The Economics of Clearing in Derivatives Markets: Netting, Asymmetric Information, and the Sharing of Default Risks Through a Central Counterparty

Craig Pirrong
University of Houston
cpirrong@uh.edu
713-743-4466

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1 Introduction

In the midst of the ongoing financial crisis, market participants, regulators, and politicians are asking whether changes to the financial market infrastructure could reduce its vulnerability to systemic risks, i.e., the risk that the financial distress of one institution would jeopardize the liquidity or solvency of others. One area of particular concern has been the burgeoning credit derivatives market, and this concern has been heightened by the failures of Bear Stearns, Lehman Brothers, and AIG.

Heretofore, credit derivatives, including credit default swaps ("CDS") have been traded in a bilateral, over-the-counter ("OTC") market. Regulators in the United States and Europe are pressing CDS market participants to move away from the bilateral market structure, and create a clearinghouse to serve as a central counterparty ("CCP") for credit derivatives, and perhaps other OTC derivatives. The regulatory rationale for creating a clearinghouse is that it would reduce systemic risk. Creation of a CCP for OTC derivatives would represent a major change in the allocation of default risk in world financial markets.

Every derivatives contract is potentially vulnerable to default by one of the parties to it. A CCP is a centralized, formalized mechanism for sharing default risks on derivative contracts among a coalition of financial intermediaries (e.g., banks). In a CCP arrangement, if one member of a CCP defaults on its obligations, the CCP, and hence the other non-defaulting members, assume these obligations. In this way, default losses are shared among the firms that belong to the CCP. Since sharing of risks can reduce the costs of bearing them, at first blush a CCP has much to offer. Unfortunately, the received analysis of the effects of the creation of a CDS clearinghouse has been superficial and incomplete. As a result, this analysis provides very weak support for the view that a CCP will improve efficiency, or reduce the vulnerability of financial markets to systemic contagion.

The formation of a CCP has myriad effects, most of which have gone largely unremarked, if not ignored altogether. This article presents a considerably more complete analysis of the implications of the adoption of a CCP, culminating in a comparative analysis of alternative mechanisms for sharing default risks; bilateral mechanisms with inter-dealer trade and insurance of counterparty default risk through the CDS market, and a CCP. I show that a CCP has several effects, including:

- In conditions of complete information, a clearinghouse can improve welfare by allocating default losses more efficiently. Specifically, defaults harm hedgers because they are most likely to incur losses from counterparty defaults when they suffer large losses on the exposure they are hedging. Hence, defaults occur precisely when a hedger's marginal utility (and hence the value of a lost cash flow) is high. A CCP can reduce the frequency and severity of default losses that hedgers suffer in these high marginal utility states, thereby improving welfare. The formation of a CCP also affects equilibrium prices, quantities, and profits.

- A CCP affects the distribution of default losses among market participants. CCPs typically net exposures. Netting effectively gives derivatives counterparties a priority claim on assets of an insolvent counterparty, and therefore transfers wealth from other creditors to derivatives counterparties. Moreover, CCPs insure non-members against losses arising from a dealer default, thereby effectively transferring the burden of these losses from non-members to the financial institutions that are members of CCPs.

- All risk transfer markets incur costs arising from asymmetric information. Asymmetric information-related costs differ between CCPs and bilateral market structures. In particular, it is likely that these costs are higher in centrally cleared markets than bilateral ones, especially for complex products traded by complex, opaque intermediaries because: (a) dealers in bilateral markets specialize in valuing complex derivatives contracts; (b) dealers in bilateral markets (who are the likely members of a CCP) have opaque and risky balance sheets; (c) dealers can more effectively monitor and price the counterparty risk of other dealers than can a CCP; and (d) dealers have stronger incentives to monitor and manage counterparty risks than a CCP.

- Since the formation of a CCP distributes wealth from one group of financial intermediaries to another, and affects the magnitude of costs associated with asymmetric information, it is not necessarily the case that the formation of a CCP is efficient, or produces positive net benefits for derivatives markets participants. The fact that the costs of asymmetric information can exceed the benefits from insuring hedgers against default losses can explain why CCPs are not ubiquitous, and why they are often not observed in markets where complex intermediaries trade complex products.

- Due to the distributive effects of clearing, and its effect on the pricing of default risk, it is not necessarily true that formation of a CCP reduces systemic risk. Indeed, it can increase systemic risk under some circumstances.

This analysis raises doubts about the prudence of exerting regulatory pressure on derivatives market participants to create a CCP for CDS products, or for OTC derivatives more generally. The regulators' case begs the question: If the benefits of central clearing are so large, why have market participants not adopted it heretofore? The analysis herein suggests that the answer to this question is: The private costs of forming a clearinghouse for credit derivatives and other exotic products exceed the private benefits, or put differently, that market participants prefer the incumbent method for sharing default risks to sharing them through a CCP. Moreover, although it is possible that negative externalities are greater in bilateral markets, and that this could justify regulatory imposition of clearing, there is no logical or empirical basis supporting this conclusion. Therefore, bilateral mechanisms for sharing default risks can be more efficient given the information conditions relevant for complex derivatives traded by complex financial firms.

The remainder of this article is organized as follows. Section 2 provides a simple mathematical characterization of default risk that draws attention to the key factors that affect this risk. These factors include the price risks of the financial instrument in question, and the balance sheet risks of the firms that trade them. Section 3 provides a brief overview of the mechanics of default risk sharing in bilateral markets and under a CCP. Section 4 summarizes a model (presented in the appendix) that shows that in the absence of information asymmetries, a CCP can improve the efficiency of risk bearing by insuring hedgers against default losses. The model further demonstrates that this affects the demand to trade derivatives, and hence equilibrium prices, quantities, and profits. Section 5 shows that one feature of a CCP–netting–effectively gives derivatives counterparties a priority claim on some of a defaulter's assets, and thereby transfers wealth from other creditors to these counterparties. Section 6 demonstrates that the default insurance aspect of clearing discussed in Section 3 implies that clearinghouse members can bear greater default losses in than they would in a bilateral market, even if netting is taken into account. Section 7 analyzes asymmetric information in a cleared market. Section 8 presents a comparative analysis of the costs and benefits of default risk allocation in cleared and bilateral markets. Section 9 analyzes the implications of clearing for systemic risk. Section 10 summarizes the analysis.

2 A Simple Model of Default Risk in Derivatives Markets

2.1 Introduction

Derivatives are financial contracts that have payoffs that are contingent on the realization of a financial price or some event at some future date. In a plain forward contract, such as on gold, the buyer and the seller agree on a forward price that the buyer will pay the seller on the contract's expiration some time hence. If the price of gold at the expiration date is higher (lower) than the forward price, the buyer profits (loses) and the seller (profits).

The losing party in a derivatives trade may be unable to bear the losses that he would incur if he were to perform on the contract. For instance, if the price of gold soars after the parties sign the forward contract, the forward seller may not have sufficient wealth to buy the gold he is required to deliver. In the event, the seller defaults on his contractual obligation. As the result of a default, the non-defaulting counterparty receives less than the promised contractual payment. The defaulter often must declare bankruptcy, and in this situation the victim of default has a claim against the bankrupt's assets. This is a risk of entering into a derivatives transaction.

Every derivatives contract poses some default risk. Moreover, for many derivatives either the buyer or a seller in a contract may default.[1]

Credit default swaps are derivatives that work somewhat differently than a "vanilla" forward contract like that for gold just discussed, but they are also subject to default risk. In a CDS, the "protection buyer" agrees to make a periodic fixed payment to the "protection seller" over the life of the CDS contract. The CDS specifies an underlying reference credit "name," e.g., General Motors. If the reference credit experiences a "credit event" (such as a bankruptcy) prior to the maturity date of the CDS, the protection buyer delivers a debt security of the named credit, and in return the protection

[1]Option sellers may default, but option buyers do not. The risks of default may be asymmetric. For instance, CDS protection sellers are typically more likely to default than protection buyers.

seller pays the buyer the face amount of the security.[2] Hence, if in the event of a GM bankruptcy, the price of GM debt falls to 20 cents on the dollar, the buyer delivers a GM note worth \$.20 per \$1 in face amount, and receives \$1 per \$1 in face amount in return. There is a risk of default on this contract. For example, the protection seller may not be able to afford the \$.8 per \$1 in face amount loss that he would suffer if he performed on the contract.

2.2 Financial Intermediaries and Default Risk

Financial intermediaries play a central role in all derivatives markets. In organized futures markets with a central counterparty, (a) all non-members must trade through futures commission merchants ("FCMs"), and (b) an FCM must guarantee the trades of exchange members. Although FCMs serve as agents for their customers, if a customer defaults on his obligations, the FCM must make good the loss.[3] In bilateral OTC markets, major financial institutions account for a substantial fraction of all trading activity, and serve as the counterparty for a very large fraction of total outstanding positions. These large financial firms that make markets in OTC derivatives are typically referred to as dealers.

This section presents a simple model of the default risk posed by a financial intermediary, be it an FCM or a large dealer. I focus on these

[2]CDS contracts also utilize cash settlement, whereby instead of delivering a security in the event of a default by the reference credit, the protection seller pays the protection buyer a cash amount equal to the difference between par and the market value of the defaulter's security. This market value is determined in an auction.

[3]Historically, most FCMs were specialty firms that focused on supplying brokerage services in futures markets. At present, most FCMs are subsidiaries or divisions of large, integrated financial institutions, including commercial banks and investment banks.

intermediaries because they are the members of existing CCPs (in the case of organized exchanges), and would almost certainly be the members of any new CCP for products traded OTC, including CDSs. To simplify the terminology, I will refer to the large intermediaries that are the focus of the analysis as "dealers."

The notation is as follows. To keep the analysis simple and minimize the notational burden, I assume there is a single derivative traded in the market. I assume dealer i has both proprietary trading positions and customer positions for which the dealer serves as a guarantor, but not necessarily the counterparty.

Market participants enter into derivatives contracts at time 0, and the positions pay off at time 1. The dealer buys some contracts, and sells others. The value of the positions that have profited is $\tilde{v}_i^+ > 0$. The value of the positions that have lost money is $\tilde{v}_i^- < 0$. The net value of the dealer's derivatives is $\tilde{v}_i^d = \tilde{v}_i^+ + \tilde{v}_i^-$ at time 1. This quantity can be positive, negative, or zero. In addition, the dealer has other assets and liabilities. For instance, if the dealer is a bank, it has assets including loans and liabilities including deposits and debt. The value of dealer i's assets net of the value of its liabilities is denoted by $\tilde{V}_i^d$.

Dealer i has customers $j = 1, \ldots, N_i$. Customer j has a derivatives position with dealer i that has time 1 value of $\tilde{v}_{ij}^c$. A customer position "with dealer i" could be either (a) a position in an account that i guarantees, for which i is not the counterparty, or (b) a position for which i is the counterparty.[4] In addition, each customer has other assets and liabilities, the net value of which are $\tilde{V}_j^c$.[5] A customer defaults on her derivative position if $\tilde{v}_{ij}^c + \tilde{V}_j^c < 0$. It performs if the opposite inequality holds. Therefore, dealer i's losses from defaults by customer j are $\min[0, \tilde{v}_{ij}^c + \tilde{V}_j^c] < 0$.

Since CCPs are mechanisms by which member intermediaries share default risk, I focus on the default risk posed by a dealer. The dealer's net value at time 1 consists of the value of its assets and liabilities (other than the derivatives); the value of its proprietary derivatives position; and the default losses of customers, as just described.

Formally, the dealer's time 1 value is:

$$X_i = \tilde{v}_i^d + \tilde{V}_i^d + \sum_{j=1}^{N_i} \min[0, \tilde{V}_j + \tilde{v}_{ij}^c]$$

Hereafter, I will use $C = \sum_{j=1}^{N_i} \min[0, \tilde{V}_j + \tilde{v}_{ij}^c]$ to denote the customer default losses absorbed by dealer i.

The dealer performs on all his derivatives contracts and all of his other liabilities if $X_i \geq 0$. If $X_i < 0$, the dealer may default on some of his derivative obligations. Whether he defaults on his these obligations depends on whether positions are netted (as in a CCP) or not (as in a bilateral OTC market.)

In a bilateral market, if $X_i < 0$, the dealer defaults on all of his positions that have lost money, even if he has larger gains on its winning trades. Thus,

[4]Importantly, these counterparty/customers could be other dealers. I explore the implications of this below.

[5]One complication, which I will finesse for now, is that $\tilde{V}_j^c$ may include the values of derivatives positions that j holds at other dealer firms.

if $X_i < 0$, derivatives default losses depend on $\tilde{v}_i^-$ (the amount owed on the dealer's losing position), X_i, and bankruptcy rules. These default losses in the bilateral setting can be represented as $f^b(\tilde{v}_i^-, X_i)$, where $f^b < 0$ if $X_i < 0$ and $\tilde{v}_i^- < 0$, and $f^b = 0$ otherwise. These losses are borne by the dealer's counterparties, who include other dealers and customers.[6]

As discussed in more detail below, a CCP nets deriviatives positions, so the amount a dealer owes on his derivatives positions is $\min[\tilde{v}_i^d, 0]$. If $\tilde{v}_i^d > 0$, even a bankrupt dealer (with $X_i < 0$) does not default on derivatives contracts. If $X_i < 0$ *and* $\tilde{v}_i^d < 0$, the loss from i's default is determined by the CCP's loss sharing rules and bankruptcy rules, and equals $f^c(\tilde{v}_i^d, X_i) < 0$. Otherwise $f^c = 0$. With a central counterparty, the default losses are borne by the other members of the clearinghouse, and sometimes the defaulter's customers.[7]

This simple mathematical description of defaults helps illuminate several important points. Most notably, it demonstrates the sources of dealer default risk. In particular, it shows that default risk arises from:

- The risk of the dealer's proprietary derivatives position. This depends on the magnitude of that position, and the risk characteristics of the particular instrument.

[6] The allocation depends on, *inter alia:* (a) the amount of collateral posted, (b) various bankruptcy rules, including close-out netting and rules relating to access to collateral, and (c) the actual operation of the bankruptcy process.

[7] In most CCP arrangements, the clearinghouse has the ability to seize customer margins that it holds to satisfy the obligations of a defaulting member if there is also a default in the customer account. See CME (2008) and Chambers-Morgan (1991).

- The risk of the other assets and liabilities on the dealer's balance sheet. Hereafter I will refer to this as "balance sheet risk."

- The risk of the dealer's customers' derivatives positions. This depends on the magnitude of those positions, the risk characteristics of the instrument, and the riskiness of customers' balance sheets.

Recent events help illustrate these factors. Lehman and Bear Stearns defaulted on their CDS derivative obligations not because of losses incurred on these derivatives, but because of losses incurred on other investments (primarily mortgage securities). That is, their balance sheet risks created derivative default losses. Balance sheet risks can also arise from operational risks, as was illustrated by the collapse of REFCO, where the revelation of hidden losses led to the firm's collapse. In contrast, AIG imploded because the huge losses on derivative positions overwhelmed the capital on its otherwise healthy balance sheet. Moreover, a major concern among market participants is that the defaults of these dealers could force some of their counterparties into defaults. This illustrates the point that customer/counterparty default risks also affect the likelihood a dealer defaults.

Moreover, all of these factors interact. Thus, the overall default risk depends on the correlations between these various risks. In particular, the correlation between the dealer's derivatives position payoff and its balance sheet value is an important determinant of default risk. To go beyond the simple one-derivative model, in real world situations where the dealer trades multiple derivatives, the relationships between the values of these derivatives positions is also an important determinant of risk exposure. In the case of credit derivatives in particular, default dependencies across names in a CDS portfolio–a notoriously tricky issue–affect the likelihood that a dealer defaults, and the magnitude of the loss resulting from that default. There is also potentially a dependence between a dealer's balance sheet risk and its derivatives portfolio.[8]

The mathematical characterization also makes it clear that the there is optionality in default risk exposure. There is in fact compound optionality. The default loss functions f^b and f^c have (short) option-like forms (because their payoffs are either negative or zero, depending on the state of the world), and one of its components–customer default losses C–is also option-like.

This non-linearity means that expected default losses depend on the volatilities of the underlying risk factors, the correlations between these volatilities, jump risks in any of the underlying factors, and other factors that affect the joint probability distribution of the various risk factors. The market value of the default losses depends on all these factors; it also depends on the covariance between the default losses and the pricing kernel. This covariance can have a material effect on the market value of these losses. If defaults tend to occur when the marginal value of consumption is high (e.g., dealers tend to fail during a market crash), the covariance effect can magnify the market value of the default losses. The optionality of default exposures can exaggerate this effect further.[9]

[8] "Wrong way risk" is a matter of special concern. Wrong way risk exists when a dealer's losses on a derivatives position increase as the value of the other assets on its balance sheet declines.

[9] See Coval, Jurek, and Stafford (2008). Their analysis of CDOs shows that the market

Although this characterization of default risk is extremely simple, it provides a very useful framework that assists in the understanding of the economic costs and benefits of alternative default risk sharing arrangements, as demonstrated in the subsequent sections.

3 Default Risk Sharing in Bilateral and Cleared Markets

In bilateral markets, default costs are borne exclusively by the defaulter's counterparties.[10] No non-counterparty is obligated to pay or assume any portion of the defaulter's obligations. In particular, if a dealer in a bilateral market defaults, other dealers bear default losses only to the extent that they have outstanding, in-the-money contracts with the defaulting dealer. They have no obligation to make payments to, or to assume obligations to, any of the defaulting dealer's counterparties.

Bilateral market participants sometimes hedge default risk exposure in the CDS market. That is, dealers often buy credit protection against their derivatives counterparties. For instance, dealer A who enters into a deriva-

price of claims that are effectively short options with considerable systematic exposure can be substantially higher their expected value would suggest.

[10]There is no necessary relation between the method of trading derivatives contracts and the risk sharing relationship. The term OTC usually indicates that these transactions are not executed on a central exchange, but are instead negotiated individually between the buyer and seller, perhaps with the assistance of a broker. Some contracts executed in this fashion are cleared; interest rate swaps traded OTC are sometimes cleared. Moreover, on some central markets, there is no central counterparty, and default losses are borne in a bilateral fashion. The Chicago Board of Trade and the London Metal Exchange both operated central markets for extended periods for executing futures transactions but did not clear these contracts. Instead, they used a default risk allocation mechanism very similar to those used in the OTC market today. (FTC, 1920).

tive contract with dealer B may purchase credit protection on B from dealer C or some other financial entity (such as a hedge fund). If dealer A buys protection on B from another dealer, B's default risk is shared among dealers; if instead A buys protection from a non-dealer, the dealer's default risk is shared with the broader financial market.

Allocation of default losses is different in a cleared market with a CCP. In particular, in a cleared market some market participants may incur default losses in excess of the losses that they would suffer on their own contracts with a defaulter. This is because a CCP "mutualizes" default risk.

Clearinghouses have been a part of the derivatives landscape for well over a century. The Minneapolis Chamber of Commerce established the first modern clearinghouse for futures in 1891, and other futures exchanges in the United States adopted clearing in the years between 1891 and 1925. One of the last futures exchanges to adopt a CCP, the London Metal Exchange, did so only in 1986.

A clearinghouse for a particular market is typically formed by a group of financial firms that supplies intermediation services in that market. These intermediation services can include brokerage or market making. A market making intermediary buys and sells on his own account to supply liquidity. A broker simply serves as an agent for the ultimate buyers and sellers. Firms that participate in a CCP are typically called members. For instance, FCMs (who supply brokerage services, and trade on their own account) are members of futures clearinghouses.[11] Large dealers are the members of

[11] All futures CCP members are FCMs, but not all FCMs are CCP members. Non-member FCMs must have their contracts guaranteed by members.

existing OTC derivatives clearinghouses, and would be the members of any CDS CCP.

As a central counterparty, the clearinghouse becomes the buyer to every seller, and the seller to every buyer, through a process sometimes known as "novation." It works as follows:

Trader S sells a contract to Buyer B. In a standard bilateral contracting relationship–like those in most over-the-counter markets–this contractual relationship endures. If B defaults on his obligation, as might occur if the losses on the contract explode because of a large and rapid decline in its price, S suffers a loss because of B's default. S had expected to receive a payment from B, but receives less than she was owed because of B's failure to perform.

Things are different in a CCP. Once the details of the contract between S and B are confirmed by the clearinghouse, the clearinghouse creates a contract to buy from S and a contract to sell to B. S still has a contract to sell, and B has a contract to buy, but the clearinghouse is substituted as the counterparty to each contract. With clearing, if B defaults, the CCP bears the loss. It draws on its financial resources to pay S what he is owed. In effect, the clearinghouse guarantees performance on the contracts it clears.

Clearinghouses almost always have members who are large trading firms, including brokerages and banks. The clearinghouses guarantee extends only to its members; non-member customers have to trade through members, who guarantee their contracts. If a customer defaults, the member through whom he clears assumes the defaulter's obligation to the member's other customers and to the clearinghouse.

The clearing members provide the financial resources for the clearinghouse to cover the losses that result from a default of another member. They do this in several ways. The members of a clearinghouse invest capital that the clearinghouse can use to cover default losses. If the members' initial investment is insufficient to cover the costs of a default, CCPs can typically require their members to contribute additional funds to cover the loss arising from a default. Thus, a CCP is a mechanism whereby financial intermediaries share default risks. It is analogous to a mutual insurance company. Default risks do not disappear, but are distributed among the other members of the clearinghouse.

As will be discussed in more detail in section 5 below, CCPs typically net exposures. Thus, if a particular firm buys and sells the same contract, the CCP nets the buys against the sells. The CCP's obligation to members and customers is limited to the net positions with the clearinghouse.

Note that in a CCP, the default losses that a member incurs are not related directly to the transactions that this member executes with the defaulting member. Indeed, a member firm can suffer default losses even if it has no net position with the clearinghouse, or if its net position with the clearinghouse is in the same direction as the defaulter (e.g., both are short.) In essence, this means that the CCP shares default losses, and effectively insures default risks through a pooling mechanism. Note too that the CCP members bear the default losses on the defaulter's entire net position. Moreover, since losses are shared among the CCP members, non-member customers bear no default losses as long as the CCP remains solvent. Thus, CCP members effectively insure the customers against default. I explore the implications of this customer insurance function in the next section.

It is important to recognize that dealer firms bear the losses from the default of another dealer under both market structures. With a bilateral OTC mechanism and no CCP, losses attributable to a dealer's default are allocated among its counterparties, who can include other dealers and non-dealers. Since dealers trade with dealers, other dealers share in the default costs that arise from the failure of a dealer. Indeed, interdealer trading dominates OTC markets. For instance, according to Bank of International Settlements data, approximately 50 percent of CDS gross market value exposures was attributable to inter-dealer positions; the figure was somewhat smaller for interest rate swaps (approximately 40 percent) and equity derivatives (30 percent).[12]

A CCP formalizes the inter-dealer default risk sharing mechanism, and severs the link between the number of transactions particular dealers execute with one another and the allocation of default losses; the dealers who are members of the CCP share default losses in shares determined by clearinghouse rules rather than by the identity of their counterparties and the volume of trading with these counterparties.

The method of "pricing" default risk deserves comment, as this subject is central to the comparative analysis presented below. In practice CCPs typically do not charge different members different fees to reflect differential default risks. Instead, CCPs price risk indirectly by choosing collateral (margin) levels and capital requirements. That is, CCPs require member

[12]Depository Trust and Clearing Corporation data show that in November, 2008, approximately 83 percent of electronically processed CDS trades were between dealers.

firms to post collateral (margins) based on the size and riskiness of their net positions. Member firms must also collect margin from their customers, and post margin with the clearinghouse to collateralize customer positions. Moreover, CCPs typically require members to make additional collateral payments if the value of their positions declines; conversely, CCPs make payments to members whose positions increase in value. This process is called "marking to market." Most CCPs mark positions to market at least daily, and sometimes intraday. Moreover, CCPs rely on current market price information to calculate these so-called "variation margin" payments.

The CCP can seize the collateral of a defaulting firm and use these monies to satisfy the defaulter's obligation on his outstanding derivatives positions.

Since the CCP is effectively a risk sharing mechanism, where the risks are not priced directly and "premiums" do not flow from one member to another, a CCP ideally sets collateral and capital levels so that the expected default cost is the same across all members. By doing so, there are no *ex ante* wealth transfers between members. Failure to do so leads to a transfer of wealth (in expectation) from one set of members to another. Systematic wealth transfers between members are not sustainable, because those that are the source of the wealth transferred to others would withdraw from the CCP mechanism.

Even though CCPs do not price default risk through insurance premia, as a convenient shorthand I will refer to the pricing of default risk by the CCP, with the understanding that this pricing is indirect through the setting of collateral.

Bilateral market participants also collect collateral from counterparties.[13] Moreover, under US bankruptcy law, firms can often seize collateral of a defaulting counterparty. Collateral mechanisms in the bilateral market are typically less mechanical and rigid than in cleared markets, and collateral payments are often the subject of (heated) negotiations in bilateral markets. Moreover, whereas CCPs typically limit collateral to cash and cash-like instruments, bilateral counterparties sometimes negotiate posting of collateral in less liquid securities.[14] Finally, counterparties in bilateral transactions can, and sometimes do, negotiate transactions prices that depend on creditworthiness. Thus, default risk can be priced into transactions in bilateral markets.[15]

4 The Effect of Clearing on the Efficiency of Risk Bearing in the Absence of Asymmetric Information

The previous section notes that clearing mechanisms provide default protection for dealers' customers (who are not members of the CCP.) Whereas the members of a CCP cover the losses arising from the default of a member-dealer, the interests of the non-members are protected as long as the CCP it-

[13]According to a survey conducted by the International Swaps and Derivatives Association, in 2007 63 percent of all OTC derivatives trades are subject to collateral agreements, and collateral covers 65 percent of all OTC derivatives exposure (ISDA, 2008). Insofar as inter-dealer exposures are concerned, the median collateral coverage in 2006 was 85 percent, and 88 percent for the ten largest dealers (ISDA, 2007).

[14]In 2007, approximately 80 percent of collateral on OTC trades was posted in cash, 10 percent in government securities, and the remainder in other instruments ISDA (2008).

[15]ISDA (1999).

self remains solvent. Thus, a CCP's members effectively insure non-members against default risk.

This risk sharing mechanism can enhance social welfare by improving the allocation of risk. Specifically, consider customers who trade derivatives to hedge against an underlying risk exposure. Hedgers, by definition, are risk averse. As a result, their marginal utility is high (low) when their wealth is low (high). A hedger trades derivatives to protect his wealth from declines. For instance, the holder of a corporation's debt suffers a loss when that corporation declares bankruptcy. By buying credit protection against this corporation, in the event of bankruptcy the hedger receives a payment that offsets in whole or in part the loss on the debt. The hedger pays for this protection in states where marginal utility would be high (in the absence of hedging) by giving up wealth when marginal utility would be low.

Default risk affects the effectiveness and value of derivatives as a hedge. A derivative is in-the-money to the hedger when the value of the underlying risk being hedged is low, and is out-of-the-money when the value of the hedger's underlying risk is high. For instance, a hedger's CDS earns a profit when the underlying credit goes bankrupt, or experiences a substantial increase in the risk of bankruptcy, but suffers losses when the firm's financial position improves. Any default by the hedger's counterparty occurs exactly when the derivatives contract would offset losses on the exposure that is being hedged. For instance, if the corporate debt hedger's counterparty were to default when the underlying credit declared bankruptcy, the hedger would not receive the full payment required to offset the effect of the decline in the price of the corporation's debt. Thus, the hedger loses from defaults precisely in the states of the world that he is seeking protection against. Moreover, these are the states in which the hedger's marginal utility is high. In this way, the possibility of default undermines the utility of a derivatives contract as a hedging mechanism.

In a bilateral market without clearing, a hedger suffers default losses whenever his counterparty defaults. In a cleared market, a non-member hedger suffers such losses on only if all of the members of the clearinghouse are collectively insolvent.[16] This occurs with lower probability in a cleared market than a bilateral one. What's more, in such a market losses conditional on default are no higher and may be lower than in a bilateral one.

An extension of the model in Section 2 illustrates why clearing reduces the losses that a customer incurs. Consider a market in which there are N dealers and M identical customers; since the customers are identical, they have identical positions with each dealer. Each dealer i has capital $\tilde{K}_i \geq 0$. Dealer i owes each customer $\tilde{v}_i^c$ on the derivatives contract. The dealer defaults if $M\tilde{v}_i^c \geq \tilde{K}_i$. If a dealer defaults, each customer receives $\tilde{K}_i$. Thus, total customer losses from default in a bilateral market are:

$$D^b = \sum_{i=1}^{N} \{M\tilde{v}_i^c - \min[M\tilde{v}_i^c, \tilde{K}_i]\}$$

In contrast, holding the customers' positions constant, the customers lose in the cleared market where the N dealers are members only if:

$$\sum_{i=1}^{N} M\tilde{v}_i^c \geq \sum_{i=1}^{N} \tilde{K}_i$$

[16]This presumes that the members' capital is committed to the clearinghouse "to the last drop." To the extent that members' obligations to the clearinghouse are limited (by something other than limited liability), the hedger suffers from a default only upon exhaustion of all of the resources that members are obligated to commit to the CCP.

In this case, default losses are:

$$D^c = \sum_{i=1}^{N} M\tilde{v}_i^c - \min[\sum_{i=1}^{N} M\tilde{v}_i^c, \sum_{i=1}^{N} \tilde{K}_i]$$

It is straightforward to prove that $D^c < D^b$. Thus, the customers receive a higher payment on a given derivatives position in a cleared market than in a bilateral one. Moreover, since these payments are received when the hedger's marginal utility is high, if dealer-members are less risk averse than the hedger, this reallocation of risk enhances welfare.

The preceeding analysis compares the hedger's default losses across market mechanisms assuming that he trades the same amount in both types of market. Of course, the fact that clearing changes the distribution of payoffs of the derivative means that the hedgers take different positions in a cleared market than a bilateral one. This, in turn, affects equilibrium prices and quantities, and the profits of dealers.

The effects of clearing on equilibrium are complicated, and difficult to analyze analytically due to the non-linearities that default risk creates. An appendix presents a formal model of the equilibrium effects of clearing, and solves the model numerically. In the model, identical agent risk averse hedgers have an endowment of an asset subject to price risk. They can hedge this exposure by selling derivatives contracts to two dealers (who act as price takers.) The dealers have risky capital, and incur increasing and convex costs; that is, their costs are increasing and convex in the size of position that they take. A dealer defaults on the derivatives contracts he buys if the value of his risky capital falls below his obligations under the derivatives contract. The hedger optimally splits his business among the two dealers.

In a bilateral market, the hedgers suffer losses from a dealer default if one of the dealers becomes insolvent. In a cleared market, the two dealers share default risk; if one dealer becomes insolvent, the other dealer absorbs the obligations of the defaulter to the hedgers. The model assumes that there are no information asymmetries regarding the contractual payoff on the derivative, or the capitals of the dealers.

Numerical solution of the model demonstrates that the adoption of a CCP causes: (a) hedgers to take larger positions, and (b) the terms of trade to change, with prices moving against hedgers (i.e., prices fall if hedgers sell derivatives.)

The intuition behind these results is straightforward. In a bilateral market, the hedger suffers losses from default in states of the world where the marginal utility of the payoff to the derivative is especially high. Clearing reduces the frequency of defaults and losses conditional on default, because (holding the hedger's total position constant) it is less likely that the CCP will default than one the dealers will. This increases the value of the derivative as a hedging instrument, and increases the hedger's demand to trade. In equilibrium, this increases the size of the hedger's position, and requires a change in prices to induce the dealers to accommodate the hedger's demand; prices fall to compensate dealers for the higher costs they incur to hold the larger positions.

Several observations are in order. First, dealer firms that combine to share default risks internalize some of the benefits of the superior risk allocation. They trade more, and obtain better prices, so their profits rise.

Second, clearing affects the distribution of default losses. The hedger suffers fewer losses from default, but *a dealer* incurs losses from another's default due to the risk sharing *via* the CCP. That is, the CCP shifts the burden of default losses from hedgers to dealers. Indeed, due to the expansion of trading activity, total default losses *rise* with clearing. Thus, clearing *creates* a contagion effect of spreading losses among dealers that is absent in bilateral markets, and affects the magnitude of these losses by increasing the scale of trading activity.

These results have implications for the incentives of dealers to form a CCP, and the systemic effects of clearing. I discuss these issues in more detail below.

5 Cost "Savings" and Redistributive Effects Arising From Netting

The analysis in the section just prior shows how clearing in the absence of asymmetric information can improve welfare, and enhance dealer profitability. Other benefits are often attributed to clearing. In particular, advocates of clearing often tout netting as a source of benefits to the formation of a clearinghouse. I show here, however, that this is not necessarily a social benefit. Netting merely redistributes wealth among a defaulter's creditors, and this redistribution does not necessarily enhance welfare.[17] Only if derivatives counterparties incur a higher cost than other creditors to bear default

[17] Section 9 discusses the implications of netting for systemic risk. There I show that netting can actually exacerbate systemic risk if the defaulter's other creditors are systemically more important than its derivatives counterparties.

risk does this redistribution improve efficiency.

Large dealers typically buy and sell the same contract in large quantities. For instance, a dealer may buy 1000 contracts and sell 500 of the same contract to different counterparties. This dealer has a net exposure of 500 long contracts.

In a bilateral market, the offsetting 500 contracts are not eliminated by netting. This has several implications. First, a firm with offsetting positions often has to post collateral on the both the purchased and sold contracts. Collateral obligations are costly because (a) they require the dealer to hold liquid instruments with lower yields than alternative investments[18], and (b) the necessity of posting collateral can constrain the ability of a market participant to implement his optimal hedging or portfolio strategy.[19] Therefore, the firm incurs a cost on the offsetting positions that could be avoided if collateral were reduced by netting out positions. Consequently, given the positions held by market participants, a CCP that nets positions economizes on collateral.

Second, netting reduces the costs of replacing defaulted positions.[20] Consider a dealer in a bilateral market who is long 1000 and short 500 contracts. Assume that the dealer defaults when the long positions are a liability to

[18] Johannes and Sundaresan (2006).

[19] Cuoco and Liu (2000), Gibson-Murawski (2007). As an example, collateral requirements have limited the ability of country elevators to offer fixed price contracts to farmers selling grain.

[20] Jackson and Manning (2006) quantify the magnitude of replacement costs under alternative settlement mechanisms including bilateral, ring-out, and netting.

him, and the corresponding 1000 short contracts are an asset to his counterparties, and his 500 short positions are an asset to the dealer. The counterparties must replace the contracts at the prevailing market price (at which the short positions they enter have zero values, and hence are neither asset nor liability.) This replacement of profitable positions is an economic loss to the victims of the default, which is reduced by whatever they realize from their claim on the assets of the defaulter. This claim is typically worth less than what they are owed on the defaulted contracts. It is important to recognize that these replacement costs are incurred on the entire gross position of 1000 contracts.

In contrast, in a cleared market, replacement costs are incurred only on the 500 net positions. Thus, clearing and netting reduces the losses that the defaulter's counterparties incur to replace the defaulted positions because fewer positions (and sometimes no positions) must be replaced. In the notation of section 2, replacement costs in a bilateral market are $\tilde{v}_i^-$, and in the CCP system are $\tilde{v}_i^d$, where $\tilde{v}_i^- \leq \tilde{v}_i^d$.

It should be noted that this "benefit" from netting is in fact a transfer, rather than a true cost savings. In the absence of netting, the non-offset "in the money" positions (in the example, the dealer's 500 short contracts) are an asset to the defaulting firm. This asset can be used to pay the defaulter's creditors, including creditors other than the derivatives counterparties. Thus, the total loss suffered by creditors does not change, although the allocation of the loss between derivatives counterparties and other creditors changes. Netting transfers wealth from other creditors to derivatives counterparties, including most notably members of the CCP.

In the context of the example, without netting shorts holding 1000 contracts must share with all the other creditors the defaulter's remaining assets, including the 500 short positions. With netting, in contrast, shorts holding only 500 contracts must share with all the other creditors the defaulter's remaining assets, which do *not* include the 500 netted short positions. Thus, in effect, netting gives derivatives counterparties a priority claim to one of the defaulter's assets, his winning derivatives positions, assets that they would have to share with other creditors absent netting.[21]

An extension of the example illustrates these points. Assume that in a default, the 1000 contracts cost the counterparties \$1 billion to replace, and hence the defaulter's 500 short contracts are worth \$500 million to the defaulter in the absence of netting. The defaulter has other assets of \$700 million, and other liabilities of \$1 billion. In a bilateral setting, the defaulter has assets of \$1.2 billion, and liabilities of \$2 billion. If the defaulter's assets are split *pro rata* among the derivatives counterparties and the other creditors, the in-the-money derivatives counterparties receive \$600 million, and hence lose \$400 million. Other creditors also receive \$600 million and lose \$400 million.[22]

[21] Various aspects of bankruptcy law also provide priorities to derivatives counterparties. For instance, derivatives counterparties are typically exempted from stays in bankruptcy, meaning that they can close out positions outside of bankruptcy procedures. Moreover, they can use close-out netting that replaces the gross contractual positions with a net position (Edwards and Morrison, 2005). Analogous to the netting model in the main text, this effectively gives a defaulter's derivatives counterparty a priority claim on some of the defaulter's assets; the defaulter's in-the-money trades with that counterparty. Moreover, derivatives counterparties can access their collateral more rapidly than other secured creditors (Bliss and Kaufmann, 2005).

[22] This analysis presumes that the price of the derivative is exogenous, and does not

With netting, the derivatives counterparties have a claim of $500 million, and the defaulter's assets are $700 million because netting reduces both assets and liabilities by $500 million. *Pro rata* division of the defaulter's assets results in a payment of $233.3 million to the derivatives counterparties, meaning they lose $266.7 million. The other creditors receive only $466.7 million and lose $533.3 million. Although netting makes the derivatives counterparties better off, it makes the other creditors worse off by the exact same amount.

Thus, netting effectively transfers wealth in a default from a defaulter's other creditors to its derivatives counterparties.[23] In the example, netting redistributes $133.3 million from other creditors to the derivatives counterparties. Reductions in replacement costs therefore do not reduce social costs, unless (a) frictions, related perhaps to systemic risks, or (b) differences in the risk aversion of different classes of creditors, imply that giving one set of claimants priority enhances welfare.[24] I discuss the systemic risk issue

depend on the number of positions that must be replaced. It is possible that netting affects prices by reducing the number of contracts to be replaced. I discuss the implications of this in Section 9 below.

[23]In an appendix I prove that this is a general result under *pro rata* distribution of the defaulter's assets.

[24]As noted above, close-out netting also gives derivatives counterparties a priority claim in bankruptcy. Moreover, the existence of close-out netting effectively reduces the position and replacement cost reductions resulting from netting through a CCP. A CCP reduces net exposures in the event of a default only to the extent that they are not already reduced by close-out netting. If the defaulter's positions with each counterparty are on the same side of the market (i.e., he is net long or net short to each counterparty), multilateral netting does not reduce positions (and therefore replacement costs) any more than close-out netting. If the defaulter is net long with some counterparties, and net short with others, replacement costs are lower under multilateral netting through a CCP than under close-out netting.

further below.

In sum, netting by a CCP benefits its members by (a) reducing collateral, and (b) reducing replacement costs. The important phrase in that last sentence is "its members." It is important for two reasons. First, these are private benefits that these firms will presumably take into consideration when evaluating the net benefits to them of cooperating to create a CCP. Second, since one of the benefits to a CCP's members is actually a transfer from other creditors, dealers may have an *excessive* incentive to form a clearinghouse.[25]

The considerations discussed above are commonly advanced to support the formation of a CCP. The fact that CCPs are not ubiquitous suggests that these are not the only factors that determine the relative costs and benefits of alternative default risk sharing mechanisms; if they were, dealers would fall over themselves to create a CCP.

[25]The analysis in the text assumes that dealers' other liabilities and the pricing thereof do not change when they form a CCP. In reality, of course, the change in priority inherent in the formation of a CCP will induce the dealers' creditors to price their loans differently as the CCP members' existing loans mature. Since a CCP essentially reduces the seniority of dealers' other lenders, they will demand a higher interest rate or impose other contractual terms that make this debt costlier to the dealers. This offsets the other creditor's losses in default states by increasing their payoffs in non-default states. Since the repricing process takes time, however, due to the longer maturities of some of the dealers' debts, formation of a CCP increases dealer equity at the expense of the dealers' other lenders. The magnitude of this transfer depends on the maturity structure of the dealers' debt. Very short term debt is unlikely to be affected substantially, as it can be repriced rapidly, and a default is less likely to occur before repricing short term debt than for longer term debt. Thus, the formation of a CCP effectively transfers wealth from dealers' longer term creditors to the dealers' equity holders. These transfers are larger, the weaker the dealers' financial position–as is the case today.

6 Other Distributive Effects of Clearing

Clearing can have other redistributive effects. In particular, as noted above, in a bilateral market, a dealer suffers from another's default only to the extent that he is a counterparty of the defaulter. In a cleared market, a dealer who is a member of the CCP bears a share of the default losses on the the defaulter's entire net position. This occurs because the CCP members assume all of the derivatives obligations of the defaulting member, including his obligations to non-members.[26] Thus, as noted above, clearing can lead to a redistribution of default losses (relative to the distribution in a bilateral market) to dealer-members from non-members. Indeed, this effect can more than off-set the effect of netting, meaning that non-defaulting dealers who belong to a clearinghouse can suffer larger losses from a default of a dealer-member in a cleared market than they would suffer in a bilateral market, even when netting is taken into account.

Another example illustrates this point. Consider dealer D. This firm has a net short position of 10,000 contracts. D has bought 2,000 contracts from other dealers, and sold 4,000 contracts to other dealers. It has bought 2,000 contracts from non-dealers, and sold 10,000 contracts to these parties.

If D defaults, in a bilateral market other dealers incur replacement costs on 4,000 contracts. The non-dealer counterparties incur replacement costs on 10,000 contracts. Now consider the situation in a cleared market where

[26]This implicitly assumes that the dealer-member's default is not accompanied by a default in its customer account. A default in the customer account can be covered in part by the margins on the member's customer account. As a result, some of the burden of the default falls on the non-defaulting customers of the defaulting member. See Chambers-Morgan (1991).

the dealers are members of the CCP, and the non-dealers are customers of these members. In this case, the non-defaulting dealer-members assume D's derivatives obligations. Thus, they incur replacement costs on the entire 10,000 contract net position of D. That is, the CCP insures nonmembers against a member's default. This tends to increase the costs that dealers incur as a result of a default.

In the example, the additional replacement costs incurred as a result of the non-defaulting dealers' obligation to non-members is larger than the reduction in replacement costs on dealer positions due to netting. Due to netting, the replacement costs on other dealer positions in the CCP is incurred on 2,000 contracts, rather than 4,000, implying a 50 percent reduction in replacement costs on dealers' proprietary positions. However, the member-dealers must incur the replacement costs on the non-members' 8,000 contract net position. Total member-dealer replacement costs increase by 2.5 times, as in the cleared market member-dealers must replace 10,000 contracts instead of 4,000. This occurs because the additional replacement obligation incurred to non-members in a cleared market is larger than the reduction in replacement cost on dealer proprietary positions that results from netting.

This analysis, and that in the previous section, demonstrate that *holding positions constant* the formation of a CCP redistributes dealer default losses. It does not reduce the total losses, but does affect the distribution of these losses. A CCP reduces the burden of a dealer default on the defaulter's derivatives counterparties, but increases the burden borne by his other creditors. Moreover, it can increase the burden borne by dealer-members and reduce the default costs that fall on non-dealers (i.e., firms that are not members of the clearinghouse). This last result means that the formation of a clearinghouse can actually increase dealer-members' counterparty exposure to other dealers. The analysis of section 3 identifies potential benefits from this allocation of risk, but it may also affect systemic risks. I discuss this possibility in section 9 below.

7 The Effects of Asymmetric Information on the Cost of Sharing Default Risk in a CCP

7.1 Introduction

The analysis of section 5 demonstrates that in the absence of asymmetric information, the formation of a CCP can improve welfare by improving the allocation of default risk. However, all risk sharing mechanisms are potentially vulnerable to asymmetric information. When evaluating the costs and benefits of alternative methods for allocating default losses, it is important to consider their susceptibility to information asymmetries because they give rise to real costs. If large enough, the costs arising from asymmetric information can make it inefficient to allocate default losses through a clearinghouse.

The discussion in section 2 provides a useful framework in which to analyze information asymmetry. Recall that the analysis there showed that default risk exposure arose primarily from position risk and balance sheet risk. I analyze each in turn.

7.2 Instrument Complexity and Asymmetric Information

First consider the issues relating to information asymmetries regarding the risks of a particular type of instrument. To price risk, a CCP uses information on (a) the risk-return characteristics of this instrument, and (b) the current price/value of the instrument. Given the current value of the instrument, and holding the (true economic) capital of a member firm constant, the likelihood of default depends on the probability distribution of returns on the instrument and the size of the position. Therefore, risk pricing (margin setting) depends on information regarding the price behavior of the instrument. Moreover, information about the current price of the instrument is important. A CCP uses an estimate of market price to adjust collateral. Using an incorrect price leads to an incorrect estimate of the gain or loss on a position, and therefore to an incorrect determination of the risk exposure, and relatedly, the collateral level.

For homogeneous, linear, traditional instruments traded in liquid, transparent markets, a CCP is likely to have information on these variables that is nearly as good as, and perhaps better than, that in possession of its members. For an actively traded instrument (e.g., S&P 500 futures), transactions are numerous and observed, so positions can be marked to current value with no difficulty. Moreover, extensive historical data is readily available to calibrate risk models, and advanced mathematical modeling ("rocket science") is not necessary to estimate these risks. Thus, for such instruments, centralized clearing is unlikely to face severe adverse selection problems, and risks can be priced correctly. One would expect to observe central clearing for such instruments–and one does.

Things are quite different for exotic instruments. These instruments are traded less frequently, and so current market price information is harder to come by. Indeed, at times, there may be no transactions, so it is necessary to "mark-to-model" rather than "mark-to-market." Moreover, sophisticated modeling is necessary to quantify and understand the risks of these instruments.

This pricing complexity is likely to be an important issue for credit derivatives, especially on individual names. The products are relatively new. Often they are not traded in high volumes in liquid transparent markets. Marking to market is not a trivial exercise as a result. Moreover, understanding the risks of these contracts is difficult. This is particularly true for portfolios of these instruments, due to the potential for default dependence between different names (i.e., the unconditional risk of default of a single name is not sufficient to determine the risk posed by a CCP member with positions in multiple instruments; the modeler needs to know about the correlations across instruments, and these dependencies are especially tricky to model and calibrate with credit products).

The risk characteristics of CDS products are also complicated due to the skewness in their price movements. The price of a bond of a company nearing default can fall precipitously; similar price increases are unlikely Thus upward spikes in the cost of protection (corresponding to downward spikes in the value of position held by a protection seller) are more common than downward spikes.

Big dealer firms specialize in developing models designed to quantify and characterize these risks. Moreover, these dealers expend resources to develop the data to calibrate and test these models. They have strong incentives to develop good models, because with better models they can manage their own risks better. Importantly, a better model allows a dealer to manage *both* price risks and default risks more effectively. Moreover, a dealer with a good model can generate higher trading profits because of his information advantage in valuing these instruments. That is, a dealer realizes a variety of benefits from investments in rocket science pricing methods, and what's more, internalizes these benefits.

In contrast, a CCP does not trade on its own account, and hence cannot realize higher trading profits from devising a better model. Moreover, since clearinghouses have zero net positions in every instrument, they face no direct price risks, only default risks (that reflect price risks only indirectly.) Thus, a CCP only benefits from a better model to the extent that this allows it to price and manage default risks more accurately, whereas a dealer that engages in proprietary trading uses models to manage price and default risks, and generate trading profits.

Even with respect to building a better model to manage default risks there is a potential problem; since the CCP is an agent of a group of member firms, a better model is effectively a public good that generates benefits for all the members collectively. Collective action problems can weaken the incentive of the CCP to develop a better model. In contrast, a better model is largely a private good for a dealer. Therefore, it is highly likely that for a product like CDSs, dealer firms that engage in proprietary trading of these instruments will have better models and better information than a CCP. It has stronger incentives to develop a more accurate model.

This is not to say that these models are accurate or precise in some absolute sense. Indeed, some dealer models have failed miserably. The key issue in risk sharing is asymmetry, which depends on the relative quality of information. If a CCP member has a better model than the CCP, there is an information asymmetry problem, even if the former's model is very inaccurate. The point is that the one eyed man is king in the land of the blind; if the dealer has a more precise model than the CCP, he is the one-eyed man and has an advantage over the blind CCP.

For an illustration of the problems associated with third party attempts to evaluate the risks of heterogeneous, complicated, non-linear derivatives, consider the credit rating agencies' disastrous experience with CDOs, and monoline insurers. It is widely acknowledged that the agencies' models were extremely deficient.

Thus, it is almost certainly the case that for exotic derivatives, and for CDSs in particular, dealer firms that make markets in these products have much better information about their values and risks than would a CCP. This creates the potential for adverse selection, which reduces the benefit of default risk sharing through a CCP. Dealers with better information on the value and risks of a particular instrument, or portfolio of instruments, can identify risks that the CCP misprices. It can trade the underpriced risks more intensively, and the overpriced ones less intensively. As a result, the CCP will suffer greater default losses than it anticipates. The CCP has to adjust prices (collateral) as a result. Due to the information asymmetry, the equilibrium prices that the CCP charges (its equilibrium collateral levels) diverge from the the first-best prices, leaving the better informed dealers with an information rent, and distorting the level of trade.

The severity of adverse selection also depends on CCP policies regarding the derivatives it clears. Futures exchanges typically require all of the products they trade to be cleared. In contrast, at least one OTC CCP, SwapClear, gives dealers the option to choose the trades to submit for clearing. This gives dealers the ability to clear trades when the CCP underprices the default risk, and to hold onto trades when the CCP overprices it.

7.3 Balance Sheet Risks and Asymmetric Information

Now consider dealer balance sheet risk. There is a substantial potential for asymmetric information about this risk as well.

The big dealer firms that (a) are the primary intermediaries in exotic derivatives and CDS products, and (b) would be the members of any OTC derivatives clearinghouse, are very complex financial firms with relatively opaque balance sheets. They are in the business of providing information-intensive intermediation, through their loans, investments, and trading. As a result of this information intensity, it is challenging for third parties to appraise their balance sheets, and quantify the risks associated with those balance sheets. It is certainly the case that the intermediaries (banks and investment banks and in some cases insurance companies) have better information than third parties about the value of the assets and liabilities on their balance sheets, and the risks of those assets and liabilities-including the correlations between those asset and liability values and the values of derivatives positions on its books.[27]

This means that if a CCP's members are complex dealer firms engaged in information-intensive intermediation, the potential for asymmetric information about balance sheet values is acute. This can lead to both adverse selection and moral hazard.

Indeed, balance sheet risks pose particularly severe challenges to a central clearing arrangement. Traditional CCPs typically do not vary risk pricing (i.e., collateral levels) to reflect the balance sheet risks specific to each member firm. CCPs ordinarily set collateral levels based on the risks of the instruments held in each members portfolio of cleared products, and two members with the same portfolio would post the same collateral even if their balance sheet risks are quite different.[28] CCPs do impose some constraints on balance sheets, but normally through capital requirements that are simply a function of collateral levels. For instance, the CME clearinghouse sets minimum member capital equal to a multiple of the member's margin level. Importantly, it does not vary capital requirements or collateral levels based on assessments of the balance sheet risks of member firms. Thus, in most CCPs balance sheet risks are not priced.

This presumably reflects a prohibitively high cost to the CCP of evaluating, monitoring, and pricing these risks. This, in turn, almost certainly results from prohibitive costs for CCPs to obtain information on these risks.

[27]Again, it is not absolute accuracy that matters. Relative precision is important.

[28]Some CCPs base collateral on credit ratings, but since there is potential for asymmetric information between dealers and rating agencies, this does not eliminate the asymmetric information problem.

It is also likely a mechanism to limit influence activities and thereby reduce governance costs. A CCP that discriminates among members on the basis of inevitably subjective evaluations of balance sheet risk is vulnerable to the attempts of members to influence it to advantage their competitive position, and to disadvantage those of competitors who are members. Such influence activities raise the cost of managing and governing the CCP, which can avoid these costs by committing not to differentiate among members.[29]

This may not be a big problem when CCP members are relatively simple-and relatively homogeneous-firms with relatively simple and transparent balance sheets, as once was the case on many futures exchanges. Where they are complex and heterogeneous, however, the lack of balance sheet risk pricing is problematic.

There is evidence of heterogeneity in the balance sheet risks posed by dealer firms. The CDS prices of dealers can exhibit considerable dispersion. This reflects differences in dealers of the likelihood and/or magnitude of dealer default losses, and/or differences in the systematic component of default risks across dealers.

CCPs could mitigate this problem by adjusting collateral levels to reflect CDS prices on member-dealers. This would introduce some balance sheet risk-sensitive pricing. Even so, the CCP would still potentially be operating at an information disadvantage relative to dealer-members. Member firms can observe their own CDS prices, but have additional private information about their balance sheet risks. Moreover, CCP members would

[29]This analysis implies that it is less costly to form a CCP when members are homogeneous, than when they are heterogeneous.

have an incentive to attempt to influence *how* the CCP uses CDS prices to set collateral, in order to advantage themselves and disadvantage their competitors. Nonetheless, conditioning CCP collateral levels on the CDS prices of member firms would improve risk pricing.

Asymmetric information about balance sheet risks, and the consequent potential for the mispricing–or no pricing at all–of these risks again creates adverse selection and moral hazard problems. A dealer that realizes that the collateral requirement established by the CCP effectively underprices its balance sheet risks has an incentive to trade cleared products more intensively. Furthermore, the lack of pricing of balance sheet risks encourages dealers that are members of CCPs to take additional risks on to their balance sheets. Again, in equilibrium, to survive the CCP must distort risk prices relative to the first-best price to combat these problems. This induces an inefficient level of trade and generates welfare losses. Moreover, the creation of a CCP induces market participants to consider member firms as nearly homogeneous (or at least, more homogeneous than is the case absent a CCP) because regardless of whom they trade with initially, the CCP is the ultimate counterparty.[30] This tends to allow high balance sheet risk firms to expand their trading activity at the expense of lower balance sheet risk firms thereby distorting the allocation of trades and positions across dealers with different balance sheet risks.

Dealers also are likely to possess better information about the risks that their customers pose than a central clearer. This is particularly true for

[30]Bliss and Steigerwald (2007).

exotic products, in part because of the dealer's information advantage discussed above. But moreover, especially for these products, dealers work with customers in the design and marketing of these products. As a result of this interaction, dealers learn about (a) the balance sheet risks of the customer, and (b) the interaction between the risks of the instrument and the customer's balance sheet. For instance, a dealer that works with a customer is more likely to understand whether a particular instrument is a hedge for other balance sheet risks, and the effectiveness of that hedge, than a third party CCP.

7.4 Summary

Information asymmetries can arise with respect to both position risks and balance sheet risks. Large, sophisticated dealer firms that are members of a CCP are highly likely to have better information about both risks than a CCP. This information advantage on position risk is greater, the more complex the instrument. It may be especially large for portfolios of CDS products given the challenges in modeling dependence across instruments. Moreover, members' information advantages regarding their own balance sheet risks are greater, the more complex and opaque are their assets and liabilities. Since most sophisticated dealer firms that trade CDS products are highly complex financial institutions with opaque balance sheets, balance sheet risk asymmetries are likely to be substantial for a CDS clearinghouse.[31]

[31]Futures clearinghouses are facing similar issues. Historically, most futures CCP members were specialized futures brokerage firms with relatively simple operations and balance sheets. In recent years, however, large banks and investment banks have come to dominate futures clearinghouses. According to CFTC data, banks and investment banks are

Information asymmetries give rise to real costs that typically make it inefficient to share risks as completely as would be optimal in the absence of such asymmetries. Controlling the costs associated with these forms of opportunistic behavior requires distortions in the pricing of insurance relative to the first best prices that would prevail under complete information.

The costs arising from asymmetric information may differ across risk allocation mechanisms. Therefore, determination of the efficient mechanism for allocating default risks requires a comparision of these costs in cleared and bilateral markets. I make this comparison in the next section.

8 A Comparative Analysis of Centralized and Decentralized Default Risk Sharing

The problem of the comparative costs of bilateral and multilateral default risk sharing is a multi-faceted one, but I will focus on two issues that are of primary importance. The first is the issue of monitoring and pricing of balance sheet risks.

The severity of information asymmetries regarding balance sheet risks can differ across default risk allocation mechanisms. In bilateral markets (a) dealers expend resources to evaluate the balance sheet risks of their counterparties, and (b) charge different prices for risks to different counterparties by establishing different collateral requirements for different counterparties,

the largest FCMs as measured by customer margin monies held. Thus, whereas balance sheet risks and asymmetric information about these risks were once arguably less serious concerns for futures clearinghouses, the dominance of complex intermediaries with opaque balance sheets presents futures clearinghouses with problems like those described in the text.

and sometimes charging different counterparties different transaction prices to reflect different default risks.[32] Since dealers trade extensively with other dealers, and internalize default losses, they have an especially large incentive to evaluate the creditworthiness of dealer counterparties, and price risks accordingly. That is, dealers face high powered incentives to mitigate default losses. The opportunity to hedge balance sheet risks of counterparties through the purchase of credit protection also provides information to price counterparty balance sheet risks more accurately.

In a cleared market, the CCP is responsible for evaluating the balance sheet and product specific risks of each member firm. That is, there is a centralized risk evaluation and risk pricing mechanism. It should be noted, furthermore, that the CCP is an agent of multiple principals (its members). Thus, with a CCP monitoring is delegated via a common agency mechanism. In contrast, in a bilateral market, each dealer firm makes individualized assessments of the product specific and balance sheet risks posed by each counterparty, including most notably other dealers.

The quantity of information, the capacity and incentive of market participants to collect and analyze it, the symmetry of its distribution, and the ability of parties to price risk conditional on this information differs between bilateral and cleared market structures. These differences affect the relative costs and benefits of these alternative structures.

Centralized monitoring has one clear benefit: there is no duplicative monitoring. Each dealer is evaluated once. In contrast, in a bilateral market,

[32] ISDA (1999).

each dealer assesses and monitors every other dealer, meaning that for N dealers there are 2^N monitoring costs incurred.[33] Note that member-dealers internalize savings in monitoring costs, and therefore take this savings into account when evaluating the costs and benefits of forming a CCP.

However, decentralized monitoring likely has substantial benefits when complex financial institutions trading complex products are involved; the dealer-monitors in a bilateral market have better information, and a stronger incentive to collect it, than a CCP. This is true for several reasons.

For one, dealer firms interact with one another in many markets, and have various sources of hard and soft information about the balance sheet risks of their counterparties. This information is almost certainly superior to what a clearinghouse can collect (which is mainly limited to what can be obtained from financial statements) because (a) as information-intensive intermediaries, the dealer firms specialize in collecting and evaluating information on creditworthiness and balance sheet risks, and (b) the dealers have a wider variety of sources of information. This suggests that counterparties in a bilateral market have more information about counterparty balance sheet risk, and superior ability to analyze and process it, than a CCP. This is particularly the case for dealers. This implies that dealers are at less of an information disadvantage when evaluating counterparty risk than the CCP.

Moreover, due to the complexity of the balance sheets of the big dealer firms, any individual dealer's assessment of the balance sheet risks of another is likely noisy. That is, monitoring is inherently imperfect, and monitors

[33]This virtue of centralized monitoring by a CCP is emphasized by Baer, France, and Moser (1995). On delegated monitoring more generally, see Tirole (2006).

collect noisy signals. Multiple signals are more precise than a single one. Therefore, monitoring by multiple counterparties generates information that is likely to be collectively more precise than the information collected by any one–including a CCP. If this information can be aggregated in some way, multiple counterparty risk assessments in a bilateral market can be more efficient than a single risk assessment by a CCP.

The mechanism for aggregation is a complicated subject. The CDS market itself can aggregate information. Dealers have the opportunity to trade CDS contracts on other dealers for both speculative and hedging purposes, and can use their private information when making their trading decisions. In this way, CDS market prices reflect dealer private information about the balance sheet risks of other dealers, and aggregates this information. This facilitates more accurate pricing of balance sheet risks.[34,35]

Dealers and a CCP also face different incentives to monitor. The dealer firms internalize the benefits of the counterparty risk information they collect, whereas the information a CCP collects is a public good to all its members. Moreover, as for-profit entities with employees that are typically

[34] The existence of a CDS market can also encourage other parties to collect information on dealer creditworthiness, and use this information to trade in the CDS market. In this way, CDS prices reflect other parties' private information about dealer balance sheet risks. Dealers can utilize this information when pricing their counterparties' balance sheet risks.

[35] Another aggregation mechanism is observing the actions of other dealer firms. Dealers will make inferences from the actions of others. If dealer A cuts back on trading with B, or decides not to trade with B altogether, dealers C, D, etc., will make inferences about A's information regarding B's performance risk. In this way, information collected by one dealer that affects its actions in a way that can be observed by other dealers is communicated to these other dealers. One issue that deserves study is whether this aggregation method encourages information cascades that can lead to inefficient outcomes.

compensated through highly performance sensitive contracts, dealer firms are subject to high powered incentives.

In contrast, (a) theory predicts that a delegated common agency monitor such as a CCP should be subject to low powered incentives, and (b) the observed organization of CCPs is consistent with this prediction. The agency literature shows that incentives are typically low powered when (a) agents engage in multiple, imperfectly measurable tasks (with some tasks easier to measure than others)(Holmstrom-Milgrom, 1991), and/or (b) there is a substantial time lag between the agent's effort and its observed effect (Laffont-Tirole, 1993), and/or (c) an agent has multiple principals with potentially divergent objectives (Dixit, 1996; Martimort, 1992, 1995).

These conditions characterize a CCP. A CCP typically multi-tasks: it monitors multiple markets, calculates and collects collateral, conducts audits of member firms, invests in information technology, and so on. Some of these tasks are relatively easy to measure, e.g., whether the CCP calculates collateral correctly and ensures its prompt collection. Others are more difficult to measure precisely, e.g., the quality of audits or the efficiency of an IT upgrade. Moreover, for a firm of a given financial condition, the time to default is random. A poorly monitored firm may default soon, but it may default later, or may not default at all. Therefore, to the extent that the occurrence of a default provides a signal on monitoring quality, there is a long and variable lag between an agent's effort to monitor and the observation of the quality of that effort. In addition, a CCP is an agent of the multiple dealer-members. Furthermore, as competitors these dealers have conflicting interests; each would prefer that the common agent, the CCP, monitor others more aggressively. Moreover, if the CCP clears multiple markets, and member firms have differing exposures to these markets, these members may have divergent interests as to where the CCP should direct its resources. All of these factors make it costly to utilize high powered incentives, and make it desirable to subject the CCP to low powered incentives instead.

Observed CCPs are indeed typically subject to low powered incentives. Many operate as cost centers, rebating any surplus in fees in excess of costs back to their members. Some are formally organized as non-profit firms. Interestingly, after operating for some years as a for profit firm, the large clearing firm LCH.Clearnet is returning to the non-profit form after its merger with DTCC.

It should also be noted that the formation of a CCP reduces the incentives of any dealer to monitor other dealers even if a mechanism exists to transfer this information to the CCP. Each dealer bears the entire cost of its monitoring effort, but if the information it produces is transferred to the CCP, the members benefit collectively. This positive externality from monitoring tends to reduce monitoring efforts in a CCP market. Thus, one would expect that in a bilateral market there is more extensive monitoring of dealer default risks, and that especially in the presence of an aggregation mechanism, counterparties have more precise information about dealer default risk than would be the case with a CCP. [36]

[36] To the extent that private signals on balance sheet risk in a bilateral market are aggregated in CDS prices, there is also a free rider problem that reduces the incentive to monitor. Thus, there is a tension between information aggregation and free riding due to trading of CDS contracts on dealers. Moreover, dealers who hedge derivatives counterparty risk through the CDS market have weaker incentives to monitor.

The foregoing considerations suggest that information on balance sheet risk is more precise, and more symmetrically distributed, in a bilateral market than a cleared one. Dealers have a comparative advantage in monitoring other dealers, and a stronger incentive to engage in monitoring. Thus, dealers should have better information about balance sheet risks than a CCP, and consequently the information asymmetry problem is likely to be less severe in a bilateral market.[37]

This is particularly important because dealers in bilateral markets can-and do-charge counterparty-specific prices for balance sheet risk. Thus, they can utilize their superior information to price default risk more accurately than a CCP that (a) has poorer information, and (b) typically does not price balance sheet risks in any event.

Specifically, dealers in a bilateral market require different counterparties to post different amounts of collateral, where variations in collateral levels and transactions prices across counterparties reflect both product-specific risks and the particular balance sheet risks of each counterparty.[38] This

[37]It is interesting to note that centrally cleared markets do not centralize the monitoring of customers, but instead utilize mechanisms similar to those in bilateral markets. Each clearing member has discretion over the margin it charges the customers it clears for (subject to clearinghouse-mandated minimums.) Thus, clearing members can charge different customers different risk prices, and as a consequence can price their customers' balance sheet and position risks. Moreover, a clearing member bears the losses from any default by his customers. These arrangements are essentially identical to those found in bilateral markets. This provides evidence that the cost of mutualized default risk sharing can exceed the cost of bilateral allocation of default risk due to differences in information costs, monitoring costs, and incentives across mechanisms.

[38]In an OTC bilateral market, firms can adjust transaction prices to reflect counterparty risk, and limit their exposure to individual counterparties based on credit risk considerations (ISDA, 1999).

mechanism tends to induce an allocation of trading activity across dealer firms that reflects their relative riskiness. High balance sheet-risk firms incur higher collateral costs, which tends to reduce their trading activity, thereby lowering the positions held by the firms most likely to default due to adverse balance sheet shocks.

In contrast, for a given cleared position, in the absence of balance sheet risk pricing (as in a CCP), high balance sheet-risk dealers do not incur higher collateral costs than lower-risk dealers. This tends to distort the allocation of trading activity among dealers, and allows higher risk firms to carry larger positions, thereby magnifying default risks.[39] Put differently, a CCP prices default risk as if all members are homogeneous, when in fact they are not necessarily so. Although this imposed homogeneity can contribute to liquidity, it misprices balance sheet risks and tends to encourage greater trading by less creditworthy firms.

Thus, a variety of considerations suggests that the costs of evaluating and pricing balance sheet risks are lower in bilateral OTC markets than centrally cleared ones, especially when the intermediaries are complex firms engaged in information-intensive intermediation.

The second issue that deserves attention is the complexity of the instruments traded, and the resulting potential for asymmetric information. I noted before that dealers were likely to have advantages over a clearing-

[39] As noted above, a CCP that uses CDS pricing information to set collateral levels could mitigate this problem. However, since the socialization of default risk through a CCP tends to reduce the incentives to monitor and collect information about dealer creditworthiness, CDS prices are likely to be less informative in a cleared market than a bilateral one.

house in valuing, and assessing the risks of, complex derivatives because the former specialize in using the most advanced quantitative techniques to analyze these instruments. If all dealers both invest in specialized valuation tools, the potential for information asymmetry is reduced accordingly.

To summarize, a comparative analysis suggests that sharing default risks as is done on bilateral OTC markets offers certain efficiency advantages over centralized default risk sharing through a CCP for (a) complex products traded on relatively illiquid markets, that (b) are traded by opaque firms specializing in information-intensive intermediation. Information asymmetries are acute for complex products traded by firms with complex balance sheets that are opaque due to the information intensity of their intermediation activties. In particular, clearinghouses almost certainly face more severe information disadvantages when attempting to evaluate the default risks posed by complex dealer firms trading complex derivative products, than dealers face when evaluating the default risks of other dealer counterparties.

An important reason for this conclusion is the information asymmetries that arise from the balance sheets of other forms of information-intensive intermediaries. This analysis raises the question of whether it is efficient to bundle the trading of these instruments with the supply of information-intensive intermediation. Big commercial and investment banks with opaque balance sheets (due to the information intensity of their various financing and trading activities) pose greater balance sheet risks than would simple, "vanilla" intermediaries that specialize in making markets in these derivatives and eschew other activities. Thus, one way to reduce the costs of centrally clearing complex derivatives would be to trade them through simpler firms that do not engage in a broad range of information-intensive intermediation activities.

Vanilla intermediaries are not observed in the markets for complex derivatives products.[40] This is likely due to the existence of scope economies between trading complex derivatives like CDSs and offering other forms of financial intermediation. After all, banks specialize in evaluating credit risk, and the resources and skills used to do this in lending and securities underwriting, can be put to use in valuing and assessing the risk of derivatives, and most particularly, credit derivatives. Moreover, there are scope economies in modeling and risk evaluation. Models, human capital expert in the creation and use of models, and computational resources needed to implement models can be utilized across a variety of different products. For instance, resources used to evaluate credit risk in commercial lending and price commercial loans can also be used to evaluate the pricing of credit derivatives. Furthermore, information generated in other intermediation activities (including interactions with other dealers) can be used to appraise counterparty risk. Thus, a strong case can be made that bundling of intermediation of complex derivatives (and especially credit derivatives) with the supply of other information-intensive financial intermediation activities is efficient. The existence of scope economies implies that it is costly to re-

[40] In the 1990s several major derivatives dealers created AAA rated, bankruptcy remote "derivatives products companies." These entities were seperately capitalized derivatives market making subsidiaries of major dealers. The intent behind creating them was to isolate derivatives counterparties from the balance sheet risk of the major dealers. However, this innovation did not flourish.

strict trading of these products to simple, focused firms that do not engage in a variety of intermediation activities.

9 Systemic Risk

Regulators in the US and Europe are exerting strong pressure on major CDS market participants to create a CCP for these products. The regulators believe that bilateral risk sharing mechanisms pose systemic risks, and that a CCP would reduce these risks. For instance, the SEC's Eric Sirri testified before Congress that "[t]he default of one major [CDS market] player therefore impacts not only the financial health but also the market and operational risks experienced by market participants distant to these transactions" (Sirri, 2008).

There is no uniformly accepted definition of "systemic risk."[41] The various treatments of systemic risk all posit, however, that the failure of one financial institution can impose an externality on other financial institutions, or on the economy more broadly.[42] For instance, a large dealer's default on its derivatives contracts can impose financial costs on its counterparties, and if these costs are sufficiently large these institutions may fail as well. Failure may result in deadweight costs (e.g., the costs of bankruptcy). Similarly, default losses that impair the capital of a defaulter's counterparties

[41] Edwards and Morrison (2005), Schwartz (2008).

[42] Allen and Gale (2007), however, argue that systemic crises can be efficient and can occur in complete markets economies. Thus, although it is conventional to assert that major banking or financial crises are axiomatically inefficient, this is not necessarily the case.

can cause a decline in liquidity in financial markets. In the extreme, if many dealer firms were to suffer large losses from the default of a dealer, in the presence of asymmetric information, markets for credit could freeze. This could threaten the viability of the payments system, or at the least impair the operation of this system. The payments system is vital to the efficient operation of the financial and real sectors of the economy (Telser, 2008), and derivatives dealers are unlikely to take into account the systemic effect of a derivatives default on the payments system. Therefore, externalities that result from defaults in a bilateral market *could* provide a rationale for mandated clearing of CDS contracts (and perhaps other OTC derivatives).

I say *could* because there are many channels by which formation of a CCP affects systemic risk, and some of these tend to *increase* systemic risk. It is not self-evident, therefore, that clearing of CDS contracts necessarily reduces systemic risk.

The primary argument advanced to support the contention that clearing reduces systemic risk emphasizes the effects of position netting. As noted above, *given the size of derivatives positions held by dealers,* netting reduces replacement costs, and therefore reduces the losses that *derivatives counterparties* suffer as a result of the default of a dealer. From this it allegedly follows that the CCP reduces the likelihood that the failure of one large derivatives market participant will cause the failure of other large financial instutitions.

But the conclusion does not follow, for a variety of reasons. This argument does not explore the implications of the fact that even holding position size constant, netting results in a redistribution of default losses, not a reduction in their total amount. Nor does it consider the redistributive effect that results from a CCP's assumption of a member-defaulter's net exposure to non-members. Nor does it consider the possibility that the adoption of clearing will affect the sizes of the positions that firms take (due to effects on hedging demand, and changes in collateral, the distribution of default losses, and the pricing of default risk). Nor does it consider the effect of a CCP on the allocation of trading activity among dealers of differing risks. Nor does it explore whether a CCP encourages firms to take on additional balance sheet risks (due to mispricing of this risk). Nor does it recognize the effects of the formation of a CCP on the incentives of counterparties to monitor dealers.

First consider the fact that netting affects the distribution of losses among a defaulting dealer's creditors, not the total magnitude of the loss (holding positions constant). Netting through a CCP reduces the replacement costs derivatives counterparties incur from another's default, but this reduction is offset dollar for dollar by additional losses suffered by the defaulter's other creditors. For instance, under netting, default of a large dealer imposes larger losses on its repo counterparties; its counterparties in non-cleared derivatives; and its lenders than they would suffer from a default absent netting. To the extent that other creditors are financial institutions whose failure could pose systemic risks, it is not necessarily true that it is better to shift the burden of default from dealers to other creditors. A CCP might save dealers, but bankrupt others. These bankruptcies could have a larger external effect than the bankruptcies of dealers avoided by netting.

This argument presumes that the prices and values of derivative contracts in the event of a dealer failure are the same with or without netting. It may be the case that the replacement in a short period of time of a large number of contracts affects prices; for instance, the efforts of protection buyers to replace defaulted CDS contracts could temporarily drive up the cost of protection, especially in an illiquid market.[43] In a bilateral market, this temporary price change would impose additional costs on those replacing defaulted contracts, but the defaulter's other creditors would not benefit on his offsetting positions unless the defaulter trades at these distorted prices.[44] Since (a) the number of contracts replaced in a bilateral market without complete netting is larger than the number replaced with netting in a CCP, and (b) it is plausible that temporary price effects are greater, the larger the number of contracts replaced, it is also plausible that netting would mitigate the price impacts arising from default.

This effect does not necessarily give rise to an externality that dealers would ignore when weighing the costs and benefits of a CCP. To the extent that dealers are counterparties who must replace contracts at disadvantageous prices, they internalize this cost. Moreover, even though non-dealers may incur these exaggerated replacement costs, as noted in the formal model of the benefits of clearing, the magnitude of default losses (or replacement costs) affects customers' demand to trade derivatives, and hence affects the

[43] Edwards and Morrison (2005).

[44] If the defaulter retains its in-the-money positions, its creditors receive values based on prices that prevail subsequent to the wave of replacements, when presumably prices have returned to normal levels. If prices return to undistorted levels follwing replacements, the other creditors obtain no benefit from the temporary, replacement-driven price changes.

derived demand for dealer services. The possibility that replacement costs will spike temporarily in response to a dealer failure reduces the hedging benefits of trading derivatives, thereby reducing the derived demand to trade them; this adversely impacts dealers. In this way, dealers internalize some of the costs imposed on customers resulting from a putative larger spike in replacement costs in a bilateral market.[45] Thus, even if derivatives prices move less in the event of a default under netting, this does not imply the existence of an externality that dealers fail to consider when considering the formation of a CCP. Absent such an externality, this effect does not warrant regulatory intervention to create a CCP.

Now consider the other redistributive effects. Recall that in a cleared market, the non-defaulting members of a CCP incur replacement costs on the entire net position of the defaulter, not just on their bilateral net exposures (under close-out netting). In effect, the CCP and its non-defaulting members provide performance guarantees to non-members, meaning that they must replace the defaulter's net position held by non-members. This can increase the cost that dealer-members incur as a result of a default, while it reduces the cost that non-members incur. It is again not necessarily the case that this redistribution of losses reduces systemic risks. If dealer-members are systemically more important than the non-members, this implies that in some states of the world systemic risks can be greater with clearing.[46]

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[45] Moreover, the replacement cost effect is a transfer from those replacing positions to those taking the other side of the replacement trade.

[46] The systemic importance of a financial institution depends on the external effect associated with its financial distress. If a given increase in the default losses borne by

At the very least, since holding positions constant the only effect of the formation of a CCP is to redistribute default losses, it is not obvious *a priori* that clearing reduces systemic risks. Even if the failure of a large dealer is considered the overriding systemic risk, since there are occasions in which clearing actually increases dealer losses from defaults (even taking netting into account), a CCP does not necessarily reduce the systemic risks attributable to dealer failure.

Only to the extent that non-dealer derivatives counterparties pose a large systemic risk does clearing unambiguously reduce this risk. Non-dealers who trade derivatives suffer lower losses from a dealer default in a cleared market (as opposed to a bilateral one) for two reasons. First, netting shifts the burden of default losses to the defaulter's other creditors. Second, the guarantee function of the CCP imposes the entire burden of the default on other members, thereby shifting it away from non-members.

Next consider the possibility that the introduction of a CCP causes an increase in the size of derivatives positions. This can occur for two reasons.

First, as noted above and analyzed in a formal model in an appendix, by insuring non-dealers against default losses, the formation of a CCP improves hedging effectiveness and increases the demand of hedgers to trade. This, in turn, increases the derived demand for dealer services and tends to increase derivatives positions, leading to greater aggregate default losses, and greater default losses borne by dealers.

Second, clearing can reduce the costs dealers incur at the margin to

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dealers imposes a larger (smaller) external cost than the same increase in default losses borne by non-dealers, then dealers are more (less) systemically important.

engage in derivatives trades. This in turn tends to lead to an expansion in the derivatives market, an increase in the size of dealer positions, and larger aggregate default losses.

There are several reasons why a CCP reduces private marginal costs, leading dealers to increase the scale of their trading activity.

First, since netting reduces costly collateral, it tends to reduce the marginal cost of entering into transactions, which in turn leads dealers to trade more. Thus, even if clearing reduces default losses suffered by other dealers conditional on position size, due to the fact that it tends to increase the positions that dealers hold, it has conflicting effects on total dealer default losses, and hence on systemic risk.[47]

Reductions in replacement costs could have a similar effect, but here the analysis is more complicated. Holding the terms of the dealers' other liabilities constant, a reduction in replacement costs due to netting encourages dealers to trade more. As noted earlier, however, the dealer's creditors will respond to the implicit reduction in their seniority resulting from clearing by adjusting the terms on which they supply capital. Increasing the scale of trading activity increases the default costs other creditors incur. If creditors price capital appropriately, and charge the dealer an additional dollar for each additional dollar of default cost they absorb as a result of an expansion

[47]This was one reason cited for the refusal of the Chicago Board of Trade to introduce clearing of grain futures for more than three decades after the Minneapolis Chamber of Commerce had introduced the first futures CCP in the United States. According to the Federal Trade Commission Report on the Grain Trade, many CBT members believed that the necessity of holding margin against offsetting long and short positions "encouraged conservatism" and limited speculative trading and hence the overall sizes of positions. FTC (1920).

in dealers' trading activity, the dealers will internalize the cost of the transfer, and reductions in replacement costs will not distort their incentives to trade. Given the complexity of dealer balance sheets and the difficulty in evaluating total derivatives exposure, however, it is possible that other creditors will not fully recognize the implications of an expansion of a dealer's trading activity, and underprice capital as a result. This would encourage the dealer to expand trading activity excessively, as the costs of this expansion are borne by other creditors. This would tend to increase systemic risks.[48]

More generally, it is certainly the case that there is an information asymmetry between dealers and lenders with regards to the dealer's derivatives risk exposure. Effectively reducing the priority of other creditors through the formation of the CCP increases the salience of this information asymmetry, and thereby exacerbates contracting frictions between dealers and their lenders. This is a real cost.

To the extent that insuring non-dealer default risks and lowering collateral requirements and replacement costs encourage dealers to trade more, reductions in dealer default exposures that result from clearing will be smaller than one would estimate holding positions constant. Larger positions increase default losses, offsetting in part or in whole the effect of netting on

[48]Dealers' creditors have another margin on which they can respond to changes in priority that favor derivatives counterparties; they can adjust loan maturities or credit terms in a way that increases a dealer's financial fragility. Due to the ability of dealers to adjust derivatives trading positions very rapidly, they can act opportunistically and expropriate long term lenders by increasing derivatives risk exposures. Shortening debt maturities can mitigate this problem. This tends to increase dealer fragility, but as Diamond-Rajan note (2000), fragility is a disciplining device.

default losses per trade.

As noted above, moreover, clearing is likely to exacerbate asymmetric information problems that lead to poorer pricing of default risk. This results in real costs, and can encourage risk taking that exacerbates systemic risk. Balance sheet risk is a particular concern. Since CCPs are unlikely to price balance sheet risk as accurately as dealers in a bilateral market, and may not price it at all, the adoption of clearing creates a moral hazard that can encourage dealers to increase inefficiently the riskiness of their balance sheets. This can also increase the likelihood of default not just on derivatives positions, but on other dealer liabilities. This would tend to exacerbate systemic risks.

Similarly, the lack of pricing of balance sheet risk tends to encourage the expansion of the trading activity of high balance sheet risk firms relative to low balance sheet risk firms. This also tends to increase systemic risk.

Finally, the formation of a CCP can exacerbate systemic risks since the formation of a CCP reduces the incentive of counterparties (dealers and non-dealers alike) to monitor the default risk of those they trade with.

Thus, received analyses of the effect on systemic risk of cutting inter-dealer default exposures through clearing are incomplete. They are incomplete because they ignore: (a) the effect of clearing on the default exposures of other creditors, (b) the possibility that clearing will induce an expansion in trading activity, (c) the effects of clearing on the allocation of trading activity among dealers who vary in creditworthiness, and (d) the implications of the mispricing of default risk on the intensity of dealer trading and the riskiness of their balance sheets.[49]

The only legitimate regulatory rationale for the mandatory creation of a CCP is that it would reduce systemic risks that impose externalities on non-dealers. Since these risks are, by assumption, external to dealer firms individually, they would also be external to a coalition/cooperative of dealer firms. Hence, the CCP would have no incentive to take these risks into account when setting collateral levels. Since the effects of the formation of a CCP on systemic risk are complicated and ambiguous, caution is warranted in proceeding with the clearing of OTC derivatives including CDS contracts.

Regulators raise another argument to support the formation of a clearinghouse. Specifically, they claim that it would (a) reduce operational risks by improving the process of confirming trades, and (b) improve the transparency of dealer positions, thereby allowing regulators to measure dealer risk exposures (including default risk exposures) more accurately and in real time, which in turn would allow them to intervene more efficiently and expeditiously to mitigate systemic risks.

These are reasonable propositions, but it is important to recognize that these benefits can be obtained without the formation of a CCP that nets derivatives positions and shares risks, with all of its implications for the pricing and allocation of default risk. Mandatory registration of all trades in a central "OTC data hub" using the methods and protocols that a clear-

[49]There are other ways in which systemic risks may differ between cleared and bilateral markets. For instance, large margin calls in response to large price moves can lead to sharp increases in the demand for liquidity, which can potentially cause systemic difficulties. It is unclear whether this is a greater problem in a cleared or bilateral market, as marking to market and collateral calls are utilized in each.

inghouse would employ would reduce operational risk, and provide regulators with additional transparency, without requiring problematic changes in the mechanism for sharing default risks. Just because CCPs improve information about positions does not imply that the only way to improve information on positions is to form a CCP. Only if the risk-allocation effects of CCPs reduce systemic risk is their mandatory creation justified; market participants have the incentive to take the private benefits into account, and the benefits arisig from lower operational risks and better information can be obtained by other means.

10 Summary

Distributive effects, asymmetric information, and hence adverse selection and moral hazard, affect the costs and benefits of alternative default risk sharing mechanisms. Moreover, asymmetric information costs differ between alternative methods for allocating default risks. In particular, centralized clearing mechanisms face substantial disadvantages relative to bilateral mechanisms in the sharing and pricing of default risks for (a) complex financial instruments, (b) traded by financial institutions with opaque balance sheets that supply a broad range of information-intensive intermediation services. Moreover, due to the scope economies of making markets in complex derivatives and supplying information-intensive intermediation, it is costly to mitigate information asymmetries relating to balance sheet risks by trading complex products through simpler intermediaries that eschew information-intensive financing activities.

Earlier, I posed the question: “If the benefits of central clearing are so large, why have market participants not adopted it heretofore?" The considerations examined herein imply the following answer: "Because for some instruments, the putative members of clearinghouses would incur costs that exceed these benefits." Indeed, the analysis actually goes further, and suggests that if anything, clearing can impose a negative externality on dealers' creditors that gives the dealers an *excessive* incentive to create a clearinghouse. The fact that they have not done so heretofore for CDS contracts and many other exotic derivatives therefore provides indirect evidence that the costs arising from asymmetric information are large indeed.

It would be possible to rationalize the mandated creation of a CCP if it could be shown that (a) this would reduce systemic risks that create an externality, such as hazards to the viability of the payments system, and (b) this external cost is greater than the additional private costs of clearing that result from asymmetric information. The case for CCPs on these grounds is also dubious. Although position netting by CCPs reduces the default losses that a bankrupt dealer's counterparties suffer, this is not necessarily a social gain; the bankrupt's other creditors suffer additional losses that exactly offset dollar-for-dollar the derivative counterparties' gains. Since the solvency of other creditors may also have systemic implications, it is not necessarily true that reducing the losses that big dealers suffer from defaults on derivatives reduces systemic risks. Moreover, the creation of a CCP can spur additional trading activity, which increases default losses. Furthermore, the mispricing of default risk due to information asymmetries and institutional constraints can also result in dealers taking on excessive position and balance sheet risks which exacerbate systemic risks.

As a result of these considerations, I have serious reservations about the efficiency of a CDS clearinghouse consisting of big banks/investment banks. Balance sheet risks are important when such firms are involved, and traditional CCPs have not priced these risks (or have priced them in a very, very crude way.) Moreover, the risks of the instruments themselves will be difficult for a CCP to quantify. Indeed, sometimes it will be difficult for the CCP just to determine the market value of these instruments. Given the instruments, and the firms trading them that would be in a clearinghouse, risk pricing will be extremely difficult, and beset by asymmetric information problems. It is by no means clear that centralized assessment, pricing and sharing of position and balance sheet risks is more efficient than decentralized, bilateral assessment, pricing and sharing of these risks.

Some may find this analysis Panglossian, in that it suggests that the existing methods for sharing default risks in OTC markets are the optimal ones. I would respond by saying that at the very least, one must give some deference to the survival principle.[50] If the formation of a CCP is so beneficial, why would highly profit motivated firms leave money on the table by using less efficient methods, especially when it is possible that they could transfer wealth from others to themselves in the bargain?

To explain the persistence of traditional default risk sharing methods in OTC markets, one must argue either that (a) collective action problems, strategic behavior, or some other transaction cost that could be mitigated by government action is preventing the implementation of the more efficient

[50]Hansmann (1996) relies on the survivorship principle as important evidence of the relative costs of alternative organizational forms.

alternative, or (b) that the existing default mechanism offers lower costs and/or higher benefits than the alternatives. To my knowledge, argument (b) has not been explicitly rejected in favor of argument (a). Indeed, argument (b) is seldom made, and argument (a) is usually implicit rather than explicit. By making argument (b) here, I believe that at the very least I have raised substantive issues that deserve serious attention. Heretofore, the debate over centralized clearing of OTC instruments has largely ignored the existence of wealth transfers or asymmetric information, or their implications for the relative efficiency of alternative mechanisms for sharing default risks. The analysis in this article should make it clear that these issues cannot be ignored, and that policymakers should investigate them seriously before plunging ahead with proposals to create a CDS CCP, or when designing such a CCP.

A A Model of Risk Allocations in Cleared and Bilateral Markets.

Consider a market with M price taking hedgers with identical preferences. Each hedger has exponential utility, with coefficient of risk aversion ϕ. Each hedger has an endowment of 1 unit of a risky asset. The current price of the risky asset is P_0. Its value in period 1, $\tilde{P}$, is uncertain, and described by the probability density $f(\tilde{P})$.

There is a forward market for the risky asset. The forward contract trades at time 0, and matures at time 1.

There are two dealers who make a market in the forward contract. Each dealer is risk neutral, but has limited capital. The current capital of each dealer is K, but the period 1 value of dealer i's capital is uncertain, and equal to $\tilde{K}_i$, $i = \{1, 2\}$. That is, the dealers are subject to balance sheet risks. The dealers' period 1 capital values are independent, and the probability density of each dealer's capital is $g(\tilde{K})$.

Dealers incur costs to execute derivatives transactions. For simplicity, I assume that these costs are quadratic in the size of the trade q:[51]

$$C(q) = \theta q^2$$

First consider a bilateral market, where each hedger trades q_i forward contracts with dealer i, where $q_i > 0$ if the hedger purchases and $q_i < 0$ if the hedger sells. Here, dealer i defaults if his losses on the forward trade exceed his capital. Formally, if dealer i trades at a forward price of F_i, default occurs if:

$$Mq_i(F_i - \tilde{P}) + \tilde{K}_i - C(Mq_i) \leq 0$$

If i defaults, the hedgers seize the defaulter's capital (net of the cost the dealer incurred) to satisfy their claim; they divide this sum equally among themselves. If i does not default, the hedger receives the contracted payoff. Thus, each hedger's payoff to the forward position with i is

$$\tilde{Z}_i = \frac{\min[\tilde{K}_i - C(Mq_i), Mq_i(\tilde{P} - F_i)]}{M}$$

Furthermore, each hedger's expected utility is:

$$EU_h = E[exp(-\phi(\tilde{P} + \tilde{Z}_1 + \tilde{Z}_2))]$$

[51] A quadratic relation between cost and total position size could also arise if the dealers are risk averse and have mean-variance preferences.

where the expectation is taken over $\tilde{P}$, $\tilde{K}_1$, and $\tilde{K}_2$.

Dealer i's expected profit is:

$$E\Pi_i = E\max[Mq_i(F_i - \tilde{P}) + \tilde{K}_i - C(Mq_i), 0]$$

where the expectation is taken over $\tilde{P}$ and $\tilde{K}_i$.

The hedgers and the dealers are price takers. Therefore, there is an equilibrium vector of forward prices $\{F_1, F_2\}$ such that the quantity of contracts that the hedgers want to sell to each dealer at these prices equals the quantity that each dealer wants to buy at those prices. That is, for a given F_i, dealer i chooses q_i to maximize expected profit, and for a vector of forward prices, the hedgers choose $\{q_1, q_2\}$ to maximize expected utility. At the equilibrium $\{F_1, F_2\}$, the quantity supplied by each dealer equals the quantity the hedgers want to buy from him.

Due to the non-linearities introduced by the option-like nature of the payoff to defaultable contracts, it is not possible to solve for the equilibrium prices and quantities in closed form, even if one assumes normality in shocks to the risky price and capitals. Since the problem must be solved numerically in any event, I make more general (and realistic) assumptions about $f(.)$ and $g(.)$. Specifically, since returns of risky assets are often skewed and heavy-tailed, I assume that $f(.)$ is a negative inverse Gaussian distribution. This distribution can exhibit both skewness and leptokurtosis.[52] Moreover, I assume that $g(.)$ is a Student-t distribution to take into account the realistic possibility that the balance sheet risks of dealers exhibit heavy tails.

[52]Credit derivatives typically have highly skewed payoffs.

Now consider a cleared market. In the cleared market, the hedger treats the dealers as homogeneous, and there is a single competitive price in the marketplace, F. I assume that the two dealers form a CCP, and share default losses. I further assume that the dealers implement a transfer pricing policy (or collateral setting policy) to choose outputs that maximize their joint profit. As before, the dealers remain price takers. Since the dealers have identical cost parameters θ, they maximize profit by trading equal quantities.

Assume that the forward price is F. If the total trade of the dealers is Q, meaning that each trades $.5Q$ contracts, since the dealers (via the CCP) collectively agree to satisfy the contractual obligations to the hedger, payoffs to each dealer depend on $\tilde{P}$, $\tilde{K}_1$, and $\tilde{K}_2$. Consider dealer 1.

If

$$.5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) < 0$$

this firm defaults, and receives a payoff of $\Pi_1(\tilde{K}_1, \tilde{K}_2, \tilde{P}, F, Q) = 0$. Conversely, if

$$.5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) \geq 0$$

dealer 1's payoff depends on dealer 2's financial condition. If:

$$.5Q(F - \tilde{P}) + \tilde{K}_2 - C(.5Q) < 0$$

(i.e., dealer 2 is unable to meet its obligations), but:

$$.5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) + .5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) \geq 0$$

(i.e., the dealers are collectively solvent), then the CCP has the resources to make the contractual payment to the hedger, and dealer 1's payoff is:

$$\Pi_1(\tilde{K}_1, \tilde{K}_2, \tilde{P}, F, Q) = .5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) + .5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q)$$

This expression reflects the fact that in the event of a default by dealer 2, dealer 1 assumes the defaulter's obligation. Dealer 2's payoff is 0 under these conditions.

If, however,

$$.5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) + .5Q(F - \tilde{P}) + \tilde{K}_2 - C(.5Q) < 0$$

(i.e., the CCP is insolvent), both dealers receive a payoff of 0.

If both dealers are solvent,

$$\Pi_i(\tilde{K}_1, \tilde{K}_2, \tilde{P}, F, Q) = .5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) \geq 0 \qquad i = \{1, 2\}$$

Now consider each hedger's payoffs. If the hedgers trade Q contracts, and:

$$.5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) + .5Q(F - \tilde{P}) + \tilde{K}_1 - C(.5Q) < 0$$

(i.e., the clearinghouse is insolvent), each hedger's payoff is:

$$H(\tilde{K}_1, \tilde{K}_2, \tilde{P}, F, Q) = \frac{\tilde{K}_1 + \tilde{K}_2}{M} + \tilde{P}$$

Conversely, if the clearinghouse is solvent, each hedger receives the full contractual payoff:

$$H(\tilde{K}_1, \tilde{K}_2, \tilde{P}, F, Q) = \frac{Q}{M}(\tilde{P} - F) + \tilde{P}$$

Again, for given F, hedgers choose a quantity that maximize their expected utilities. Similarly, for a given F the dealers collectively choose a quantity of forwards to trade that maximizes their expected joint profit. This expected joint profit is:

$$E\Pi_{ccp} = E \max[0, Q(F - \tilde{P}) + \tilde{K}_1 + \tilde{K}_2 - 2C(.5Q)]$$

where the expectation is taken over the capitals and the risky price. At the equilibrium forward price, the quantity of contracts that the hedger wants to sell equals the quantity that the dealers want to buy.

I have solved the model for a variety of choices of parameters. These parameters include the size of the interest to be hedged, M; the hedger's risk aversion ϕ; the parameters for the NIG price distribution (which determine the moments of this distribution); the parameters of the t-distributions for the distribution of the risky capitals; starting capital K; and the cost parameter θ. Regardless of the choice of parameters, the equilibria exhibit the same behavior. The salient features of these equilibria are:

- The hedger sells contracts.
- The forward price is downward biased. This downward bias occurs because the dealers need to earn a profit from their contracts on average to cover their execution costs. They earn a profit by purchasing contracts at a forward price that is below the expected spot price.
- The quantity of contracts traded is smaller in the bilateral market than in the cleared market.
- The forward price is higher in the bilateral market than in the cleared market.
- Dealer profits are higher in the cleared market.

The last three results are of particular interest, and are readily explained. Default occurs more frequently in a bilateral market, and the loss conditional on a default is larger. This occurs because for a given quantity of contracts

Q, there are states of the world where one dealer is insolvent, but the other has sufficient capital to cover the defaulter's obligations. In these states of the world, the hedger receives the full contractual payment in the cleared market, but suffers default losses in the bilateral market. Since default occurs when prices are low, the hedger's marginal utility is high in these states of the world. Thus, defaults are very costly to the risk averse hedger. The reduction in the frequency and severity of default induces the hedger to sell a larger number of contracts at a given price F. That is, the hedger's supply of forward contracts curve shifts out and to the right. This leads to higher quantities traded in equilibrium, and lower prices. The lower prices obtain because marginal execution costs are higher at the higher output. Dealer profits rise because, in essence, clearing increases the derived demand for their services.

The fact that dealer profits rise with clearing means that they internalize the benefits of improved risk sharing. Thus, in the model, clearing is welfare enhancing, and dealers have incentives to adopt this efficiency enhancing mechanism.

Other points are also relevant. In particular, in a bilateral market there is no potential for one dealer to suffer losses as result of another's default.[53] However, in the cleared market, a solvent dealer suffers losses if another defaults. Thus, clearing can *increase* dealers' exposure to default costs. Indeed, this is a feature, not a bug: the (welfare enhancing) sharing of default risk among dealers that improves hedging effectiveness in high hedger

[53]This is because there is no inter-dealer trading here. A more complicated model would be required to produce inter-dealer trading.

marginal utility (low price) states is what produces the welfare gain.

Put differently, the social benefit of clearing is to increase the utility of hedgers by reducing default losses in states where marginal utility is high. The only way that this can occur is for the risk neutral dealers to share default losses. Therefore, one dealer's insolvency imposes costs on other dealers that belong to the CCP.

Thus, CCPs *create* additional connections between dealers. As a result, they can serve as a mechanism for communicating default losses among dealers. That is, they can be a means by which contagion is spread from one dealer to another. In the model, in the bilateral market there is no inter-dealer contagion, but such contagion exists in the cleared market.

This potentially has implications for systemic risk. Clearing shifts the burden of default risks from hedger-customers to dealers. If dealers are systemically more important (i.e., the efficiency or liquidity of the financial market declines when dealers absorb large default losses), clearing increases systemic risk. If customers are more systemically important, clearing reduces systemic risk.

B Proof That Netting Transfers Wealth From Other Creditors

Denote by A a defaulting dealer's assets other than the value of its in-the-money derivatives positions that would be extinguished by netting. Call N the value of its in-the-money derivatives that netting would extinguish. D is the value of its derivatives liabilities, and L is the value of its other liabilities.

Under bilateral arrangements, in the event of default, with *pro rata* allocation of the bankrupt dealer's assets other creditors suffer losses of:

$$L - L\frac{A+N}{D+L}$$

Total claims on the bankrupt's assets are $D + L$, and total assets available to satisfy these claims are $A + N$, so the ratio in the expression gives the fraction of the claims that are paid. With netting, other creditors suffer a loss of:

$$L - L\frac{A}{D-N+L}$$

Due to netting, assets available to satisfy claims fall to A, and liabilities also fall by N to equal $D - N + L$.

Creditors' losses are greater under netting if:

$$\frac{A}{D-N+L} > \frac{A+N}{D+L}$$

This is true if:

$$D + L > A + N$$

This condition holds if and only if the firm is insolvent. Therefore, the creditors of a bankrupt dealer are worse off under netting.

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