

## CENTRAL CLEARING COUNTERPARTIES: BENEFITS, COSTS AND RISKS

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Since the international financial crisis, central clearing counterparties (CCPs) have assumed a key role in the over-the-counter (OTC) derivatives market. One of the factors behind this increase in activity is the G20 requirement to centrally clear standardised OTC derivatives. This initiative rests on the belief that centralised clearing can help reduce counterparty risk, and the systemic risk associated with OTC derivatives markets. But risk concentration in CCPs (chiefly counterparty risk), potential loss mutualisation in the event of one or more clearing members defaulting and the high interdependencies with the rest of the financial system entail significant consequences for financial stability. Hence international agencies, such as the Financial Stability Board (FSB) and the European Commission and other regulators, are working on initiatives to strengthen their soundness and the capacity for recovery and resolution in the event of crisis. From the banking perspective, the analysis of these entities is significant insofar as a big portion of clearing members are banks. Accordingly, any tool aimed at ensuring the continuity of the CCP will have a direct effect on them. This article analyses the functions of a CCP, its risks and the tools available for facing losses given the role that banks play in centralised clearing.

### 1 Introduction

Central clearing counterparties (CCPs) are financial entities that interpose themselves, in their own name, in financial instrument trades, becoming a seller to each buyer and a buyer to each seller.<sup>1</sup> Through a process known as novation, each trade cleared through a CCP is converted into two transactions, with both having the CCP as a counterparty. While its net position is zero, the CCP assumes the counterparty risk of both the purchaser and the original seller, both being clearing members. To protect itself against this risk, the CCP establishes lines of defence that include initial and variation margins to positions, members' contributions to a default fund and a buffer of its own capital, with a well-defined default waterfall established in its regulation.

Centralised clearing began to develop over a century ago, linked to the organised exchanges where highly standardised derivatives (ETD or exchange-traded derivatives), such as bond and stock market futures and options, are traded. In parallel, and above all in the 80s and 90s, OTC derivatives markets and products such as swaps, credit default swaps (CDSs) and exchange rate derivatives, in which trading and clearing were bilateral, were progressively developed. Since then, both markets have existed alongside one another, serving different needs of their participants, with much activity and each with a certain degree of specialisation. However, before the crisis, some CCPs had already begun to offer centralised clearing of instruments traditionally cleared bilaterally, such as swaps, CDSs, repos and even shares.<sup>2</sup>

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1 Clearing is the set of processes that take place after the trading of a transaction and before settlement (e.g. payment versus delivery of securities). Specifically, clearing involves determining the obligations and entitlements of the parties. It also includes the possible netting of obligations between buyer and seller. Clearing can be bilateral (between the buyer and seller) or centralised, through a CCP. In that case, the CCP becomes the buyer to the seller and the seller to the buyer. Trading can also be bilateral (OTC markets), or through organised exchanges (e.g. on a stock exchange).

2 For example, in 1999 LCH Ltd began to clear interest rate swaps. In 2009, ICE Clear Credit US and ICE Clear Europe Limited began to clear CDSs. Notably, in some jurisdictions such as Spain, centralised clearing of stock market equity transactions is obligatory. In the United States, for example, transactions with listed bond and exchange trade funds are also cleared.

The financial crisis highlighted the differences between bilateral and centralised clearing. Firstly, whereas the centrally cleared derivatives markets proved relatively stable, the opaqueness and complexity of the OTC derivatives markets hampered the valuation of the positions held by financial institutions, fuelling mistrust and generating bouts of acute volatility.

Secondly, the centralised clearing markets were seen to be more resilient for absorbing losses. For example, when Lehman Brothers collapsed, it was one of the most active participants in the interest rate swaps (IRSs) segment of the London clearing house LCH Ltd. In particular, the bank had an outstanding position for 9 of the \$100 trillion cleared in this segment. Despite the volume of exposure, it was possible to resolve the bank's failure through the auctioning of its positions and the use of the collateral posted by Lehman, without any other participant incurring losses [see Monnet (2010) and Gregory (2014)].

The shortcomings on the OTC derivatives markets prompted G20 leaders, meeting in Pittsburgh in 2009, to agree to an ambitious reform package. The aims were to enhance transparency, prevent market abuse and mitigate systemic risk. The G20 authorities committed themselves to having all standardised OTC derivatives contracts traded on electronic trading markets or platforms and centrally cleared before end-2012. In the case of bilaterally cleared contracts it was agreed, with the aim of encouraging centralised clearing, to raise capital requirements of banks, to require margins on positions and to improve their transparency through the recording of trades in a repository [see G20 Research Group (2009) and FSB (2018 a)]. This package has given rise to legislative changes at the national level. In Europe, for instance, the agreement was incorporated in 2012 through the European Market Infrastructures Regulation (EMIR), and in the successive technical standards drawn up by the European Securities and Markets Authority (ESMA). In the United States it was passed in 2010, through the Dodd-Frank Wall Street Reform and Consumer Protection Act. Significantly, the timing of the implementation of these obligations has differed in terms of instruments and across jurisdictions.<sup>3</sup>

Mandatory centralised clearing has posed a significant challenge for CCPs. It involves a considerable increase on one hand in the volume of positions to be cleared, and, on the other, in more complex and less standardised products. In 2007, the clearing of OTC derivatives was essentially bilateral: only 17% of interest-rate derivatives (swaps and FRAs) were centrally cleared.<sup>4</sup> By contrast, as at June 2018, this proportion had risen to 76%. In the case of CDSs, the increase in positions cleared in CCPs has also been significant, exceeding 50% of outstanding positions as at mid-2018.

CCPs are not free from risks. First, even when they can reduce the overall exposure to credit risk, by setting themselves up as counterparties in all transactions, they concentrate that risk; and, by means of the lines of defence they set up, they mutualise and distribute it among their clearing members. Further, CCPs are also subject to operational and liquidity risk. Moreover, on assuming the counterparty risk of all outstanding contracts, CCPs are highly exposed to other financial agents. That means that the failure of one of its members may translate into losses for the CCP and vice versa. It is thus essential to ascertain which financial institutions act as counterparties and their degree of activity.

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<sup>3</sup> For example, the centralised clearing of interest rate swaps (in yen) has been obligatory in Japan since November 2012 and, in the United States (in the main currencies), since March 2013 (see Annex 1).

<sup>4</sup> Interest-rate derivatives account for approximately 81% of the total derivatives traded on OTC markets.

The Financial Stability Board (FSB) has pursued an avenue of research focusing on the analysis of interdependencies between CCPs and their clearing members. Drawing on a study of 26 global CCPs, it concludes that clearing activity is highly concentrated in a small number of clearing members which, moreover, are common to several CCPs [see FSB (2018b)]. Moreover, a big portion of these members are banks. Indeed, the global systemically important banks (G-SIBs) generally clear in several CCPs. Consequently, in the absence of appropriate risk-management mechanisms, the default of a global bank might generate losses at several CCPs which, in the event of failure, would affect all participating banks and the other members.

The systemic nature of CCPs explains why they are highly regulated and supervised entities; the aim is to ensure their soundness, and prudent and transparent risk management. Moreover, they need to have an orderly recovery and resolution framework in place and, given the high degree of interdependencies with banks and other entities in the financial system, it is vital this framework should ensure effective coordination between different supervisors.

This article examines the functioning and resilience of CCPs in order to understand not only the advantages linked to centralised clearing, but also the risks this imposes on banks in their capacity as participating entities. Section 2 describes the activity on derivatives markets and the activity of CCPs at the aggregate and individual level. The aim is to ascertain the volume of the market studied in this article and its degree of concentration. Section 3 explains what a CCP is, how it is structured and the role banks play. Then, in section 4, an analysis follows of the mechanisms that enable CCPs to absorb the losses caused by a member's default, and section 5 assesses the possible recovery and resolution tools. Section 6 summarises the costs and benefits of centralised clearing, and its implications for financial stability. Finally, section 7 draws the main conclusions.

## 2 The activity of CCPs

### 2.1 THE SIZE OF THE OTC DERIVATIVES MARKET

Chart 1.1 shows the large size of the OTC financial derivatives market and describes the market's growth, in terms of notional outstanding volumes<sup>5</sup>, over the 1998-2017 period. It can be seen that, in outstanding balances, the size of the OTC market is much greater than that of the ETD markets, even adjusting the OTC derivatives series for possible double counting.<sup>6</sup> OTC derivatives grew substantially in the years running up to the financial crisis, tripling in size from 2004 to 2008, when they attained a notional value of \$647 trillion. Since 2013, a declining trend has been seen. This trend could be explained by the shift towards centralised clearing, as the obligation to clear through a CCP progressively took root. As will later be seen, central clearing facilitates multilateral netting of positions and portfolio compression.<sup>7</sup> Conversely, this declining trend is not observed in traded volumes (not affected by netting).

In contrast to the outstanding volumes, the activity of the OTC derivatives markets in terms of trading is somewhat smaller in size than the market for futures and options. In this

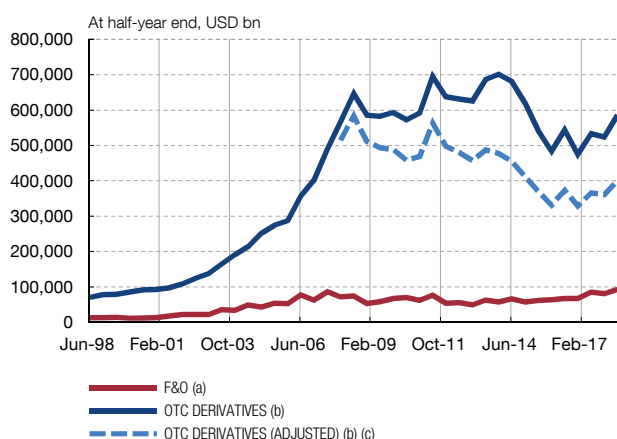
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5 The outstanding volumes of OTC derivatives can be measured in two ways: by notional value or by market value. Notional value is generally the face value of the underlying asset and market value is the price at which the derivative is bought or sold (without including commission, charges or taxes). For example, in a 10-year swap for a nominal value of €100 million that receives a fixed rate of 3% per annum and pays a 3-month EURIBOR variable rate on each payment date, the notional value is €100 million and the market value is the present value of net future flows (fixed-variable).

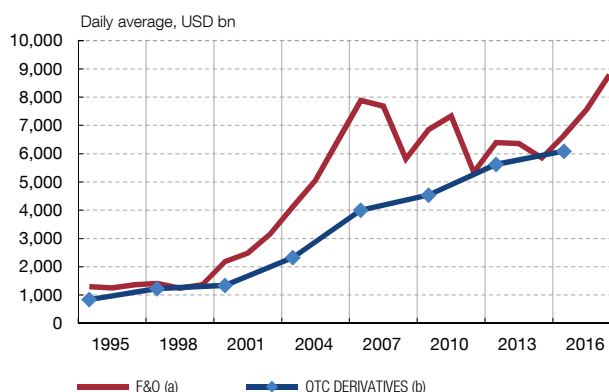
6 As explained in Annex 2, the BIS data on OTC derivatives may include double counting that affects those transactions originally traded between the banks that report to the BIS, and which are subsequently centrally cleared. The adjusted series estimates this double counting and deducts it from the original series.

7 Reducing then outstanding position. See Annex 3.

1 OUTSTANDING POSITIONS (NOTIONAL VALUE)



2 TRADING (NOTIONAL VALUE)



SOURCE: BIS (*Semiannual Derivative Statistics and Triennial Survey*).

- a Futures and options on interest rate and exchange rate traded and cleared on organised markets.
- b Includes OTC interest rate and foreign exchange derivatives and CDSs.
- c Series adjusted for possible double counting (see Annex 2).

latter market the maturity of contracts is shorter and turnover much greater. Thus, in 2016 (the last year with available information on OTC derivatives), average daily trading in OTC derivatives was \$6.1 trillion and that in futures and options \$8.8 trillion (see Chart 1.2).

Chart 2 depicts the outstanding volumes by OTC derivatives instrument, both in notional value and in market value, being the latter much lower. The largest market is, by far, that of swaps and other interest rate derivatives (IRD).<sup>8,9</sup>

Both the swaps and CDS markets grew substantially in the years running up to the financial crisis, respectively increasing 2.5 and 9.5 times. After the crisis, the CDS market shrank drastically. The size of the swaps market has declined in terms of outstanding volumes since 2013. This reduction is, at least partly, due to the shift towards centralised clearing and to the subsequent netting and portfolio compression of a considerable number of positions, as mentioned above.<sup>10</sup>

## 2.2 CENTRALISED CLEARING ACTIVITY

The percentage of swaps and CDSs centrally cleared are shown in Chart 3. These two instruments are those which, largely, are subject to the obligation of CCP clearing.<sup>11</sup> As can be seen in the chart, the proportion of swaps and FRAs and of CDSs that are cleared through a CCP has been growing notably since the obligation for centralised clearing began to be introduced (late 2012-early 2013, see Annex 1). However, in the case of swaps, this percentage was already of some size previously. As regards other OTC derivatives, not subject to the obligation of CCP clearing, such as foreign exchange

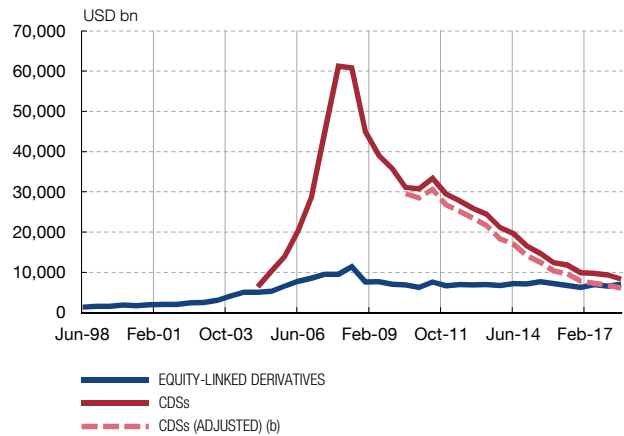
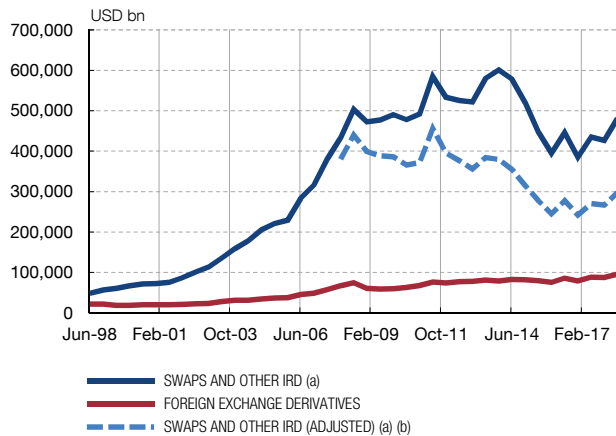
<sup>8</sup> Interest rate derivatives include swaps, FRAs and options. The largest market is for swaps, followed by FRAs. The interest rate options market is much smaller.

<sup>9</sup> As at December 2018, Spanish significant institutions held OTC derivatives on their balance sheets (consolidated data) for a notional amount of €10.77 trillion, 74% of which were interest rate derivatives other than options (i.e. swaps and FRAs).

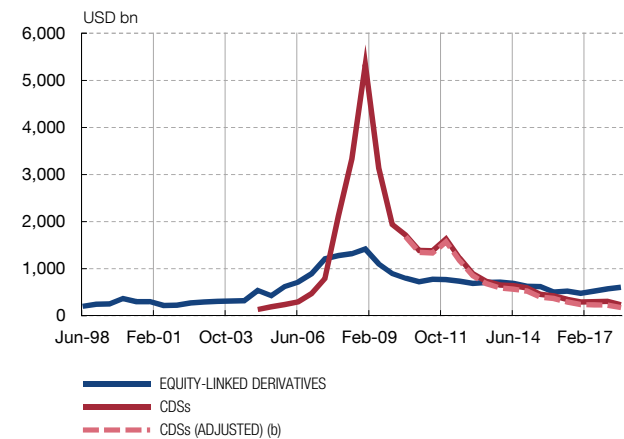
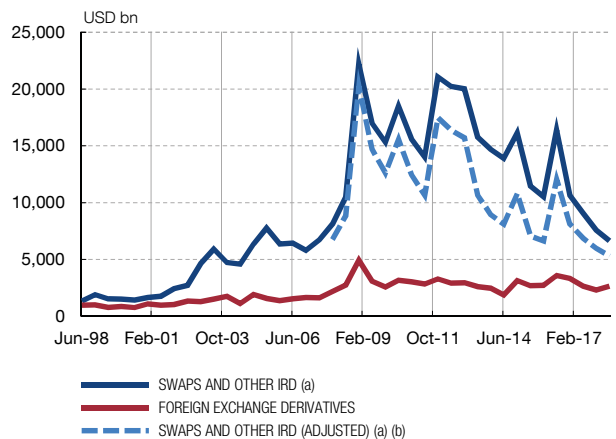
<sup>10</sup> See Annex 3.

<sup>11</sup> Neither all swaps nor all CDSs are subject to the centralised clearing obligation. For a list of those that are, see Annex 1.

1 NOTIONAL VALUE



2 GROSS MARKET VALUE



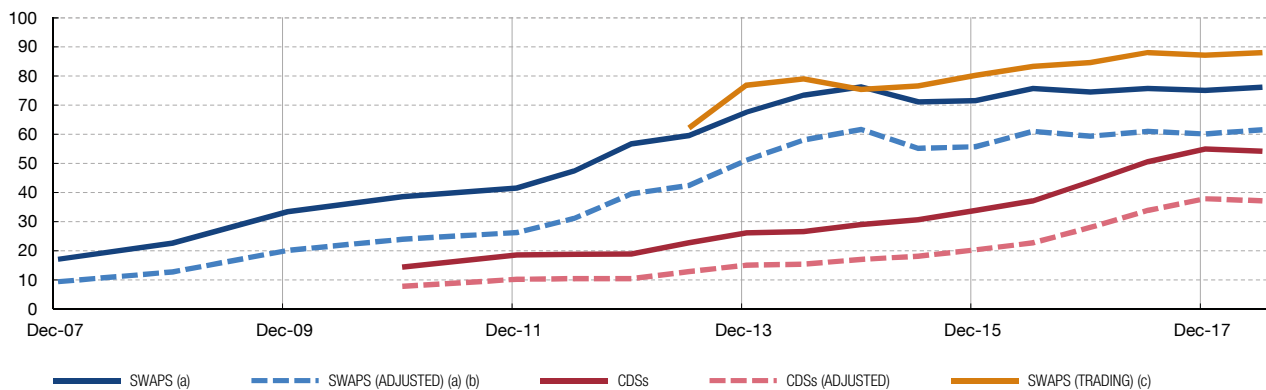
SOURCE: Prepared by the authors on the basis of data supplied by BIS (*Semiannual Derivative Statistics*).

- a Data includes FRAs and Interest Rate Options.
- b Serie adjusted by potential double counting (see Annex 2).

derivatives and equity linked derivatives, the percentage of centralised clearing is very low (5% and 0.3%, respectively, in June 2018).

In 2007, the percentage of centrally cleared swaps was 17% (9.3% in the adjusted series), while in June 2018, this proportion had risen to 76% (62% in the adjusted series). For CDS, these percentages rose from 14% in 2010 (8% in the adjusted series) to 54% in 2018 (37% in the adjusted series). This notable increase in the proportion of centrally cleared OTC derivatives (especially in the largest market, that for swaps) implies that the activity of CCPs has increased substantially.

Significantly, the percentage of centrally cleared swaps is somewhat higher than would correspond to the strict fulfilment of the obligation to clear through CCPs. Hence, ISDA (2018) indicates that, according to the information drawn from the US Commodity Futures Trading Commission (CFTC), in 2016 at least 7% of centrally cleared swaps were not subject to the obligation to clear, with this percentage standing at 3% in 2017.



SOURCE: Prepared by the authors on the basis of data supplied by ISDA and BIS (*Semiannual Derivative Statistics*).

- a Data includes FRAs. Data prior to 2016 has been estimated by applying to BIS data the rate of change of the data reported by ISDA. Since 2016, data are reported by BIS.
- b Serie adjusted by potential double counting (see Annex 2).
- c Data includes FRAs and refers to trading (source: ISDA).

### 2.3 THE CONCENTRATION OF CENTRALISED CLEARING ACTIVITY

Chart 4 shows the shares of activity of the different CCPs, by market segment, highlighting the fact that centralised clearing is a highly concentrated activity.<sup>12</sup> In the case of Europe, this concentration is apparent in the different market segments. It is very notable in that of futures and options, CDSs and, above all, in swaps, where the London CCP LCH Ltd concentrates practically all activity.<sup>13</sup>

The high concentration of centralised clearing in LCH Ltd also recurs at the global level. This can be seen in Chart 4.2, which shows the shares of activity, for the swaps segment, across different CCPs by currency and region. The lower share (44%) is in yen-denominated swaps, the markets in which the Japanese authorities impose certain restrictions that constrain clearing in foreign CCPs.

Globally, the centralised clearing of CDSs also shows a very high concentration (see Chart 4.3). Here it is the US CCP ICE Clear Credit that shows a high share, exceeding 70% for the CDS market as a whole, followed by the British CCP ICE Clear Europe (of the same group), with a share of 20%.

This high concentration of centralised clearing means that the increase in clearing activity (largely induced by the obligation to clear centrally) has materialised in very few entities, giving rise to a high concentration of risk and, accompanying this, to a heightening of its systemic nature.

<sup>12</sup> This high concentration is partly due to economies of scale and to the greater possibilities of netting and contract compression offered for market participants when they concentrate their clearing activity in just a few CCPs.

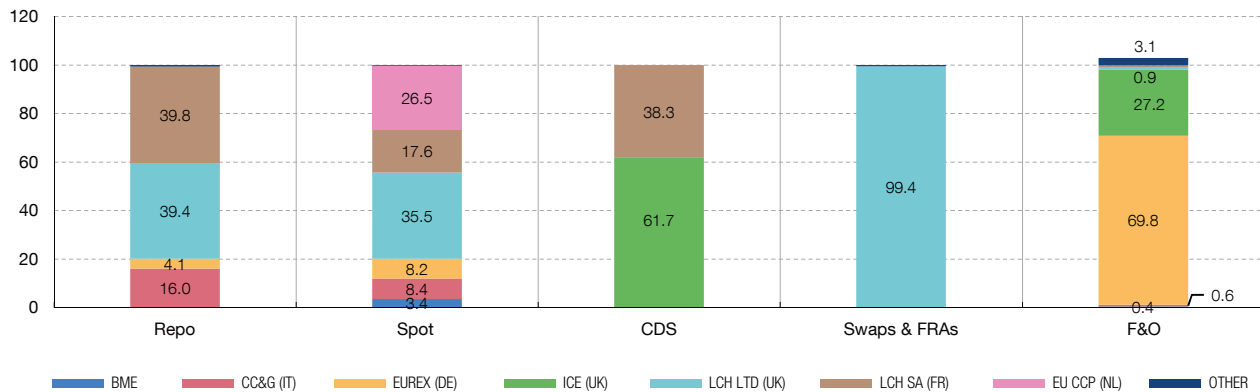
<sup>13</sup> In the course of 2018 a slight shift in clearing was seen from LCH Ltd towards the German CCP Eurex (as observed in Chart 4.2). This shift is attributable to Brexit, since – in the absence of a transitory period – following the UK's withdrawal from the EU and until LCH Ltd were declared a Qualified CCP, European banks would face regulatory constraints to operate or hold positions in British CCPs. Nevertheless, in December 2018 the European Commission published a decision where under it considers British CCPs equivalent for a temporary period.



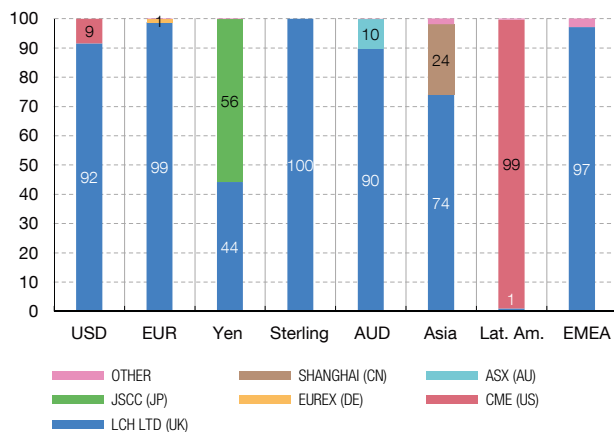
**CENTRAL CLEARING BY CCP AND SEGMENT**  
Market shares (%)

CHART 4

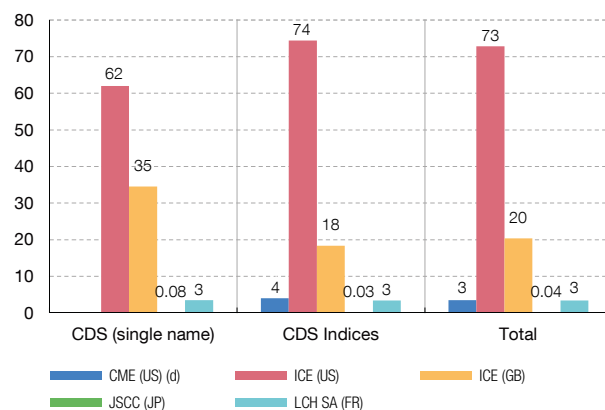
1 EUROPEAN CCPs (a)



2 GLOBAL CCPs. SWAPS AND FRAs (b)



3 GLOBAL CCPs. CDSs (c)



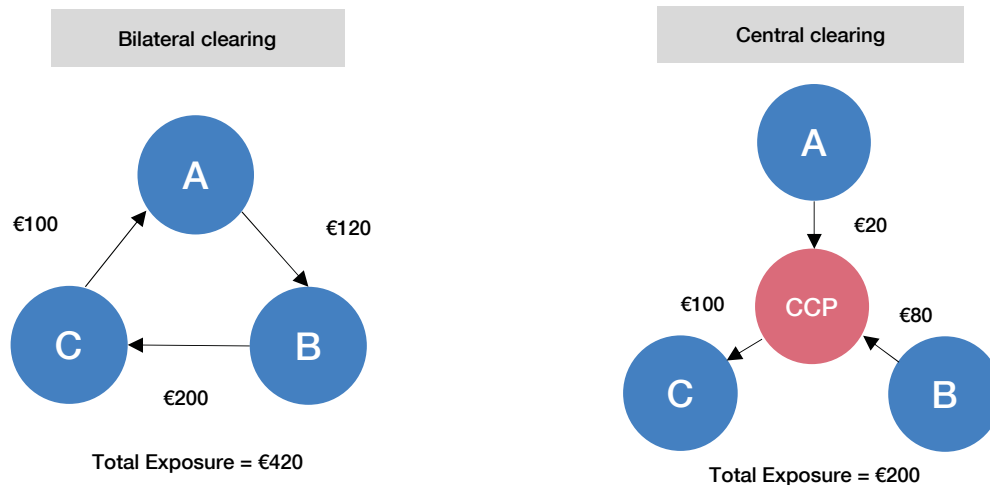
SOURCES: ECB (Chart 4.1) and Clarus FT (Chart 4.2 and Chart 4.3).

- a 2017 data.
- b 2018 data.
- c 2015-2017 data.
- d CME (US) ceased clearing the CDSs segment in 2018.

**3 CCP functioning and participants**

As mentioned, CCPs are entities that interpose themselves in their own name in financial instrument contracts, becoming a seller to each buyer and a buyer to each seller. When an operation is registered in a CCP it gives rise to a purchase transaction and a sale transaction, with both having the CCP as a counterparty (see Diagram 1). In this way, the open position of the CCP is zero and, if because of a member's default the position were not thus, the CCP would have to act immediately to return to the net zero position (a matched book). That said, by interposing itself, in all contracts, the CCP is exposed to counterparty risk, both with the original buyer and with the original seller.<sup>14,15</sup>

14 Counterparty risk is defined as the risk of the counterparty not meeting its obligations. The obligations with a CCP are: to post and replace the initial margin; to post, where appropriate, the variation margin; and those obligations arising from the purchase or sale of the security upon maturity of the contract.  
15 For a detailed description of the functioning of a CCP, see Gregory (2014).



As will later be seen, one of the main benefits that centralised clearing offers is to facilitate the netting of positions for participants (members).<sup>16</sup> As the CCP is counterparty to all the contracts, positions of the opposite sign are automatically netted, thus reducing or eliminating the participant’s exposure, both in terms of market and of counterparty risk (see Diagram 1). Conversely, in bilateral clearing, positions of the opposite sign will reduce the participant’s exposure to market risk, but not to counterparty risk (nor the attendant obligations), unless the counterparty entity is the same in the positions being netted.<sup>17</sup>

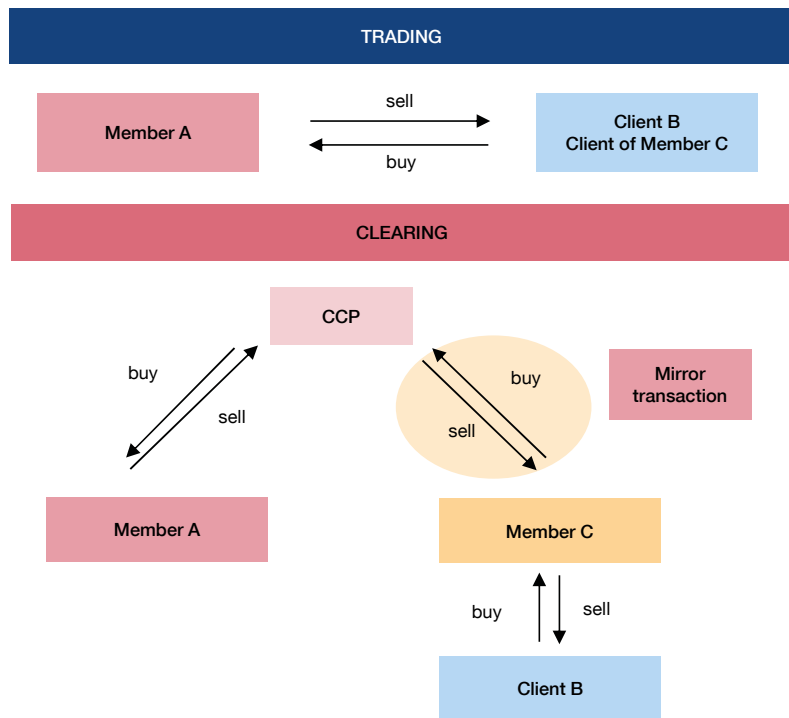
3.1 CCP PARTICIPANTS: MEMBERS AND THE ROLE OF BANKS

CCPs are closed clearing systems and only operate with those entities that are members and, through these, with entities that act as clients. To act as a member, CCPs impose a series of requirements relating, for example, to solvency and members’ operating capacity, with the aim of lessening default risk.

Most CCPs have at least two types of members: non-clearing members that operate only on their own account (through a clearing member), and clearing members that clear contracts on their own account and some also on behalf of clients. In turn, there are two models in the relationship between the client and the clearing member: the principal model (predominant in Europe), in which the clearing member acts as a counterparty to the client, performing as well a mirror transaction with the CCP (see Diagram 2); and the agency model (predominant in the United States), in which the member manages clients’ accounts and guarantees its obligations, being the CCP the counterparty to the client. There are two types of client accounts: individual accounts, in which the client’s positions are individually recorded; and omnibus accounts, in which the positions of several clients are recorded. In the case of omnibus accounts the clients’ initial margin can be posted on a gross basis (i.e. by aggregating the initial margin of each client’s position) or on a net basis (i.e. the initial margin stemming from netting the clients’ positions).

<sup>16</sup> CCPs also provide for portfolio compression, which is a netting technique whereby two or more counterparties replace their positions with another of less notional value and the same market risk. Annex 3 describes the effect of netting and portfolio compression on the outstanding balance of one of the main CCPs.

<sup>17</sup> In the example in Diagram 1, in the case of bilateral clearing, entity A has market risk of €20, but counterparty risk of €120 with entity B and of €100 with entity C.

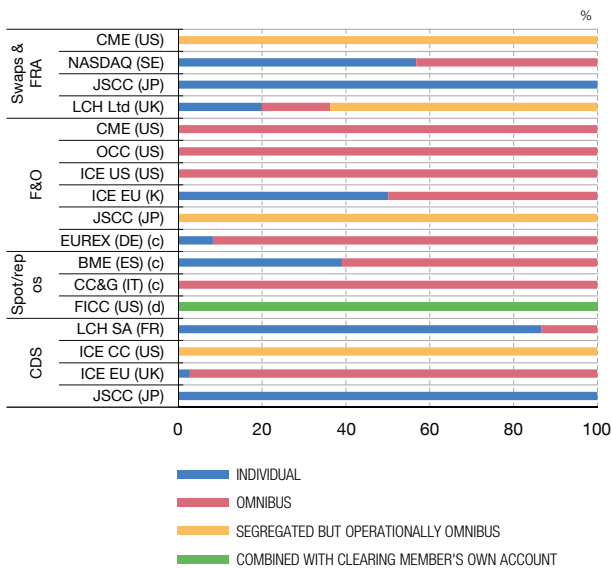


In the event of a member defaulting, the CCP will close its positions and transfer its clients' positions to another or other clearing members (this characteristic is known as the portability of client accounts). This transfer is less complex in the case of individual accounts, as it is easier to identify each customer's positions. Chart 5 shows the type of account and the initial margin posted by clearing members and clients, for a set of CCPs. It can be seen how, in a good number of CCPs (particularly those with most activity), clients' total positions exceed those of the clearing members and, omnibus accounts in which the clients' initial margin is posted on a gross basis are more frequent.

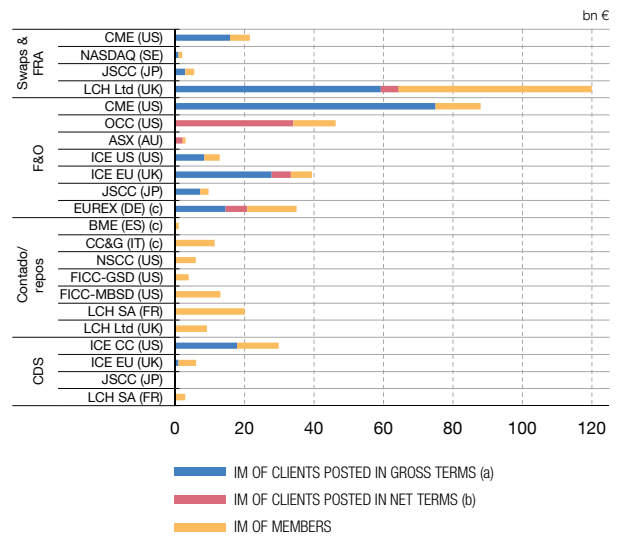
While any entity that meets the minimum requirements set by a CCP can gain member status, in practice, a high percentage are banks. Chart 6 shows, by segment of activity, the number of banks that are clearing members for a set of CCPs. With very few exceptions (especially in the futures and options segment) the substantial weight of banks as clearing members is apparent. In the particular case of the London clearing house LCH Ltd, for example, approximately 86% of participants in the swaps segment are banks. This figure is significant in that LCH Ltd concentrates practically all swaps contracts that are cleared in Europe and a very high percentage of those cleared globally. The swaps market is, moreover, the most active of the OTC derivatives markets (see Section 2).

The role of banks in centralised clearing takes on particular significance in the case of global systemically important banks (G-SIBs). Indeed, the more systemic the bank is, the greater the number of CCPs in which it is a member: Citigroup and JP Morgan, for example, clear in practically all the CCPs with most activity (see Chart 7.1). CCPs, for their part, are generally exposed to at least 10 global banks (see Chart 7.2). In Spain's case, Santander

1 TYPE OF CLIENT ACCOUNTS



2 INITIAL MARGIN POSTED BY CLIENTS AND CLEARING MEMBERS



SOURCE: CPMI-IOSCO Quantitative Disclosure, Q4 2018, published on the websites of the CCPs listed.

- a Initial margin calculated on clients' positions on a gross basis.
- b Initial margin calculated on clients' positions on a net basis.
- c For BME this refers to the repos segment, and for CC&G, the equities segment. Eurex reports jointly for all the segments (assigned to F&O since this is the segment of most activity).
- d FICC includes FICC-MBSD, FICC-GSD and NSCC, all of which belong to the DTCC group.

and BBVA are clearing members of 12 and 7 CCPs, respectively. In turn, the Spanish CCP BME Clearing operates with 15 large banks.

In addition to the types of clearing members, it is important to ascertain whether clearing activity is concentrated or not in a small number of participants. In this case, default by a particularly active member might result in significant losses for the CCP. Globally, this scenario appears to be the case: the 20 biggest clearing members amass 75% of clearing activity<sup>18</sup> [see FSB (2017a)]. Given that banks are the most common members (see Chart 6), it is reasonable to think that a big portion of the most active members are banks. The degree of concentration of the positions of CCP members can also be seen in Chart 8, which shows the percentage of total initial margins posted by the five most active clearing members in each of the main CCPs. Chart 8 also shows that the concentration is even higher in the client's activity, although the number of members that clear contracts on behalf of clients is, generally, low (see Chart 6).

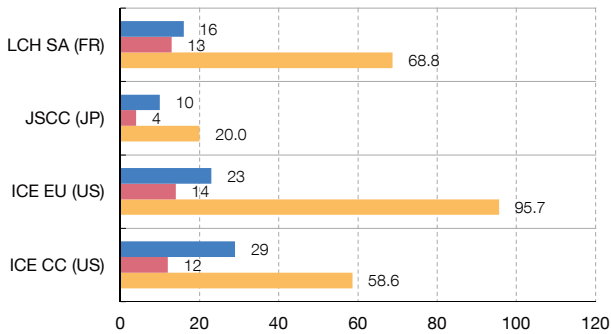
Banks' relationship to CCPs is not confined to their role as clearing members. They may also be critical services providers. Indeed, more than half of the entities providing custody settlement, liquidity provision and investment services for collateral assets are also clearing members [see FSB (2018a)]. In the specific case of LCH Ltd, most payments are settled through two G-SIBs [see Wendt (2015)]. Accordingly, the failure of one of them will affect

<sup>18</sup> Analysis of 26 globally systemic CCPs (data as at September 2016). The degree of activity is proxied by the initial margin and the default fund. In August 2018, the FSB published an updated version of the report (October 2017 data), which confirmed the main conclusions of the 2017 report.

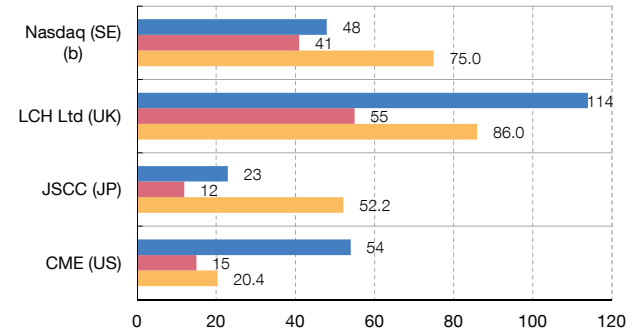
**NUMBER OF CLEARING MEMBERS. TOTAL, CLEARING MEMBERS THAT ARE BANKS (%) AND CLEARING MEMBERS WITH CLIENT ACCOUNTS**

CHART 6

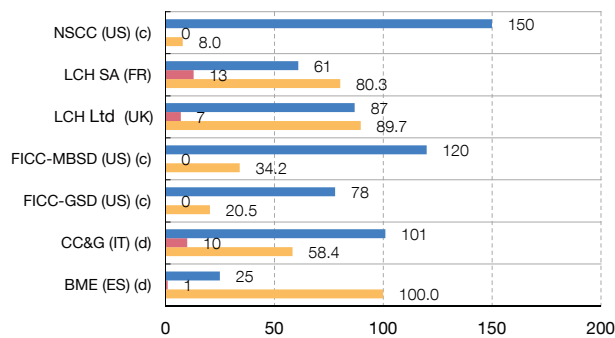
**1 CDSs**



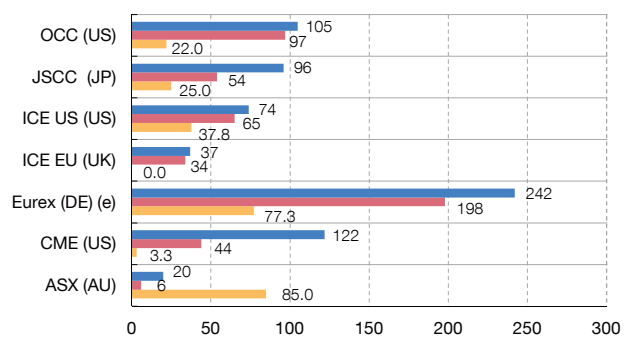
**2 SWAPS Y FRAs**



**3 SPOT/REPOS**



**4 F&O**



■ TOTAL NUMBER OF MEMBERS ■ MEMBERS WITH CLIENT ACCOUNTS ■ % MEMBERS THAT ARE BANKS (a)

SOURCE: CPMI-IOSCO Quantitative Disclosure, Q4 2018, available on the websites of the CCPs listed.

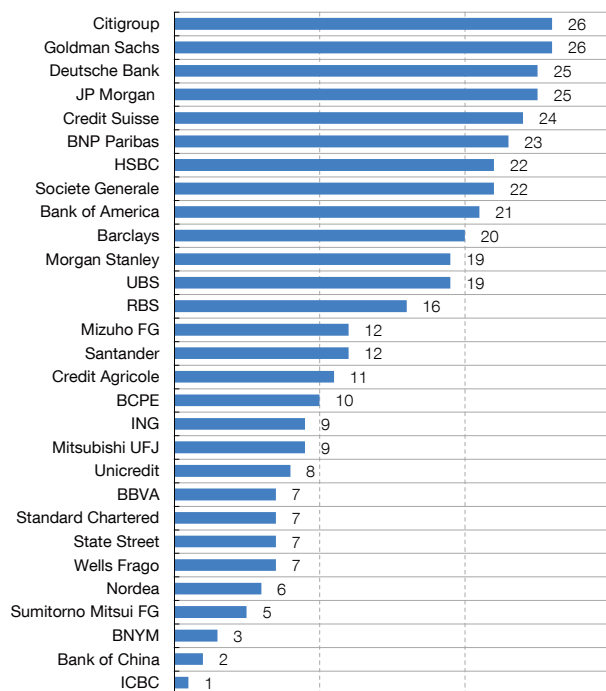
- a Does not include broker-dealers or investment companies that are subsidiaries of banks. As a result, the percentage of members belonging to banking groups is notably higher.
- b Only FRAs segment.
- c NSCC, FICC-MBSD and FICC-GSD (of the DTCC group) do not report information on the number of members that clear on behalf of client.
- d For BME this refers to the repos segment, and for CC&G, the equities segment.
- e Eurex reports jointly for all the segments. Assigned to F&O since this is the segment of most activity.

the clearing house through two channels. This multiplicity of functions increases the exposure of banks to the CCP and vice versa.

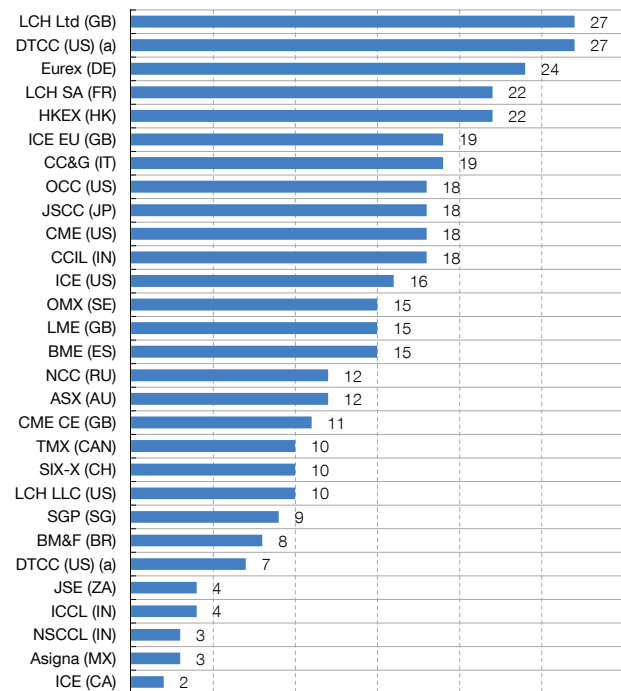
The existence of common clearing members and services providers across CCPs gives rise to a core of highly connected CCPs at the international level. It is thus important that the authorities reflect on whether current regulatory framework is suitable or not for addressing the high interdependencies between CCPs and banks. International bodies such as the FSB have indeed concentrated some of their efforts on analysing interdependencies between CCPs as a source of systemic risk [see FSB (2017a), FSB (2018a)].

Beyond their role as clearing members or services providers, banks may also be shareholders. This third dimension might derive in conflicts of interest in those cases where, to strengthen the soundness of the clearing house, more resources from members are needed. It might also increase contagion risk between banks and the clearing house.

1 NUMBER OF CCPs IN WHICH G-SIBs ARE CLEARING MEMBERS



2 NUMBER OF G-SIBs THAT ARE MEMBERS OF CCPs



SOURCE: Prepared by the authors on the basis of the information from European Commission (2016).

a Includes FICC-GSD, FICC-MBSD and NSCC.

Given banks' majority participation as clearing members and the high degree of concentration of activity (at the level of CCPs and of clearing members), in the face of a bout of tension, the tools used by CCPs or by the competent authorities to absorb losses will have a direct and likely significant impact on banks. This dimension should be borne in mind in any regulatory initiative seeking to strengthen the resilience, recovery or resolution of a CCP. Cooperation and coordination among the authorities responsible for supervising CCPs and banks is key to heading off any collateral damage arising from financial difficulties on either side.

4 Lines of defence in the face of defaults

As indicated, a CCP bears a counterparty risk both with the purchaser and with the seller of all the positions it clears. To cover this risk, the CCP has lines of defence geared exclusively to covering losses owing to the failure of one or more clearing members to meet their obligations (e.g. in replacing margins or at the date of maturity of the operations).

In general, and unlike banks, CCPs do not operate with leverage and do not issue debt. A CCP's capital is relatively small in relation to the volume it clears, as it is intended to cover risks other than that of member default. The main lines of defence in the face of losses owing to default (the biggest risk a CCP bears) are the resources contributed by the clearing members themselves: the initial margin, the variation margins and the default fund.

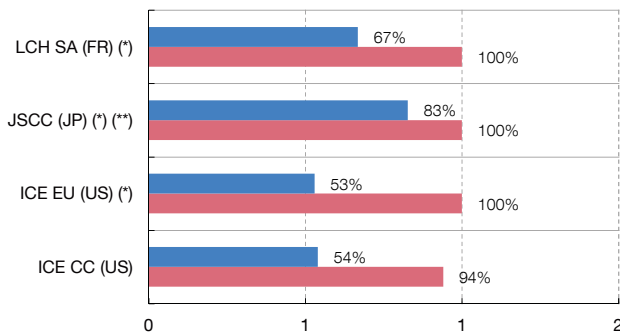
4.1 INITIAL AND VARIATION MARGIN

Firstly, CCPs require to their clearing members to post collateral to cover the future potential exposure of their position: the initial margin (IM). That is to say, the IM

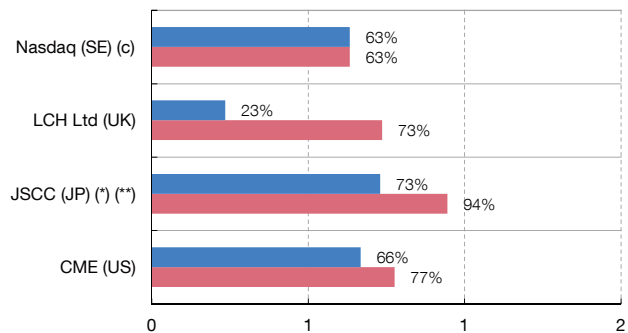
**CONCENTRATION OF CLEARING MEMBERS' OWN ACTIVITY AND OF BEHALF OF CLIENTS**  
Initial margin posted by the 5 top clearing members (%)

CHART 8

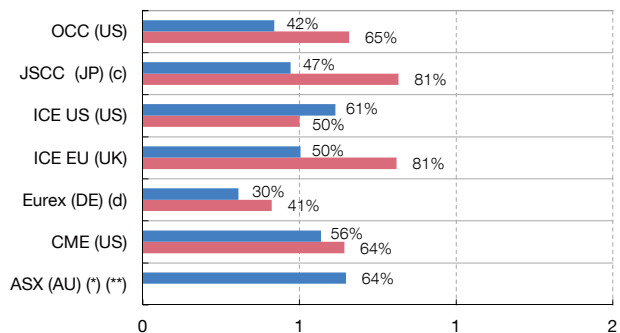
**1 CDS**



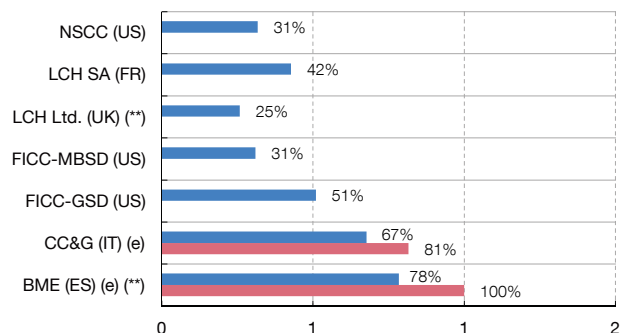
**2 SWAPS**



**3 F&O**



**4 SPOT/REPOS**



■ % IM POSTED BY 5 TOP MEMBERS (a) ■ % OF CLIENT ACCOUNTS' POSITIONS OF THE 5 TOP CLEARING MEMBERS (b)

SOURCE: CPMI-IOSCO Quantitative Disclosure, Q4 2018, available on the websites of the CCPs listed.

NOTES: (\*) CCPs with fewer than 25 members; (\*\*) CCPs with fewer than 10 members with client accounts.

- a % of initial margin posted by the 5 members with highest positions.
- b % of client accounts' positions of the 5 clearing members with most activity with clients. Some CCPs do not report this information or do not have client accounts.
- c Includes only FRAs.
- d Eurex reports jointly for all market segments. Assigned to F&O as this is segment with most activity.
- e For CC&G, this refers to equity spot, and for BME, repos.

attempts to cover the losses that might arise during the period since member fails (e.g. non-contribution of the variation margin) up to the time that the CCP manages to close or transfer the position. The IM is updated daily, and its calculation is a complex task requiring sophisticated systems capable of assessing whether the level of coverage is suitable. An unjustifiably low initial margin would increase the CCP's exposure to counterparty risk, and an overly high margin would discourage members from undertaking clearing.

Most CCPs use methodologies such as VaR (Value at Risk) or SPAN (Standard Portfolio Analysis of Risk). The IM thus calculated tends to be procyclical: it is very low in times of plenty and very demanding in lean times. This may be a problem given that it is precisely at times of tension that it may prove more complicated for clearing members and clients to raise liquidity in order to post the IM, thereby increasing the likelihood of defaults. Heeler and Vause (2012) estimate that, without adjustments, the procyclicality of IMs in respect of a position in an interest-rate swap may multiply twofold at times of high volatility. So as to

mitigate the procyclicality of IMs, CCP use mitigating factors in the models they employ for its calculation. However, these factors do not eliminate totally the procyclicality of margins. For instance, Faruqui, Huang and Takáts (2018) estimate that in the days following the Brexit referendum (23 June 2016) the margins calls in the centralised clearing of swaps amounted to \$27 billion, five times more than the daily average of the 12 previous months.

In addition to the IM, CCPs raise and post the variation margin (VM) daily (and even on an intraday basis). This margin is tantamount to a daily settlement of gains and losses in the position of each of the clearing members, caused by the daily movements in the value of the derivatives or assets held. Given that the CCP has a zero net position, the daily net balance of the VM for the CCP is also zero. The VM generally has to be contributed in cash. Like the IM, the VM is calculated on the basis of position in a specific segment, although some CCPs apply a cross-margin.<sup>19</sup>

#### 4.2 DEFAULT FUND AND SKIN IN THE GAME

In addition to margins, the CCP requires its clearing members to contribute to a fund to cover losses in the event of default that go beyond the initial margin posted by the member or members defaulting. This fund, known as the default fund, means that all members are exposed to the losses generated by any other member. This therefore entails a mutualisation of risk. Hence, it is essential that members ensure that the CCP appropriately manages counterparty risk, by participating, for example, in its risks committee [see McPartland and Lewis (2017)]. In the case of banks, moreover, the Basel framework requires them to set aside, *inter alia*, capital requirements for their contribution to the default fund [see BCBS (2014)]. In this way, the contagion risk that a bank might assume by being a clearing member is recognised.

Regarding its size, the international framework recommends that, at a minimum, the fund should be enough to cover the losses that might be generated, in extreme but plausible market conditions, by the clearing member with the highest exposure [see CPSS-IOSCO (2012)].<sup>20</sup> In Europe, clearing members contribute to this fund in proportion to the size of their exposure.<sup>21</sup> Their credit quality is not, therefore, taken into account. This framework has been criticised on occasion for being arbitrary [see Cont (2015)]. However, any model taking into account the probability of default of clearing members would be very complicated.

Significantly, in the event of default of a member, the CCP may demand additional funds from the non-defaulting clearing members to replenish the fund or to cover additional losses. In Europe, clearing houses cannot request additional contributions for an unlimited amount.<sup>22</sup> The existence of this limit is pivotal to members being able to assess at all times their level of exposure. Otherwise, clearing might be very costly and ultimately prove not to be worth, particularly when undertaken on behalf of clients. On setting this limit the CCP should weigh up, for example, the advantages of having greater resources to cover losses (which plays in favour of its survival) set against the risk of contagion among members. In practice, clearing houses such as CC&G and LCH Ltd limit the obligation to replenish the fund in its

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19 That is to say, they calculate and demand margins for the net aggregate amount of the positions in the different segments for which clearing services are offered [see Gregory (2014)].

20 In globally systemic CCPs, the size of the fund should be sufficient to cover the losses of the two biggest clearing members.

21 See Art. 42.2 of Regulation 648/2012 of the European Parliament and of the Council of 4 July 2012 relating to OTC derivatives, central clearing counterparties and trade repositories (EMIR).

22 See Art. 43.3 EMIR.



entirety, while others, such as BME Clearing and Eurex, allow up to double the original endowment.

Besides the contributions made by clearing members, CCPs allocate a portion of their own capital to covering the losses generated by the members. This buffer, known as “skin in the game” (SIG), encourages the clearing house to set in place prudent risk management. In the absence of this buffer, the clearing house might have incentives to request low margins, in order to lower the cost of centralised clearing and to increase its market share. In relation to its size, European regulations require clearing houses to ensure, at least, that the SIG amounts to 25% of the CCP’s minimum regulatory capital<sup>23</sup>; however, as indicated, the capital of CCPs is small in that it is intended to cover losses other than those relating to counterparty risk.

#### 4.3 MEASURES IN THE EVENT OF A DEFAULT: THE “WATERFALL”

In sum, to cover counterparty risk losses, CCPs have collateral (IM) provided by clearing members, contributions to the default fund and a portion of its own capital (SIG). These resources make up what is known as the “default waterfall” (see Diagram 3).

CCP internal rules establish the order in which these resources would be used. Depending on the clearing house and on the regulations applicable to it, the skin in the game will be available for use before or after the default fund. In most global CCPs and, in any event, in Europe (where it is mandatory<sup>24</sup>) the SIG absorbs losses before non-defaulting members.

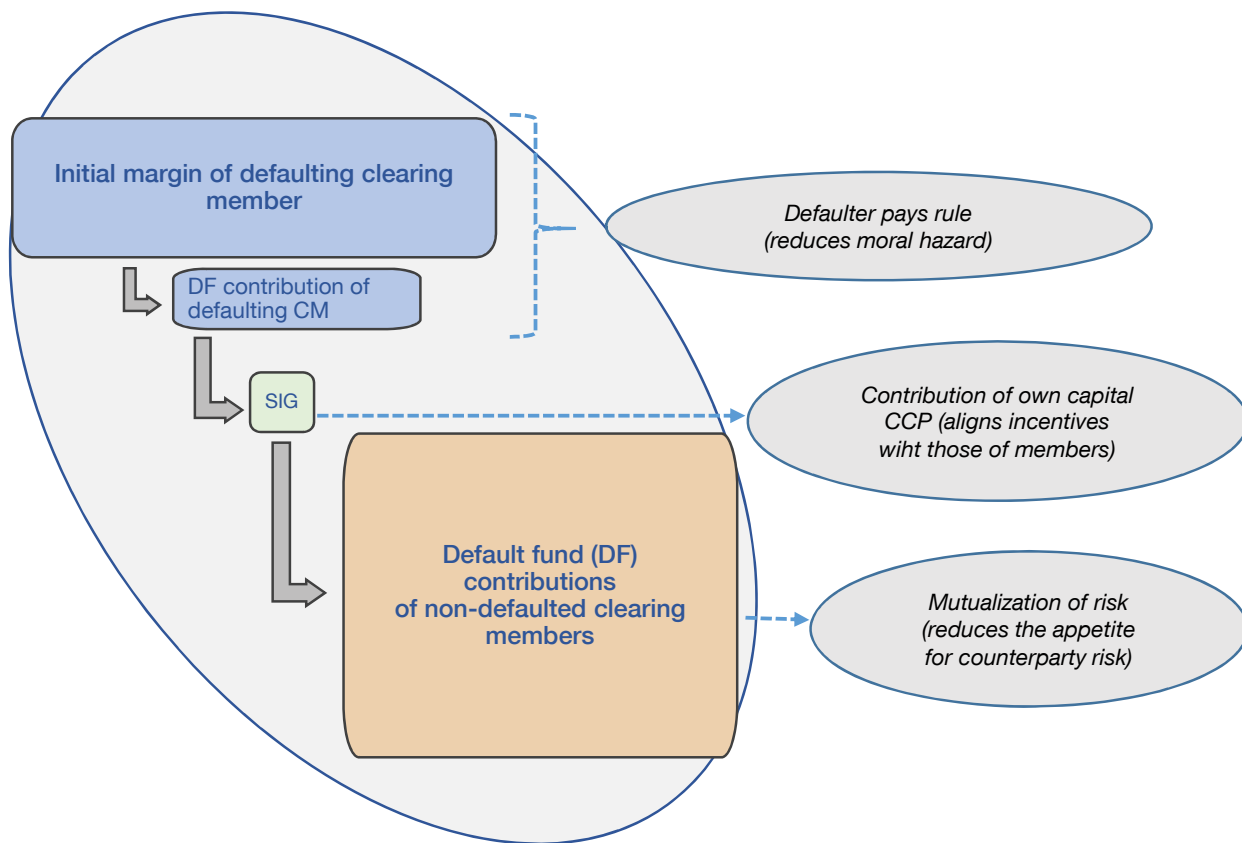
In the event of a clearing member default, for example in posting the VM or in satisfying IM calls, the CCP’s exposure becomes unbalanced while it has to meet its obligation with non-defaulting counterparties. Faced with this scenario, the clearing house will firstly liquidate the failed positions (preferably through an auction among non-defaulting members) in order to return to the matched book. Secondly, it will have to cover the loss incurred.<sup>25</sup> In that connection, the CCP will make use of the IM posted by the defaulting member and of its contribution to the default fund. Were these resources not enough, the CCP will contribute through the SIG (if this is so established in its order of ranking) and, if the losses persist, it will draw on the contributions to the default fund by the non-defaulting clearing members (see Diagram 4).

Table 1 breaks down the volume of pre-funded resources available to absorb losses for a group of CCPs. The contribution of the SIG does not, generally, exceed 5% of the contributions of the members to the default fund. The appropriate size of the SIG in order for it to be an effective risk management tool has been the subject of debate. Generally, both members and clients advocate increasing the contribution [see European Commission (2015)]. They claim, for instance, that the SIG should be equivalent to the contribution by the clearing member with the highest exposure or to a fixed percentage of the default fund [see JP Morgan Chase (2014) or BlackRock (2014)], claiming the CCP’s risk to large exposures is thus mitigated.

<sup>23</sup> See Art. 35.2 of Commission Delegated Regulation No. 153/2013 of 19 December 2012, supplementing Regulation 648/2012 of the European Parliament and of the Council, referring to technical standards of the Regulation on the requirements central clearing counterparties must meet.

<sup>24</sup> See Art. 45.4 EMIR.

<sup>25</sup> The losses might arise from the CCP obligation to meet its commitments with non-defaulting members and in the process of closing out the defaulting member’s positions ((e.g. the price the CCP has to pay in the auction of the positions)).



SOURCE: Prepared by authors. Relative size of each element of the waterfall is estimated using the information given by one of the main CCPs in its *CPMI-IOSCO Quantitative Disclosure* of Q4 2018.

Clearing houses, in contrast, do not consider appropriate to increase the SIG to cover risks with very little likelihood of materialising [see European Commission (2015)]. They further claim that this would affect the CCP’s risk profile, by increasing its exposure to the defaulting member at a time at which the CCP needs to be resilient [see LCH Ltd (2014)]; they argue also that it could discourage the appropriate participation of clearing members in the auctions of the defaulting member’s positions, given that there is a greater probability that the losses will be covered by the CCP.

4.4 IF A MEMBER DEFAULTS, IS THE DEFAULT WATERFALL SUFFICIENT?

It is worth asking whether the pre-funded resources available to the CCP are sufficient in the event of defaults and, otherwise, what additional tools are available to prevent the failure of the CCP.

Firstly, it should be pointed out that the defaulting member’s guarantees should suffice to cover its losses.<sup>26</sup> Theoretically, the use of additional resources will be a remote possibility.

There are few real cases allowing for the study of whether the CCP’s loss allocation and absorption mechanisms are effective. Since the 1980s, there have been some few defaults where a member’s losses exceeded the resources provided by such member [see

<sup>26</sup> In Europe, for example, to calculate initial margins CCPs must use, at least, the following confidence intervals: (a) 99.5% when OTC derivatives are involved, and (b) 99% for financial instruments other than OTC derivatives (Delegated Regulation 153/2013, Art. 24).

## PRE-FUNDED FINANCIAL RESOURCES TO COVER DEFAULTS

TABLE 1

Data in million of Euros

CCP	Segment	SIG contributed by CCP	Default fund contributed by clearing members	Initial margin (*) posted by clearing members	% SIG over pre-funded resources
		(1)	(2)	(3)	(4) = (1) / (1) + (2)
ICE CC (US)	CDS	43.67	2,333.94	12,001.87	1.84
ICE EU (UK)	CDS	43.61	888.62	5,046.49	4.68
JSCC (JP)	CDS	11.92	359.48	224.87	3.21
LCH SA (FR)	CDS	20.00	1,247.34	2,772.74	1.58
BME (ES)	Spot/repos	1.00	25.00	1,078.84	3.85
CC&G (IT)	Spot/repos	16.48	4,600.96	11,280.64	0.36
FICC-GSD (US)	Spot/repos	47.09		3,888.21	
FICC-MBSD (US)	Spot/repos	47.09		13,067.25	
LCH Ltd (UK)	Spot/repos	9.00	1,088.36	9,202.28	0.82
LCH SA (FR)	Spot/repos	7.14	1,089.17	19,984.06	0.65
NSCC (US)	Spot/repos	66.84		5,963.28	
ASX (AU)	F&O	73.98	123.30	848.50	37.50
CME (US)	F&O	87.34	3,814.92	13,030.92	2.24
Eurex (DE)	F&O	150.00	4,076.40	14,224.17	3.55
ICE EU (UK)	F&O	136.24	2,515.38	6,145.55	5.14
ICE US (US)	F&O	53.28	630.09	4,399.59	7.80
JSCC (JP)	F&O	158.92	2,299.23	2,431.18	6.47
OCC (US)	F&O	0.00	8,177.60	12,247.22	0.00
CME (US)	Swaps and FRA	131.00	3,119.66	5,761.55	4.03
JSCC (JP)	Swaps and FRA	15.89	1,439.57	2,596.65	1.09
LCH Ltd (UK)	Swaps and FRA	46.21	5,589.53	55,685.56	0.82
Nasdaq (SE)	Swaps and FRA	6.83	226.53	1,073.66	2.93

SOURCE: Prepared by the authors based on the information from *CPMI-IOSCO Quantitative Disclosure*, Q4 2018, available at CCP's websites. Foreign exchange rate as at 31 December 2018.

NOTE: (\*) Initial margin of clients' accounts is not included, except if clearing members' own accounts are jointly reported.

(1) For BME data refers to repos and for CC&G refers to equity.

(2) FICC-MBSD and FICC-GSD have a shared SIG.

McPartland and Lewis (2017)], two of them recently. There are also few cases where the CCP itself has failed (see Annex 4).

In 2013, the Korean clearing house Korea Exchange (KRX) registered the failure of HanMag Securities, after sizeable losses accumulated owing to a trading algorithm error. The collateral posted by this member were not sufficient to cover the incurred losses (approximately \$39.6 million) [see McPartland and Lewis (2017)], then impacting non-defaulting members through the partial use of the default fund (the default fund amounted to \$190 million). From among the 60 clearing members, several large global banks bore a substantial portion of the loss [see Vaghela (2014)]. However, the SIG remained intact. Unlike European clearing houses, KRX internal regulations envisaged the prior use of the default fund for defaults. This singular fact drove large global banks to initiate an ongoing review of the main CCPs' default management mechanisms [see Grant (2014)]. This case highlights the importance for banks of undertaking appropriate due diligence processes, which enable them to know their level of exposure in the event of default.

In September 2018, a member of the Swedish CCP Nasdaq Clearing was unable to meet the required margin calls. In this case, the failure was caused by the highly marked price fluctuations in certain products traded in the commodities derivatives segment (Nasdaq Clearing Commodities). The losses were covered by using the CCP's SIG (€7 million) and the default fund, which had to be replenished by the clearing members in the days following the default for the amount of €108 million [see Nasdaq Clearing (2019)].

Following this episode, the CCP decided to introduce some changes, and, for example, it increased initial margins. It also temporarily endowed the SIG with €19 million, available during the three months following the default and additional to the initial SIG of €7 replenished by Nasdaq. Had a new episode been recorded, the fund would have been used immediately after the resources provided by the defaulting member [see Nasdaq Clearing (2019)].

The global financial crisis was also a test bed for the resilience of clearing houses in the face of the failure of a global bank. In 2008, the investment bank Lehman Brothers was an active player in the main equity, bond and derivatives markets. At the time of its collapse it had, for example, an outstanding position of \$9 trillion (relating to 66,390 transactions) in Swap.Clear of the London clearing house LCH Ltd [see Monnet (2010) and Gregory (2014)]. The investment bank was one of the main participants in this segment of activity, which had 20 members (all of which banks) and an overall position of around \$100 trillion (equivalent to approximately one-fifth of the total market for interest rate swaps) [see Gregory (2014)].

Once the collapse was announced, most CCPs with direct exposure to Lehman acted almost immediately. In the space of 24 hours, clearing houses such as LCH Ltd, Eurex, and Six x-Clear announced the Lehman default or the suspension of its activity<sup>27</sup>; meantime, others such as HKCC allowed the bank to continue clearing under certain restrictions, before definitively announcing its suspension. Within five days, most CCPs had successfully closed out Lehman's own positions through auctions among non-defaulting members. Within 15 days, the main clearing houses finalised the transfer of the client accounts to solvent clearing members and announced that the crisis had been resolved without losses for non-defaulting members, clients or the clearing houses themselves [see CCP 12 (2009)].

Other clearing houses such as CME (US) and HKSCC (HK) were affected as well. In the case of CME, the gains in two of the segments in which Lehman Brothers had positions sufficed to offset the losses that arose in another three segments. In the case of HKSCC, losses exceeded the initial margin and the Lehman contribution to the default fund, using then HKD394 million of the non-defaulting members contribution to the default fund. Non-defaulting members had to post additional resources in order to replenish the default fund[see Gregory (2014)].

Yet overall, the collapse of Lehman Brothers reaffirmed the role of CCPs as effective mechanisms for reducing counterparty risk. The previous examples illustrate that clearing houses' default management mechanisms were functioning appropriately in practice.

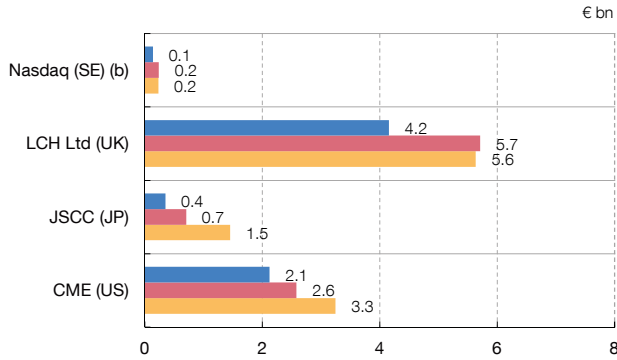
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27 Among the causes of a member's default are, for example, the initiation of the filing for bankruptcy or insolvency proceedings.

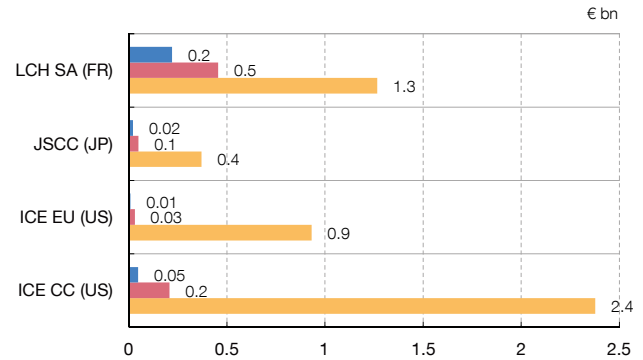
ESTIMATED LARGEST LOSS AND FINANCIAL RESOURCES BY CCP (a)

CHART 9

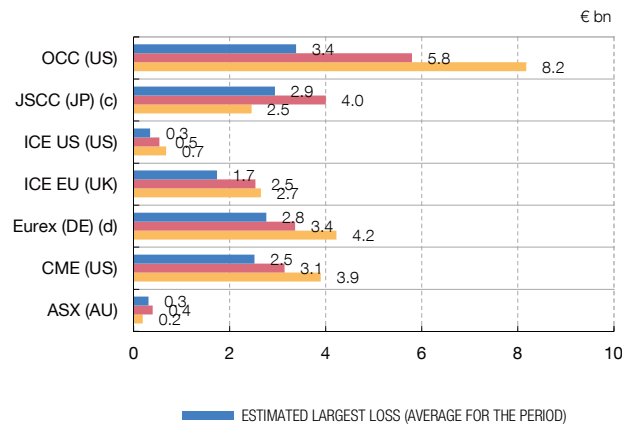
1 SWAPS AND FRAs



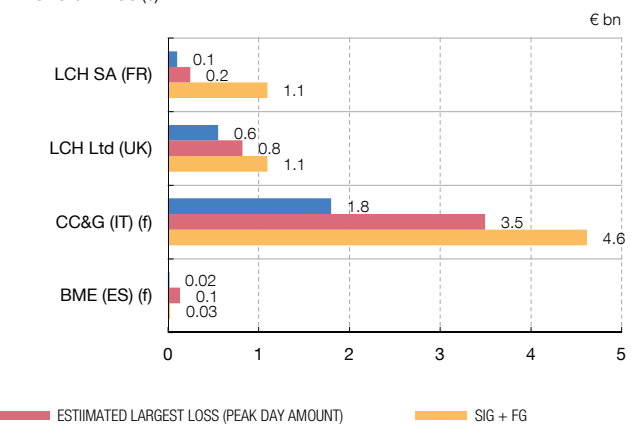
2 CDS



3 F&O



4 SPOT/REPOS (e)



ESTIMATED LARGEST LOSS (AVERAGE FOR THE PERIOD) ESTIMATED LARGEST LOSS (PEAK DAY AMOUNT) SIG + FG

SOURCE: CPMI-IOSCO Quantitative Disclosure, Q4 2018, available on the websites of the CCPs mentioned in the chart.

- a Estimated largest loss (in excess of initial margin) that would be caused by the default of any two participants in extreme but plausible market conditions. The chart reports the peak day amount in the reported quarter and mean average over previous twelve months (Q4 of 2018). SIG = capital buffer contributed by the CCP. DF = default fund contributed by all clearing members.
- b Includes only FRAs.
- c Includes only equity-linked F&O with the exception of SIG, which also covers bonds and spot F&O.
- d Eurex reports jointly for all segments. Assigned to F&O as this is the segment with most activity.
- e Does not include US CCPs most active in spot/repos (FICC-GSD, FICC-MBSD and NSCC) as there is no information on the size of the DF.
- f For CC&G, only the equity segment is included, and for BME, the repos segment.

Quarterly, CCPs publish on their websites the *CPMI-IOSCO Quantitative Disclosure* [see CPMI-IOSCO (2015)], which contains information on the SIG, default fund, initial and variation margins, and the number of members, among other details. In particular, they report the maximum loss (not covered by the initial margin) which they estimate may cause the default of the two largest clearing members in extreme but possible market conditions (this estimate is provided in average of the previous 12 months and in its maximum value during the reporting quarter). This information, along with that on the volume of the default fund and of the SIG, provides an approach to ascertain whether the default waterfall funds would suffice to withstand a highly adverse scenario of losses.<sup>28</sup> Chart 9 shows, for the main segments of activity in the derivatives market, the maximum expected loss and the volume of resources available to cover losses by the global clearing houses most active in each segment. Generally, the default waterfall appears to be robust in the sense that SIG plus default fund contributions are larger than

<sup>28</sup> Note that the data on the default fund and on the SIG relate to the end of the quarter, while the expected losses are offered as an average and the maximum amount for the past 12 months.

the maximum estimated loss, net of initial margin, of the two largest members. This hypothesis is in line with the results of the stress tests conducted by ESMA on the European clearing houses in 2017 [see ESMA (2018)]. The ESMA exercise indicates that there is no evidence of systemic implications arising from the mutualisation of the risk; however, in the adverse conditions analysed, a small CCP would need very small additional contributions to the default fund (less than €1 million) and one of the large clearing houses would practically deplete it.

**5 And if more resources are needed to cover losses?**

Although such a possibility is remote, if the waterfall were not sufficient to cover losses, there are recovery and resolution plans with additional measures available to the clearing house or to the resolution authorities.

The international framework requires that clearing houses have a recovery plan detailing, *inter alia*, what tools to use and under which scenario. It further highlights the importance of considering the potential impact that the use of such instruments would have on all the participants affected. It therefore urges clearing houses to be transparent so that members may be aware of and manage *ex ante* their exposure.<sup>29</sup>

Namely, a CCP can define mechanisms geared to covering losses caused by a member's default, withstanding liquidity shortages, replenishing financial resources, closing out the position of a defaulting member to return to a matched book and covering losses other than those caused by default. This section exclusively addresses the tools intended for covering default losses.

Firstly, one of the most habitual tools is the capacity to require cash calls to clearing members. These contributions may be intended both to cover residual losses and to replenish the default fund. This tool gives the CCP advantages in terms of flexibility. But it also has limitations: as committed but not pre-funded resources are involved, it is possible that clearing members may not be able to contribute or that they have incentives to close positions and operate with a more solvent clearing house (it is therefore subject to uncertainty). With the aim of ensuring that members manage their resources on the basis of this commitment, it would be recommendable for the clearing house to communicate the loss-allocation mechanism to the clearing members (e.g. proportionate to their contribution to the default fund), and to set, moreover, the maximum number of days during which the clearing members are expected to post the guarantees. In Europe's case, the regulations restrict the maximum contribution that a member can make.

Secondly, the clearing house may apply (full or partial) haircuts to the variation margins (VM) corresponding to those positions that have recorded gains while continuing to demand the payment of VM of positions with losses. That is to say, the clearing house ceases to credit in full or in part the gains of those clearing members pending payment. From the CCP's standpoint, this tool offers advantages such as immediate availability. Further, it encourages participation by certain clearing members in the auction of defaulted member's positions with a view to minimising the accumulation of losses. However, it is controversial in that it only distributes losses to a limited group of clearing members. CCPs such as LCH Ltd, JSCC and ICE Clear Europe Ltd, among others, envisage the use of this tool in their respective plans [see Gibson (2013)].

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<sup>29</sup> For further details see CPMI-IOSCO (2014).

Thirdly, clearing houses could use the initial margins (IMs) of non-defaulting members, provided that the legal framework allows it. In Europe, for example, it is forbidden.<sup>30</sup> The main advantage is that it ensures access for the CCP to a most sizeable volume of resources already paid in. But its implementation would give rise to many unwanted effects. For instance, their use would entail a significant loss for clearing members, since they would have to replenish the IM in order to continue operating. That might, moreover, temporarily leave the CCP sub-collateralised. Further, it is not a tool that encourages appropriate risk management: the high cost would encourage clearing members to operate in those clearing houses with lower margins. Lastly, in the case of banks, the cost of centralised clearing would increase, since capital would have to be provided for IM. None of the main CCPs envisage this tool in their recovery/resolution plans.

All the recovery tools entail costs for participants and, unsurprisingly, there is no alignment between the preferences for one tool or another. For instance, BlackRock (2014) states that it is preferable to liquidate them than to maintain a greatly weakened CCP. Meantime, for ISDA (2013) and JP Morgan Chase (2014), the main goal should be to ensure the continuity of the clearing house.

If the recovery plan were not successful, or its implementation were to pose a danger to financial stability, the resolution of the clearing house would follow. In this phase, it is the competent authority (and not the CCP itself) that is entrusted with applying the measures deemed appropriate to ensure financial stability and the continuity of the CCP's critical functions. Significantly, unlike banks, CCPs do not generally have instruments on which to perform a bail-in.<sup>31</sup> Consequently, as in the recovery phase, the financial resources available will mainly be those that clearing members can provide.

The authorities should regularly assess which tools and financial resources should reasonably be available in this phase, and whether they are sufficient. To assist the authorities in this process, the FSB has analysed the nature and quality of the financial resources and the treatment of the capital, so as to ensure that resolution is no more punitive than liquidation pursuant to ordinary insolvency proceedings [see FSB (2018b)]. In 2017, it published guidelines on resolution planning, identifying matters of significance for the design of resolution plans and strategies (e.g. the time of moving into resolution and the powers of the authorities) [see FSB (2017b)].<sup>32</sup>

The measures available in resolution may be very similar to those described in a recovery process. However, both processes differ in their objectives. Recovery seeks to maintain the continuity of the clearing house, whereas resolution should focus on preserving financial stability, avoiding the use of public funds. For Cont (2015), the process should be based on a valuation of overall losses under different scenarios. In this connection, the effects on any institution that may be exposed should be included.

The potential impact of resolution on members emphasises the need for the process to be transparent. The resolution authority should, as far as possible, coordinate with banking supervisors in order to anticipate the impact of each measure, and thereby mitigate the risk of contagion.

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30 See Art. 45.4 of EMIR.

31 Process whereby the losses are borne by the creditors: shareholders, bondholders and depositors.

32 Work is under way in Europe on a regulation on recovery and resolution of CCPs which, at the time of this article going to press, has not yet been adopted..

There are essentially two resolution alternatives. Firstly, to inject capital into the clearing house and restructure its obligations with clearing members and other participants. The challenge for this alternative is to obtain the necessary capital and, above all, the undertaking of the clearing members to continue operating through the clearing house.

Secondly, to transfer the CCP's obligations to another clearing house or to a bridge CCP. This alternative will be easier if there are institutions that offer the same products, have sufficient capacity and share common clearing members. That said, acceptance by the recipient CCP will be required, an aspect that is not ensured given that it will possibly be facing challenges of the same nature as the institution under resolution. Moreover, it will have to face highly complex processes such as the renewal of all contracts with members, access by the recipient CCP to all the information needed for the transfer of the positions and of the guarantees provided, or obstacles arising from different legal frameworks if CCPs operating in a different jurisdiction. In practice, the effectiveness of the resolution frameworks for CCPs has not been tested.

## 6 Benefits, costs and risks of centralised clearing

Some conclusions may be drawn from the previous sections regarding the costs and benefits of centralised clearing, and the implications for financial stability.

Centralised clearing offers, at least potentially, a series of economic and risk-mitigating benefits, both for participants and for the system as a whole. As indicated in section 3, one key benefit is that it allows multilateral netting in a legal and operational fashion, which has the potential to significantly reduce each member's aggregate exposure and, thereby, their capital requirements (if they are banks). This ease in netting positions, along with the standardisation of the contracts that are cleared, contributes to greater market liquidity.

As the CCP is the counterparty to each of the positions, centralised clearing transforms the complex network of relations of a market with bilateral clearing into a simple and transparent network (see Diagram 4). This greater transparency allows market participants to better assess and manage their level of exposure thus facilitating a prudent risk management. It also makes it easier for the authorities to oversee and assess the overall risk in the system, and for the CCP to intervene swiftly if any member takes particularly large positions.

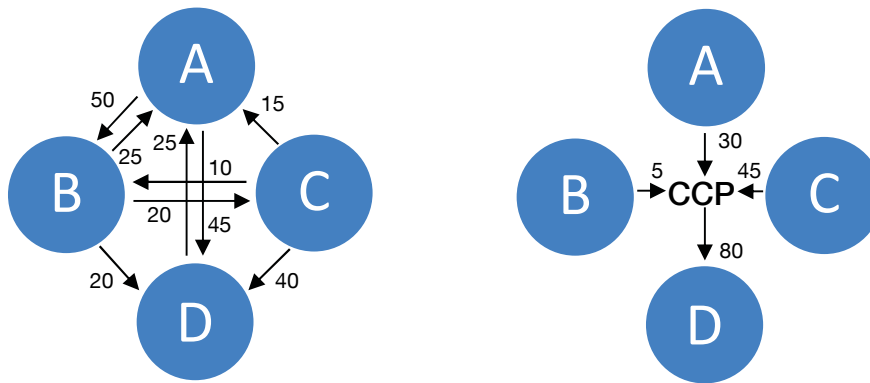
In contrast to bilateral clearing, a CCP provides a coordinated and predictable process when faced with defaults of members. Through this process, the positions of a defaulting member are closed out or replaced, thereby mitigating possible market disruption and the bouts of volatility this would entail, along with operational and legal risks.

### 6.1 SYSTEMIC RISK-MITIGATION

Some of the key characteristics of the functioning and structure of a CCP have the potential to reduce systemic risks in relation to a market dominated by bilateral clearing. This risk-reducing potential is what motivated, for example, the G20 authorities to promote centralised clearing.

Thus, the netting possibilities offered by centralised clearing result in less exposure for the market as a whole; and also diminished the position to be closed or replaced in the event of one or more clearing members failing, which will contribute to mitigating the impact on prices and on volatility. Further, the initial margin offers protection against default (reducing





the impact of this default) and the variation margin contributes to lessening the probability of defaults, since the losses are settled as they arise.

The fact the CCP is the counterparty to all positions places it in a better position to monitor and manage the counterparty risks associated with its exposure, and to intervene swiftly if necessary, e.g. by requiring margin calls or applying higher collateral haircuts that reduce the impact of defaults.

Moreover, the simplified network of interconnections entailed by a centralised structure of clearing and default management, with the CCP as the pivot, may reduce the potential for contagion and domino effects in the event of default. Finally, the loss mutualisation mechanisms (established in the default management process) may encourage clearing members not to take excessive risks, given that the contributions of clearing members to the default fund are proportionate to their exposures.

## 6.2 COSTS AND RISKS

Not everything is an advantage with central clearing. Participation in a CCP entails costs, in addition to posting of margins and capital requirements. The clearing members incur both fixed and variable operating costs, and collateral costs owing to the requirement to deliver highly liquid assets at short notice.

Clients also face fees, and operating and collateral costs, with these potentially be high enough to represent an entry barrier to centralised clearing. This is the case, in particular, for certain small clients or those with a highly defined directional portfolio [see FSB (2018c) and Slive *et al.* (2011)].

Participating in a CCP involves risks. The most significant is the counterparty risk vis-à-vis the CCP, and vis-à-vis all the other clearing members through possible loss mutualisation. Clients, for their part, face counterparty risk with their clearing members and, directly or indirectly (according to the model for clearing client transactions used) with the CCP [see Duffie and Zhu (2010a)].

In addition to counterparty risks (explained in previous sections), a CCP faces operational and liquidity risks. To perform its functions, a CCP needs sophisticated systems and procedures to calculate positions and initial margins, and to make the payments and charges relating to the variation margins. The possibility that such systems and procedures may not be appropriate means that the CCP faces operational risks. Indeed, the materialisation of this risk, that is not covered by the default waterfall



SOURCE: Reproduced from FSB (2018a). The nodes in red represent the CCPs, and those in blue the clearing members. The size of the nodes is proportional to that of the institution they represent.

is, potentially, one of the main causes of a CCP failing, other than that of default by a member (see Annex 4).

The liquidity risk a CCP faces arises from the large cash flows it moves, mainly as a consequence of the charges and payments entailed by the variation margin. CCPs should seek to optimise their investments, bearing in mind that they should be limited to instruments capable of being liquidated immediately (e.g. in the event of a member defaulting, the CCP should continue meeting its obligations with the other members). To mitigate this risk, the CCP should quantify daily its potential liquidity needs and pursue very prudent investment policies.<sup>33</sup>

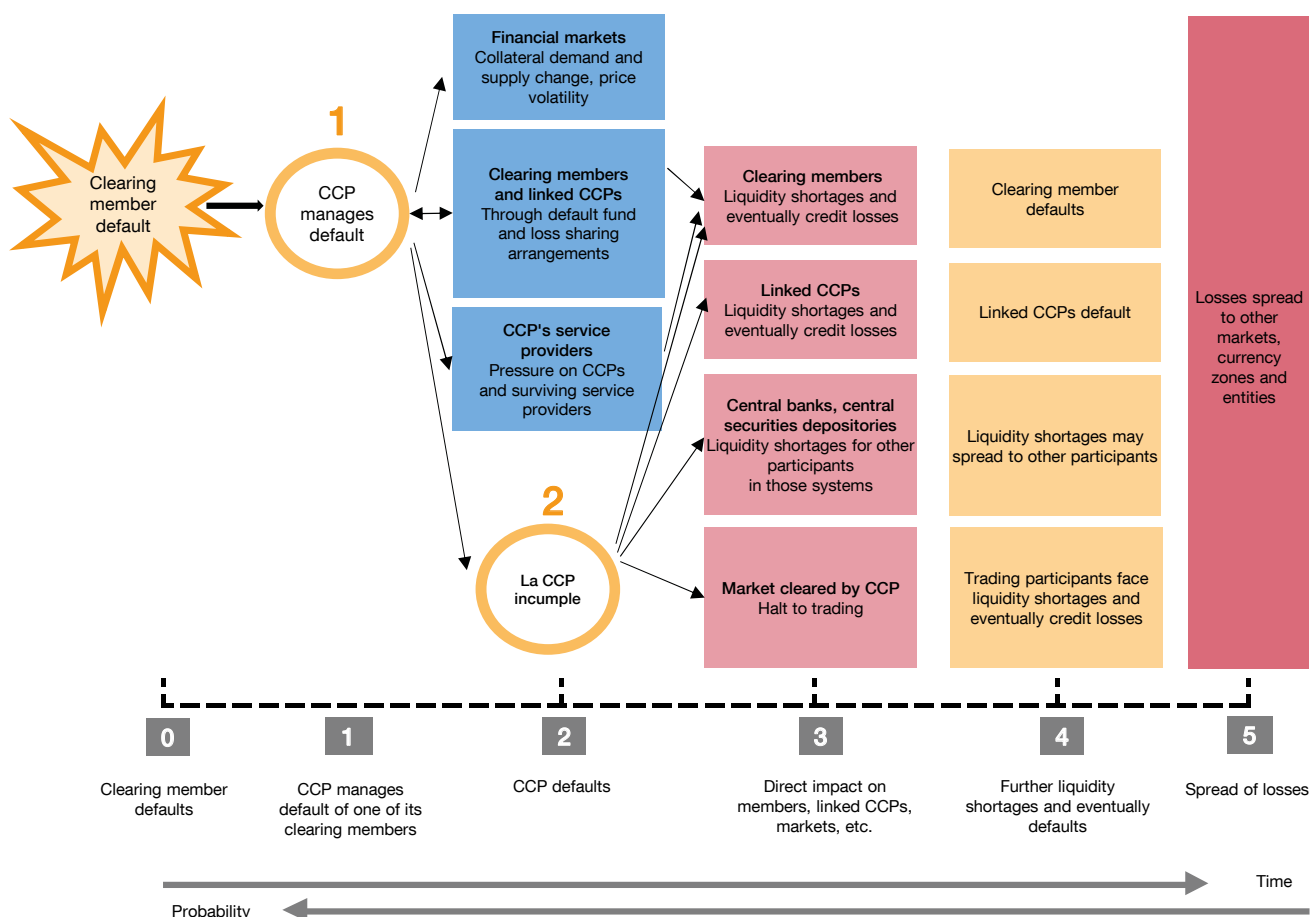
### 6.3 THE SYSTEMIC NATURE OF CCPS

As highlighted, the concentration of risks in CCPs means they become crucial nodes of the financial system with a most significant systemic nature. Their failure may suddenly expose their participants to severe losses, if they do not have the appropriate risk-management resources and procedures [see Duffie and Zhu (2010a)].

If the losses stem from the default of a clearing member, the very characteristics of CCPs that make the financial system more resilient may also be sources of instability. Ultimately, if a CCP had to go into recovery, or worse, into resolution, a chain of defaults by clearing members might take place, with devastating effects on the entire system. The risk of the CCP failing is remote, but not impossible. The serious consequences should it occur mean that CCPs should have rigorous controls, sound risk-management mechanisms and effective supervision [see Duffie (2010b)].

CCPs can contribute to the instability of financial markets, even in the absence of a default by clearing members. In particular, margin calls may have destabilising effects. For

<sup>33</sup> See Articles 44.1 and 47.1 of EMIR.



SOURCE: Prepared by the authors based on the Diagram 1 in Wendt (2015).

example, at times of market tension, the margins and haircuts required may increase drastically, as a result of the high volatility in underlying assets, thereby increasing tensions in what are already fragile markets. Moreover, the search by participants for liquid and safe assets to meet margins in a very short period of time may impose liquidity tensions on markets. A significant reduction in the market value of collateral might also have destabilising effects [see Milanese (2017)].

The systemic nature of CCPs is even more evident if two factors previously highlighted in the preceding sections are taken into account: the high concentration of clearing activity in very few CCPs (see Section 2); and the interdependencies observed (see Diagram 5). In relation to interdependencies, CCPs simplify the network of interconnections, but do not eliminate them. Clearing members are exposed to one another through the default fund and, potentially, through the use of recovery or resolution tools. In turn, CCPs are linked to other CCPs through interoperability agreements – although in practice, these are not very frequent – and, above all, by common members.

In particular, as seen in previous sections, there is a close interconnection between CCPs and the banking system. First, because the major banks are clearing members of the biggest CCPs. Second, the major banks are an important source of liquidity for the CCPs, their clearing members and their clients. And third, because the payments of margins depend notably on the transfers of deposits, the custodial services and the settlement

systems provided by the major banks (see Diagram 6). This close interdependency between banks and CCPs means that CCPs are affected by banks' risks, and vice versa.

The systemic nature of CCP has broadened further, with the mandates of clearing and the imposition of other regulatory initiatives, such as capital and margins requirements in bilaterally cleared positions that encourage centralised clearing.

In short, centralised clearing can have the potential to reduce systemic risks, and to strengthen financial stability. However, it poses some elements of systemic risk which should be addressed. Acknowledging this concern, regulators have expended considerable effort in order to strengthen the soundness and resilience of CCPs. For instance, they have demanded stricter risk management; rigorous stress tests; the introduction of measures to diminish the procyclicality of margins; the imposition of capital requirements on members in order to ensure that bank capital and liquidity cover the risks associated with banking exposure to CCPs; enhanced transparency; and reinforced supervision and cooperation among the authorities involved, both at the national and cross-border levels. More recently, the approach has been to develop robust recovery and resolution regimes for CCPs in order to ensure the continuity of their critical functions and, if necessary, to have the capacity to resolve the institution in a way that prevents or limits systemic risks.

## 7 Conclusions

In 2009, the G20 agreed to require the centralised clearing of standardised OTC derivatives. This decision was based on the benefits attributed to CCPs. Firstly, their capacity to significantly reduce the level of exposure of members to OTC derivatives (and of the market as a whole), thanks to multilateral netting. Secondly, the simplification and transparency of a traditionally opaque market characterised by bilateral relations. Thirdly, the existence of coordinated and predictable processes for default management, enabling clearing members to be aware of their level of exposure in the best interests of prudent risk management.

However, as set out in the article, not everything is advantages. A CCP's high volume of activity and the concentration of counterparty risk might expose the system to heavy losses if the institution does not have appropriate risk-management resources and procedures. And compounding this is the high degree of interdependency with its members and services providers.

For protection from counterparty risk, CCPs have lines of defence in the form of resources provided, in the main, by clearing members (initial margin, the variation margin and contributions to the default fund in the face of defaults). The CCP assigns a buffer of its own capital (skin in the game), that promotes prudent risk-management. The limited size of this buffer has often been questioned by clearing members and clients of CCPs. Indeed, real instances of losses due to default substantiate the fact that, when collateral provided by the defaulting member is insufficient, crisis management rests on the capacity of the other clearing members to contribute.

The loss mutualisation entailed by the use of the default fund and cash calls may translate into contagion risk if the CCP does not bear in mind the potential impact of the tools on members. Accordingly, it is essential that these measures should be as transparent and predictable as possible so that participants may estimate and manage their exposure to the clearing house. Appropriate risk-management by clearing members not only minimises the probability of default; it also reduces uncertainty over the possibility of providing additional collateral.

The CCP should have appropriate risk control and management systems, so that the collected collateral drawn together as margins is enough to cover losses in an extreme but possible scenario. The real instances of default recorded to date evidence that, generally, the default waterfall is sufficient. Consequently, the probability of a CCP failing due to a member's default is small, but not zero. If the default waterfall were to prove insufficient, the CCP (unlike banks) does not have high capital or debt instruments with the capacity to absorb losses. Hence, in recovery and resolution phases, the financial resources available are once again those that clearing members are capable of contributing. In a stressed scenario, clearing members may not have sufficient liquidity to support the survival of the clearing house. Hence, it is of vital importance that the CCP is robust enough to be able to properly manage default losses with pre-funded resources to prevent the entering into recovery or resolution.

On the side of the authorities, the systemic nature of CCPs and the risk of contagion emphasise the need to know what type of institutions act as clearing members and what their level of exposure is. As the article shows, a good number of the clearing members are banks which, often also provide services to the CCP. Furthermore, the fact that banks clear in a high number of clearing houses reinforces the interconnections between CCP, despite the fact that there are few interoperability agreements. This network of interdependencies takes on particular importance in those cases in which the most active clearing members are globally systemic banks.

The high presence of banks, and the direct impact on banks, as clearing members, of all the measures available to ensure the continuity of the clearing house (both in recovery and in resolution) requires close cooperation between the competent authorities at the level of CCPs and of banks, in recognition of the fact that the risks of both institutions are closely related. Early involvement and information exchange may contribute to minimising the most serious effects that the failure of a bank or a global CCP might have on the system as a whole.

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## Annex 1 The obligation to centrally clear in different jurisdictions

### THE CENTRAL CLEARING OBLIGATION, BY JURISDICTION

TABLE A.1.1

Jurisdiction	Instrument	Currencies/index	Maturity	Entry into force	Scope (c)	Threshold (d)
US	Swaps IRS (fixed-variable)	USD, EUR, GBP, JPY, AUD, CAD, HKD, MXN, NOK, PLN, SGD, SEK, CHF	28 d-30 y/50 y (a)			
	Swaps (basis, variable-variable)	USD, EUR, GBP, JPY, AUD		Mar-13	Financial institutions	10 bn USD
	FRA	USD, EUR, GBP, JPY, PLN, NOK, SEK	3 d-3 y			
	OIS	USD, EUR, GBP, AUD, CAD	7 d-2 y			
	CDS (index)	iTraxx Europe, iTraxx World, CDX.NA	5 a/10 y (a)			
Japan	Swaps IRS (fixed-variable)	JPY	0 d-30 y	Nov-12		
	Swaps (basis, variable-variable)	JPY	0 d-30 y	Nov-12		
	Swaps IRS	JPY/EUR	up to 5 y/10 y (a)	Jul-14	Financial institutions	300 bn JPY
	Swaps (basis)	JPY/EUR		Jul-14		
	CDS (index)	iTraxx Japan	5 y	Nov-12		
EU	Swaps IRS (fixed-variable)	USD, EUR, GBP, JPY	28 d-30 y/50 y (a)			
	Swaps (basis, variable-variable)	USD, EUR, GBP, JPY, NOK, PLN, SEK		Jul-16 (gradually) (b)	Financial and non-financial institutions	3 bn €
	FRA	USD, EUR, GBP, NOK, PLN, SEK	3 d-3 y			
	OIS	USD, EUR, GBP	7 d-3 y/10 y (a)			
	CDS (index)	iTraxx Europe	5 y	Feb-17 (gradually) (b)		1 bn €
Australia	Swaps IRS (fixed-variable)	USD, EUR, GBP, JPY, AUD	28 d-50 y			
	Swaps (basis, variable-variable)	USD, EUR, GBP, JPY, AUD	28 d-50 y	Apr-16	Financial institutions	100 bn AUD
	FRA	USD, JPY, AUD	3 d-3 y			
	OIS	USD, EUR, GBP, AUD	7 d-2 y			
Canada	Swaps IRS (fixed-variable)	USD, GBP	28 d-30 y/50 y (a)			
	Swaps (basis, variable-variable)	USD, EUR, GBP	28 d-50 y	Apr-17	Financial institutions	1 bn CAD
	FRA	USD, EUR, GBP	7 d-2 y/3 y (a)			
	OIS	USD, EUR, CAD	3 d-3 y			
China	Swaps IRS (fixed-variable)	CNY	5 d-3 y/5 y (a)	Jul-14	Financial institutions	ND
Hong Kong	Swaps IRS (fixed-variable)	USD, EUR, GBP, JPY, HKD	28 d-10 y	Sep-16 (gradually) (b)	Financial institutions	20 bn USD
	Swaps (basis, variable-variable)	USD, EUR, GBP, JPY, HKD				
	OIS	USD, EUR, GBP, JPY	1 d-2 y			
Korea	Swaps IRS (fixed-variable)	KRW	3 m-20 y	Jun-14	Financial institutions	1 bn KRW
Mexico	Swaps IRS (fixed-variable)	MXN	56 d-30 y	Apr-16 (gradually) (b)	Financial institutions	3 bn USD
Singapore	Swaps IRS (fixed-variable)	USD, SGD	28 d-30 y/50 y (a)	Oct-18	Financial institutions	3 bn USD
Switzerland	Swaps IRS (fixed-variable)	USD, EUR, GBP, JPY	28 d-50 y			
	Swaps (basis, variable-variable)	USD, EUR, GBP, JPY	28 d-50 y			
	FRA	USD, EUR, GBP	3 d-3 y	Sep-18 (gradually) (b)	Financial institutions	ND
	OIS	USD, EUR, GBP	7 d-3 y			
	CDS (index)	iTraxx Europe	5 y			

SOURCE: Prepared by the authors based on the information reported by jurisdictions to IOSCO. Available at: <https://www.iosco.org/library/informationrepositories/zip/20180920-Information-repository-for-central-clearing-requirements.zip>.

- a Depending on the currency or index.
- b Gradual entry into force depending on the type of the entity. In the EU, June 2019 is the effective date of the requirement for positions up to 8bn euros of both financial and non-financial institutions.
- c Generally, central banks, governments, IFI and intragroup positions are exempted from central clearing obligation.
- d The central clearing obligation does not apply to outstanding positions below the threshold.

## Annex 2 Bis statistics on OTC derivatives

The BIS publishes statistics on OTC derivatives half-yearly.<sup>1</sup> The statistics are based on information provided by 13 central banks which, in turn, obtain the information from their main banks.<sup>2</sup> The information refers to outstanding positions in notional and gross market values, and is provided for several attributes: market segment (swaps, FRAs, options, CDSs, equity derivatives and exchange rate derivatives, among others), currency, maturity and counterparty.

Counterparties are classified into three types: another participant dealer (bank); other financial institutions; and non-financial institutions, the latter being a minor part. Regarding the category “other financial institutions”, a distinction has been drawn by type of institution (i.e. other financial institutions or banks that are not in the sample and CCPs) since June 2010 (for CDSs) and since June 2016 (for other derivatives).

In the case of positions reported by participant dealers whose counterparty is another dealer (bank) in the sample, the BIS halves the total for these positions to avoid double counting, since both the seller and purchaser are reporting the same operation. However, for positions whose counterparty is a CCP, the adjustment cannot be made since it is not known whether originally (i.e. before registration in the CCP<sup>3</sup>) the counterparty was a participant bank in the sample or other institution. Hence for these positions originally traded between two participant banks there will be double counting, since the two participant banks in the sample report the same transaction, with the CCP as counterparty. Nonetheless, if it is assumed that all outstanding positions with a CCP as counterparty relate to operations originally entered into with another participant dealer, it is possible to adjust the series of the above-mentioned double counting [see BIS (2018)]. In this connection, the total position with the CCP as counterparty is divided by two.<sup>4</sup>

To complete the series of centrally cleared swaps prior to 2016, the rates of change obtained from the information provided by ISDA (2016) on the volumes of swaps centrally cleared for the period 2007-2016<sup>5</sup> have been applied to the figures for June 2016 given by the BIS. The series thus estimated are shown in Charts 1, 2 and 3 of the text. Since it has been assumed that all the outstanding positions with the CCP as a counterparty relate to operations originally entered into by participant dealers, the series estimated will have a degree of over-adjustment. This is because it is likely that at least a small portion of the positions with a CCP as a counterparty relate to operations originally entered into by a participant bank in the sample and another institution that is not a participant dealer.

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1 Additionally, the BIS publishes a statistic every three years with information on trading and with a broader sample than for its half-yearly one, and a further statistic with monthly information on trading and open interest in relation to the exchange traded derivatives (ETD) markets.

2 The representativeness of the sample is, according to the BIS, very high: 100% in the CDSs segment, 98% in that of equity derivatives, 97% in that of interest rate derivatives (swaps, FRAs, etc.), 90% in that of exchange-rate derivatives and 90% in that of commodities derivatives.

3 Following the negotiation, when a transaction is centrally cleared, the CCP becomes the buyer of the seller and the seller of the buyer. This process is known as novation.

4 The adjustment is made for swaps and CDSs, since for exchange rate and equity derivatives the centrally cleared volumes are very small.

5 This type of exercise is not necessary for CDSs, since these began to be centrally cleared in 2009, and the series with a CCP as counterparty began in 2010.



### Annex 3 Netting and portfolio compression

The change from one date to another in the outstanding volume, in notional terms, held by a CCP in a specific derivatives segment is, generally, less than the volume cleared during that period owing to three factors: maturity of contracts, netting of positions and portfolio compression.

The netting of positions consists of the full or partial offset of positions, registered on behalf of a clearing member or a clearing member's client, whose characteristics are identical (e.g. in a swap: maturity, fixed rate and variable rate of reference) but of the opposite sign.

The compression of derivatives portfolios is a netting procedure or technique whereby two or more counterparties substitute positions for another one, resulting in a lower outstanding notional amount but with the same net value and, therefore, with the same market risk.<sup>1</sup> This service requires the authorisation of the parties concerned.<sup>2,3</sup> The reduction of the notional outstanding amount lessens the regulatory capital requirement and management costs. And that is why portfolio compression is particularly attractive for banks, subject as they are to capital requirements, on their exposures and those of their clients, in CCPs.

Portfolio compression services began to be offered in 2003 by Tri-Optima, for traded and bilaterally cleared swaps. The rise in CCPs' activity has contributed to increasing portfolio compression, since centralised clearing enables the use of sophisticated techniques for identifying positions that can be compressed.<sup>4</sup>

Portfolio compression and the netting of positions give rise to a notable reduction in the notional outstanding amount for the market as a whole. Thus, LCH Ltd reports that, in the year from December 2017 (with a notional outstanding amount of \$252 trillion) to December 2018, contracts for a notional value of \$1,952 trillion were cleared, contracts for a value of \$612 trillion matured, and a netting and portfolio compression for a notional

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1 Formally, Art. 2 of Regulation (EU) 600/2014 of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments (MIFIR) describes portfolio compression as follows: "a risk reduction service in which two or more counterparties wholly or partially terminate some or all of the derivatives submitted by those counterparties for inclusion in the portfolio compression and replace the terminated derivatives with another derivative, whose combined notional value is less than the combined notional value of the terminated derivatives."

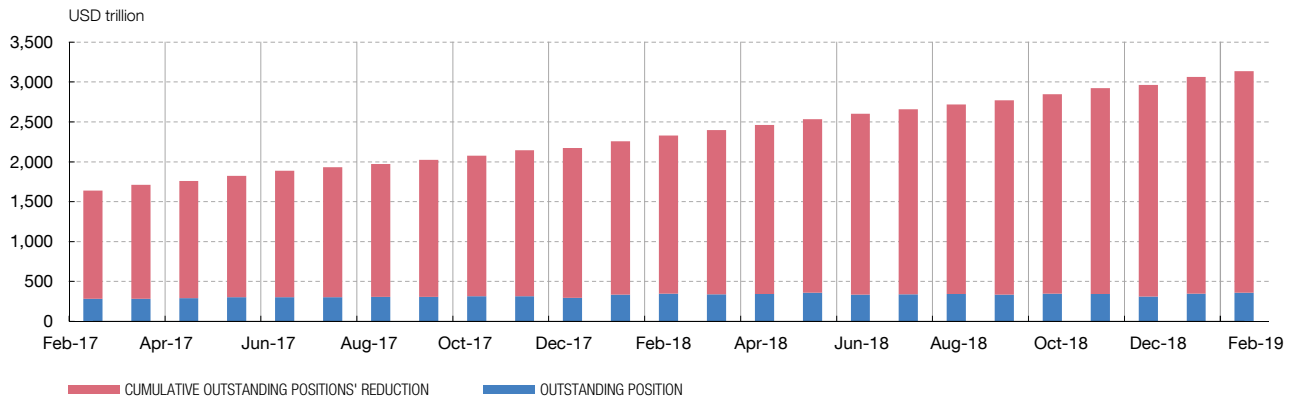
2 Example: banks X and Y bilaterally trade, not necessarily on the same date, two swaps: swap A with maturity of 10 years and a notional value of 100 M €, for which X pays variable Euribor 6M and receives 3% fixed, while Y pays fixed and receives variable, and swap B with maturity of 9.8 years and a notional value of 90 M €, for which Y pays variable Euribor 6M and receives 2.9% fixed and X pays fixed and receives variable. Further to authorisation by the parties, the CCP compresses the positions, replacing swaps A and B with swap C with maturity of 10 years and a nominal value of 10 M €, for which X pays variable Euribor 6 M and receives 3% fixed, and Y pays 3% fixed 3% and receives variable. Each of the parties has reduced its outstanding position from 190 M € to 10 M €. (Example taken from the Eurex booklet "Eurex Clearing netting and compression" June 2015).

3 Usually, CCPs also offer unilateral portfolio compression services, i.e. affecting only the positions of one participant. This is the case of the "rate blending" service, which requires positions of the opposite sign in swaps with different fixed rates and notional value, but the same reference variable rate and payment dates. The resulting position has a lower notional value and the same flows as the initial positions as a whole, with a blended rate (a combined fixed rate between the two initial rates), i.e. the same market risk. Example: bank X has a position in swaps for 10 M €, for which it pays 4% fixed and receives variable Euribor 6M, and a position in swaps for a notional value of 8 M €, for which it pays variable Euribor 6M and receives 3% fixed. These two swaps are replaced by one with a notional value of 2 M €, for which X pays 8% fixed and receives variable Euribor 6M.

4 See Schrimpf (2015).

OUTSTANDING POSITION AND REDUCTION DUE TO NETTING AND PORTFOLIO COMPRESSION

CHART A3.1



SOURCE: LCH SwapClear, *Monthly Statistics* (March 2019).

value of \$1,383 trillion, resulting in a notional outstanding amount as at December 2018 of \$309 trillion. Chart A3.1 describes the monthly changes in reductions due to netting and compression and in the outstanding position of LCH Ltd.

#### Annex 4 Cases of failure of CCPs and main defaults of clearing members

The failure of a CCP is a remote event. However, in recent decades, there have been cases in which, faced with a stressed scenario on the financial markets, inadequate risk-management practices have led to the insolvency of a CCP. This Annex details the basic characteristics of some of these events.

In 1974, the French CCP Caisse de Liquidation collapsed after a period of high volatility in sugar futures prices. Under this scenario, the CCP did not require of its clearing members new contributions to the initial margin that would reflect the increase in the expected loss derived from the high market volatility. Further, the clearing house was highly exposed to a single entity (Nataf Trading House). After recording default losses, the CCP required contributions of new resources of its members (margin calls), which were not met in all cases. The situation worsened (to the extent of leading to liquidation) owing to the lack of transparency in loss-allocation among the clearing members [see Gregory (2014), Kiff (2019)].

In 1983, the CCP Kuala Lumpur Commodity Clearing House went into liquidation following the collapse of the palm oil futures market. Six members, with high exposure to the clearing house, failed to meet their payment obligations and the CCP requested new contributions of the other members to cover these losses. As in the previous case, the CCP had not required new contributions to the initial margin. In fact, the government accused the CCP of inactivity in the period from the time at which the first signs of difficulties on the futures market were recorded, to the first default arising [see Gregory (2014), Kiff (2019)].

In 1987, Hong Kong Futures Exchange Clearing Corporation failed following the global crash in stock markets. The temporary closure of the Hong Kong stock exchange fuelled the mistrust of market participants regarding the sufficiency of financial resources available to cover losses, and the capacity of clearing members to make new contributions, if needed. Once the default losses were recorded, the CCP had to request additional contributions from shareholders and clearing members, which were not sufficient. Once again, among the causes behind the failure of the institution were the absence of appropriate margins-calculation policies (the CCP also failed to update the initial margin). Moreover, the CCP was not exposed to the losses arising from default, that is, there was not SIG [see Gregory (2014)].

The 1987 stock market crash also posed serious difficulties for the US CCPs Chicago Mercantile Exchange (CME) and The Options Clearing Corporation (OCC), owing to several clearing members defaulting on posting the variation margin. Both CCPs avoided collapse thanks to emergency loans. Table A4.1 summarises the most significant cases of CCPs with one or several members defaulting (some have been explained in the article).

**CLEARING MEMBERS DEFAULTS, BY CCP**
**TABLE A4.1**

Year	CCP	Amount of losses caused by defaults	Were the financial resources contributed by clearing members sufficient?
1985	Comex Clearing Association	\$ 9 millions	NO
1987	The Options Clearing Corporation	\$8.6 million	NO (the CCP requested an emergency loan)
1987	Chicago Mercantil Exchange (CME)	n/d	NO (the CCP requested an emergency loan)
1989	New Zealand Futures and Options Exchange	GBP 1 million	NO
1991	LCH Ltd	GBP 900,000	YES
1995	SIMEX	n/a	YEs (exceeded by \$86 million)
2000	New York Clearing Corporation (NYCC)	n/a	NO (the CCP contributed \$4 million to protect clients from losses)
2008	LCH Ltd	n/a	YEs (positions were auctioned succesfully)
2008	Hong Kong Exchange and Clearing (HKSCC)	n/a	NO
2008	Chicago Mercantil Exchange (CME)	n/a	YES
2013	Korea Exchange CCP	\$39.6 million	NO
2016	LCH Ltd	n/a	YES
2018	Nasdaq Clearing	n/a	NO

SOURCE: Prepared by the authors based on the information available in McPartland and Lewis (2017), Gregory (2014) and Nasdaq Clearing (2019).

NOTE: n/a shows that precise figures are not available.