

WP/15/21

IMF Working Paper

Central Counterparties: Addressing their Too Important to Fail Nature

Froukelien Wendt

IMF Working Paper

Monetary and Capital Markets

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Prepared by Froukelien Wendt

Authorized for distribution by Ghiath Shabsigh

January 2015

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Abstract

Central counterparties (CCPs) can offer significant benefits to a market. However, CCPs are also highly interconnected with financial institutions and markets and therefore too important to fail. The increased volumes cleared through CCPs and their increasing global scope, in particular in the OTC derivatives market, make it even more important that systemic risks related to CCPs are managed. This paper argues that the current set of international policy measures does partly address these risks, but that alternative policy measures are needed to reduce remaining systemic risks. For example, the paper recommends network analysis to be conducted by CCPs and authorities to gauge potential losses and suggests a common international approach to central bank services to help reduce the dependency of CCPs on services provided by commercial banks.

JEL Classification Numbers: G01, G18, G23, G33

Keywords: central counterparties, interconnectedness, interdependencies, too important to fail, recovery and resolution, risk waterfall.

Author's E-Mail Address: fwendt@imf.org

The author is grateful for contributions received from John Kiff and for comments from Thomas Book, Teo Floor, Lex Hoogduin, Sander van Leijenhorst, Daniela Russo, Robert Steigerwald, Els de Vogel and Elias Kazarian, Pierpaolo Grippa, Tanai Khiaonarong, Peter Lindner, Jodi Scarlata, and Manmohan Singh. Research assistance was provided by Karen Lee. All remaining errors are my responsibility.

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I. INTRODUCTION

Central counterparties (CCPs) acted like firewalls during the global financial crisis in 2008. They successfully contained the consequences of the default of Lehman Brothers International, stopping contagion of losses to spread to other financial institutions active in markets cleared by those CCPs. Historically, CCPs have been used in exchange-traded derivatives markets, but during the last decade CCPs have been increasingly used in securities, repo, and over-the-counter (OTC) derivatives markets, mainly in advanced economies. In 2009, the firewall capacity of CCPs has been one of the drivers of the G20 decision to mandate central clearing for standardized OTC derivatives. The decision aimed at correcting the structural weaknesses in the OTC derivative markets that became evident during the global financial crisis.

A CCP, however, is not without risks and its firewall function will only hold as long as the CCP's risk management is sufficiently sound. A CCP limits credit risk, but at the same time increases concentration risk by substituting for a whole network of financial institutions. CCPs are highly interconnected with market participants and financial markets. Its activities or default may cause negative externalities in extreme circumstances, exposing its participants and the financial market in general to unexpected credit losses and liquidity shortages. That is why CCPs are typically considered systemically important institutions by central banks and securities regulators and why CCPs are subject to their oversight and supervision.¹ The systemic importance of CCPs makes them in many cases “too important to fail” (TITF), implying that their failure would have such a negative impact on the financial system and the economy as a whole that the government would do whatever it takes to prevent such a failure, including effecting transfers from taxpayers.

In the last couple of years, the G20, international standard setting bodies, individual authorities, and the industry have taken new measures to address the systemic importance of CCPs. International standards increase requirements for CCPs, jurisdictions are implementing these requirements into their legal and regulatory frameworks, and recovery and resolution regimes are being developed. In addition, capital requirements for banks intend to incentivize CCPs and their stakeholders to increase compliance with the new standards. Whether these measures are sufficient to reduce the negative externalities related to a the TITF nature of CCPs remains an open question. This question becomes more relevant with the increased volumes cleared by CCPs in global markets.

This paper takes interconnectedness as the key determinant of the TITF nature of the CCP. It analyzes how the interconnections among CCPs, their clearing members, other entities and markets impact the stability of the financial system. The paper then evaluates different policy

¹ The internationally accepted presumption is that, in principle, all CCPs are systemically important at least in their own jurisdiction. See introductory part of CPSS-IOSCO, 2012.

measures that are currently in place or being developed to limit the negative externalities created by TITF CCPs. It concludes that the current multi-faceted approach is a good way to address the failure of a CCP, but that significant risks remain.

II. BENEFITS AND COSTS OF CENTRAL CLEARING

A CCP is an entity that interposes itself between counterparties to contracts traded in financial markets, becoming the buyer to every seller and the seller to every buyer and thereby guaranteeing the performance of open contracts.

Well-functioning CCPs can vastly improve the safety, efficiency, and transparency of the financial system. In a market cleared by a CCP, clearing members² are no longer exposed to each other but to one counterparty (the CCP), instead of many counterparties with different risk profiles. Market-wide management of credit risk may improve as the CCP covers its exposures with high quality collateral. In case of a default of a clearing member the CCP may facilitate the transfer of customer positions and collateral of that failing clearing member to solvent, surviving clearing members and coordinate the orderly replacement of defaulted trades through auctions and hedging of exposures. In that sense the CCP acts as a firewall. CCPs enable multilateral netting³ among clearing participants, reducing the total credit exposure in the market as well as the number of transactions that need to be settled, which results in operational efficiencies. A CCP also allows for anonymous trading, resulting in benefits such as increased liquidity and reduced spreads (Ripatti, 2004). A CCP may further contribute to the transparency of a market as it provides for the centralized administration of long and short positions of clearing members. Benefits and cost of central clearing are summarized in Table 1.

CCPs, however, give rise to certain risks and costs. One of the most important risks is the increase of systemic risk through risk concentration within the CCP. The default of a CCP may have a strong impact on clearing participants, linked CCPs, and other linked entities and markets, potentially affecting national (or global) financial stability. Credit and liquidity losses may quickly spread to other markets and financial institutions. Another drawback of CCPs is the cost for clearing members to participate. Membership in a CCP carries several cost, including membership fees, operational costs and collateral cost, although operational costs may be compensated by the operational benefits of participating in a CCP. Collateral cost, however, can be substantial and relate to margin and default fund contributions of clearing members to the CCP: to protect itself against the default of one of its clearing

² Clearing members are usually large banks and non-bank financial institutions that have concluded a clearing agreement with the CCP, subjecting themselves to the rules of the CCP and gaining access to its clearing services and systems.

³ Netting is the offsetting of obligations between or among participants, thereby reducing the number and value of payments or deliveries needed to settle a set of transactions.

members the CCP calls for regular (typically daily or intraday) deposits of margin and default fund contributions to collateralize exposures.⁴

Table 1. Benefits and Costs of CCPs

Benefits	Costs
Risk reduction through: <ul style="list-style-type: none"> • multilateral netting; • improved risk management practices; and • firewall function. 	Risk concentration creates systemic risk through: <ul style="list-style-type: none"> • default of CCP may result in credit losses and liquidity shortages of clearing; participants and linked CCPs; and • contagion to other markets and (financial) institutions.
Operational efficiencies through: <ul style="list-style-type: none"> • reduced amount of settlement instructions; and • straight through processing. 	Costs of participating: <ul style="list-style-type: none"> • cost of collateral for margin and default fund contribution; • membership of CCP; and • operational cost.
Trading benefits in the form of: <ul style="list-style-type: none"> • anonymity of trading; and • increased liquidity and reduced spreads. 	Economic cost from a potential freeze of the market if CCP fails
Transparency: <ul style="list-style-type: none"> • source of market information. 	

III. INTERCONNECTEDNESS OF CENTRAL COUNTERPARTIES

The central position of a CCP in financial markets and its interconnectedness with other market participants are the main determinants of its systemic importance.⁵ Higher levels of interconnectedness generally result in an increased impact of a CCP's actions on participants,

⁴ The introduction of a CCP in a market may, however, reduce the cost of collateral compared to the case where trades are bilaterally cleared by market participants. When the current and potential exposures in a bilaterally cleared market are collateralized with high quality assets the multilateral netting feature of a CCP reduces collateral needs.

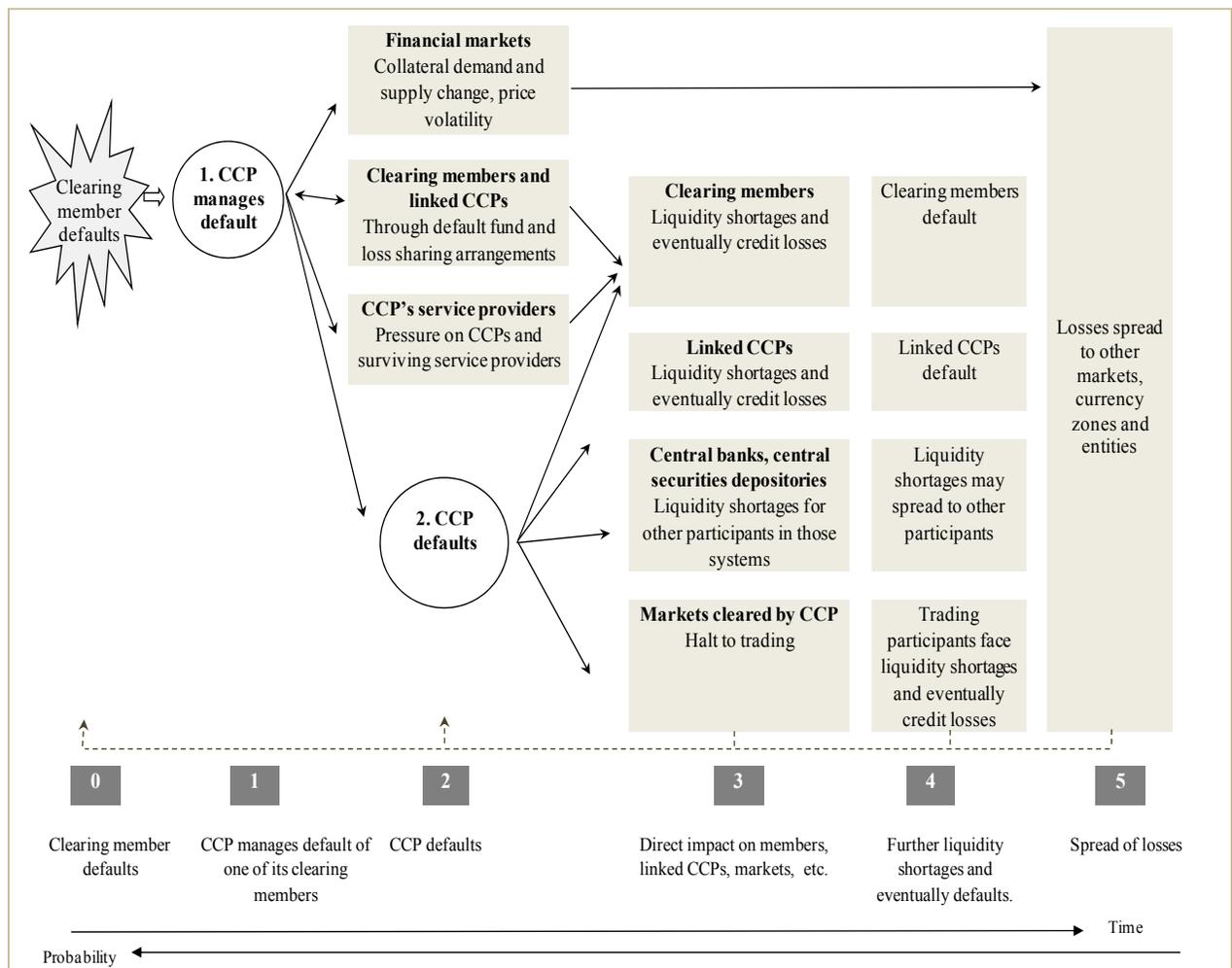
⁵ Other indicators of the TITF nature of CCPs comprise its size, cross-border activity, substitutability, and complexity, comparable to the set of indicators used to assess "too big to fail" banks (BCBS 2013). The failure of a large CCP servicing multiple countries is more likely to negatively impact global financial markets than the failure of a small CCP that only serves its national market. The larger a CCP's global reach the more widespread the potential spillover from its failure. The systemic impact of a CCP's failure is also expected to be negatively related to its degree of substitutability. In the absence of other CCPs taking over positions of market participants, trading may be disrupted. A generally available substitute for a CCP is the return to bilateral clearing among market participants. Such a shift may however be conducted in an unorganized manner if the CCP fails, creating further turmoil. Finally, the systemic impact of a CCP's failure is expected to be positively related to the complexity of products that are cleared and the complexity of risk management models.

linked CCPs, other financial market infrastructures (FMIs), such as payment systems, and markets.

The establishment of a CCP reduces the interconnectedness of banks. A CCP guarantees the performance of open positions despite the failure of one of the clearing members. In that sense a CCP that is well designed and capitalized insulates counterparties from one another. In its role of firewall a CCP can be considered a prudential tool to reduce the interconnectedness among banks (Arregui and others, 2013).

However, the establishment of a CCP also creates new interconnections. Figure 1 illustrates the interconnectedness of CCPs with its ecosystem. Contagion of stress and losses may occur as a result of (i) a CCP's actions to survive following the default of a clearing member or (ii) a CCP's eventual default.

Figure 1. Possible Contagion Channels in a CCP's Ecosystem



Interconnections of CCPs and clearing members

Interconnections of CCPs with their clearing members are channels through which losses can spread. This may occur in different ways. A first way is through the default of one of the clearing members, i.e. in case one of the clearing members is unable to fulfill its payment obligations towards the CCP. A CCP typically has in place a risk waterfall consisting of layers of protection to cover losses following the default of a clearing member. The layers typically comprise prefunded financial resources consisting of margin, default contributions and CCP's capital (Box 1). These structures, however, vary across CCPs as there is no internationally prescribed risk waterfall structure. The firewall function of the CCP holds as long as losses following the default of a clearing member can be covered with collateral of the defaulter and eventually the CCP's capital, i.e. the first three layers described in Box 1. In extreme circumstances, however, the losses may exceed those and the CCP will turn to the default fund contributions of surviving clearing members. At that point in time the default of a clearing member will also impact other clearing members. This happened for example at the Korea Exchange in 2013, where the default of HanMag resulted in losses for other clearing members of the Korea Exchange.

Margin calls of a CCP may put further pressure on clearing members during periods of market stress. The value of collateral that clearing members have deposited on behalf of a CCP may deteriorate. A CCP will seek to have its exposures fully collateralized to maximize its chances of survival, without taking into account the systemic risk it may be adding. CCPs will therefore call for additional margin, which may put pressure on the liquidity of its clearing members. In extreme circumstances clearing members can face liquidity shortages and default, with a potential impact on the stability of financial markets. For example, the tight coupling of derivative market participants, particularly via margin calls, can put strains on the liquidity of individual firms and the system at large (Pirrong 2011).

Loss-sharing arrangements of a CCP are another way through which clearing members may face losses. Loss sharing arrangements come into play when the end of the risk waterfall is reached and all prefunded financial resources of the CCP are used. Their purpose is to allocate losses among surviving clearing members, allowing for winding down of operations and/or continuation of some critical operations. Loss-sharing arrangements may allow the CCP to survive, but they may also impose on the CCP's clearing members (and their clients) contingent liabilities that they may not be able to cover. Different loss-sharing arrangements result in different allocations of losses. For example, unlimited assessment calls expose clearing members and shareholders to theoretically unlimited liabilities. Liquidations and tearing-up of trades will create externalities to counterparties of the defaulter. Variation Margin Gains Haircutting (VMGH) place the burden on those clearing members or clients that made financial gains on their position as the CCP keeps those to cover the losses on the position of the defaulter (JP Morgan 2014).

Box 1. The CCP Risk Waterfall

A CCP's risk waterfall is a tiered loss absorption mechanism consisting of layers of protection that a CCP accesses to satisfy the losses following the default of a clearing member.

When a clearing member fails, a CCP may first stabilize the situation by taking on opposite trading positions to hedge the market risk of the defaulting clearing member's portfolio. The CCP may then replace all of the failed clearing member's positions to flatten its market-price risk exposure. The portfolios are either auctioned to surviving clearing members or other market participants, or liquidated and re-established with the receiving clearing member upon closing of the old ones. Any remaining settlement obligations have to be met by the CCP on behalf of the defaulting clearing member. Losses resulting from the hedging and liquidation process are covered by the components of the risk waterfall:

- ✓ ***Initial and variation margin contributions of the defaulting clearing member:*** initial margin serves to cover potential future exposures in the interval between the last margin collection and the close out of positions following a clearing member's default. Initial margin is typically determined taking the worst probable one or more-day loss that the position could sustain using market volatility and specific counterparty risk. Variation margin passes losses or gains from losers to gainers to ensure that market risk exposures are covered.
- ✓ ***Default or guarantee fund contributions of the defaulting clearing member:*** these are tapped when a CCP's losses exceed the defaulting clearing member's posted margin. The default fund serves to cover potential losses under stressed market conditions.
- ✓ ***CCP's capital or 'skin in the game':*** the CCP steps in with its pre-defined contribution to the loss allocation waterfall, a part of its own capital.
- ✓ ***Default fund contributions of surviving clearing members.***
- ✓ ***Assessment calls*** of the CCP requesting replenishment of funds by surviving clearing members and/or other loss-sharing calls.
- ✓ ***Remaining capital of the CCP:*** when the CCP's capital is exhausted, the CCP will cease operations.

The waterfall structure of a CCP varies per CCP and there is no internationally prescribed one. For example, the use of a CCP's capital before the funds of surviving clearing members (or 'skin in the game') is not implemented by every CCP.

International standards (CPSS-IOSCO 2012) do however require that a CCP that is involved in activities with a more-complex risk profile or that is systemically important in multiple jurisdictions should maintain financial resources sufficient to cover the default of the two participants and their affiliates with the largest aggregate credit exposure to the CCP in extreme but plausible market conditions. All other CCPs should maintain financial resources sufficient to cover the default of only the participant and its affiliates with the largest exposure to the CCP in extreme but plausible market conditions. A CCP should regularly conduct stress testing to verify whether financial resources are indeed sufficient.

The risk waterfall typically aims to manage credit risk, more specifically replacement cost risk. Other tools exist to manage liquidity risk, such as accepting only high quality liquid collateral, monitoring payment flows, stress testing liquidity needs and maintaining committed credit lines with commercial banks and/or a routine intraday credit line with the central bank if available. A CCP can in no way count on emergency liquidity assistance of a central bank to manage its liquidity risk.

Additional stress occurs in case clearing members fulfill one or more services to the CCP. Global systemically important banks (G-SIBs) and other commercial banks may fulfill roles of general clearing member (clearing for clients), liquidity provider, depository bank, custodian and settlement bank. As a general clearing member they provide access to the CCP for clients that cannot become a direct member of the CCP themselves. As a liquidity provider they grant credit lines to the CCP to draw upon in case the CCP faces liquidity strains. The CCP also may use clearing members as depositories for cash. Similarly, a CCP may use commercial banks as custodians to deposit securities collateral. Clearing members may also provide settlement bank services to a CCP that has no account in, for example, a large value payment system or a central securities depository. Last, but not least, clearing members may be of critical importance during a default of a clearing member by helping the CCP to liquidate and hedge the defaulter's positions and by taking over the positions of the defaulter's clients. This may include providing prices for illiquid contracts. Several large CCPs make use of the services of G-SIBs. For example, a majority of payments to LCH.Clearnet Ltd, the UK-based CCP, are settled through two G-SIBs as LCH.Clearnet Ltd itself has no direct account in the Bank of England payment system. Similarly, the Fixed Income Clearing corporation (FICC), a U.S.-based CCP for government securities, employs the services of two G-SIBs operating as settlement bank and custodian.

These service-providing clearing members will be impacted more than other clearing members. Clearing members that fulfill multiple roles may come under severe stress during a crisis period. Not only will they have to manage their own operations, but they may also have to support the CCP through provision of liquidity, accepting client positions of the defaulting clearing member, and participating in auctions to help the CCP hedge or liquidate the defaulters' positions (Steigerwald 2014).

Conversely, CCPs are particularly vulnerable to the default of a service-providing clearing member. This event will impact the CCP, not only because it has to cover the default of the clearing member, but because it may also lose access to the collateral kept by that clearing member in its role as custodian. The CCP also may lose access to the credit lines that were provided by the defaulting clearing member and it may face operational problems due to the loss of one of its settlement banks. More generally, the default of a large G-SIB that fulfills services to a multitude of CCPs may present a threat to global financial stability.

Clearing members will also be affected by the unlikely event of a CCP's default. A CCP may default in extreme situations; for example, following the default of one or more clearing participants. A CCP can also face non-default losses that exceed a CCP's financial resources, for example, through operational failures or investment losses. Clearing members would not receive payments from the CCP and may not be able to access their margin and remaining default fund contributions for some time, which, in turn, may cause direct liquidity problems (Elliott 2013). Depending on the country's legal framework the CCP may take the default

contribution of clearing members to cover its losses and call for a replenishment of the default fund and additional cash contributions to cover additional losses.

Interconnectedness of CCPs and financial markets

In its attempts to survive a CCP can negatively impact financial markets. In particular, the pro-cyclicality of margin calls may exacerbate market pressures via feedback loops between market stress and collateral haircuts (Murphy and others, 2014). Procyclicality refers to changes in risk management practices that are positively correlated with market, business, or credit cycle fluctuations and that may cause or exacerbate a financial crisis (CPSS-IOSCO 2012). Market stress may impact the volatility or illiquidity of the underlying assets, which may result in increased collateral requirements. As the risk management methodologies of CCPs are typically based on historical price observations, covering a relatively short period, collateral requirements imposed on clearing members can increase abruptly in times of sudden market volatility (CGFS 2010). Still, the potential increase in collateral requirements in a stress event would be smaller than if no collateral had been collected, which is often the case in bilaterally cleared markets (Chande 2010).

Another negative impact on financial markets may result from a CCP's attempt to sell large amounts of collateral following the default of a clearing member. As G-SIBs and other large financial institutions are clearing members of many CCPs, including the large, global ones, a default by one of them would hit all CCPs where the entity was a clearing member. CCPs may try to dispose of collateral to cover its losses. If several CCPs try to sell the same type of assets, collateral markets will tend to exhibit high volatility and price peaks.

If a CCP fails, trading will be interrupted in those markets that were cleared by the CCP. Market participants will no longer be able to use the CCP to clear transactions, which will directly impact their ability to trade (Elliott 2013). This will have direct liquidity and sometimes credit implications for market participants, which in extreme circumstances may make them default. Also, the inability to trade would adversely affect the ability of investors to hedge positions.

Interconnections among CCPs and other financial market infrastructures

Links among CCPs can be sources of contagion. Links enable clearing members of different CCPs to clear transactions without opening accounts in every CCP. Links among CCPs also allow for shock absorption, where shocks can be shared and absorbed through substitution of services, for example by transferring positions of clients of clearing members to a linked CCP. However, links among CCPs create channels for risk propagation, particularly if CCPs can transmit the effects of a participant failure among themselves. Such transmission could occur, for instance, if CCPs contributed to each other's default funds, so that the failure of a participant in one CCP would oblige the linked CCPs to bear the loss through the use of the default fund contributions (CGFS 2011). Depending on the interoperability arrangements

agreed among the linked CCP, they may be confronted with liquidity problems, as it will not be able to receive payments due from the defaulting CCP and have problems with accessing any collateral deposited on behalf of the defaulting CCP. Examples of links among CCPs are the interoperability arrangement for equities involving EuroCCP, LCH.Clearnet Ltd and SIX x-clear AG; the link for government securities between LCH.Clearnet SA and CC&G; and the link for exchange-traded derivatives between the U.S. based CME with the Singapore Exchange.

A defaulting CCP may also impact other linked financial market infrastructures (FMIs). CCPs typically settle payment obligations in large value payment systems (often operated by central banks) and securities transactions in central securities depositories (CPSS 2008). These interdependencies may result in disruptions if a delay in the settlement in one system has an impact on the settlement in another system, in particular when a participant relies on liquidity received from the settlement in one system to fund its obligations in another system. For example, a globally active bank does not receive payments or securities deliveries in one system and as a result cannot release payments or securities in another system. Such interdependencies can be significant within a country as well as across countries.

Domino effect

In extreme circumstances the default of a clearing member and/or CCP may have a domino effect and spread to other markets and market participants. The first-round effect of contagion may be followed by second-round effects, eventually spreading losses and liquidity shortages throughout the financial system and, in extreme circumstances, causing the default of one or multiple banks, CCPs, and other financial institutions.

The ex ante probability that losses spread along the contagion paths in Figure 1 is low, and decreases further down the chain, but is not zero. Where the probability of a clearing member's default is low,⁶ the default of G-SIBs and CCPs hardly ever occurred.⁷ Still, there is always a small risk that the contagion chains in Figure 1 materialize. The increased use of CCPs, in particular in the OTC derivatives market, and globalization of markets further increase that risk. The probability depends on the quality of the risk management, such as the

⁶ In recent years CCPs have managed defaults of Drexel Burnham Lambert (1990), Barings (1995), Griffin (1998), Enron (2001), Refco (2005), Lehman Brothers (2008) and MF Global (2011). In nearly all these cases, CCPs handled defaults by closing-out or transferring the positions of the defaulters, without impacting other participants, and using the margin of the defaulter to cover any losses (Zickwolff 2010).

⁷ Three CCPs have been closed due to an (envisaged) insolvency of the CCP. The CCPs were Caisse de liquidation Paris in 1974, the Kuala Lumpur Commodity Clearing House in 1983, and the Hong Kong Futures Guarantee Corporation in 1987 during the 1987 world stock market crash. In all cases the insolvency was caused by improper risk management practices of the CCP, combined with the default of one or more CCP participants. The Chicago Mercantile Exchange (CME) experienced a near failure in the wake of the October 1987 crash.

accuracy of stress tests and the components of the risk waterfall, capital buffers and other lines of defense at the CCP.

Large globally active financial institutions may have a key role in spreading contagion to other markets. G-SIBs and other large financial institutions typically are members of all the main CCPs in OTC derivatives, exchange-traded derivatives and securities markets and in other FMIs (Lin and Surti 2013). For this reason they could simultaneously disrupt the normal functioning of multiple systems.

A worst case scenario would be the combination of the default of a G-SIB, that is a clearing member of multiple CCPs, and extreme market circumstances with large price movements. In such scenario, several CCPs would try to liquidate the positions of the defaulter with the help of surviving participants. Pressure on the CCP and surviving clearing members would be higher if the G-SIB was a key service provider to the CCP. High volatility would complicate the valuation of the positions, adding to the potential losses of the CCP. At the same time the value of the collateral posted with the CCP may drop,⁸ leading to an increase in collateral calls towards surviving participants. This may lead to a global collateral squeeze, squaring surviving participants to help with the liquidation process, resulting in huge losses at one or more CCPs and/or its participants.

International coordination among authorities will be challenging, in case of a default impacting multiple jurisdictions, as interests may differ. The home authority may give priority to maintaining the CCP's operations, whereas the authorities of other countries may prioritize the stability of their financial system or local banks. For example, a global active CCP in country A that accepts government bonds from country B as collateral will increase haircuts on those governments in case country risks for country B increase. The CCP would act that way to protect itself against a potential default of country B. Clearing members from country B may typically prefer to deposit governments bonds of their own country, at the CCP in country A. A further deterioration of the creditworthiness of country B confronts clearing members of country B with a simultaneous increase in collateral requirements and a potential credit downgrade, which may trigger additional haircuts and margin calls from the CCP. In case of substantial downgrades and substantial amounts of collateral the solvency of banks from country B may be come into question. Authorities in country B would then be facing potential bank defaults and may try to reduce the pro-cyclical effects of the CCP's margin calls, but would need support of the home authorities of country A. Insufficient coordination may result in a lack of or delayed responses to manage the situation with negative consequences for financial stability.

⁸ This is not necessarily the case for high quality assets, such as certain government securities. The value of these assets may increase during market stress as the result of increased demand.

The impact of a CCP's interconnectedness in times of crisis depends on the size of the exposures among CCPs, clearing members and other entities and on the size of their financial buffers. Standardized and harmonized data on the exposures of CCPs vis-a-vis their clearing participants is unfortunately not yet available. Table 2 provides some proxy information, namely an overview of the daily average value of transactions cleared by CCPs in 2013. While cleared volumes are not the same as the current and potential exposures of a CCP they provide an indication in which CCPs the largest exposures are located. Exposures are typically much lower than daily cleared volumes as CCPs net the transactions per clearing participant and instrument. This netting results in net long or short positions per clearing participant that are used as the basis for the calculation of the potential future exposure to be covered by initial margin. Open interest can be a measure of the extent to which the CCP will impact a financial market if trading is halted.

Table 2. Size of Markets and Activity of CCPs, 2013

	OTC Derivatives Market	Exchange Traded Derivatives Market	Equity Market
Open interest (trn USD)*	292.930	na	-
Turnover value cleared by CCPs (bln USD, daily avg)**	1,261	7,545	232
Total number of CCPs	16	> 50	32
Top 5 CCPs in turnover	LCH.Clearnet (U.K.) CME Group (U.S.) ICE Clear Credit (U.S.) JSCC (Japan) ICE Clear Europe (U.K.)	Options Clearing Corporation(U.S.) National Stock Exchange (India) CME (U.S.) Eurex Clearing (Germany) BM&FBOVESPA (Brazil)	NSCC (US) JSCC (Japan), SD&C (China), EuroCCP (Netherlands) LCH.Clearnet Group (U.K.)
Percentage of open interest represented by top 5 CCPs	95%	na	-
Percentage of turnover cleared by top 5 CCPs	> 99%	59%	78%

* August 2014.

**Turnover data is single counted

Sources: IMF staff estimates, based on data from websites of exchanges, trading platforms, CCPs, the Bank for International Settlements, World Federation of Exchanges, Futures Industry Association and the Depository Trust and Clearing Corporation.

Several CCPs and groups of CCPs are TITF from a global perspective. In particular the U.K.-based LCH.Clearnet Group and CME are TITF as they also operate CCPs in the exchange-traded or equity markets. Also, the size of Eurex Clearing is substantial, as it clears for several markets and its cross-border activity is increasing. Information on bond markets is limited, but FICC and LCH.Clearnet SA clear substantial amounts servicing clearing participants from a broad range of countries. Cleared volumes in equity markets are

substantially lower than in other markets and CCPs in this market are either focused on their national market or have potential substitutes to reduce the impact of a potential CCP default. Duration of exposures is also typically much shorter.

These CCPs are for-profit entities (Table 3), where shareholders are not necessarily clearing members. The governance structure of for-profit CCPs does not necessarily provide sufficient incentives to optimize the risk management framework. These CCPs may feel pressure to reduce the size of financial resources in the risk waterfall, potentially increasing the probability of a CCP's failure.

Table 3. Governance Structures of Largest CCPs Worldwide

CCP	Governance structure
Chicago Mercantile Exchange, Inc.(CME)	Owned by the CME Group, a publicly listed company.
ICE Clear Credit L.L.C / ICE Clear Europe (ICE)	Operated by Intercontinental Exchange, a publicly listed company.
Eurex Clearing	Operated by Deutsche Börse, a publicly listed company.
Korea Exchange	Publicly listed company (CCP is not a separate legal entity).
LCH.Clearnet Group Ltd	LCH.Clearnet Group Ltd is majority owned by the London Stock Exchange, with the remainder being owned by its users and other exchanges. The London Stock Exchange is a publicly listed company.
National Stock Exchange India	NSE is owned by financial institutions, banks, insurance companies and other stock exchanges.
BM&FBovespa	The CCPs for the different markets are entities within the exchange group BM&FBOVESPA, which is a publicly listed company.
Japan Securities Clearing Corporation	Owned by the Japan Stock Exchange, other exchanges in Japan and users.

Source: websites of individual CCPs.

IV. ARE THE CURRENT MEASURES SUFFICIENT?

G20 leaders and regulatory authorities worldwide have recognized that the systemic importance of CCPs require measures to manage systemic risks. They have embarked on a multi-faceted approach to retain the benefits of CCPs, while limiting the risks that their activities may pose to national and/or global financial stability. Table 4 lists the various measures that have been proposed and in some cases adopted. The approach focuses on two complementary strands, namely:

- Measures aimed at reducing the *probability* of a CCP's failure by increasing the standards and requirements for CCPs and introducing recovery plans; in addition capital requirements for bank clearing participants incentivize CCPs and their clearing members to ensure that the CCP complies with the strengthened requirements. Capital requirements for banks are substantially lower for participation in a "qualified" CCP, which jurisdiction has implemented the CPSS-IOSCO Principles for FMIs (PFMI) (BCBS 2014); and

- Measures aimed at reducing the *impact* of a failure of a CCP by introducing resolution frameworks. In addition, capital requirements provide bank clearing members with a buffer against the negative consequences of a CCP's default.

While these policy measures tend to lower default probability of individual CCPs they address only part of the risks related to interconnectedness in general. As noted earlier the probability of a contagion following a CCP's default (the second event in Figure 1) is very low. Recovery and resolution planning, if appropriately implemented by CCPs and their authorities, would lower further that probability and ensure that the CCP continues critical operations and does not have to be closed and enter into liquidation. However, a CCP's struggle to survive may still give rise to significant risks. In particular the CCP's activities to manage a default (the first event in Figure 1) are not addressed by the current set of policy measures. Concretely, the following risks are not yet mitigated:

- *The composition of the risk waterfall and loss sharing arrangements may be a source of contagion for surviving clearing members:* Increasing collateral haircuts, loss sharing arrangements and other tools may be beneficial for the purpose of protecting the CCP, but may weaken banks.
- *The dependency of CCPs on only a few commercial banks for liquidity, custody, settlement, and other services can put the CCP and surviving clearing members under severe pressure:* If the defaulting clearing member is one of the contracted service providers of the CCP, the surviving banks may have to step in, placing them under significant pressure. At the same time, the ability of the CCP to manage the default can be significantly weakened by its dependence on those banks.
- *Collateral sales of multiple CCPs may increase market volatility:* Especially in a global market the default of a G-SIB may impact more than one CCP, putting international markets under severe stress.
- *Diverging interests of authorities in a globally cleared market:* If the authority in charge of supervising a CCP is not from the same country as the authorities in charge of banks international coordination would be very difficult to achieve during distress.

International standards address interconnectedness and interdependencies of CCPs only to a certain extent. The CPSS-IOSCO Principles for FMIs contain new and more demanding requirements for CCPs, for example on governance and calculations of margins, stress testing and liquidity risk (Russo, 2013). The principles require that FMIs, including CCPs, regularly review the material risks they bear from and pose to other entities. The FMIs are expected to take a broad perspective in the identification of risk. The principles also require that CCPs only use supervised entities for custody, liquidity and settlement services that fulfill certain criteria and monitor concentration of risk exposures. These requirements, while good, are very general. For example, there are no specific requirements for a CCP that uses a range of services from only a few commercial banks. Also, implementation is subject to interpretation

of the CCPs and its authorities. Furthermore, the principles do not address global interconnections, for example, by requesting that a clearing member should hold a diversified set of collateral.

The new regulations strengthen supervision and oversight of CCPs, but there is no explicit requirement that authorities analyze interconnections and interdependencies. Supervision and oversight are strengthened in the sense that the implementation of international standards by authorities is no longer voluntary; CPSS-IOSCO members commit to apply them “to the fullest extent possible,” for example, through implementation in their legal and regulatory.

Table 4. Current Measures to Reduce the Probability and Impact of a CCP’s Failure

Measures	Objective of Measures	Status of Implementation
Measures to reduce probability of CCPs failure		
Increased standards for CCPs and strengthened regulation ⁹	<ul style="list-style-type: none"> • Increase responsibilities of authorities. • Improve risk management at CCPs. • Higher buffers for CCPs. 	<ul style="list-style-type: none"> • PFMI⁹ published in 2012. • Jurisdictions in process of implementation. • CCPs in process of implementing.
Recovery planning	<ul style="list-style-type: none"> • Maintain critical operations. • Introduce last line of defense before resolution. • Prepare CCPs to handle very extreme circumstances. • Increase CCPs’ understanding of risks. 	<ul style="list-style-type: none"> • CPSS-IOSCO guidance underway. • Recovery plans of CCPs in infant stage.
Central bank emergency liquidity assistance	<ul style="list-style-type: none"> • Maintain stability of the market through lender of last resort support to cover solvent CCPs’ emergency liquidity needs. 	<ul style="list-style-type: none"> • U.S. Dodd Frank Act allows for emergency liquidity to CCPs. • Bank of England in process. • No consistent international approach.
Capital requirements for banks to cover exposures at CCP	<ul style="list-style-type: none"> • Provide incentive to improve risk management of CCP through high capital requirements for non-qualifying CCPs. 	<ul style="list-style-type: none"> • BCBS published capital requirements containing different requirements for qualifying and non-qualifying CCPs in 2014. • Jurisdictions in process of implementation.
Measures to reduce impact of CCPs failure		
Resolution planning	<ul style="list-style-type: none"> • Maintain critical operations. • Prepare resolution authorities for handling extreme circumstances. • Increase CCPs’ understanding of risks. 	<ul style="list-style-type: none"> • FSB key attributes of resolution frameworks for nonbank financial institutions underway. • Legal and regulatory for resolution frameworks in infant stage.
Capital requirements for banks to cover exposures at CCP	<ul style="list-style-type: none"> • Provide for buffer against losses at CCP. 	<ul style="list-style-type: none"> • BCBS published capital requirements containing different requirements for qualifying and non-qualifying CCPs in 2014. • Jurisdictions in process of implementation.

Sources: IMF, based on BCBS (2014), CPSS-IOSCO (2012), CPSS-IOSCO (2013), FSB (2013), FSB (2014B).

⁹ Following the global financial crisis of 2008 the sets of standards for financial market infrastructures, including CCPs, have been updated and replaced by new international standards: the Committee on Payments and Market Infrastructures (CPMI) and International Organization of Securities Commissions (IOSCO) issued Principles for Financial Markets Infrastructures (PFMI) in April 2012.

frameworks, self assessments of FMIs and authorities, and the completion of a disclosure framework to enhance transparency. However, authorities are not required to assess the level of interconnectedness of the CCP with the broader financial system, and to further analyze the impact of a contagion of losses following a CCP's activities or the failure of a large, service providing bank.

While recovery and resolution planning are important to manage the 'too important to fail' nature of CCPs they have the potential to backfire. Recovery planning requires a CCP to prepare risk management and contingency measures to manage potential extreme circumstances that could threaten its viability. Resolution steps in where recovery ends: in case a CCP cannot continue critical operations through its own efforts the resolution authority takes over, aiming to maintain the CCP's critical operations, for example through loss-sharing arrangements or a transfer of its contracts to a different clearing house. The obvious strength of recovery and resolution planning is the ex ante development of a strategy to maintain the critical operations of a CCP as going concern, even in the face of losses that would otherwise have caused their insolvency.¹⁰ As discussed before, however, recovery and resolution planning are not reducing interconnections, but may confront clearing members and other market participants with additional losses through loss-sharing arrangements.

Although emergency liquidity assistance by central banks can help prevent the default of a CCP and therefore serves as a shock absorber it should, however, not be regarded as part of the risk management framework of CCPs (Singh 2014). Since the financial crisis of 2008 several central banks have reconsidered their backstop function for the provision of emergency liquidity to CCPs. They have recognized that in extreme circumstances credit lines of commercial banks may be unavailable to provide timely and sufficient liquidity to CCPs and therefore, if no other funding is available, central banks may stand ready to provide lender of last resort support to cover solvent CCPs' liquidity needs. In 2012, the Economic Consultative Committee¹¹ publicly stated that central banks are working towards a regime that ensures there are no technical obstacles for the timely provision of emergency liquidity assistance by central banks to solvent and viable CCPs. Essentially, the statement recognizes the need for emergency liquidity assistance to CCPs, while trying to address moral hazard¹² by not pre-committing such assistance. Although important, this measure may

¹⁰ CPSS and IOSCO have prepared guidelines for recovery of CCPs (CPSS-IOSCO 2014). Guidance on resolution planning for CCPs is being developed by the Financial Stability Board (FSB 2014A).

¹¹ The Economic Consultative Committee includes all Board member Governors of the Bank for International Settlements, the central bank Governors from India and Brazil, and the BIS General Manager. The statement is publicly available in the FSB third progress report on implementation of the OTC derivative markets reforms (June 2013).

¹² Expectations that a firm will not be allowed to fail creates moral hazard as the CCP and its clearing participants expect that the CCPs failure will be prevented. They may therefore take greater risks than otherwise because they are shielded from the negative consequences of those risks at the taxpayers' expense.

only help to limit the contagion of losses in extreme circumstances at the discretion of the central bank and there is no common international approach that facilitates a level playing field for CCPs.

Finally, capital requirements for banks with exposures towards CCPs may help reduce the probability and impact of a CCP's default, but also have limited use in addressing risks related to interconnections and interdependencies. Capital requirements distinguish between so-called qualifying and non-qualifying CCPs. A qualifying CCP is “an entity that is licensed to operate as a CCP [] by the appropriate regulator/overseer [] subject to the provision that the CCP is based and prudentially supervised in a jurisdiction where the relevant regulator/overseer has established, and publicly indicated that it applies to the CCP on an ongoing basis, domestic rules and regulations that are consistent with the CPSS-IOSCO Principles for Financial Market Infrastructures” (BCBS 2014). The capital risk weights for qualifying CCPs are significantly lower than for non-qualifying CCPs, incentivizing CCPs, and their authorities to comply with the new international standards. Capital requirements also provide banks with a buffer against potential losses following a CCP's default.

V. ADDITIONAL MEASURES

In order to reduce risks related to interconnectedness and interdependencies of CCPs it would be useful to adopt additional risk measures on four broad fronts (Table 5).

Table 5. Proposed Measures to Reduce Systemic Risks

Measures		Objective of measures
Strengthen international standards	<ul style="list-style-type: none"> • Network analysis by CCPs. • Additional capital buffers in case of high dependency on commercial bank services. • Limits on type of collateral per CCP participant. • Skin in the game for-profit CCPs. 	<ul style="list-style-type: none"> • Understand and manage connections and dependencies among CCPs, markets and financial institutions. • Reduce risk of large sales of collateral on market volatility • Reduce contagion of losses through risk waterfall.
Strengthen supervision and oversight	<ul style="list-style-type: none"> • Network analysis conducted by authorities. 	<ul style="list-style-type: none"> • Understand and manage connections and dependencies among CCPs, markets and financial institutions. • Understand and manage ex ante diverging interests of authorities in a globally cleared market.
Common approach on central bank services for CCPs	<ul style="list-style-type: none"> • Direct access to central bank payment systems. • Collateral services. • Intraday liquidity. • Overnight or emergency liquidity. 	<ul style="list-style-type: none"> • Reduce dependence of CCP on G-SIBs.
CCPs establish direct relationships with central securities depositories		<ul style="list-style-type: none"> • Reduce dependence of CCP on G-SIBs.

First, international standards can be strengthened in the following areas:

- CCPs should be expected to conduct periodical network analyses of interconnections and interdependencies among CCPs, other market participants and financial markets. Those analyses will enable to CCP to gauge the additional losses it will face in case a defaulting clearing member also provides services to the CCP.
- CCPs that are heavily dependent on the services of only a few commercial banks should be expected to maintain additional capital buffers. This will provide additional resources for the CCP in case this service provider would default. The size of the capital buffer would depend on the loss that the CCP might face in case of a service provider's default.
- Requirements on collateral should be introduced to reduce the risk that the sale of the same type of assets by multiple CCPs at the same time causes price distortions and volatility shocks.
- Finally, international standards could link the governance of CCPs directly to prescriptions for the structure of the risk waterfall. In discussions on the structure of the risk waterfall those who bear the risk should also be able to control the risks. With regard to the risk waterfall, CCPs that have a demutualized structure, a part of the CCP's capital should be placed in the risk waterfall before the assets of non-defaulting clearing members is taken, the so called 'skin in the game'. This should ensure that both clearing members and shareholders are incentivized to ensure that the CCP has a solid risk management.

Second, network analysis should be required as part of the supervision and oversight of CCPs. It is essential that authorities understand how the activities of a CCP impact markets and market participants and how a CCP's recovery plan or resolution tools may affect clearing members and other stakeholders. The network analysis, or similar reviews, may feed in market-wide stress tests.¹³ The analysis can also feed into recovery and resolution plans and macro-prudential policies. Authorities can make use of data obtained from trade repositories if available.

The network analysis, or similar review of risks related to interdependencies and interconnections, should have a cross-border dimension. A network analysis at an international level would allow considering the impact of a failure of a G-SIB on multiple

¹³ These stress tests are different than the stress tests proposed by CPMI and IOSCO. The stress tests of CPMI and IOSCO aim to standardize the stress testing of the financial resources of CCPs. The market wide stress tests proposed here aim to stress test exposures among financial institutions in a market, including CCPs, to detect contagion channels and impact of any failures.

CCPs and not just on one CCP. Based on the analysis national authorities should, in close cooperation with relevant foreign authorities, pick and choose resolution tools that minimize losses for market participants to reduce the probability of a further contagion of losses.

Third, a common international approach to the provision of central bank services to CCPs will help reduce CCPs' dependence on commercial banks. Examples of central bank services are:

- *Direct access to the central bank payment system:* A CCP should have an account in the large value payment system operated by a central bank. Legal barriers to grant CCPs direct access to the payment systems should be removed. CCPs may be recognized as a specific class in the central bank's rules that set out participation criteria for the payment system.¹⁴ An account in the central bank payment system would help to reduce the CCP's dependency on clearing members that provide settlement bank services.
- *Collateral services:* CCPs should also be allowed to keep cash at an account at the central bank. The central bank can provide daily settlement services related to margin calls and other collateral calls by debiting and crediting accounts of clearing members of the CCP that participate in the payment system. These collateral services reduce the CCP's dependence on clearing members that provide those services.
- *Intra-day liquidity:* CCPs may have intraday credit lines from the central bank. The available cash at the CCP's account can be used as collateral for intraday liquidity in the central bank's payment system. In addition, a direct link between the central bank and the local central securities depository can facilitate the use of eligible securities as collateral for intraday liquidity. Routine access to intraday liquidity of central bank would reduce the CCP's dependence on clearing members that provide credit lines.
- *Overnight or emergency liquidity:* in case of a fire sale of collateral, following the default of a clearing member, the CCP, in close coordination with the central bank, could use that collateral to obtain liquidity to reduce negative externalities for financial markets. For global CCPs, liquidity assistance in multiple currencies may be organized through currency swaps between central banks of issue.

In order to obtain access to central bank services CCPs should be subject to oversight of the central bank. The central bank should have a good understanding and knowledge of the CCP's soundness and level of compliance with the CPSS-IOSCO Principles for FMIs.

¹⁴ Some countries have granted CCPs a banking license to provide them access to central bank facilities. It would be preferable that central banks explicitly recognize CCPs as entities that are systemically important and therefore be allowed to have access to central bank facilities (Chamorro-Courtland, 2012).

Preferably, the CCP should be overseen by the central bank directly; if this is not possible, the central bank should have information-sharing arrangements with the supervisor or overseer of the CCP. The CCP should adhere to stringent regulatory, financial, and operational requirements that are set out in rules of the central bank in order to obtain access to intraday liquidity. Such liquidity support should be conditioned, among others, on the solvency and systemic importance of the CCP and the potential impact of its failure on financial markets.

Several central banks already offer one or more services to CCPs, but there is no common international approach. Central banks in Europe, for example the Bundesbank, the Nederlandsche Bank and Banque de France, provide not only a direct account to the CCPs in their jurisdiction, but also manage their cash collateral through direct accounts of eligible clearing members and the CCP in TARGET2. Intra-day liquidity is provided under certain conditions and a link with the national central securities depository enables the use of securities as collateral. In 2013, the Board of Governors of the Federal Reserve in the U.S. approved a final rule relating to the opening and maintenance of accounts for designated financial market utilities, including CCPs, as well as the provision of services to these utilities, although the services do not include access to routine intraday credit. In all these cases the central bank also oversees the safety and efficiency of the CCPs.¹⁵

A common international approach is necessary to ensure a level playing field. For example, some jurisdictions allow a CCP access to regular intra-day credit facilities (under a banking license or by recognizing the status of a CCP), whereas other jurisdictions face legal or other constraints to do so. This has implications for the efficiency and cost of services and thus for the competitive position of CCPs in an international environment. The level playing field may be further impacted by an additional capital buffer, to be held by CCPs using commercial bank services (as proposed above).¹⁶

Finally, a central securities depository can be an alternative to custody functions provided by G-SIBs, further reducing the CCP's dependence on its clearing members. A central securities depository is an entity that provides securities accounts, central safekeeping services and asset services (CPSS-IOSCO 2012). Not all CCPs have direct accounts in central securities depositories, but rather rely on G-SIBs and other financial market participants that have direct access. A direct account would reduce interdependencies, facilitate direct settlement of securities transactions and collateral management and enable, where applicable, the use of securities as collateral for intra-day liquidity facilities. Not all central securities depositories

¹⁵ Although the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC) are the primary supervisory authorities for the CCPs they regulate.

¹⁶ Of course, to avoid that competition among CCPs leads to unsafe lowering of risk management standards all CCPs should observe the CPSS-IOSCO principles, see also IMF (2010).

allow CCPs to open their own account. This uneven playing field inhibits fair competition among CCPs.

VI. CONCLUSIONS

Interconnections among CCPs, financial institutions and markets can create financial disruptions and aggravate a crisis. Although this is nothing new—CCPs have existed for decades—the increased volumes cleared through CCPs and the increasing global scope of CCPs have the potential to create severe, global shocks. Existing and planned measures reduce the probability of a CCP's default, but have yet to address risks arising from interdependencies and interconnections.

Remaining risks identified in this paper are that (i) the composition of the risk waterfall and loss sharing arrangements may be a source of contagion for surviving clearing members; (ii) the dependency of CCPs on only a few, commercial banks for liquidity, custody, settlement, and other services puts additional pressure on CCPs and surviving clearing members during a crisis; (iii) simultaneous collateral sales of multiple CCPs can impact market volatility; and (iv) diverging interests of authorities in a globally cleared market probably hamper effective cross-border solutions to manage systemic risks.

These remaining risks may pose a significant threat to financial stability. It is therefore important that additional measures are taken. International standards should be strengthened by recognizing these risks and requiring explicit measures, such as the use of network analysis by CCPs and authorities. Analysis of interconnections of a CCP and its ecosystem, at a national and international level, would help to better understand contagion channels and to take appropriate risk management measures. International standards could be more prescriptive on the structure of the risk waterfall and relate it explicitly to the governance structure of the CCP. CCPs dependence on commercial bank services should be reduced, for example by using central bank services and by keeping additional capital buffers. A common international approach is needed to allow for fair competition among CCPs.

REFERENCES

- Arregui, Nicolas, Mohamed Norat, Antonio Pancorbo, and Jodi Scarlata, 2013, “Addressing Interconnectedness: Concepts and Prudential Tools”, IMF Working Paper No. 13/199.
- BCBS, 2014, “Capital requirements for bank exposures to central counterparties”, April.
- CPSS, 2008, “The interdependencies of payment and settlement systems”, Bank for International Settlement Systems, June.
- CPSS-IOSCO, 2012, “Principles for Financial Market Infrastructures”, April.
- CPSS-IOSCO, 2014, “Recovery of Financial Market Infrastructures”, October.
- CGFS, 2010, “The role of margin requirements and haircuts in procyclicality”, CGFS Publications No 36, March.
- CGFS, 2011, “The macrofinancial implications of alternative configurations for access to central counterparties in OTC derivatives markets”, Paper No. 46, November.
- Chamorro-Courtland, Christian, 2012, “The Trillion Dollar Question: Can a Central Bank Bail-Out a Central Counterparty (CCP) Clearing House which is 'Too Big To Fail?'”, *Brooklyn Journal of Corporate, Financial & Commercial Law*, Spring., March.
- Chande, Nikil, Nicholas Labelle and Eric Tuer, 2010, Central Counterparties and Systemic Risk, *Bank of Canada financial system review*, December
- Elliott, David, 2013, “Central counterparty loss-allocation rules”, Bank of England Financial Stability Paper No. 20.
- FSB, 2013, “OTC derivatives reforms, 3rd progress report”, June.
- FSB, 2014 (A), “Key Attributes of Effective Resolution Regimes for Financial Institutions”, October.
- FSB, 2014 (B), “OTC derivatives reforms, 7th progress report”, April.
- International Monetary Fund (IMF), 2010, “Making Over-the-Counter Derivatives Safer: The Role of Central Counterparties”, *Global Financial Stability Report*, April.
- JP Morgan Chase & Co, 2014, “What is the Resolution Plan for CCPs?”, *Perspectives*, September.
- Lin, Li and Jay Surti, 2013, “Capital requirements for Over-the-Counter Derivatives Central Counterparties”, IMF Working Paper No 13/3.

Murphy, David, Michalis Vasios, and Nick Vause, 2014, “An Investigation into the Procyclicality of Risk-Based Initial Margin Models,” Bank of England Financial Stability Paper No. 29, May.

Pirrong, Craig, 2011, “The Economics of Central Clearing: Theory and Practice”, ISDA Discussion Papers Series Number, May. .

Ripatti, Kirsi, 2004, “Central counterparty clearing: constructing a framework for evaluation of risks and benefits”, Bank of Finland Discussion Papers 30.

Russo, Daniela, 2013, “CPSS-IOSCO Principles for financial market infrastructures: vectors of international convergence”, Banque de France Financial Stability Review No. 17, April.

Singh, Manmohan, 2014, “Limiting Taxpayer “Puts”—An Example from Central Counterparties”, IMF Working Paper No 14/203.

Steigerwald, Robert, 2014, “Chapter 7: Central Counterparty Clearing and Systemic Risk Regulation”, Federal Reserve Bank of Chicago, Revised draft: 05/16/2014.

Zickwolff, Marcus, 2010, “The role of central counterparties in financial crisis recovery”, World Federation of Exchanges, available at: <http://www.world-exchanges.org/insight/views/role-central-counterparties-financial-crisis-recovery>