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The Economics of Central Clearing: Theory and Practice

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Executive Summary

Regulations requiring the clearing of certain OTC derivatives through central counterparties ('CCPs') are causing a profound change in market structure and trading practices. This paper discusses how CCPs are structured and what effects increased use of them will have on the financial system.

The principal risk in the financial system which CCPs seek to address is *counterparty credit risk*. CCPs intermediate between OTC derivatives counterparties, and thus face substantial counterparty risk. This is partially mitigated as CCPs demand collateral (or 'margin') from their counterparties, through the netting of positions, and through other forms of credit enhancement.

Due to the size and importance of the risks that they bear, CCPs must have *strong risk management practices* to ensure that they can correctly value, call for margin on, and control the risks of all cleared positions. In order to facilitate this, and since complex or illiquid products can impose substantial risks on a CCP, *OTC derivatives clearing should focus on liquid, standardized products*.

Firms directly clearing with a CCP are known as *clearing members*. If a clearing member fails, the CCP may facilitate the orderly replacement of its cleared positions by for instance auctioning the defaulting member's portfolio to other clearing members. Thus *CCPs can reduce the disruptive effects of default.*

CCPs are important inter-connectors in the financial system and thus likely to be systemically important financial institutions. Their operations *transform systemic risk*. They can both decrease it (for instance by reducing the impact of clearing member failure) and increase it (for instance by increasing margin requirements during a period of financial stress). It is vital to understand the various mechanisms by which CCPs affect the financial system in order to assess their contribution to financial stability. This is particularly true as CCPs have failed in the past.

It may be the case that a CCP, while solvent, cannot meet immediate demands for the return of clearing member collateral (or other cash calls made on it). *Central banks* should be aware of this risk and make provision to mitigate it. This could, for instance, include either direct CCP access to central bank funding, or central bank lending to clearing members. To avoid the moral hazard problems that such lending mechanisms can create, it is essential that CCPs be subject to close prudential oversight of the same standard as that which applies to other large systemically important financial institutions.

CCPs are a risk pooling and sharing mechanism. In particular, clearing members provide funds to the CCP for a *default fund* which can bear the costs of counterparty non-performance should margin provide inadequate. The use of a default fund *results in risk mutualization*. Like most such mechanisms, clearing is susceptible to moral hazard and adverse selection issues. These become more significant if CCP membership is more heterogeneous or if more complex products are cleared. Thus CCPs are best served by *relatively high membership criteria* which are still consistent with equitable access to clearing.

Central clearing is subject to strong *economies of scale and scope* arising from netting economies and diversification effects. These scale and scope economies favor the use of a small number of 'utility' CCPs. *Fragmentation of clearing* on jurisdictional lines will increase the costs and risks of clearing, including systemic risks.

The *governance of CCPs* is an important issue: CCPs should be organized so as to align the control of risks with those who bear the consequences of risk management decisions. Failure to align rights with risk bearing will tend to decrease the effectiveness of CCPs in reducing systemic risk.

Some derivatives counterparties will not be CCP clearing members. If they wish to clear, these parties will have to find a clearing member to act for them. Margin will still be required on their portfolio, and thus they could potentially be exposed to the default of that clearing member. There are two key mechanisms by which CCPs can reduce the impact of this:

- CCPs can adopt a variety of rules regarding *the segregation of client margin*. These rules not only affect the allocation of the risk of clearing member (and client) default, but also the incentive which clients may have to monitor the credit quality of their clearing members.
- CCPs may facilitate *the ability of clients to port their positions* from one clearing member to another. This can reduce client exposure to default losses, and discourage customers from engaging in destabilizing runs, but reduces their incentive to monitor the riskiness of their clearing firms.

Note, though, that central clearing is subject to some potential legal risks, notably relating to segregation and netting. It is vital that CCPs have the highest level of confidence that their purported arrangements here will perform as advertised during and after a default.

Clearing mandates will affect the behavior of market participants on many dimensions, including: trading behavior, the sizes of positions, funding strategies and needs, and capital structure (leverage). Many of these effects will be unintended, and in fact often reverse (at least partially) the intended effects of clearing mandates. These indirect, unintended effects are difficult to predict in advance of the implementation of mandates, but are likely to be widespread and profound, and have important systemic implications. Policymakers should be acutely aware of the potential for such effects, monitor them carefully, and be prepared to adjust policies in response to them.

Contents

I. Introduction

The Financial Crisis that culminated in 2008 has led to the search for new market institutions that can reduce the likelihood and severity of future crises. Even as the crisis was ongoing, policymakers and many commentators identified counterparty credit risk in over-the-counter ("OTC") derivatives contracts as a major source of risk to the system, and proposed the widespread adoption of central clearing of OTC derivatives as a means of reducing that risk. These proposals were embodied in various pieces of legislation including the Dodd-Frank Wall Street Reform and Consumer Protection Act passed by the US Congress in July, 2010, and the new European Market Infrastructure Regulation ("EMIR") currently pending in the European Union. Both mandate that certain derivatives transactions be centrally cleared.

To advance understanding of the likely effects of these new rules, this paper analyzes the economics of clearing. It focuses on the effects of clearing, and clearing mandates, on the allocation of the risk of non-performance on derivatives contracts, the incentives faced by market participants, and systemic risk. I pay particular attention to the indirect effects of clearing because these effects are likely to be pronounced and profound, and because they have received far too little attention or analysis.

Central clearing alters the allocation of performance risk that is inherent in derivatives trades. In a traditional OTC transaction, the original counterparties remain at risk to the failure of each other to perform on their obligations for the life of the contract. In contrast to such "bilateral" trades, when trades are cleared the original counterparties' contracts with one another are replaced with a pair of contracts with a central counterparty ("CCP"). The CCP becomes the buyer to the original seller and the seller to the original buyer. If buyer or seller defaults, the CCP is contractually committed to pay all that is owed to the non-defaulting party. To meet its obligations, the CCP has recourse to a variety of financial resources, including collateral posted by those who clear through it and financial commitments made by its members and owners.

CCPs have been widely employed in exchange-traded futures and options for decades. They had also made some inroads into OTC markets prior to the late financial crisis. However, Dodd-Frank and EMIR, and similar measures under consideration elsewhere, will dramatically expand the volume of cleared transactions; they will require that many—and indeed most—OTC transactions be cleared. This will represent a seismic change in the financial markets.

In essence, clearing *via* CCPs reallocates the risk of loss arising from non-performance in derivatives transactions. This reallocation will have myriad important effects, some direct, some indirect. This paper describes and analyzes salient aspects of CCPs in order to identify these effects, and to provide a framework that is useful for understanding them. Although the intent is to provide a balanced appraisal of the consequences of CCPs and clearing mandates, I pay particular attention to the risks inherent in clearing and the ways that clearing works, and how it will affect the behavior of market participants. This focus is justified by the fact that CCPs are intended to reduce systemic risks in the financial system. In order to realize this promise, it is necessary to understand that CCPs are not panaceas, but have their own vulnerabilities. Identifying these sources of fragility is essential to devising policies that can mitigate their adverse effects.

Clearing mandates represent a major change to the entire financial system that will alter the behavior of market participants in many dimensions; these changes will represent some of the major indirect effects of clearing mandates. Consequently, I take a systemic approach that attempts to identify some of these indirect effects. That said, the financial system is extremely complex, and the potential changes in behavior are so far reaching and dynamic that they are impossible to predict with any precision. This means that many of the indirect effects of clearing mandates will be unintended. Thus, although I endeavor to identify likely outcomes of clearing mandates, the broader message of this paper is that market users and policymakers should be especially vigilant to identify and understand the systemic effects of widespread adoption of derivatives clearing on the behavior of market participants, and most notably its effects on liquidity, capital structure (leverage), risk taking, and risk management decisions of financial and non-financial firms, and on their trading and financing decisions during times of market stress.

One final cautionary note. This paper necessarily presents a broad overview of important clearing related issues, but the devil is truly in the details. Much future research remains to be done to understand clearing and its economic effects in all their complexity.

II. The Economic Function of Central Counterparties I: Reducing & Reallocating Default Risks

A. Introduction

Central Counterparties are organizations that are intended to reduce counterparty performance risk.[1] More specifically, they are intended to increase the likelihood that contractually promised payments will be made. Derivatives contracts are promises to pay amounts that depend on some market price (e.g., an interest rate, a commodity price) or event (e.g., a bankruptcy), and there is always the risk that the party that is obligated to make a payment under the contract will be unable to pay what it owes, i.e., it will default. This harms the defaulter's counterparties. For instance, if a counterparty is using the contract as a hedge of another exposure, the defaulted contract will not provide the desired hedge protection, and will fail precisely when the hedger needs the protection. Furthermore, the victim of the default will often have to replace the defaulted contract at unfavorable prices.

Widespread defaults on derivatives contracts may harm more than the counterparties on the defaulted contracts. The losses suffered by the victims of the original defaults may be so severe as to force those victims into financial distress, which harms those who have entered into financial contracts with them—including their creditors, and the counterparties to derivatives on which they owe money. Such a cascade of defaults can result in a systemic financial crisis.

OTC derivatives central counterparties affect and reallocate default losses in a variety of ways. These include: netting, collateralization, insurance, equity, and mutualization. Netting of

[1] "Counterparty performance risk" is the risk that a party to a derivatives contract will not meet the financial obligations created by the contract. Throughout, I use the term "default" to mean "fail to perform on contractual obligations" and "defaulter" to refer to a party that does not perform.

positions, exposures, and cash flows reduce the potential magnitude of default losses. Collateral, equity, and mutual risk sharing arrangements allocate default losses among various participants in the clearing system. These are typically referred to as the elements of a CCP's default risk "waterfall," with default losses absorbed sequentially by the different stages of the waterfall.

B. Netting

Parties to bilateral OTC contracts frequently enter into offsetting transactions. Upon default, off-setting contracts, and off-setting amounts owed on different contracts are typically netted.

By replacing bilateral agreements between buyers and sellers with contracts between these buyers and sellers and the CCP through a process called "novation," the CCP can net out these offsetting transactions. This netting can be across positions and exposures at default.[2]

As an example of position netting, *A* may sell a contract; *B* may buy an identical contract and then sell it; and *C* may buy this contract. In a bilateral OTC market, *B*'s offsetting positions remain open, and one (or even in some circumstances both) of its counterparties on these contracts could lose from its default. In contrast, if all of these contracts are cleared through a CCP, *B*'s contract would be netted out and *B*'s contractual obligations would be extinguished. If *B* went bankrupt, neither *A* nor *C* could suffer a default loss (as long as the CCP remains solvent).

Under exposure netting, if a firm trading through a CCP defaults when it has mark-to-market gains on some contracts and losses on others, the gains are netted against the losses. This limits the exposure of the CCP in the event of a default to the net amount owed by the defaulter.

Both position and exposure netting tend to reduce exposures at default, meaning that derivatives counterparties lose less in the event of a default than in the absence of netting. As with collateral (discussed below), however, it is necessary to recognize that position and exposure netting have distributive effects: although they increase the payments made to derivatives counterparties in the event of default, they reduce the payments made to a defaulter's other creditors.

C. Collateral (Margin)

The values of derivatives contracts vary with market conditions and prices. Changes in market conditions subsequent to the creation of a derivatives contract tend to cause the contract to become an asset to one party, and a liability to the other. If the party for whom the contract is a liability defaults, its counterparty is at risk to losing some or all of the value of the contract.

Parties can reduce the losses they suffer in the event of a default by posting collateral. If contracting parties post collateral when entering into derivatives transactions, the victim of a default can seize the collateral posted by the defaulter to cover some or all of the amount owed by the latter.

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[2] CCPs typically (but not always) also net payments owed and received to calculate one net payment owed by or owed to each firm it clears for on all the products it clears. As an example of an exception, ICE separately settles margin and coupon payments resulting from credit events.

Parties in bilateral over-the-counter contracts can negotiate whether collateral will be posted; who will post it; the amount of collateral; and how collateral postings are adjusted over the life of a transaction (or a contracting relationship). In contrast, CCPs invariably require the posting of collateral on all derivatives transactions, and the periodic and frequent adjustment of collateral to reflect changes in market prices and conditions.

Specifically, CCPs require firms entering into derivatives transactions to post collateral (margin) on each trade at its initiation. This is called "initial margin."[3]

CCPs also require the parties to the derivatives contracts that they clear to make margin payments that vary as the prices of these contracts change. Specifically, CCPs mark contracts to market, and charge "variation margin" in response to changes in market values.

At least daily, but frequently intra-day, based on changes in prices since the last mark-to-market calculation, CCPs calculate the gains and losses on each portfolio. Those whose contracts have declined in value as a result of these price changes are obligated to pay the CCP an amount equal to this change in market value. This is a variation margin payment. In turn, the CCP is obligated to pay those whose contracts have increased in value an amount equal to this change in market value.

CCPs set initial margin amounts, and the frequency of mark-to-market, with the intent that the likelihood that any derivatives trader it clears for will suffer a loss on its cleared position that exceeds the amount of margin held is very small (e.g., less than 1 percent). To do this, CCPs typically set initial margin to reflect their estimate of the riskiness of the underlying transaction. For instance, they typically charge higher margins on instruments with more volatile prices, and on less liquid instruments that take a CCP longer to cover in the event of a default. Crucially, CCPs typically do *not* vary initial margin based on the creditworthiness of the party to a contract.

If initial margins and collections of variation margin are such that in the event of default the defaulter's collateral is always sufficient to cover its derivative contract obligations, it is said that the "defaulter pays." In reality, a pure defaulter pays model is impractical because margin is costly[4], meaning that it is inefficient to collateralize contracts against all possible price movements. However, through the choice of margin levels, CCPs can tailor its exposure to losses from default.

The extent to which derivatives transactions are collateralized determines the likelihood and the magnitude of credit losses arising from default. Higher collateral, and more frequent marking-to-market, reduce the amount of credit implicit in a derivatives transaction.

It should be noted, however, that reducing the amount of credit implicit in derivatives transactions has uncertain effects on the amount of credit in the financial system as a whole

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[3] In OTC markets, this is typically referred to as the "independent amount," i.e., an amount that is independent of market prices.

[4] Margins are costly because CCPs typically require that they be posted in liquid assets (e.g., cash or government securities) that yield less than competing investments. Moreover, these costs differ across CCP users, meaning that changes in margin levels can affect the composition of derivatives market participants. Michael L. Hartzmark, *The effects of changing margin levels on futures market activity, the composition of traders in the market, and price performance*. Journal of Business 59 (1986) S147.

because derivatives traders can sometimes substitute other forms of credit when margins are raised. That is, they can sometimes utilize the credit capacity freed up through collateralization of derivatives transactions to obtain other forms of credit that they can use to pay margin in whole or in part. To put it even more tersely, market participants are likely to be able to borrow some of the funds that are used to collateralize derivatives.

This illustrates a broader point that must always be kept in mind when evaluating the effects of CCPs. They are only a part of the financial system, and changes in CCP policies will typically induce changes in financial contracting on other markets. Furthermore, CCP policies often have distributive effects. To understand the systemic effect of CCPs it is necessary to analyze how market participants will respond to clearing mandates. These responses will be complex, dynamic, and almost certainly surprising and unpredictable.

D. Insurance

Historically, some CCPs purchased insurance that covered some losses in the event of a default in excess of the defaulter's margins. Insurance reallocates default losses from derivatives counterparties to the insurer's (or insurers') equity holders. Presently, no major CCP utilizes insurance for this purpose, although most do have insurance against some operational risks because losses arising from such risks cannot be assigned to CCP default or guaranty funds.

E. Equity

CCPs are typically for-profit corporations, or subsidiaries of for-profit corporations. These corporations have equity that can be used to absorb default losses. Indeed, to ensure that CCPs have the appropriate risk-taking and risk management incentives, it is essential that CCP equity be in a first loss position once the defaulter's resources (its collateral and contributions to the default fund) are exhausted. A CCP not in a first loss situation would potentially have an incentive to take additional risks because the profits arising from such risk taking would accrue to the equity holders, but some, and perhaps all, of the losses would accrue to others.

F. Mutualization

Most CCPs have member firms that agree to absorb some default losses. These CCPs typically require their member firms to make contributions to a default fund (or its equivalent).[5] Losses in excess of those covered by the defaulter's margin and default fund contribution[6] are drawn from the general default fund. If losses exhaust the fund, CCPs typically obligate the members to make additional contributions. These additional contributions ("capital calls") are typically capped, often at an amount equal to the original contribution to the CCP default fund.[7]

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[5] These are sometimes called "guaranty funds."

[6] Some CCPs put some of the equity at risk between the defaulting member's default fund contribution and everyone else's.

[7] Many CCPs create the cap implicitly by permitting members to relinquish their membership once they have met a capital call equal to their initial default fund contribution.

In this way, default losses are shared—"mutualized"—among the CCP members. Since CCP members are often large, systemically important financial institutions, this mutualization process distributes default losses among such institutions. The risk does not disappear: it is merely reallocated.

G. Summary

CCPs implement a variety of measures to reduce and reallocate the losses resulting from the default of a derivatives counterparty. Netting of offsetting exposures reduces the exposure of contracts at risk of default, and exposure netting across different contracts cleared at a particular CCP reduces the dollar amounts at risk upon default. Collateral reduces the amount of credit implicit in derivatives trades. Equitization and mutualization shift default losses to the equity holders of the CCP, and CCP members that share in default risks.

CCPs essentially provide protection against default, using a variety of mechanisms. Like other providers of protection, CCPs do not make risk disappear: they reallocate it. Moreover, this reallocation of risk can improve welfare by shifting risk from those who bear it at a high cost (e.g., a hedger who could be wiped out if its counterparty were to default) to those that bear it at a lower cost. Crucially, however, it must be remembered that protection mechanisms have costs arising from information and incentive problems, and clearing of derivatives trades *via* CCPs is no exception. Good policy should recognize these potential problems, and make appropriate accommodations to them. This issue is discussed further in Section V below.

III. The Economic Function of Central Counterparties II: Managing Defaults

When a party to derivatives contracts defaults, the defaulter's counterparties typically need to replace the defaulted exposure. In the event of a default by a substantial trader, this replacement process can be associated with large price movements as large trades can impact prices. In bilateral OTC markets, large moves in prices may occur during the scramble to replace trades with a stressed counterparty. Thus while the massive hedge fund Long Term Capital Management[8] did not default in 1998, trade unwinds by both it and its counterparties caused large market moves. Since stress is often caused by significant economic shocks (such as the Russian default and Asian crisis that precipitated LTCM's problems), these replacements of defaulted contracts often occur when markets are already illiquid. This in turn makes the replacement process more difficult, and can exacerbate the price impacts of replacement trades.

CCPs can reduce the disruptions associated with the replacement of defaulted positions. Netting of positions across multiple parties typically reduces the total positions that need to be replaced, which tends to mitigate price impact. Moreover, CCPs can facilitate orderly replacement by auctioning off the defaulter's contractual obligations. A well-managed centralized auction

[8] Franklin Edwards and Edward Morrison, *Derivatives and the Bankruptcy Code: Why the Special Treatment?,* 22 Yale J. Reg. (2005) 91.

mechanism can be more liquid, and result in smaller price disruptions, than uncoordinated replacement of positions during periods of pronounced uncertainty.[9]

CCPs can also facilitate the orderly transfer of customer positions from financially troubled intermediaries.[10] CCP rules facilitate the "portability" of customer positions held in accounts at a troubled CCP member to financially sound member firms. This reduces the likelihood that a defaulter's clients will lose as result of a default, reduces the risk that customer margin monies will be encumbered by the bankruptcy process, and facilitates the ability of customers to trade unhindered by the default of their clearing firm.

IV. The Micro- and Macro-prudential Consequences of Central Clearing

Most CCPs were originally created by the members of futures exchanges to serve the members' interests by allocating and managing default risk more efficiently. That is, CCPs were not designed as macro-prudential institutions with responsibility to improve the safety and soundness of the broader financial system.

As derivatives markets grew, particularly in the 1970s and 1980s, some CCPs became big enough and interconnected enough with the financial system to become systemically important. For instance, the difficulties faced by futures and options CCPs in the Crash of 1987 posed a serious threat to the entire financial system.[11]

The systemic importance of CCPs will expand dramatically as a result of Dodd-Frank, EMIR, and other regulatory initiatives around the world that mandate the clearing of derivatives contracts heretofore traded primarily on a bilateral basis. There will be more clearinghouses, and these CCPs will be bigger: their soundness is essential to ensuring the stability of the entire financial system.

Moreover, these regulatory changes are expressly intended to make CCPs an important bulwark in the financial system. That is, under Dodd-Frank and EMIR, CCPs are explicitly macro-prudential institutions with an impact on the safety and soundness of the financial markets.

CCPs can contribute to the stability of the financial system. In particular, by facilitating more efficient, coordinated replacement of defaulted positions, and by reducing (by position netting) the positions that need to be replaced in the event of a default, CCPs can reduce price volatility and the incidence of extreme price moves that can occur when a large derivatives trading firm defaults. Moreover, by allocating default losses more efficiently (and in particular, by reducing the concentration of default exposures), CCPs can mitigate and sometimes eliminate the potential for cascading defaults.

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[9] Bruce Greenwald and Jeremy Stein, *Transactions Costs, Market Crashes, and the Role of Circuit Breakers* 64 J. of Business (1991) 443.

[10] Firms that trade derivatives, but which are not members of CCPs, typically trade as customers of CCP members.

[11] Ben Bernanke, *Clearing and Settlement During the Crash*, 3 Review of Financial Studies (1990) 133. See also *Report of the Presidential Task Force on Market Mechanisms* (1988) (commonly referred to as the Brady Report).

That said, it must also be recognized that CCPs can create, or contribute to, systemic risks. In particular, the dramatically expanded macro-prudential role of CCPs engendered by Dodd-Frank and EMIR has important implications because it is well known that many policies that are micro-prudentially sensible can be macro-prudentially dangerous. This is particularly true of CCPs, especially with respect to margin.

Specifically, although margin provides protection against default, changes in margin requirements can induce destabilizing trading. Firms that must meet large margin calls may respond by selling assets and reducing positions in ways that exacerbate the price changes that caused the initial margin calls. The margin dynamic can lead to exaggerated, systemically destabilizing price movements. The mechanical nature of CCP margining contributes to this risk. Moreover, CCPs are able to increase initial margin requirements with little notice; LCH RepoClear's increase of margins on Irish bonds provides a recent and instructive example of this. If such an increase were imposed in a period of stress it would increase the safety of the CCP at the expense of a damaging system-wide liquidity drain.[12]

Margin requirements can impose acute strains on the funding system and market liquidity as firms subject to large margin calls scramble to secure liquid assets in very short periods of time (hours) to meet their obligations. This can lead to jumps in interest rates and credit rationing. Spikes in the demand for liquidity can also lead to inefficient asset sales—even by firms not subject to margin calls, but who find it costlier or impossible to access normal sources of liquidity. These strains on the funding system may require central bank intervention to prevent a severe dislocation in the financial system.[13]

Furthermore, another source of systemic risk is that sufficiently severe defaults (especially multiple defaults) can threaten the solvency of CCPs. The financial resources of CCPs are not unlimited, and it is possible that a CCP or CCPs could suffer defaults large enough to exhaust these resources. Given the centrality of CCPs to the post-crisis financial system, CCP insolvencies would have devastating systemic effects.

It should also be recognized that the expansion of clearing will lead to changes that will have implications for systemic stability, but which are impossible to predict, or even measure with any precision once they have occurred. For instance, clearing will affect the overall size of derivatives markets; to the extent that position and exposure netting improve the efficiency of capital utilization, markets for cleared derivatives may grow larger, which will affect default exposures. It will affect the allocation of trading among firms; if moral hazard is not controlled adequately, this reallocation will tend to increase default risks.[14] It will affect how derivatives trading firms finance themselves. It will also affect the allocation of risk among financial market participants. Importantly, it will affect the risks borne by all in a contractual relationship with derivatives traders—not just the risks borne by derivatives traders. This means that it will change

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[12] See Committee on the Global Financial System, *The Role of Margin Payments and Haircuts in Procyclicality* (2010). Available at http://www.bis.org/publ/cgfs36.pdf.

[13] See Bernanke, *Clearing and Settlement During the Crash* op.cit.

[14] Moral hazard in clearing is discussed in Section V.A.

financial contracting generally. The systemic consequences of these changes will be profound, but impossible to understand or especially predict, even approximately.

In sum, clearing and CCPs will have systemic effects, some positive, some potentially negative. It is essential to understand what these risks are, and to devise policies accordingly. It is particularly important to recognize that certain CCP actions—most notably margining—that are sensible from a micro-prudential standpoint can be systemically destabilizing, and can lead to changes in behavior (such as funding decisions and capital structures) that have systemic implications.

V. The Costs and Risks of Central Clearing

A. Moral Hazard and Adverse Selection

Clearing *via* CCPs is in essence a protection mechanism whereby risks are redistributed. Although this redistribution of risk can generate benefits, risk sharing mechanisms can also create costs, in the form of distorted incentives, in the presence of information imperfections. In particular, risk sharing mechanisms are frequently subject to moral hazard: when the insurer cannot observe or control the risk taken by the insured, the latter has an incentive to take on excessive amounts of risk.

Clearing is vulnerable to this kind of behavior. Indeed, one of the benefits of clearing, the fact that it makes cleared instruments fungible by making all potential counterparties interchangeable[15], gives rise to moral hazard. Clearing tends to reduce the costs that riskier firms incur to trade relative to the costs incurred by lower risk firms, thereby allowing the riskier to expand their trading activity relative to the low risk.[16]

Since collateral is costly, margin requirements can constrain risk taking. However, as typically implemented by CCPs, margins control moral hazard imperfectly. CCP margins typically depend on product risk characteristics, rather than the creditworthiness of the clearing member.[17] This is problematic because counterparty risk depends on both product risk and member creditworthiness (and the interaction between these). Therefore, margins that do not vary meaningfully among members who bring different risk to the CCP underprice the risks of less creditworthy firms and overprice the risks of more creditworthy firms, which tends to lead the former to trade too much, and the latter too little. Moreover, the incomplete sensitivity of margin

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[15] Lester Telser, Why There Are Organized Futures Markets, 24 J. of Law and Economics (1981) 1.

[16] See Craig Pirrong, *The Inefficiency of Clearing Mandates*, Cato Institute Policy Analysis (2010). Available at http://www.cato.org/pubs/pas/PA665.pdf. See also Craig Pirrong, *Mutualization of Default Risk, Fungibility, and Moral Hazard: The Economics of Default Risk Sharing in Cleared and Bilateral Markets* (2011).

[17] Some CCPs base margin rates on credit ratings in limited circumstances, in particular when a clearing member's credit is cut below a certain minimum level. This is problematic for many reasons. First, credit ratings measure creditworthiness quite imperfectly. Second, the imposition of ratings "triggers" result in a substantial increase in margins when a firm is downgraded sufficiently. Ratings triggers are macro-prudentially suspect, as they can initiate destabilizing trading activity by a firm that is downgraded. Randall S. Kroszner, Making the Financial System More Robust, in Randall S. Kroszner and Robert J. Schiller, Reforming U.S. Financial Markets (2011). See Committee on the Global Financial System, *The Role of Margin Payments and Haircuts in Procyclicality* (2010).

costs to actual creditworthiness means that firms do not incur the full cost of bringing additional, non-derivatives-related, risk onto their balance sheets; some of the cost of incremental balance sheet risks incurred by one member are effectively borne by other CCP members.[18] As discussed in greater length in Section VIII below, higher membership requirements (e.g., high capital requirements for CCP members) can mitigate this problem.

CCPs also monitor the creditworthiness of their members, but this monitoring is largely based on standards and information (e.g., accounting statements) that do not reflect variations in creditworthiness among members in a discriminating way. Moreover, even to the extent that the information the CCP utilizes implies differences in creditworthiness, the CCP typically does not impose differential capital or margin requirements on members that meet a certain creditworthiness threshold. Thus, monitoring imperfectly controls moral hazard.

CCPs are also vulnerable to another information problem that makes it costly to share risk: adverse selection. Adverse selection occurs when the insured know more about risks than the insurer. In a clearing context, to the extent that firms that trade derivatives know more about the risks of particular cleared products than the CCP, these firms will tend to over-trade the products for which the CCP underestimates risk, and under-trade the products for which the CCP overestimates risk. Many firms trading derivatives (e.g., large banks, hedge funds) specialize precisely in understanding risks and pricing, and hence are likely to have better information than CCPs. This is especially true for more complex and novel derivative instruments.[19]

Like virtually all mutual protection arrangements, clearing is vulnerable to moral hazard and adverse selection problems that impose real costs. This vulnerability depends on who participates in the protection (clearing) arrangement, and the kinds of products protected (cleared). Thus, as discussed in Section VIII, CCP membership requirements, the products that should be cleared, and the power of decision over membership and the clearing slate, should depend on moral hazard and adverse selection considerations. If this is not done, CCPs are more vulnerable to systemically damaging failure.

B. Netting Economics

As noted above, increased netting opportunities represent one benefit of central clearing. The benefits of netting depend on the scale and scope of CCPs. In particular, there are both scale and scope to economies in clearing.

With respect to a single derivatives product, position opportunities are maximized when a single CCP clears this product. Moreover, position netting opportunities depend on product

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[18] As an example of non-derivatives related risks that firms can bring onto their balance sheets that increase their risk of defaulting on derivatives, consider Lehman's investments in various mortgage-backed securities; AIG's investment in such securities as part of its securities lending business; or the widespread (sometimes tacit) commitments of conduit or SIV sponsors to bring them on-balance sheet in the event they could not roll over commercial paper.

[19] Clearing mandates reduce adverse selection created by asymmetric information about the credit risk of counterparties. They do not eliminate adverse selection based on information asymmetries about prices and risks across cleared, and cleared and non-cleared, products.

standardization: the greater product standardization, the more extensive are position netting opportunities.

Well-understood diversification effects generate benefits to netting exposures at default to multiple products in a single CCP. The exposure at default to a portfolio of derivatives products is smaller than the sums of the exposures at default of the individual elements of the portfolio.[20]

This last effect implies that there is a cost of mandating the clearing of some products. Moving some products that are currently not cleared to CCPs eliminates the exposure-reducing diversification effect between those products and those that remain bilateral. This is a real cost, and it is legitimate to take it into consideration when determining which products should be cleared.

The pervasive scale and scope effects will decisively influence the way the clearing sector evolves, which will have competitive implications. They also have important implications for regulation and systemic risk.

With respect to competitive evolution, scale and scope economies will tend to result in the survival of a small number of large CCPs. CCPs have strong natural monopoly characteristics. It is therefore likely that CCPs will raise anti-trust concerns.

This tendency towards the dominance of clearing by a small number of large CCPs will make these entities highly systemically important. The failure of a dominant CCP would have potentially catastrophic effects. But regulatory or legislative interventions that impede consolidation will prevent CCPs from realizing all of the risk-reducing benefits of scale and scope. Regulators and legislators will therefore face difficult trade-offs in their oversight of CCPs.

Jurisdictional considerations are likely to result in the survival of multiple, under-scaled or under-diversified CCPs. Several major jurisdictions have already made it clear that they will require products traded in them, or by firms located in them, to be cleared there. This jurisdictional fragmentation will prevent the realization of all scale and scope economies. It will also complicate coordination between CCPs, especially in the event of a crisis. Against that, clearing across jurisdictions poses thorny legal issues, especially insofar as bankruptcy law is concerned. Again, regulators and legislators (and market participants) will face difficult trade-offs when determining the best legal and jurisdictional arrangements for CCPs.

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[20] See Craig Pirrong, *Rocket Science, Default Risk, and the Organization of Derivatives Markets* (2008) and Darrell Duffie and Haoxiang Zhu, *Does a Central Counterparty Reduce Counterparty Risk* (2011). The Lehman default provides an excellent example. Lehman held a variety of positions at the CME clearinghouse. The CME had to pay the firm assuming Lehman's interest rate derivatives positions $110 million, and the firm assuming its energy derivatives positions $74 million, because the losses on these positions exceeded the amount of collateral on these positions Lehman had with the CME. However, the firm assuming Lehman's equity derivatives positions accepted $287 million less than the amount of collateral available to those positions held at the CME. The CME was able to use the remaining collateral on the equity derivatives positions to cover its losses (due to under margining) on the interest rate and energy positions. If the positions had been cleared separately (and the various clearinghouses margined the products the same way as the CME), the CCPs for the interest rate and energy positions would have had to call on other financial resources to cover the resulting loss. See *Lehman Brothers Inc. Holdings Inc. Chapter 11 Proceedings Examiners Report*, Section IIB available at http://lehmanreport.jenner.com/.

Product liquidity also impacts on the optimal number of CCPs via default management. To see this, suppose that we had a CCP that cleared one very liquid class of products, and one illiquid class. On default of a clearing member, the liquid products could be closed out quickly, while the illiquid ones would take longer. Since different clearing members would be involved in the two processes, it is likely that one or more clearing members would have completed their management of the liquid part of the defaulter's portfolio well before other clearing members had dealt with the illiquid part. This could result in an effective priority whereby those managing the liquid portfolio had a claim on the defaulter's initial margin and default fund which was met before claims of those managing the illiquid portfolio. In order to avoid this arbitrary prioritization, CCPs will typically only clear one asset class, or, to the extent that they clear multiple asset classes, these should be of similar liquidity.

C. Risk Management

CCPs must commit resources to engage in a variety of risk measurement and risk management functions. These include:

- *Initial margin setting*. CCPs must set and periodically review initial margin levels. As part of this process, CCPs must establish methodologies, including statistical methodologies; monitor market data for changes in conditions (e.g., increases or declines in market volatility) that necessitate changes in margin; and "backtest" the performance of margin methodologies to ensure that they measure risk accurately. These functions require CCPs to invest in significant data collection, storage, and analysis technologies, and to retain staff with the training and experience necessary to quantify price risks.

- *Default fund calculations*. Similarly, CCPs must set and review default fund obligations. CCPs often base default fund contributions on member firm margin requirements.

- CCPs also must *monitor the financial condition of their members*, and the risks associated with the proprietary and customer positions that members clear. Monitoring member financial conditions involves audits that require the employment of suitably trained and experienced personnel capable of evaluating the financial condition of complex financial entities.

- CCPs need to *monitor member positions* virtually continuously in order to evaluate risks accurately, and to understand the positions that need to be replaced in the event of a default.

- *Concentration risk monitoring*. Highly concentrated positions pose particularly great risks for CCPs. If a CCP member has a highly concentrated position in a particular product, or class of related products, adverse price movements will impose a large loss on it, making default more likely. Moreover, it is more difficult to replace concentrated positions. Therefore, CCPs need to monitor carefully the concentration of positions,

and because these positions pose greater risks, CCPs either should limit it or preferably charge higher margins on concentrated positions.

- *Funding and liquidity risk*. CCPs face funding risks, especially in the event of large market price movements, the withdrawal of one or more large clearing members, or the default of a large member. They must evaluate and plan for these risks, and take precautions against it. These precautions may include, for instance, taking out credit lines. Banks charge CCPs for these lines.

VI. The Suitability of Products for Clearing

A. Introduction

A variety of attributes of derivative products affect the costs and benefits of clearing them, and hence their suitability for clearing.

B. Standardization

Standardization of contract terms facilitates clearing in several ways. First, standardized contracts can be netted, thereby extinguishing offsetting positions in identical contracts.[21] Second, standardization can contribute to liquidity by concentrating trading activity in a smaller number of instruments. This can facilitate the hedging and replacement of defaulted positions in the event of a default.

Standardization also involves costs. Specifically, customization permits derivatives users to create products that fit more closely their particular risk management and trading objectives. Hedgers often reduce risk exposures more precisely with customized products.

C. Complexity

It is necessary to distinguish between standardization of contractual terms, and the complexity of an instrument. An instrument can have standardized terms, but be economically complex. For instance, it is possible to standardize the terms of exotic options, but that does not eliminate the complexity of these instruments.

Complexity poses several challenges to central clearing.[22] More complex instruments, and indeed less liquid instruments generally, are typically more difficult to value, making under-collateralization or over-collateralization more likely. This mis-estimation of collateral can occur for both initial margin, and variation margin: complex instruments are frequently less heavily traded, meaning that they are more difficult to mark-to-market. Furthermore, due to these valuation difficulties, more complex instruments are more vulnerable to adverse selection: sophisticated firms which specialize in valuing and understanding the risks of complex instruments are at an information advantage relative to a CCP, and can identify those for which the CCP

[21] As noted above, exposures at default can be offset even if contracts are not identical.

[22] Craig Pirrong, *Rocket Science, Default Risk, and the Organization of Derivatives Markets* (2008).

charges too little initial margin (and hence underestimates default exposure). Finally, and crucially, complex instruments are often far more difficult to hedge. This complicates the task of managing defaults of portfolios that include such instruments.

D. Liquidity

The liquidity of a product is an important determinant of the costs and risks of clearing it. Liquidity influences cost and risk in several ways.

First, more accurate pricing information is available for more heavily traded, liquid products. This allows more accurate valuation of positions, which in turn reduces the risk that positions will be under-collateralized or over-collateralized. Under-collateralized trades impose more risk on the CCP in the event of default. Over-collateralized trades raise the costs of trading derivatives because collateral is costly.

Second, more actively traded, liquid products typically have more reliable time series price data. Such data facilitates the development, testing, and calibration of more accurate risk models that permit CCPs to choose initial margin levels that more precisely reflect the true risks posed by these products.

Price information problems can be mitigated by prudent CCP policies. For instance, in the absence of active trading activity one way to obtain prices for marking positions to market is to obtain bids and offers from CCP members. In order to provide an incentive for the members to provide reasonable quotes, these bids and offers should be executable. As an example, ICE Trust members that submit prices that are out of line with those submitted by others are required to trade at the price they submit, with those submitting high (low) prices being required to buy (sell). This provides a powerful incentive to submit accurate prices, and to eschew submitting out-of-market prices with the intent of advantaging the mark on one's own positions.

Third, it is less costly and less risky to manage and replace defaulted positions in liquid instruments than in illiquid ones. The less liquid a particular instrument, (a) the higher the bid-ask spread, and (b) the greater the price impact of trades. Those responsible for managing defaulted positions face a trade-off between reducing price impact costs and risk: price impact can be mitigated by trading out of a position over a longer period, but this requires a more enduring retention of risks.

In evaluating liquidity, it is important to take into consideration the product life-cycle. This is notably different for many OTC products than for the futures and exchange traded options that are cleared at present. In futures and exchange traded options, liquidity tends to increase as a contract approaches expiration, peaking a few weeks before contract maturity. In contrast, in many OTC products, liquidity tends to decline over time, and these positions are often retained for extended periods. For instance, a 5 year credit default swap has the greatest liquidity when it first traded, with about 5 years to maturity. As time passes, liquidity in the product declines: a CDS with 4 years to maturity is far less liquid than current 5 year CDS. This decline in liquidity can be pronounced, and such illiquid positions can remain open for years.

It is also important to consider a product's liquidity under stressed market conditions. During periods of market stress and crisis, it is typical to observe a "flight to quality" in which the

liquidity of some products (e.g., Treasury securities) rises, and the liquidity of other products (e.g., CDS referencing low grade-corporate debt) falls, often precipitously. The latter type of product poses much greater challenges and risks for a CCP than does the former.

E. Risk Characteristics

A variety of characteristics affect the risks and costs of clearing a particular derivative product. These include:

- *Volatility*. All else equal, more volatile products are riskier and more difficult to clear, and create higher exposures at default for the CCP.

- *Tail/gap risk*. Whereas volatility properly refers to the magnitude of continuous price movements, some products are subject to discontinuous price movements. For instance, equity prices and commodity prices sometimes crash or spike. A prominent example that is inherent in the nature of the product is the "jump to default" risk of CDS; when a company unexpectedly encounters financial distress, the prices of its debt and derivatives on them frequently falls discontinuously.

  Price discontinuities pose a variety of challenges to CCPs. For instance, when prices move continuously, daily and intra-day marking to market and variation margining permits the CCP to reduce the risk that positions will become under-collateralized. In contrast, when prices can jump or gap, there is significant risk of under-collateralization between calculations of variation margin obligations.

  Moreover, infrequent but extreme price movements are often difficult to model and quantify. In particular, it is difficult to calculate the probability that rare but extreme events will occur, and the magnitude of the price movements that occur during these extreme events. This makes it more difficult to determine appropriate initial margins, leading to elevated risk that margins will be insufficient to reflect actual risks, or that margins will be excessive, and hence unduly burdensome.

- *Dependencies*. Although it is common to focus on the risks posed by a particular product in isolation, in reality CCPs face a portfolio of exposures. A CCP's members typically hold positions in a variety of products that it clears, and, due to the ability to net amounts a defaulter is owed against the amount it owes, the CCP's exposure depends on the distribution of the sum of the net exposures. This distribution depends on the dependencies between instruments in a CCP member's portfolio.

  Low correlation of price movements of different products means that broader portfolios are less risky, all else equal, than portfolios concentrated in a single instrument or a small number thereof. Negative correlations permit even greater reductions in risk exposures for broader portfolios.

  Correlation is one form of dependence between exposures, but not the only one. While it is conventional to use the word "correlation" when referring to relations between risks, there are other forms of dependence that are not strictly speaking linear in nature. Hence, they are not measured properly using a correlation statistic which pertains

strictly to linear relations. Indeed, in stressed conditions the co-dependency of asset returns is typically not well-described by correlations estimated in ordinary conditions.

Another form of dependence that is of critical importance is that between the exposure on a clearing member's portfolio and its likelihood of default. A CCP faces elevated risks when a clearing firm's probability of default is elevated precisely when it owes the CCP substantial amounts on its cleared positions. This is sometimes referred to as "wrong way" risk and is particularly pernicious. This is especially true inasmuch as (a) clearing member positions can change over time, meaning that the risk it poses to the CCP can switch from "right way" to "wrong way" risk in short time periods, and (b) CCPs do not generally adjust margins or capital requirements or default fund contribution requirements to reflect changes in clearing member creditworthiness or changes in the direction or magnitude of the "way" risk.[23]

Dependency-driven risks pose acute challenges to CCPs. Dependencies are difficult to model. Moreover, dependency tends to change dramatically during periods of market stress and crisis. Thus, levels of margin that appear prudent in normal times may become severely insufficient during periods of market stress.[24]

As noted above, diversification--which involves exploiting imperfect dependency among risks--contributes to scope economies. Relatedly, the contribution of any product to a CCP's default risk exposure depends on its dependence between the instruments the CCP already clears, and between the instrument and the creditworthiness of clearing members. Thus, it is not possible to determine the riskiness of clearing a particular product at a specific CCP without knowing about the dependence between that product and the CCP's existing portfolio of risks (including the default risks of its members).

F. Implications

It is essential to be realistic about the suitability of many OTC derivatives products for clearing. The factors which make products unsuitable, notably illiquidity and complexity (and the associated valuation, hedging, and replacement difficulties), are quite widespread. Specifically, contractual standardization is not sufficient to determine suitability: even contractually standardized products that are liquid today often become quite illiquid quite early in the lifecycle of a trade. It is therefore necessary to consider product characteristics over this entire lifecycle when evaluating suitability for clearing. It must also be emphasized that requiring clearing of unsuitable products increases CCP risks, and given the systemic importance of CCPs, such risks would be systemic in nature.

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[23] ICE Trust does not clear CDS whose reference credit is a clearing member due to wrong way risk considerations.

[24] Even if margins are inadequate to ensure that a loser pays in the event of a default during a stressed period, the CCP will remain solvent as long as the default fund is adequate. However, the same problems that can lead to an underestimation of the amount of margin necessary to ensure that the loser pays can also lead to an underestimation of the size of the default fund necessary to ensure CCP solvency. Indeed, default fund contributions are typically closely related to clearing member margins. Also, any deviation from the loser pays principle increases the amount of credit risk borne by other derivatives market participants.

VII. CCP Structure and Operation

A. Financial Resources

In order to achieve their economic functions of allocating counterparty risks and ensuring that market participants receive payments contractually owed to them, CCPs must have adequate financial resources to absorb the default of member firms. In order to carry out these functions even during periods of stress to the financial system, and to avoid defaulting themselves, large CCPs should have sufficient resources to absorb the simultaneous defaults of two or more large members during periods of time when exposures at default are large.

CCPs conventionally rely on a "waterfall" of financial resources to absorb defaults. The first element of the waterfall is the defaulter's margin. The second element is the defaulter's contribution to the CCP default fund (or its equivalent). As noted above, in a pure defaulter pays model, these elements would always be sufficient to cover the obligations of defaulting firms, but it is inefficient to impose margin or default fund contributions that would cover exposures at default under all eventualities.

Once the resources contributed by a defaulter are exhausted, CCPs can utilize other resources. One source can be its own equity: CCPs are typically for profit corporations or subsidiaries of for-profit corporations. (Even not-for-profit firms can accumulate surpluses that can be used to cover default losses.) Moreover, CCPs can utilize default fund contributions of non-defaulting members. If default losses exceed even this element of the waterfall, CCPs typically have the right to assess non-defaulting members to make additional contributions. These additional assessment rights are usually limited, commonly to a firm's initial contribution to the default fund.

In some CCPs, under some circumstances, CCPs may utilize the margins of non-defaulting customers of a defaulting clearing member firm to satisfy the obligations of any defaulting customers. Specifically, if client funds are held on an omnibus basis, and (a) a customer of a clearing member defaults, and (b) the clearing member is not able to cover those obligations, the CCP may utilize customer monies to meet the defaulting costumer's obligations.[25]

The various elements of the waterfall can be ordered in a variety of ways. Ordering affects the incidence of loss, and can also affect its magnitude *via* its effect on incentives. For instance, putting CCP capital at risk at the first stage of the waterfall (after the defaulter's resources) provides the CCP with a strong incentive to control risk, monitor its members, and choose margin levels prudently.

Determination of the adequacy of financial resources requires a quantification of the risks arising from the products cleared, and the creditworthiness of the clearing members. I consider the elements of the waterfall in turn.

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[25] James Morgan and George Morgan, *Default Risk in Futures Markets: The Customer-Broker Relationship*, 45 J. of Finance (1990) 909.

B. Margin Determination

Initial margins are conventionally calculated so that the probability that prices will move sufficiently between markings-to-market to generate losses in excess of margin is sufficiently small. The methodology for doing so can explicitly establish a "tail probability" that gives the likelihood that margin is exhausted between variation margin payments, and set the margin on a particular product or account portfolio accordingly.[26] Other methodologies do not explicitly establish a tail probability, but estimate changes in market values under various price (and volatility) scenarios, and set margins so that they are sufficient to cover losses under all the scenarios considered; the likelihood of the various scenarios used to set margins implicitly defines the probability that margins will be insufficient to cover losses. Only when a clearing member has suffered losses in excess of its margin is the CCP vulnerable to a default loss.

Under simplifying assumptions, calculation of these amounts is conceptually straightforward. However, real world complications greatly increase the complexity of this process, and challenge the reliability of the calculations. In particular, changes in market volatility, liquidity, and crashes or spikes in prices are all real possibilities, but it is difficult to model these types of market behavior, or to estimate the parameters necessary to quantify the likelihood that price moves will breach margin thresholds. This is particularly true across portfolios of products due to dependencies discussed in Section VI, and to changes in these dependencies over time.

The fact that CCPs can adjust margins in response to changes in market conditions limits their vulnerability. However, market conditions can change precipitously in short time periods. Moreover, margin changes can themselves be destabilizing; large changes in margin can lead to liquidations of positions that influence prices, especially during unsettled periods.

CCPs also recognize that although the risks of margin shortfall can be mitigated by choosing extremely conservative margin thresholds, this is costly because collateral is costly. Thus CCPs face a delicate trade-off between choosing margins that reduce its default exposure on the one hand, but unduly constrain trading activity on the other.

C. Default Fund Resources

The default of a CCP member or members that exceeds the defaulters' margin and default fund contributions is met out of the other resources committed by CCP members, CCP equity holders, or insurers. It is important to recognize that these resources are drawn upon only if price movements are in excess of margin, which occurs only with the tail probability selected by the CCP when it sets margins (assuming that these tail probabilities are calculated accurately). Thus, the

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[26] This is analogous to a Value-at-Risk (VaR) calculation. For instance, the SPAN approach implemented by LCH.Clearnet utilizes a "probabilistic/statistical approach of Value-at-Risk type, with a general policy of a 2-day holding period and a 99.7 % 2-tail confidence interval (e.g. the equivalent of 3 standard deviations and a breach less than once a year, under normality assumption)." LCH.Clearnet complements this calculation using a "deterministic approach of worst-case scenario type, based on observed market movements, especially regarding spread positions." See http://www.lchclearnet.com/risk_management/sa/margining_methodology/derivatives.asp.

adequacy of these other resources is determined by the exposure conditional on the occurrence of price changes large enough to exhaust the margins of some clearing members.[27]

Calculation of these conditional exposures is even more complex and fraught with potential for error than the calculations of margins based (implicitly or explicitly) on tail probabilities. By definition, these tail events occur infrequently, and such extreme events are challenging to model. Even if a plausible model can be identified, it is often extremely difficult to estimate or calibrate the parameters necessary to calculate the distribution of such conditional exposures, or to test the ability of the model to represent accurately these distributions.

The dependencies discussed in Section VI pose particular challenges to models. So does market liquidity. Liquidity often declines precipitously during extreme events. Since a CCP's exposure to a default that exhausts the defaulter's (or defaulters') resources available to the CCP depends on the impact of replacement trades on prices, and the time required to replace defaulted positions, it depends on market liquidity. Modeling market liquidity and its impact on CCP risks is extremely difficult, not least because of the difficulty of characterizing the dependence between market liquidity and the events that caused a large default or defaults. Given the fact that market liquidity is often quite low when large defaults occur, it is reasonable for CCPs to make very conservative assumptions about liquidity when evaluating the adequacy of default fund resources.

Two other issues deserve comment. First, the standard that CCPs have sufficient resources to withstand the defaults of two large members is potentially destabilizing. Once one large default has occurred, the adequacy of the capitalization of a CCP that just meets the two default standard is likely to be questioned, especially during times of market turmoil (when a large default is likely to occur—or can cause). Doubts about the adequacy of capitalization can lead to a run on the CCP, with market participants trying to close out positions in that CCP. This would tend to stress the liquidity of the CCP, and lead to destabilizing price movements.

This is a problem with any capitalization standard based on a known number of member defaults. Although the likelihood of such a run is smaller, the larger the number of defaults the CCP is capitalized to withstand, it must be remembered that capital is costly and it is not efficient to capitalize sufficiently to absorb an arbitrary number of defaults. An alternative is to require CCPs to have a recapitalization mechanism that is activated in the aftermath of the first default, and every subsequent member failure. Precommitted conditional capital would reduce the likelihood of a run, to the extent that those who have committed to provide additional capital are widely believed to be able to perform on those obligations. This would likely require obtaining these commitments from financial entities that are not participants in the CCP, such as insurance companies or unlevered "real money" investors.

Second, the uncertain and contingent nature of clearing members' default fund liabilities is a matter of serious concern to them. There are conflicting considerations here. On the one hand, higher limits on the amount of capital CCPs can call for increases their ability to withstand defaults. On the other hand, higher limits increase the "contagion" effect that can result from large clearing member defaults, thereby largely defeating the intent of clearing mandates, which is

[27] David Bates and Roger Craine, *Valuing the Futures Market Clearinghouse's Exposure During the 1987 Crash*, 31 J. of Money, Credit and Banking (1999) 248.

to limit the exposure of large financial firms to derivatives counterparty risk. Furthermore, concerns about uncertain clearing member exposure to CCP capital calls can increase the likelihood of runs on members. Due to these considerations, the ability of CCPs to make large (or especially, uncapped) capital calls is likely to induce the structuring of clearing members in ways that limit the amount of their capital that a CCP can tap. Put differently, if the ability of CCPs to call for capital is not constrained, market participants will devise means to limit exposure to such calls. This, in turn, has implications for other elements of the default waterfall, most notably margin.[28]

D. Default Simulation and Stress Tests

Models that attempt to quantify the probability distributions of exposures for the purposes of setting margin and default fund resources are vital to CCPs, but for the reasons just discussed, exclusive reliance on the models necessary to make these calculations is unwise due to their inherent limitations. Thus, CCPs should—and typically do—utilize additional tools to identify potential vulnerabilities that could jeopardize their abilities to perform their economic functions. Two crucial tools include stress tests and default simulations.

Stress tests assess the ability of a CCP to withstand extreme, but not impossible, market conditions. Stress tests have the virtue of not being model or parameter dependent. It is therefore possible to identify scenarios that could test a CCP's ability to withstand extreme conditions without the need to commit to what is likely an untestable model. But that virtue is also a limitation: being model-free, the stress test provides no way to determine the likelihood of these scenarios, or even their plausibility. Scenarios are inherently arbitrary, and since it is prohibitively costly to take precautions sufficient to ensure survival of the CCP under all possible scenarios, identification of a scenario (or scenarios) in which a CCP is in danger of default has limited utility. The most beneficial outcome of stress tests is to identify unsuspected vulnerabilities which, after further analysis, are reasonably deemed to have a non-trivial probability of occurring (even if that probability cannot be estimated precisely). A requirement to carry out reverse stress tests—which take as their starting point the insolvency of the CCP and then infer what events might have lead to that—could also provide valuable information for supervisors.

Default simulation allows a CCP to "war game" one or more defaults. CCP and clearing member personnel can practice the actions they need to perform in the event of a default. This familiarizes them with these tasks, and gives them practice working with one another. The simulations can also be made realistic and challenging to provide better training, and to help identify weaknesses in training and procedures. That said, real financial markets are complex and tightly coupled, and thus prone to act in novel and unpredictable ways.[29] Moreover, politics and

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[28] At one time, the Chicago Mercantile Exchange had a 'good to the last drop' ("Maxwell House") rule in which the CME clearinghouse had unlimited rights to call on the capital of member firms: in essence, clearing members were liable to fund the clearinghouse up to their entire capital. Based on discussions with those involved with the CME during this period, I have learned that there were doubts about the CME's ability to enforce this right even when the rule (Rule 802) was operative, and that a cap on clearing member's contributions was therefore preferable. Around the time the CME demutualized, the rule was amended to replace good-to-the-last-drop with a cap on additional contributions to the amount of the initial default fund contribution.

[29] Richard Bookstaber, *A Demon of Our Own Design* (2008).

policy (e.g., central bank actions) influence the market behavior during crises, and these are also quite difficult to predict. Hence, no default simulation will anticipate all of the contingencies that will occur in a particular default scenario, especially one that that could threaten the viability of a CCP.

One particularly important feature that should be incorporated in default simulations is the size of defaulted positions. These positions could have notional values in the trillions of dollars, and be very large relative to the normal flow of trading activity. In contrast to typical futures or exchange-traded options positions, OTC derivatives portfolios often include positions accumulated and held over extended time periods. Thus, the magnitude of the positions that must be replaced or hedged in a short period following a default is likely to be very large relative to normal order flows. To provide realistic training for default scenarios, simulations must reflect this fact.

E. Infrastructure and Information Technology, and Operational Risk

Recent years have seen considerable technological advances and the application of state-of-the-art information technology to all elements of the process of making and recording transactions, and tracking positions and risks. For instance, automatic, electronic confirmations and portfolio reconciliation technology are best practice.

CCPs have participated in this process, and in so doing have mitigated a major source of operational risk. It is imperative, however, that CCPs continue to make the necessary investments in technology to ensure that they achieve and maintain best practices in order to control operational risk.

F. Disclosure to Market Users

Like other financial intermediaries, CCPs are potentially susceptible to runs due to a loss in confidence in their solvency.[30] For instance, concerns about a CCP's solvency could lead market participants to exit positions in order to recover their margins. This could lead to price pressures, and create a liquidity shock for the CCP as it attempted to meet its obligations to return collateral.

Lack of information is one source of this type of financial fragility, and extensive disclosure is one means of providing such information.[31] Whereas banks are required to make extensive disclosures about a variety of risks (e.g., market, concentration, credit, operational risks), CCPs typically make far fewer risk disclosures. The relative opacity of CCPs affects the risk of runs on CCPs.

Disclosure of methodologies about margins is a particularly important issue. As noted above, CCPs rely on margins as the first line of defense against customer default, and often base default fund contributions on margin. Therefore, to understand the sufficiency of CCP financial

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[30] Bernanke, *Clearing and Settlement During the Crash*, and *The Presidential Commission on Market Mechanisms* document how uncertainty about the financial condition of major derivatives clearinghouses in October, 1987, led to run-like behavior that threatened serious systemic consequences.

[31] Historically, bank clearinghouses attempted to mitigate runs by disclosing information on the financial condition of their members. See Elmus Wilker, *Banking Panics of the Gilded Age* (2000).

resources, it is necessary for CCP users to have relatively detailed information on margin setting methodologies. Heretofore, however, CCPs have not made extensive disclosures of these methodologies. Improved disclosures regarding margins, and the other elements of CCP default waterfalls would reduce the vulnerability of clearinghouses to destabilizing runs.

G. Disclosure to Regulators

Disclosure of information to regulators is an important role of CCPs. The movement of the bulk of derivatives trading to CCPs facilitates the disclosure of positions and risks to regulators, particularly those with responsibility for the stability of the financial system. By knowing who holds what positions, CCPs can assist regulators in mapping risk exposures in the financial system. Lack of this type of information has impeded the ability of regulators to respond to previous systemic crises: regulators did not know who was exposed to troubled financial entities, and in what amounts, and therefore were unable to understand fully the implications of the collapse of these entities.

That said, the information available to a given CCP (which can be provided to regulators) does not give a complete characterization of the relevant risks. To the extent that there are multiple CCPs, information must be obtained from all of them to construct a complete map of cleared derivatives exposures and connections; this may be particularly challenging when large entities have cleared positions in CCPs located across multiple jurisdictions.

Moreover, since most large firms will utilize both cleared and non-cleared derivatives, positions held at CCPs provide an incomplete and misleading depiction of derivative risk exposures. Derivatives data repositories that include both cleared and non-cleared positions should therefore be the primary source of information that regulators rely on. CCPs can contribute their information to these repositories.

Furthermore, derivatives represent only a portion of the risk exposures of financial firms, and only a fraction of the linkages between them. Thus, although CCPs and derivatives data repositories can provide valuable information to regulators, they are not sufficient to permit regulators to understand all relevant exposures and interconnections.

VIII. CCP Organization and Governance

A. Alignment of Control Rights, Risks, and Incentives

Efficient and prudent operation of CCPs requires an alignment of ownership and control rights on the one hand, and the incidence of risk on the other. That is, those who bear the counterparty risks assumed by a CCP should have the power to make decisions that affect the riskiness of the CCP, and the distribution of that risk. Moreover, these decision rights should be distributed in accordance with the distribution of risk: those who bear greater risks should have similarly greater rights over decisions that affect CCP riskiness. These decisions include, *inter alia*, margins, the choice of products to be cleared, pricing methodologies, default management protocols, capital requirements and membership requirements.

Failure to align control/decision rights would mean that those with decision rights would not bear the costs of their decisions, and would have an incentive to make decisions that increase CCP riskiness because these costs are borne by others. Moreover, it must be recognized that mismatches between risks and control rights will tend to reduce the incentive of members to supply capital necessary to absorb default risks, and may cause some firms to decide not to become clearing members.

B. Membership Requirements

To achieve their economic purpose, CCPs must be sufficiently capitalized to absorb default risks. Moreover, they must have access to the trading expertise and resources necessary to manage the replacement of defaulted positions.

Membership requirements affect the ability of CCPs to muster the necessary resources. In particular, less restrictive membership requirements (e.g., a small minimum capital requirement for membership, no requirement for members to commit trading resources to manage replacements) tend to increase the heterogeneity of CCP membership.

Heterogeneity is problematic for several reasons. First, interests among members are more likely to diverge, the more heterogeneous they are. These divergences create an incentive to influence CCP decisions to shift costs and risks from one type of member to another. Relatedly, they make it more difficult to design governance and decision making mechanisms (e.g., committees, voting rules) that align control rights and risks. Heterogeneity leads to the adoption of more cumbersome governance and decision-making mechanisms; more elaborate constraints on management and committee decision making are necessary to reduce the likelihood that rules and decisions are used to benefit one type of member at the expense of other types.[32] Also, broader and more diverse memberships make it economical to reduce the power of management incentives.[33] As a consequence, CCPs with more diverse memberships are more prone to conflict, more cumbersome to manage, less effective at responding to changes in the marketplace, and less effective at responding to crises that are likely to have disparate impacts on different types of firms.[34]

Second, heterogeneity makes it more costly to control moral hazard problems. A CCP has a limited array of instruments—primarily margin requirements and default fund contributions—to influence the allocation of trading among members that pose default risks. Heterogeneous members differ in their susceptibility to moral hazard, and in their costs of posting collateral. The more heterogeneous the membership, the more difficult it is to choose the margin requirement to provide the appropriate risk-taking incentives. Inevitably, with a very heterogeneous membership, margins will be too low for some members (meaning they bring more risk to the clearinghouse than is optimal) and too high for others.

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[32] Craig Pirrong, *A Theory of* Financial Exchange Organization. 43 J. of Law and Economics (2000) 437.

[33] Avinash Dixit, *The Making of Economic Policy: A Transactions Cost Politics Perspective* (1998).

[34] Elmus Wilker, *Banking Panics in the Gilded Age* (2000) shows how heterogeneity in the membership of the New York Clearing House (a bank clearinghouse in the 19th and early-20th centuries) impeded its ability to respond to financial crises, such as the Panic of 1907.

Similarly, when only a subset of member firms has the capability to manage defaulted positions, it is likely that other members can effectively free ride on their services. Absent a method of accurately estimating the costs of providing these services, and compensating those providing them (and charging those receiving them) accordingly, there will be free riding, and this free riding will also contribute to moral hazard. The free riders will tend to operate in ways that bring too much risk to the CCP because they do not pay the price for doing so.[35] Homogeneity—notably, the ability of all members to contribute to default management—reduces free riding and the associated moral hazard.

Third, these difficulties arising from heterogeneity will reduce the willingness of some firms to commit capital or trading resources. In particular, since heterogeneity increases the likelihood that risks will be misallocated among members, those who are vulnerable to bearing a disproportionate share of the risks have an incentive to reduce their commitment to the CCP. For instance, with relatively unrestrictive membership requirements, some large financial institutions may create separately capitalized subsidiaries to limit their exposure to CCPs risks, and thus their vulnerability to bearing risks disproportionately.[36]

Membership requirements can also have competitive implications. Due to the extensive economies of scale and scope in clearing discussed in Section V.B, CCPs are likely to possess market power. Moreover, even if a CCP has a suboptimally small membership, no competing CCP may be able to achieve sufficient size to overcome its scale and scope economies.

One way to exercise this market power for the benefit of members is to limit membership to an inefficiently small number through the imposition of unduly restrictive membership requirements.[37] Therefore, it cannot be ruled out that CCPs will utilize membership requirements for strategic, competitive purposes.

There is a fundamental tension between the prudential and competitive implications of membership requirements. More restrictive requirements, especially to the extent that they generate a more homogeneous, highly capitalized membership, contribute to the safety and soundness of CCPs. But such requirements can also impede competition in derivatives trading, and the provision of clearing and trading services to clients.

It is extremely difficult to specify *ex ante* regulatory standards that achieve the appropriate balance between competitive and prudential effects. Given the reliance that will be placed on CCPs to ensure the safety of the financial system, considerable care should be taken in imposing regulations on membership requirements intended to enhance competition. An alternative would be to establish a rebuttable presumption that CCP membership requirements are justified on prudential grounds, but to give regulators and those who the standards exclude from membership

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[35] Given the highly uncertain and contingent nature of the cost of providing default management services, pricing these services accurately (so as to charge those who benefit, and compensate those who provide) is a daunting, and arguably impossible, task.

[36] As an illustration of the importance of homogeneity, in 2009 LCH.Clearnet restructured in large part to streamline its membership structure.

[37] Craig Pirrong, *Securities Market Macrostructure: Property Rights and the Efficiency of Securities Trading*, 18 J. of Law, Economics, and Organization (2002) 385.

the right—and the burden of proof—to revise such requirements if they can show that they were adopted for anti-competitive reasons, or place an undue burden on competition not justified by any prudential benefit. Generally, it will be difficult to create competition due to the extensive scale and scope economies (discussed in Section V.B).

C. Committees and Committee Membership Standards

Committees are the critical governance structure in a cooperative or quasi-cooperative organization like a CCP. They are the mechanism by which those that bear counterparty risks (the members) can act collectively to influence critical CCP decisions.

As such, the principles outlined above apply with particular force to committees and committee representation. Specifically, the authority of committees to establish CCP policies, and the membership on these committees, should align with the incidence of risk.

The authority and composition of the Risk Committee is of particular importance. This committee should play a pivotal role in decisions that affect CCP risks, and the distribution of those risks, including margins, the clearing product slate, and default management procedures.

D. Conflicts of Interest

One commonly expressed concern is that CCPs that are dominated by large banks will utilize their control over CCPs to protect their OTC derivatives trading businesses from competition by limiting the products the CCPs clear. Limits on bank control of CCPs have been advanced as a means of addressing this perceived problem. Such limits include aggregate ownership limits that would put a ceiling on large bank CCP ownership and control.

Note, however, that clearing *per se* does not increase an end user's choice of counterparties with the expertise in structuring more complicated products tailored to his particular needs; large dealers would retain a strong competitive advantage over smaller banks and other intermediaries in the marketing of complex products, even if those products were cleared.[38]

Moreover, the primary explanation that has been advanced to explain why dealers have market power, and thus conjecturing that they earn supercompetitive profits in trading and marketing derivatives, is that the lack of pre-trade transparency raises customer search costs and thereby gives dealers bargaining power. Clearing does not affect pre-trade transparency, and therefore regulating CCP ownership and governance does not reduce the source of dealer market power. Other regulatory initiatives, such as the SEF requirement under Dodd-Frank, will affect pre-trade transparency directly. If the assertion that pre-trade opacity creates market power is correct (which is debatable), these initiatives will address that problem, thereby vitiating the need to regulate CCP ownership and governance to do so (especially in light of the ineffectiveness of such regulations at addressing at the alleged source of market power in OTC derivatives).

It should also be noted that CCP members internalize the bulk of the costs and benefits associated with the decisions regarding what products are cleared. As the ultimate bearers of the

[38] Profit margins on standard, heavily traded products, such as vanilla interest rate swaps on major currencies, are very thin, limiting incentives to retain trading of these products.

default risks assumed by CCPs, they have an incentive to ensure that only suitable products are cleared. Moreover, they realize the benefits that arise from multilateral netting and more efficient use of capital that clearing can generate; they also realize the cost associated with loss of netting benefits when some products are cleared and others are not.

Given the importance of ownership and governance structures that are aligned with risks; the adverse effects that misaligned structures have on the incentives of firms to contribute capital to CCPs; the substantially increased risk of misalignment when CCP membership is too heterogeneous; the fact that CCP members internalize most of the costs and benefits associated with the choice of cleared products; and the likelihood that clearing a broader variety of products would not undermine large dealer's putative market power and that other policy initiatives (e.g., SEFs) would; it is dubious policy to impose membership requirements or aggregate membership limits on CCPs in order to counter perceived conflicts of interest.

IX. Clients, Collateral and Clearing Members

A. Segregation of Collateral

The segregation of collateral (initial and perhaps variation margin) affects the risk that customers will lose some or all of their collateral in the event of a default. Depending on the segregation model, a client is at risk to (a) a clearing member, (b) a clearing member and other clients, (c) the CCP, (d) both, or (e) none of the above.

In US futures CCPs, member and customer collateral are held in segregated accounts, but all customer collateral is co-mingled in an omnibus account. If a customer defaults, leaving a deficit in the customer margin account balance owed the CCP, and the clearing member has insufficient capital to cover the deficit, non-defaulting customers are at risk to having the CCP utilize the monies in the omnibus account to pay what is owed the customers of other clearing members.

This risk can be eliminated by segregating initial margin at the customer level, with each individual customer's margin being held in separate accounts. If these segregated accounts are held at the CCP, however, these monies may be at risk in the event of a CCP bankruptcy. That is, they may become part of the CCP's bankruptcy estate. Even if the client eventually recovers these funds, this may take some time and considerable legal expense. This risk can be eliminated by holding collateral in bankruptcy remote accounts.

The degree of segregation has a variety of cost, distributive, and incentive effects. Finer segregation is more costly from an operational perspective.[39] Moreover, bankruptcy remote segregation typically requires the payment of additional fees. In terms of distributive effects, omnibus segregation exposes customers of a clearing member to the default risk of other customers.[40] If a customer defaults, and the clearing member is unable to cover the loss (i.e., it also

[39] Mixed segregation mechanisms can mitigate these costs. For instance, it is possible to segregate collateral legally, but co-mingle it operationally.

[40] This risk can be reduced by putting non-defaulting margins at risk only after the default fund and the CCP's own equity commitment are exhausted.

defaults), the CCP can utilize the customer margins of non-defaulting customers to meet the defaulting member's obligations to the CCP.[41] This tends to shift risk from those with a relatively high likelihood of default, to those with a relatively low risk. This explains why high credit quality institutions, like some money managers and pension funds, prefer individual segregation to omnibus customer accounts.

However, such segregation effectively transfers the risk of customer default (joint with a clearing member default) to other clearing members *via* the default fund. Thus, greater segregation typically requires greater member capital contributions because they bear more risk *via* the default fund, and/or greater initial margins in order to reduce the risk passed onto default fund contributors. In other words, there are no free lunches with segregation: it primarily determines who pays for customer default risk, and how they pay for it.

The allocation of customer default risk, which depends on the degree of segregation, affects the incentives of customers to monitor the firms they clear through. A customer whose margins are segregated has no incentive to monitor the risk of his clearing firm, or the care that the clearing firm takes to monitor and control the counterparty risks brought by its customers. Thus, greater segregation tends to lead to less monitoring, and accordingly greater customer default losses because risks are commensurately greater with lower monitoring. That is, greater segregation creates a moral hazard. This is a real cost of greater segregation. Thus, like clearing generally, segregation involves a trade-off between risk allocation and incentive effects.

The facts that (a) margins posted with CCPs will not typically be rehypothecated (i.e., used as collateral in other transactions), and (b) excess margins held by clearing members under segregation agreements will typically not be available for rehypothecation, have implications as well. The lack of rehypothecation of collateral will tend to increase, and likely increase substantially, the demand for liquid assets. As discussed in more detail in section X.B, this can create systemic vulnerabilities. Firms needing to free up liquid assets may trade out of derivatives positions to release margins: this can impact prices. Moreover, increases in the demand for liquid assets will make derivatives trading more costly, thereby impairing derivatives market liquidity.

There is a strong argument to be made for permitting market participants to contract on segregation, as opposed to prescribing a segregation method *via* regulation. One possibility would be to establish omnibus segregation as a default standard, but permit clearing members and their clients to negotiate to create individually segregated accounts to contract around the standard. This would permit those who value segregation more highly than it costs clearing members to segregate to negotiate mutually beneficial arrangements with clearing firms. Such contracts would reflect information available only to the contracting parties, but which regulators could not know when setting a one-size-fits-all standard.[42]

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[41] James Morgan and George Morgan, *Default Risk in Futures Markets: The Customer-Broker Relationship*, 45 J. of Finance (1990) 909 provides a detailed overview of how customers are at risk to default by other customers. Two examples of this occurring are Volume Investors, a COMEX clearing firm that defaulted in 1984, and Griffin Trading Company, a Chicago Board of Trade clearing firm that defaulted in 1998.

[42] This would not necessarily properly price all risk transfers that result from segregation. For instance, if a large money manager and a clearing member negotiate a segregation arrangement, this would shift risk to the member's other customers, and to the CCP default fund. The shift in risk to other customers would tend to reduce their

B. Account Portability

The ability of clients to move trades from one clearing member to another also affects their vulnerability to losses arising from the member's default, and to legal complications that may accompany such a default. Moreover, such "portability" eliminates the need to close-out and replace positions held at defaulted clearing members. This economizes on transactions costs, and tends to reduce price movements associated with a large default.

Portability is intimately linked with segregation. Segregation at the client level facilitates portability. That said, portability is still feasible if customer funds are held on an omnibus basis. Portability in this case can be complicated, however, when there is a deficit in the omnibus customer margin account.

Portability requires another clearing member to agree to accept the client trades. A clearing member to whom customer positions are transferred takes on a credit exposure to those customers, and it may be unwilling to do so, or will do so only if the porting customer agrees to post additional collateral.

Operational considerations also affect the ease of portability. The failure of a large clearing member requires the movement of a large number of customer accounts. It may well occur during periods of market stress. These conditions may greatly complicate the difficulties of transferring customer trades from troubled clearing members. Clients can alleviate some of these operational risks by pre-arranging transfer arrangements with one or more clearing members. Establishing accounts at multiple clearing members also facilitates transfer of positions, but it may be costly because (a) it is costly to maintain multiple accounts, and (b) customers may incur higher margins or fees.

Portability can reduce substantially the costs, risks, and disruptions that clients incur as a result of a clearing member failure. It can also have important incentive effects. In particular, if customers are confident that portability will protect them in the event of the default of their clearing member, they have less incentive to "run" when the financial condition of their clearing firm falls under suspicion. On the other side of the ledger, like segregation, it reduces the incentives of clients to monitor their clearing firms.

C. Permissible Collateral

If customers (or clearing members) post margin in assets other than cash, they can become under-margined due to changes in the value of the collateral. The risk of this under-margining depends on the volatility of the price of the collateral: the greater the volatility, the greater the risk of under-margining. It also depends on the correlation between the value of the collateral and the value of the collateralized positions. If the assets posted as collateral tend to decline in value when the associated position loses money, the risk of under-collateralization is greater. The risk also depends on the liquidity of the collateral. A CCP runs the risk of forcing down the price of

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demand for the member's services, leading it to internalize some, and perhaps all, of the effects of this risk transfer. However, the risk transferred to the default fund would not necessarily be priced. This problem could be addressed by allowing the CCP to set default fund contributions based on segregation, with members with larger sums in segregated accounts being required to make a larger default fund contribution.

collateral when it sells it to cover a defaulter's obligations: this risk is greater, the less liquid the collateral.

The risks of under-margining can be addressed *via* "haircuts", i.e., by discounting the value of collateral. Riskier assets can be assigned a larger haircut to reduce the probability of under-margining.

CCPs face a variety of trade-offs when specifying what assets are eligible for margin. Very strict specifications limited to cash and cash-like instruments reduce the risk of margin shortfall, but impose costs on market users: higher quality collateral is costlier. Broader specifications reduce costs to users, but impose more risk on the CCP. Moreover, broader specifications impose greater operational burdens on CCPs. They must value more instruments, and determine more haircuts. Furthermore, given that market participants are likely to have better information about the values and risks of some instruments, especially relatively illiquid ones, a CCP is exposed to adverse selection on such instruments; the better-informed market participants can identify eligible assets that the CCP has assigned too small haircuts, or to which it has overvalued, and use these instruments to meet margin obligations.

The definition of eligible collateral has systemic implications. High-quality, cash-like assets (e.g., Treasury bills) tend to become scarce and highly priced during market crises. Limiting permissible collateral to such assets can lead to destabilizing trading during such crises; the increased demand for high-quality collateral will lead some market participants to liquidate positions in order to free up such assets. This can move prices.

Relatedly, there is an interaction between CCP collateral policies and central bank policy. The more restrictively CCPs define eligible collateral, the greater the burden on central banks to provide liquidity to derivatives market participants to avoid destabilizing liquidations of positions caused by an increased scarcity (demand for) high-quality collateral. For instance, by lending against lower quality collateral, central banks can supply funds that derivatives market participants can use to support their positions. As another example, if central banks are willing to lend to CCPs against lower-quality assets, clearers can accept such assets as collateral in the knowledge that they will not be required to engage in "fire sales" of such collateral in the event of a default.

D. Legal Enforceability of Segregation and Netting

The enforceability of segregation and netting is a legal risk faced by CCP clients, and a potentially important one. If a segregation arrangement is found unenforceable, upon default by the party holding margin, the party who has posted the margin is at risk of having those funds co-mingled with the bankrupt's estate, and becoming its unsecured creditor. If position or exposure netting are unenforceable, upon a CCP default (a) the non-defaulting party is at risk of becoming an unsecured creditor with respect to those positions that are in the money, and becoming fully liable for amounts owed on out of the money positions, and (b) non-defaulting parties may have to replace gross positions, rather than (smaller) net positions.

The relevant rules are abstruse, and vary significantly across jurisdictions. Moreover, since the enforceability of segregation and netting are tested only in "worst-case" scenarios and are subject to judicial interpretations that almost certainly will depend on the specific facts in

particular cases, identifying iron-clad principles that will hold in all instances is effectively impossible.

A variety of factors will determine the risk that segregation arrangements will be held unenforceable. These include: whether customers post margin by granting a security interest or under a title transfer arrangement; whether CCPs collect margin on a net or gross basis; whether margin is posted in securities or cash; whether the margin is held by a clearing member, the CCP, or a third party custodian; is margin commingled with other assets; whether margin is subject to liens or setoff rights; and whether margin is subject to rehypothecation.[43]

It is likely that the risks to segregation and netting at CCPs are doubly remote because the events that would endanger them–defaults and a successful challenge to carefully crafted legal arrangements–are highly unlikely. However, in the event of a default, someone (non-derivatives creditors) always has an incentive to challenge segregation and netting arrangements in order to secure a bigger recovery from the bankruptcy estate. This incentive is particularly strong during a large bankruptcy (as during the bankruptcy of a CCP or a large clearing member), and non-derivatives creditors are likely to litigate aggressively in such an event. Thus, threats to segregation and netting occur with low probability, but could be extremely costly if they occur.

E. Operational Risks Relating to Margin

The legal treatment of collateral can create operational risk. In particular, there is a heightened risk in jurisdictions in which collateral passes by title transfer. In these jurisdictions (notably, many European countries), the CCP receives the income from investing collateral and has the authority to invest collateral. In contrast, in other jurisdictions (notably the US), the poster of margin receives the income from the collateral.

An operational risk exists in the title transfer jurisdictions that does not exist in security interest jurisdictions. Specifically, there is a rogue trader risk: the trader responsible for investing collateral monies may engage in excessively risky investments in order to earn a high profit. A CCP would have to rely on its own equity capital or insurance (and not on the default fund) to cover any loss incurred by a rogue trader. CCPs can reduce their vulnerability to this by establishing and enforcing restrictive policies regarding permissible investments. However, there is always a risk that these policies can be circumvented.

X. CCPs and Systemic Risk

A. CCPs as Crucial Nodes in the Financial Network

The dramatic expansion of the use of clearing will fundamentally alter the topology of the world's financial network. In particular, CCPs will be crucial nodes in this network. Given the

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[43] See *Report to the Supervisors of the Major OTC Derivatives Dealers on the Proposals of Centralized CDS Clearing Solutions for the Segregation and Portability of Customer CDS Positions and Related Margin* (2009) available at http://www.newyorkfed.org/markets/Full_Report.pdf . To give an idea of the intricacies of this issue, the introduction of this 153 page report cautions that "[e]ven though this Report is detailed as to matters within its scope . . . it is not an exhaustive analysis of all potential legal issues."

scale and scope economies discussed above, it is likely that the number of CCPs will be small, and that most CCPs will be large. Furthermore, all major financial institutions will be interconnected *via* their linkages (direct and indirect) to CCPs. It is therefore profoundly incorrect to assert that clearing mandates reduce the interconnectedness of the financial system: these mandates reconfigure, but do not eliminate, interconnections between systemically important financial institutions ("SIFIs").

Since they will be crucial nodes in the financial network, the failure of a large CCP would have highly adverse consequences. The failure of a CCP would likely result in the closure of the markets for the products it clears for some time. Moreover, the failure of a CCP resulting from the defaults of one or more of its members would be a channel for the spread of financial contagion. It should also be noted that the mutualization arrangements that are a fundamental feature of CCPs mean that even if a CCP survives the default of one or more members, other CCP members may default or be required to recapitalize the CCP. Again, a primary effect of clearing is to reallocate default losses: reallocation can be efficiency enhancing, but it is not the same thing as eliminating these losses.

One purported virtue of clearing is that conservative margining reduces the leverage implicit in derivatives transactions. It is essential to remember, however, that reducing leverage in one category of transactions is altogether different from reducing the leverage in the financial system as a whole. It is likely that market participants will substitute other forms of leverage (including unsecured borrowings) for the credit capacity previously utilized in bilateral derivatives transactions. Moreover, the move to clearing will induce market participants to adjust risk taking, funding, and capital structure decisions. Indeed, many of these adjustments will tend to reverse (at least partially) the intended effects of clearing mandates; modern financial engineering has proved quite adept at devising structures that reverse some of the intended effects of regulatory and legal changes, and clearing mandates are unlikely to prove an exception to this rule. All of these changes will affect the financial system's responses to economic shocks—and will also affect its systemic vulnerabilities.

These indirect (and unintended) changes caused by clearing mandates are likely to be pervasive, but are difficult to predict with any confidence. Suffice it to say that a change to the financial system as far-reaching as clearing mandates will have systemic effects that extend well beyond CCPs and their members and clients. Indeed, they are likely to affect the entire financial system, and the real economy as well.

That said, the direct impact of CCPs on the stability of the financial system is also important, and deserves detailed analysis. I turn to that subject now.

B. The Effects of CCPs on Market Dynamics During Periods of Stress

Large shocks to asset prices, such as those occurred in 2008, the Asian and Russian crises of 1998, and the Crash of 1987, can sharply increase the risk of insolvency by systemically important financial institutions. Moreover, these shocks can also be associated with declines in liquidity in asset and derivatives markets, and sharp increases in the demand for, and reductions in the supply

of, credit. These various effects can create destabilizing positive feedback effects that pose grave risks to the soundness of the financial system.

An appraisal of the role of any financial entity during a period of sharp revaluations of financial assets should therefore focus on how that entity influences these positive feedback effects. With respect to CCPs, in some ways they can dampen, and in other ways exacerbate, these feedback effects.

One serious source of instability in the aftermath of large asset price changes is the replacement of derivatives trades defaulted on as a result of these price shocks. As noted at Section III above, CCPs can mitigate the destabilizing effects of the replacement of defaulted positions by (a) reducing *via* position netting the magnitude of positions that need to be replaced, (b) transferring customer trades to solvent CCP members, and (c) coordinating the orderly replacement of defaulted trades through auctions and orderly hedging of exposures created by defaults. These measures can reduce the knock-on price movements that result from a large default or defaults precipitated by an asset price shock. By dampening post-default price volatility, CCPs dampen destabilizing feedback.

On the other side of the ledger, CCP policies—most notably rigid collateralization and mark-to-market over very short time frames—can exacerbate asset price shocks. To meet variation margin obligations in the aftermath of a large price shock, and to reduce exposure to the risk of subsequent margin obligations, those suffering large losses may liquidate losing positions. They may also liquidate other assets or positions to reduce risk exposures and raise cash to meet margin obligations. These liquidations of positions or assets are likely to occur when trading and asset markets are already illiquid; large liquidations in illiquid markets tend to exacerbate price movements, often sharply. Moreover, those owing variation margin payments also turn to funding markets to raise cash, and do so at times when credit conditions are tight.

Similarly, CCP increases in initial margins in response to elevated price volatility can induce position liquidations in illiquid markets, and increased demand for funding in tight market conditions.

More extensive collateralization of derivatives trades also makes CCPs, and the broader financial system, vulnerable to liquidity shocks that arise outside the derivatives markets. As a result of clearing mandates, vast amounts of liquid assets will be tied up in margin. Moreover, these assets will be immobilized, because they cannot be rehypothecated. The only way to obtain access to these assets is to liquidate derivatives positions. An increase in the demand for liquid assets arising anywhere in the world economy will tend to trigger such derivatives transactions, which will impact prices; the larger the liquidity shock, the bigger the price impacts.[44]

These effects also occur in markets without clearing, of course—including in bilateral derivatives markets. It is essential to recognize however, that (a) greater reliance on clearing does

[44] As noted in Section IX.C, these impacts will depend in part on the assets that CCPs permit to be pledged as collateral. Given the positions held in derivatives markets, the more restrictive CCP standards on eligible assets, the more acute the effects of liquidity shocks. Against that, it is likely that derivatives exposures will be smaller with more restrictive standards as these standards raise the cost of collateral. The net impact of these off-setting effects is impossible to know.

not eliminate these effects, and (b) it can exacerbate them due to the highly rigid and time-constrained margining process in cleared markets, the higher levels of margin required by CCPs, and the "locked up" (not rehypothecateable) nature of margin held at CCPs.

C. CCPs as Potential Sources of Systemic Risk

The foregoing relates to ways that CCPs can affect systemic risk indirectly, *via* their impact on feedback effects. CCPs can also contribute to systemic risk directly, primarily due to the potential for a CCP default.

Historically, CCPs have defaulted. One of the first, the New York Gold Exchange Bank, failed in the aftermath of the defaults by two large gold speculators in the aftermath of "Black Friday" in September, 1869. More recently, the Caisse de Liquidation failed in 1974, the Kuala Lampur Commodity Clearinghouse failed in 1983, and the Hong Kong Futures Exchange Clearing Corporation failed in the aftermath of the Crash of 1987.[45]

A CCP default, if it occurs, would typically follow the default of one or more member firms. A member firm could default because it is insolvent, or because it is insufficiently liquid to meet a margin (or delivery) settlement obligation. If the defaulter's (or defaulters') margin with the CCP is insufficient to cover its (their) obligation, the CCP would have to call upon other financial resources, including its equity and default fund and its ability to call on additional capital contributions by members. If all of these resources are exhausted as a result of the member default(s), the CCP would default on its obligations to other members and their clients.

A CCP could also default due to a lack of liquidity. For instance, in the event of a member default, the CCP is obligated to make a timely payment to those owed variation margin payments. This will require the CCP to liquidate the defaulter's (defaulters') collateral, and perhaps some of its own assets. The CCP may also attempt to borrow to meet its obligations. If such collateral sales and borrowings occur during stressed market conditions (which is when a large member default is most likely), the CCP may be unable to raise sufficient funds to meet its obligations in the short time available to do so.

These outcomes are likely to be remote possibilities for well-structured and capitalized CCPs, but they are not impossibilities. Indeed, the nature of CCPs makes them most vulnerable to default at the times that they are most needed as a systemic bulwark. In particular, they are susceptible to wrong-way risk, in which the financial condition of the CCP is weakest at the time its financial obligations are greatest.

Wrong-way risk tends to be largest for the most senior component of payment waterfalls, and highly rated counterparties.[46] These features are characteristic of CCPs. Entities with these characteristics seldom fail, but their failure tends to occur concurrently with large asset price movements, thereby exacerbating market crises. Given that CCPs have attributes that make them vulnerable to wrong-way risk, this is a major concern.

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[45] The Davison Report details the events surrounding the failure of the HKFECC. Ian Hay Davison, *Securities Review Committee Report* (1989).

[46] Jon Gregory, *Counterparty Credit Risk: the new challenge for global financial markets* (2010).

D. Policy Responses to CCP-Related Systemic Risks: The Resolution of Failed CCPs

The fact that CCPs can fail also makes it imperative to design a resolution mechanism to address this contingency. The cessation of operation of a CCP for only a short period of time would have devastating consequences, as this would deprive market participants of very basic functions such as trade processing; thus a shutdown of a CCP would entail shutdown of entire markets which would have knock-on effects even on markets not directly affected.

To prevent such an outcome, CCPs require committed resources that cannot be used to satisfy obligations on derivatives contracts, but which are sufficient to permit the CCP to continue to undertake its operational (as opposed to risk bearing) functions in the event of its inability to perform its contractual obligations.

A resolution mechanism must also transfer the positions of a defaulted CCP to solvent counterparties. One possible arrangement would be to transfer positions (and the associated margins) to another, solvent CCP—if a suitable one exists. Such a transfer may be challenging because the scale and scope considerations discussed in Section V.B mean that it is likely that only a small number of CCPs will exist in a given jurisdiction, and because inter-jurisdictional transfers pose daunting legal (and perhaps political) challenges.

Another arrangement that has been proposed is to make the defaulted CCP's contracts bilateral, at least until such time as they can be re-novated to a successor CCP. A CCP has a zero net position in every instrument it clears: for every contract it has bought, it has sold an identical one. Thus, buyers and sellers of each contract with open positions in the CCP could be matched exactly, and the contracts that they had held with the CCP could be novated to create bilateral contracts between them.

This mechanism is problematic because any means of matching counterparties to "declear" contracts that is not based on voluntary transactions raises serious concerns. For instance, some counterparties may not have mutual credit lines and may not even have signed master agreements between them.[47]

It would also be possible to add another layer to the CCP waterfall that would result in an outcome that approximates the economic outcome of a CCP bankruptcy, but which would not require an actual bankruptcy filing. Specifically, in the event of a shortfall of funds from all other elements of the waterfall (defaulter's margin, defaulter's default fund contribution, CCP equity contribution, non-defaulters' default fund contributions including any additional capital

[47] To optimize the assignment of buyers to sellers, the resolution mechanism for a CCP could include a matching-market mechanism. Methods used to assign medical school graduates to hospitals could provide a model for a mechanism to match buyers and sellers of the positions held at a defaulted CCP. Similarly, there are electronic many-to-many matching platforms that permit users to specify acceptable counterparties and credit lines that could be adapted to the resolution of a defaulted CCP's positions, although it must be recognized that the matching problem is much more complicated when positions in a large number of products must be re-novated. Given that it is quite likely that it will not be possible to transfer the positions of a defaulting CCP to a successor clearinghouse, however, it is imperative to develop means to declear contracts of a defaulted CCP. The absence of any such mechanism will make bailouts of CCPs more likely. Avoidance of such bailouts should be a high priority.

contributions), clearing members who are "in the money" against the CCP will only get a percentage of the mark-to-market value they are owed. This is similar to the economic result in a bankruptcy of the CCP. Since the CCP does not actually become insolvent, however, all contracts remain in force, and the process is much more orderly. This mechanism would still require a method for recapitalizing a CCP to permit it to continue to perform its economic function of absorbing counterparty risk.

Legal considerations are also relevant. In particular, the mechanism must take into consideration the possibility that some of the contracts cleared by a failed CCP are subject to a clearing mandate. Regulations relating to mandates need to be crafted to facilitate the transfer of a defaulted CCP's positions, and to permit continued trading until the time a successor CCP can be formed or the failed CCP recapitalized sufficiently to permit it to resume full operation; for instance, a clearing mandate could be suspended in the event of a CCP default. Further legislation may be required in order to support the creation of flexible and efficient resolution mechanisms.

E. Policy Responses to CCP-Related Systemic Risks: Access to Central Bank Liquidity

CCP access to central bank liquidity has been one of the most contentious policy issues arising out of clearing mandates. The fundamental issues relating to provision of central bank liquidity to CCPs do not differ, however, from those relating to its provision to other SIFIs.

The primary concern about central bank support is that ostensible liquidity support could be in fact a bailout of an insolvent institution, and that the prospect of receiving a bailout could create a moral hazard: a CCP would operate in a riskier fashion if assured of a bailout.

Against that potential for moral hazard is the fact that CCPs, or their members, can be illiquid but solvent. Indeed, as discussed above, CCPs or their members may face acute liquidity strains during periods when credit/funding markets are disrupted. A CCP trying to liquidate a defaulter's (or defaulters') collateral under these conditions might have to sell it at fire sale prices, thereby exacerbating the losses imposed on CCP members, and perhaps resulting in a CCP default. Moreover, such fire sales could dislocate already stressed asset markets, thereby imposing costs on other market participants. Similarly, a CCP might not be able to obtain credit *via* private transactions, or may only receive it at punitive rates (or haircuts).

These difficulties are directly comparable to the kinds of liquidity problems that financial institutions like banks can encounter, and which the central bank can alleviate using its lender of last resort powers. Given the similarity between SIFIs like banks, and CCPs, there is no readily apparent reason of extending central bank liquidity support to one, and not the other. Failure to extend central bank liquidity support to CCPs would likely produce the kinds of market dislocations that lender of last resort powers are intended to address.[48]

Similarly, just as moral hazard concerns for banks must be addressed through rigorous prudential oversight and capital requirements, providing central bank liquidity support to CCPs

[48] For a thorough discussion of this issue, see Jeremy Kress, *Credit Default Swaps and Clearinghouses: Why Centralized Counterparties Must Have Access to Central Bank Liquidity* (2010).

makes it essential to subject them to similarly rigorous oversight and capital requirements. Moreover, it should be recognized that policies regarding membership requirements and the kinds of contracts that are cleared affect the risks that CCPs incur, and hence the likelihood that they would tap central bank liquidity. Thus, policymakers need to be cognizant of the implications of regulations regarding these aspects of CCP operation that influence its need for liquidity support.

It should also be noted that CCP members may experience extraordinary needs for liquidity during periods of large price movements. These liquidity needs arise from the necessity of meeting variation margin obligations. The closest that US CCPs have come to default in modern times occurred when some large members of futures and options CCPs members faced acute funding strains during the Crash of 1987. To alleviate these strains, the Federal Reserve (indirectly) provided liquidity to broker-dealers and futures commissions merchants. Absent such liquidity, there was a serious risk of CCP failure.[49] With the vast expansion of clearing resulting from Dodd-Frank and EMIR, it is likely that central banks will need to provide similar liquidity support both directly to CCP members that are banks with access to central bank liquidity, and indirectly to non-bank CCP members.

F. Policy Responses to CCP-Related Systemic Risks: Prudential Oversight

Policy-makers are increasingly acutely aware of the systemic importance of CCPs, especially in a world in which mandates drive the bulk of derivatives activity to central clearing. Consequently, throughout the world, but especially in the US and Europe, legislators and regulators are developing prudential oversight regimes for CCPs.

A recent speech by US Federal Reserve Chairman Ben Bernanke illustrates the seriousness financial regulators with which financial regulators view the systemic importance of CCPs[50]:

> *Of course, increased reliance on clearinghouses to address problems in other parts of the system increases further the need to ensure the safety of clearinghouses themselves. As Mark Twain's character Pudd'nhead Wilson once opined, if you put all your eggs in one basket, you better watch that basket.*

In the United States, Title VIII of the Dodd-Frank Act mandates that regulators including the Federal Reserve, the Securities and Exchange Commission ("SEC"), and the Commodity Futures Trading Commission ("CFTC"), establish enhanced risk management standards for "financial market utilities," including CCPs. Title VIII also directs regulatory agencies to implement closer oversight of CCPs. Furthermore, Dodd-Frank permits some CCPs to obtain emergency credit under terms set by the Federal Reserve after consultation with the Secretary of

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[49] Bernanke, Clearing and Settlement During the Crash. Mark Carlson, A Brief History of the Stock Market Crash With a Discussion of the Federal Reserve Response (2007).

[50] See Ben Bernanke, *Clearinghouses, Financial Stability, and Financial Reform* (2011). Available at http://www.federalreserve.gov/newsevents/speech/bernanke20110404a.htm

the Treasury. Pursuant to Title VIII, the Federal Reserve, the SEC, and the CFTC have released proposed rules.[51]

Internationally, the European Union is in the process of formulating legislation that will govern the prudential oversight of CCPs. Moreover, international organizations are developing standards and facilitating coordination among regulators in different jurisdictions. Notably, IOSCO and the Committee on Payment Systems are in the process of reviewing comprehensively standards for the operation of CCPs.[52]

These efforts are salutary, and should serve to bolster the already strong incentives of CCPs and their members to take prudent measures to ensure their safety and soundness. The main source of concern about existing proposals is that they incorporate provisions that are micro-prudentially sound, but which are macro-prudentially problematic.

For instance, the CFTC's proposed rule (a) requires that CCPs set margins "actual coverage of the initial margin requirements produced by such models, along with projected measures of the models' performance, shall meet an established confidence level of at least 99%", (b) determine the adequacy of margins on a daily basis, (c) backtest the adequacy of margins on a daily basis for products experiencing "significant market volatility," and (d) backtest the adequacy of margins for all products at least monthly. Similarly, both the Federal Reserve's and the SEC's proposed regulations require the use of risk-based models and at least monthly review of margin levels.

All of these requirements are micro-prudentially sensible, but will result in margin increases during periods of heightened market volatility. As noted above, this can create destabilizing feedback effects, particularly during periods of extreme market volatility.[53]

G. Jurisdictional Issues

Regulators and legislators in multiple jurisdictions have indicated a preference that derivatives denominated in their respective currencies, or traded by entities subject to their authority, be cleared *via* CCPs in their respective jurisdictions. Moreover, trading firms may have a preference to clear in a particular jurisdiction, due to bankruptcy laws, for instance.

The creation of multiple CCPs domiciled in various jurisdictions has several adverse consequences, and measures to address these consequences can pose systemic risks and regulatory challenges. In particular, it can lead to fragmentation which results in incomplete realization of

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[51] See, for instance, the CFTC's proposed *Risk Management Standards for Designated Clearing Organizations* (2011) available at http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/file/2011-690a.pdf and the SEC's proposed *Clearing Agency Standards for Operation and Governance* (2011) available at http://www.sec.gov/rules/proposed/2011/34-64017.pdf.

[52] These organizations are in the process of reviewing and revising the 2004 *Standards for Central Counterparties* available at http://www.bis.org/publ/cpss64.htm.

[53] In contrast, the Committee on the Global Financial System recommended the use of a "through-the-cycle approach employing data from a long time series of market movements" when setting initial margins, precisely to reduce the procyclicality in margin that results from adjusting it frequently based on changes in market risks. Committee on the Global Financial System, Committee on the Global Financial System, *The role of margin requirements and haircuts in procyclicality* (2010).

scale and scope economies. If the same product is cleared in CCPs in multiple jurisdictions, some position netting opportunities will be foregone, thereby reducing the efficiency of capital utilization and increasing the costs and risks of position replacement in the event of default. Clearing of different products at different CCPs results in the loss of some close-out netting possibilities, and efficiencies from portfolio margining.

Clearing of the same product in multiple CCPs can also fragment liquidity. Without interoperability of CCPs, counterparties to a trade will have to agree on which CCP to use. Some may be unwilling or unable to agree, thereby reducing the potential number of counterparties with which a particular firm can trade and reducing liquidity. This problem can be mitigated to the extent that market participants (or their brokers) make arrangements to clear at multiple CCPs, but this increases costs and operational burdens. Similarly, firms can clear through firms that are members of multiple CCPs. Maintaining multiple memberships imposes additional costs and operational challenges on the intermediaries. Moreover, this means of facilitating connections of end users to multiple CCPs tends to encourage the concentration of client business in a small number of clearing member firms. This concentration has systemic implications.

Interoperability between CCPs clearing the same product can mitigate these problems, but this exposes each CCP to the credit risk of those with which it interoperates. Furthermore, structuring an interoperability agreement across jurisdictional lines is complex, not least due to differences in bankruptcy law (and its treatment of collateral).

Moreover, interoperability requires close coordination between CCPs, particularly in a crisis; a CCP interconnection is an essential linkage that can fail in a crisis. Coordination of the respective regulatory authorities is also essential.[54] This coordination can be extremely difficult to achieve, not least because of substantive differences across legal and regulatory regimes. Connections between CCPs are systemically important, and connections across jurisdictional lines are a major systemic fault line.

All of these difficulties make it extremely challenging to create robust interoperability arrangements. In particular, it is highly likely that each CCP will be extremely reluctant to trust another's risk management. At the very least, the road to interoperability will be a long one. Thus, it is highly likely that clearing will be highly fragmented across products, and even fragmented within products due to jurisdictional barriers. This fragmentation will tend to raise the costs and risks of clearing, and also reduce market liquidity.

XI. Conclusions

The mandated central clearing of the bulk of OTC derivatives transactions is one of the most important consequences of sweeping legislative and regulatory changes implemented in the aftermath of the late financial crisis. Mandated clearing will transform the way counterparty default risk is allocated, priced, and managed in the vast OTC derivatives markets.

[54] The experience in coordinating an international regulatory response when Barings collapsed in 1995 provides an illustration of the difficulties involved, as does the experience with Lehman Brothers.

A far heavier reliance on clearing will have both direct and indirect effects. The most pronounced direct effect will be to increase the likelihood that clients of dealers will receive their full contractual payments on derivatives transactions. Moreover, clearing is likely to improve substantially the process of hedging and replacing positions in the event of a default by a large financial firm. Clearing is intended to reduce outstanding contractual positions through netting, but whether this will occur is more problematic because (a) mandating the clearing of some products can eliminate netting economies between those products and others that remain uncleared, and (b) the establishment of CCPs in multiple jurisdictions will preclude the realization of some netting possibilities.

The indirect effects of clearing are more difficult to identify, but they are almost certain to be profound, and often unintended. An overriding objective of clearing mandates is to extend the "defaulter pays" model to a far larger fraction of derivatives transactions in order to reduce counterparty risks on these trades. It may indeed be the case that defaulters pay a larger portion of their derivatives liabilities under clearing than in bilateral markets, but some of these additional payments are likely to come at the expense of other creditors. Moreover, market participants are likely to respond to clearing mandates by adjusting their financing and trading decisions in ways that result in a reallocation in credit risk, rather than a reduction thereof.

Clearing mandates are intended to reduce the risk of a systemic crisis originating in the OTC derivatives market, or being transmitted through this market. There are certainly circumstances in which CCPs can mitigate systemic crises; their facilitation of the orderly replacement of defaulted positions is particularly important in this regard. But CCPs have their own systemic vulnerabilities, and the clearing mechanism incorporates features that give rise to the kinds of feedback effects in trading and funding decisions that can create or exacerbate crises. Regulators need to be acutely aware of the macro-prudential consequences of CCPs, and evaluate their rules and policies accordingly.

Lastly, it must be recognized that clearing is incredibly complicated, and that CCPs will be vital interconnections in a vast and complex financial system. Consequently, CCP decisions on margining, products cleared, membership, governance, segregation, risk sharing, financial resources, and default resolution—to list just a few of the most important—will have profound and far-reaching effects on not just the derivatives market, but on the wider financial system, and the real economy. Any appraisal of CCP decisions and rules must be mindful of this complexity and interconnectedness. This paper sets out a framework that can assist in such appraisals, and identifies and analyzes some crucial issues. It only represents a beginning, however. The vast expansion of clearing will alter the entire financial system in ways that are impossible to anticipate, and ongoing analysis of OTC clearing and its effects is imperative to ensure that market participants, legislators, and regulators respond prudently and constructively to these changes in order to ensure that OTC clearing achieves its intended purposes.