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Incentives to centrally clear over-the-counter (OTC) derivatives

A post-implementation evaluation of the effects of the G20 financial regulatory reforms – final report

19 November 2018

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Abbreviations used in this report

BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
CCP	Central counterparty
CCSP	Client clearing service provider
CDS	Credit default swap
CEM	Current exposure method
CGFS	Committee on the Global Financial System
CPMI	Committee on Payments and Market Infrastructures
CSA	Credit support annex
CVA	Credit valuation adjustment
DAT	Derivatives Assessment Team
DVA	Debt (or debit) valuation adjustment
ETD	Exchange traded derivative
FCM	Futures commission merchant
FRA	Forward rate agreements
FSB	Financial Stability Board
FVA	Funding valuation adjustment
FX	Foreign exchange
G-SIB	Global systemically important bank
IM	Initial margin
IMM	Internal model method (or International Money Market, when referring to interest rate swap date conventions)
IOSCO	International Organization of Securities Commissions
IRS	Interest rate swap
KVA	Capital valuation adjustment
LEM	Leverage exposure measure
MPOR	Margin period of risk
MVA	Margin valuation adjustment
NDF	Non-deliverable forward
OIS	Overnight indexed swaps
OTC	Over-the-counter
PFE	Potential future exposure
QCCP	Qualifying central counterparty
RC	Replacement cost
RWA	Risk weighted asset
SA-CCR	Standardised approach for counterparty credit risk
SIMM	Standard initial margin model
SSB	Standard setting body
TR	Trade repository
UMR	Uncleared margin requirements
VM	Variation margin

Incentives to centrally clear OTC derivatives

A post-implementation evaluation of the effects of the G20 financial regulatory reforms

Part A Executive summary

The FSB and the other standard-setting bodies (SSBs) (i.e. the Basel Committee on Banking Supervision, the Committee on Payments and Market Infrastructures, the Financial Stability Board and the International Organization of Securities Commissions) reconvened the Derivatives Assessment Team (DAT) to "re-examine whether adequate incentives to clear centrally over-the-counter (OTC) derivatives are in place" as one of the first evaluations under the FSB framework for the post-implementation evaluation of the effects of the G20 financial regulatory reforms. This report sets out the DAT's findings. A consultative document was published in August 2018.[1]

The central clearing of standardised OTC derivatives is a pillar of the G20 Leaders' commitments to reform OTC derivatives markets in response to the financial crisis. A number of post-crisis reforms are, directly or indirectly, relevant to incentives to centrally clear. These include mandatory clearing requirements; capital, liquidity and margin requirements relating to OTC derivatives activity; and reforms relating to the resilience, recovery and resolution of central counterparties (CCPs). A large majority of the relevant international standards have been agreed upon and are being implemented at the jurisdictional level.[2]

The DAT study's evaluation of the interaction of the reforms, notably capital and margin requirements and the clearing mandate, and their impact, will help inform relevant SSBs regarding any subsequent policy efforts and potential adjustments, bearing in mind the original objectives of the reforms. This does not imply a scaling back of those reforms or an undermining of members' commitment to implement them.

The DAT has collected and analysed a rich and informative data set from a variety of sources including publicly available data, regulatory data, academic research, qualitative and quantitative surveys, and market outreach. As with any empirical analysis, individual data sources have their merits and limitations. These should be considered when weighing the data and considering the strength of the potential conclusions which can be drawn. In particular, survey data may be subject to selection or reporting bias. Where possible, corroboration has been sought from multiple, varied data sources, to mitigate some of the limitations of individual data sources.

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1 For a summary of responses to the consultative document, see http://www.fsb.org/2018/11/Evaluation-of-incentives-to-centrally-clear-OTC-derivatives-Overview-of-responses-to-the-consultation.

2 See FSB, *OTC Derivatives Market Reforms: Thirteenth Progress Report on Implementation,* November 2018 (www.fsb.org/2018/11/otc-derivatives-market-reforms-thirteenth-progress-report-on-implementation).

The data collected and the analysis conducted by the DAT suggest the following findings:

1. **The changes observed in OTC derivatives markets are consistent with the G20 Leaders' objective of promoting central clearing as part of mitigating systemic risk and making derivatives markets safer.**

   Data from trade repositories and other regulatory reporting shows that central clearing has increased markedly for many types of derivatives, notably interest rate and credit derivatives. Increased clearing is found both for products subject to mandatory clearing and for some that are centrally cleared on a voluntary basis. For example, clearing levels (as measured by notional amounts outstanding) increased from 24% (in 2009) to 62% (in 2017) for interest rate derivatives. Increased clearing levels are found among the large dealing banks and, more recently, among clients.

2. **The relevant post-crisis reforms, in particular the capital, margin and clearing reforms, taken together, appear to create an overall incentive, at least for dealers and larger and more active clients, to centrally clear OTC derivatives**.

   Mandatory clearing requirements have led to increased central clearing. The preferential capital treatment of centrally cleared derivatives is considered an important incentive for dealer banks. Analysis of quantitative survey results suggests that the incentive to centrally clear OTC derivatives is also strong where standards requiring the exchange of initial margin for uncleared derivatives trades are in effect. This finding generally holds across a range of product types in different asset classes, but it is not universal. It is supported by regulatory data showing a marked increase in clearing volumes for some non-mandated OTC derivatives around the implementation dates of the margin requirements for uncleared derivatives.

3. **Non-regulatory factors are also important and can interact with regulatory factors to affect incentives to centrally clear**.

   Surveys and market outreach show that market participants, especially larger firms, consider that factors such as market liquidity, counterparty credit risk management and netting efficiencies are also important factors for incentives to centrally clear. Regulation can interact with such factors to affect incentives. For example, clearing mandates may shift liquidity into central clearing. Once liquidity is established, market participants may also wish to clear non-mandated products, perhaps to benefit from netting opportunities or a lower capital requirement. On the other hand, the relatively higher fixed costs of accessing central clearing can have a material impact on incentives too, especially for smaller, lower activity firms.[3]

4. **Some categories of clients have less strong incentives to use central clearing, and may have a lower degree of access to central clearing.**

   Mandatory clearing requirements have contributed to an increase in the total number of clients clearing derivatives and increases in the notional cleared by clients overall. However, while there are challenges in identifying effects on small and less active

[3] For the purposes of this this report, a 'smaller' client is one that typically engages in smaller volumes and/or values of OTC derivatives activity. This may cover a range of firm types (e.g. banks, insurers, pension funds, asset managers and non-financial corporates) and a wide range of sizes of overall balance sheet.

clients in regulatory data, survey responses and information from market outreach suggest that the incentives for them are mixed. Some clients reported a preference not to centrally clear when not required to do so by a clearing mandate.

There are several factors that may be contributing to this. The benefits of central clearing, such as netting opportunities and deeper liquidity pools, may be lower for smaller clients or for those with more directional positions. Survey responses state that providing connectivity to CCPs requires incurring high fixed costs, which are likely passed on to clients through minimum fees and other charges, increasing clients' costs of central clearing. For smaller, lower activity clients in particular, this can raise their cost of cleared trades, and thus can have a material impact on their incentives to centrally clear.

Some smaller clients and some of those with more directional portfolios report experiencing difficulties gaining and/or maintaining access to central clearing. These access issues in turn impact the incentives for these clients to centrally clear.

5. **The provision of client clearing services is concentrated in a relatively small number of bank-affiliated clearing firms.**

   The majority of OTC derivatives market participants are not direct clearing members of CCPs, but rather access central clearing as clients through clearing service providers. Therefore, access to client clearing is a key structural feature of the post-reform derivatives markets.

   The provision of client clearing for OTC derivatives remains generally concentrated. For example, five firms, all bank-affiliated, account for over 80% of total client margin for cleared interest rate swaps in the United States, United Kingdom and Japan. Regulatory data illustrates that, although the overall amount of client margin posted at CCPs has increased substantially since the implementation of reforms, the number of clearing service providers has stayed broadly flat over the same period.

   Survey responses and market outreach are also consistent with a view that concentration in clearing service provision could amplify the consequences of the failure or withdrawal of a major provider. In particular, concerns have been expressed about the ability to port client positions and collateral in this situation. This could impact clients' incentives to centrally clear.

6. **Some aspects of regulatory reform may not incentivise provision of client clearing services.**

   Survey data, research and market outreach suggests that some regulations aimed at improving institutional resilience may in some circumstances be discouraging individual firms from providing client clearing services; see below for further discussion. This may in turn affect access challenges for clients and the concentration of client clearing service provision.

While the social costs and benefits of individual regulatory and non-regulatory factors can be hard to disentangle and measure**,** results from the DAT's analysis suggests that, overall, the reforms are achieving their intended goals of promoting central clearing, especially for the most systemic market participants. This is consistent with the goals of reducing complexity and improving transparency and standardisation in the OTC derivatives markets. Moreover, higher

levels of collateralisation for uncleared exposures have been observed, and the financial resources available to CCPs have increased. These developments, taken together, suggest that meaningful progress has been made toward enhancing systemic stability.[4]

Beyond the systemic core of the derivatives network of CCPs, dealers/clearing service providers and larger, more active clients, the incentives are less strong. The impact of an entity on financial stability from OTC derivatives is likely to depend on the extent of their activity. Lower levels of OTC derivatives activity, all else equal, are likely to result in a lower impact. Thus, while the financial stability benefits from central clearing by such entities can still exist, the gains are likely to be smaller than those for entities in the systemic core, particularly relative to the costs of access to central clearing for their low volumes of activity.

The following areas may merit consideration by the relevant SSBs.

In developing the post-crisis reforms, authorities recognised the likely higher cost of compliance and the likely smaller impact of smaller firms on financial stability; for example, through various thresholds, exemptions, and phased implementations of the reforms. **The DAT's findings reinforce the importance of understanding and carefully considering the effects of the scope and interaction of the reforms on market participants that are not considered systemically important.** In particular, based on the DAT's analysis, capital, clearing mandates and margin requirements for uncleared derivatives appear to be key reforms in driving regulatory incentives to centrally clear. If this is indeed the case, the scope and design of these reforms, including the product and entity scope of the clearing mandate and the threshold for the exchange of initial margin for uncleared derivatives, are key drivers for incentivising central clearing and reducing systemic risk. The relevant SSBs should be aware of the importance of these factors and their interaction when considering the costs and benefits of reforms and their impact on financial stability in changing circumstances. The DAT's findings also reinforce the need to understand and consider non-regulatory incentives in forming a holistic view of these issues.

Analysis of quantitative and qualitative survey data and market outreach suggest that the treatment of initial margin in the **leverage ratio** can be a disincentive for client clearing service providers to offer or expand client clearing. There are two aspects to consider:

- As the leverage ratio is a non-risk-based approach, initial margin does not reduce the leverage ratio's exposure measure for derivatives, including for client cleared OTC derivatives.[5]
- When client initial margin is held on a firm's accounting balance sheet, it may increase the leverage ratio's exposure measure, even in jurisdictions where relevant regulations require that such margin is segregated and restrictions exist on its use by the firm as a source of leverage. This might increase the cost of clearing, especially for clients with portfolios which attract higher amounts of initial margin (e.g. due to the size and/or directionality of their portfolios).

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[4] FSB, *Review of OTC derivatives market reforms: Effectiveness and broader effects of the reforms,* June 2017 (www.fsb.org/2017/06/review-of-otc-derivatives-market-reform-effectiveness-and-broader-effects-of-the-reforms/).

[5] According to the Basel Committee "a simple leverage ratio framework is critical and complementary to the risk-based capital framework" and "a credible leverage ratio is one that ensures broad and adequate capture of both the on- and off-balance sheet sources of banks' leverage". See www.bis.org/publ/bcbs270.htm.

The leverage ratio is meant to serve as a backstop to risk-based measures and many dealer banks are not constrained by the Basel III leverage ratio at group level. The amount of regulatory capital needed to support the leverage exposure of client clearing activity is typically a small part of the group total. However, depending on the specific characteristics of a service provider's balance sheet and risk exposures and its own internal policies for managing them, the leverage ratio can constrain the client clearing business, and so affect the willingness of individual firms to provide access to centrally cleared OTC derivatives markets, particularly to large directional clients. Bearing in mind the original objectives of the reform, additional analysis would be useful to further assess these effects.[6]

The largest client clearing service providers are often part of groups subject to the G-SIB methodology. This methodology uses the leverage ratio exposure calculation, and in some cases does not distinguish between cleared and uncleared OTC derivatives. Further analysis may therefore be appropriate to determine whether it provides appropriate incentives to support client clearing.

The final responsibility for deciding whether and how to amend a particular standard or policy remains with the body that is responsible for issuing that standard or policy.

Client clearing service providers play a crucial role in providing access to central clearing. Some client clearing service providers reported having high fixed costs and may in some cases be disinclined to provide access to some classes of clients. This disinclination may not, in turn, be consistent with suitable parties having access to efficient risk transfer using OTC derivatives markets. Further analysis of the economics of client clearing and the relevant standards and their interaction with non-regulatory factors may be warranted in order to understand better the role of regulation in this phenomenon and whether policy action is merited given the authorities' objectives. This could include further quantitative analysis of the fixed costs associated with the business, the structure of clearing fees, the allocation practices of firms, and the interaction of the relevant factors.

[6] The Basel Committee on Banking Supervision published a consultative document on the leverage ratio treatment of client cleared derivatives in October 2018; see www.bis.org/bcbs/publ/d451.htm.

Part B Introduction and context to the DAT

The FSB and the other SSBs reconvened the DAT to "re-examine whether adequate incentives to clear centrally OTC derivatives are in place". This is one of the first exercises under the framework for the post-implementation evaluation of the effects of the G20 financial regulatory reforms.[7]

This part of the resulting report sets out the background and motivation for the study in more detail, contextualising it in the goals of the post-crisis regulatory reforms. The objectives and scope of the DAT study are considered, followed by a discussion of the data and analytical methodology used in the study.

The remainder of this report is arranged as follows.

Part C describes the current state of OTC derivatives markets, including market structure, clearing rates and other observations from regulatory and other data.

Part D provides an overall analysis of the effects of reforms on the incentives to centrally clear with a particular focus on two sets of reforms, clearing mandates and margin requirements for uncleared derivatives.

Part E sets out observations relating to access to client clearing.

Part F discusses the overall costs and benefits of OTC derivatives, central clearing, and the post-crisis reforms which are pertinent. It also considers the transmission of reforms, the effects of specific reforms based on the DAT's analysis, and the policy questions these raise.

B1 Background and motivation for the DAT study

With the main elements of the post-crisis reforms agreed and implementation of reforms underway, initial analysis of the reforms' effects is becoming possible. To that end, the FSB published a framework in July 2017 for the post-implementation evaluation of the effects of the G20 financial regulatory reforms.[8] The framework serves as a guide for evaluation work by the FSB and other SSBs, by suggesting analyses of whether the reforms are operating as intended, and helping to identify any material unintended consequences that may have to be addressed, without compromising on the objectives of the reforms.

The application of this framework informs structured policy discussions among FSB members and SSBs. Evaluations, if findings warrant it, could provide a basis for further study or consideration of possible fine-tuning of the post-crisis regulatory reforms, without compromising on either their original objectives or the agreed level of resilience; or implying a scaling back of those reforms or undermining members' commitment to implementing them. This dynamic implementation of the G20 reforms will ensure that the reforms remain fit for purpose amidst changing circumstances.

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[7] The other initial evaluation under the Framework concerns the effects of the G20 regulatory reforms on financial intermediation, including the financing of infrastructure investment (published in November 2018) and of small and medium-sized enterprises (to be published in 2019).

[8] FSB, *Framework for Post-Implementation Evaluation of the Effects of the G20 Financial Regulatory Reforms*, July 2017 (www.fsb.org/2017/07/framework-for-post-implementation-evaluation-of-the-effects-of-the-g20-financial-regulatory-reforms/).

One of the first evaluations under the framework is an evaluation of the impact of G20 reforms on incentives to centrally clear OTC derivatives. This study, undertaken by the Derivatives Assessment Team (DAT), reviewed the interaction of reforms affecting incentives for central clearing.

The central clearing of standardised OTC derivatives was a pillar of the G20 Leaders' commitment to reduce the systemic risk associated with OTC derivatives markets in response to the financial crisis. The standards, which affect incentives for central clearing, have been agreed and are being implemented.

However, concerns have been raised that the interaction of some post-crisis reforms may contribute to inadequate incentives to centrally clear or may otherwise affect costs associated with providing client clearing services or with accessing central clearing for some market participants, in ways that do not support the G20 Leaders' commitments.

The FSB and the other SSBs therefore agreed to undertake a study to investigate the intended and unintended consequences of the reforms, given the authorities' objective of promoting central clearing. The study follows an earlier review of the topic published in 2014.[9] It will help to inform the relevant SSBs as they identify and deliver adjustments and perform further analysis, where appropriate, bearing in mind the original objectives of the reforms. The final responsibility for deciding whether and how to amend a particular standard remains with the body that is responsible for issuing that standard or policy.

This report sets out the findings of the DAT study.

B2 Post crisis regulatory goals

The policy statements issued by the G20 Leaders following the global financial crisis have provided the political impetus for the creation of new global standards for financial regulation, with the overarching objective of reducing both the likelihood and the impact of future financial crises by promoting a more resilient financial system. The G20 Leaders' Pittsburgh declaration of 2009[10] listed several reform objectives, including, among others:

- to raise capital standards in the international financial system;
- to discourage excessive leverage;
- to reduce the risks and moral hazard associated with systemically important financial institutions; and
- to ensure standardised OTC derivative contracts are cleared through CCPs.

The commitment to central clearing for standardised OTC derivatives was thus a pillar of the Pittsburgh declaration. The implementation of the reform objectives delivered a fundamental overhaul of OTC derivatives markets with the goals of mitigating systemic risk, improving

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9 BIS, *Regulatory reform of over-the-counter derivatives: an assessment of incentives to clear centrally: A report by the OTC Derivatives Assessment Team, established by the OTC Derivatives Coordination Group*, October 2014 (www.bis.org/publ/othp21.pdf).

10 G20, *Pittsburgh Summit Leaders' statement*, September 2009 (www.fsb.org/wp-content/uploads/g20_leaders_declaration_pittsburgh_2009.pdf).

transparency in the derivatives markets, and protecting against market abuse. The Pittsburgh declaration was subsequently accompanied by a set of FSB recommendations on the implementation of the clearing obligation.[11] The Cannes declaration of November 2011[12] built on this, noting the need for the minimum standards for margin for uncleared (i.e. non-centrally cleared) derivatives.

Altogether, the G20 Leaders made five commitments to reform OTC derivatives markets. These were:

- standardised OTC derivatives should be centrally cleared;
- uncleared derivatives should be subject to higher capital requirements;
- uncleared derivatives should be subject to minimum standards for margin requirements;
- OTC derivatives should be reported to trade repositories; and
- standardised OTC derivatives should be traded on exchanges or electronic trading platforms, where appropriate.

In the ensuing years, the largest derivatives jurisdictions have partially or fully implemented these reforms.[13] There is broad acceptance that the G20 reform measures have helped strengthen the resilience of large financial institutions, and that meaningful progress has been made towards mitigating systemic risk.[14] The DAT was tasked with reviewing the effects of a subset of these derivatives market reforms on incentives to centrally clear. The key reforms addressed by the DAT are discussed below and a summary of the other relevant standards is included in Annex 2.

Standards relevant to CCPs

The resilience of CCPs has been increased by various policy measures in recent years promulgated under the CPSS and IOSCO *Principles for Financial Market Infrastructures* (PFMI) (2012).[15] These principles set out standards designed to ensure that the infrastructure supporting global financial markets is robust and thus well placed to withstand financial shocks. Supervisory stress tests for CCPs are now being conducted regularly in some jurisdictions, and the PFMIs require that CCPs themselves conduct daily stress tests. Monitoring of CCPs and the

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11 FSB, *Implementing OTC Derivatives Market Reforms*, October 2010 (www.fsb.org/wp-content/uploads/r_101025.pdf).

12 G20, Cannes Summit Final Declaration, November 2011 (www.fsb.org/wp-content/uploads/g20_leaders_declaration_cannes_2011.pdf).

13 For an overview of the current status of derivatives reform globally see the FSB, *OTC Derivatives Market Reforms: Thirteenth Progress Report on Implementation*, November 2018 (www.fsb.org/2018/11/otc-derivatives-market-reforms-thirteenth-progress-report-on-implementation).

14 FSB, *Review of OTC derivatives market reforms: Effectiveness and broader effects of the reforms,* June 2017 (www.fsb.org/2017/06/review-of-otc-derivatives-market-reform-effectiveness-and-broader-effects-of-the-reforms/).

15 CPSS and IOSCO, *Principles for Financial Market Infrastructures*, April 2012 (www.bis.org/cpmi/publ/d101.htm and www.iosco.org/library/pubdocs/pdf/IOSCOPD377-PFMI.pdf). Subsequently, the Committee on Payment and Settlement Systems (CPSS) was renamed Committee on Payments and Market Infrastructures (CPMI).

derivatives system by supervisory authorities and market participants has also been made easier by mandatory transaction reporting and by quarterly CCP quantitative disclosures.[16]

Further guidance on the resilience of CCPs was published by CPMI and IOSCO in July 2017.[17] This provided additional guidance on the principles and key considerations in the PFMI regarding CCP financial risk management in five key areas: governance, stress testing for both credit and liquidity exposures; risk coverage; margin; and CCPs' contributions of their own financial resources for loss absorption.

Despite these enhancements, it is not impossible for CCPs to find themselves subject to significant financial stress or even to fail. CCPs are therefore required to have in place recovery plans, consistent with the PFMIs and other relevant CPMI and IOSCO guidance. A report on recovery of FMIs was published in 2014, and revised in 2017.[18] The FSB has provided guidance that there should also be credible CCP resolution plans in place, consistent with the *Key Attributes of Effective Resolution Regimes for Financial Institutions* and related guidance,[19] and work is continuing on this topic.[20]

Standards relevant to market participants

The resilience of banks and other OTC derivatives market participants is being strengthened by the post-crisis reforms including the margin, leverage and risk-based capital requirements of the Basel III framework. There are a number of standards relevant to OTC derivatives, including:

- The BCBS-IOSCO minimum standards for margin requirements for non-centrally cleared derivatives;
- The IOSCO risk mitigation standards for non-centrally cleared OTC derivatives;[21]
- The BCBS standards[22] for capital requirements for OTC derivatives, relating to:

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16 See CPMI and IOSCO, *Public quantitative disclosure standards for central counterparties*, February 2015 (www.bis.org/cpmi/publ/d125.htm and https://www.iosco.org/library/pubdocs/pdf/IOSCOPD475.pdf).

17 CPMI and IOSCO, *Resilience of central counterparties (CCPs): Further guidance on the PFMI*, July 2017 (www.bis.org/cpmi/publ/d163.htm and www.iosco.org/library/pubdocs/pdf/IOSCOPD568.pdf).

18 CPMI and IOSCO, *Recovery of financial market infrastructures*, 2014 (revised 2017) (www.bis.org/cpmi/publ/d162.htm and www.iosco.org/library/pubdocs/pdf/IOSCOPD569.pdf).

19 FSB, *Key Attributes of Effective Resolution Regimes for Financial Institutions*, October 2014 (www.fsb.org/2014/10/r_141015/) and FSB, *Guidance on Central Counterparty Resolution and Resolution Planning*, July 2017 (www.fsb.org/2017/07/guidance-on-central-counterparty-resolution-and-resolution-planning-2/).

20 The DAT has not studied the incremental effect of these most recent standards on the incentives to clear, partly because policy development for CCP resolution is still underway. However, it might be informative for the relevant SSBs to note that some survey respondents did indicate that concerns related to recovery and resolution of CCPs was a factor influencing their incentive to centrally clear.

21 See IOSCO, *Risk mitigation standards for non-centrally cleared OTC derivatives*, January 2015 (www.iosco.org/library/pubdocs/pdf/IOSCOPD469.pdf).

22 Higher capital requirements for non-centrally cleared derivatives were developed by the BCBS as interim and final standards. The interim standards were due to be implemented by 1 January 2013, while the final standards (comprising the standardised approach to counterparty credit risk (SA-CCR) and final standards for bank exposures to CCPs) were due to be implemented by 1 January 2017.

  - default and credit migration risk in OTC derivatives counterparty credit risk (known as 'jump-to-default risk');[23]
  - credit valuation adjustment (CVA) risk; and
  - bank exposures to CCPs;
- The BCBS standard for the leverage ratio;
- The BCBS standards for measuring and controlling large exposures; and
- The BCBS requirements for G-SIBs.

All of these standards include financial stability (i.e. the reduction of systemic risk) as an objective, but only a subset of them also mention explicitly the encouragement of central clearing (not necessarily limited to OTC derivatives central clearing) among the goals pursued. Indeed, within the standards issued since 2009 and addressed in this report, apart from clearing mandates, only the *BCBS-IOSCO minimum standards for margin requirements for non-centrally cleared derivatives* declared an explicit goal of incentivising central clearing of OTC derivatives (as well as the explicit aim of reducing systemic risk). Other standards have, more broadly, an objective of incentivising the use of CCPs in a manner that appropriately reflects associated risks, e.g. the *BCBS Capital requirements for bank exposures to central counterparties*, or maintaining such incentives in stressed circumstances, e.g. the *FSB Guidance on Central Counterparty Resolution and Resolution Planning*. The differing objectives of the various G20 reforms are an important consideration in evaluating the effects of the reform packages on incentives to centrally clear.

Financial regulation is intended to achieve a wide range of public policy goals in addition to financial stability; these objectives may include the pursuit of market efficiency and integrity, the prevention of market abuse and illicit activities such as money laundering and the financing of terrorism, the protection of investors, the maintenance of an appropriate degree of transparency, the prevention of moral hazard and the protection of taxpayers from losses. The DAT's analysis considers financial stability and the interplay between market efficiency and institutional resilience, but not the other goals.

In many cases, regulatory goals are complementary; for example, the prevention of market abuse and of illicit activities is consistent with the goal of preserving market integrity. In other cases, however, depending on the specific methods chosen to achieve supervisory objectives, the outcome of one policy may not reflect the goals of another. Regulators and supervisors, when making decisions, may therefore need to balance any potential trade-offs between the various goals.

B3 Objectives and scope

The DAT study seeks to deliver an assessment of whether the relevant reforms are incentivising central clearing for derivatives dealers and their clients. A number of post-crisis reforms are relevant, as discussed in the previous section. Some reforms may have a direct impact upon incentives; for others, the impact is indirect.

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[23] The standards here include the Current Exposure Method (CEM), the Standardised Approach to Counterparty Credit Risk (SA-CCR) and the Internal Model Method (IMM).

A study of incentives to centrally clear begins with a presumption that market participants can choose the manner in which they transfer risk. Transactions can either be centrally cleared through a CCP or conducted bilaterally ('uncleared'). However, clearing obligations require central clearing of certain products for a large subsection of institutions, so there are constraints on the choices of many market participants.

Regulation, as implemented by national authorities, may influence incentives to centrally clear OTC derivatives by changing the private costs and benefits of cleared and uncleared transactions. These effects of reforms may fall directly on market participants, or indirectly, as intermediaries pass through the economic impacts they face. These costs and benefits are discussed further in Sections F1-F3. Section F4 discusses the transmission mechanism by which they may affect market activity.

B4 Data and methodology

This report represents findings based on the approach, methodology and data available. The DAT collected data from a variety of sources. These included:

1. Four expansive **qualitative surveys** requesting information on the effects of regulatory reforms and how these effects differ across time, regions, and participant types. Separate surveys were sent to CCPs, dealers, client clearing service providers and clients. In total, 118 responses were received across the four surveys.

   The qualitative survey data was enriched by **outreach** to representatives of various market participants including CCPs, dealers and large and small clients. This included roundtables in the United States and the United Kingdom as well as a conference call with Asia-Pacific market participants.

   While no market participant has a full view of the impact of the reforms, and there is a potential for bias, the collective views of participants as gathered by market outreach and surveys can be potentially informative about effects. Thus, they complement other data gathering.

2. A **quantitative survey** of 21 of the largest OTC derivatives dealers, requesting information on costs for a set of products both centrally cleared and traded bilaterally under various common credit support arrangements.[24] This survey enabled the DAT to compare the total cost of centrally clearing these products with uncleared alternatives.

3. **Regulatory and other data** for centrally cleared and uncleared derivatives. This included input from trade repositories from two jurisdictions; from CCPs; from clearing members; and from other sources such as the Bank for International Settlements' (BIS) semi-annual derivatives survey and quarterly CPMI and IOSCO CCP quantitative disclosures.

[24] See Table D.5 in this report for further information about the CSA types used in the survey.

4. A **review of academic research** which focused on clearing and OTC derivatives regulatory reform. See Annex 3 for more detail on this, including a bibliography of the research referenced in this report.

An earlier version of this report was also subject to public consultation and responses to the consultation have informed the final report.[25]

General considerations regarding limitations

There are important limitations to the various data sets described above, which can be inherent (e.g. bias in survey responses) or specific (e.g. some data sets are only reported quarterly). Survey respondents may bias their responses to quantitative and qualitative questions based on their beliefs about how their responses will be interpreted and in order to influence policy change. Further, information provided by public disclosure may be 'noisy' and may represent snapshots of the market at low frequency. Finally, market data may reflect several interacting factors that make the identification of the impact of individual regulatory reforms difficult. These limitations are not unexpected.

The DAT sought to use a wide variety of data sources to reduce the impact of these issues. Corroboration across the different sets is sometimes possible and, when it is, a wider and more complete perspective can be achieved. For example, responses to the quantitative survey about bid/mid spreads for a specific set of clearable products represent a non-binding estimate at a specific point in time for a specific portfolio type and credit support arrangement. These responses are potentially prone to bias, especially given that participants understood the remit and focus of the DAT was to evaluate the effects of post-crisis reforms. In contrast, trade repository data is not prone to this reporting bias because it reflects actual, rather than hypothetical, risk transfer. However, it may not provide sufficient data, such as bid/mid spreads, to robustly identify each factor that impacts transaction prices. Nor does it contain significant information on the underlying order history which resulted in a trade. It does however reflect a broader time frame and number of counterparty pairs. Used together, assuming they do not contradict one another, quantitative survey and trade repository data can complement each other. These sources, together with qualitative survey responses and academic research, give the DAT a more informative data set overall. As with any economic analysis, whether theoretical or empirical, the DAT has relied extensively on the collective expertise, or expert judgement, of its members.

A fuller description of survey analysis approaches is provided in Annex 1. It is summarised below and, for the quantitative survey, in Box 1 in Part D and Annex 6.

Qualitative survey

The DAT's qualitative surveys were intended to provide a general assessment of market participants' views of derivatives markets and relevant regulations, to be used alongside other sources of data and academic literature. This approach (and the fact that all survey submissions were anonymised before being analysed by the DAT) encouraged more open responses, although as with all surveys of this type, a risk of bias remains. In particular, given the nature and context of the survey, and the fact that surveys were completed on a voluntary basis,

[25] For an overview of responses to the consultative document, see http://www.fsb.org/2018/11/Evaluation-of-incentives-to-centrally-clear-OTC-derivatives-Overview-of-responses-to-the-consultation.

negatively affected institutions were potentially more likely to respond (selection bias) and exaggerate responses (reporting bias) than less affected institutions.

The surveys were disseminated in December 2017 to a number of market participants and industry associations and were also made publicly available for response on the FSB website.[26] There were 17 responses to the qualitative survey from CCPs, 39 responses from OTC derivatives dealers, 18 responses from client clearing service providers and 44 responses from clients. Not all respondents provided responses to every survey question.

The responses received for CCPs, dealers and services providers represent a high proportion of the key derivatives participants in each role.[27] For clients, due to the number of responses compared to client heterogeneity and variety, it is not possible to be confident that the responses are fully representative. This is particularly true in relation to subsets of clients, such as specific types of end user. However, client responses were often consistent with those from other respondent types, notably client clearing services providers, giving some measure of comfort that they reasonably reflect the views of a range of market participants.

The responses to the qualitative survey are most useful in providing additional insights when used in combination with other data and information. Summaries of the responses to many of the survey questions are presented in the body of the report and additional analysis is made available in Annex 5.

Each of the surveys comprised a mix of question types, including binary response; multiple choice; 'ranked' choice; free text responses; and combinations of the above. The analysis of the responses involved categorising free text answers, developing a methodology to review ranking and multiple-choice selections, and comparing responses across surveys. The analysis was performed by teams of analysts from a range of different jurisdictions in North America, Europe and Asia.

The analysis required choices to be made on the aggregation of responses. This process sometimes required survey team members to rely on their expertise to interpret what the respondents were trying to convey where options were not pre-defined. The subjective element introduced through such interventions could have potentially impacted some of the results through confirmation bias. On the other hand, expert judgement could also help counter the respondent bias implicit in such survey responses. Analysis was more challenging and required more judgement for answers that had to be categorised manually, where a wide range of responses were aggregated into a smaller number of categories, and for the analysis of questions where the response rate was comparatively low.

Quantitative survey

The DAT's quantitative survey asked the largest global OTC dealers to voluntarily provide a variety of data and information on clearing activity. Twenty-one dealers were asked to complete the survey, and 20 responded. The data requested included the running bid/mid spread on a variety of (mostly OTC) derivatives under a variety of contractual terms, and specified other factors relevant to estimating the total cost of transacting a derivative. To improve consistency

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[26] Available at www.fsb.org/2017/12/call-for-responses-to-surveys-on-incentives-to-centrally-clear-otc-derivatives/.

[27] All responses were anonymised before being made available to the analysis teams, but the identities were known by either intermediating national authorities or, where responses were not intermediated, by the Secretariat. Based on this, there can be confidence in the coverage of the CCP, dealer and client clearing service provider survey responses.

and comparability, data was requested within a specified period of 10 working days in January 2018, which did not include reporting or month end dates, public holidays, or other dates that could be anticipated to distort data. Responses included the date on which each spread was provided.

Even though the survey respondents were the largest global OTC derivatives dealers, not every dealer provided client clearing for every type of derivative in the survey. Interest rate derivatives were the most frequently offered service, while OTC FX derivatives were the least. As the survey sought to balance complexity and the burden of completion with comprehensiveness, some data was only requested for interest rate derivatives as the largest and most widely traded and cleared asset class.

As the respondents were the largest global OTC derivatives dealers, the response base for the quantitative survey was highly representative of the group of firms likely to answer a given request for an OTC derivatives quote. However, as with the qualitative survey, there is a risk of respondent bias. This was in some cases mitigated by the use of trade repository and other data to provide independent insight into the same issues.

A particular challenge faced by the survey was specifying the characteristics, portfolio and credit support arrangements of the counterparties assumed when quoting. Dealers normally consider these features when pricing a trade. Specifying actual client portfolios was not feasible and so respondents were asked to provide bid/mid spreads under different types of credit support arrangements for stand-alone trades. Thus, while the quantitative survey gives important insight into the incentives faced by OTC derivatives price takers, it cannot capture all the relevant features. Further detail on the methodology and analysis employed for the quantitative survey can be found in Box 1 in Part D and Annexes 4 and 6.

Regulatory, position and risk data

The DAT used public and regulatory datasets where the underlying data came primarily from or related to derivatives traders, clearing members, their clients, and CCPs.

The availability of public data related to cleared derivatives activity has increased over the last decade. Examples of increased transparency include: details on the size of global cleared markets included in the BIS semi-annual derivatives statistics, quarterly public disclosures provided by the major CCPs on multiple risk measures, liquidity and capital resources and clearing member risk distributions; and weekly swaps information published by the CFTC on OTC derivatives exposures and trade activity.

Regulators now have access to a wider variety of derivatives data than before the post-crisis financial reforms were implemented, with trade repository ('TR') data in particular being a useful and detailed source of information. However, analysis of this data is often subject to a number of challenges. First, the historical coverage of TR data differs across data sets in different jurisdictions, with many of them not extending beyond a few years. This can make comparisons of current markets to the pre-crisis period, or even to the immediately post-crisis period, more difficult. Second, detailed standards for the data can often differ across geographical regions and across time. Even within a jurisdiction, information sent by one reporter may not always be entirely compatible with that sent by others. Currently, there is international data harmonisation work underway to bring consistency to derivatives data

reporting[28] but comparing data across geographical regions can nevertheless still be challenging. As a consequence, even when TR data can be analysed with confidence at a jurisdictional level, cross-jurisdictional results can be less robust. For instance, client concentration measures as reported by clearing members may not coincide with those reported by CCPs, because clearing members often clear at multiple CCPs in multiple jurisdictions and clients through multiple members. Therefore, in some instances, data for individual jurisdictions or regions is used in this report to illustrate observations and findings.

Despite these issues, the volume of TR and other regulatory data available to authorities (and to the DAT) is significantly greater today than pre-crisis and it can provide useful indicators regarding the effects of reforms on OTC derivatives markets.

[28] For example, under the FSB's Working Group on Unique Transaction Identifier (UTI) and Unique Product Identifier (UPI) Governance, and the CPMI and IOSCO Working Group for the harmonisation of key OTC derivatives data elements.

Part C The current state of the OTC derivatives markets

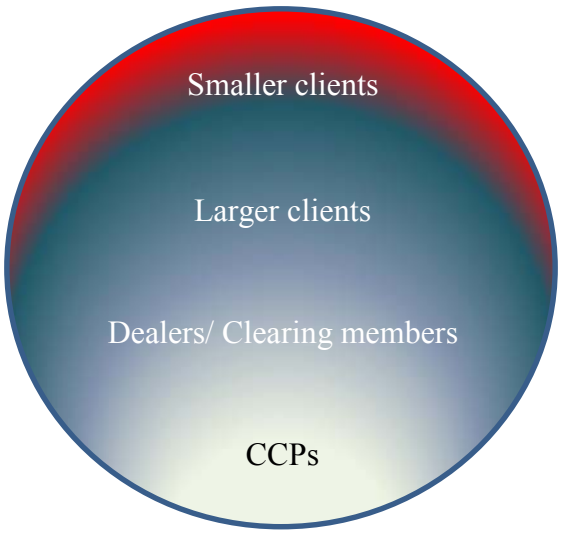
After the global financial crisis, the G20 agreed to a number of financial reforms aimed at reducing systemic risk, improving transparency in the derivatives markets and protecting against market abuse. These reforms included mandating centralised trading and clearing for standardised OTC derivatives, requirements for the exchange of margin for derivatives that are not centrally cleared, and regulatory reporting for all derivatives transactions.

A number of changes have been observed in OTC derivatives markets that are consistent with the G20 objective of promoting central clearing and enhancing systemic stability. This section discusses the principal trends relevant to incentives to clear noted by the DAT.

C1 Entities participating in clearing

Figure C.1 illustrates a stylised view of the sets of entities within the post-reform OTC derivatives system.

Figure C.1 Highly stylised illustration of the OTC derivatives system



The system can be understood as an inner core of CCPs surrounded by a small set of clearing members (which are typically G-SIBs) that serve as intermediaries between CCPs and users of derivatives. In turn, these are surrounded by clients who make heavy use of intermediary services. Smaller clients[29] are differentiated by colour, and are in the periphery in the sense that they are generally less active in OTC derivatives markets. The systemic importance of OTC derivatives activity broadly decreases as one moves towards the periphery.

Each segment of this system is discussed in the following paragraphs.

The use of **CCPs in the core of the OTC derivatives system** ensures that counterparty credit risk is mitigated, provided that CCPs are robust. The features of OTC derivatives central clearing, its costs, and benefits are further discussed in Box 2 in Part F.

[29] For the purposes of this this report, a 'smaller' client is one that typically engages in smaller volumes and/or values of OTC derivatives activity. This may cover a range of firm types (e.g. banks, insurers, pension funds, asset managers and non-financial corporates) and a wide range of sizes of overall balance sheet.

In the next part of the system sit the large OTC derivatives dealers. These firms often act as clearing members of CCPs, clearing their own ('house') trades. Some also provide client clearing; when they undertake this role, they are known as client clearing service providers. In addition to their centrally cleared transactions, dealers may also trade OTC derivatives on a bilateral basis. These trades do not pass through the CCPs in the core of the system and so the counterparty credit risk associated with them remains with the original two parties to the trade. Dealers often also take the role of market makers in both centrally cleared and uncleared markets, providing liquidity to counterparties who wish to gain exposure or hedge using derivatives markets.

Larger clients (such as some large and medium sized banks, insurers, asset managers, and pension funds) sit in the next part of the system. Many sovereign, quasi-sovereign, municipal and multilateral development bank counterparties can also be found here. Mandatory clearing obligations in many jurisdictions require some large clients to clear standardised OTC derivatives and thus to pay the fixed costs associated with central clearing. Margin requirements for uncleared OTC derivatives may also apply.

Finally, in the outer part of the system sit the smaller, less active clients. These include many non-financial entities. Depending on the jurisdiction, these firms may or may not be captured by reforms such as the clearing mandate or margin requirements for uncleared derivatives. The latter requirements are being phased in through to 2020, so they may apply in due course even if they do not currently. Given their exemption from mandatory clearing requirements in many jurisdictions, the choice between cleared and uncleared trades for such clients may depend on factors such as their ease of access to central clearing, fixed costs, ease of accessing acceptable collateral, and the relative costs of cleared versus uncleared trades.

C2 Clearing rates and levels

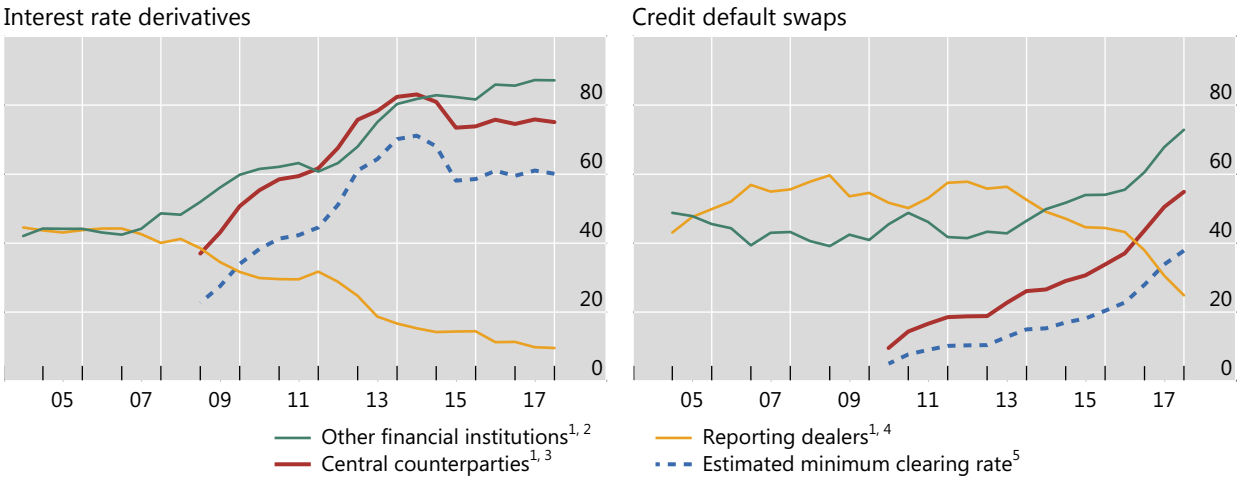
Clearing levels represent the share of outstanding derivatives that has been cleared via CCPs, while clearing rates show the share of new derivative transactions that are centrally cleared. Both views can provide insight into how the clearing business has evolved in recent years, and both demonstrate significant changes in clearing practices in OTC derivatives markets.

The BIS has collected information on global derivatives markets, including exposures to CCPs, since the mid-2000s. After processing, this data shows a significant increase in the notional amount outstanding of centrally cleared OTC derivatives since the crisis. This is especially true for interest rate and credit derivatives, as can be seen in Figure C.2. Clearing levels for these asset classes were around 24% and 5% respectively in 2009; by Q1 2018 these levels had risen to approximately 60% and 38%.

Clearing levels for the most standardised OTC derivatives such as fixed-floating interest rate swaps (IRS) and default swaps referencing standard credit indices are even higher than this in some large jurisdictions. For instance, as of the beginning of May 2018, data reported to the CFTC indicates that clearing levels for some interest rate swaps were well above 65%, and exceeded 50% for index or index-related credit default swaps (CDS), as Table C.3 shows.

Figure C.2 The growth of central clearing

Notional amounts outstanding by counterparty, in per cent[1]



Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

[1] As a percentage of notional amounts outstanding against all counterparties. [2] Including central counterparties but excluding reporting dealers. [3] For interest rate derivatives, data for CCPs prior to end-June 2016 was estimated by indexing the amounts reported at end-June 2016 to the growth since 2008 of notional amounts outstanding cleared through LCH's Swapclear service. [4] Adjusted for the double counting of positions between dealers (that are not novated to CCPs). [5] The proportion of trades that are cleared, estimated as (CCP/2)/(1-(CCP/2)), where 'CCP' represents the share of notional amounts outstanding that dealers report against CCPs. The CCP's share is halved to adjust for the potential double counting of interdealer trades novated to CCPs.

Sources: LCH.Clearnet Group; BIS derivatives statistics.

Table C.3 Centrally cleared and uncleared notionals outstanding in US interest rate derivatives and credit derivatives

Product	Centrally cleared (USD bn)	Uncleared (USD bn)	Total (USD bn)
Interest rate derivatives			
Fixed-Float	84,610 (69%)	38,117 (31%)	122,727
Forward Rate Agreement	34,884 (87%)	5,106 (13%)	39,990
Overnight Indexed Swap	29,459 (82%)	6,680 (18%)	36,139
Other	17,680 (26%)	51,542 (74%)	69,222
TOTAL	**166,633** (62%)	**101,445** (38%)	**268,078**
Credit derivatives			
Index Tranche / Index	**1,871** (55%)	**1,553** (45%)	**3,424**
Asia	13 (13%)	86 (87%)	99
Europe	1,208 (68%)	574 (32%)	1,782
North America	592 (42%)	803 (58%)	1,395
Other regions	57 (39%)	91 (61%)	148
Other*	**0.53** (0%)	**764** (100%)	**765**
TOTAL	**1,871** (45%)	**2,318** (55%)	**4,189**

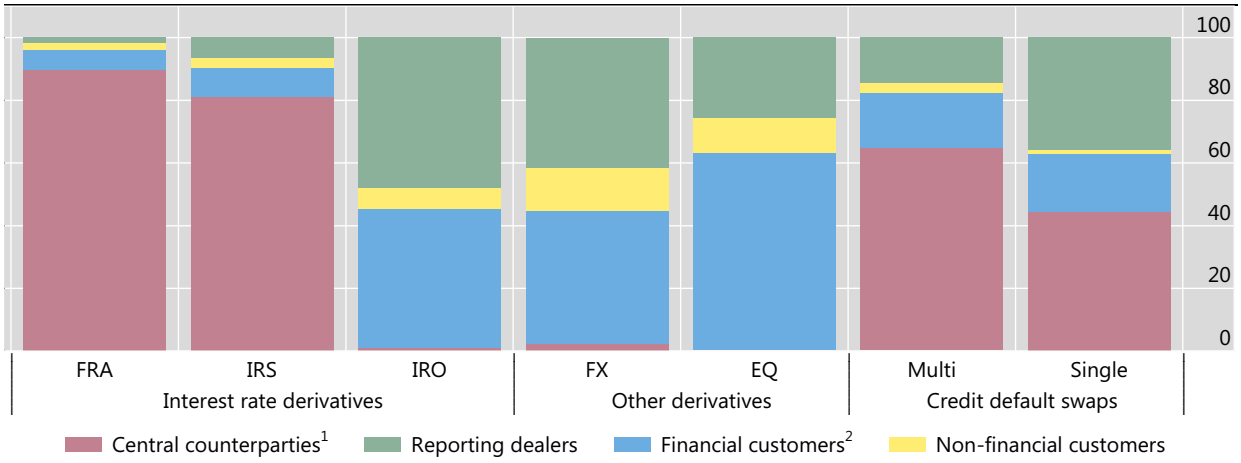
* E.g. credit swaptions, credit total return swaps and other 'exotic' credit products.
As reported to the CFTC in May 2018. Figures rounded to the nearest billion.

Source: CFTC.

Related analysis by the BIS indicates that over 80% of current open derivatives exposures created by both fixed-floating interest rate swaps and forward rate agreements have a CCP as one counterparty: see Figure C.4.

Figure C.4 The significance of central clearing: OTC derivatives split by underlying risk and instrument

Notional amounts outstanding by type of counterparty, at end-December 2017, in per cent



Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm

EQ = equity-linked derivatives; FRA = forward rate agreements; FX = foreign exchange derivatives; IRO = interest rate options; IRS = interest rate swaps; multi = multi-name credit default swaps; single = single-name credit default swaps.

[1] Contracts between reporting dealers that are subsequently novated to CCPs are recorded twice. [2] Excluding central counterparties and reporting dealers.

Source: BIS derivatives statistics.

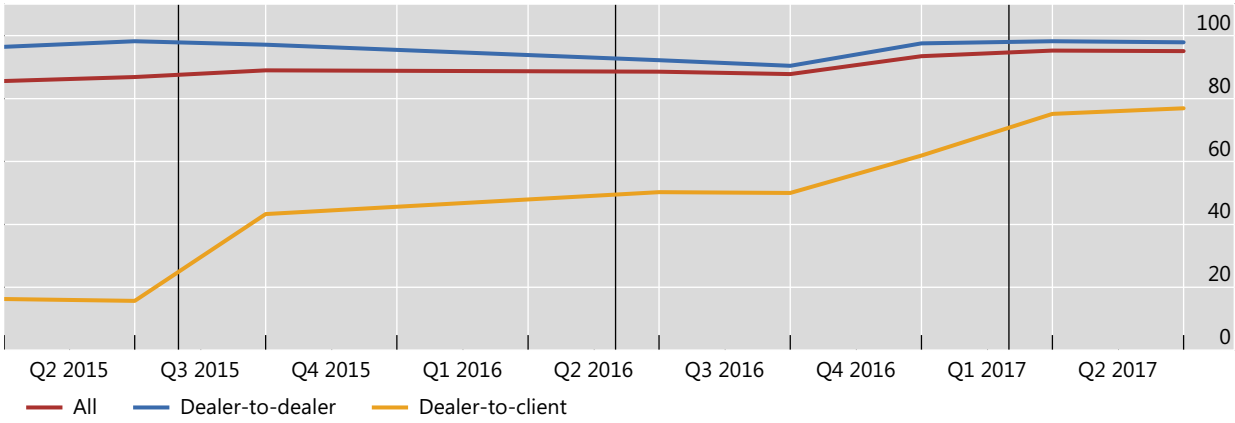
C3 Clearing rates and levels around the implementations of the clearing mandate and margin requirements for uncleared derivatives

The clearing mandate was phased in across relevant jurisdictions, starting with larger financial entities and eventually extending to smaller entities. The take-up of clearing was therefore also gradual, with dealers tending to migrate to central clearing before clients, reflecting their earlier compliance date. Plain vanilla Euribor IRS traded via German dealers are an example of this. Clearing rates for new dealer-to-dealer trades had already reached 90% percent by mid-2015, but the rates for dealer-to-client transactions were only at 20% at the same point. They eventually rose to over 70% by mid-2017 as clients were captured by the phase in of the clearing mandate. Figure C.5 illustrates this.

Clients are often more likely to hold directional positions than dealers, so the level of market risk associated with client cleared positions can often be higher than implied by relative notional levels. As measured by initial margin posted at large OTC derivatives CCPs, clients now can often be at least as large as dealers: see Figure C.6.

Figure C.5 Historical Euribor clearing rates

Notional cleared by type of transacting counterparties in per cent

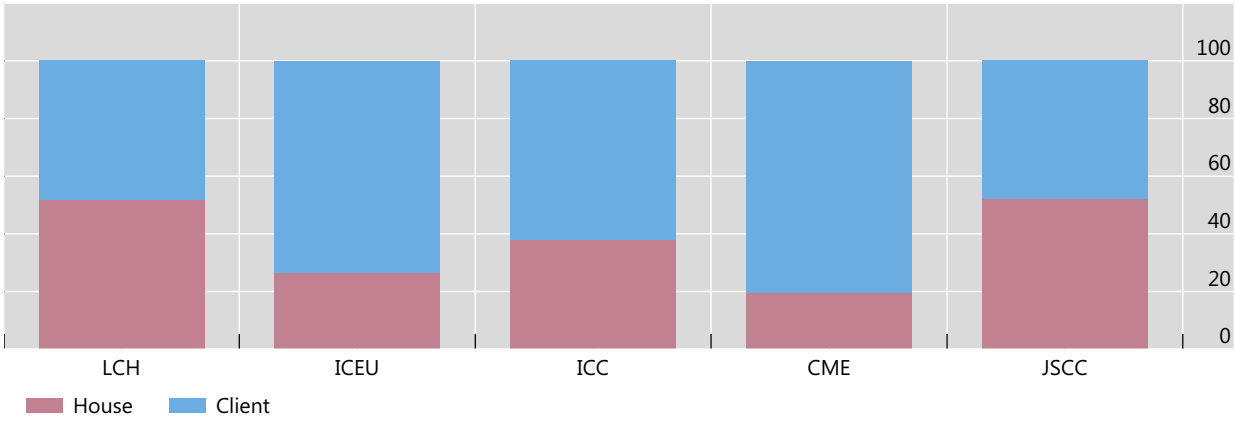


Calculated as notional amount cleared per quarter / total notional amount (cleared and uncleared) per quarter. The vertical lines indicate August 2015 (announcement of mandatory clearing reforms), June 2016 (beginning of mandatory clearing phase-in) and March 2017 (phase-in of uncleared margin requirements).

Sources: DTCC GTR Europe, Deutsche Bundesbank.

Figure C.6 The split of initial margin between house and client accounts at five large OTC derivatives CCPs

In per cent



Reported as at end December 2017. ICEU = ICE Clear Europe. ICC = ICE Clear Credit. JSCC = Japan Securities Clearing Corporation.

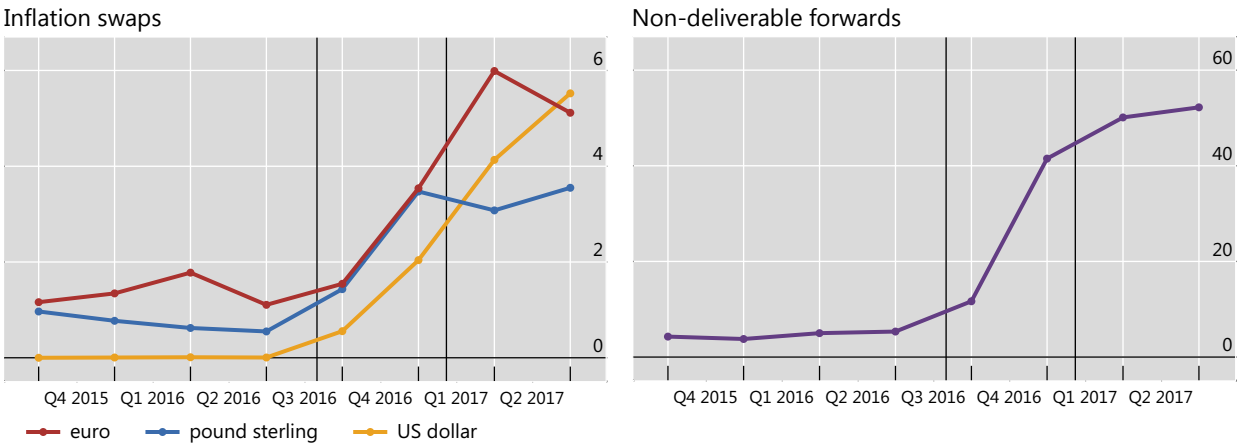
Source: CPMI and IOSCO quantitative disclosures.

A number of dealers have chosen to centrally clear derivatives on a voluntary basis in recent years, especially since the standards requiring margin for uncleared derivatives began to be phased in. This is discussed further in Part D. Figure C.7 presents trends in average daily cleared notional for inflation swaps and non-deliverable forwards, two non-mandated, but clearable products. The region of greatest increase in the Figure begins around the date when uncleared margin requirements were first introduced for the largest OTC derivatives participants in Canada, Japan and the United States, in September 2016.

Taken together, the data presented above indicates that CCPs have become centralised risk managers for systemically important entities in the OTC derivatives markets.

Figure C.7 The cleared notional of inflation swaps (left) and non-deliverable forwards (right) over time

In billions of US dollars



The vertical lines indicate 1 September 2016 (US/CAN/JPN margin requirements for uncleared derivatives) and 4 February 2017 (EMIR requirements for the same). Figures are not adjusted for underlying market changes in these product types.

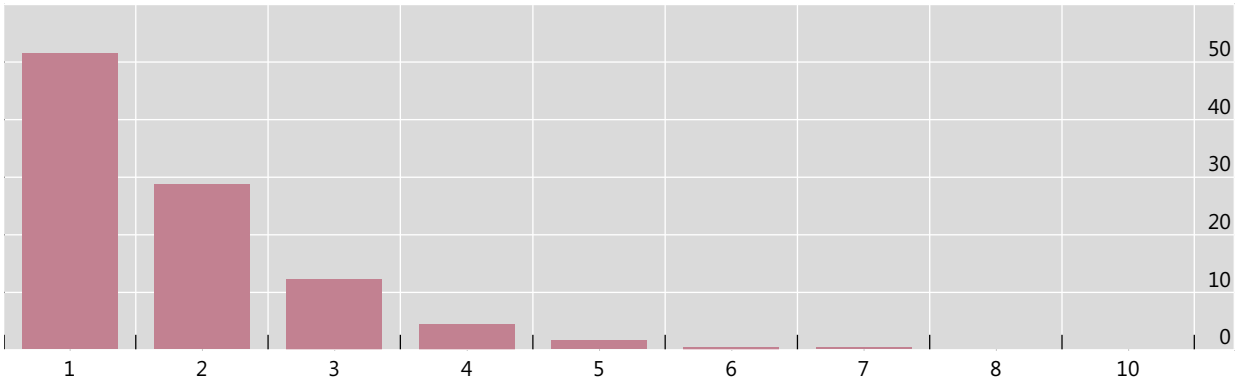
Source: CPMI and IOSCO quantitative disclosures.

C4 Client clearing service provision

Many market participants access CCPs as clients via a clearing member. As illustrated in Figure C.8, most clients have a relationship with just a single client clearing service provider.

Figure C.8 The distribution of the number of clearing members used by clients at a large OTC derivatives CCP

In per cent



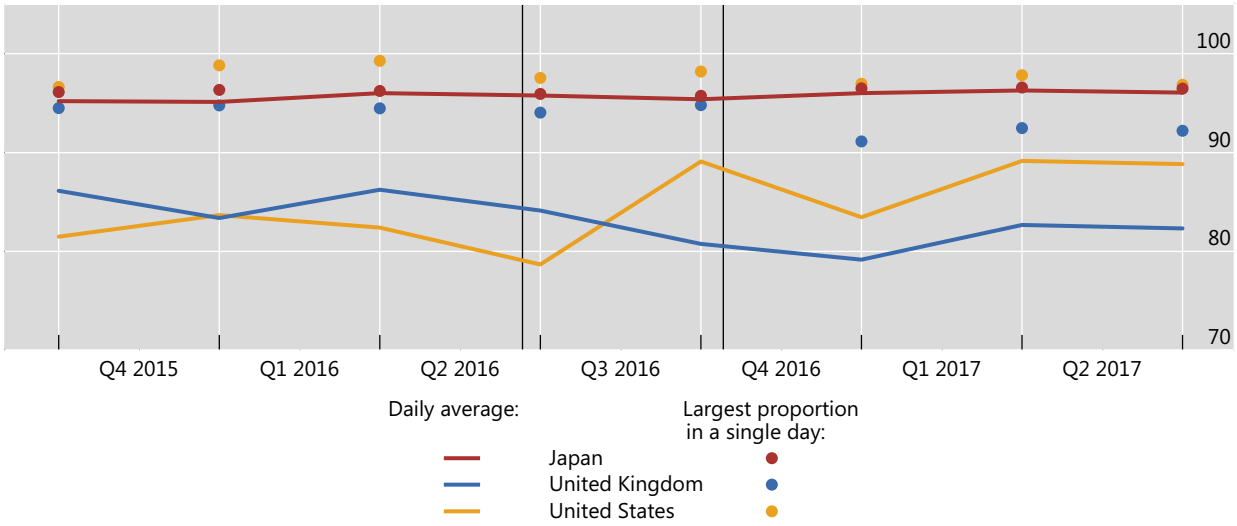
Source: CFTC.

For the reasons discussed in Part E, unlike traditional exchange traded derivatives, client clearing for OTC derivatives is concentrated in a small group of clearing firms. Data published on a quarterly basis by the largest global CCPs provides information on the extent of concentration in provision of these services. Across the United States, the United Kingdom and Japan, the amount of cleared client trading activity which passes through the top five clearing members exceeds 80% for IRS, as measured by notional value. Figure C.9 provides another

perspective on this, showing the fraction of client initial margin associated with the largest five clearing members at several large OTC derivatives CCPs.

Figure C.9 The percentage of IRS client margin posted by the top five clearing members at large OTC derivatives CCPs

In per cent



The vertical lines indicate 21 June 2016 (EMIR IRS clearing obligation) and 14 October 2016 (CFTC IRS clearing obligation extension). Based on data disclosed by individual CCPs under the CPMI and IOSCO quantitative disclosure framework.

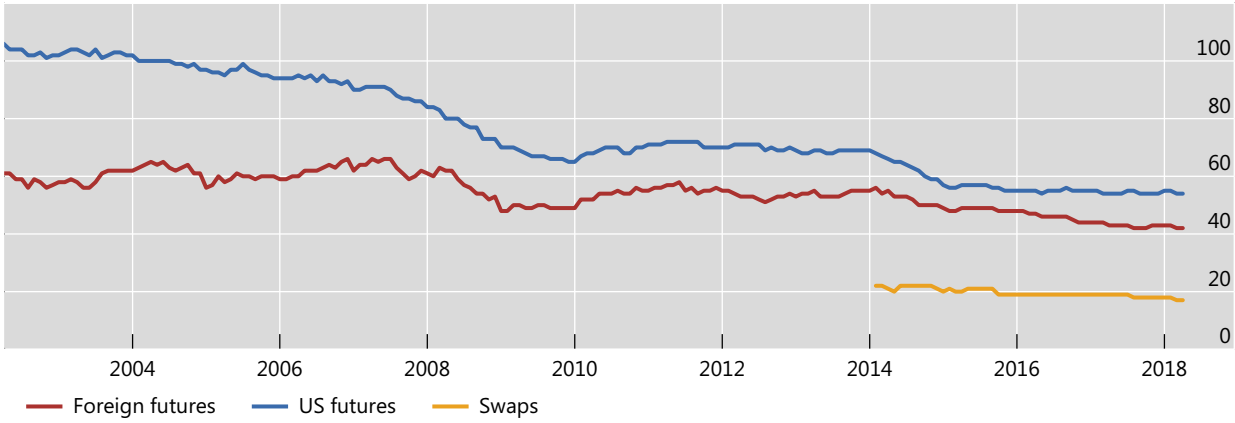
Source: CPMI and IOSCO CCP quantitative disclosures.

Broadly, this level of concentration in OTC derivatives client clearing service provision has existed since client clearing became commonplace for these instruments. A longer-term trend of a progressively smaller total set of entities providing client clearing for exchange traded derivatives ('ETDs') has also been observed. For instance, according to data from the CFTC, the number of firms providing clearing services in the United States (known for historical reasons as futures commission merchants, or FCMs) has fallen from 84 at the beginning of 2008 to 55 at the beginning of 2018, partly due to mergers and acquisitions and partly to service closures. There has also been a decline, albeit a smaller one, in OTC derivatives service providers. Figure C.10 illustrates this.

This trend of increasing concentration is not uniform across markets and CCPs. For instance for one large EU interest rate derivatives CCP, the number of client clearing service providers has increased from 48 in 2015 to 54 in 2017, and client positions attributable to the five largest clearing members have fallen from 83% to 78%.

It is important to note here that a number of the 20 largest derivatives dealers globally do not offer client clearing services for every asset class. Table C.11 reports the responses to the DAT's quantitative survey on this issue.

Figure C.10 Historical count of Futures Commission Merchants (FCMs)



Based on data submitted by registered FCMs

Source: CFTC.

Table C.11 Summary of the client clearing services offering by quantitative survey respondents

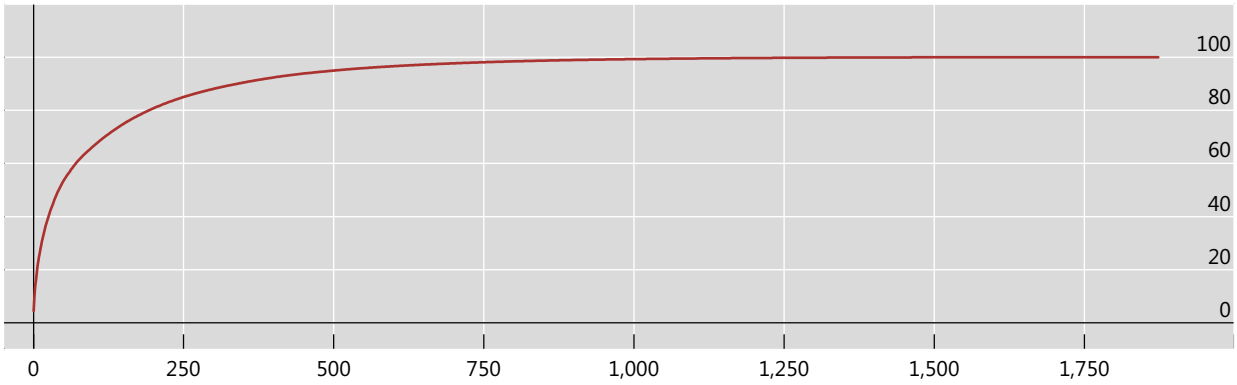
Asset class/derivative type	Client clearing service offered?	
	Yes	No
OTC interest rate derivatives	78%	22%
Exchanged traded interest rate derivatives	72%	28%
Credit derivatives	67%	33%
Exchange traded FX derivatives	67%	33%
OTC FX derivatives	33%	67%

Source: DAT quantitative survey

The distribution of activity in centrally cleared OTC derivatives is skewed. The largest participants represent a substantial proportion of the total risk transferred, with a long tail of smaller participants making smaller contributions. Figure C.12 illustrates an example of this, showing the cumulative share of client initial margin at two large CCPs clearing interest rate derivatives. The 50 largest clients represent more than half of all client margin, even though there are over 1,800 clients in total.

Figure C.12 The cumulative client initial margin at two large OTC derivatives CCPs

In per cent



Number of clients

For this calculation, each client represents the aggregate total margin posted against all client clearing accounts posted on behalf of the parent company.

Source: CFTC aggregation based on data from CME and LCH.

Part D Analysis of the incentives to centrally clear OTC derivatives

D1 Introduction

This section considers the effects of the post-crisis reforms and the incentives they might create in relation to central clearing. In particular, it focuses on two of the reform areas which the DAT's findings suggest are likely to be highly influential in changing OTC derivatives clearing behaviour: central clearing mandates and the BCBS-IOSCO margin requirements for uncleared derivatives. Both of these areas of reform apply to OTC derivatives market makers (referred to as dealers for the purposes of this report) and price takers with sufficiently large amounts of activity in the OTC derivatives markets (referred to as large clients). In some jurisdictions, they can also apply to smaller, less active price takers (referred to as small clients). This Part assesses the impact of the reforms from their perspectives.

The caveat described earlier, that clearing mandates potentially restrict the choices available to market participants in their derivatives transactions, applies to the analysis below. It should also be noted that other reforms, such as higher capital requirements for uncleared derivatives, have an impact on the incentives to centrally clear for parties who are subject to them.

The first clearing mandates came into force in November 2012 and are now in place in 11 jurisdictions covering a large proportion of the global OTC derivatives activity, including over 95% of the OTC interest rate derivatives market.[30] The clearing mandates have so far been applied primarily to standardised interest rate and credit derivatives contracts such as forward rate agreements, interest rate swaps, and credit default swaps on liquid indices. Of the main asset classes, interest rate and credit derivatives exhibit the highest clearing levels. It should be remembered in this context that the G20 reforms focus on central clearing of *standardised* OTC derivatives. It is recognised that some derivatives, notably those which are non-standard and/or illiquid, may not be appropriate for central clearing.

The BCBS-IOSCO *Minimum standards for margin requirements for non-centrally cleared derivatives* set out phase-in schedules for mandatory exchange of variation and initial margin. The first phase came into force on 1 September 2016. With respect to variation margin, implementation of the second and final phase began on 1 March 2017, with several jurisdictions granting forms of time-limited transitional relief or supervisory guidance until 1 September 2017. For initial margin, the phase-in period began on 1 September 2016 and will end on 1 September 2020.

D2 Incentives to centrally clear as reported by survey respondents

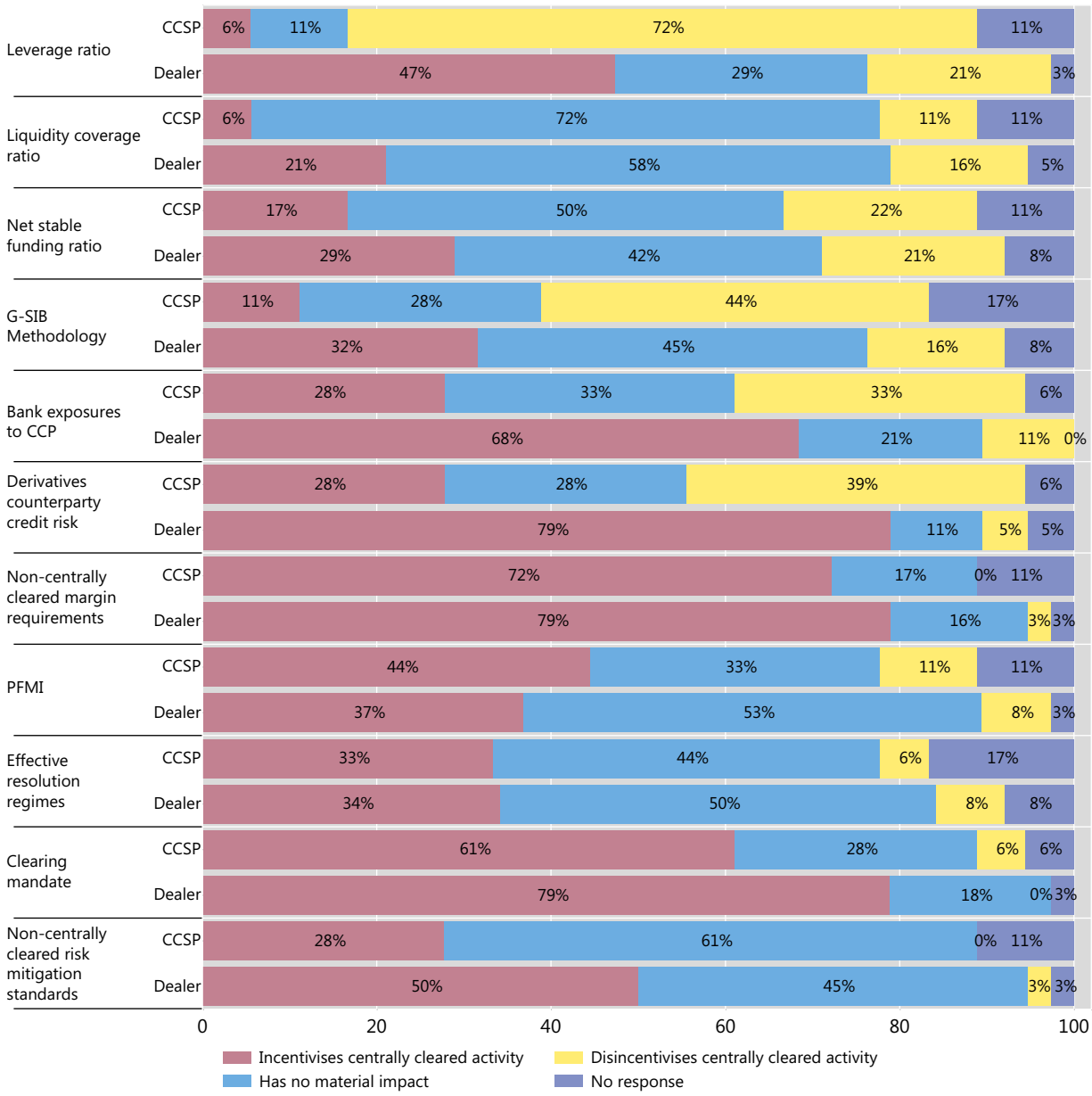
Responses to the DAT's qualitative survey provide insights into market participants' views on the role of the post-crisis reforms in incentivising or disincentivising central clearing of OTC derivatives. There were a range of responses which suggest that the relative importance of these incentives varies by, for example, product, category of participant, and the risk profile of the participant's activities. In aggregate, the specific post-crisis reforms most frequently cited by dealers and client clearing service providers in qualitative survey responses (other than clearing mandates) as providing an incentive to centrally clear were margin requirements for uncleared

[30] Source: BIS derivatives statistics.

trades, the BCBS capital standards for derivatives counterparty credit risk, and the BCBS capital standards for exposures to CCPs. Figure D.1 summarises the relevant survey responses on the effect of certain reforms on incentives to centrally clear.

Figure D.1 Views of dealers and client clearing service providers on the impact of regulatory reforms on incentives to centrally clear

In per cent



CCSP = client clearing service provider. Dealer survey question 15a (39 responses) and CCSP survey question 33 (18 responses). CCSPs were also asked to consider the impact on incentives to provide client clearing services.

Source: DAT qualitative survey.

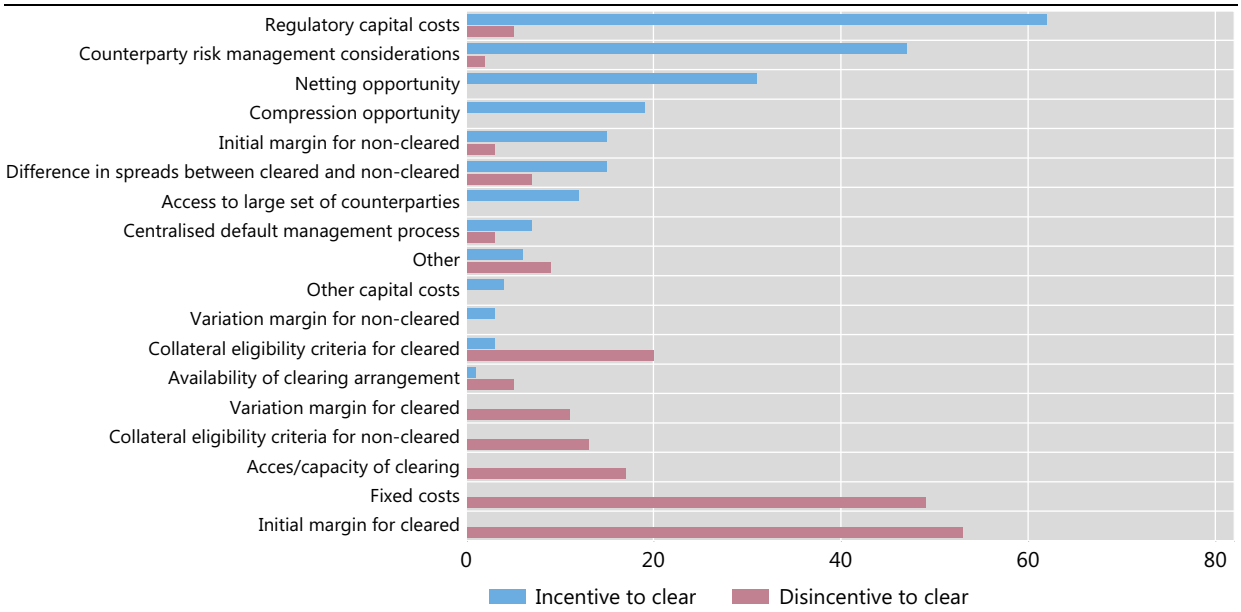
The incentives to centrally clear are affected by both regulatory and non-regulatory factors. When asked to rank factors incentivising the central clearing of non-mandated products, dealers (who are also typically part of G-SIBs) ranked the comparative regulatory capital costs for centrally cleared and uncleared derivatives, counterparty risk management considerations and

the netting opportunities offered by CCPs as the most important factors in incentivising the central clearing of a non-mandated derivatives product: see Figure D.2.

In addition, 87% of dealers responding to the survey said that the comparative capital treatment of centrally cleared derivatives transactions relative to that of uncleared ones has incentivised central clearing.[31]

Dealers identified initial margin requirements for centrally cleared trades, the high fixed costs associated with participating in clearing, and collateral eligibility criteria for centrally cleared trades as the top three disincentives to centrally clear.[32] It should be noted that the banks who participated in the surveys are also clearing members at many or all of the major CCPs, with their dealing desks clearing their trades through affiliated client clearing service providers, so the same group often contains both dealing and client clearing businesses.

Figure D.2 The weighted rank of the top factors incentivising/disincentivising dealers from centrally clearing non-mandated products



Dealer survey question 10b (34 responses). Numbers not shown are equal to zero. Respondents selected an option from a pre-defined list so no manual categorisation was required. The ranking was based on the weighted methodology, so the x axis does not represent number of respondents.

Source: DAT qualitative survey.

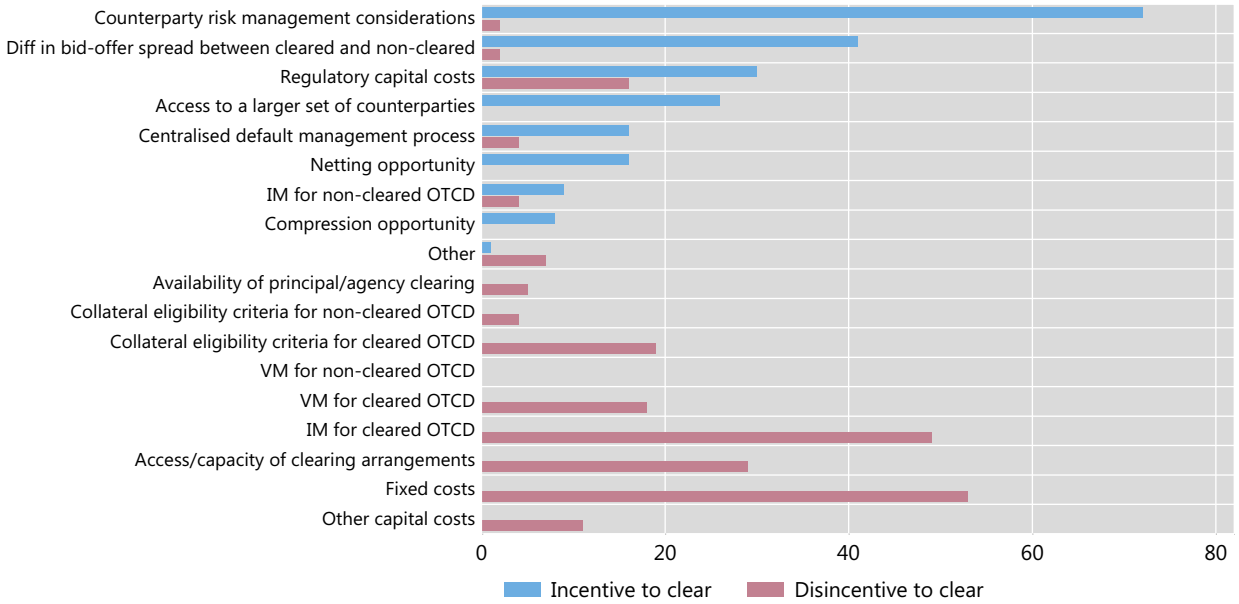
Clients who responded to the survey ranked counterparty risk management considerations, differences in bid-offer spreads between cleared and uncleared derivatives; and the comparative regulatory capital costs of cleared and uncleared derivatives as the most important factors incentivising the clearing of non-mandated products. Similarly they ranked the high fixed costs associated with participation in clearing (such as IT, staffing and other operational costs, liquidity requirements and minimum fees); initial margin requirements for centrally cleared

[31] Source: DAT qualitative survey, dealer survey question 18 (34 out of 39 respondents selected yes). Respondents selected an option from a pre-defined list so no manual categorisation was required. Some also provided additional free text comments.

[32] Many dealers' comments on incentive ranking did not clarify whether the factors applied to the dealers themselves or whether they were reflecting their view of the market in general.

OTC transactions; issues relating to access to and the capacity of clearing arrangements; and CCPs' criteria for eligible collateral and requirements for variation margin to be paid in cash as the most important factors disincentivising participation in clearing: see Figure D.3. Part E includes a further discussion of access issues for clients. In survey responses, neither dealers nor clients ranked margin standards for uncleared trades amongst the top incentives to centrally clear.

Figure D.3 Weighted rank of the top factors incentivising/disincentivising clients to centrally clear non-mandated products



Client survey question 53b (39 responses). Numbers not shown are equal to zero. Respondents selected an option from a pre-defined list so no manual categorisation was required. The ranking was based on the weighted methodology, so the x axis does not represent number of respondents.

Source: DAT qualitative survey.

It is important to contextualise these results with an analysis of the mechanisms by which the various regulatory and non-regulatory factors create incentives or disincentives to centrally clear. One important factor is price differences between centrally cleared and bilateral trades; another is regulatory requirements to centrally clear. A discussion of these issues is set out in the remaining sections of this Part.

D3 Introduction to the quantitative survey

Absent regulatory requirements such as clearing mandates, and if the choice is unconstrained by other factors such as business needs or ability to access clearing, one can hypothesise that the relative cost of centrally clearing an OTC derivative trade compared to the cost of a uncleared derivative is an important determinant of whether such trades are cleared centrally or not. To shed light on relative costs, the DAT surveyed the largest 21 OTC derivatives dealers (of whom 20 responded), asking them to price hypothetical trades in both centrally cleared and uncleared forms. Specifically, respondents were asked to provide the indicative spread to mid-market price for a number of different derivatives trades under a variety of credit support annexes (CSAs). Normal market size and trading conditions were assumed. A CSA is a privately negotiated agreement between counterparties which stipulates the margin exchange

applicable to a trade and hence affect the residual counterparty credit risk after margin. The CSA is therefore an important element of pricing. Given its role, the terms of the CSA will likely be affected by any regulations on margin requirements which apply.

The trade types and CSAs surveyed by the DAT are summarised in Tables D.4 and D.5.

Table D.4 Summary of the trade types surveyed

Short name	Description of trade*
IRS10	Ten year interest rate swap (IRS) in USD
IRS30	Thirty year IMM IRS in USD
iTraxx5	Five year iTraxx series 28 index CDS
iTraxx5/10	Curve steepener trade where the client buys five year iTraxx Main and sells ten year iTraxx Main, both series 28, with equal CR01
syntheticIRS	Buy IRS swaption at-the-money (ATM) call and sell ATM put on 10Y IMM IRS USD, both with one year maturity, settling into a cleared swap
BrazilCDS	Five year single name Brazil Sovereign USD single name credit default swap
Linker30	Thirty year GBP zero coupon inflation swap
Brent	One year Brent future (centrally cleared) or forward (uncleared)

* Data was also collected for an FX derivative, a USD/KRW NDF and a cross-currency swap, a 7yr JPY/USD swap, but these were largely excluded from this section due to data quality concerns. Data on equity derivatives was not collected.

The CSAs chosen are intended to be a representative selection of the most common CSA types. Because different types of CSA are often associated with particular types of client, the use of certain CSAs can help to evaluate the incentives of the classes of market participants who use them. For example, some predominantly smaller financial firms are currently only required to exchange variation margin, whereas larger financial firms are also often required to exchange initial margin and variation margin for uncleared derivatives. Hence these two major counterparty types are represented by VM only and VM-and-IM CSAs respectively. Similarly, the no CSA case is relevant for those non-financial corporates that are exempt from requirements to exchange margin.

The survey data was analysed to estimate the 'all-in cost' of different trades. A ratio was calculated which is termed the 'cleared cost advantage'. For a given trade and bilateral CSA, this is defined as:

$$\frac{\text{All-in bilateral cost} - \text{All-in cleared cost}}{\text{All-in cleared cost}}$$

In other words, the cleared cost advantage for a trade is the difference between the average all-in cost for it under the bilateral CSA and the average all-in cost assuming the trade is centrally cleared, expressed as a fraction of the average cleared cost. Further details and discussion of the methodology for the quantitative survey can be found in Box 1 and Annex 6.

Table D.5 Summary of the CSA types surveyed

CSA type (*with short name in brackets*)	**Examples of the types of entity that would trade under this CSA type for new trades**
CSA requiring both parties to post initial and variation margin in cash only in the currency of the trade on a daily basis *(2 way VM & IM – cash*)	Dealers, large clients and others captured by the requirement to exchange initial margin for uncleared derivatives, and who can do so in cash.
CSA requiring both parties to post variation margin in cash only in the currency of the trade on a daily basis, and initial margin in G4 sovereign bonds, agency bonds, investment grade US equities, and/or investment grade US corporate bonds (*2 way VM & IM – cash VM, bond IM*)	Entities who are captured by the requirements to exchange initial margin for uncleared derivatives but who wish to post securities.
CSA requiring both parties to post variation margin in cash only in the currency of the trade on a daily basis (*2 way VM – daily cash*)	Entities whose activity is below the threshold to exchange initial margin for uncleared derivatives, but who are required to exchange variation margin, or entities that voluntarily choose to exchange variation margin.
CSA requiring both parties to post variation margin in cash only in the currency of the trade on a weekly basis (*2 way VM – weekly cash*)	
CSA requiring the dealer to post cash to the client but not vice versa. (*1 way out*)	Entities who are exempt from requirements to exchange initial margin for uncleared derivatives and typically of high credit quality, such as some governments and supra-nationals.
No CSA (*No CSA*)	Entities whose activity is below the threshold to exchange initial margin for uncleared derivatives but who are required to exchange variation margin; or entities that voluntarily choose to exchange variation margin despite not being required to do so.

Box 1 Summary of quantitative survey analytical inputs and outputs

Inputs – survey data

The DAT designed a quantitative survey to analyse the collective impact of capital, margin, and clearing obligations as they apply to various OTC derivatives and counterparty relationships. It sought to collect data to estimate the 'all-in costs' of centrally clearing different trades, assuming normal market size and no market impact, for different CSA types, compared to the costs of bilateral trading. This survey did not collect data on the upfront costs of establishing access to central clearing such as those associated with operational, legal and compliance requirements or for establishing bilateral clearing arrangements. See Part E for a further discussion of these and other related costs.

Survey respondents were asked to provide the following cost inputs:

- The running spread from the mid-market price for each trade and CSA type, i.e. the bid/mid spread.
- Estimated initial margin requirements for each trade type in centrally cleared and uncleared form.

- Lifetime Expected Positive Exposure (EPE) for each trade.
- In addition for some trades, (i) the spread from the most liquid version of the trade for different holding period assumptions and diversification assumptions and (ii) information relating to capital ('KVA'), funding ('DVA/MVA/FVA') and credit ('CVA') valuation adjustments in those spreads.
- The total annual clearing fees that would be charged to the client for different, specified levels and volumes of trading activity, differentiating between (i) whether client margin is held on-balance sheet or not and (ii) whether the client portfolio is diversified and compression is possible.

Spreads for a range of trade types were requested across four asset classes: interest rates, credit, foreign exchange and commodities.

Details of the cost calculations used to carry out this analysis can be found in Annex 6.

Outputs – Cost comparison tables and dispersion using violin charts

The analysis of quantitative survey data is presented in two main ways; cost comparison tables, and cost dispersions using so-called 'violin charts'.

The cost comparison tables present the cleared cost advantage for a given CSA and trade type. For example, the first entry in Table D.6 is 30% for a ten year IRS under a 2 way VM and IM cash CSA. This means that that the average cost of bilaterally trading a ten year IRS under this CSA is 30% greater than the cost of centrally clearing the same trade. Positive percentages indicate situations where central clearing is estimated to be less costly than bilateral trading. This can be interpreted as a cost incentive to centrally clear the trade. These are shaded in the tables. Conversely, negative percentages suggest that there is a cost incentive to trade bilaterally under the specific CSA, and these cases are left unshaded.

The cleared cost advantage reported in the tables is based on average costs. The average of each component of the cost was used. This means that the results reflect the general incentive in the market across all respondents, and not the cost differential using a specific firm's quotes. In particular a positive percentage does not exclude the possibility that a market participant could find a more advantageous all in cost for a specific bilateral trade at some dealer, compared to the average centrally cleared cost.

To examine the dispersion of results, the centrally cleared cost for each respondent was calculated relative to the average cleared cost. Similarly, the bilateral cost for each respondent relative to the average cleared cost was calculated.

The dispersion of costs is presented graphically using violin charts, such as Figure D.7. These figures present curves fitted to the cost distribution separately for cleared costs (left side, in red) and bilateral costs (right side, in blue). Each distribution is centred on the average cleared cost and truncated at the minimum and maximum observed value. The short dashed lines mark the quartiles of the distribution and the long dashes indicate the median.

D4 All-in cost comparison for interest rate swaps

Table D.6 presents the cleared cost advantage for ten and thirty year USD interest rate swaps, both of which are highly liquid OTC derivatives that are subject to central clearing mandates. It is positive, indicating a cost incentive to centrally clear. The higher relative costs of the bilateral trades are mainly due to higher bid/mid spreads and higher initial margin. The difference would be bigger were it not for the fact that cleared trades incur clearing fees. Comparing rows shows that the cost difference relative to central clearing increases with the maturity of the trade.

The estimates in Table D.6, and similar tables below, represent point-in-time estimates of average costs. These costs and their impact on incentives to centrally clear vary by entity and CSA. The dispersion of costs is presented graphically in Figure D.7.

Table D.6 The cleared cost advantage for a typical client trading under the given CSA

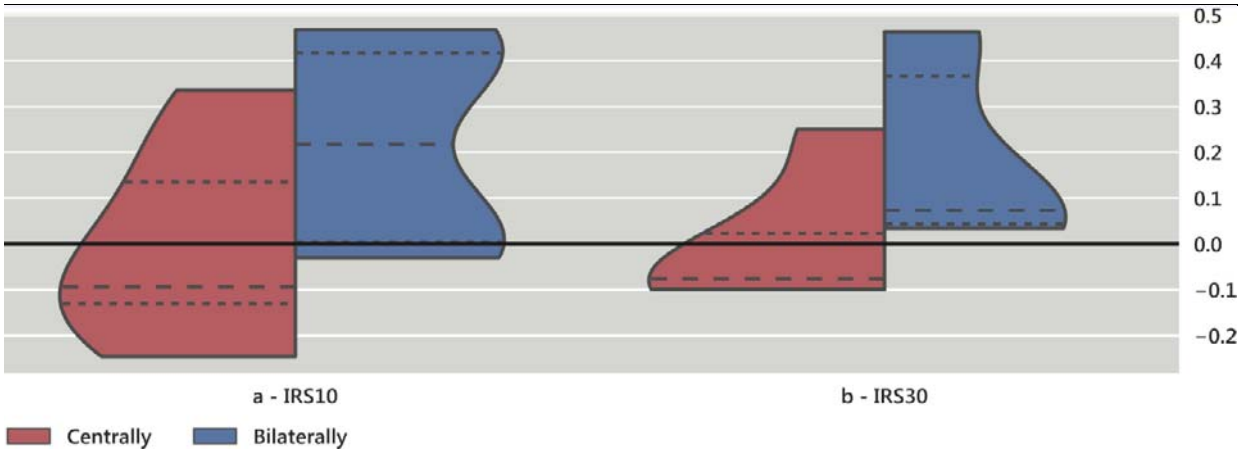
Trade	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM
IRS10	30%	33%
IRS30	49%	51%

Assumptions: Client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and the client is A rated. The minimum number of observations used for any cell in this table is 11.

Source: DAT quantitative survey.

Figure D.7 Distribution of respondent relative costs for trades cleared centrally vs uncleared with initial margin and variation margin

Difference from average cleared costs, in per cent



The distributions are fitted by kernel estimation and truncated at the maximum and minimum of the data. Bilateral trades use a CSA with daily initial margin and variation margin requirements. The dashed line shows the average result and the dotted lines the 25th and 75th percentile result.

Source: DAT quantitative survey.

The distributions of all-in centrally cleared and bilateral costs for the IRS trades are seen to overlap. While centrally cleared trades have a lower average cost, and also a lower minimum and lower maximum, the cost of a cleared transaction quoted by all dealers is not always less than that of a bilateral transaction quoted by any dealer. Naturally, dealers would not be expected to quote identical prices, but some dealers provided lower quotes for the bilateral

trades than the average quote for cleared trades. However, given that the lower quartile for bilateral trades is still above the median for ten year cleared IRS and above the upper quartile for thirty year cleared IRS trades, cleared trades have an advantage in many situations. The overlap between distributions is more pronounced in the ten year IRS compared to the thirty year IRS, suggesting that differences in costs incentives are greater for contracts with longer duration. This makes sense as a difference in initial margin requirements causes a larger difference in costs if it is in effect for longer.

Figure D.7 also provides some further information about the distributions of responses for the two IRS. The cleared cost distributions for both the IRS instruments seem to be skewed upwards. This is due to a number of outliers where costs are higher.

D5 All-in cost comparison for clients who trade less frequently

The analysis so far has assumed that all clients within a CSA type have similar patterns of both trading activity and funding costs. Other DAT work, including the qualitative surveys and industry outreach, suggest that central clearing may be more expensive relative to not centrally clearing for clients that trade less frequently.[33] Analysis from the quantitative surveys is consistent with this view; for low activity clients, defined here as ones that only trade one IRS contract per month, the cost incentives to centrally clear appear to be much less pronounced. The cost advantage of central clearing for a low activity client is small relative to a higher activity client but still present, as shown in Table D.8.

Table D.8 The impact of client activity levels on the cleared cost advantage

Trade, client	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM
IRS10, high activity client	30%	33%
IRS10, middle activity client	30%	33%
IRS10, low activity client	2%	4%
IRS10, low activity & high funding cost client	6%	7%

Assumptions: client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and client is A rated. The minimum number of observations used for any cell in this table is 11. A high activity, middle activity, and low activity client is assumed to clear 100, 50, and 1 trades per month, respectively.

Source: DAT quantitative survey.

These results may be best understood in the context of the structure of clearing fees: clients usually have to pay a minimum annual clearing fee to maintain access to a clearing member. Assuming similar variable costs, the high and middle activity clients would pay a relatively lower 'per trade' fee compared to lower activity clients. In effect, for a firm actively trading in OTC derivatives, the high fixed cost of central clearing can be averaged out over a larger number of trades; but if activity levels are low, then the per trade cost will be higher. The result that lower activity clients are more likely to be bound by fixed minimum clearing fees is

[33] 'Small' clients for the purposes of the quantitative survey are therefore those with small amounts of OTC derivatives activity; the term does not imply that the client has a small balance sheet or a small contribution to the economy.

supported by the qualitative survey which shows that responding clients view fixed costs (which include minimum clearing fees) as the biggest disincentive to centrally clear. See Figure D.3 for more details.

The cost of funding margin payments could also affect the incentives to centrally clear. Although the impact of layering high funding costs on top of low activity were not pronounced in Table D.8, additional survey results for other CSA types suggest that higher funding costs do tend to reduce, but do not eliminate, the incentive to centrally clear: see Annex 4 for more details.

D6 All-in cost comparison for other asset classes

The DAT also analysed the cleared cost advantage for other asset classes. Table D.9 summarises the relative costs of trades in credit and commodity derivatives, specifically Brent crude, five-year iTraxx, and a sovereign CDS on Brazil. As can be seen in Table D.9, central clearing is cheaper on average than bilateral trading where a two-way exchange of initial margin and variation margin is required.

Table D.9 The cleared cost advantage for a typical client in other OTC derivatives

Trade	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM
Brent	38%	24%
iTraxx5	67%	67%
Brazil CDS	67%	67%

Assumptions: client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and client is A rated. The minimum number of observations used for any cell in this table is 5.

Source: DAT quantitative survey.

The Brent results are particularly interesting in that the cleared trade is a future, and minimum margin requirements for futures are subject to a lower margin period of risk (MPOR) than cleared OTC derivatives.[34] This, and the tight bid/mid spread reported for this highly liquid product, increases the advantage of the centrally cleared product. On the other hand, the shorter maturity (one year) decreases the advantage, as the lower funding cost of the centrally cleared trade applies for a shorter period. The net effect still produces, on average, an advantage for central clearing.

The results discussed thus far are for outright trades. In order to examine an example of slightly more complex risk taking, respondents were also asked to price an iTraxx curve steepener.[35] Curve steepeners have a very different risk profile than outright iTraxx transactions. They consist of two trades which hedge each other against the risk of parallel moves in the iTraxx curve. As the name suggests, this trade is only exposed to steepening or flattening movements. Since the first order risk is hedged, the margin for this trade will be lower than for an outright position of the same notional size. This trade provides a lens to examine the effect of

[34] Exchange traded (and therefore cleared) derivatives are sometimes an economic near substitute for uncleared OTC derivatives. As such they are relevant to incentives to clear.

[35] Here the trade was buying a five year iTraxx swap and selling a ten year iTraxx swap.

diversification on relative costs due to its partially self-hedged nature. Table D.10 compares the cleared cost advantage for the curve steepener to the straight five year iTraxx trade (i.e. the middle row in Table D.9). Directionally, the cost incentive appears to be the same, in that centrally clearing is cheaper, but the incentive appears higher for the curve steepener.

The stronger incentive to centrally clear for the curve steepener may stem from more recognition of the risk offset embedded in the trade under CCP margin requirements than under uncleared margin requirements.

Table D.10 The impact of a curve trade on the cleared cost advantage

Trade	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM
iTraxx5	67%	67%
iTraxx5/10	81%	81%

Assumptions: client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and client is A rated. The minimum number of observations used for any cell in this table is 5.

Source: DAT quantitative survey.

The portfolio offsets available in a single netted portfolio whether centrally cleared or bilateral may, in the DAT's view, discourage clients from central clearing some but not all offsetting trades. This is because a portfolio of clearable products which is split into a centrally cleared and a bilateral piece likely has higher total margin requirements than the same portfolio fully cleared.[36] In particular, the strong portfolio effects many CCP margin models offer likely mean that if a client is required to clear some trades at a CCP, they will want to clear everything that is clearable at that CCP. Such a 'tipping effect' would be consistent with feedback from market outreach which suggested that, when clients are required to centrally clear certain trades due to mandates, they are incentivised to also clear other, non-mandated trades too.

In order to explore the impact of cost incentives on clearable but not mandatory OTC derivatives, respondents were asked to price a thirty year inflation swap. Table D.11 explores the cleared cost advantage here.

Table D.11 The cleared cost advantage for a thirty year inflation swap

Trade	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM
Linker30	22%	24%

Assumptions: Client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and the client is A rated. The minimum number of observations used for any cell in this table is 9.

Source: DAT quantitative survey.

Figure D.12 illustrates the distribution of costs relative to the average. The range of the distributions is larger than for IRS and there is a large overlap.

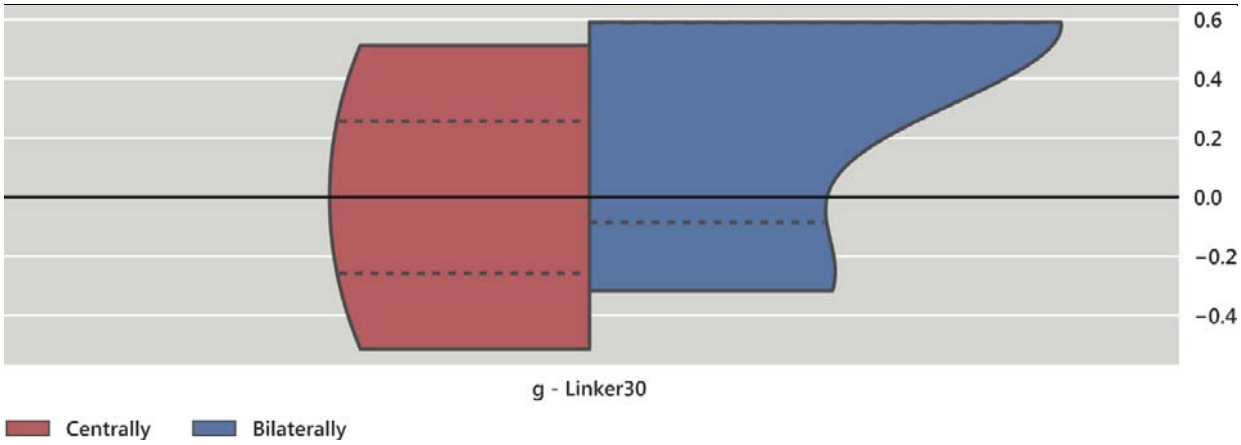
A different pattern is seen for centrally cleared and bilateral cost distributions. The distribution for centrally cleared costs, on the left, is nearly perfectly symmetric. In contrast, the bilateral distribution shows skewness on the upper end of the distribution. The overlap between the two

[36] Depending on its characteristics, the split portfolio may even have higher margin requirements than if none of it were centrally cleared.

reflects costs below the median, as the median bilateral cost is above maximum centrally cleared cost. Part of these effects may be due to smaller response sizes, but the skewness of the bilateral distribution suggests that the incentive to centrally clear inflation swaps may be stronger than the average alone indicates. Observed market behaviour here is consistent with a robust incentive to centrally clear.

Figure D.12 The distribution of respondent relative costs for inflation swaps

Difference from average cleared costs, in per cent



Source: DAT quantitative survey. The dotted lines show the 25th and 75th percentile result.

D7 Cost comparison under bilateral variation margin only

The BCBS-IOSCO standards for margin requirements for uncleared derivatives state that margin requirements "need not apply to non-centrally cleared derivatives to which non-financial entities that are not systemically important are a party".[37] There are two main classes of exemption to the rules: entities which currently do not have to post initial margin, but are required to post variation margin; and those who are exempt from any margin posting requirement. This section deals with entities in the first class, while the subsequent one deals with bilateral trading without initial or two-way variation margin.

An entity covered by the uncleared margin requirements may be required only to post variation margin during the phase-in period of the requirements; or if it is below the threshold for initial margin. In such situations, the initial margin cost for the uncleared trades is zero. As a result, central clearing is incentivised only if the uncleared trades are charged a high enough spread to offset the central clearing costs attributed to initial margin and clearing fees.

Table D.13 shows the relative cost advantage under variation margin only CSAs. Bilateral trading is cheaper under both daily and weekly exchange of variation margin, demonstrating that the spread for these examples is not big enough to outweigh the cost impact of not having to post initial margin. The cost disadvantage is shown by the negative percentages and the lack of shading. Bilateral thirty year IRS are cheaper when variation margin is exchanged daily, and a price taker here is relatively indifferent between bilateral trading and central clearing under CSAs with weekly exchange of variation margin.

[37] See Element 2, paragraph 2(a) of the standard.

The pattern for non-IRS contracts under variation margin only CSAs is mixed. Bilateral transactions are favoured for Brent futures, five year iTraxx CDS, and thirty year inflation swaps when clients only need to provide variation margin. However, the iTraxx curve steepener is similar to the thirty year IRS trade, in that it is cheaper to trade bilaterally for the daily variation margin only CSAs, but the difference is negligible when variation margin is exchanged weekly. Finally, the Brazil sovereign CDS displays the inverse pattern: the client is nearly indifferent between the two models when variation margin is exchanged daily and is incentivised to centrally clear by costs when variation margin is exchanged weekly.

Table D.13 The cleared cost advantage under VM only CSAs

Trade	2 way VM, daily cash	2 way VM, weekly cash
IRS10	-35%	-19%
IRS30	-27%	1%
Brent	-22%	-31%
iTraxx5	-20%	-20%
iTraxx5/10	-17%	-3%
Brazil CDS	-4%	10%
Linker30	-17%	-8%

Assumptions: Client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and the client is A rated. The minimum number of observations used for any cell in this table is 11.

Source: DAT quantitative survey.

As well as reinforcing the importance of initial margin in cost incentives, these results also illustrate an important distinction between the two different variation margin collection frequencies. Weekly collection leaves dealers more exposed to counterparty credit risk, which is reflected in the price quoted. Other results for these CSAs also provide useful information regarding lower activity clients where again there is a disincentive to centrally clear, but somewhat less so for weekly variation margin: see Annex 4 for more details.

D8 Bilateral trades without two-way exchange of margin

Some counterparties are fully exempted from the requirement to exchange initial and variation margin, consistent with the standards for uncleared derivatives. These include sovereigns and supranationals, and firms with low levels of outstanding OTC derivatives. In this situation there is no regulatory constraint on the terms of the CSA. Thus there may be no CSA, or a CSA might have been negotiated which requires one-way posting of variation margin from the dealer to the client. In these cases, the client's costs for bilateral trades are driven by the bid/mid spread paid, while cleared trades are subject to initial margin, variation margin and clearing fees. Central clearing will therefore be incentivised versus bilateral trading only if there is a sufficient difference in the bid/mid spread to offset the counterparty credit risk costs. In contrast to the last subsection, central clearing is usually incentivised. This suggests that margin requirements have a strong impact on counterparty credit risk and hence on dealer spreads.

Table D.14 shows that IRS trades are less costly if centrally cleared under these CSAs. The result implies that the spreads charged for the bilateral trades are very high. The table also shows that the incentive to centrally clear is stronger for thirty year IRS trades. This higher cost for the longer-dated position is consistent with bilateral costs being spread driven and therefore highly duration sensitive.

Table D.14 The cleared cost advantage for 1 way out and No CSA trades

Trade	1 way out	No CSA
IRS10	32%	40%
IRS30	90%	92%
Brent	-40%	-7%
iTraxx5	-46%	276%
iTraxx5/10	37%	172%
Brazil CDS	1%	261%
Linker30	66%	71%

Assumptions: Client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and the client is A rated. The minimum number of observations used for any cell in this table is 11.

Source: DAT quantitative survey.

Brent forwards under no or 1 way out CSAs appear to not be charged as proportionally wide a spread, so bilateral forwards are cheaper than centrally cleared futures. CDS contracts without a CSA attract a substantial spread premium and are prohibitively more expensive than centrally cleared trades. But trades under 1 way out CSAs are priced such that the iTraxx outright trade is cheaper bilaterally, and the cost is balanced for the Brazilian single name CDS trade. For the iTraxx steepener, central clearing is less costly than bilateral trading for both types of CSA, albeit more strongly without a CSA. Finally, the inflation swap behaves similarly to the thirty year IRS, with the incentive to centrally clear strengthened in line with the expected impact for longer duration positions.

D9 Discussion of cost advantages due to differences in initial margin requirements

Analysis of the quantitative data gathered by the DAT confirms and clarifies the important role margin plays in incentivising central clearing. Generally, the quantitative survey analysis suggests that all-in costs support central clearing, at least when compared to bilateral trades where initial margin is collected. However, the support does not appear to be so strong that it potentially could not be offset by other factors. The data also showed substantial variation in the pricing patterns for trades not subject to either central clearing or the bilateral requirements to post initial margin. Because smaller or less active clients are more likely to trade under such CSAs, these results suggest that, from a cost perspective, such clients will choose not to centrally clear if possible. This does not imply that such clients should necessarily be subject to initial margin requirements for uncleared trades, as the balance between the cost of such requirements and the systemic risk reduction benefits must be considered.

Taken together, the results above suggest that the minimum standards for margin requirements for uncleared derivatives, and specifically for the exchange of initial margin, support central clearing. This result is consistent with the expectation in the previous (2014) DAT study that the application of a substantially higher MPOR in the minimum standards for margin requirements for uncleared OTC derivatives compared to those in the cleared case would be determinative. However, the cost incentive implied by the quantitative survey analysis is not as strong or universal as might have been anticipated by the difference in MPOR. This would suggest a c.40% margin cost advantage for client cleared OTC trades.

This observation is consistent with recently published research[38] directly comparing centrally cleared and uncleared margin models to better understand the differences in practice. Using current cleared IRS portfolios, the analysis compares uncleared margin calculated using a standard bilateral margin methodology, the ISDA SIMM, to the margin charged by large CCPs. The paper provides two margin comparisons. First it compares the baseline market risk component of CCP margin (i.e. the value-at-risk or expected shortfall on the portfolio) with the SIMM margin for bilateral positions. It then includes the add-ons (such as those for liquidity and concentration risks) required by CCPs to provide a comparison of total centrally cleared and bilateral margin requirements. Though the MPOR is longer in the case of bilateral trades, the ten-day SIMM market risk measure does not necessarily exceed the five-day CCP measure, with portfolio composition playing an important role in the relative size of the margin requirements.

This insight helps to illustrate that different margin model design choices and differences in safety standards can sometimes offset a two-fold difference in MPOR. For example, the SIMM uses a parametric approach, while CCPs often use some form of historical simulation model for calculating margin. Moreover the SIMM uses a 99% confidence interval for margin, against at least a 99.5% level for CCPs, and in practice a higher standard at some large CCPs. Finally, the SIMM is designed to have a baseline margin which is rather stable, while some CCPs' margin models have anti-procyclicality tools incorporated in them.[39] Thus there can be an incentive in the regulatory minimum standards for centrally cleared versus uncleared margin without that incentive necessarily carrying over in all cases to the margin required for a given portfolio at a particular CCP compared to that required by a particular bilateral counterparty.

Table D.15 summarises the findings of the research. It presents summary statistics of the ratio of bilateral to baseline CCP margin and bilateral margin to 'all risks' CCP margin for actual client portfolios. A ratio above one implies higher initial margin for bilateral compared to the centrally cleared portfolio. The statistics suggest that bilateral margin requirements on average exceed those the same portfolio would generate if centrally cleared. However, there is a dispersion in the ratio and this is larger when comparing bilateral margin to CCP 'all risks'

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[38] M. Roberson, *Cleared and Uncleared Margin Comparison for Interest Rate Swaps*, April 2018 (www.cftc.gov/sites/default/files/idc/groups/public/%40economicanalysis/documents/file/dcr_cleared_uncleared_margin.pdf). Also see A. Capponi, W. Cheng, R. Haynes, *The collateral rule: an empirical analysis of the CDS market*, November 2017 (www.cftc.gov/sites/default/files/idc/groups/public/@economicanalysis/documents/file/oce_collateral_rule.pdf).

[39] The goal of the two approaches is similar, but the dynamics of the resulting margin levels are often different.

client margin. In particular, when margin add-ons are included in the ratio, bilateral margin can be as low as 54% of the 'all risks' cleared margin for the same portfolio.[40]

Table D.15 Summary statistics of the ratio between bilateral and centrally cleared margin for a range of portfolios.

Statistic	Ratio of bilateral margin to CCP margin for market risk	Ratio of bilateral margin to CCP charge for all risks
Minimum	0.96	0.54
25th percentile	1.34	0.92
Average	1.58	1.16
75th percentile	1.74	1.37
Maximum	2.88	2.11

Source: CFTC.

Figure D.16 illustrates the survey results here. It compares centrally cleared initial margin on the horizontal axis with uncleared initial margin amounts on the vertical axis. The type of trade is represented by different colours, with points representing individual survey responses. If a point lies above the dashed line, bilateral initial margin is greater than that for the centrally cleared product. Cases where points are below this dashed line represent responses where centrally cleared initial margin exceeds bilateral initial margin. The results support the general assumption that, especially for simple portfolios, initial margin requirements should incentivise central clearing. (The data quality for NDFs was lower than for other transaction types, so these points should be treated with greater caution.)

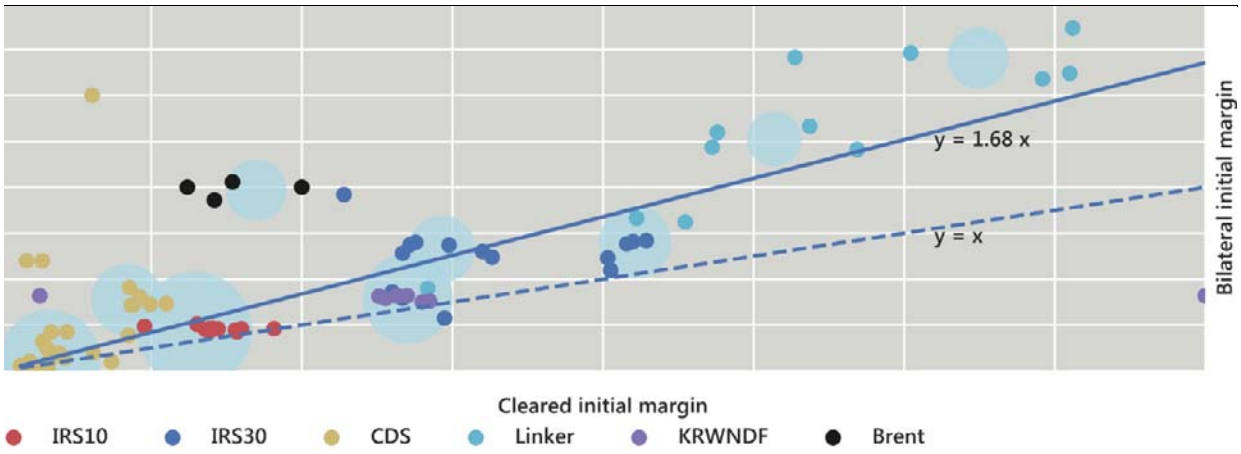
Several additional pieces of analysis have been included in the chart.[41] As noted above, given the MPOR, the expected ratio of bilateral to cleared margin should be around 1.4. The regression across all included survey responses has a slope of 1.68, slightly higher than this estimate. One reason for this higher value is the set of inflation swaps in the upper right of the chart, almost all of which fall above the regression line. It is useful to note the location of other clusters and their composition. There are four clusters that seem to generally contain points lying between the dashed 45 degree line and the higher solid regression line. Moving from left to right, the first cluster consists of CDS trades, some of which are below the regression fit. The second cluster contains almost exclusively ten year IRS and lies below the regression line. The third cluster contains a mix of thirty year IRS, NDFs, and one Linker observation; its points all lie below the regression line. Finally, the fourth cluster consists mainly of thirty year IRS with a couple of Linker observations, all of which are below the regression line. For these four clusters, the ratio of reported initial margin levels seems likely to fall below the square-root-of-time rule of thumb.

[40] The fact that CCPs often have these additional components of margin for factors such as concentration risk and wrong way risk, while these are not necessarily required by the minimum standards for uncleared margin, does suggest the question whether there is a disincentive to clear for portfolios where these additional components are large compared to the baseline market risk component of margin.

[41] Trades were also identified by region of the respondent, but regional location did not sort into clusters, indicating that trade-type is important in determining initial margin, but geographical region is not, at least for the global derivatives' dealers surveyed by the DAT.

Figure D.16 The relationship between centrally cleared and uncleared initial margin

For different trade types, in US dollars



Source: DAT quantitative survey.

IRS is the largest class of OTC derivatives; therefore, it is important to note that all of the ten year IRS initial margin observations and many of the thirty year IRS observations belong to clusters where the ratio of uncleared to centrally cleared initial margin is relatively high.

D10 Discussion of cost advantages observed in trade repository data

The DAT used regulatory data to try to confirm the finding that there is a cost advantage for some centrally cleared products. The first step was to construct a proxy for the bid/offer spread using reported transactions. The spread between the average swap rate received and the swap rate paid for closely time-stamped transactions was used. Care is required with this measure,[42] and it only accounts for the direct trading cost, not collateral or clearing costs. Nevertheless it provides an alternative perspective to the survey data and provides support to the cleared cost advantages seen there.

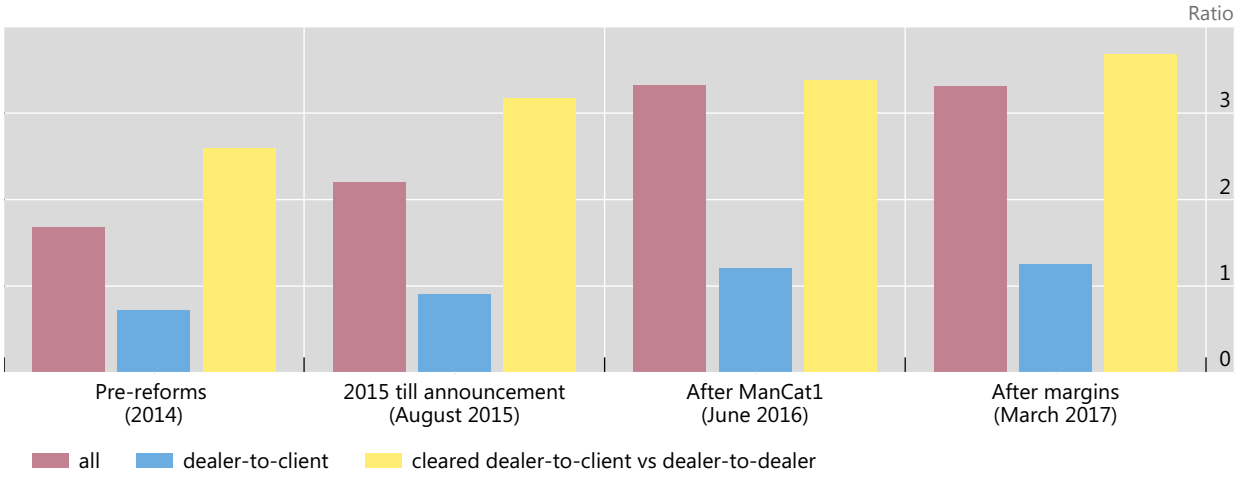
Figure D.17 illustrates the inferred spread proxy using data on euro denominated interest rate swaps from five to fifteen years maturity traded via German dealers. The Figure shows the ratio of the bilateral to the cleared spread (as proxied in both cases). The ratio is presented for all transactions (in red) and separately for dealer-to-client trades (in blue). A ratio above one suggests a cost advantage of central clearing in terms of transaction cost, while a ratio below one suggests a cost advantage for uncleared trades. It can be seen that for dealer-to-client trades there is a cost advantage, but it is smaller compared to that for the full sample. The third bar (in yellow) supports this view and shows that the ratio for dealer-to-client cleared trades over dealer-to-dealer trades. As the bilateral-to-cleared ratio is well above one, this suggests that trading costs are lower for by dealer-to-dealer trades compared to dealer-to-client transactions, and that it is increasing as the reforms progress.

[42] The issues involved include the difficulty with obtaining near-simultaneous transactions, package trades where the observed transaction is one component, and the fact that trade prices may include counterparty or credit-support specific factors which are not necessarily recorded in regulatory data. The empirical spread proxy derived from transactions between different counterparties at different points in time will be larger than a market bid-offer spread at a single point in time.

This data, which only accounts for a highly standardised and liquid type of derivative instrument, is useful in that it covers an extended time period which encompasses reform implementation dates. It suggests that the inferred spread of centrally cleared transactions improved compared to that for bilateral trades after reform implementation.

Figure D.17 The spread ratio by regulatory period and trade type in certain EUR IRS before and after the implementation of various reforms

Fixed-for-EURIBOR6M trades involving a German dealer or clearing bank, 5y-15y maturities



'Announcement' = announcement of mandatory clearing obligation in Europe. 'After ManCat1' = implementation of mandatory clearing for 'Category 1' firms in Europe as defined under EMIR. 'After margins' = implementation of margin requirements for uncleared derivatives. The figure shows euro-denominated IRS transactions involving at least one German clearing member reporting to DTCC GTR Europe and registered at a CCP that was either authorised or registered with ESMA for central clearing of G4 currency interest rate swaps. Transaction costs are estimated as the spread between fixed leg received and paid for uncleared transactions.

Source: Deutsche Bundesbank, DTCC GTR Europe.

D11 The impact of the clearing mandate

The analysis in the quantitative survey above assumes that firms had a choice about whether or not to clear centrally. In this section and subsequent ones in this Part, the impact of the mandatory clearing requirements which affect that premise is discussed.

There is little doubt that, overall, clearing mandates have been a driving factor contributing to the increases in central clearing levels observed post-crisis. The responses to the DAT qualitative surveys reported in Table D.18 reinforce this view. When survey respondents were asked to rank the factors behind changes in cleared OTC derivatives volumes, the clearing mandate was selected as most important by CCPs, dealers, client clearing service providers and clients alike.

Table D.18 The top three drivers for volume change in cleared OTC derivatives between 2012 and 2017

	No. 1 Driver	No. 2 Driver	No. 3 Driver
CCPs	Clearing mandate	Product availability	Capital requirements
Dealers	Clearing mandate	Market liquidity	Capital requirements

CCSP*	Clearing mandate	Margin requirements	Clients consideration
Clients	Clearing mandate	Market liquidity	Product availability

Client survey question 10b (44 responses), dealer survey question 7 (38 responses), CCSP survey question 9 (18 responses) and CCP survey question 8 (15 responses). Clients and dealers selected options from a pre-defined list so no manual categorisation was required. Responses from CCSPs and CCPs were free text so expert judgement was required to categorise these responses.

* Due to data quality it was not possible to apply the weighted methodology for the ranking to CCSPs and instead the number of times an option was listed first was used.

Source: DAT qualitative survey.

The specific effects of clearing mandates are likely to vary by region and sometimes jurisdiction. They may reflect different jurisdictions' varying implementation of the clearing mandate, different levels of market standardisation and liquidity, and regulatory or infrastructure challenges in clearing transactions.[43]

Responses to the DAT survey indicate that the combination of the clearing mandate and market liquidity dynamics is an important consideration for market participants in choosing whether to conduct risk transfer in centrally cleared or uncleared markets. Quantitative survey responses support the view that in many cases the most liquid version of standard OTC derivatives is in many cases centrally cleared. Table D.19 reports the results here.

The table shows that, excluding the synthetic IRS trade, a cleared trade is often considered the most liquid form of each of the derivatives considered in the survey. This is most pronounced in IRS and credit derivatives, which are the classes most subject to clearing mandates, but it is also evident in other asset classes.

Qualitative survey responses on the impact of the clearing mandate on market liquidity were mixed. Many respondents believed that the G20 reforms have had no impact on trading liquidity, with a generally smaller proportion reporting that trading liquidity has decreased. See Figure F.1 for more details.

However, consistent with the migration of liquidity to central clearing discussed above, comments received from some dealers and clients suggested that there has been a bifurcation in liquidity, with an improvement reported for products subject to the clearing mandate but a deterioration in some uncleared products. Literature reviewed by the DAT, such as Loon and Zhong (2014) and Du et al (2016) in the context of CDS markets, also suggests that the bid-offer spread in cleared markets tends to be tighter than in the uncleared markets. The impact, however, may also in part be driven by trading reforms.

Table D.19 – The percentage of dealers reporting a given form of a derivative as the most liquid

Derivative	Cleared	Bilateral	Both	No. of respondents who trade this
IRS10	100%	0%	0%	19
IRS30	100%	0%	0%	19

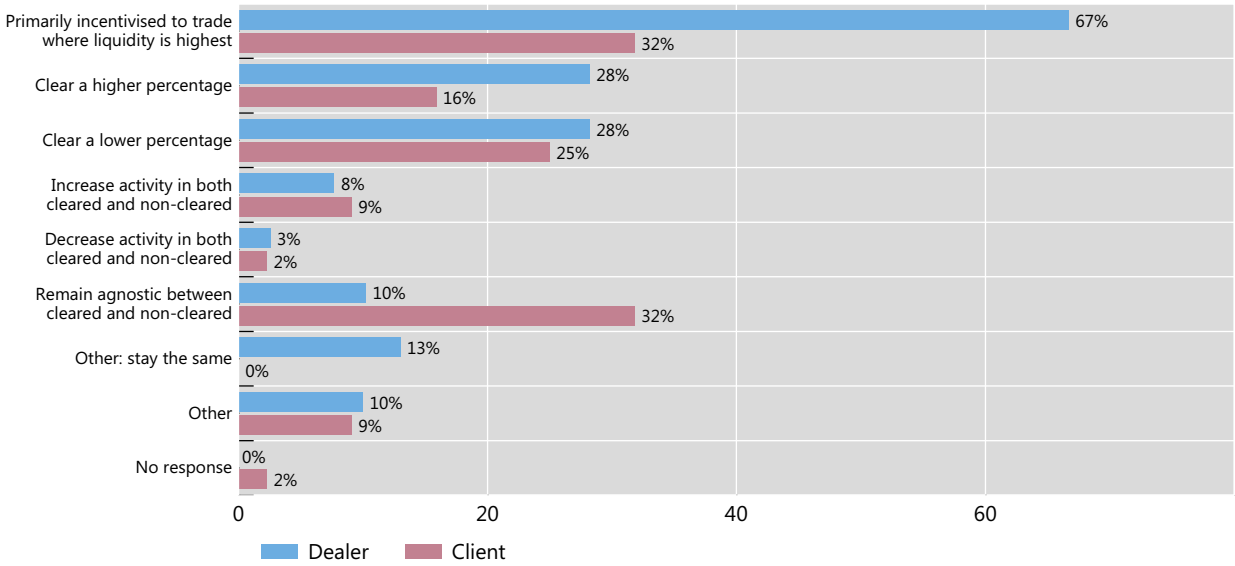
[43] The number of qualitative survey responses meant that the DAT could not, with confidence, analyse responses on a regional level to investigate these effects further.

iTraxx5	88%	6%	6%	17
iTraxx5/10	82%	12%	6%	17
syntheticIRS	7%	93%	0%	14
BrazilCDS	73%	27%	0%	15
Linker30	63%	38%	0%	16
Brent	75%	25%	0%	12

Source: DAT quantitative survey.

In the qualitative survey, dealers and clients were asked about their likely stance on clearing if there was no clearing mandate, but all the other G20 reforms had been fully implemented. 67% of responding dealers and 32% of responding clients said that in this scenario they would be primarily incentivised to trade wherever liquidity was highest, as Figure D.20 reports.

Figure D.20 Views on the impact on clearing if no clearing mandate were in place but all other G20 reforms were fully implemented



Dealer survey question 16b (39 responses) and client survey question 54 (44 responses). The response was free text so expert judgement was required to categorise the responses.

Source: DAT qualitative survey.

There was a range of positions on clearing rates in this counterfactual. A significant minority of respondents indicated that they expected that clearing levels would fall if clearing mandates were removed, with 28% of dealers and 25% of clients indicating they would likely centrally clear a lower proportion of their OTC derivatives transactions in this case. In contrast, 28% of dealers and 16% of clients indicated they would centrally clear a higher percentage of trades without a mandate.[44] One large asset manager respondent to the client survey stated that in the absence of a clearing mandate, the firm's clearing rate would likely be lower but, explaining

[44] In the DAT's view, one possible explanation as to why some dealers and clients said they would clear a higher percentage of trades in the absence of a mandate is that the question told respondents to assume that all other G20 reforms were fully implemented. This includes assuming that margin requirements for uncleared derivatives are fully implemented, which respondents may have considered would push additional volumes of OTC derivatives into central clearing.

further, the firm noted that such mandatory clearing 'forces' a critical mass of participants to transact in a common liquidity pool enabling the firm to transact with a larger number of counterparties than before. For this firm, the liquidity gains of clearing far outweigh the fixed and variable costs associated with it. This is consistent with dealer responses reported above of liquidity migrating towards centrally cleared derivatives.

D12 Views on voluntary clearing from survey respondents

A number of clients reported in the qualitative survey that once a sub-set of firms start clearing a product, either voluntarily or to comply with regulations, liquidity is bifurcated into centrally cleared and uncleared pools. This is consistent with the observations in Section D5 above. Larger firms generally prefer the superior execution and lower transaction costs in the centrally cleared pool. Smaller firms state that while transaction costs (such as bid-offer spreads) might be higher in the uncleared, less liquid market, the higher costs are offset by cost savings elsewhere. They can, for example, avoid clearing fees by clearing bilaterally. Overall, larger or higher volume clients were more likely to cite the benefits of central clearing in the absence of a clearing mandate, whereas smaller clients were more likely to report a preference for transacting in the uncleared markets.

Whilst 43% of the 44 client survey respondents state that they voluntarily centrally clear non-mandated OTC derivatives products, the percentage of their portfolio which is voluntarily centrally cleared is lower: 80% of respondents who undertake voluntary clearing did so for less than 20% of their activity as measured by OTC derivatives gross notional outstanding.

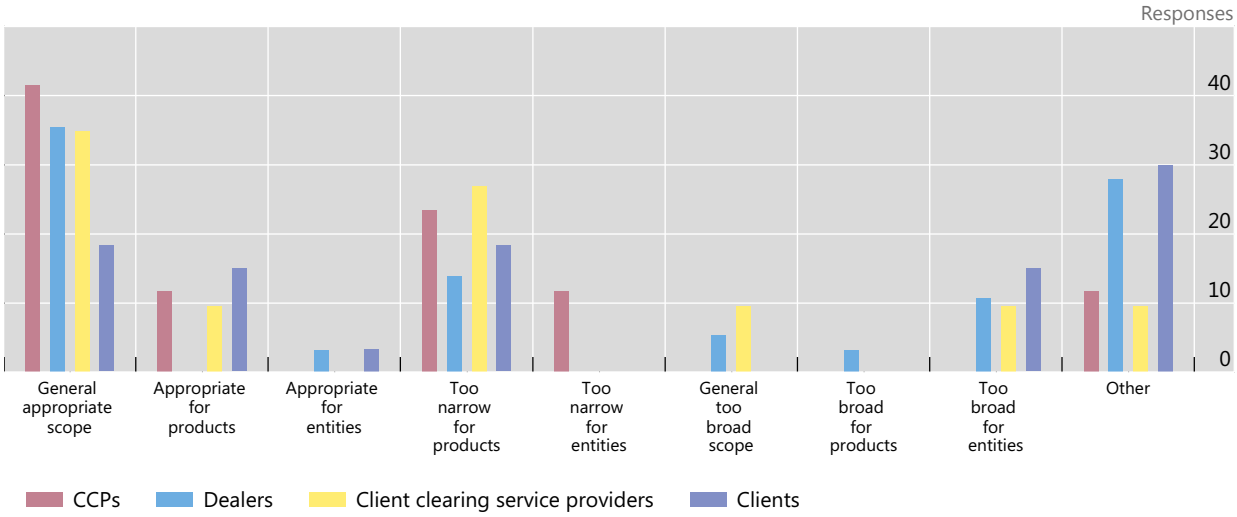
D13 The scope of the clearing mandate

The scope of entities captured by the clearing mandates varies across jurisdictions, but generally covers large financial institutions. Medium sized and smaller financial institutions are also included in the mandate in many jurisdictions. In some jurisdictions the mandate for these firms is still in the process of being phased-in. Some market participants (such as small non-financial counterparties and pension funds) benefit from exemptions in certain jurisdictions. The qualitative survey questions sought views on the scope of the clearing mandate from the perspective of whether it has reduced systemic risk, both in terms of products and entities covered. The most frequently received response across all four surveys was that the scope of the mandate was generally appropriate, as Figure D.21 reports.

Where respondents said that the scope of the mandate should be adjusted, their responses were varied, with some participants (across all respondent types) favouring a wider and some a narrower scope. Some respondents said that the scope of the mandate covered firms that are too small to represent a systemic risk, while others mentioned FX and single name CDS derivatives as products which in their opinion should be included within the scope of the mandate.

The market capacity available for client clearing, and the access issues discussed in Part E, are also relevant factors when considering the scope of clearing mandates.

Figure D.21 Views on scope of the clearing mandate



CCP survey question 22 (16 responses), dealer survey question 16a (36 responses), CCSP survey question 36 (13 responses) and client survey question 53 (27 responses). The response was free text so expert judgement was required to categorise the responses.

Source: DAT qualitative survey.

D14 Avoiding the clearing mandate

When jurisdictions' regulations were being implemented, there was some concern that firms might choose to engineer their traded contract structures to avoid complying with mandatory clearing requirements. One potential method market participants could use to avoid clearing mandates is to replicate trades subject to the clearing mandate using trades which are not subject to it.

The quantitative survey considered the potential for such regulatory arbitrage by comparing the cleared cost advantage for a synthetic IRS constructed using swaptions with its vanilla counterpart. The results reported in Table D.22 suggest there is little cost advantage to be gained by engaging in this example of potential regulatory arbitrage.

There are other economic reasons that evasion does not appear widespread too, apart from the obvious impact of potential enforcement actions. Regulatory data indicates that dealers are on one side of a substantially large fraction of the transactions in IRS and CDS, the two main asset classes subject to mandatory clearing.[45] Using non-mandated contracts would reduce the netting and compression opportunities that dealers use to reduce the notional size of their portfolios. Moreover, given their non-standard nature, non-mandated contracts are likely to be less liquid and have wider bid-offer spreads: and, as noted above, contract liquidity is a key driver of trading decisions in many cases. For some of the largest firms, both banks and non-banks subject to mandatory clearing, having incurred the fixed costs of clearing, splitting a portfolio within a specific asset class between standardised cleared and non-standard uncleared

[45] See CFTC, *Swap Dealer De Minimis Exception Preliminary Report*, available at www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfreport_sddeminis_1115.pdf.

instruments would likely not be cost-effective, and instead expose the firm to higher operational and counterparty credit risks.

Table D.22 The cleared cost advantage for synthetic vs. 'vanilla' ten year IRS

	2 way VM, daily cash	2 way VM, weekly cash	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM	1 way out	No CSA
Synthetic IRS	-35%	-19%	30%	33%	32%	40%
IRS10	-33%	-32%	14%	14%	-7%	20%

Assumptions: client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, client is A rated. The minimum number of observations used for any cell in this table is 8.

Source: DAT quantitative survey.

Part E Access to central clearing

A market participant can access a CCP by becoming either a clearing member, or a client of a clearing member.

The majority of OTC derivatives market participants by number are not clearing members of CCPs, either because they do not meet CCP membership requirements (e.g. due to size or risk profile), or because they are not able to become clearing members due to their own governance constraints (for instance due to prohibitions on participating in the risk mutualisation aspect of CCPs), or because they decide not to become members, perhaps due to the costs of membership. Instead, they access clearing through client clearing service providers (which are typically bank-affiliated entities) as clients. FSB recommendations on the implementation of the clearing obligation[46] emphasise that fair and non-discriminatory access to CCPs, based on objective criteria, is a necessary precondition for market participants to be able to satisfy mandatory clearing requirements.[47]

This Part considers data on aspects of client clearing and the light this sheds on the incentives for central clearing. Specifically, given the critical role played by client clearing service providers in the central clearing process, the DAT has examined issues related to the ability of clients to obtain and maintain access to clearing services, the costs of such services, factors affecting the business models of client clearing service providers, the industrial organisation of this sector, and the collective impact all of this has on the incentives of different types of clients to centrally clear.

The DAT is aware of little publicly available literature, whether from academic or policy sources, on the issue of access to clearing services.[48] Detailed information on the fees charged by clearing members is typically confidential,[49] and even where it is available, it is not necessarily collected by authorities. Accordingly, conducting targeted impact analysis on certain types of clients, especially smaller clients where fees and the fixed costs of accessing clearing services are often proportionally more important, can be challenging. Therefore what follows is reliant on the qualitative survey and feedback from market outreach.

The qualitative surveys included multiple questions on a range of issues related to access to clearing. The observations presented in this section are based on responses to a subset of these questions. Some other questions had low response rates, especially those seeking information on fees, and hence have not been included in the DAT's analysis. In addition to the responses to various multiple choice questions in the survey, the analysis below is informed by the free-text answers. As previously noted, survey responses may be affected by sample size and bias,

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46 FSB, *Implementing OTC Derivatives Market Reforms,* October 2010 (www.fsb.org/2010/10/fsb-report-on-implementing-otc-derivatives-market-reforms/).

47 The CPMI and IOSCO PFMI reiterated the importance of fair and open access to FMIs, CCPs included, stating that they "should have objective, risk-based, and publicly disclosed criteria for participation" (Principle 18) and "endeavour to set requirements that have the least-restrictive impact on access that circumstances permit" (Key Consideration 2). Fair and open access to clearing services encourages competition, promotes efficient and low-cost clearing and can also reduce the concentrations of risk that may result from highly tiered arrangements for clearing.

48 One study which touches on this area is CGFS, *The macrofinancial implications of alternative configurations for access to central counterparties in OTC derivatives markets,* November 2011 (www.bis.org/publ/cgfs46.htm).

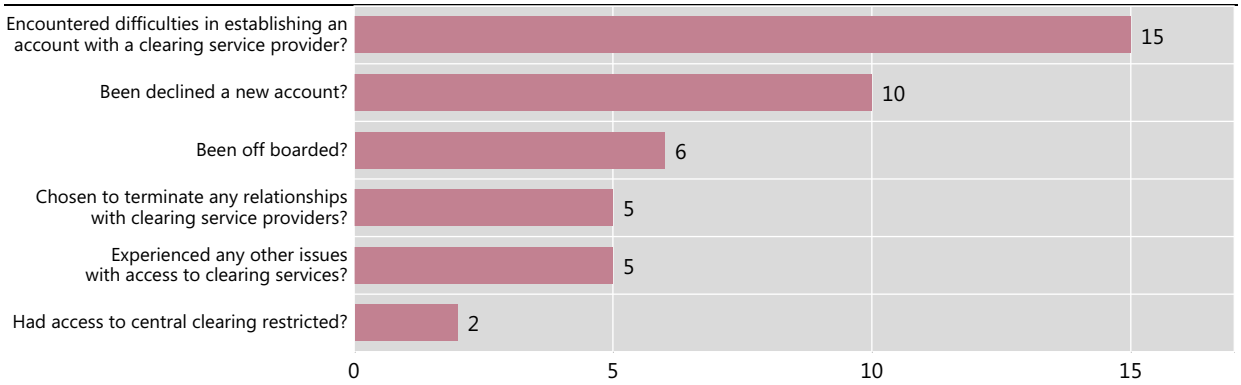
49 Data on clearing fees was collected as part of the quantitative survey with a commitment that any analysis of fees would only be disclosed when aggregated with other data from the survey to estimate an all in cost of clearing.

and the analysis may be affected by subjectivity when the DAT exercised its expert judgement in drawing inferences. Nevertheless, the survey responses are illustrative of the issues that have been raised by market participants more broadly.

E1 Access to clearing services and restrictions on activity

Survey responses reveal that a large fraction of responding clients consider they face challenges obtaining and maintaining access to clearing services. Over two-thirds (68%) of the 44 clients who responded reported that they have encountered one of the difficulties listed in Figure E.1. The most common access issues faced by clients as stated in their responses were difficulties in establishing an account with a client clearing service provider, being declined a new account by an existing provider, or being off-boarded.

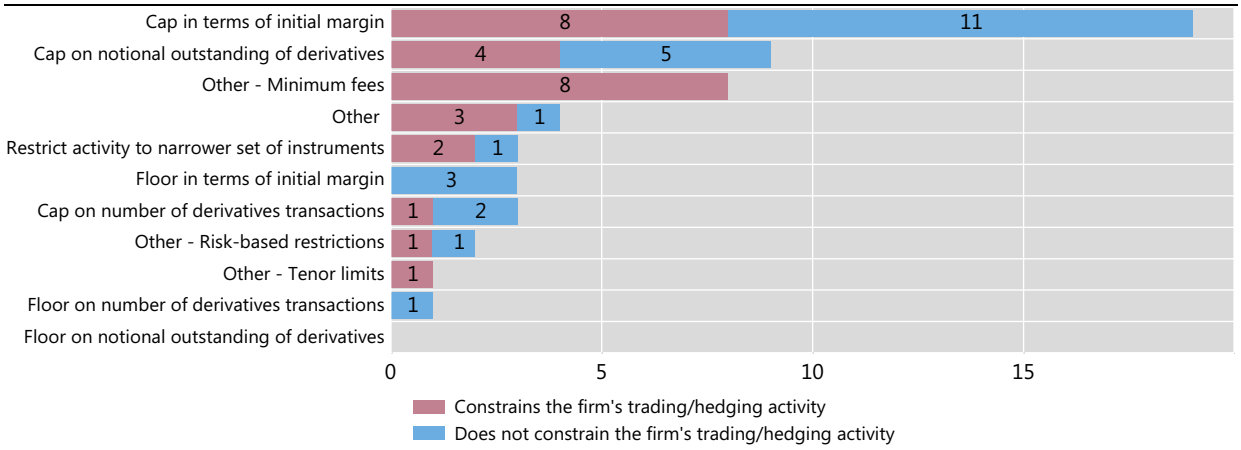
Figure E.1 Views on client access related issues



Client survey question 33 (30 out of 44 responses identified access issues). Respondents selected an option from a pre-defined list so no manual categorisation was required. It is not known whether the other 14 client survey respondents did not experience issues; or experienced issues which were not included in the predefined list.

Source: DAT qualitative survey.

Figure E.2 The impact of restrictions on clients trading/hedging activity



Client survey question 27 (31 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required.

Source: DAT qualitative survey.

At the same time, among those clients that continue to have clearing arrangements, 70% (31 respondents) reported having restrictions placed on their cleared OTC derivatives activity. Such restrictions can constrain clients' ability to conduct trading and/or hedging. The most common

restrictions typically cited were minimum clearing fees, caps on initial margin, and caps on notional outstanding: see Figure E.2.

In responses to the client clearing service provider survey, 94% (17 out of 18 responses) stated they had imposed some sort of restriction on client activity. Equally, a similar proportion indicated they had on-boarded clients since 2015.[50]

While minimum clearing fees are not a direct constraint on clients' ability to access central clearing, they likely increase the per trade cost, particularly for clients who trade infrequently. Caps on initial margin are designed to limit the amount of risk or balance sheet exposure of centrally cleared OTC derivatives that a client could transact through a single client clearing service provider (with initial margin serving as a proxy). Caps on notional outstanding are similar, although by directly targeting notional rather than initial margin, they could potentially be a more restrictive tool for certain clients.[51] Both forms of cap could potentially impact clients' clearing behaviour.

Service providers reported in survey responses that low turnover clients (39%) and clients with directional portfolios (39%) would be most affected by restrictions on their clearing activity.[52] In their responses on the main reasons for off-boarding clients, they also suggest that small clients may have a higher chance of being off-boarded as they are most likely to have an insufficient transaction flow to cover the cost of providing clearing services. Market outreach revealed that clearing service providers actively manage their client relationships with a view to optimising their risk-return targets. This could cause them to place additional restrictions on certain clients, and/or to reassess their existing client relationships.

Activity restrictions are not the only form of access issue. Clients are sometimes off-boarded by their clearing service providers. The survey also provides some insight into the reasons service providers give for this. 'Constraints by one or more of the measures introduced under the Basel III capital framework' had the highest weighted ranking, ahead of 'insufficient transaction flow to cover costs' and 'insufficient transaction flow to exceed target return on capital', as Figure E.3 reports.

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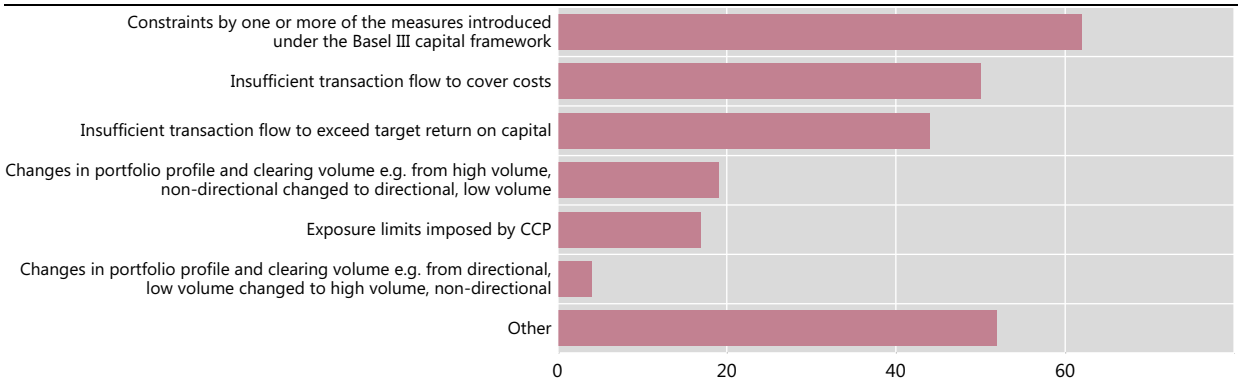
50 CCSP survey question 23 (17 responses) and question 19a (18 responses).

51 For example, Part D examined the total cost of transacting a particular credit derivatives trade, a curve steepener; this belongs to a generic class known as spread trades. As spread trades typically depend on the difference between two quantities rather than an absolute level, they are often less risky than an outright trade of the same size, and the initial margin requirement will likely be lower. Holding everything else constant, a cap on notional outstanding instead of on initial margin will disproportionately affect such trades.

52 Source: DAT qualitative survey. CCSP survey question 26 (17 responses). The response was free text, so judgement was required to categorise the responses.

Figure E.3 Weighted ranking of client clearing service provider reasons for off-boarding clients



CCSP survey question 25a (14 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required. Weighted indicator ranking methodology used, so the scale does not represent number of responses.

Source: DAT qualitative survey.

E2 Clearing fees

Quantitative survey analysis supports the view that clearing fees can have a significant impact on the relative incentives to centrally clear. For small clients especially, minimum clearing fees can be binding and can be a significant factor in the relative cost of clearing: see Section D5 for a further discussion of this.

Minimum fees are designed to cover the fixed and upfront costs associated with offering clearing services to clients. These include the cost of client on-boarding and ongoing costs such as those associated with know your client requirements ('KYC'), due diligence and legal requirements, as well as infrastructure and operational costs. Minimum fees typically increase per trade costs for those who are affected by them: these are predominantly clients with lower levels of OTC derivatives activity.

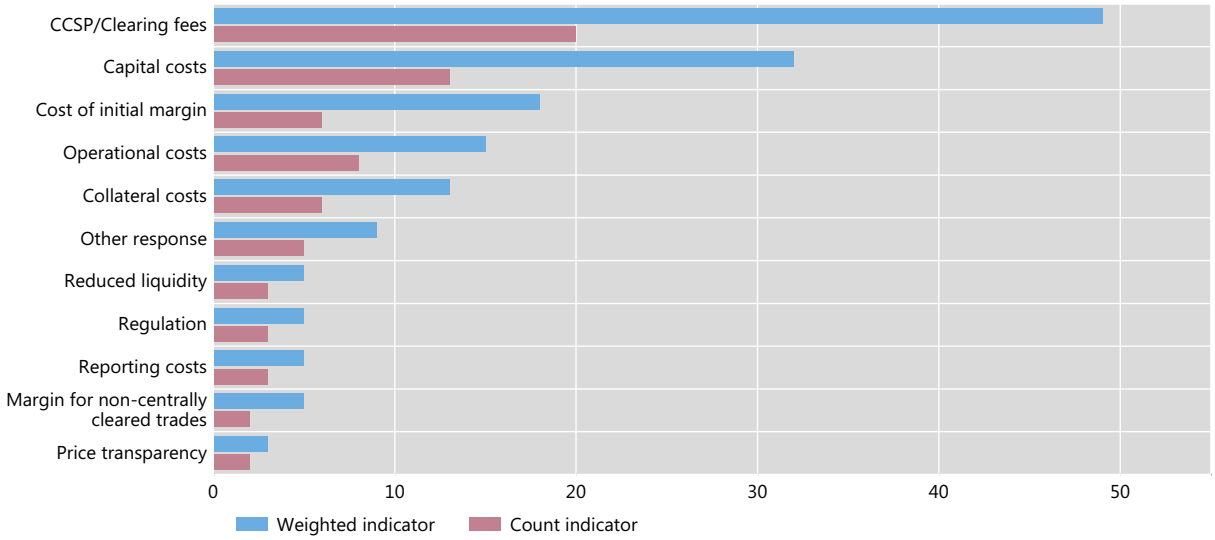
Almost half[53] of clients in the qualitative survey reported an increase in the total cost of transacting cleared OTC derivatives since 2012, leaving aside the impact of volume changes. No respondent reported a decrease. Clients ranked clearing fees as the most important factor behind their change in total cost of transacting cleared OTC derivatives: see Figure E.4. Fixed costs were ranked by clients as the single most important factor disincentivising clearing: see Figure D.3.

44% of client clearing service providers reported that they have adjusted their pricing for OTC derivatives client clearing services since mandatory clearing went into effect in their jurisdiction.[54] Of those who said that they had adjusted fees, all but one reported that the reason for their change in fees was regulatory capital costs.

[53] Source DAT qualitative survey client question 25 (44 responses, of whom 21 reported an increase).

[54] Source: DAT qualitative survey CCSP question 29a (8/18 respondents said they had adjusted prices). Respondents selected an option from a pre-defined list so no manual categorisation was required.

Figure E.4 Weighted rank of most important factors behind clients' change in total cost of transacting cleared OTC derivatives



Client survey question 46 (33 responses). The response was free text so expert judgement was required to categorise the responses. The ranking was based on the weighted and count methodologies, so the scale represents number of responses for count only.

Source: DAT qualitative survey.

E3 The changing business model of client clearing

Survey responses and market outreach suggest that the business of client clearing is in transformation. The economics of OTC derivatives clearing is different from that of exchange traded derivatives, especially that of futures, with key differentiating factors including significantly longer tenors, larger notional size, lower trade count, higher capital requirements, larger margin flows and necessarily more sophisticated risk management and operational requirements. The risk management requirements of OTC derivatives client clearing in particular are substantially more burdensome than those of futures clearing, as managing a defaulting client portfolio requires access to significant trading capacity. This requirement could explain why the vast majority of client clearing capacity for OTC derivatives is offered by bank dealers or their affiliates.

The qualitative survey asked respondents for their views regarding the profitability and economic viability of the client clearing business.[55] The responses suggest that the provision of OTC derivatives clearing has caused some firms to change how they measure the performance of their client clearing business, and to modify their fee structures and activity based on these new measures. This behaviour is a specific example of the allocation of regulatory constraints described in Section F4.

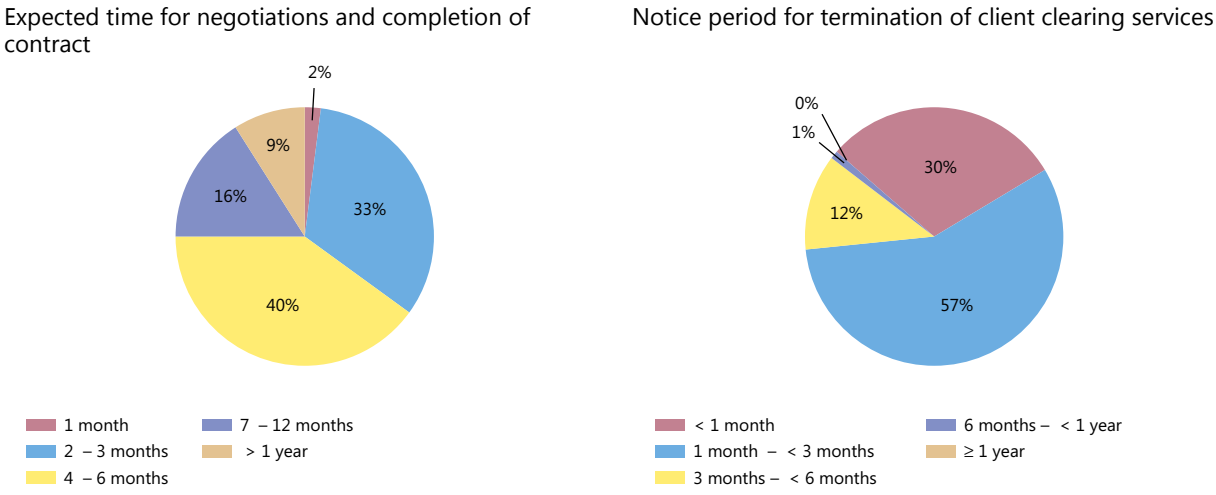
Despite this optimisation to meet business goals, some providers report that client clearing service provision still does not meet internal return on equity targets. This is likely to be an important factor causing some firms to withdraw or to reduce their offering of client clearing services. There may however be counterbalancing factors such as the need to provide a full service to their clients, the reputational impact of exiting OTC derivatives client clearing, and

[55] DAT qualitative survey CCSP survey questions 27-32. See, for example, see Figures E.2 and A5.8 in this report.

the difficulty of rebuilding the franchise if the decision to exit was subsequently reversed. In their free text responses to the qualitative surveys, several client clearing service providers stated that their decision to continue offering these services to clients is predicated on an expectation that the regulatory factors they believe are currently constraining their business will eventually ameliorate.

The DAT's survey responses and market outreach indicate that the client clearing business is often provided as one of a number of 'bundled' banking services to clients, highlighting the importance of the total client relationship for some clearing service providers. In the DAT's view, this could suggest that some firms may subsidise client clearing using revenue from other, likely related, business lines, or view the performance of client clearing together with that of related businesses rather than as a standalone activity. Further research in this area, such as that discussed in Annex 3, may provide additional insight on these issues.

Figure E.5 Time that clients expect will be required to access new clearing arrangements vs. clearing service provider notice period for termination of access



Client survey question 31 (43 responses) (left) and CCSP survey question 17 (18 responses) (right).

Source: DAT qualitative survey.

A number of CCPs have developed or are considering developing 'direct' or 'sponsored' access models for certain types of entities that traditionally access CCPs as clients.[56] Such models are in early stages of development. The implications of these models for incentives to centrally clear, and their consistency with relevant risk management standards, are yet to be assessed. This may be an area of future interest.

E4 Concentration of client clearing service providers and portability

The potential issues relating to client access to central clearing and client incentives to centrally clear may be exacerbated by the concentration in clearing provision described in Part C. As illustrated in Figure C.8, especially outside the largest clients, many clients only have one clearing service provider. Responses to the DAT qualitative survey indicate that clients do not

[56] Source: DAT qualitative survey CCP question 15 (12 responses).

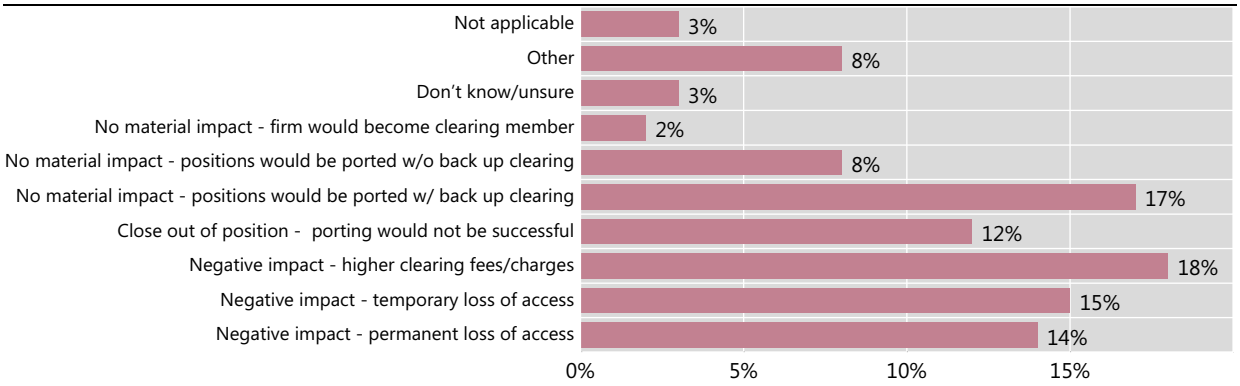
have back-up clearing providers most commonly because they are viewed as economically unviable or because the firm was unable to obtain a back-up arrangement.[57] There may be systemic implications to these private choices. These relate to the resilience of the market if one or more of the existing providers were to cease to provide client clearing services, either voluntarily or due to default. In this case other providers may be unwilling to take on additional business, leaving some of the affected clients without access to OTC derivatives clearing. This issue is discussed further in Section F5.

It should be noted in the context of withdrawals from client clearing service provision and the risk of loss of access to central clearing, survey responses indicate that there is a significant gap between the average time responding clients report it would take to gain access to clearing (6.7 months) and the average termination notice period given by the client clearing service provider (less than 3 months), as shown in Figure E.5. Such a gap could leave many clients unable to access clearing if their contract with their service provider is terminated, particularly as many clients report that they do not have a back-up clearing service provider. This has led some market participants to express the concern about the uncertainty they may face regarding future access to central clearing, especially in stressed conditions. They suggest that client clearing may not provide them with sufficient certainty regarding their contracts and that this may constrain their hedging activity.

Responses to the DAT qualitative survey also suggest that many market participants have concerns over whether their portfolios would be ported after the default of their client clearing service provider. Amongst clients, some 41% (of 43 client respondents) said they expect they would lose access to the cleared OTC derivatives market (either permanently or temporarily) or have their positions closed out by the CCP. A further 18% believed that they would only be able to port successfully by paying higher clearing fees, as Figure E.6 reports.

Figure E.6 Views on the impact on client cleared OTC derivatives activity if the client's main clearing service provide were to default

In per cent



Client survey question 42 (43 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required.

Source: DAT qualitative survey.

[57] Client survey question 19 (42 responses, of whom 28 (67%) gave the reasons identified above).

Part F Reform analysis and issues in incentivising clearing

An evaluation of the overall effects of the G20 financial regulatory reforms involves assessments of their benefits and costs. This is a complex task as there are both private and social costs, and both private and social benefits. Often, social costs and benefits are more difficult to quantify than private ones. Market participants tend to be vocal in highlighting their private costs, but consideration of all the relevant effects is important to inform the various policy choices implicit in the design of the standards which implement the reforms.

One purpose of evaluations is to help inform the considerations of relevant SSBs to identify policy responses and other further work, and to deliver adjustments where appropriate, without compromising on either the original objectives of the reforms or the overall level of resilience. This could be the case if a particular calibration of individual reforms and regulations may further encourage the benefits of central clearing to be realised without compromising resilience or distorting incentives, for example in favour of certain types of market participants or sectors.

Part D highlighted that the calibration of the margin requirements for uncleared derivatives, particularly the threshold for the exchange of initial margin, has an important impact on incentives. So the calibration of the scope and boundaries is critical.

This Part considers cost-benefit issues, then discusses certain reforms where the DAT's analysis of data and information suggests further work is merited to consider whether an appropriate balance of resilience and efficiency or access has been achieved.

F1 Cost-benefit considerations

Prior ex ante impact assessment studies on the effects of the post-crisis reforms have found strong net overall systemic benefits.[58] These studies estimate social costs by assuming that more stringent regulatory requirements increase the funding costs of financial institutions, who then likely pass these costs on to customers and clients through fees, spreads and other charges. However, in the case of OTC derivatives, other mechanisms may be important too. Product standardisation, the level of clearing fees compared to direct bilateral trade costs, and difficulties in accessing client clearing could mean that the real economy hedges less risk than it would have done in a counterfactual with alternative regulatory reforms. In other words, an alternative reform design might achieve the same overall systemic benefits with less impact on market functioning. To date, the impact of these mechanisms has not been studied.

The long-term social benefits of reforms are also very difficult to quantify. Higher resilience enhances the financial system's ability to absorb shocks and intermediate financial flows through the cycle and reduces the macroeconomic costs of financial crises, in particular in the form of output and employment losses. Prior studies typically tried to assess the benefits of reforms in terms of reducing the likelihood and severity of financial crises. However, estimates of the impact of reform on crisis probability and severity are difficult, especially as the financial system adapts to reforms and these adaptations potentially change the dynamics of financial system stress. Given the interaction of regulatory and non-regulatory factors, attempting to isolate, quantify and evaluate the particular impact on OTC derivatives markets is even more

[58] See the MAG/LEI (2010), G-SIB (2011), OTCD (2013), TLAC (2015); and *Adding it all up: the macroeconomic impact of Basel III and outstanding reform issues* by Fender and Lewrick (2016, BIS Working Papers, No. 591).

challenging. For example, one relevant non-regulatory factor here would be the extent of product standardisation, which can contribute to reduced transaction costs, improved counterparty credit risk mitigation through standardised margining and default management, and provide more opportunities to compress positions.

Given all of these issues, the DAT has not attempted to quantify the costs and benefits of reform within a single unifying framework. Instead, benefits and costs are discussed separately using a partial equilibrium approach, relying on a mix of qualitative and quantitative tools.

Box 2 The role and risks of central clearing of OTC derivatives

The role of derivatives

A core social benefit of derivatives is the increased ability to manage risks. This results in the more reliable provision of goods and services. Some (mainly financial) firms also use derivatives to increase their exposures to underlying assets and to economic fundamentals, and to tailor their risk position. Well designed and active risk transfer markets allow risks to be managed by the most capable party, reduce the overall cost of hedging, and improve price discovery.

As noted above, in the years preceding the financial crisis, many firms actively participated in OTC derivatives markets. These markets operated in an opaque manner, and created a complex and fragile web of bilateral exposures that, as the crisis demonstrated, relevant actors could not always value or even understand. When the credit worthiness of some financial institutions came into question, OTC derivatives contributed to contagion and a loss of confidence. Thus unconstrained trading of OTC derivatives can have a social cost. In contrast, many markets for exchange traded derivatives functioned well during the financial crisis with a relatively more robust price formation process.

Central clearing

In a centrally cleared trade, the CCP interposes itself between the two counterparties to the trade, becoming the seller to every buyer and the buyer to every seller through novation. This implies that CCPs' net position is nil, absent clearing member default. However, CCPs are exposed to the counterparty risk of their clearing members. In order to manage this risk, CCPs establish several lines of defence including strict access criteria for membership; the requirement of initial margin, to collateralise potential future exposures in the event of a counterparty's default; and of variation margin, to limit the build-up of current losses from changes in market prices; and the requirement of contributions by members to a mutualised default fund. CCPs also provide a dedicated amount of their own capital (known as skin in the game).

The costs and risks of central clearing

Central clearing gives rise to costs and risks as well as benefits. Participating in a CCP imposes direct costs on members and market participants, in addition to those coming from capital requirements and margining. Clearing members incur membership fees and operational costs including significant investments in infrastructure. Pursuant to CCP rules, clearing members may also incur additional costs associated with requirements to post highly liquid assets at short notice including intraday, which can create collateral funding and liquidity risks. Clients also face clearing fees, operational and collateral

costs. These costs may be so high that they do not compensate for the private benefits of central clearing. Finally, in addition to counterparty risks, CCPs themselves also face business, operational and liquidity risks, and managing these can involve placing additional requirements on their clearing members.

The importance of CCPs to financial stability

Central clearing redistributes counterparty risks and concentrates them in a single point, the CCP. CCPs simplify the network of exposures but do not eliminate risks or interconnections. By concentrating the risks associated with the trades being cleared, CCPs become themselves crucial nodes in the financial system. This is an intended consequence of the reforms. However, it means that the distress of a CCP could expose its clearing members and market participants to severe losses if not properly managed. This risk is being mitigated through policy measures to enhance CCP resilience, recovery and resolvability, discussed in Section B2.

The importance of CCPs to financial stability is even more evident once two additional factors are considered: the concentration of derivatives clearing activity in a few CCPs, and the interconnectedness of CCPs. Currently, a small number of CCPs provide most of the capacity in OTC derivatives clearing. Furthermore, there are a small number of clearing members who offer the majority of clearing services to clients at all of these systemic CCPs. These firms are often also those that provide other key services to CCPs such as settlement and investment services, custody, and liquidity backstops.[59]

Even in the absence of a default, CCPs may impose stress on market participants. In particular, sudden large changes in margin requirements can have destabilising effects. For example, in times of market stress, notwithstanding anti-procyclicality measures in many margin models, margin requirements and collateral haircuts can increase due to the volatility of the underlying assets, adding pressure on already fragile markets. Market participants who search for assets suitable to post as collateral to meet margin calls can exert pressure on the funding system. The funding system itself may be prone to fragility due to concentration of critical functions in a small number of firms. All of this means that it is important for market participants to plan for the potential future burdens that might be imposed upon them as a result of their participation in clearing.

F2 The benefits of reforms

Central clearing offers a number of potential economic and risk-reducing benefits, both from a private and social point of view. A key advantage is that by having the CCP as the counterparty of each trade it clears, multilateral netting of each clearing member's exposure to the others is facilitated in a legally and operationally robust and efficient manner. The risk reduction created by multilateral netting is both a private benefit (in that it reduces clearing member exposure and margin requirements compared to an uncleared counterfactual), and a social benefit, in that it makes the OTC derivatives system (and other centrally cleared markets) less complex and

[59] See BCBS, CPMI, FSB and IOSCO, *Analysis of central clearing interdependencies*, July 2017 (www.fsb.org/2017/07/analysis-of-central-clearing-interdependencies/) and August 2018 (www.fsb.org/2018/08/analysis-of-central-clearing-interdependencies-2/).

potentially less prone to contagion. Box 2 discusses the role of central clearing in more detail, while Box 3 illustrates one of the benefits which is enhanced by multilateral netting at CCPs.

There are other benefits beyond netting associated with clearing. For instance, after the default of a clearing member, it is possible to move or 'port' client positions to another clearing member. This potentially provides continuity of exposure for clients, at least on a short-term basis, and reduces their risk of forced close-out of their positions. CCPs also provide their participants with a centralised, coordinated and predictable default management process through which outstanding house, and (if not ported) client positions of a defaulted clearing member are hedged, closed out, replaced or transferred.[60] CCP default management practices and porting may therefore represent both a private and a social benefit. Finally, the margin and loss mutualising mechanisms inherent in CCPs may encourage effective governance and cause clearing members and market participants to internalise the externalities that their risk taking might impose on others. For these reasons central clearing has been used in OTC derivatives markets on a voluntary basis even before the financial crisis, notably for interest rate swaps.

Trade reporting of OTC derivatives brings transparency to a previously opaque network. Taken together, central clearing of standardised transactions and trade reporting increase confidence in OTC derivatives markets and allow supervisors to better monitor exposures. A higher degree of standardisation may also lead to improved liquidity and hence lower transaction costs for cleared trades. This could help lower the cost of central clearing. However, it could also have an adverse impact on the costs of uncleared derivatives.

The July 2017 FSB review of the effectiveness and broader effects of OTC derivatives market reforms considered other reforms to derivatives markets alongside central clearing. Although there are challenges in directly measuring the effectiveness of the reforms in meeting the objectives, including theoretical challenges in devising reliable and comprehensive measures of systemic risk, it identified a number of areas which suggest meaningful progress has been made towards mitigating systemic risk. These include higher levels of central clearing; improvements in CCP's resilience including their governance, risk management frameworks and the financial resources they are required to hold to manage a member default; and markedly higher levels of collateral for OTC derivatives exposures than before the financial crisis.[61]

As the reforms affecting OTC derivatives markets continue to be phased in, the gains could increase further. Once implemented, these financial stability gains are likely to be highest with respect to institutions at or near the core of the derivatives network, such as CCPs and large dealers, and to decrease as we move to firms at the periphery; see Part C for more detail. This differential impact was planned for in the original reform design. For instance, exemptions to some mandates are permitted for small entities, given their likely lower impact on financial stability, and higher cost of compliance.

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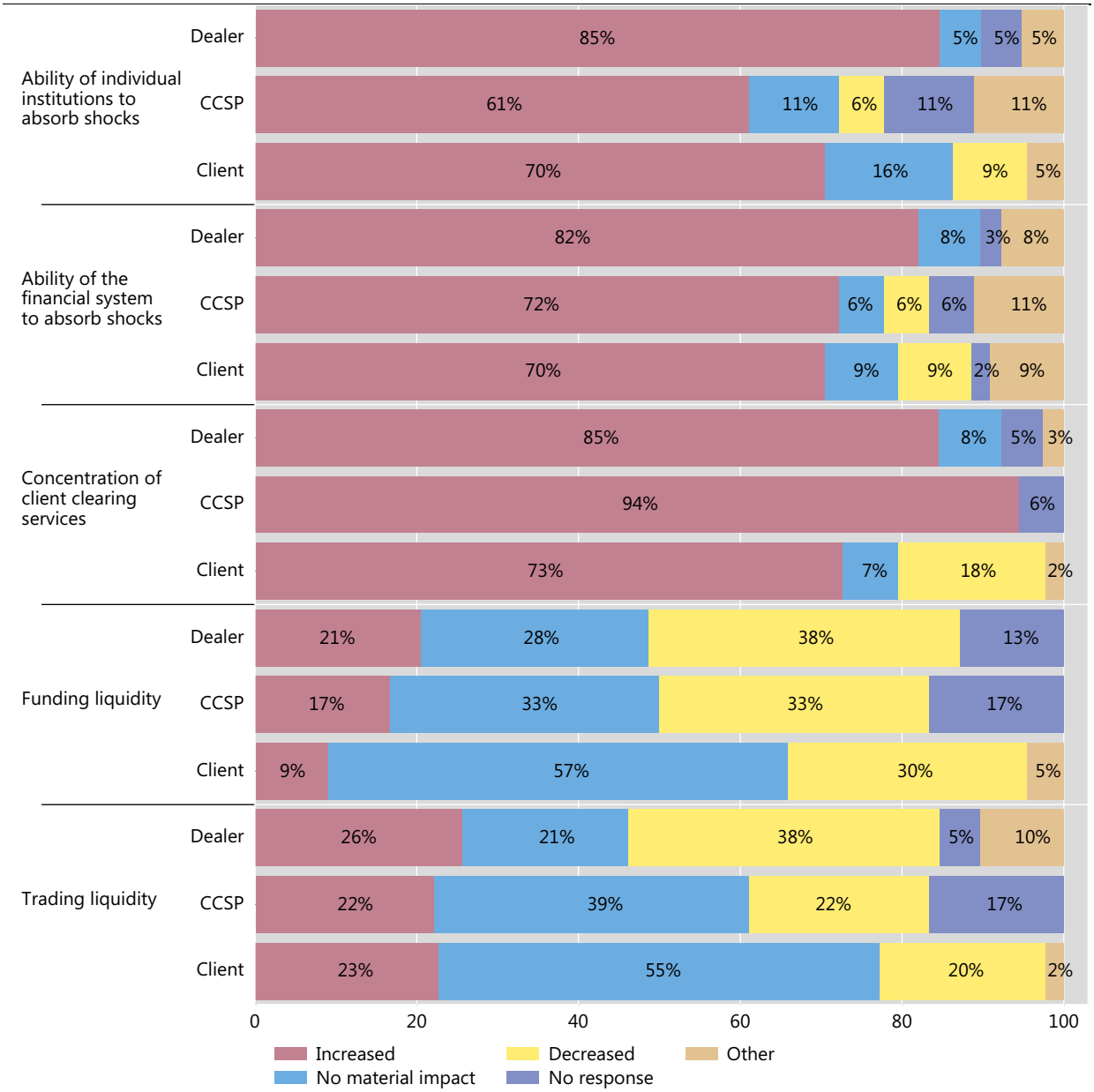
[60] For more on the benefits of central clearing, see Duffie and Zhu (2011) and FSB, *Review of OTC derivatives market reforms: Effectiveness and broader effects of the reforms,* June 2017 (www.fsb.org/2017/06/review-of-otc-derivatives-market-reform-effectiveness-and-broader-effects-of-the-reforms/).

[61] For example, see Figure 7 in FSB, *Review of OTC derivatives market reforms: Effectiveness and broader effects of the reforms,* June 2017 (www.fsb.org/2017/06/review-of-otc-derivatives-market-reform-effectiveness-and-broader-effects-of-the-reforms/).

Figure F.1 Views on the impact of G20 reforms

In per cent



Dealer survey question 24a (minimum 34 responses) ; CCSP survey question 40 (minimum 15 responses); client survey question 56 (44 responses).

Source: DAT qualitative survey.

The qualitative surveys included a set of questions on market participants' views on whether the reform measures have helped to make the system more resilient. There is broad consensus in the survey responses that the measures have indeed made the financial system stronger. The DAT further queried if firms themselves have become more resilient thanks to the reform measures. As illustrated in Figure F.1, most respondents believe that the reforms have helped improve the resiliency of both the financial system and individual institutions.

F3 The costs of reforms

Box 2 discusses both the costs and benefits of central clearing. The cost of reforms may manifest in increases to private costs, for instance via higher fees, operational or capital costs or the cost of funding additional margin requirements. Reforms (if not appropriately calibrated) could also have the effect of increasing the inherent risks and potential systemic externalities of OTC derivatives. The mechanisms here could include CCP stress or failure, the inability to port client positions, or unexpected liquidity demands on market participants.[62] Authorities, market participants and other stakeholders are engaged in ongoing vigilance and research into potential new vulnerabilities. Annex 3 discusses this and other research suggested by the DAT's work in more detail.

The reforms aim to ensure that market participants internalise systemic interconnectedness by modifications to, for example, the capital treatment of exposures to CCPs and to uncleared OTC derivatives. One of the effects can be seen in the higher levels of capital and collateral related to derivatives activity in the financial system, and is an intended consequence of reform.

There may be other impacts too. One example is the impact on market liquidity (as distinct from funding liquidity). The evidence presented in Part C suggests that trading liquidity has shifted for certain products into central clearing. For activity either in products or conducted by specific entities that do not – or cannot – migrate to central clearing, there may be effects as a result of no longer being part of a large liquidity pool. The higher margin and capital costs for uncleared transactions aim (amongst other objectives) to incentivise central clearing, not specifically to impact such activities. But if particular firms cannot access the largest liquidity pools, perhaps due to their location or because their derivatives activity makes them unattractive to clearing service providers, this can create a boundary between the core of the derivatives system which enjoys plentiful liquidity in cleared products and the periphery which does not.

The direct and indirect costs of reforms can be passed on to end users in the real economy. These include pension funds, small and medium sized lenders, and non-financial corporates. The allocation mechanism by which this occurs is discussed further in the next section. If the higher margin levels for uncleared transactions raise the cost of using OTC derivatives to hedge business risks, then this increase may merit further consideration as reform evaluation continues.

The costs and benefits of reforms, both in aggregate and for different types of users or different parts of the network, obviously depend on the calibration of regulations. Section F4 describes in general terms the transmission of regulatory requirements into financial system activity.

F4 The transmission mechanism from changes in regulatory requirements to financial system activity

A crucial step for the analysis of the effects of reforms is to identify the transmission channels through which reforms affect financial institutions and thereby influence financial intermediation and economic activity more broadly. This will facilitate a comparison of realised outcomes with the reforms' intended objectives. The key transmission mechanism by which

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[62] Standards addressed at increasing CCP resilience and mitigating these risks, including the PFMI and the CCP recovery and resolution standards were discussed in Section B2 above.

regulatory constraints such as risk-based capital, leverage, or liquidity requirements affect activity is the allocation of constraints by regulated firms.

Box 3 OTC trade compression: An example of optimisation under constraints

Reform measures directed at strengthening the solvency of specific institutions, especially large global banks, require them to hold capital against their OTC derivatives exposures. Some of these standards use exposure measures which depend on the notional amount of the outstanding positions. Accordingly, some firms have sought ways to reduce the notional size of their OTC derivatives books. Centrally cleared OTC derivatives have standardised terms with a CCP on one side of every trade. This makes optimisation easier, as the CCP or other service providers can identify and eliminate redundant trades across the cleared market, reducing trade notionals without changing risk positions. This process is known as a risk-free compression cycle.[63]

One consequence of these efforts is that the total gross notional size of the OTC derivatives markets has steadily declined. Compression cycles also help to mitigate the operational risk involved in clearing, and are typical of the optimisation processes that firms engage in to manage the constraints they are under.

Surveys and market outreach indicate that transaction costs are often lower in the centrally cleared markets. The efficiency gain from multilateral netting and risk free compression was mentioned as a factor contributing to the differences in pricing across these markets. The corollary is that to the extent liquidity conditions may have worsened in some uncleared OTC derivatives; such an impact might be an unintended consequence of the reform efforts.

Large financial services groups are subject to multiple constraints at multiple levels. They may decide to allocate some constraints down to individual desks within the firm, while managing others at a higher level. Some constraints may be subject to a limit while others could instead be charged for, so that managers are required to generate a certain return from their consumption of a resource. The allocation structure may change regularly or only infrequently, and the practices of different firms may differ in important respects. Nevertheless, the basic mechanism of allocation of significant regulatory constraints to business lines within a financial institution is an important one.[64]

If a regulatory constraint changes and this constraint is allocated by the firm, then business units may face new limits or revised targets. If a business unit were close to its limit, and that limit is lowered, it would have to reduce its consumption of the limited resource, or increase its returns to justify a higher allocation. Box 3 discusses one class of reaction here, optimisation of the constraints. But however firms react, all other things being equal, changes in regulatory

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[63] Compression was available before clearing and does not rely on one counterparty to the transactions being compressed being a CCP. However, it is often more efficient when applied to multilaterally netted portfolios. Other forms of exposure transformation are also available or under development, some of which do change the risk of individual portfolios.

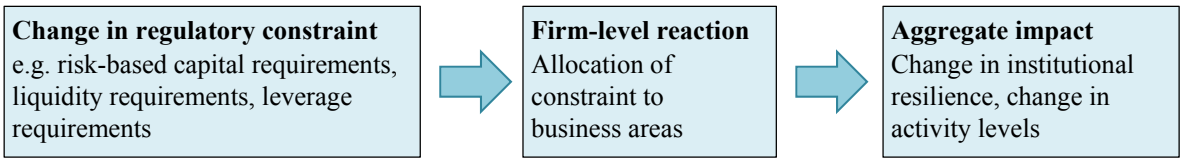
[64] See R. Bajaj, A. Binmore, R. Dasgupta, Q. Vo, *Banks' internal capital markets: how do banks allocate capital internally?*, Bank of England Quarterly Bulletin Q2 2018 (www.bankofengland.co.uk/quarterly-bulletin/2018/2018-q2/banks-internal-capital-markets-how-do-banks-allocate-capital-internally) for a description of the capital allocation process.

constraints are likely to produce firm level reactions, even if these are somewhat uncertain in timing or scale.

Regulatory change affects the resilience of individual institutions and the likelihood that critical economic functions will continue to be provided in stress. Firm-level reactions to it in aggregate are likely to produce changes in the level and balance of financial system activity. Figure F.2 illustrates the mechanism.

Of course, changes in activity may often be an intended consequence of regulatory change. However in other cases they may be an unintended consequence, and may result in less efficient markets, or unanticipated adaptations. Thus a key question in the analysis of reform is whether the benefits of reform could have been achieved with a lower cost in unintended market inefficiency.

Figure F.2 Stylised illustration of the transmission mechanism of regulatory constraints to economic activity



Based on graph 1 of the BCBS Research Task Force *Literature review on integration of regulatory capital and liquidity instruments,* March 2016 (www.bis.org/bcbs/publ/wp30.htm).

F5 The leverage ratio

Overview of the leverage ratio and its treatment of OTC derivatives

The BCBS Basel III leverage ratio was designed with the intention of restricting the build-up of leverage in the banking sector using a simple, transparent non-risk-based measure of the ratio of tier 1 capital to total exposure, as measured by the leverage exposure measure ('LEM'). Conceptually, a simple leverage ratio framework acts as a critical complement and backstop to the risk-based capital framework. The leverage ratio was designed to capture both the on- and off-balance sheet sources of banks' exposures. The LEM therefore consists of balance sheet exposures and measures of derivatives, securities financing transactions and some other on- and off-balance sheet exposures.[65]

For a clearing member bank providing client clearing of derivatives, if a client transacts with the bank, then the bank must include the resulting trade exposure in its LEM. If the client transacts directly with the CCP, and the bank guarantees this transaction, then the bank must calculate its LEM as if the client had traded directly with the clearing member bank. In either case, if the bank does not guarantee the performance of the CCP to the client, then the bank need not include the trade exposures to the CCP in the LEM; otherwise they should be included. These treatments result in an identical measurement of client cleared derivatives transactions in

[65] See BCBS, *Basel III: Finalising post-crisis reforms*, December 2017 (www.bis.org/bcbs/publ/d424.htm). Note that the Basel leverage ratio varies from a purely accounting-based leverage constraint, in that it includes items in the LEM which do not appear on the balance sheet.

the leverage ratio framework regardless of whether the clearing member bank utilises a principal-to-principal model or an agency model for client clearing.[66]

For derivatives, the finalised Basel III standard prescribes a modified version of the standardised approach to counterparty credit risk ('SA-CCR') to calculate the leverage ratio exposure of derivatives.[67] It uses the SA-CCR measure of replacement cost ('RC') and potential future exposure ('PFE'), but differs, inter alia, from the standard SA-CCR in its approach to the treatment of margin.[68]

SA-CCR, and the modified version of it used in the calculation of the LEM, treats client cleared transactions more favourably compared to uncleared transactions in terms of the margin period of risk (MPOR). For client cleared transactions an MPOR of five days is assumed, while the MPOR for uncleared transactions is at least ten days. For non-margined transactions, i.e. transactions where there is no variation margin exchanged, an MPOR of one year is assumed.

The use of SA-CCR in the leverage ratio is typically more capital intensive compared to its use for risk-weighted requirements. In the 'standard' version of SA-CCR, used for the risk weighted requirements, there is a (less than one-for-one) reduction in PFE as initial margin increases. However, consistent with its general approach to not allow collateral or guarantees to reduce the LEM, the leverage ratio modifies this treatment, and does not allow initial margin to cause any reduction in the PFE component of the LEM.

Separate from the treatment of client initial margin in the use of a modified version of SA-CCR, the LEM may also include amounts of client initial margin insofar as they are reported on the clearing service provider's accounting balance sheet, regardless of whether those amounts of client initial margin are held in a segregated account.

These aspects could affect incentives for firms to provide client clearing services, and for clients to centrally clear (as their clearing member bank may increase the price of services in order to offset its leverage ratio capital requirements). For banks that allocate capital requirements at the business line level, the leverage ratio is likely to be more constraining for client clearing businesses than risk-weighted capital requirements.

The leverage ratio as a potential constraint on groups

As noted in Section C1, the vast majority of OTC derivatives client clearing is provided by G-SIBs. Figure F.3 plots the leverage ratio and risk-weighted capital ratio for these banks at the consolidated level. It can be seen that, at this aggregate level, most of these banks are not bound

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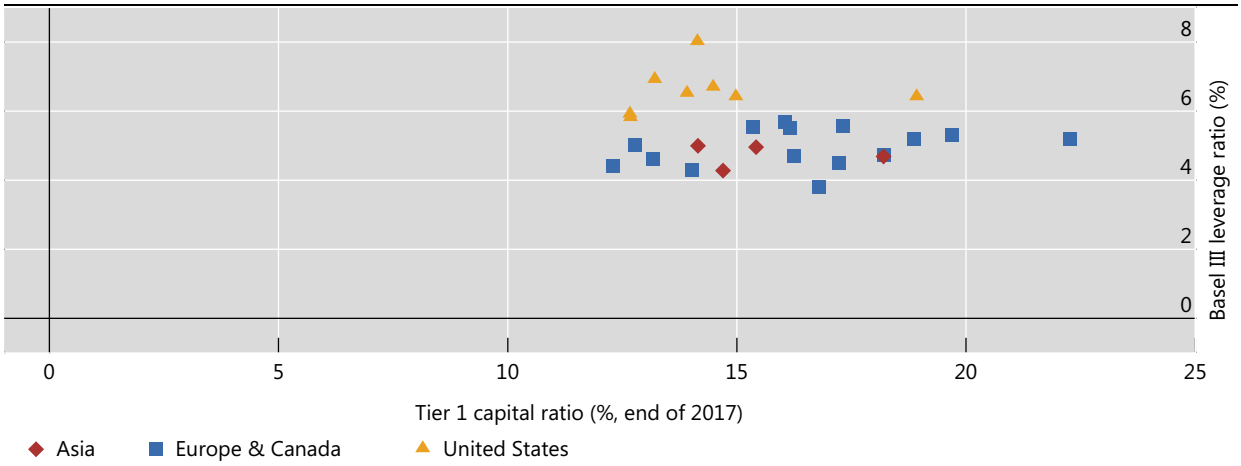
[66] In the principal-to-principal model, a centrally cleared client trade is made up of two parts or 'legs'; a trade between the client and its clearing member; and a matching trade between the clearing member and the CCP. In the agency model in contrast, there is one trade between the client and the CCP, and the clearing member guarantees the performance of the client to the CCP.

[67] This is due to come into effect by 2022. The current leverage ratio requirement contains a measure based on an earlier standardised approach for the measurement of counterparty credit risk, the current exposure method (CEM).

[68] The Basel Committee on Banking Supervision published a consultative document on the leverage ratio treatment of client cleared derivatives in October 2018; see www.bis.org/bcbs/publ/d451.htm. The description of the leverage ratio treatment of client cleared derivatives in this report and responses to quantitative and qualitative surveys are based on the leverage ratio standards as specified in BCBS publications in January 2014 and December 2017 and do not reflect consideration of the potential revisions to the treatments set out in the October 2018 consultative document.

by the Basel III leverage ratio. (This does not rule out the possibility that some banks might be bound by national implementations of the leverage ratio.)

Figure F.3 Basel III leverage ratio and Tier 1 capital for G-SIBs



As at 31 December 2017.

Sources: BIS calculations based on FDIC Global Capital Index and Pillar 3 regulatory capital and liquidity coverage ratio disclosures.

Nevertheless, even if the leverage ratio is not binding, it may act as a constraining requirement and may create an incentive for a firm to actively manage its business based on LEM usage. As noted in Section F4 above, for purposes of their own internal management, firms may allocate capital requirements at the business unit level. The design and impact of this process varies from firm to firm. It means that while a constraint might not bind at the group level, it may do so when a bank applies it at a more granular level.

Survey responses on the leverage ratio and the provision of clearing services

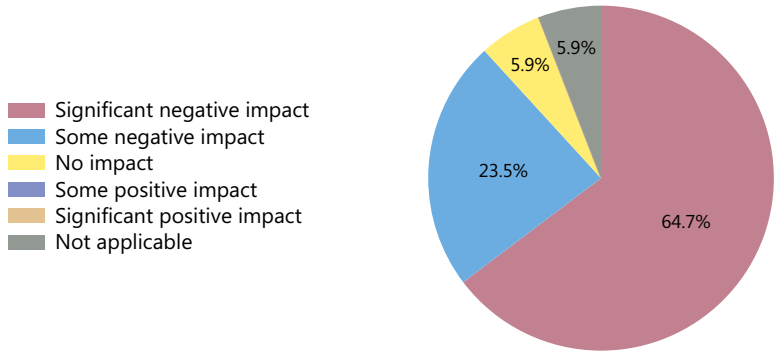
In response to survey questions on whether various regulatory reforms offered an incentive or a disincentive to clear, there was a clear split between dealers and client clearing service providers; see Figure D.1. The majority of dealer responses stated that the leverage ratio provides an incentive or has no material impact. Several factors, driven by the functional differences between dealing and client service provisioning activity, might affect this view. Cleared trades typically imply lower costs for margin and capital requirements compared to bilateral trades. Also, netting benefits are likely larger for cleared trades, especially for standardised transactions and for dealers holding a balanced portfolio. Centrally cleared trades also present greater compression opportunities than uncleared trades for house accounts, and these techniques allow the leverage ratio exposure charge to be reduced, as discussed in Box 3.

The factors most relevant for entities holding OTC derivatives exposures for their own account are different from those that affect client clearing service providers. The only capital standard which the majority of respondents to the client clearing service provider survey stated acted as a disincentive to the provision of client clearing services was the leverage ratio. Views here are likely to be driven by client rather than house account clearing, as the initial margin posted by clients will likely have a larger impact on the LEM than the house account. Figure C.6 supports this, showing that at some of the largest CCPs, aggregate client initial margin is now bigger than house. Thus, while the executing broker (dealer) part of an institution might have an incentive to centrally clear, and the institution might receive additional revenue for a trade by

acting as a client clearing service provider, all else equal, the leverage ratio might negatively affect the incentives to provide client clearing services.

Figure F.4 Effect of leverage ratio on ability to offer client clearing services

In per cent



CCSP survey question 37a (17 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required.

Source: DAT qualitative survey.

The leverage ratio was the most often-cited driver of the incentive or disincentive for central clearing both in the DAT surveys and in market outreach. Half of the narrative responses to associated survey questions cited as a key issue the leverage ratio's disallowance of the PFE reducing effect of client initial margin. When asked about the impact of the leverage ratio on their ability to offer client clearing, 89% of client clearing service providers responded that it had some negative impact or a significant negative impact on their ability to offer client clearing, with two thirds saying it had a significant negative impact: see Figure F.4.

Recent research analyses the impact of the leverage ratio on client clearing. One such paper uses confidential transaction and portfolio level data from UK CCPs (and covering over 75% of the interest rate derivatives market in Europe), applying a difference-in-difference approach.[69] This paper studied the periods around the introduction (January 2016) and tightening (January 2017) of the leverage ratio in the United Kingdom, to conduct a differential analysis of clearing service providers where the leverage ratio was, and was not, a potential constraint.

The paper found that clearing members for which the leverage ratio was the dominant constraint became more reluctant to provide client clearing services than their peers after both events. A significant effect (with a reduction of the number of client cleared trades of around 5%) was observed in terms of the number of transactions they were willing to clear on behalf of their clients, and their overall number of clients. The impact is greatest on the firm's willingness to take on new clients: where the leverage ratio was not the dominant constraint, client numbers increased significantly more than when it was. This insight may be relevant when considered in the light of Figure C.8 showing the long tail in the distribution of the number of clearing service providers per client.

[69] J. Acosta-Smith, G. Ferrara, and F. Rodriquez-Tous, *The impact of the leverage ratio on client clearing*, Bank of England Staff Working paper No.735, June 2018 (www.bankofengland.co.uk/working-paper/2018/the-impact-of-the-leverage-ratio-on-client-clearing).

Research from the CFTC investigating the impact of the leverage ratio on options on the S&P 500, in particular for E-mini options, points in a similar direction.[70] Using confidential data on house and customer accounts in the US, it compares client clearing prior to the implementation of leverage ratio disclosure requirements in January 2015. The results showed that the market share of European banks in this market increased compared to US banks (for which a more stringent domestic implementation of the leverage ratio requirement was imposed). The incentives created by the requirement to disclose the ratio, and possibly the incentive to begin managing the exposures which drive the LEM, may have been sufficient to drive market share from firms subject in the future to higher leverage requirements to firms with lower requirements.

Both pieces of research give insight and are consistent with the view that the leverage ratio might act as a constraint on the provision of client clearing. Equally, neither demonstrate that there has been a decline in aggregate, in clearing clients or cleared volumes. In fact, overall, the number of clients and centrally cleared client positions has increased.[71] Nevertheless the research is consistent with observations from the qualitative surveys that some clearing service providers limit access to clearing and impose restrictions on some clients, as discussed in Section E1. Neither piece of research sought to assess the broader effects of the leverage ratio, so conclusions cannot be drawn on the overall intended effects from these.

The impact of on-balance sheet initial margin on fees for client clearing service provision

The DAT quantitative survey considered the effect of having client initial margin on the balance sheet, which would likely also result in its inclusion in the LEM. For this, dealers were asked to provide clearing fees where initial margin for client trades is reported on-balance sheet and not passed-through to the qualifying CCP; and fees where it is off-balance sheet.[72] Table F.5 reports the analysis performed. At low transaction levels, the results suggest that the cost of holding initial margin on-balance sheet is not material. However, as the number of transactions increases, the clearing fees associated with initial margin held on-balance sheet are on average substantially higher than those where it is not.[73] Moreover portfolios that are not diversified (as they hold directional positions which by definition do not offset each other), and hence have higher level of initial margin, appear to show a significantly larger increase in clearing fees compared to portfolios that are diversified. The results also show the effects of on-balance sheet treatment are more pronounced for large directional portfolios. This suggests that the leverage ratio might, from a variable cost perspective, have a smaller impact on clearing fees for smaller clients with only a few transactions.[74]

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[70] Haynes et al. (2018), *Assessing the Impact of the Basel III Leverage Ratio on the Competitive Landscape of US Derivatives Markets: Evidence from Options*, CFTC Policy Brief, June 2018 (www.cftc.gov/sites/default/files/About/Economic%20Analysis/oce_leverage_and_options.pdf). Although E-mini options are not OTC traded derivatives, these results are relevant to the DAT.

[71] The research also showed that overall the average number of clients per CCP also increased from 50 to 80 between spring 2015 and spring 2017.

[72] Survey respondents were asked to assume that all on-balance sheet initial margin is cash, where appropriate, and all off-balance sheet initial margin is high quality governments bonds.

[73] Other factors such as concentration risk add-ons, could also be relevant.

[74] However, the analyses performed do not allow speculative large directional portfolios to be distinguished from portfolios built up for hedging purposes.

The pricing structure observed encourages client initial margin to be held off-balance sheet, where it does not contribute to the LEM. It is substantially easier to exclude securities margin from balance sheets under accounting rules than cash. However, the margin taker is subject to fire sale risk or the risk of stress in securities financing markets when it takes non-cash margin. Cash margin is not exposed to these risks, and has the substantial benefit for the margin taker of being immediately available to offset a loss on default.

Table F.5 Percentage increase in clearing fees assuming initial margin is held on- versus held off-balance sheet)

Number of trades/month	1	10	50	100	500
Diversified portfolio					
Non-diversified portfolio					

Green = less than 10%; yellow = between 10 and 40%; orange = between 40 and 70%; red = over 70%. Figures are based on the assumption that initial margin being excluded from the balance sheet means that it is not included in the LEM.

Source: DAT quantitative survey.

In practice, few firms have achieved off-balance sheet accounting treatment for cash initial margin despite the capital incentives to do so. Such differences in accounting treatment could have an impact on the level of concentration in client clearing service provision.

The relevance of the leverage ratio for concentration in client clearing service provision

Some elements of the post-crisis reforms may have relevance from a market concentration perspective. To the extent that the leverage ratio acts as a disincentive to the provision of client clearing services as suggested by survey responses, it might incentivise clearing providers to discontinue their offering. This could increase market concentration and could also have implications for the ability to port the clients of a large client clearing service provider, as discussed in Part E.

In order to be able to accept clients that wish to port in, a clearing service provider must have sufficient 'head room' in its regulatory metrics before accepting them, and additional client clearing business must offer an acceptable return on the required capital thus deployed.[75] Thus, although it is not the only relevant factor, the leverage ratio treatment of client clearing may further complicate porting.

Overall, the information available to the DAT supports the view that the leverage ratio may pose some disincentives for certain firms that offer client clearing services, and this might translate into higher costs for clients and a reduced availability of clearing services. There are many relevant factors affecting the precise impact of the leverage ratio requirement on individual firms, such as contractual agreements, allocation models and clearing models (including the question of whether clearing is bundled with other services or is a standalone business). The treatments that result in these disincentives might in part be intended and should be weighed against net benefits such as the stability of clearing firms that have a crucial role in providing access to central clearing, house account clearing, and in the provision of other

[75] Other factors would also be relevant in porting decisions, including impact on the concentration of that member's positions in the CCP, client due diligence and 'know your client' requirements, etc.

services to CCPs. There may also be some substitution effects, whereby less leverage constrained clearing members may choose to step in to replace their more leverage constrained peers, though further analysis would be needed to understand if this is actually occurring.

Taken together, the discussion in the prior sections and market outreach suggests that some banks' management practices, whereby capital to support leverage ratio requirements is allocated to business units, can be an important constraint for client clearing service providers. When this happens, it is likely to have an effect on client clearing service activity levels, consistent with the transmission mechanism discussed in Section F4. Further analysis of the economics of client clearing, including the fixed costs associated with the business, the structure of clearing fees, the allocation practices of firms, and the interaction of regulatory and non-regulatory factors may therefore be warranted.

F6 The G-SIB methodology

Overview of the G-SIB score

The G-SIB score is determined via an indicator-based methodology and is used to identify banks that, due to their systemic importance, are to be subject to higher capital requirements, additional supervisory oversight and total loss absorbing capacity requirements. It is a relative measure of the impact of a bank's failure to the financial system.[76] The G-SIB indicators are grouped into five categories reflecting different aspects of the bank's systemic importance: size; complexity; interconnectedness; substitutability and financial institution infrastructure; and cross-jurisdictional activity. Each category is composed of between one and three different indicators. For a particular bank, the score for a particular indicator is calculated as the ratio of the bank's indicator to the sum of the same indicator across a sample of large banks that serves as a proxy for the global banking sector. Indicators are assigned a weight within their respective categories. In turn, each of the five categories has an equal weight in the final G-SIB score.[77] G-SIB scores are mapped into buckets, each with a corresponding higher loss absorbency capital requirement. All G-SIBs are required to meet a minimum risk-based capital requirement based on their assigned bucket.[78]

Measurements of OTC derivatives activity (including, but not limited to, client clearing activity) are included in G-SIB indicators in three ways. First, the size category's sole indicator is based on the LEM, which includes measurement of OTC derivative exposures. Second, the notional amount of OTC derivatives outstanding is used as an indicator in the complexity category. For client clearing activity, where a bank acts as a financial intermediary serving as a counterparty to both the client and to the CCP,[79] the bank must include the notional amounts of both contracts for purposes of the OTC derivatives outstanding indicator. For banks that act as agent and that provide a guarantee for a cleared transaction, only the notional amount of the

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[76] The purpose of the G-SIB framework is to assess the individual bank's relative contribution to systemic risk. In abstract, more complex banks (including regarding their derivatives activity) may be more difficult to resolve and their failure would have a larger impact, thus they attract a higher 'score' under the methodology.

[77] A revised methodology was published in July 2018; see BCBS, *Global systemically important banks: revised assessment methodology and the higher loss absorbency requirement*, July 2018 (www.bis.org/bcbs/publ/d445.htm).

[78] Effective January 2022, G-SIBs will also be subject to a higher leverage ratio requirement.

[79] This would generally be the case for banks subject to the principal-to-principal model.

guarantee is to be included. Where a bank acts as agent, the guarantee of the client's performance it provides to the CCP is not included. Third, the intra-financial system assets and liabilities in the interconnectedness category include OTC derivatives exposures. For client clearing activity, where a bank serves as financial intermediary, the exposure to the CCP and the exposure to the client (if the client is a financial institution) is included. For banks that act as agent and that provide a guarantee to a CCP of the performance of a financial institution client for a cleared transaction, only the exposure associated with the guarantee is included.

Survey responses on the impact of the score on clearing

Qualitative survey respondents (in free text comments related to the question presented in Figure F.6) raised two main concerns about the G-SIB methodology in connection to OTC derivatives:

i) As noted above, the treatment of client clearing in the LEM has been identified by market participants as a disincentive to provide client clearing services. To the extent that the leverage ratio has an impact, this carries over into the G-SIB methodology (which uses the leverage ratio exposure measure as the indicator of size).

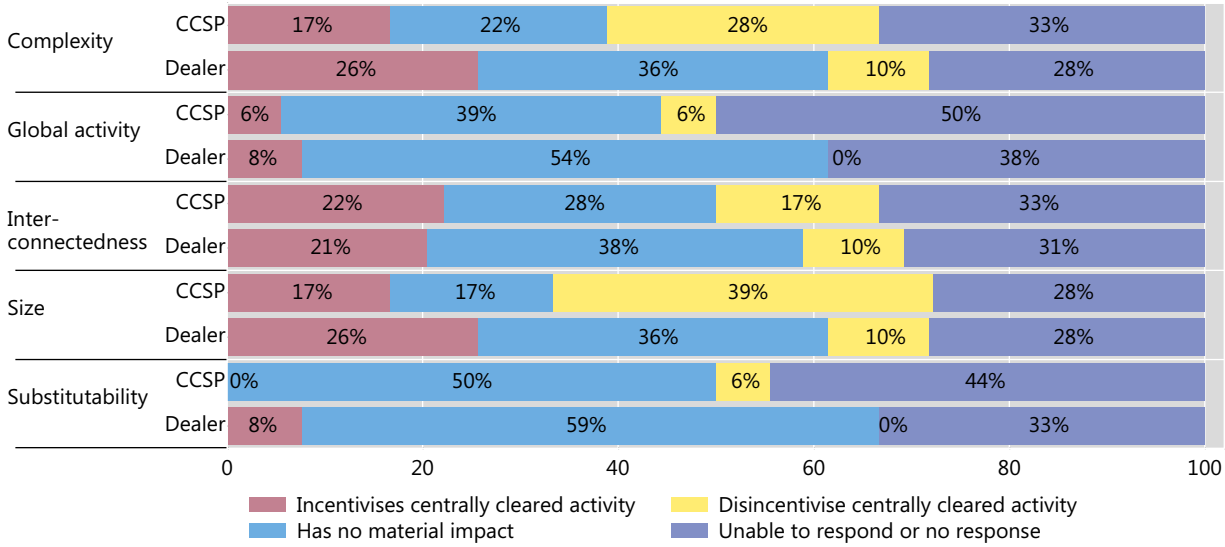
ii) The equivalent treatment of the same notional whether centrally cleared or uncleared in the complexity measure was seen as failing to recognise the benefits of central clearing in reducing complexity in the financial system. Trade standardisation, robust margining practices and other aspects of CCP financial resources, and predictable default management and porting processes are all viewed as significant here.

The G-SIB framework was identified by client clearing service providers in the qualitative surveys as the second most commonly cited disincentive to clear or provide client clearing services, as Figure D.1 reports. 44% of client clearing service providers stated that the G-SIB score was a disincentive to clear, 28% that it had no material impact and 11% that it incentivises central clearing. However, 45% of dealers stated that the score had no impact on incentives to clear, 32% that it incentivised clearing and 16% that it was a disincentive to clear. Comments from dealers indicated that the biggest incentive the G-SIB framework provides for clearing is due to netting benefits and compression in CCPs. These, due to their ability to reduce portfolio values and notionals outstanding, reduce the impact of OTC derivatives on the G-SIB score.

In terms of specific categories, the size category (which is entirely based on the LEM) was most commonly cited as a disincentive to clear by client clearing service providers, followed by the complexity category: see Figure F.6 for details.

Figure F.6 Views on the G-SIB categories as incentives or disincentives to centrally clear

In per cent



Dealer survey question 23b (35 responses) and CCSP survey question 41a (15 responses).

Source: DAT qualitative survey.

Impact on incentives to centrally clear and to provide client clearing services

The bucket to which banks are allocated and the corresponding capital requirement depends on the bank's G-SIB score. In the case of banks for which a marginal increase in score caused by client clearing results in a higher bucket assignment, this may impact the bank's incentives to provide clearing services in general or to guarantee clients' performance for cleared derivatives transactions.

OTC derivatives contracts have in general become more standardised and more likely to be centrally cleared. As a result, complexity has declined in these markets, and consequently the likelihood this activity is a source of contagion following bank failure has reduced. These are intended consequences which reduce systemic risk. An assessment whether the G-SIB methodology provides appropriate incentives for central clearing and whether it provides any unwarranted disincentives for banks to provide client clearing services may be merited.

F7 Other issues

This section discusses a number of other potential questions in regulation arising from the DAT's work which may merit further analysis by the relevant SSBs. These are:

- the treatment of smaller counterparties in the capital standards for CVA risk;
- the calibration of the standardised approach for counterparty credit risk; and
- incentives created by the use of the CEM for cleared portfolios.

The credit valuation adjustment

The credit valuation adjustment or CVA on a portfolio of OTC derivatives is the difference between the value of the portfolio assuming that the counterparty cannot default and its value

assuming the actual probability of default of the counterparty. Typically margin agreements dramatically reduce or eliminate CVA, so the CVA is most important for un-margined portfolios. Because CVA is typically low for centrally cleared exposures, CVA and the associated capital requirements for CVA risk potentially affect incentives to clear.

The standard theory[80] of CVA valuation treats it as a derivatives pricing problem. The CVA on a portfolio depends on the value of the portfolio – which in turns depends on all the market risk factors in the portfolio – and the probability of default of the counterparty. If all of the market risk factors and counterparty default risk can be hedged, then this is a reasonable approach. For many sizable OTC derivatives counterparties, the credit spread risk component of CVA can often be adequately hedged through single name CDS.

The situation is different for counterparties where single name CDS on the counterparty is not available. Here, the standard theory of CVA pricing does not immediately apply. Some academics question whether the 'exit price' demanded by accounting standards is best captured by a mark-to-model price based on a non-tradable counterparty credit spread or by some other approach.[81]

The 2011 revision to the Basel III framework, recognising the importance of CVA risk as a driver of losses during the crisis, introduced a capital charge for the risk that CVA could increase. This was revised in the 2017 Basel standards. The key improvements are a closer alignment with the accounting framework, recognition of market risk hedging, and a recognition of counterparty credit risk hedges. The extent of hedge recognition depends on whether the hedge references the counterparty directly, a legally related party, or a party in the same sector and industry. The standard therefore allows banks to reduce their CVA capital requirements when CVA risk is hedged.

The impact of capital requirements for CVA risk on small counterparties

As discussed earlier in Part D, OTC derivatives dealers typically charge counterparties a price for a trade which reflects not just the trade itself (e.g. a ten year interest rate swap in USD) but also the costs associated with the agreed CSAs. Thus uncollateralised trades will typically be more expensive for credit risky counterparties than fully collateralised ones, reflecting both the additional CVA and the capital required to support CVA risk.

Table F.7 The cleared cost advantage for a typical client (i.e. one with single A credit quality and funding cost) under the given CSA

Trade	2 way VM & IM, daily cash	No CSA
IRS10	30%	40%
IRS30	49%	92%

Assumptions: client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, client is A rated. The minimum number of observations used for any cell in this table is 11.

Source: DAT quantitative survey.

[80] See D. Brigo, M. Morini, A. Pallavicini, *Counterparty credit risk, collateral and funding*, John Wiley, 2013.

[81] See for instance the discussion in J. Gregory, *The XVA challenge*, John Wiley, 2014 section 4.3.4.

The DAT's quantitative survey demonstrates this phenomenon. For instance, Table F.7 shows the cleared cost advantage of a cleared swap to a bilateral transaction using two different types of credit support arrangements, a 2 way CSA with initial and variation margin, and no CSA. The trade with the 2 way CSA will generate no or very little CVA, while the trade without a CSA will be expected to generate a significant CVA. Consistent with this expectation, and despite other costs of clearing, the centrally cleared trade has a bigger cost advantage over the no CSA bilateral trade, as the latter is more expensive.

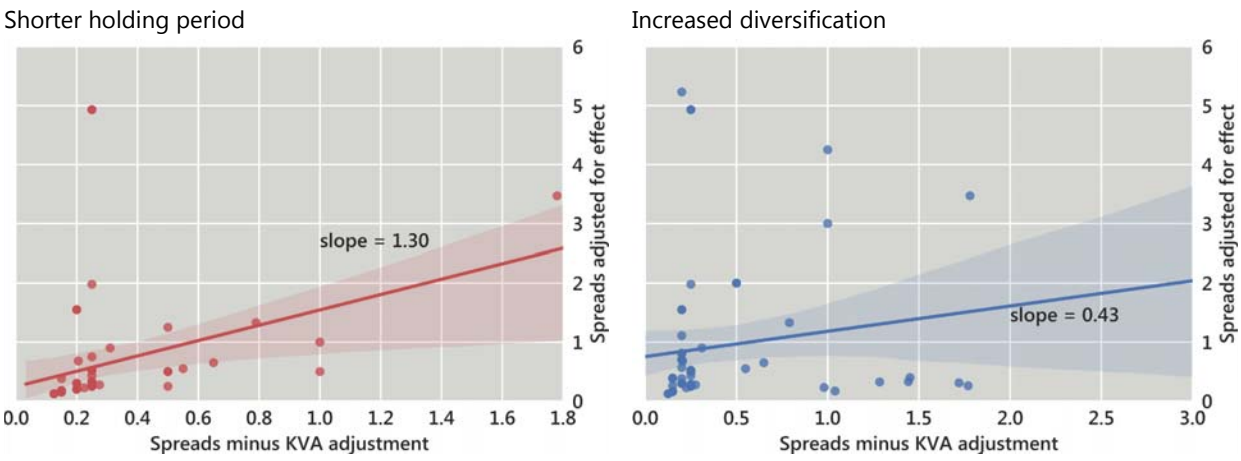
It is not straightforward to determine how much of the difference in cleared cost advantage is driven by the additional CVA of uncollateralised trades, how much by the additional capital required to support CVA risk, and how much by jump-to-default capital requirements.

However, the quantitative survey gives some insight into how much of the differences between CSA prices is explained by capital (or, more precisely, by KVA). Figure F.8 shows the impact of changing assumptions for the trades on KVA.

The left panel shows the impact of a shorter holding period; the effect is strongly related to the KVA-adjustment included in the original trade. In contrast to this strong sensitivity, increasing diversification has a more muted relationship to KVA as shown in the right panel. As the KVA included in trades without a CSA is much higher than the negligible KVA for cleared trades, the higher cost of trades without a CSA relative to cleared trades would be muted, if not eliminated, for shorter holding periods. Conversely, the evidence is consistent with CVA charges driving higher capital charges that are reflected in the expense of trades without a CSA. Funding such capital charges generally would be borne by smaller less active firms that qualify to trade without a CSA.

Figure F.8 Holding period and diversification effects

In relation to KVA



Source: DAT quantitative survey.

The bilateral market for small non-financial counterparties

There are three linked definitions which affect the CSAs required by the post-crisis reforms:

i) when a counterparty is required to clear mandated OTC derivatives;

ii) when and how a firm is required to post initial margin on bilateral OTC derivatives; and

iii) when and how a firm is required to post variation margin on bilateral OTC derivatives.

As noted elsewhere in the report, small non-financial end users are typically exempt from the clearing mandate and both parts of the bilateral margin rules.

While some counterparties can trade without margin, these trades are more expensive due to CVA and due to capital requirements for CVA and for jump-to-default risk. Thus there is a disincentive to trade in this form. This is appropriate given that trading without margin poses more risk. However, it is important that this incentive is properly calibrated to avoid a disproportionate impact, bearing in mind the financial stability objectives of reforms. This is especially the case as the credit spread of small counterparties will often not be perfectly hedgeable, and hence the opportunities to reduce CVA capital requirements by hedging may be limited. Thus there may be a case to consider whether a different treatment of CVA risk for non-financial counterparties who are exempt from the clearing mandate and the uncleared margin requirements is warranted.

The standardised approach to counterparty credit risk

The SA-CCR is scheduled to take effect in many jurisdictions on a timeline which extends to 2022. It plays a number of roles in the prudential framework for banks. For OTC derivatives these include:

- its use as one option in the risk weighted framework for the calculation of counterparty credit risk capital requirements for jump-to-default risk;
- its use to determine the risk weight applied to default fund exposures in the requirements for bank exposures to CCPs; and,
- the use of a modified version of SA-CCR in the leverage ratio and large exposures frameworks as the only option for calculating exposure, as noted above.

A recent CFTC research paper[82] examines the application of the SA-CCR to cleared client portfolios, with particular attention paid to the interaction of initial margin and exposure. For cleared and margined transactions, the SA-CCR first estimates the uncollateralised portfolio exposure (called the 'Add-On' in the SA-CCR), and then scales this value down due to initial margin to produce a residual exposure amount. The level of risk offset from collateral depends on the relative sizing of the Add-On compared to the initial margin posted by the client. Any methodological disconnect between the margin model and the weighted notional sums used to compute the Add-On could lead to either a conservative or generous residual exposure amount.

Over 7,000 client interest rate swap portfolios and their initial margin requirements were used to calculate estimates of residual exposure after collateral using SA-CCR. 95% of portfolios demonstrate a higher residual exposure than would be expected given the safety standard used by CCPs to calculate initial margin requirements. These portfolios are treated as under-collateralised by the SA-CCR. On average, initial margin requirements for leading derivatives CCPs offset only 74% of the exposure, leaving a residual of 26%. This result is equivalent to the SA-CCR effectively treating margin which covers 99.7% of the risk as if it only covered 89%. The residual exposure estimates also show a wide variability from 5% to nearly 100%,

[82] M. Roberson, *An empirical analysis of initial margin and the SA-CCR*, CFTC working paper, July 2018 (www.cftc.gov/sites/default/files/2018-07/SA-CCRPaper0718.pdf).

with a discernible pattern across portfolio types. Large, multi-currency portfolios (such as those often found in client clearing) and short-dated instruments receive a relatively harsher treatment, while portfolios with small net risk in each of the SA-CCR's duration buckets receive comparatively lower estimates.

There are good reasons why the SA-CCR's estimates are more conservative than those of CCP margin models. For instance, capital is the last defence in bilateral transactions, but CCPs have additional resources beyond margin, such as the default fund. Moreover, the SA-CCR is a standardised approach, and hence it is designed to be conservative. Sophisticated banks can apply for permission to use internal model approaches for counterparty credit risk capital calculations in the risk weighted framework (but not the leverage framework), and such a model would presumably often produce counterparty credit risk estimates which were closer to those of CCPs. However, the dispersion in the results for SA-CCR is interesting in the light of the multiple uses it is put to in the prudential framework.

Part C of this report evidenced the growth of clearing in general and client clearing in particular. As client cleared portfolios grow in size, it is important to ensure that the calibration of prudential rules remains appropriate. There may be merit in further analysing the treatment of intra-bucket offsets in SA-CCR and the relative calibration of the approach for single currency vs. multi-currency portfolios and for very short vs. longer maturity IRS exposures in this context.

The current exposure measure

The DAT received comments in qualitative survey responses and market outreach on the impact of the Current Exposure Method (CEM) which is used in many jurisdictions as a standardised approach in the risk-based framework and in a modified form to compute the PFE of derivatives activity for leverage ratio purposes, although it was scheduled to be replaced by SA-CCR to determine risk-based capital requirements by 2017 and to determine the LEM in the leverage ratio by 2022. The responses and emerging research of the impact of the CEM in markets where the standard is applicable are instructive, as they illustrate how policy choices are transmitted and may cause unintended consequences, including impacts on market functioning.

Some of the comments received on the CEM allude to the impact of its treatment of risk-offsetting positions within exchange traded options portfolios. The CEM often treats a deep out-of-the-money strike as equivalent to an at-the-money strike, with no recognition of the former's smaller market risk sensitivity (i.e. lower delta). Thus options portfolios which are well-hedged in delta terms can generate substantial capital charges. Market participants have commented that these features of CEM can cause client clearing service providers to hold capital well in excess of their estimates of the actual risk exposure of their clients' positions in exchange traded options. Seeking to meet their internal return targets, client clearing service providers have reportedly imposed restrictions on the activities of their clients to manage their exposure to the regulatory measure.

Research from the CFTC[83] shows that these restrictions seem to have caused client transactions in options on some equity index futures (a market not examined by the DAT) to shift their

[83] Haynes et al. (2018), *Assessing the Impact of the Basel III Leverage Ratio on the Competitive Landscape of US Derivatives Markets: Evidence from Options*, CFTC Policy Brief, June 2018 (www.cftc.gov/sites/default/files/About/Economic%20Analysis/oce_leverage_and_options.pdf).

business from client clearing service providers affiliated with banks subject to the standard to other client clearing service providers which are not subject to it. In contrast, options on US Treasury futures, which benefit from higher level of offset in the CEM, have not witnessed this shift in client clearing activity. In the survey responses and the market outreach, market participants have commented that the CEM has caused liquidity providers in some equity index options to reduce the range of strikes at which they are willing to provide two way quotes. If this is the case, it may suggest that the treatment of different strike options on the same underlying in the CEM has had an impact on market liquidity.

Annex 1 DAT data sources and inputs

This annex describes the work of the DAT's workstreams in more detail.

Review of regulatory reforms and literature review

This workstream prepared a detailed compendium of relevant standards (including those that have been implemented and those yet to be implemented) in scope for the study, including G20 Leaders' statements on central clearing of standardised OTC derivatives contracts, and standards issued by the BCBS, CPMI, FSB and IOSCO (including in combination) covering bank capital, bank liquidity risk, large exposures, centrally cleared and uncleared margin, and CCP resilience, recovery and resolution.

The workstream also prepared a review of relevant literature (principally peer reviewed journal articles and staff working papers) directly or indirectly relevant to the question of incentives to central clearing of OTC derivatives. These are discussed in Annex 3. Over 50 articles were reviewed and summarised. It is noteworthy that most of the literature relates to credit default swaps, perhaps due to the easier availability of trade data in this asset class. The literature provided insights into: costs and benefits of clearing; multilateral netting efficiencies; the impacts of clearing on market and funding liquidity; CCP risk; interconnectedness and contagion; and collateral dynamics.

Qualitative surveys

Four qualitative surveys were issued by the DAT, targeted at CCPs, OTC derivatives dealers, client clearing service providers, and clients/end users. The surveys covered a wide range of topics including: the scope and size of derivatives activity; the costs of clearing; the impact of the G20 financial reforms relevant to OTC derivatives; the provision of client clearing; access to and the costs of client clearing services; and market structure, capacity and innovation.

Survey responses

Respondents were instructed to provide responses on a group-wide basis. They were also encouraged to complete the survey that best fitted their main role in derivatives, e.g. as a dealer or client. However, where a respondent considered itself to be active in more than one role and wished to respond to more than one survey, they were permitted to do so, while still providing responses on a group-wide basis in each case.

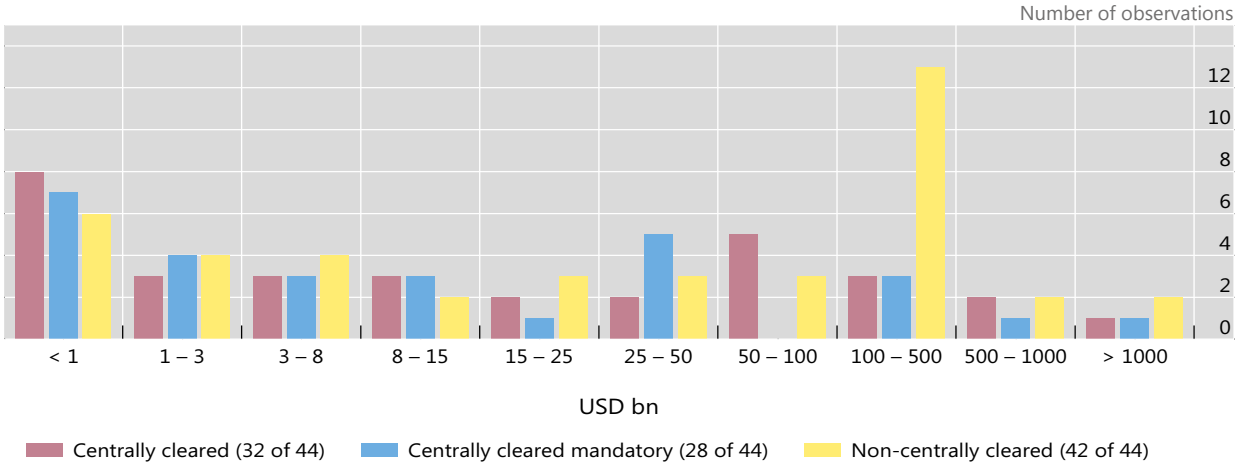
The surveys included a variety of question types such as multiple choice questions, 'tick box' questions, ranking questions (asking respondents to identify and rank answers in order of importance), numerical questions and free text questions. Typically, where numerical information was requested it was by selection of a range rather than a precise value in order to preserve confidentiality. Figure A1.1 summarises the response rates for the qualitative survey.

Responses to the client survey were predominantly from asset managers and banks.[84] A wide variety of client portfolio size types were represented, ranging from less than USD 1 billion of OTC derivatives outstanding to over USD 1 trillion (Figure A1.2).

Table A1.1 Summary of the qualitative survey response rates

Survey type	North America	Europe	Asia Pacific	Africa & Middle East	Total
CCP	3	6	7	1	17
Dealer	8	17	14	0	39
Client clearing service provider	5	10	3	0	18
Client	10	28	6	0	44
Total qualitative	**26**	**61**	**30**	**1**	**118**

Figure A1.2 Client survey respondents by size of notional outstanding derivatives position



Client survey question 6a (minimum 28 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required.

Source: DAT qualitative survey.

Data cleaning process

Responses to the surveys had to be reviewed and 'cleaned' in preparation for data analysis. Where respondents had provided seemingly implausible, inaccurate or inconsistent answers,

[84] There were 22 client surveys responses from banks and other deposit taking institutions; 14 asset managers; seven other financials (including five insurers); and one non-financial respondent.

they were given an opportunity to review and, should the respondent wish to do so, revise and resubmit their answers for those specific questions.

Data cleaning required expert judgement to categorise free text narrative questions. At least two analysts were assigned to each of the four surveys to categorise the responses, with a fifth pair assigned to consider a list of 'common questions' (i.e. where the same, or near identical, questions were asked in multiple surveys). Where responses proved more difficult to categorise, these were subject to review by at least one further analyst not previously assigned to that survey. Each analyst was from a different authority, with a mix of geographic regions represented, providing a range of views and perspectives.

It was not possible to categorise the responses to every question in all the surveys. In some cases this was because the response rates were low, so categorisation would not provide reliable data. In others, the answers were highly heterogeneous making it impossible to create categories that could meaningfully aggregate the responses.

Multiple choice questions did not require as much data cleaning as other types. However, some of these questions provided respondents with the opportunity to add 'other' responses outside the predefined list. Where a large number of respondents provided a similar 'other' answer, these were aggregated into an additional category.

Data analysis and methodology

Given the response rate to the surveys, in particular the client survey, there would be challenges in carrying out meaningful analysis at more granular levels (such as splitting results by region, firm type or firm size) that could be considered sufficiently robust. Thus most of the analysis was conducted at an aggregated level per survey. Granular analysis was also limited due to data confidentiality requirements.

Many respondents provided additional comments alongside their responses to multiple choice questions. These comments were valuable in providing additional information and highlighting circumstances where a response might differ depending on circumstances, but they can also require expert judgement in validation and analysis.

The surveys were not designed to produce precise results which could be tested for their statistical significance. Rather they were intended to provide a more general assessment of the derivatives market which could be used alongside other sources of data and academic literature. As with any surveys of this type, the interpretation of the results should be mindful of the risk of bias in responses. In particular, given the nature and context of the survey, negatively affected institutions were more likely to respond and highlight their specific problems, and less affected institutions were less likely to respond (i.e. the survey was subject to selection bias). There is also a risk of exaggeration (reporting bias).

Questions which asked respondents to rank their answers were analysed according to the ranking methodologies. The following three methodologies ('count', 'first' and 'weighted') were used for computing the responses to ranking questions. Each methodology has benefits and drawbacks.

- The 'count' methodology illustrates the number of times any specific factor was mentioned in a ranking, regardless of where in the ranking it was placed, providing the frequency with which a factor is mentioned.

- The ‘first’ methodology shows the number of times a specific factored was ranked first. This then informs the reader what the single most important factors was for a question.
- The ‘weighted’ method provides the number of times a specific factor was mentioned, weighted by the order in the ranking it was given. The resulting score gives a broader indicator of how important a factor was in the responses to the question. The formula used to derive the score for a given factor here is:

$$\text{score} = \sum_i \left(\text{count}_i \times \text{weight}_i\right)$$

  The weight is determined by where in the ranking the factor is placed. For example, if respondents could choose from seven different options, their first choice would receive a weight of seven, their second choice a weight of six and so on. The weight is therefore conditional on the number of options allowed in each question.

  In cases where respondents provide an incomplete ranking i.e. they are given five options but only ranked three, the same methodology would apply. The top choice would be given a weight of five, the second a weight of four and the third choice a weight of three.

For each free text narrative question across the surveys, the analysis teams prepared an initial list of categories or ‘buckets’ into which each response could be classified. These were then reviewed and updated in light of the actual responses that were submitted.

Quantitative survey

The quantitative survey sought to estimate the all-in cost of cleared trades compared to bilateral alternatives by gathering information on the factors relevant to these costs. Specifically, respondents were asked to provide the actual bid/mid spread they would quote for a given trade structure. A variety of transactions and credit support agreements were studied, as detailed in Part D. The trade types and credit support agreements were selected as a proxy for different proto-typical client types subject to different types of regulation and with different trading requirements. In addition, respondents were asked to provide data on: the clearing fees that are charged to clients of differing levels of activity; initial margin requirements for each trade in cleared and uncleared forms; and lifetime Expected Positive Exposure for each trade (as input for the calculation of variation margin funding costs).

Twenty one of the largest OTC derivatives dealer banks globally were requested to complete the survey, of which 20 responded. Table A1.3 summarises the responses by region. Due to confidentiality and market sensitivity, hypothetical prices were requested rather than actual prices, but reflecting realistic market practices and conventions. Also, certain assumptions were necessary for analysing the data. In practice some costs, such as clearing fees, are influenced by a wide range of factors which vary from firm to firm. However, the quality and reliability of data provided by the respondents was generally considered good and the results are consistent with other data.

Table A1.3 Summary of the quantitative survey response rates

North America	Europe	Asia Pacific	Africa & Middle East	Total
6	11	3	0	20

Regulatory data

The workstream dedicated to TR and regulatory data reviewed this information to provide an overview of OTC derivatives activity globally and in specific regions, asset classes or markets, including around the time of implementation of various relevant reforms. It also sought to corroborate pricing survey data by estimating spreads based on trade data; to provide additional context by analysing trends in centrally cleared vs uncleared trading costs; and to consider the impact of mandatory central clearing and uncleared margin requirements on cleared activity, including changes in client clearing activity and concentration.

Data quality and confidentiality issues created some challenges for TR and regulatory data; these were mitigated through the use of public data, but some issues remained. For example, when corroborating the quantitative survey, observed spreads were widely dispersed, and this limited the ability to control for any reporting bias. Therefore, although no contradictions have been identified, the regulatory data analysis should be seen as a high-level complement to the quantitative survey and potentially useful context, rather than a true validation of it.

Annex 2 Background on other pertinent standards

This annex discusses standards relevant to the work of the DAT which were not fully described in the main body of the report.

CCP robustness and the PFMI

The increased focus on central clearing post-crisis means that CCPs are critical to the overall safety and soundness of the financial system. In response, the SSBs developed standards and guidance to address the risks and authorities have taken steps to ensure that CCPs do not themselves become a source of systemic risk.

The CPSS and IOSCO *Principles for financial market infrastructures* (PFMI)[85] first published in April 2012 are broadly designed to apply to all systemically important payment systems, central securities depositories, securities settlement systems, CCPs and TRs (collectively, FMIs). Some of the PFMI apply only to one or more specific types of FMIs. FMIs that are determined by national authorities to be systemically important are expected to observe these principles. The objectives of the PFMI are to enhance safety and efficiency in payment, clearing, settlement, and recording arrangements, and more broadly, to limit systemic risk and foster transparency and financial stability.

The PFMI do not set forth specific incentives to centrally clear OTC derivatives. However, the PFMI set out certain financial resources, membership, default management, and segregation/portability standards for CCPs that have downstream impacts on clearing members and end users, as discussed in Section B2.

In 2015, the FSB and other SSBs adopted a joint workplan[86] which called for the development of further guidance in those areas building on and supporting the implementation of existing standards relating to CCP resilience, recovery planning, resolution and resolution planning, and analysis of central clearing interdependencies. Implementation of that workplan was largely completed in July 2017.[87]

Implementation monitoring by the CPMI and IOSCO shows that many member jurisdictions have implemented laws and regulations consistent with the PFMI.[88] Figure A2.1 illustrates the position as at July 2017.

In addition, CPMI and IOSCO review CCPs' progress in implementation and the consistency of the CCPs' outcomes of implementation, both with the PFMI and across CCPs, with the last assessment (published in May 2018) covering 19 CCPs (of which 12 clear OTC derivatives). This assessment highlighted that overall, participating CCPs have made progress in

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85 CPSS and IOSCO, *Principles for Financial Market Infrastructures*, April 2012 (www.bis.org/cpmi/publ/d101.htm and www.iosco.org/library/pubdocs/pdf/IOSCOPD377-PFMI.pdf).

86 See *2015 CCP Work Plan* (www.fsb.org/2015/09/2015-ccp-workplan/).

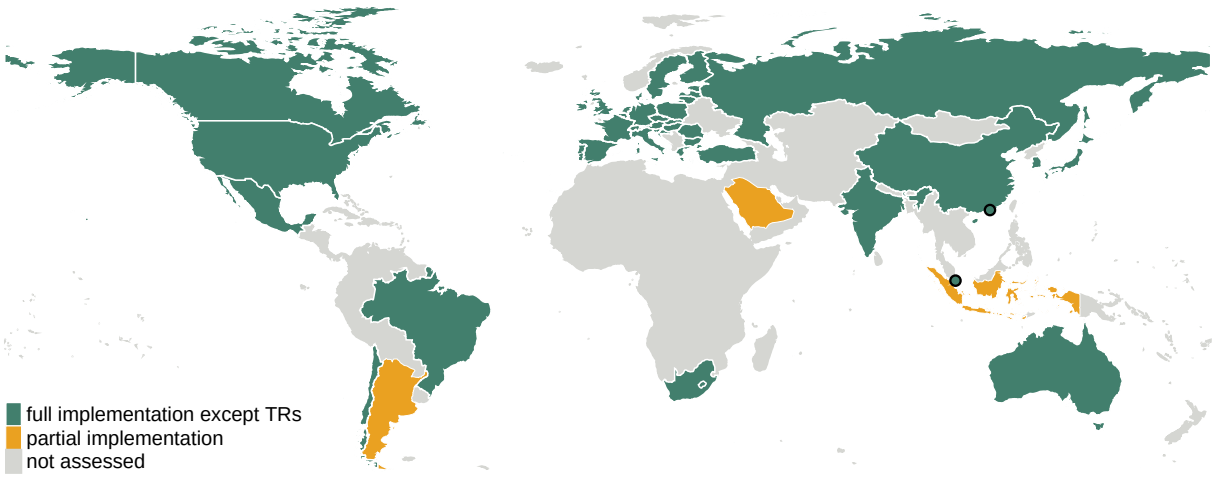
87 See *Chairs' Report on the Implementation of the Joint Workplan for Strengthening the Resilience, Recovery and Resolvability of Central Counterparties*, July 2017 (www.fsb.org/2017/07/chairs-report-on-the-implementation-of-the-joint-workplan-for-strengthening-the-resilience-recovery-and-resolvability-of-central-counterparties/).

88 For example, see *CPMI and IOSCO, Implementation monitoring of PFMI: Fifth update to Level 1 assessment report*, July 2018 (www.bis.org/cpmi/publ/d179.htm and www.iosco.org/library/pubdocs/pdf/IOSCOPD605.pdf).

implementing arrangements that, collectively, help advance the public policy objectives of the PFMI. However in some areas, notably recovery planning, coverage of financial resources and liquidity stress testing, some CCPs have not yet implemented practices that are fully consistent with specific standards of the PFMI.[89]

Figure A2.1 PFMI implementation rating[1]

All FMI types except TRs



[1] Self-assessed PFMI implementation rating for all FMI types except TRs. The black circles represent Hong Kong SAR and Singapore, respectively. In case of split ratings across different authorities within a jurisdiction the minimum rating is used.

Source: CPMI and IOSCO, Implementation monitoring of the PFMI: Fifth Update to the Level 1 assessment report (July 2018).

The clearing mandate

In February 2012, the Technical Committee of IOSCO published the report on *Requirements for Mandatory Clearing*,[90] which set out recommendations that authorities should follow in establishing a mandatory clearing regime within their jurisdiction. These recommendations were in relation to:

- determination of whether a mandatory clearing obligation should apply to a product or set of products;
- consideration of potential exemptions to the mandatory clearing obligation;
- establishment of appropriate communication among authorities and with the public;
- consideration of relevant cross-border issues in the application of a mandatory clearing obligation; and
- monitoring and reviewing on an ongoing basis of the overall process and application of the mandatory clearing obligation.

[89] CPMI and IOSCO, *Implementation monitoring of PFMI: follow-up Level 3 assessment of CCPs' recovery planning, coverage of financial resources and liquidity stress testing*, May 2018 (www.bis.org/cpmi/publ/d177.htm and www.iosco.org/library/pubdocs/pdf/IOSCOPD601.pdf).

[90] See www.iosco.org/library/pubdocs/pdf/IOSCOPD374.pdf.

Since then, a number of jurisdictions have put in place legislative frameworks or other authority, and comprehensive standards or criteria for making specific central clearing determinations, as well as in many (but not all) instance making central clearing determinations.[91] The determinations in force in FSB member jurisdictions as at end-September 2018 are listed in Table A2.2.

Table A2.2 Central clearing determinations[(a)]

AU	*Interest rate:* certain fixed-floating and basis swaps, forward rate agreements (FRA) and overnight indexed swaps (OIS) denominated in AUD, EUR, GBP, JPY and USD
CA	*Interest rate:* certain fixed-to-floating swaps denominated in CAD, USD, EUR and GBP; certain basis swaps denominated in USD, EUR and GBP; certain OIS denominated in CAD, USD, EUR and GBP; certain FRA denominated in USD, EUR, and GBP
CN	*Interest rate*: fixed-floating swaps denominated in CNY
EU	*Credit:* selected European (iTraxx) indices *Interest rate:* certain fixed-floating, and basis swaps, FRA and OIS denominated in EUR, GBP, JPY and USD *Interest rate:* certain fixed-floating swaps and FRA denominated in NOK, PLN and SEK
HK	*Interest rate:* certain fixed-floating and basis swaps denominated in EUR, GBP, HKD, JPY and USD and OIS denominated in EUR, GBP and USD
IN	*FX*: INR-USD forwards *Interest rate:* OIS & Mumbai Interbank Forward Offer Rate (MIFOR)
ID	*Commodity*: OTC commodity derivative transactions are required to be registered at the clearing house.
JP	*Credit*: selected Japan (iTraxx) indices *Interest rate*: fixed-floating and basis swaps denominated in JPY
KR	*Interest rate*: fixed-floating swaps denominated in KRW
MX	*Interest rate*: certain fixed-floating swaps denominated in MXN
RU[(b)]	*Interest rate*: certain fixed-floating and basis swaps, OIS denominated in RUR
SG[(b)]	*Interest rate*: fixed-floating swaps denominated in SGD and USD
CH[(b)]	*Credit*: selected European indices (iTraxx) *Interest rate*: certain fixed-to floating swaps and basis swaps, in each case denominated in EUR, GBP, JPY, USD; certain FRA and OIS in each case denominated in EUR, GBP, USD
US	*Credit*: selected North America (CDX) and Europe (iTraxx) indices *Interest rate*: certain fixed-floating, basis swaps, FRA and OIS denominated in EUR, GBP, JPY (ex-OIS) and USD. Swaps in such currencies other than fixed-floating and basis swaps, FRA, and OIS denominated in EUR, GBP and USD with terms between 2 and 3 years. *Interest rate*: certain fixed-floating swaps denominated in AUD, CAD, HKD, MXN, NOK, PLN, SGD, SEK, and CHF; certain basis swaps denominated in AUD; FRA in NOK, PLN, and SEK; and certain OIS denominated in AUD and CAD.

(a) For more details on mandatory clearing requirements currently in force, see IOSCO information repository available at: www.iosco.org/publications/?subsection=information_repositories. (b) Indicates that as at end-September 2018 the determination had been made and was due to come into force on 1 October 2018 (SG and CH) or Q4 2018 (RU).

Source: FSB member jurisdictions.

[91] See FSB, *OTC Derivatives Market Reforms Thirteenth Progress Report on Implementation*, November 2018 (www.fsb.org/2018/11/otc-derivatives-market-reforms-thirteenth-progress-report-on-implementation).

Margin requirements and other risk mitigation standards for uncleared derivatives

Standards and reforms relating to uncleared derivatives are also relevant to the question of incentives to centrally clear.

The March 2015 BCBS-IOSCO *Minimum standards for margin requirements for non-centrally cleared derivatives*[92] carry an explicit objective of promoting central clearing. In these standards, margin for uncleared derivatives is expected to reflect the generally higher risk associated with these instruments. Other objectives of the standards include reducing systemic risk and limiting both the build-up of uncollateralised exposures within the financial system contagion and spill-over effects, by ensuring that collateral is available to offset losses caused by the default of a derivatives counterparty.

All covered entities under this standard that engage in uncleared derivatives must exchange, on a bilateral basis, the full amount of variation margin regularly (e.g. daily) and initial margin with a threshold not to exceed EUR50 million. Covered entities include all financial firms and systemically important non-financial entities. Central banks, sovereigns, multilateral development banks, the Bank for International Settlements, and non-systemic, non-financial firms are not covered by these requirements.

Assets collected as collateral for initial and variation margin should be highly liquid and should, after accounting for an appropriate haircut, be able to hold their value in a time of financial stress.

The standards apply only to new transactions that take place after the implementation date. The implementation dates for various requirements are phased in depending on a covered entity's notional amount of uncleared derivatives. The initial implementation date to exchange variation and initial margin was 1 September 2016. The initial margin schedule includes progressively lower thresholds, ending with a final implementation date of 1 September 2020. The implementation date for exchange of variation margin for all other covered entities was 1 March 2017.

IOSCO also published *Risk Mitigation Standards for non-centrally cleared OTC Derivatives* in January 2015,[93] which aim to promote legal certainty, facilitate timely dispute resolution, facilitate the management of counterparty credit risk and other risks, and increase overall financial stability. They include standards in the following areas: trading relationship documentation; trade confirmation; valuation processes; portfolio reconciliation; portfolio compression; and dispute resolution.

BCBS standards for measuring capital requirements for counterparty credit risk

The internationally agreed post-crisis set of measures developed by the BCBS known as Basel III aim to strengthen the regulation, supervision and risk management of banks. Amongst these, there are some standards relevant to OTC derivatives, briefly summarised below.

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92 BCBS-IOSCO, *Margin requirements for non-centrally cleared derivatives*, March 2015 (www.bis.org/bcbs/publ/d317.htm and www.iosco.org/library/pubdocs/pdf/IOSCOPD480.pdf).

93 IOSCO, *Risk Mitigation Standards for Non-centrally Cleared OTC Derivatives*, January 2015 (www.iosco.org/library/pubdocs/pdf/IOSCOPD469.pdf).

Counterparty credit risk

The BCBS *Standardised approach for measuring counterparty credit risk exposures* (March 2014, revised April 2014),[94] known as SA-CCR, is a component of the risk weighted asset (RWA) framework for determining risk-based capital requirements. SA-CCR was introduced to provide an approach that: is suitable to be applied to a wide variety of derivatives transactions (margined and unmargined, as well as uncleared and centrally cleared); is capable of being implemented simply and easily; addresses known deficiencies of the prior methods, the Current Exposure Method (CEM) and the Standardised Method; draws on prudential approaches already available in the Basel framework; minimises discretion used by national authorities and banks; and improves the risk sensitivity of the capital framework without creating undue complexity.

The SA-CCR applies to OTC derivatives, exchange traded derivatives and long settlement transactions, for internationally active banks that do not use an internal model for measuring counterparty credit risk. It is the only method permitted to calculate OTC derivatives exposure in other areas of Basel III such as the leverage ratio (and, as a result, one of the G-SIB measures). Similar to the CEM, the exposures under the SA-CCR consist of two components: replacement cost (RC) and potential future exposure (PFE). However, SA-CCR has developed more sophisticated methods to compute those two components.

The formulae for RC are differentiated between transactions with or without a margin agreement so as to reflect the effect of margining agreements and the associated exchange of collateral in the calculation of counterparty credit risk exposures. The formulae for PFE consist of (i) aggregated add-ons calculated by asset class-specific formulae and (ii) a multiplier for the recognition of excess collateral or negative mark-to-market value for the transactions so that the risk-reducing property of excess collateral can be reflected.

Some (typically larger) banks may instead in some cases be able to use the Internal Model Method.[95] A qualifying internal model for measuring counterparty credit exposure must estimate the forecasting distribution for changes in the market value of the netting set attributable to changes in market variables, such as interest rates, foreign exchange rates, etc. The model then computes the firm's counterparty credit risk exposure for the netting set at each future date given the changes in the market variables. Banks may include eligible financial collateral in their forecasting distributions for changes in the market value of the netting set, if the quantitative, qualitative and data requirements for Internal Model Method are met for the collateral.

Bank exposures to CCPs

The BCBS considers that banks' exposures to CCPs should be subject to capital requirements to ensure that they manage and monitor their exposures to CCPs, and to reflect the fact that even though CCPs may carry lower counterparty credit risk, they are not risk-free. To that end,

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[94] See www.bis.org/publ/bcbs279.pdf.

[95] See Annex 4 para 25 through 68 of *Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework - Comprehensive Version*, June 2006 (www.bis.org/publ/bcbs128.pdf).

the *Capital requirements for bank exposures to central counterparties* was published in April 2014.[96]

The standard distinguishes, first, between the exposures of CCP clearing members and the exposures of clients. With respect to a clearing member, the regime deals both with the clearing member's exposures to a CCP and its exposures to its clients. Second, the standard differentiates between exposures to qualifying CCPs (QCCPs), which carry lower capital requirements, and to non-qualifying CCPs. Third, it distinguishes between 'trade exposures' (i.e. trade exposures to the CCP arising from OTC and exchange traded derivatives transactions, securities financing transactions and long-settlement transactions and their associated margin) and default fund exposures. Back-to-back exposures to QCCPs that correspond to client trades, and assets posted as collateral to a CCP that are bankruptcy remote in the event of the CCP's insolvency carry a zero weight. The risk weight relating to default fund exposures depends on the riskiness of the default fund, which in turn is determined by the total amount of initial margin required by the CCP compared to the amount that would have been required had SA-CCR been used to calculate PFE.

The value of the trade exposure to QCCPs is calculated using either the IMM or SA-CCR, consistent with the methods applied by the bank to other trade exposures, and making use of counterparty credit risk mitigation techniques permitted for OTC derivatives. For trade exposures to non-qualifying CCP, the Standardised Approach for credit risk is to be used.

Exposures to clients arising from central clearing are largely calculated as if they were uncleared trades, reflecting the counterparty credit risk of the client.

[96] See www.bis.org/publ/bcbs282.pdf.

Annex 3 Research discussion

This annex summarises the research on OTC derivatives market structure and central clearing published as working papers or in peer-reviewed journals reviewed by the DAT. It also suggests further research topics which, in the light of the DAT's findings, may be of interest to the broader academic community.

Literature Review

The following subsections summarise the main areas of research investigated by the DAT, and provide references to some of the literature in each area.

Incentives to centrally clear

Several papers relate directly to the DAT's objectives. For instance, Ghamami and Glasserman (2017) study whether recent regulatory standards imposed in OTC derivatives markets incentivise central clearing by offering a cost advantage for central clearing versus non-central clearing; they observe that, under certain assumptions, bilateral clearing may have lower costs than central clearing.[97] The authors examine whether rules relating to OTC trading of higher capital and margin requirements incentivise central clearing by increasing the relative cost of uncleared transactions. Bellia et al. (2017) perform a related asset-specific study where they analyse whether the post-crisis regulatory reforms have created appropriate incentives for different types of market participants to centrally clear single-name sovereign CDS contracts.[98] They observe that incentives to clear vary across different reference entities depending on the underlying factors from margin costs, counterparty credit capital requirements, risk management and transparency. Aldasoro and Ehlers (2018) show how these incentives have played out in the CDS market.

The current state of the OTC derivatives markets

Various official sector data sources contain a wealth of data on OTC derivatives markets and analysis of them. See for instance BCBS (2018), BCBS et al. (2017), FSB (2017), and the CFTC's Weekly Swaps Report.

ISDA (2016) summarised market trends for clearing access, and identified new costs and fees.[99] Their note emphasises a deterioration of clearing access for smaller derivatives users, particularly in the United States.

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[97] Ghamami and Glasserman (2017) use a unique data set which allows for a rich analysis. Nevertheless, there are some limitations, one of them being that there are regulatory standards on OTC derivatives that are not considered, for example the leverage ratio. Also a limiting assumption is that the model does not allow for cross-asset class netting in central clearing, and does allow for it in bilateral portfolios. However some CCPs allow for it in some circumstances, while it is not permitted in the uncleared margin rules. The authors note that the main factors driving their cost comparison are netting benefits, the margin period of risk, and CCP guarantee fund requirements. Lower guarantee fund requirements lower the cost of clearing but make CCPs less resilient.

[98] Bellia et. al. (2017) analysis is limited to sovereign CDS transactions.

[99] The ISDA note refers exclusively to uncleared transactions.

Central clearing and counterparty credit risk transformation

Academic literature examining the cleared CDS market is richer than in other asset classes, due to better data availability, often via the Trade Information Warehouse. To the extent that a wider range of data could be made available to suitable academic researchers with appropriate safeguards, it might stimulate research in other asset classes.

Loon and Zhong (2014) show that CDS spreads of centrally cleared reference entities increase with the initiation of central clearing, consistent with the notion that central clearing reduces counterparty risk. Campbell (2014) estimates that central clearing of US CDS reduced notionals outstanding by 60%.[100] Gündüz (2016) notes in a working paper that market participants are able to hedge counterparty risk using CDS contracts written on their counterparties, suggesting ways that market participants can mitigate counterparty risk themselves, even when central clearing is not available.[101] Du et al. (2016) investigate whether central clearing has had an impact on how participants value CDS contracts.[102] They find that transaction spreads on centrally cleared trades are significantly lower relative to spreads on contemporaneous uncleared transactions, pointing to lower costs partially due to the reduced counterparty risk. More recently, Kaya (2017) argues that increases in the CDS spread associated with central clearing may be attributable to the costs of central clearing that are passed on to the end-users of CDS contracts and not to reductions in counterparty risk.[103]

Garratt and Zimmerman (2015) extends the work of Duffie and Zhu (2011) to show that introducing a CCP to an OTC market is likely to reduce both the level and the variation of net exposures.[104] Glasserman et al. (2015) study margins in a model of multiple CCPs. Their model shows how, in a stylised setup where CCPs share common beliefs about price impact and member positions, CCPs can impose margin charges that cause members to internalise the full cost of liquidation in the event of default.

The netting efficiency of central clearing sometimes depends on jurisdictional factors which can influence the topology of the network of exposures. Anderson et al. (2013) discuss this in the context of linked CCPs, while Budding and Murphy (2014) consider the design choices in central clearing for small advanced economies.

Market liquidity, funding liquidity, procyclicality and costs of trading

Loon and Zhong (2016) find that centrally cleared CDS trades are associated with higher liquidity than uncleared trades. Specifically, they note that cleared trades have a lower transaction cost, price impact, and price dispersion than uncleared trades, and the differences are statistically significant. Their results suggest that the reduced counterparty risk associated with central clearing, and increased post-trade transparency, have beneficial effects on liquidity.

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[100] Loon and Zhong (2014) concentrate their analysis on only 132 North American reference entities.

[101] Gündüz (2016) baseline transaction-level dataset encompasses all new trades' referencing German entities from November 2006 to February 2012.

[102] Du et al. (2016) is limited to viewing CDS data held by the DTCC's Trade Information Warehouse where at least one counterparty, or the reference entity, is regulated by the Board of Governors.

[103] Kaya (2017) uses a very short time span from 2009 to 2013 and an specific sample of reference entities, single-name non-financial corporate CDSs that became clearing-eligible at ICE Clear Credit between December 2009 and January 2013.

[104] Garratt and Zimmerman (2015) and Duffie and Zhu (2011) use a stylised model, which are difficult to calibrate to real-world data.

Haynes and McPhail (2017) examine trading costs by mapping out the dealer-to-customer network in the index CDS market and find that more connected clients on average face reduced transaction costs. Using audit trail data, Riggs et al. (2017) examine the mechanism design of the electronic trading networks for index CDS and find similar patterns in activity of client and dealer choice.

Relatedly, Brunnermeier and Pedersen (2009) examine how funding liquidity and market liquidity interact. They find that reductions in funding liquidity can translate into degradations of market liquidity, paralleling arguments that excessive procyclicality of margins may have negative implications for market functioning during periods of stress. A number of other papers seek to understand further implications for funding flows and risks. See for instance Cont (2017), Duffie et al. (2015), Glasserman and Wu (2017), Lewandowska and Glaser (2017) and Murphy et al. (2014).

Empirical research on the evolving market structure of OTC derivatives markets in other asset classes in the post-reform period remains somewhat preliminary. Using a mix of TR and other regulatory data, Benos, Paynes, and Vasios (2018) examine the impact of the introduction of the execution mandate in the US on the interest rate swap markets and generally find positive effects.

The DAT is not aware of any relevant research on impact of the Basel capital rules on market liquidity and execution costs in the OTC derivatives markets. This is likely due to the fact that detailed data from these markets has been available only recently. Nonetheless, emerging research on this topic, though in the context of corporate bond and government securities markets is illustrative of research questions and econometric approaches, especially as trading in these markets is linked to OTC derivatives. Recent papers include Adrian et al (2015), Adrian et al (2016), Mizrach (2015), Bessembinder (2016) and Cho (2016).

Collateral and its role in clearing

Work on collateral flows has focussed on the increased demand for collateral caused by the post-crisis reforms, the reduced capacity for banks to act as collateral intermediaries and examples of risks and vulnerabilities in collateral flows. See for instance Aguiar et al. (2016), Murphy et al. (2016) and Singh (2014).

The calibration of regulation relevant to OTC derivatives and repo markets

Kotidis and van Horen (2018) study adjustments within dealer-client quotes in repo clearing and find that dealer banks subject to a more binding leverage ratio, following regulatory changes, offered lower rates. In repo markets, they found the volume traded with smaller clients reduced compared to dealer banks not affected by the change. Larger clients and clients with whom the dealer has a strong lending relationship prior to the change were not affected. Related work on the impact of the leverage ratio on OTC derivatives client clearing from Acosta-Smith et al. (2018) was discussed in Section F5. In the context of funding liquidity, Duffie (2016) examines impact of recent regulatory mandates like stricter capital and leverage requirements on historically low-return businesses such as repo intermediation.

The calibration of various risk-weighted capital and margin requirements as they apply to OTC derivatives has also been studied in the literature: see for instance Lin and Surti (2015) for margin and Roberson (2018) for counterparty credit risk capital requirements.

CCP risk management and risk analysis

Literature focused on measures of CCP risk typically assess resilience using the 'CCP as CDO' analogy which treats the various tranches of CCP financial resources as akin to the tranches of a CDO whose underlying assets are the receivables arising from clearing. These techniques can also be extended to recovery tools and other contingent obligations. See Armakola and Laurent (2017), Cont (2015) and Murphy and Nahai Williamson (2014), or for a broader view of indicators of CCP resilience, Alfranseder et al. (2018) and Armakola and Bianchi (2017).

Another strand of work in this area examines legal risk around clearing, CCP default management, and recovery and resolution frameworks. Work here includes Braithwaite and Murphy (2016). Finally, as Carter and Garner (2016), Huang (2016) and McPartland and Lewis (2017) point out, it is also important to understand the incentives created by the structure and sizing of CCP financial resources and to ensure that these do not undermine the objectives of the OTC derivatives reform. Braithwaite (2016), Roe (2013) and Squire (2014) also discuss incentives and systemic risk from the perspective of legal scholars, pointing out the potential for clearing in some circumstances to exacerbate the market interconnectedness and systemic risk that policy makers intended to reduce.

Systemic risk

Early work on systemic risk and central clearing, such as Pirrong (2011) and Allen (2012), focussed on new or newly important risks created by the uptake of OTC derivatives central clearing. Subsequent work, such as the BIS analysis of 2013, includes an attempt to assess the benefits: see the discussion in Section F1 for further details of this strand of work.

In addition to the particular aspects of systemic risk discussed above, such as procyclical liquidity risk and CCP robustness under stress, there are also more general assessments of the contribution of central clearing to systemic risk. See for instance Boissel et al. (2017) and Domanski et al. (2015). Another strand of work in this area is formed by the literature on network fragility and the impact of the geometry of exposures on robustness. Paddrik et al. (2016) is an example of this which uses CDS data, while Borovkova and El Mouttalibi (2013) and Marshall et al. (2018) considers centrally cleared vs. uncleared networks more generally.

Potential research questions arising from the work of the DAT

The DAT's mandate was to investigate the impact of reform measures and their interaction on incentives to clear OTC derivatives. In pursuing that mandate, a number of questions have arisen that may be of interest to the academic community and other interested parties. This section presents those questions.

Empirical work on OTC derivatives market structure transformation

The post-crisis reforms have resulted in a large-scale transformation of the structure and interconnectedness of OTC derivatives exposures. This is an intended consequence. Valuable further empirical work on this transformation could include studying:

- the **structure** of centrally cleared markets, as measured by variables such as the level and types of interconnectedness within the network, the content and standardisation of the underlying contracts, the ownership and governance of CCPs, and the structure and terms of CCP financial resources;

- the level of **concentration,** of client risks, of house risks, of client clearing service provision, and of CCPs;
- the ability of end-users to **access** both bilateral and centrally cleared markets and when necessary to port cleared positions and collateral;
- the changes in liquidity conditions in the OTC derivatives markets, the market structure of centrally cleared and uncleared, and the cost of transferring risk in these markets;
- the costs and benefits, both private and social, of **alternative approaches for and designs of CCP capital resources**; and
- the design of CCPs' **recovery and resolution procedures** and the incentives or disincentives that they might create.

Work in this area could further contribute to assessments of how market adaptations, partly but not wholly driven by regulatory reform, contribute to systemic risk. There is also value in mapping the various available data sources, so that interested parties have a better sense of the potential resources in public sources, trade repositories, and other regulatory data.

Research questions on OTC derivatives policy choice and calibration

The design of regulation can have a profound influence on market structure, efficiency, and systemic risk. Broader questions than the DAT's focus on incentives to centrally clear are also relevant in exploring this influence. Questions include:

- How do the regulatory costs end users of OTC derivatives bear compare to the risk they bring to the system? That is, if regulatory costs are designed to price externalities, how well do they actually do that? The issues in answering this question are formidable, not least in quantifying the externalities generated by financial instability, in allocating them to their causes, and in analysing the mechanisms by which they give rise to stress. Nevertheless, even a relative analysis of costs for various classes or sizes of user versus systemic risk contribution could be valuable for regulatory calibration.
- Could either the micro-prudential risk of CCP stress or its macroprudential (systemic) consequences be reduced at acceptable cost by modifications to minimum requirements for CCP financial resources, the structure and terms of the default waterfall and/or recovery and resolution mechanisms? This question is important both for understanding the limits of CCP resources during periods of extreme stress, but also for analysing what impact they are likely to have on the redistribution of risk within the financial system. Work here would also involve further development of CCP risk analysis techniques.
- Where do the benefits of central clearing outweigh the dangers of putting more risk into CCPs? Specifically what are the costs and benefits of mandating central clearing for large directional end user positions? The efficiency benefits for end users (e.g. availability of inter-dealer liquidity and cost synergies from shared clearing infrastructure) could be balanced against higher safety standards (and therefore costs) for CCPs. Research in this area might be useful to shed light on the appropriate calibration of the boundary between those who are required to clear and those that are not.

- What impact do changes in trading liquidity in cleared and uncleared markets (including as a result of G20 post-crisis reforms), and any bifurcation between them, have on availability of efficient risk transfer for various classes of market participant?
- Is regulation concerned with the uncollateralised bilateral market properly calibrated for its intended user base of non-systemic clients? In particular, what implications does the debate about the valuation of XVAs have for the capitalisation of the risk of these adjustments? For example, is marking the CVA of counterparties for whom a credit spread is not directly observable to a proxy, and the hedging of that CVA with that proxy, appropriate given the residual risks, or would an alternative treatment be more appropriate?
- How could the benefits and costs of using margin as a counterparty credit risk reduction mechanism be compared to using capital? Research in this area could consider the optimal scope and size of initial margin requirements in the uncleared margin standards.

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Annex 4 Additional methodology, charts and data from survey analysis

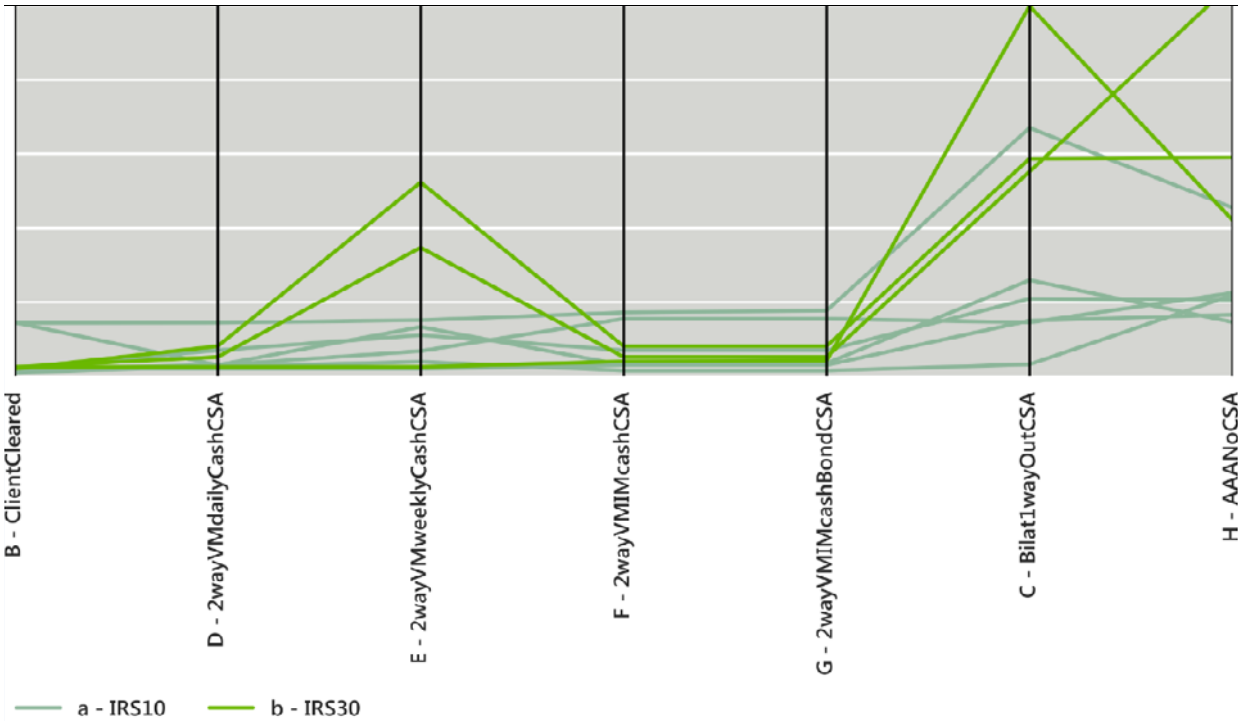
This annex presents additional tables, figures and discussion on aspects of the quantitative survey not covered in the main text.

Bid/mid spread comparison

The most straightforward comparison of trades under different CSAs focuses on spreads, because these are directly reported in the survey. To illustrate the observed pattern here, Figure A4.1 shows bid/mid spreads for the two interest rate swap trades across various client CSAs. Moving from left to right, the first CSA denotes central clearing; the next two denote trades that require two-way variation margin only; the next two denote trades requiring variation margin and initial margin; and the last two denote trades without client variation margin.

A4.1 Average bid/mid spreads for IRS Trades by CSA Type

In basis points



Source: DAT quantitative survey.

The general pattern, seen most easily by the green lines for the thirty year IRS trades, is that the spreads for central clearing are the lowest; this result holds in the aggregate for all trades.[105] Spreads tend to be somewhat higher for uncleared trades that include initial margin and trades where variation margin is exchanged daily. Trades with weekly variation margin show a premium, and trades where clients do not pay variation margin have an even higher premium.[106]

[105] In the responses, dealer-to-dealer spreads are equal to centrally cleared spreads for clients. Consequently, results for dealer-to-dealer spreads will generally not be included. The all-in costs for such trades should universally be cheaper than the costs for the comparable centrally cleared client trade.

[106] Trades with no variation margin for clients with lower credit quality are not shown; the spreads for such trades are substantially higher.

This pattern in spreads is a necessary, but certainly not sufficient condition for central clearing to be incentivised, because there are additional costs associated with central clearing. Consequently, most of the analysis in the main body of the report focused on comparing all-in costs.

The impact of client funding costs on incentives to clear

Although the impact of layering high client funding costs on top of low activity were not impactful in Table D.8, the complete survey results suggest that higher funding costs do tend to reduce, but do not eliminate, the incentive to clear. Table A4.2 illustrates this for the ten year IRS. A higher cost of funding increases the cost of posting margin, increasing costs for both centrally cleared and bilaterally cleared trades. Although funding effects increase the margin cost for bilaterally cleared trades, somewhat counterintuitively the percentage difference shrinks. The reason for this is that a higher overall cost means that the difference is smaller in percentage terms. This effect provides further evidence that initial margin requirements for bilateral trades are sometimes not much larger than centrally cleared initial margin.

Table A4.2 The impact of client rating and funding cost on the cleared cost advantage for two way CSAs

Trade	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM	2 way VM, daily cash	2 way VM, weekly cash
IRS10, AAA client	41%	45%	-25%	0%
IRS10, single A client	30%	33%	-35%	-19%
IRS10, BB client	23%	24%	-41%	-33%

Assumptions: client clears 50 trades per month, client has a diversified portfolio, and clearing member holds client initial margin on its balance sheet. The minimum number of observations used for any cell in this table is 11.

The survey often shows that the collection frequency of variation margin – daily or weekly – substantially affects costs. The only avenue for this is in the spreads charged. The last two columns of Table A4.2 show that weekly collection leaves dealers more exposed to counterparty risk as compared to daily, and this is reflected in the spread charged, reducing the disincentive to clear.

Because clients trading under VM only CSAs are more likely to be low activity clients, it is worthwhile repeating the analysis of the impact of trading activity for these CSAs. Table A4.3 shows an unsurprising disincentive to centrally clear. However, there is an interesting pattern. Specifically, for lower activity clients, and particularly those with high funding costs, the difference between the relative costs for daily versus weekly variation margin is greatly reduced.

Table A4.3 The impact of client OTC derivatives clearing activity on the cleared cost advantage

Trade	2 way VM, daily cash	2 way VM, weekly cash	1 way out	No CSA
IRS10, high activity client	-35%	-19%	33%	40%

IRS10, middle activity client	-35%	-19%	32%	40%
IRS10, low activity client	-49%	-37%	4%	9%
IRS10, low activity and high funding cost client	-49%	-42%	-36%	-33%

Assumptions: client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and client is A rated. The minimum number of observations used for any cell in this table is 11. A high activity, middle activity, and low activity client is assumed to clear 100, 50, and 1 trades per month, respectively.

The relative costs of these trades respond to funding costs and credit rating somewhat differently. In Table A4.4, clients rated AAA are strongly incentivised to clear bilaterally under a 1 way out CSA, while the incentive under no CSA is similar to that under full bilateral margining. For A rated clients, centrally clearing is incentivised for both types of bilateral trades near the levels observed for full bilateral margining. Finally, BB rated clients' incentives diverge, as central clearing is very strongly supported for trades without a CSA, but disincentivised for 1 way CSAs. This divergence is surprising, but it is not clear whether there are many, or any clients with this rating who trade with this CSA.

Table A4.4 The impact of client rating/funding cost on the cleared cost advantage

Trade	1 way out	No CSA
IRS10, AAA client	121%	40%
IRS10, single A client	32%	40%
IRS10, BB client	-26%	101%

Assumptions: client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and client is A rated. The minimum number of observations used for any cell in this table is 11.

Clients versus clearing members

It is worth confirming that the cost structure of the OTC markets supports dealers' central clearing. Client clearing entails a different cost structure compared to being a clearing member: clients pay clearing fees, whereas clearing members contribute to mutualised CCP resources amongst other member obligations. In the first row, Table A4.5 shows that central clearing is incentivised for dealers; the results are similar to the client incentives. The analysis does not, however, include the other costs associated with being a clearing member (such as default fund contributions), so it may overstate the cost advantages of clearing membership.

Table A4.5 The cleared cost advantage for clearing members vs. clients

Trade	2 way VM & IM, cash	2 way VM & IM, cash VM, bond IM
IRS10 as clearing member	35%	38%
IRS10 as client	30%	33%

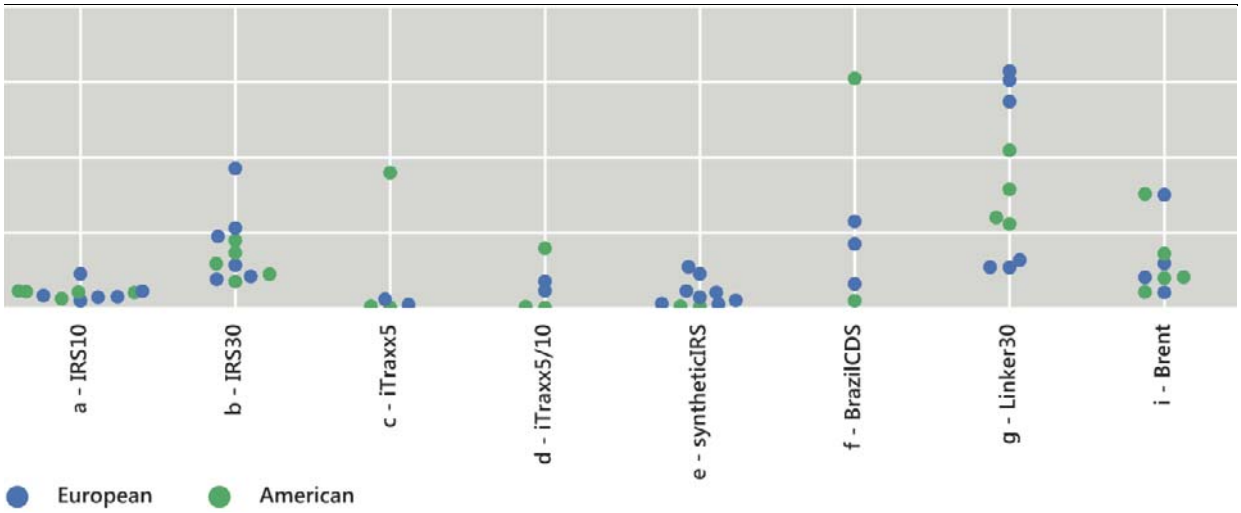
Assumptions: client clears 50 trades per month, client has a diversified portfolio, clearing member holds client initial margin on its balance sheet, and client is A rated. The minimum number of observations used for any cell in this table is 11.

Spread variability for 1 way and no CSA trades

The relative incentives for centrally cleared vs. uncleared trades sensitively depend on contract spreads, as previously discussed. The variability of results is driven by variability in these spreads. The DAT reviewed the spreads for patterns, without significant insight. As shown in Figure A4.6, even for a highly-rated client, the spreads dealers quoted often varied significantly.

Figure A4.6 Spreads for trades with 1 way and no CSA and AAA-Rated Counterparty

Spread in basis points



Source: DAT quantitative survey.

This dispersion was larger for longer-dated trades, which also tended to have higher spreads. The jurisdiction of dealers was examined, but it did not seem to have power in predicting the spreads quoted. Interestingly, for the thirty year inflation swaps the variability in quoted spreads amongst European dealers was much greater than that amongst American dealers, and there were two clusters of spreads from European dealers that bracketed the American dealers' quotes.[107] However, the bracketing implied that the average of European and American spreads was close.

The most significant finding for the analysis of these exceptional trade structures was to confirm the observation of high bilateral costs relative to central clearing, particularly for trading without a CSA.

The dispersion of cleared cost advantage for other trades

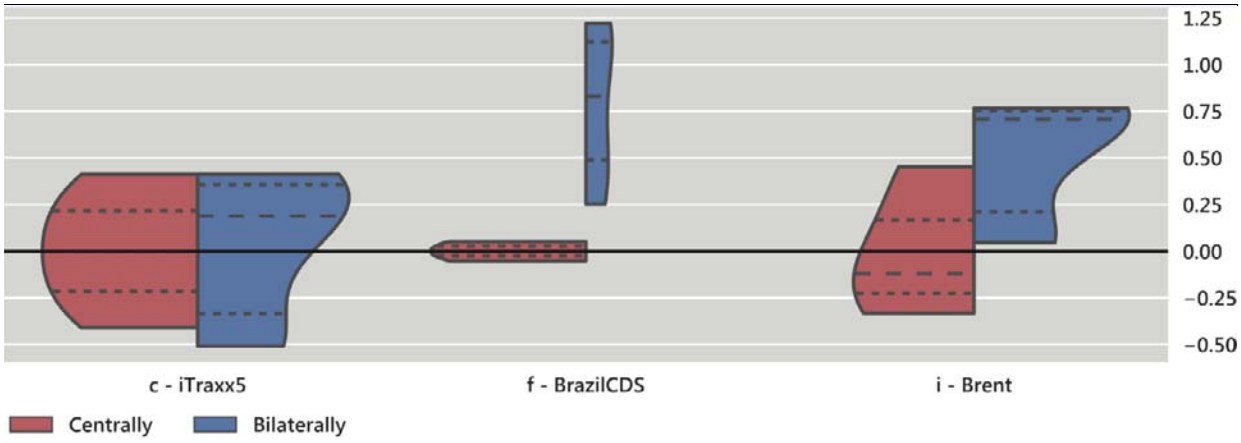
Figure A4.7 presents the distributions of relative costs for centrally cleared and uncleared trades in other asset classes for initial and variation margin CSAs. This is more complicated than for the interest rate derivatives discussed in the main body of the report. First, the distributions for iTraxx largely overlap, showing a relatively weak incentive to centrally clear. In contrast, the distributions for CDS on Brazil do not overlap at all, consistent with a universal incentive to clear across all respondents. However, this strong result may partly reflect fewer respondents

[107] Asian dealers were included in the survey but not included in the figure, for sample size concerns.

for these trades. Finally, the distribution for Brent is similar to that for IRS, suggesting that central clearing is often more beneficial, but not always so.

Figure A4.7 The distribution of respondent relative costs for trades cleared centrally vs bilaterally with initial and variation margin

Difference from average cleared costs, in per cent



Source: DAT quantitative survey.

Annex 5 Additional insights from qualitative survey responses

This annex presents additional figures which provide analysis of qualitative survey responses relevant to the DAT study. These are grouped into five mains areas:

i) Figures A5.1 and A5.2 discuss drivers of change in OTC derivatives clearing activity, while Figure A5.3 looks at the specific question of the drivers of clearing for non-mandated products.

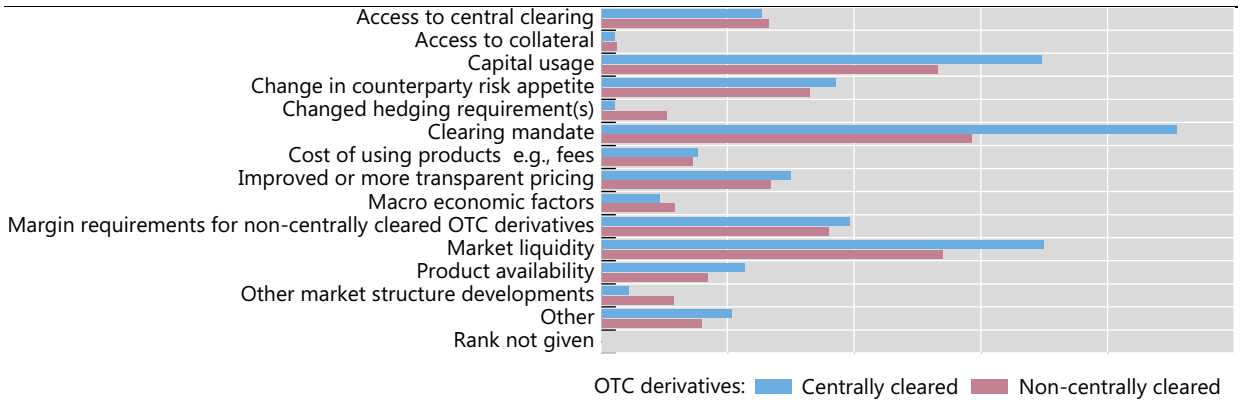
ii) Figure A5.4 presents survey respondents' views on the impact of reform on financial system stability.

iii) Figure A5.5 presents survey respondents' views on the impact of reform on the concentration in client clearing service provision.

iv) Figures A5.6, A5.7 and A5.8 look at aspects of client clearing, specifically restrictions placed on clients, the impact of changes in the cost of clearing, and the types of fees clients are charged.

v) Figures A5.9 and A5.10 examine the substitutability of clearing service provision and the consequences of concentration. A5.9 presents responses on client reasons for not having multiple providers while A5.10 presents client clearing service provider views on the sufficiency of the market capacity available to absorb the clients of a defaulting large clearing member.

Figure A5.1 Weighted ranking of drivers behind volume change in centrally and uncleared OTC derivatives between 2012 and 2017 for dealers

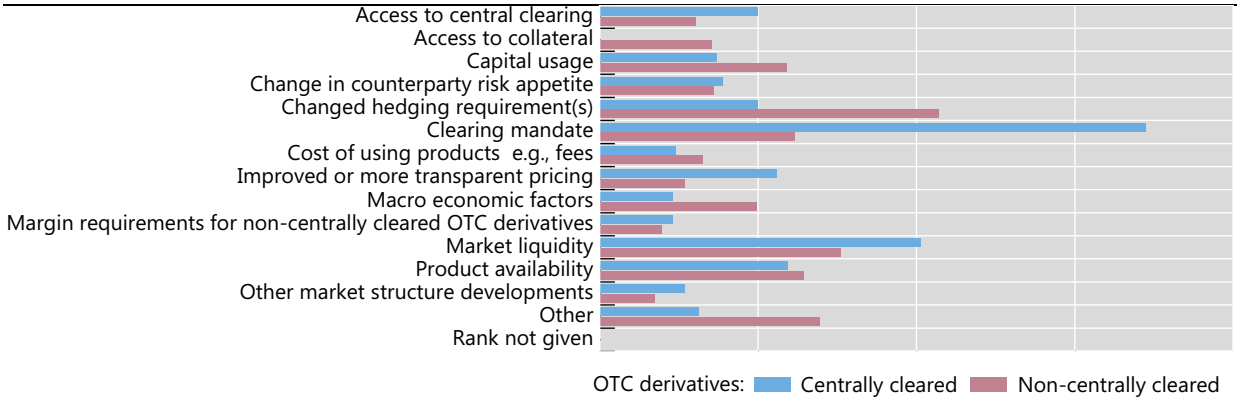


Dealer survey question 7 (38 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required. The ranking was based on the weighted methodology.

Source: DAT qualitative survey.

Figure A5.2 Weighted ranking of drivers behind volume changes in centrally and uncleared OTC derivatives between 2012 and 2017 for clients

Weighted ranking



Client survey question 10b (44 respondents). Respondents selected an option from a pre-defined list so no manual categorisation was required. The ranking was based on the weighted methodology.

Source: DAT qualitative survey.

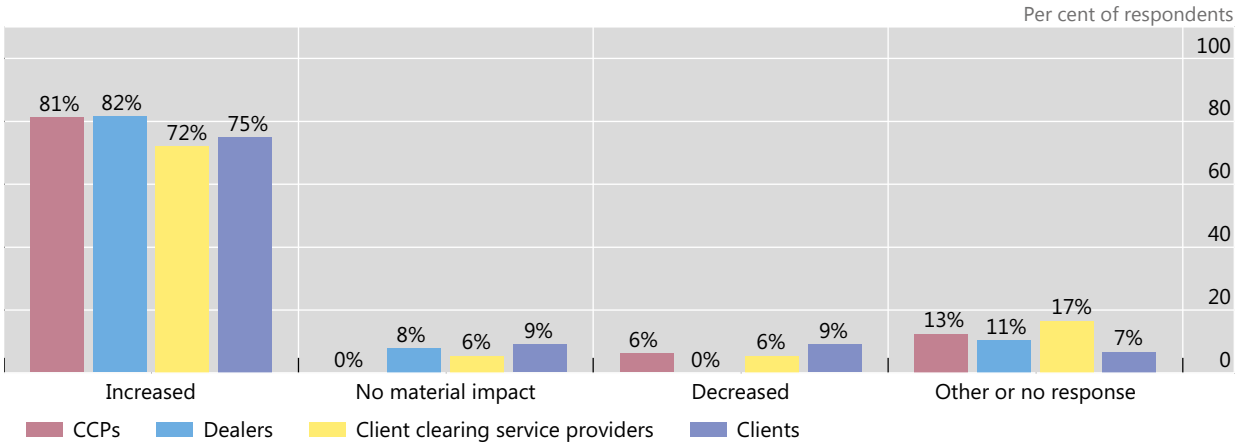
Figure A5.3 Top 3 incentives to clear a non-mandated product for clients and dealers

	No.1 Incentive	**No.2 Incentive**	**No.3 Incentive**
Clients	Counterparty risk	Bid-offer spread	Regulatory capital costs
Dealers	Regulatory capital costs	Counterparty risk	Netting opportunities

Client survey question 53b (44 responses) and dealer survey question 10b (39 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required. The ranking was based on the weighted methodology.

Source: DAT qualitative survey.

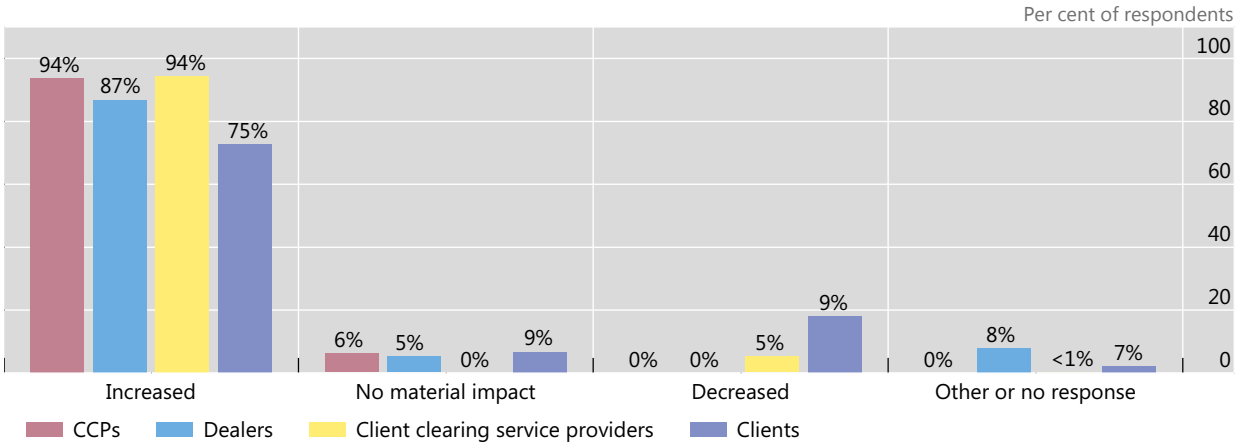
Figure A5.4 Dealer views on the impact of the OTC reforms on the ability of the financial system to absorb shocks



CCP survey question 24 (14 responses), dealer survey question 24a (minimum 34 responses), CCSP survey question 40 (minimum 15 responses), client survey question 56 (44 responses). Respondents selected an option from a pre-defined list so no manual categorisation was needed.

Source: DAT qualitative survey.

Figure A5.5 Views on the impact of the OTC derivatives reforms on the concentration of client clearing services



CCP survey question 24 (14 responses), dealer survey question 24a (minimum 34 responses), CCSP survey question 40 (minimum 15 responses), client survey question 56 (44 responses). Respondents selected an option from a pre-defined list so no manual categorisation was needed.

Source: DAT qualitative survey.

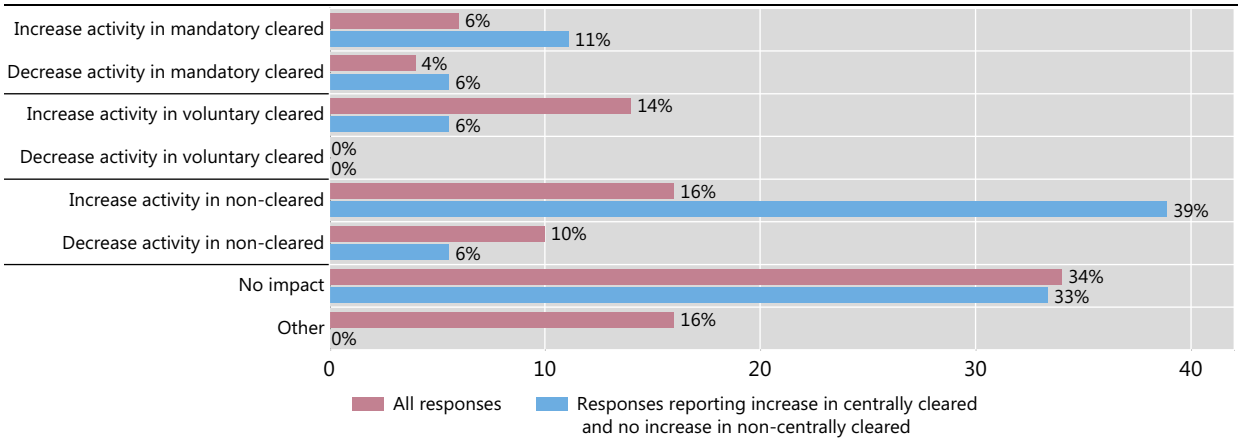
Figure A5.6 Restrictions imposed by client clearing service providers on clients' cleared OTC derivatives activity

Number of responses

CCSP survey question 23 (17 respondents). Respondents selected an option from a pre-defined list so no manual categorisation was required.

Source: DAT qualitative survey.

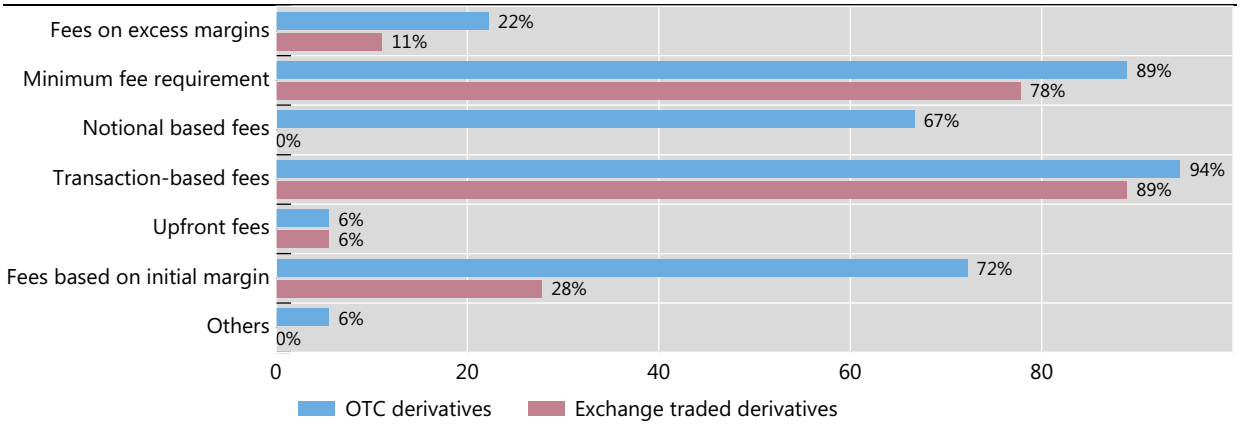
Figure A5.7 The impact of changes in the total cost of transacting OTC derivatives on the incentives to clear



Client survey question 47. Respondents selected an option from a pre-defined list so no manual categorisation was required. All responses (n=43), increase in centrally cleared and no increase in non-centrally cleared (n=15).

Source: DAT qualitative survey.

Figure A5.8 Types of fees charged by client clearing service providers

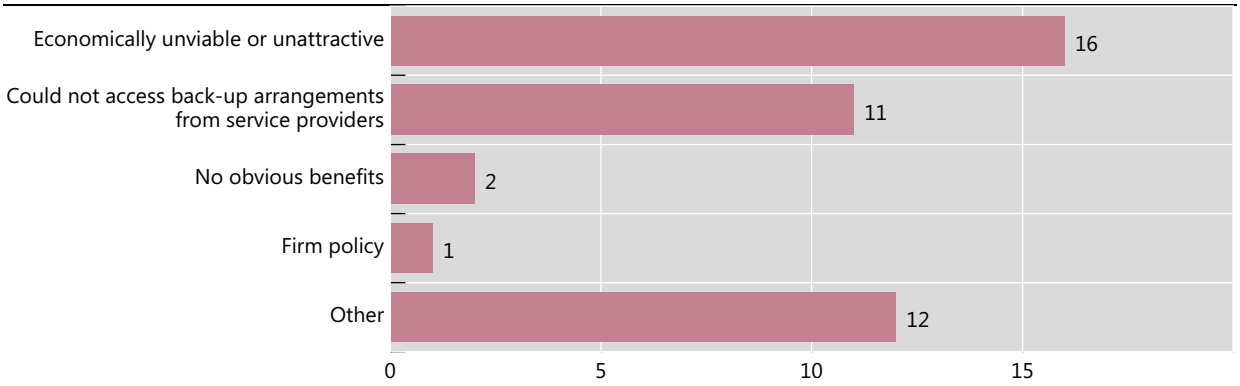


CCSP survey question 28a (17 responses).

Source: DAT qualitative survey.

Figure A5.9 Clients reasons for not having a back-up clearing service provider

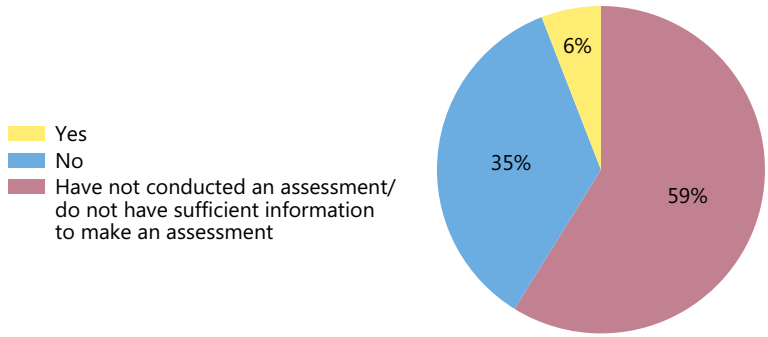
Number of responses



Client survey question 19 (42 responses). The response was free text so expert judgement was required to categorise the responses.

Source: DAT qualitative survey.

Figure A5.10 Client clearing service provider views on whether market capacity is sufficient to absorb all the clients of a large defaulting clearing member



CCSP survey question 43b (17 responses). Respondents selected an option from a pre-defined list so no manual categorisation was required.

Source: DAT qualitative survey.

Annex 6 Calculation of Clearing Costs

This annex details the methods and calculations used to construct the all-in cost comparisons of different OTC derivatives contracts from the responses to the quantitative survey. The assumptions needed are clarified, before presenting how explicit and implicit costs are constructed.

Notation

Each respondent provided spreads for up to 14 trade types (10 base trades and four more interest rate swap (IRS) trades reflecting diversification and holding period effects) and up to 10 Collateral Support Annex (CSA) types. The trade types are included in Table 1 below and the CSA types in Table 2.

Table 1: Trade Types

Trade	Description
a - IRS10	10y IMM interest rate swap (IRS) USD
b - IRS30	30y IMM IRS USD
c - iTraxx5	5y iTraxx series 28 index credit default swap (CDS)
d - iTraxx5/10	Buy 5y iTraxx Main, Sell 10y iTraxx Main both series 28 index CDS equal CR01
e - syntheticIRS	Buy IRS Swaption ATM call and sell ATM put on 10y IMM IRS USD, both with 1 year maturity, settling into a cleared swap
f - BrazilCDS	5y SN Brazil Sovereign USD single name CDS
g - Linker30	30y GBP zero coupon inflation swap
h - KRWNDF	1m USD/KRW non-deliverable forward
i - Brent	1y Brent future (cleared) or forward (uncleared)
j - USDxccyJPY	7y JPY/USD cross currency swap

Five cost drivers are used in the quantitative survey analysis: spreads (S); initial margin (IM); variation margin (VM); guaranty funding (GF) and clearing fees (CF). In addition, the capital valuation adjustment (KVA), is reported for IRS trades. Table 3 defines notation for drivers of costs. For different drivers, a superscript capital letter identifies the CSA and a subscript lower-case letter identifies the trade. A second subscript indicates the presence of diversification or holding period effects for IRS trades or whether KVA has been subtracted from the spread.

The drivers represent parts of total cost, where parts are added when calculating total cost. When comparing different costs, often some drivers can be eliminated, simplifying comparisons. However, assumptions are needed to fix the precise amounts.

Trading Cost Drivers

Every cost calculation represents the cost to a counterparty of engaging in a particular trade with a responding dealer. The formulation of all-in costs mainly will vary across CSA-type. The function $c(\cdot)$ represents the cost associated with individual drivers.[1]

A *- ClearedInterdealer*

For a cleared trade, with a dealer counterparty that is a clearing member at the same CCP, the all-in cost $\forall y \in \{a, \ldots, j\}$ is driven by: the spread, S_y^A; the IM, IM_y^A; the VM, VM_y^A; the guarantee fund

[1] The function $c(\cdot)$ is overloaded depending on the type of cost driver to which it is applied. The function could be represented as depending on a set of parameters Θ as $c(\cdot, \Theta)$.

Table 2: CSA Types

CSA	Description
A - ClearedInterdealer	Cleared trade, dealer counterparty who is a clearing member at the same CCP
B -ClientCleared	Cleared trade, counterparty is a client of the dealer's clearing member (i.e. the respondent assumes it is both clearing member and executing broker for the trade)
C - Bilat1wayOutCSA	Bilateral trade, one-way (out) CSA to a AAA-rated supranational/ quasi-government entity, cash or G-4 government bonds
D - 2wayVMdailyCashCSA	Bilateral trade, two-way uncleared margin rule (UMR) compliant CSA, counterparty posts VM only, daily, in the currency of the notional of the trade only
E - 2wayVMweeklyCashCSA	Bilateral trade, two-way UMR compliant CSA, counterparty posts VM only, weekly, in the currency of the notional of the trade only
F - 2wayVMIMcashCSA	Bilateral trade, two-way UMR compliant CSA, counterparty posts VM and IM only, daily, VM in the currency of the notional of the trade only, and IM in cash in G-4 currencies only
G - 2wayVMIMcashBondCSA	Bilateral trade, two-way UMR compliant CSA, counterparty posts VM and IM only, daily, VM in the currency of the notional of the trade only, IM in G-4 sovereign bonds, agency bonds, high grade US equities, and/or investment grade US corporate bonds
H - AAANoCSA	Bilateral trade, no CSA, AAA-rated counterparty
I - SingleANoCSA	Bilateral trade, no CSA, A-rated counterparty
J - BBNoCSA	Bilateral trade, no CSA, BB-rated counterparty

GF_y^A; and, the clearing fees, $\mathrm{CF}(z)_y^A$.[2] The cost of a cleared interdealer trade is represented as

$$c\left(S_y^A\right) + c\left(\mathrm{IM}_y^A\right) + c\left(\mathrm{VM}_y^A\right) + c\left(\mathrm{GF}_y^A\right) + c\left(\mathrm{CF(z)}_y^A\right). \tag{1}$$

Calculating this cost would require specifying the value for each of the five applications of the (overloaded) cost function.

No information on the guaranty fund was included in the survey. Neither did the survey differentiate between initial margin required for a clearing member versus a client. Furthermore, because each dealer is assumed to have already paid the fixed costs to centrally clear, the marginal cost of clearing fees for a new trade is assumed to be negligible. Equation (1) therefore simplifies to

$$c\left(S_y^A\right) + c\left(\mathrm{IM}_y^A\right) + c\left(\mathrm{VM}_y^A\right) \tag{1′}$$

***B** - ClientCleared*

For a cleared trade with a client, the drivers for all-in cost $\forall y \in \{a, \ldots, j\}$ are similar to (1′)

$$c\left(S_y^B\right) + c\left(\mathrm{IM}_y^B\right) + c\left(\mathrm{VM}_y^B\right) + c\left(\mathrm{CF}(z)_y^B\right). \tag{2}$$

[2]The survey also requested the difference between the spread and the most liquid mid-market spread for different trades; respondents generally did not report any such differences.

Table 3: Cost Sources

Note that the cost associated with any source is defined by the function $c(\cdot)$.

Variable	Description
S_y^X	Spreads for CSA-type X and trade type y
$S_{y,\text{Modifier}}^X$	Modified spread, where the modifier can equal Div., HP, or KVA.
KVA_y^X	Capital valuation adjustment (KVA) for CSA-type X and trade type y
IM_y^X	Amount of initial margin for CSA-type X and trade type y
VM_y^X	Amount of variation margin for CSA-type X and trade type y
GF_y^X	Amount of additional guaranty fund for CSA-type X and trade type y
$\text{CF}(z)_y^X$	Clearing fees for z-level of activity for CSA-type X and trade type y

The notable difference is the need to impute the cost of clearing fees $\text{CF}(z)$ for different client levels of activity z.

C *- Bilat*1*wayOutCSA*

For a bilateral trade under a one-way (out) CSA to a AAA-rated supranational/quasi-government entity, posting cash or G-4 government bonds, the all-in cost $\forall y \in \{a, \dots, j\}$ is

$$c\left(S_y^C\right) \tag{3}$$

Here there are no IM or VM cost drivers. The trade includes VM, but only from the dealer to the client; therefore, it is not included in the client's cost. These trades often show much higher spreads than cleared trades, so that $S_y^C > S_y^B$; in this respect, these trades have reported spreads that resemble those for trades without CSAs more than trades with them.

D *-* 2*wayVMdailyCashCSA and* ***E*** *-* 2*wayVMweeklyCashCSA*

For a bilateral trade with a two-way UMR compliant CSA, where the counterparty posts VM only, either daily or weekly, in the currency of the notional of the trade only, the all-in cost $\forall y \in \{a, \dots, j\}$ is

$$c\left(S_y^{D \text{ or } E}\right) + c\left(\text{VM}_y^{D \text{ or } E}\right), \tag{4}$$

where the D represents trades with VM exchanged daily and E represents trades with VM exchanged weekly. The additional term compared to (3) reflects that VM is two-way, so the client funds the cost. Because VM is exchanged less often, the expectation would be that $c\left(\text{VM}_y^E\right) \leq c\left(\text{VM}_y^D\right)$, but the survey does not capture such a difference.

For these CSAs, additional spreads for the IRS trades were provided, so there are additional cost equations $\forall y \in \{a, b\}$:[3]

$$c\left(S_{y,\text{Modifier}}^{D \text{ or } E}\right) + c\left(\text{VM}_y^{D \text{ or } E}\right) \tag{5}$$

F *-* 2*wayVMIMcashCSA*

For a bilateral trade with a two-way UMR compliant CSA, where the counterparty posts VM and IM daily, in the currency of the notional of the trade only, the drivers for all-in cost $\forall y \in \{a, \dots, j\}$ are

$$c\left(S_y^F\right) + c\left(\text{IM}_y^F\right) + c\left(\text{VM}_y^F\right) \tag{6}$$

[3]The survey did not ask for a separate VM amount for modified trades, so the second term is unchanged.

The crucial addition here is the cost of bilateral IM.

For this CSA, there are the additional spreads for the IRS trades, generating $\forall y \in \{a, b\}$:[4]

$$c\left(S^F_{y,\text{Modifier}}\right) + c\left(\text{IM}^F_y\right) + c\left(\text{VM}^F_y\right) \tag{7}$$

G - *2wayVMIMcashBondCSA*

For a bilateral trade, two-way UMR compliant CSA, where the counterparty posts VM and IM daily, with VM in the currency of the notional of the trade only, and IM in G-4 sovereign bonds, agency bonds, investment grade US equities, and/or investment grade US corporate bonds, the drivers for all-in cost $\forall y \in \{a, \ldots, j\}$, similar to (6), are

$$c\left(S^G_y\right) + c\left(\text{IM}^G_y\right) + c\left(\text{VM}^G_y\right) \tag{8}$$

By definition, the cost of VM equals that of CSA F, so $c\left(\text{VM}^G_y\right) = c\left(\text{VM}^F_y\right) = c\left(\text{VM}^D_y\right)$, and in practice also equals $c\left(\text{VM}^E_y\right)$. Due to greater flexibility, it should be the case that $c\left(\text{IM}^G_y\right) \leq c\left(\text{IM}^F_y\right)$, but the cost difference is not observable in the data.

For this CSA, the additional spreads for the IRS generates, $\forall y \in \{a, b\}$:

$$c\left(S^G_{y,\text{Modifier}}\right) + c\left(\text{IM}^G_y\right) + c\left(\text{VM}^G_y\right) \tag{9}$$

H - *AAANoCSA,* ***I*** - *SingleANoCSA, and* ***J*** - *BBNoCSA*

The last three CSA-types all represent trading without a CSA. For all three, cost is driven strictly by spreads, repeating the form of the cost for a one-way CSA in (3).

For a bilateral trade with no CSA for differently rated counterparties, the all-in cost $\forall y \in \{a, \ldots, j\}$ is either

$$c\left(S^H_y\right), \quad c\left(S^I_y\right), \text{or} \quad c\left(S^J_y\right) \tag{10}$$

depending on the client's rating. Any difference between the cost for these CSAs stems strictly from different spreads; not surprisingly, responses report that $S^H_y \leq S^I_y \leq S^J_y$ with generally strict inequality.

Differences in Trading Cost Drivers

This section compares different cost drivers. Often different drivers are eliminated from the comparison, eliminating dependence on any assumptions about calculating cost for such a comparison.

Cleared dealer versus client

If we take the difference between (2) and (1′) we have, $\forall y \in \{a, \ldots, j\}$,

$$\left(c\left(S^B_y\right) + c\left(\text{IM}^B_y\right) + c\left(\text{VM}^B_y\right) + c\left(\text{CF}(z)^B_y\right)\right) - \left(c\left(S^A_y\right) + c\left(\text{IM}^A_y\right) + c\left(\text{VM}^A_y\right)\right). \tag{11}$$

Based on the data and simplifications, this becomes

$$c\left(S^B_y\right) - c\left(S^A_y\right) + c\left(\text{CF}(z)^B_y\right) \tag{11′}$$

The cost comparisons are all going to have a spread differential (possibly equal to zero). To simplify notation further, lets define a overall spread differential as

$$\Delta^{X-Z}_y = c\left(S^X_y\right) - c\left(S^Z_y\right) \tag{12}$$

so we can write $\forall y \in \{a, \ldots, j\}$

$$\Delta^{B-A}_y + c\left(\text{CF}(z)^B_y\right) \tag{11″}$$

[4] Again, the VM term does not reflect the modification of the trade. Similarly, neither does the IM term.

Bilateral versus cleared client costs

Introducing partitions for bilateral CSA-types condenses these cost comparisons. Let $\overline{\text{VM}} \in \{D, E\}$ denote the CSAs that require two-way VM, but not IM; the line over VM differentiates the partition from VM itself. Let $\overline{\text{IM}} \in \{F, G\}$ denote the CSAs that require two-way VM and IM; again, the line over IM differentiates the partition from IM itself. Finally, let noVM $\in \{C, H, I, J\}$ denote the remaining bilateral types that do not require VM posting by the client. These partitions collapse the comparisons to three, rather than eight.

Bilateral VM only

The difference between the cost drivers for bilateral trades that only require VM versus cleared client trades after simplification is, $\forall y \in \{a, \dots, j\}$,

$$\Delta_y^{\overline{\text{VM}}-B} - c\left(\text{IM}_y^B\right) - c\left(\text{CF}(z)_y^B\right). \tag{13}$$

The cost difference is a function of the costs driven by differences in spread and the costs of IM and clearing fees.

For these trades, there are modified costs for trade types a and b,

$$\Delta_{y,\text{Modifier}}^{\overline{\text{VM}}-B} - c\left(\text{IM}_y^B\right) - c\left(\text{CF}(z)_y^B\right). \tag{14}$$

To the extent that the diversification and holding period modifications reduce spreads for the bilateral trades, cleared trades are relatively more costly for the modified trades as compared to the unmodified trades.

Bilateral VM and IM

The difference between the cost drivers for bilateral trades that require VM and IM versus cleared client trades after simplification is, $\forall y \in \{a, \dots, j\}$,

$$\Delta_y^{\overline{\text{IM}}-B} + c\left(\text{IM}_y^{\overline{\text{IM}}}\right) - c\left(\text{IM}_y^B\right) - c\left(\text{CF}(z)_y^B\right). \tag{15}$$

The cost difference is a function of costs driven by differences in spread, the differences in IM, and clearing fees.

For these trades, we also have modified costs for trade types a and b,

$$\Delta_{y,\text{Modifier}}^{\overline{\text{IM}}-B} + c\left(\text{IM}_y^{\overline{\text{IM}}}\right) - c\left(\text{IM}_y^B\right) - c\left(\text{CF}(z)_y^B\right). \tag{16}$$

Again, to the extent that the diversification and holding period modifications reduce spreads for the bilateral trades, cleared trades are relatively more costly for the modified trades, compared to the unmodified trades.

Bilateral one-way VM or no VM

The difference between the cost drivers for bilateral trades where VM is not posted by the client, either because the CSA has one-way VM or there is no CSA, versus cleared client trades after simplification is,$\forall y \in \{a, \dots, j\}$,

$$\Delta_y^{\text{noVM}-B} - c\left(\text{IM}_y^B\right) - c\left(\text{VM}_y^B\right) - c\left(\text{CF}(z)_y^B\right). \tag{17}$$

The cost difference is a function of costs driven by differences in spread and the costs of IM, VM, and clearing fees.

Summary of cost driver differences

For convenience, the differences derived in this section are collected in Table 4. To keep it more compact, the formulae for IRS trades with modified characteristics are excluded and only the most simplified formulae are included.

Table 4: Differences between Cost Drivers

CSA Difference	Formula	Equation
Cleared Client B - A	$\Delta_y^{B-A} + c\left(\mathrm{CF}(z)_y^B\right)$	$(11'')$
VM only CSAs to B	$\Delta_y^{\overline{\mathrm{VM}}-B} - \left(c\left(\mathrm{IM}_y^B\right) + c\left(\mathrm{CF}(z)_y^B\right)\right)$	(13)
VM and IM CSAs to B	$\Delta_y^{\overline{\mathrm{IM}}-B} + c\left(\mathrm{IM}_y^{\overline{\mathrm{IM}}}\right) - c\left(\mathrm{IM}_y^B\right) - c\left(\mathrm{CF}(z)_y^B\right)$	(15)
No VM to B	$\Delta_y^{\mathrm{noVM}-B} - c\left(\mathrm{IM}_y^B\right) - c\left(\mathrm{VM}_y^B\right) - c\left(\mathrm{CF}(z)_y^B\right)$	(17)

Cost Calculations

Each cost comparison has one or more components, where the $c(\cdot)$ function needs to be defined for one or more of spreads, IM, VM and CFs. In this section, calculations for each of the costs will be developed. Time-discounting is ignored because it affects different components similarly, and it can be dropped because this analysis focuses on differences. Calculating clearing fees also requires discussing the cost of funding.

Spread Costs

Costs driven by spread costs are the easiest to calculate. Let D_y stand for the duration of a trade in years. Let N_y represent the notional amount of the trade. Note these values do not vary by CSA. Then $\forall X \in \{A, \ldots, J\}$ and $\forall y \in \{a, \ldots, j\}$, the the costs associated with the spread from mid of a trade are calculated as

$$c(S_y^X) = S_y^X \times D_y \times N_y. \tag{18}$$

The spreads in the survey are running basis points (annualised). Duration, therefore, is defined as fractions of years and was provided to the respondents for calculating prices. Table 5 presents the trade durations from the survey.

In contrast, notional trade sizes are not clearly pinned down in the survey. The instructions were that the trade size should represent normal sizes traded in different markets, so that the trade is assumed not to move the market. Regulatory data was used to calculate nominal trade sizes for some of the trade types. Estimates are presented with means, medians and interquartile ranges in Table 6. The analysis used the average trade sizes for the six trade types where the mean was calculated; for the other four trade types a notional size of \$10 MM was assumed. Because the notional sizes are not too large, trades of such sizes would not be expected to move market prices materially. Therefore, the assumption that the spread would not change with notional seems reasonable.

Note the same formula applies for the modified spreads with the important caveat that the value of duration will be no more than one for trades a and b under the holding period modification.

The spreads for h-KRWNDF and i-Brent have not always been quoted as a running basis. Rather the spread has been quoted based on a different market convention of bid on notional according to received comments. Such spreads would have to be translated into a running basis before (18) can be applied.

Table 5: Durations

Trade	Duration (in years)
a - IRS10	10
b - IRS30	30
c - iTraxx5	5
d - iTraxx5/10	5
e - syntheticIRS	1
f - BrazilCDS	5
g - Linker30	30
h - KRWNDF	$\frac{30}{360}$
i - Brent	1
j - USDxccyJPY	7

The cost associated with a spread differential is simply the difference in spreads multiplied by duration and notional value, so $\forall (X, Z) \in \{A, \dots, J\}^2$ and $\forall y \in \{a, \dots, j\}$ by

$$\Delta_y^{(X-Z)} = c(S_y^X) - c(S_y^Z) = \left(S_y^X - S_y^Z\right) \times D_y \times N_y. \tag{19}$$

IM Costs

For IM, the survey does not measure costs directly. The survey asked for cleared and uncleared initial margin estimates for a \$10 MM notional size trade; these amounts are represented, $\forall X \in \{A, B, F, G\}$ and $\forall y \in \{a, \dots, j\}$ by IM_y^X. The variation by CSA-type only reflects whether it is cleared or uncleared IM: $X \in A, B$ versus $X \in F, G$. Then, the total cost of margin associated with a trade is assumed to be linear in trade size. This assumption certainly can be inaccurate. However, the scaling factors applied in the analysis are not too large, so assuming IM scales linearly in trade size seems reasonable.

In order to calculate the cost of IM, how initial margin varies over the life of the trade must be specified. Proprietary analysis suggests that IM roughly declines linearly over the life of a trade. Under that assumption, the cost of IM, ignoring discounting, $\forall X \in \{A, \dots, J\}$ and $\forall y \in \{a, \dots, j\}$, is estimated to be

$$c\left(\text{IM}_y^X\right) = \frac{1}{2} \times \text{IM}_y^X \times \frac{N_y}{1.0 \times 10^7} \times D_y \times F(l), \tag{20}$$

where the constant rescales notionals to units of ten million dollars and $F(l)$ represents the annualised funding cost of the counterparty in US dollars. We have specified funding costs in a function notation, anticipating that it may vary for different levels.[5] We suppress the dependence of $F(l)$ on CSA, so there is no superscript X. Under the linearity assumption, estimating the cost of posting IM has been reduced to identifying the funding cost $F(l)$. We will delay discussing estimating funding costs.

[5]Specific counterparties have their own idiosyncratic funding costs. We do not specify specific counterparties and therefore do not specify funding costs to that level of granularity, but rather give generic levels.

Table 6: Estimates of Traded Notional Sizes from SDR
(rounded to nearest millions USD)

Trade	Mean	Median	Interquartile Range
a - IRS10	50	28	11–55
b - IRS30	20	12	6–23
c - iTraxx5	40	22	40–60
d - iTraxx5/10	100		50–110
e - syntheticIRS			
f - BrazilCDS			
g - Linker30	16	10	6–16
h - KRWNDF	13	5	2–10
i - Brent			
j - USDxccyJPY			

The linear decay assumption could be altered leading to a more complicated function. In general, the cost requires calculating an integral over the duration of the contract; the linearity assumption collapses the integral to $\frac{1}{2} \times D$.

There is not a formulaic cost difference between cleared IM and bilateral IM. Any difference would solely be due to differences in the amount of IM required for the respective trade types for a given counterparty.

VM Costs

The survey includes estimates of expected positive exposure for a \$10 MM notional size trade for $\forall y \in \{a, \ldots, j\}$; define that value as EPE_y. Then, the total cost of variation margin associated with a trade can be calculated by multiplying the EPE response by duration and funding cost. Thus we can write, $\forall X \in \{A, B, D \ldots, G\}$ and $\forall y \in \{a, \ldots, j\}$

$$c(\text{VM}_y^X) = \text{EPE}_y \times \frac{N_y}{1.0 \times 10^7} \times D_y \times F(l) \tag{21}$$

Note that EPE does not vary by CSA except that it does not exist for some of them, so the CSA-superscript has been dropped.

This calculation is more completely specified than that for IM, because no decay assumption is required. However, the funding cost, $F(l)$, must still be defined and determined.

Funding Costs

The funding rate for clients, $F(l)$ in (20) and (21), is a key unknown. It should be set equal to the marginal funding rate, which tends to imply a wholesale funding rate rather than say the funding rate for a smaller bank using deposits. The wholesale funding rate is also more applicable for non-bank clients.

For the analysis, the actual identity of clients is not specified. Combining this abstraction, and the challenge of determining actual marginal funding costs, several levels were specified. Table 7 reports these varied levels. The low end was designed to be a bit above where the Libor-OIS spread

Table 7: Funding Cost Assumptions
(basis points)

Level	Cost
Low	25
Medium	50
High	100

had been, although in January, 2018, when the survey responses were provided, it was around this value. The middle value was closer to where CDS spreads for large banks have traded, which might also be representative of high quality counterparties' costs of funding. At the time of the survey, the CDX and iTraxx indices for investment grade reference entities were trading 3–5 bps above this level. The high category was designed to capture higher risk counterparties that likely have a higher cost of funding.

With these assumptions, we have $\forall l \in \{\text{Low, Medium, High}\}$,

$$F(l) = \begin{cases} 25\,\text{bps} & l = \text{Low} \\ 50\,\text{bps} & l = \text{Medium} \\ 100\,\text{bps} & l = \text{High} \end{cases} \tag{22}$$

as the definition of the simple function $F(l)$.

Clearing Fees

Lastly, average clearing fees per trade need to be derived to bundle into costs.

Let location, whether on balance sheet or off balance sheet, be denoted by $L \in \{on, off\}$. Let the portfolio, whether directional or diversified, be denoted by $P \in \{dir, div\}$. Let the number of \$20 MM trades per month be represented by $z \in 0, 1, 10, 50, 100, 500$, where including zero represents the dealer cleared case where no clearing fees are added. The survey response can then be represented as $\text{cf}_P^L(z)$. The average clearing fee for a trade is now a function of the triple (z, L, P)

$$\text{CF}(z, L, P)_y^B = \begin{cases} 0, & \text{if } z = 0; \\ \text{cf}_P^L(z) \times \frac{1}{12 \cdot z} \times D_y \times \frac{N_y}{2.0 \times 10^7} & \text{otherwise,} \end{cases} \tag{23}$$

where $\frac{1}{12 \cdot z}$ divides the annual clearing fees by the number of trades, D_y adjusts for the length of the trade, and $\frac{N_y}{2.0 \times 10^7}$ adjusts for relative size of the notional. Dividing the response by $12 \times z \times 2.0 \times 10^7$ transforms the annual clearing fee response for a given trade flow to an average charge per dollar notional cleared per year; multiplying by $D_y \times N_y$ calculates the average fee imputed to a particular trade. The clearing fees are only reported for IRS trades; these fees are imputed to other trade types.

Discussion

Table 8 collects the cost calculation formulae and effectively defines the composite cost function for each cost driver. Examining Table 8 shows that a factor of $D_y \times N_y$ is present in each cost calculation, so that differences between costs for different CSAs are not going to be driven by duration or notional value; in every comparison, the factor acts as only as scale coefficient on other differences.

The spread differences have the least uncertainty. The margin costs are more uncertain because of the difficulty in estimating the funding costs. The ability to extrapolate from the initial margin responses is likely also uncertain, because the actual margin collected on trading activity will very much depend on a client's portfolio. Finally, the clearing fees are uncertain because of both portfolio dependence, extrapolation from rates to other trades, and the general tendency for clearing fees to reflect specific client characteristics. In addition, there is uncertainty in allocating clearing fees to different trades.

Table 8: Cost Formula

Cost Source	Formula	Equation
Spread Difference	$\Delta_y^{(X-Z)} \times D_y \times N_y$	(19)
Initial Margin	$\frac{1}{2} \times \text{IM}_y^X \times \frac{N_y}{1.0 \times 10^7} \times D_y \times F(l)$	(20)
Variation Margin	$\text{EPE}_y \times \frac{N_y}{1.0 \times 10^7} \times D_y \times F(l)$	(21)
Clearing Fees	$\text{cf}_P^L(z) \times \frac{1}{12 \cdot z} \times D_y \times \frac{N_y}{2.0 \times 10^7}$	(23)

Aggregate Cost Comparisons

The last step is to calculate cost comparisons at the aggregate level. Before doing so, the cost function is explicitly defined with an added notation denoting a respondent. The added notation enables averages and ratios to be defined for respondents.

Cost Function

The cost function depends on a set of parameters. It is a composite function, consisting of four sub-functions which are applied to different cost drivers:

$$c(\cdot, X, y, z, l, L, P, R) = \begin{cases} c_1(S, X, y, R) = S_y^X \times D_y \times N_y & \text{for Spreads} \\ c_2(IM, X, y, l, R) = \frac{1}{2} \times \text{IM}_y^X \times \frac{N_y}{1.0 \times 10^7} \times D_y \times F(l) & \text{for IM} \\ c_3(VM, y, l, R) = \text{EPE}_y \times \frac{N_y}{1.0 \times 10^7} \times D_y \times F(l) & \text{for VM} \\ c_4(CF, y, L, P, R) = \text{cf}_P^L(z) \times \frac{1}{12 \cdot z} \times D_y \times \frac{N_y}{2.0 \times 10^7} & \text{for Clearing Fees} \end{cases} \tag{24}$$

Different sub-functions depend on different parameters. The third and fourth cost sub-functions are only defined for certain CSA-types. Because the forms of the sub-functions do not depend on the CSA-type for CSAs that have these costs, the notation drops X as a parameter to be simpler. Note that the previously defined spread difference is the difference between the first sub-function for two different CSAs, $c_1(S, X, y, R) - c_1(S, Z, y, R)$.

The reason for writing this function out is two-fold. First, to explicitly present parameters for empirical analysis. To fully price a trade, the following parameters must be specified:

1. CSA - type;
2. Trade type;
3. Clearing activity level;

4. Funding level;
5. Balance sheet location; and,
6. Portfolio classification.

These parameters identify how to calculate costs for each respondent.

Second, the respondent notation was added, where the cost function for a particular respondent is populated using their responses. Aggregation across respondents then can be represented using this index. For example, let **R** be a vector of the respondents indexed by $i = 1, \dots, r$, and then an average cost, for any of the costs would be calculated as

$$\frac{1}{r}\sum_{i=1}^{r} c(\cdot, X, y, z, l, L, P, R_i) \tag{25}$$

Other statistics across respondents or different parameters can be defined similarly.

Calculating Average Costs

The average cost of a trade, X, for a specific CSA, y, can be written as

$$\frac{1}{r}\sum_{i=1}^{r} \left(c_1(S, X, y, R_i) + c_2(IM, X, y, l, R_i) + c_3(VM, y, l, R_i) + c_4(CF, y, L, P, R_i)\right) \tag{26}$$

However, (26) requires only using complete responses. In order to maximise the use of the data, particularly the spread information, components of the average where calculated separately; this method imputes the component average cost to non-respondents for that component. Specifically, separate component average costs are calculated as:

$$\frac{1}{r_1}\sum_{i=1}^{r_1} c_1(S, X, y, R_i) \tag{27}$$

$$\frac{1}{r_2}\sum_{i=1}^{r_2} c_2(IM, X, y, l, R_i) \tag{28}$$

$$\frac{1}{r_3}\sum_{i=1}^{r_3} c_3(VM, y, l, R_i) \tag{29}$$

$$\frac{1}{r_4}\sum_{i=1}^{r_4} c_4(CF, y, L, P, R_i) \tag{30}$$

where, $\forall n \in \{1, 2, 3, 4\}$, r_n is the number of respondents that provided enough data to calculate the respective cost function and **R** is reordered in each calculation so that the respondents that provided data come first.

The total average cost is then calculated by adding these for component costs functions:

$$\begin{aligned}\text{Avg. Cost}(X, y, z, l, L, P, R) = {} & \frac{1}{r_1}\sum_{i=1}^{r_1} c_1(S, X, y, R_i) + \frac{1}{r_2}\sum_{i=1}^{r_2} c_2(IM, X, y, l, R_i) \\ & + \frac{1}{r_3}\sum_{i=1}^{r_3} c_3(VM, y, l, R_i) + \frac{1}{r_4}\sum_{i=1}^{r_4} c_4(CF, y, L, P, R_i)\end{aligned} \tag{31}$$

If there was no missing data, this method would be equivalent to the formula in (26). These component averages are also used to fill-in costs for a given respondent that is missing data that prevents a particular component cost from being calculated.

Percentage Cost Differences

The report focuses on the percentage differences in all-in costs, first between uncleared and cleared trades, and second between a particular respondent and the average for a specific CSA.

Let Unc $\in \{\overline{\text{IM}}, \overline{\text{VM}}, \text{noVM}\}$ represent the uncleared trades. Then, $\forall y \in \{a, \dots, j\}$, the percentage difference in average cost of an uncleared trade versus a cleared trade is

$$\frac{\text{Avg. Cost}(\text{Unc}, y, z, l, L, P, R) - \text{Avg. Cost}(B, y, z, l, L, P, R)}{\text{Avg. Cost}(B, y, z, l, L, P, R)} \tag{32}$$

The percentage difference of respondent i from the average can be represented as

$$\frac{\text{Avg. Cost}(X, y, z, l, L, P, R_i) - \text{Avg. Cost}(X, y, z, l, L, P, R)}{\text{Avg. Cost}(X, y, z, l, L, P, R)} \tag{33}$$

where Avg. Cost(X, y, z, l, L, P, R_i) is the cost constructed by adding the respondents component costs where available and substituting the average component cost where necessary.

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