions are collateralised, to a world where the new requirements apply. The pace of increased collateral demand depends on the rate at which the existing derivatives contracts mature and are, subsequently, renewed.

To get an idea about the renewal rates, we rely on the gross notional breakdown by maturity reported by TriOptima and DTCC and estimate the percentage of the outstanding gross notional amount likely to be replaced each year. **Chart 11** shows that around 60% of IRS contracts might be renewed within one year, around 87% within five years and about 95% within ten years. In the case of CDS we obtain 24%, 89% and 99%, respectively (**Chart 11**). According to our exercise, the impact of the OTC reforms will be more immediate in the IRS market, where a bulk of the gross notional outstanding is made up of contracts with short maturity, whereas in the CDS market the one to five-year maturity dominates (Chen *et al* (2011)) and hence the impact will be more gradual.

**Chart 11** Percentage of trades renewed each year in IRS and CDS markets



Note: Calculations are based on percentage of gross notional renewed each year.

Sources: DTCC, TriOptima and Bank calculations.

## 5 Conclusion

The financial crisis revealed significant risks that the uncleared OTC derivatives market pose to the financial system. As a result, regulatory reforms in the OTC derivatives market mandate that standardised contracts must be cleared through CCPs while margin requirements are being developed for non-centrally cleared trades. The benefits of central clearing include potential netting efficiencies, improved transparency and a reduction of counterparty risk, particularly during member defaults.

The aim of this paper is to construct a model that estimates the combined total initial margin associated with both centrally cleared and non-cleared (bilateral) OTC derivatives transactions. We provide a range of estimates by varying market conditions, netting assumptions and the extent of rehypothecation. The baseline results show that under 'normal' market conditions (as defined in the paper) and holding the current notional value of trades fixed, the total initial margin for cleared and non-cleared trades ranges between US\$200 billion–US\$800 billion, if 80% of trades are subject to central clearing. This wide variation primarily reflects the impact that netting assumptions have on the results. For example, in the IRS market we use a lower-bound netting range of 95% which corresponds to total initial margin demand of US\$648 billion. However, if netting benefits were reduced to 90% the total initial margin would be around US\$1.3 trillion.

These estimates assume a set of contracts of the same type, value and maturity as those currently outstanding, and that the clearing and margin requirements apply to the entire contract set. The impact of the OTC reforms is expected, however, to be gradual, because central clearing and margin requirements will apply only to new trades, not existing positions. The impact in the IRS market is expected to be relatively the more rapid as a significant portion of notional outstanding is made up of contracts with short maturity (ie less than one year).

It is also highly likely that market participants will adapt to the new regulation of OTC derivatives. A common drawback of these and other existing estimates lies, therefore, in abstracting from the potential equilibrium implications of the new regulations. Most studies, including ours, assume that market participants will not respond to the changes in new rules and will keep trading the same derivative instruments in the same quantities as before. It is hard to predict with accuracy what impact the regulatory change will have on the trading volumes and positions in the derivatives market. Market participants may respond, for example, by trading less, or inventing new, non-standardised but economically equivalent products to circumvent central clearing requirements.

These estimates also assume the current set of CCPs: essentially a single global CCP for each asset class of derivatives. But an increase in the number of CCPs clearing the same asset classes could reduce opportunities to net offsetting exposures, and lead to an increase in margin required.

Beyond the direct collateral demand impact of these reforms, there are other indirect financial stability issues to consider.

(1) [www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/file/2011-9598a.pdf](http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/file/2011-9598a.pdf).

Growing demand for margin collateral, against a backdrop of a shrinking range of assets that are perceived as safe, creates incentives to manage collateral assets more actively. This may, for example, induce greater use of collateral upgrade trades in which high-quality securities are borrowed in return for less liquid securities.<sup>(1)</sup> Prudential supervisors of clearing members (and their consolidated group supervisors) need to be attentive to that. Further, since a wide range of institutions will be subject to the clearing mandate, the role of major dealers as providers of clearing services to their clients may expand. This would create new interdependencies and new risks. Clients are likely to need to provide their clearing member with collateral and dealers may need to advance liquidity during the day to meet intraday margin calls on behalf of their clients. It is important that these risks are understood, and managed appropriately, by both parties.

Another set of potential financial stability risks arises from CCPs having incentives to expand the pool of eligible collateral to less liquid assets in order to reduce collateral costs for their members, particularly in markets where CCPs face competition. Some CCPs have, or are exploring, arrangements to take account of the correlations in the risk of different products (for example, fixed-income securities and interest

rate futures) in their margin models. While such 'portfolio margining' can reduce margin requirements, it may also introduce model risks. For example, observed correlations may not be robust in periods of stress. If carried out across products cleared at different CCPs ('cross-margining'), this activity may create exposures between the CCPs. Where two or more CCPs are authorised to offer cross-margining, CPSS-IOSCO standards require that they have appropriate safeguards and harmonised overall risk management systems.<sup>(2)</sup> Again, it is important that CCPs and their supervisors are vigilant to the new risks these arrangements give rise to.

More widespread use of margining arrangements may also amplify the procyclical effect of margin practices. This issue was considered in depth by the Committee on the Global Financial System in its 2010 report on the role of margin requirements in procyclicality. It highlighted how procyclical margin requirements can have destabilising effects on the financial system by draining liquidity just when market participants need it the most.<sup>(3)</sup> Procyclicality is also being considered by the Financial Stability Workstream on Securities and Repos under the Financial Stability Board Shadow Banking Task Force with the aim of developing policy recommendations, where necessary, by the end of 2012.<sup>(4)</sup>

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(1) Bank of England (2012).

(2) BIS (2012b)

(3) [www.bis.org/publ/cgfs36.pdf](http://www.bis.org/publ/cgfs36.pdf).

(4) Financial Stability Board (2012b).

## Appendix

In this appendix, we provide details of the methodology for calculating initial margin rates used in the paper. All market data used in the models come from Bloomberg.

### VaR model for IRS

We model separately the US dollar and euro swap curves using a three-factor term structure model based on principle components. We first extract daily zero-coupon LIBOR curves from the 6M LIBOR, and 1Y, 2Y, 3Y, 4Y, 5Y, 7Y, 10Y and 30Y swap rates, by bootstrap. The first three principle components of the changes in the zero rates are assumed to follow an AR(1)-GARCH(1,1) process. To map the changes in the zero rates into changes in the value of a swap contract, we follow Chen and Chaudhury (1996). Finally, we obtain the five-day and ten-day IRS excess return distributions for a gross-notional weighted portfolio of the different maturities by re-sampling with replacement the AR-GARCH residuals (10,000 replications) and setting the conditional volatility to the levels described in Section 3.2. The portfolio weights are based on the breakdown of the gross notional into the different maturity buckets reported by TriOptima (2011).

### VaR model for CDS

We approximate the single-name segment of the CDS market by the CDX.HVOL index and the index/tranche segment by the CDX.IG index. We model the daily changes in the CDS spreads by AR(1)-GARCH(1,1) models. To map the changes in the CDS spread into changes in the value of the CDS contract, we employ the constant hazard rate model and calculate the CDS excess returns following Bernd and Obreja (2010). The US-dollar zero curve described in the previous paragraph is used for discounting. Finally, we obtain the five-day and ten-day CDS return distributions for a gross-notional weighted portfolio of single names (CDX.HVOL) and index/tranche (CDX.IG) by re-sampling with replacement the AR-GARCH residuals (10,000 replications) and setting the conditional volatility to the levels described in Section 3.2. The portfolio weights are based on the gross notional data reported by DTCC (2011).



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