

Policy Analysis

No. 665

July 21, 2010

The Inefficiency of Clearing Mandates

by Craig Pirrong

Executive Summary

In the aftermath of the financial crisis, attention has turned to reducing systemic risk in the derivatives markets. Much of this attention has focused on counterparty risk in the over-the-counter market, where trades are bilaterally executed between dealers and derivative purchasers. One proposal for addressing such counterparty risk is to mandate the trading of derivatives over a centralized clearinghouse. This paper lays out the advantages and risks to a mandated clearing requirement, showing how, in some instances, such a mandate can actually increase systemic risk and result in more financial bailouts.

This paper also describes the dynamics of counterparty risk in the derivatives market. Discussing the relative importance of both the risk that arises from the price risk of the instrument at issue and the financial condition of the counterparty. The analysis then turns to an evaluation of how bilateral markets and clearinghouses manage these two risks. After demonstrating that resolving and replacing defaulted trades is the primary resolution problem facing both market structures, the paper lays out an auction alternative designed to address this issue.

Craig Pirrong is professor of finance at the Bauer College of Business at the University of Houston.

Clearing has become a deus ex machina to solve all the problems inherent in derivatives markets.

Introduction

Prior to the financial crisis of 2008–2009, the subjects of counterparty risk in derivatives transactions (i.e., the risk that a party to a derivatives contract will not perform on its obligations), and the use of central counterparty clearing (CCP) to control and allocate this risk, were of interest primarily to a very limited set of practitioners. Most academics, and certainly most politicians and journalists, ignored the subject altogether.

In the aftermath of the crisis, however, the subjects of counterparty risk and clearing are on the lips of myriad politicians, regulators, journalists, and commentators. Indeed, it is widely viewed as a panacea that will prevent future panics and ensure the stability of the financial system. As a result, the current consensus is that uncleared, bilateral over-the-counter (OTC) derivatives transactions are a threat to financial stability, that these transactions should be restricted, and that whenever possible, derivatives transactions should be cleared by CCPs.

Based on this belief, all major pieces of derivatives legislation currently under consideration in Congress include provisions that would mandate the clearing of as many OTC derivatives transactions through CCPs as possible. The only major areas of contention relate to the extent of the clearing mandate, and who would make the judgment as to what products must be cleared. These pieces of legislation are of a piece with the Obama administration's derivatives regulation proposals, which also incorporate a broad clearing mandate. Administration officials, notably Treasury Secretary Timothy Geithner and Commodity Futures Trading Commission (CFTC) chairman Gary Gensler, have been adamant that a broad clearing mandate with few exceptions must be included in any legislation.

In the debate over financial regulation in the aftermath of the financial crisis, clearing has become a deus ex machina to solve all the problems inherent in derivatives markets. In particular, clearing has been advanced as a

panacea for systemic risk arising from derivatives markets; that is, the risk that derivatives contracts can serve as the cause of insolvency of major financial institutions, and a channel of contagion by which the failure of one institution could cause the failure of others.

There is considerable room for skepticism about these claims. They are not predicated on a thorough analysis of the economics of clearing. Indeed, many of the claims made on behalf of clearing are patently wrong. Those making such claims would be at risk of a Federal Trade Commission (FTC) false-advertising claim if they were engaged in commercial advertising. Moreover, many of the examples routinely trotted out to demonstrate the need for clearing—notably, the example of AIG—are deeply misleading.

Furthermore, implicit in the demand for clearing mandates is a belief that the prevailing structure of OTC markets is fundamentally flawed. This belief is rather stunning, because it implies that one of the largest financial markets in the world—the OTC derivatives market—is in fact the largest market failure in financial history.¹ Although many might say just that, there is room to doubt this sweeping judgment, inasmuch as those advocating this view seldom identify, with any precision, the source of the market failure. Moreover, advocates of clearing mandates typically identify private benefits (such as multilateral netting) that market participants would have the incentive to exploit, which begs the question: why haven't they?² Thus, the advocates of clearing mandates provide no clear answer as to why market participants would not adopt such a putatively beneficial institution voluntarily.

Nor is the reluctance to voluntarily adopt clearing a new phenomenon. The Chicago Board of Trade resisted it for almost 30 years, until forced to adopt it by its regulator, the Department of Agriculture, in 1925. Similarly, even in the aftermath of the Tin Crisis, the London Metal Exchange only implemented clearing under pressure from the UK's Securities and Investment Board.³ The reluctance now—and then—to adopt clearing voluntarily certainly raises the possibility that the costs of

clearing exceed the benefits. This underlines the need for a more thorough understanding of just what those costs and benefits are.

There is a “fire, ready, aim!” feel to many of the policy proposals emanating from Capitol Hill and the administration. Prescription precedes understanding. To evaluate the costs and benefits of clearing mandates, this order must be reversed. It is necessary to understand the economics of counterparty risk and the means of allocating it.

In this article I draw on first principles to analyze the costs and benefits of clearing, and to identify the factors that affect the relative costs of clearing and bilateral OTC dealings. The most basic principle is that clearing is a way of sharing—mutualizing—the risk of counterparty default. It is well known that such risk sharing can increase welfare by improving the allocation of risk. It is equally well known, however, that risk-sharing mechanisms are also subject to a variety of incentive and informational problems, most notably moral hazard and adverse selection. Thus, any comparative analysis of the costs of benefits of clearing vis-à-vis the use of bilateral contracts to allocate default risk must examine the potential benefits of counterparty default risk sharing in derivatives markets, the vulnerability of these mechanisms to moral hazard and adverse selection, the means available to counter these problems, and the factors that affect their severity.

The conclusions of this analysis are straightforward:

- In the absence of moral hazard and adverse selection, and with accurate pricing of counterparty risks and efficient allocation of these risks among a CCP’s owners, central clearing that creates fungible derivatives contracts leads to a more efficient allocation of default risk. Derivatives counterparties are more likely to receive the full contractual payment in a cleared market than a bilateral one.
- Risk sharing through a clearinghouse makes the balance sheets of the clearinghouse members public goods, and encourages excessive risk taking. That is,

the clearing mechanism is vulnerable to moral hazard.

- Clearinghouses can control moral hazard by imposing margin requirements and limits on the amount of insurance provided. Since collateral is socially costly, however, it is costly to control moral hazard in this way. Furthermore, limiting coverage limits the benefits of risk sharing.
- It is particularly costly for a clearinghouse to use collateral to control moral hazard when its members are heterogeneous and possess better information than the clearinghouse about the default risks of cleared positions. These default risks arise from the price risks of these instruments, the balance sheet risks of member firms, and the interaction among these risks. If the clearinghouse has imprecise information, the margin levels it chooses will sometimes overly constrain the trading of its members and sometimes constrain them too little. Moreover, if the clearinghouse has poorer information about risks than its members, it is subject to adverse selection. All of these factors mean that it is costly for the clearinghouse to control moral hazard.
- The bilateral OTC market is less vulnerable to moral hazard than a clearinghouse mechanism because dealer balance sheets are not public goods; dealers allow others to transfer risks to their balance sheets via derivatives transactions by contract and must agree to every such transfer. Moreover, dealers can utilize their information on price and balance-sheet risks to mitigate adverse selection costs, and differentially price counterparty default risk in a way that clearinghouses do not, and arguably, cannot. This can lead to a more efficient allocation of trading activity across market participants, as each internalizes its default costs or internalizes its counterparties’ estimates of the default costs it imposes on them.
- Collateralization practices in clearinghouses, namely daily mark to market,

It is particularly costly for a clearinghouse to use collateral to control moral hazard when its members are heterogeneous and possess better information about the default risks of cleared positions.

The main idea is to devise a policy that exploits the advantages of OTC markets, but which addresses their most problematic feature.

impose costs on many market users in the form of greater cash flow volatility and cash flow mismatches. Bilateral markets utilize more flexible collateralization methods that are preferred by many derivatives end users.

- The formation of multiple clearinghouses may increase the costs of bearing risk by precluding the exploitation of scale and scope economies in the way large derivatives dealers do.

The foregoing points relate to the ex ante incentive effects of clearing and bilateral mechanisms. The basic idea is that bilateral mechanisms can utilize more information about the relevant risks, and therefore price them more effectively, and more effectively limit exposure to moral hazard and adverse selection costs that are inherent in any risk-allocation mechanism.

This analysis makes it clear that the dominance that bilateral OTC derivatives markets achieved in the 1990s and the first decade of the 21st century was not necessarily a market failure of historic proportions. Instead, a case can be made that for many transactors and many instruments, it is cheaper to allocate default risks through bilateral OTC transactions than through centralized clearing. Clearing creates fungible instruments, but this fungibility is not free. Achieving fungibility through clearing creates moral-hazard problems that are costly to mitigate. These costs are especially great when transactors are heterogeneous and informational problems acute. In these circumstances, it can be more efficient to forego some risk-sharing possibilities in order to control moral hazard and adverse selection costs. Bilateral OTC trading can do just that.

In this sense, financial derivatives markets are not different from other risk-sharing markets. It is well known that in insurance, and in other financial markets, moral hazard and adverse selection problems make it (relatively) efficient to eschew some risk-sharing opportunities. The analysis of this paper demonstrates that these considerations are relevant in derivatives markets as well.

Cleared and bilateral markets can also differ on other dimensions, notably their performance in the event of a default, including the systemic risks they pose as the result of the default of a large market participant. A complete analysis must consider these factors.

Although the failure of large OTC market participants, such as Long Term Capital Management during the Russian default crisis of 1998 and Lehman Brothers in 2008, are examples of the potential systemic consequences of an OTC default, cleared markets are not immune from systemic problems, and certain features of central counterparties can make them sources of systemic risk. I will discuss, in detail, the events surrounding the crash of 1987 to illustrate that the failure of clearinghouses, with the associated systemic implications, is not a merely theoretical issue. It is a very real possibility, but this issue has been largely ignored in the policy debates.

The main problematic feature of bilateral markets is that the uncoordinated efforts of market participants to replace the positions lost due to a default can be destabilizing. In contrast, cleared markets can engage in a coordinated response that places less stress on the pricing mechanism.

Together, these findings motivate several policy recommendations. The main idea is to devise a policy that exploits the advantages of OTC markets, but which addresses their most problematic feature.

The primary policy recommendations are:

- Clearing mandates are seriously defective because clearing can have inferior ex ante incentive properties, compared to bilateral OTC transactions, and the default resolution mechanism in cleared markets (with multiple CCPs) is potentially problematic and does not address all of the difficulties associated with the default of a large financial firm.
- The development of an auction-type mechanism to facilitate the replacement of defaulted OTC derivatives positions would mitigate the primary weakness of OTC markets, while exploiting their

desirable information and incentive properties.

- The operation of an auction-type mechanism would require the creation of comprehensive OTC derivative trade repositories like those being mandated in pending legislation.

In brief, fundamental economic considerations suggest that a clearing mandate is likely to reduce market efficiency and pose its own systemic risks in a world where information is costly. The major weakness of OTC markets can be mitigated through the creation of a more effective and efficient coordinated resolution mechanism. With such a mechanism in place, OTC markets and cleared markets will be able to exploit their comparative advantages, and private ordering of trading activity can minimize the costs arising from derivative default risks. In this private ordering, both OTC and cleared markets will survive, providing a diverse array of market mechanisms that can accommodate the diverse needs of myriad transactors.

The Determinants of Default Risk in Derivatives Markets

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 date. If the price of gold at the expiration date is higher (lower) than the forward price, the buyer profits (loses) and the seller loses (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 that 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 party'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.⁴

Credit default swaps (CDSs) are derivatives that work somewhat differently from the "vanilla" forward contract 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, such as 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 seller pays the buyer the face amount of the security.⁵ 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 \$.80 per \$1 in face amount loss that he would suffer if he performed on the contract.⁶

Financial Intermediaries and Default Risk

Financial intermediaries play a central role in all derivatives markets. In organized futures markets with a central counterparty, all non-members must trade through futures commission merchants (FCMs), and 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.⁷ In bilateral OTC markets, major financial institutions account for a substantial portion of all trading activity, and serve as the counterparty

A clearing mandate is likely to reduce market efficiency and pose its own systemic risks in a world where information is costly.

Counterparty risk arises from both the price risk of the instrument at issue and the financial condition of the counterparty.

for a very large portion of total outstanding positions. These large financial firms that make markets in OTC derivatives are typically referred to as dealers.

This section presents an analysis of the default risk posed by a financial intermediary, be it an FCM or a large dealer. I focus on these 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 crucial thing to understand about derivatives default risk is that two things have to happen for an intermediary to default on a particular derivatives contract, and thereby impose a loss on the counterparty. First, that derivative must have negative value (be underwater) to the intermediary. For example, if the instrument is an interest rate swap that the intermediary has bought, the current fixed rate prevailing in the market must be above the fixed rate that the intermediary receives under the swap agreement. Second, the intermediary must not have the financial resources to perform on the contract; it is either insolvent or sufficiently illiquid that it cannot meet its obligations under the agreement.

Thus, counterparty risk arises from both the price risk of the instrument at issue and the financial condition of the counterparty—and thus on the value of the other assets, liabilities, and financial contracts held by the counterparty. These other financial contracts may include other derivatives transactions that the dealer has entered, and the contracts that the intermediary’s customers have entered and the intermediary guarantees (as in a cleared market).

More specifically, 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.
- 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) and their reliance on very short-term funding. 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.⁸ In contrast, AIG imploded because the huge losses on derivative positions overwhelmed its capital. 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 of dealer defaults.

Moreover, all of these factors interact. Thus, the overall default risk depends on the correlations among 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 are also important determinants 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, as well as the magnitude of the loss resulting from that default. There is also potentially dependence between a dealer’s balance-sheet risk and its derivatives portfolio. “Wrong-way risk” is a matter of special concern. Wrong-way risk exists when a dealer’s losses on a derivatives posi-

tion worsen as the value of the other assets on its balance sheet declines.

These factors also highlight the kind of information that is needed to evaluate—and price—counterparty risk exposure. Information on the value and risk of the individual contracts is necessary, but not sufficient, to appraise this exposure. Information on the balance sheets and balance-sheet risks of counterparties is also essential. Moreover, information on the interactions between these various risks is material.

This in turn implies that the efficient way of allocating counterparty risk will depend on who has what information. As I discuss in detail below, different allocation mechanisms, such as clearing or bilateral trading, may have access to different information, and differing amounts of information. This, in turn, leads to different costs of bearing default risk across these structures.

It is also important to note that there is optionality in default risk exposure. That is, the default loss exposure on a contract is not a linear function of either the price that determines the payoff of the instrument, or of the value of the balance sheet of a party to the contract. Consider a firm that has bought an oil forward contract at a price of \$90 per barrel. The default loss exposure of that contract is zero for current prices above \$90, and may be positive (depending on the solvency of the firm) for prices below \$90. If it is positive, the default loss increases as the oil price declines. This means that the sensitivity of the default loss to a change in the price of oil is not constant, but depends on the price of oil. Similarly, if the current price is \$80 (so the contract is underwater to this firm), the default loss is zero as long as the firm is solvent, but becomes non-zero when the firm is insolvent, and increases as the financial strength of the firm erodes further. This nonlinearity/optionality, and dependence on multiple risk factors, makes evaluation of counterparty risk a particularly complex analytical problem.⁹

This nonlinearity means that expected default losses depend on the volatilities of the underlying risk factors, the correlations

among 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 marginal value of consumption. 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.¹⁰

Although this characterization of default risk is relatively straightforward, it provides a very useful framework for understanding the economic costs and benefits of alternative default risk-sharing arrangements, as demonstrated in the subsequent sections.

Default Risk Sharing in Bilateral and Cleared Markets

In bilateral markets, default costs are borne exclusively by the defaulter's counterparties.¹¹ 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 derivative 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

The efficient way of allocating counterparty risk will depend on who has what information.

Default risks do not disappear, but are distributed among the other members of the clearinghouse.

nondealer, 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.¹²

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.¹³ Large dealers are the members of existing OTC derivatives clearinghouses and would be the members of any new CCPs created as a result of a mandate.

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. Trader 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. Trader S still has a contract to sell, and Buyer 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 she is owed. In effect, the clearinghouse guarantees performance on the contracts it clears.

Clearinghouses almost always have members who are trading firms, and often large ones, including brokerages and banks. The clearinghouse's guarantee extends only to its members; nonmember 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.

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, nonmember customers bear no default losses as long as the CCP remains solvent.¹⁴ 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 nondealers. 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).¹⁵

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 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 premiums, 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.¹⁶ Moreover, under U.S. 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. Furthermore, whereas CCPs typically limit collateral to cash and cash-like

Dealer firms bear the losses from the default of another dealer under both market structures.

instruments, bilateral counterparties sometimes negotiate posting of collateral in less liquid securities.¹⁷ Furthermore, counterparties in bilateral transactions can, and sometimes do, negotiate transactions prices that depend on creditworthiness, and the amount of collateral posted.¹⁸ Thus, default risk can be priced into transactions in bilateral markets.¹⁹ Finally, OTC participants sometimes implicitly extend credit to their counterparties. For instance, a dealer may not require a counterparty to post any collateral at the initiation of a transaction, and require this firm to post no collateral as long as the amount it owes to the dealer remains below a pre-established credit limit. Since the dealer often has a variety of credit relationships with this counterparty, derivatives credit exposure contributes to the dealer's overall exposure to this firm, and is managed and priced accordingly.

It should also be noted that bilateral market participants have other ways of pricing default risk. In particular, they can condition the prices at which they trade on their appraisal of the creditworthiness of their counterparty (and on whatever credit support, such as collateral or third-party guarantees that the counterparty provides). This can happen in a face-to-face bilateral market, but it cannot occur in an anonymous, cleared exchange market.

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 nonmembers are protected as long as the CCP itself remains solvent. Thus, a CCP's members effectively insure nonmembers 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 nonmember hedger suffers such losses on only if all of the members of the clearing-

Default risk can be priced into transactions in bilateral markets.

house are collectively insolvent.²⁰ 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.

It is important to note that the default-risk-sharing mechanism effectively transfers a particular dealer's balance-sheet risk from its customers to other dealer-members of the clearinghouse. For instance, other members step in to cover the obligations of a dealer that has suffered a sufficiently adverse shock to the value of its assets that it is unable to meet its derivatives obligations. In the bilateral arrangement, the payoff that dealer A's customers receive depend on the realization of its risky capital. For instance, an adverse shock to the balance sheet of dealer A can result in its customers receiving less than the contractually promised payment on the derivatives contract. In contrast, in the cleared market, if this capital is insufficient to meet that dealer's obligations, other dealers must dip into their capital to make up the deficiency. Thus, clearing works as a mechanism to shift balance-sheet risk from one group of agents—customers—to another—the dealers who belong to the clearinghouse.

Note, as well, that two kinds of risk are shared. One is the risk associated with the payoff to the derivatives contract. The other is the risk associated with the capital of the dealer firms. That is, a clearing mechanism exposes each member of the clearinghouse to the risks not only of the derivatives cleared, but of the risks on the balance sheets of the other members.

Equilibrium Effects of Clearing

The preceding 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 in 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 nonlinearities that default risk creates. In a working paper, I derive a formal model of the equilibrium effects of clearing and solve the model numerically.²¹ 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 increase at an increasing rate 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 hedgers to take larger positions and 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 that one of the dealers will default. This increases the value of

A clearing mechanism exposes each member of the clearinghouse to the risks not only of the derivatives cleared, but of the risks on the balance sheets of the other members.

Clearing creates a contagion effect of spreading losses among dealers that is absent in bilateral markets.

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.²²

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. It increases 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.

Moreover, this analysis makes it clear that customers are the primary beneficiaries of clearing in this model. They receive a larger portion of the payments promised them in a cleared market than in an uncleared one because solvent dealers chip in to cover what insolvent dealers owe their customers but are unwilling to pay. This consideration is relevant in interpreting end-user opposition to mandatory clearing, as I discuss below.

Lastly, it should be noted that the efficiency-improving effects of clearing depend in part on two assumptions: first, that risks are shared efficiently among the members of the clearinghouse, and second (and particularly), that the existence of a sharing mechanism does not create perverse incentives for the CCP members or its customers. These are not innocuous assumptions, and the following sections consider these issues in detail.

The Costs of Default Risk Sharing: Moral Hazard

The foregoing analysis demonstrates that mutualization of default risk through clearing can improve welfare. But mutualization has costs as well. In particular, such arrangements are subject to moral hazard. A moral hazard problem exists because dealer firms can affect the amount of risk that they assume through their trading decisions or through decisions that affect the riskiness of their balance sheets. Increasing the scale of their trading activities or increasing the riskiness of their balance sheets increases the likelihood that dealer firms will default on their derivatives obligations. Due to risk pooling, moreover, some of the resulting losses are borne by other clearing members.²³

In a cleared market, absent any restrictions (as was the case in the earlier example), no dealer internalizes the cost of its default. This default cost is absorbed by other members of the clearinghouse. What's more, since each customer looks to the clearinghouse for performance, each is indifferent to the default losses arising from the trades of any individual dealer. Hence, customers have little incentive to monitor the creditworthiness of any individual dealer.²⁴

Absent any restrictions, in the pure sharing situation analyzed in the previous subsection, these considerations mean that the collective capitals of the dealer-members are a public good to the other members—and customers—thereby creating a classic tragedy of the commons. Each dealer has an incentive to trade too much because it does not bear the associated (default) costs. Similarly, each has an excessive incentive to add risk to its balance sheet, because other members of the clearinghouse bear some of these risks.

Put differently, clearing makes derivative contracts fungible, in the sense that customers are indifferent as to whom they trade with—but fungibility is costly.²⁵ The creation of a clearinghouse that shares default risks among its members makes the contracts of

each member-dealer a perfect substitute for those of any other because the clearinghouse is the counterparty to every trade. But creation of this fungibility necessarily mutualizes risk in a way that gives each member an incentive to trade excessively, or to add risk to its balance sheet, because some of these risks are borne by other members of the clearinghouse.²⁶

In contrast, a bilateral market is not as vulnerable to such moral hazard problems.²⁷ There are mechanisms whereby a dealer that adds more risk, either by expanding the scope of its trading, or increasing the riskiness of its balance sheet, internalizes the costs and the benefits of that decision. Individual counterparties can take into account this riskiness when entering into contracts with the dealer and will trade at prices, or impose other terms (e.g., collateral, exposure limits), that reflect this riskiness. A riskier firm trades at less favorable prices or must post more collateral. These bilateral contracts are not fungible, but are also not subject to the same type of moral hazard as a centralized clearing mechanism.

Controlling Moral Hazard

The members of the clearinghouse have an incentive to control moral hazard. There are several ways to do this.

One is to limit the amount of risk sharing. For instance, the clearing arrangement may limit clearinghouse recourse to member balance sheets by capping the amount of money they are obligated to contribute in the event of a member default. The simple model discussed above assumes that the clearinghouse has full recourse to each member's entire capital. Importantly, it has recourse to each non-defaulting member's entire capital. That is, it assumes that each member is obligated to "the last drop" of its capital. Due to the moral-hazard problem this presents, however, the clearinghouse members can agree to cap risk exposure by limiting the clearinghouse's recourse to their balance sheets.²⁸

Indeed, although some clearinghouses have so-called "Maxwell House" (good to the last drop) rules, which allow the clearinghouse to require members to contribute additional capital in the event that the clearinghouse's resources are insufficient to cover its obligations in the event of a default, this term is somewhat misleading. In fact, members are not committed to the full amount of their capital. Instead, the amount of additional contribution they can be required to make to the clearinghouse is usually capped under these rules. In other words, clearinghouses are not like Lloyd's of London of yore.²⁹

It should be noted that although this limitation on recourse reduces moral hazard, it also reduces the amount of risk sharing that occurs. This limits the economic benefits of a CCP that derive from risk sharing discussed above.

Another way to limit moral hazard is to restrict the sizes of positions that members can take. This can be done directly, through the imposition of position limits presumably based on information regarding the size and riskiness of each member's capital.³⁰ Alternatively, positions can be controlled indirectly, through collateralization—that is, margins.

Margins are costly.³¹ Moreover, the cost of margins is likely to depend on the size and riskiness of balance sheets. This means that position risk taking, and exposure to balance sheet risk, can be affected by a margin.

It is possible for the clearinghouse to constrain this excessive trading by increasing margins. Higher margins raise the marginal cost of trading, leading each dealer to trade less.

Although raising margins constrains trading, thereby mitigating the excessive trading arising from moral hazard, it is important to recognize that this mitigation of moral hazard comes at a cost: namely, the deadweight costs attributable to margins. Thus, fungibility is not free. Fungibility gives rise to moral hazard. Control of moral hazard through margins imposes deadweight costs on the clearinghouse members.

The costliness of moral hazard, or of controlling it through costly collateral, and the

Higher margins raise the marginal cost of trading, leading each dealer to trade less.

The costliness of moral hazard, and the resulting costliness of fungibility, implies that the formation of a clearinghouse may not be efficient.

resulting costliness of fungibility, implies that the formation of a clearinghouse may not be efficient if the benefits of fungibility, net of its costs, are lower than the net benefits of alternative means for trading derivatives and sharing default risks. This raises the questions of what determines the costs of fungibility and what are the net benefits of alternative mechanisms. Further, what determines these net benefits?

The primary alternative mechanism is to eschew clearing, and to rely on bilateral default risk allocation mechanisms. Thus, to evaluate the effects of different policies, including clearing mandates, it is necessary to undertake a comparative analysis of the costs of these alternative mechanisms.

Central to this analysis is the pricing of counterparty risk, whether through collateral, or through transactions prices. It is desirable that such prices reflect, at the margin, the costs of the risks transferred in derivatives transactions. The ability to set such prices depends crucially on the amount of information available about these risks. The amount of information, and the ability to utilize it, can differ across institutional structures.

In the following sections I analyze how information is likely to differ between cleared and bilateral markets, how these differences may depend on the characteristics of the products traded and the identities of those who trade them, and how the ability to condition risk prices on information is likely to differ between cleared and bilateral markets.

The Pricing of Counterparty Risk: A Comparative Analysis of Cleared and Bilateral Markets

The analysis in the earlier section on the effects of clearing in the absence of information demonstrated that the formation of a CCP can improve welfare by improving the allocation of default risk. However, this conclusion is dependent on counterparty risks

being priced efficiently. If they are not, risk will be allocated less efficiently than assumed in the model, and this reduces the value of clearing as compared to alternatives.

Information about risk is crucial to pricing it efficiently. The amount of information, the distribution of information, and the ability to use it, can differ across alternative institutional structures. Therefore, the comparative advantages relating to the amount of information available for pricing the relevant risks, and the ability to use it in cleared and bilateral settings, is essential to understand the relative efficiency of these alternatives. It is not much of an exaggeration to say that it is all about the information.

The discussion on default risk in derivatives markets provided a useful framework in which to analyze the information necessary to price default risk. Recall that the analysis there showed that default risk exposure arose primarily from position risk and balance-sheet risk. In what follows, I examine these risks, how the information about these risks and the ability to use it differs between cleared and bilateral structures, and how these differences may depend on the type of product and the characteristics of the firms that trade them.

Information about Price Risk and How It Depends on Instrument Complexity

First consider the issues relating to information regarding the risks of a particular type of instrument. To price risk, a CCP uses information on the risk-return characteristics of this instrument, and 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 held by 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 is not necessary to estimate these risks. Thus, for such instruments, centralized clearing is unlikely to face difficulties in evaluating the sufficiency of margin for a particular product.³² One would expect to observe central clearing for such instruments—and one does.

Things are quite different for instruments that are more complex, and/or which are traded in less liquid markets. 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.

Furthermore, in the event of a default, the clearinghouse must manage the risk of defaulted positions. It is more difficult to quantify and manage (hedge) the risks of more complex products.

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, the dealer internalizes these benefits.³³

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—which 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 as well as to 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. Such firms have 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 dealer has a better model than the CCP, it is able to price the risk more accurately, even if the former’s model is inaccurate. 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, nonlinear derivatives, consider the credit rating agencies’ disastrous experience with Collateralized Debt Obligations and monoline insurers. It is

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.

The default risk posed by a particular trade depends on the interaction between the payoffs to that trade and the value of the counterparty's balance sheet.

widely acknowledged that the agencies' models were extremely deficient.

Thus, it is almost certainly the case that for exotic derivatives, dealer firms that make markets in these products have much better information about their values and risks than would a CCP. This allows them to evaluate and price default risks more accurately. All else equal, this tends to favor bilateral trading of more exotic instruments and of instruments traded in less liquid markets.

It should be noted that CCPs that clear exotic instruments, about which sophisticated market participants have better information, are vulnerable to adverse selection. Sophisticated market participants who have developed better models about particular cleared instruments than has the clearinghouse can determine which risks the clearinghouse has underpriced and which ones it has overpriced (i.e., which risks are overmarginated and which risks are undermarginated). They will tend to trade those risks that are undermarginated (overmarginated) more (less) heavily, thereby exposing the clearinghouse to greater default losses than it expects based on its model.

In contrast, dealers, who are likely to have the best (again, not perfect) understanding of the risks of particular products, because of their extensive investment in modeling and evaluating these risks are less vulnerable to this type of adverse selection. Since adverse selection is a cost of risk sharing, this tends to reduce the costs of bearing counterparty risk in bilateral OTC markets relative to the costs of centrally cleared structures.

Balance Sheet Risks and Asymmetric Information

Now consider balance sheet risk. Dealers are likely to have better information for evaluating counterparty balance sheet risk than a CCP.

CCPs collect information on the balance sheets of their members and rely on the members to evaluate and manage the balance-sheet risks of the customers they clear for. The main source of information for CCPs regarding balance sheet risks is the financial statements of

member firms, augmented with information collected during audits.

This "hard" information is important and valuable, but other sources of information are valuable, too. In particular, a market participant who deals repeatedly with other firms in a variety of markets collects information about the positions, risks, and financial condition of its counterparties over and above what is available in financial statements. Indeed, financial intermediaries specialize in the collection and analysis of information and the use of this information to evaluate the creditworthiness of their trading partners; large financial firms are, first and foremost, information intermediaries. Put differently, by virtue of their repeated interactions with other dealers in multiple markets and their extensive commercial information networks, OTC market dealers have private information about the balance-sheet risks posed by their counterparties.

Moreover, there is the potential for considerable heterogeneity among dealer firms and among CCP members. They have different amounts of capital. They engage in different activities. They have different assets on their balance sheets and different sources of funding. All of these differences create heterogeneity in balance-sheet risks across members.

It should also be noted that there is an interaction between product risk and balance-sheet risk. The default risk posed by a particular trade depends on the interaction between the payoffs to that trade and the value of the counterparty's balance sheet. A dealer with a better understanding than a CCP of the risks of a particular product and of the balance-sheet risks of a counterparty will have a more accurate understanding of the relevant default risk than will the CCP. This is particularly true for exotic products, in part because of the dealer's information advantage relating to such products discussed above. Moreover, especially for these products, dealers work with customers in the design and marketing of the products themselves. As a result of this interaction, dealers learn about the balance-sheet

risks of the customer and 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 to understand the effectiveness of that hedge, than a third-party CCP.

And, of course, a large financial intermediary is certain to have better information about the interaction between its own balance sheet and price risks than would a CCP. The CCP therefore faces an adverse selection problem when facing this intermediary. Other dealers trading with this firm bilaterally in the OTC market would also be subject to adverse selection, but it is likely that their superior understanding of the price risks of more complex instruments and the financial condition of other large intermediaries makes them less vulnerable to this problem than a CCP.

The differences in information about balance-sheet risk between OTC and centrally cleared markets, and the heterogeneity of financial institutions, tend to make bilateral markets comparatively efficient at evaluating and pricing balance-sheet risks. Institutional constraints reinforce this information disadvantage of CCPs.

To provide the proper incentives, and to avoid a redistribution of wealth among members, a CCP would have to charge different counterparty risk prices to the heterogeneous members. Informational and governance considerations make this extremely difficult, and costly, however. As just noted, the CCP is unlikely to have the information necessary to make accurate and discriminating analyses of balance-sheet risks and to price these risks accordingly.

Moreover, a CCP that attempts to differentiate counterparty risk prices across members creates an incentive for each to influence the CCP to set its risk price favorably and its competitors' risk prices unfavorably. These influence activities are costly.³⁴ Indeed, they can be so costly that it is cheaper for the CCP to eschew any effort to set counterparty-spe-

cific risk prices and instead to charge all members the same prices.

In fact, 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 member's portfolio of cleared products, such that two members with the same portfolio would post the same collateral even if their balance-sheet risks were quite different.³⁵ CCPs do impose some constraints on balance sheets, but normally through capital requirements that are simply a function of collateral levels, and which, hence, do not reflect individualized information on balance-sheet risks, because these collateral levels do not. 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.

The lack of balance-sheet-risk pricing is costly for several reasons. First, it leads to an inefficient allocation of trading activity across members and inflates default and margining costs; high-balance risk firms tend to trade too much, while low-balance risk firms trade too little. Second, it provides an incentive for members of the CCP to take on additional balance-sheet risks because such risks are not priced; at the margin, each member does not bear the entire cost of adding additional risk to the balance sheet (e.g., by investing in risky securities or making risky loans), because the costs this action imposes on other CCP members is not priced.

In contrast, OTC dealers in a bilateral setting have information about the balance-sheet risks of their counterparties that is not generally available to a CCP, and they can use this information to price risks in various ways. For instance, OTC dealers can use this information to vary collateral to reflect their estimates of counterparty balance-sheet risk. Moreover, OTC dealers can price credit into deals. That is, they can vary transaction prices and other transaction terms (such as counterparty expo-

The differences in information about balance-sheet risk between OTC and centrally cleared markets tend to make bilateral markets comparatively efficient at evaluating and pricing balance-sheet risks.

Moral hazard is inherent in the mutualization of risks, and it is costly for clearinghouses to control moral hazard.

sure limits) to reflect their information about counterparty credit risk. CCPs cannot do so, and this is one of the costs of fungibility.

Summary

There is a fundamental trade-off involved in market structure. Bilateral markets do not provide fungibility, but since fungibility is costly, fungible cleared markets are not necessarily more efficient than bilateral ones. The costs of fungibility vary by product and by the characteristics of dealers. When these costs are sufficiently large, bilateral markets can be the more efficient way of organizing transactions and allocating performance risk.

Absent moral hazard and adverse selection, and given comparable information to price risks, a clearinghouse would be an efficient way to share default risk because it can achieve the greatest possible pooling of risks. But moral hazard is inherent in the mutualization of risks, and it is costly for clearinghouses to control moral hazard.

Informational considerations are of paramount importance in determining which market structure is the most efficient at allocating and controlling counterparty risk. Better information allows better pricing of risks, thereby providing better incentives. Moreover, asymmetries of information are of crucial importance. Centralized risk sharing via a CCP is more costly when market participants have better information about price and balance-sheet risks than does the CCP. Information disparities make the CCP vulnerable to adverse selection.³⁶

Bilateral OTC markets are less vulnerable to moral hazard than is a CCP. Moreover, dealers in bilateral markets are likely to have better information about the price risks of certain products, especially more complex ones that trade less frequently, and the balance-sheet risks of counterparties. Superior dealer information permits more accurate pricing of risks and more efficient control of moral hazard and adverse selection. This is particularly true in the cases of substantial dealer heterogeneity and private information about dealer balance sheet and price risks. These conditions tend to

force the clearinghouse to choose a single “one-size-fits-all” margin for all members, even though they impose different default costs. Clearinghouses are also forced to choose this single margin using relatively imprecise information and poorer information than other market participants have.

Externalities in Performance Risk Management

The foregoing analysis concludes that informational and contracting frictions make bilateral mechanisms the (relatively) efficient way to bear and manage some counterparty risks. There are counterarguments. For instance, Acharya et al. argue that clearing improves efficiency because bilateral arrangements result in an externality.³⁷ They essentially make an asset substitution argument. A dealer firm, A, that enters into a new contract with counterparty, B, fails to take into account the effect this deal has on the riskiness of contracts previously entered into with C, D, and so forth. They further argue that clearing would internalize this externality, thereby improving efficiency.

Several things deserve comment. First, as noted above, clearing also potentially creates an externality that is costly to manage. Second, the potential for this asset substitution problem is inherent in all sequential financial contracting, and market participants have developed mechanisms for addressing it that do not involve clearing. Many of these mechanisms are also employed in bilateral markets.

An externality involves a cost or a benefit that is not priced. There are a variety of mechanisms by which the risks identified by Acharya et al. are priced. Most notably, repeat dealing and capital structure impose costs on financial institutions that engage in the risk-increasing asset substitution strategy that they decry.

Major dealer firms deal nearly continuously on the market. Although their counterparties cannot assess their creditworthiness perfectly, they do collect information about it

on an ongoing basis (and as argued above, likely have better information about it than a clearinghouse). Changes in riskiness, as measured by counterparties, will affect the terms on which a dealer can trade, including prices, quantities, and collateral.

Moreover, the liability structures of dealer firms limit their ability to engage in these asset substitution strategies.³⁸ Dealers typically rely on very-short-term financing, including repurchase agreements and short maturity debt. Changes in perceived riskiness will affect the financing terms that creditors offer such dealers. Indeed, as has been demonstrated repeatedly, changes in perceived riskiness, if sufficiently acute, can lead to a complete loss of access to credit for a large intermediary—this is effectively a death sentence to the firms thus affected. That is, dealers are subject to runs.

The very-short-maturity liability structure effectively ensures that dealer risks are repriced on a nearly continuous basis, thereby sharply limiting the profitability of the asset substitution strategy analyzed by Acharya et al. Put differently, as noted by Diamond and Rajan, intermediaries typically have very fragile financial structures; these structures serve as a disciplining device that punishes opportunistic behavior.³⁹

The argument that bilateral structures create an externality that leads to excessive risk taking presumes that there is no mechanism by which the firm taking on the risk is charged for it. But the necessity of dealing repeatedly in the market and financing its activities ensures that a dealer's risks are priced continuously. When one considers that, as noted above, it is also the case that CCPs typically do not condition collateral charges on estimates of counterparty risk, and dealer firms are likely to have better information about the risks posed by other dealers than would a clearinghouse, it is plausible that risks are priced more accurately in dealer markets than in cleared structures. Furthermore, it must also be noted that, at best, a clearinghouse is likely to take into account only the economic interests of its members; this means that even a clearinghouse does not internalize all relevant costs and risks

because nonmembers incur some of these costs.

Other Factors Affecting the Comparative Costs and Benefits of Cleared and Bilateral Markets

Clearing and bilateral mechanisms differ along other dimensions that those already discussed. These include the scope of netting, scale and scope economies, and the cash intensity and flexibility of collateralization.

Netting

One of the putative benefits of clearing is that it permits multilateral netting. That is, whereas only offsetting bilateral exposures can be net in a noncleared market, offsetting positions across “rings” of three or more traders can be netted out in a clearing system.⁴⁰ Netting reduces exposures, and thereby reduces the amount of collateral required to support a given set of net positions.⁴¹ This economizes on costly collateral. Moreover, in the event of a default, only multilaterally net positions need be replaced, whereas in a bilateral market, a default may require some parties to replace larger bilaterally net positions. Reducing the number of positions that must be replaced can mitigate the price disruptions that result from a default, and the consequent rush to replace the defaulted positions.

That said, multilateral netting does not necessarily justify the adoption of clearing. As noted earlier, there are other costs associated with clearing that may exceed the benefits attributable to multilateral netting. Indeed, since netting economies are captured by the clearing participants, their conscious choice to eschew clearing for some products is consistent with these other costs exceeding these netting economies.

Moreover, netting effectively alters creditor priority. Multilateral netting gives the participants in a clearing arrangement priority over a defaulter's other creditors.⁴² Close-

The argument that bilateral structures create an externality that leads to excessive risk taking presumes that there is no mechanism by which the firm taking on the risk is charged for it.

The benefits of netting are internalized by those who participate in the netting arrangement.

out netting in the event of default also gives derivatives counterparties priority over other creditors in bilateral markets. Thus, netting reallocates wealth in the event of a default from the defaulter's non-derivatives creditors to its derivatives counterparties; this is not necessarily socially beneficial or systemically stabilizing.

Finally, it is possible to achieve some multi-lateral netting economies without sharing risk via clearing. For instance, prior to the adoption of clearing at the Chicago Board of Trade in 1925, groups of three or more market participants would ring out offsetting positions. These rings were voluntary. Sometimes traders would refuse to participate in a ring, even when it would reduce exposures, because they preferred larger exposures to some counterparties than the smaller exposures to other counterparties that would result from the formation of a ring.

At present, compression and tear-up services perform a similar function in OTC derivatives markets. Furthermore, some mechanisms, such as the system created by NetDelta, impose netting but do not share default risks as in a clearinghouse. Another prominent example comes from the oil industry, where market participants who are parties to long "daisy chains" of dated Brent contracts "book out" offsetting deals by mutual consent.⁴³ Thus, although clearinghouses net, netting does not require clearing.

Finally, it should be noted that the benefits of netting are internalized by those who participate in the netting arrangement. The benefits of netting therefore do not provide a justification for *requiring* clearing.

Scale and Scope Economies

There are extensive scale and scope economies in default risk allocation mechanisms. These arise in part from scale and scope economies in netting.⁴⁴ They also arise from the fact that the amount of capital required to assure a particular probability that all contractual payments will be made is larger if two dealers, or two clearinghouses, merge than if they remain separate.⁴⁵

Both phenomena arise from a common source. Default exposures are effectively options. The exposure to default of a large dealer, or a clearinghouse, is an option on a portfolio, because the dealer (or clearinghouse) has a portfolio of positions. Since it has long been well known that an option on a portfolio is cheaper than a portfolio of options, the expected value of the default exposure on two portfolios is greater than if those portfolios are merged. In essence, a large dealer (clearinghouse) that is the counterparty to a large number of different trading partners (clears a large number of firms) in deals involving a varied set of instruments exploits the diversification effects arising from the imperfect correlations between the different balance-sheet risks and price risks in its portfolio.⁴⁶

The structures of the exchange-traded and OTC markets reflect, in part, these scale and scope economies. The consolidation of exchanges in the United States and Europe has been intended, in part, to exploit these scale and scope economies. Similarly, the highly concentrated nature of the OTC derivatives markets, where a small number of huge dealers dominate, also reflects the scale and scope economies: the costs of large dealers are smaller due to their scale and scope.

Pirrong shows that informational factors can also give rise to scope economies.⁴⁷ A dealer that transacts with a particular counterparty in a variety of instruments—which may include things other than derivatives, such as loans or repurchase agreements—is likely to possess information on this counterparty that can be used to control moral hazard and adverse selection costs (i.e., to price default risks more accurately). This information can be utilized across a variety of transactions, giving rise to a scope economy.

Scale and scope economies are frequently in tension. As shown for netting economies by Duffie-Zhu, and for capital costs by Pirrong, formation of a clearinghouse for a subset of derivative instruments typically generates scale economies because the risks for these instruments are being shared among a larger number of entities, but it sacrifices scope

economies, either because the dealers are left with a less diversified portfolio of instruments on their OTC books, or because other instruments are cleared at separate CCPs.⁴⁸

Assuming for the sake of argument that some derivatives are unsuitable for clearing, scope economies may impede the creation of a clearinghouse for other instruments not subject to these impediments. Moving these trades from dealer books to a clearinghouse achieves additional scale economies but sacrifices scope economies, as the dealer's remaining OTC portfolio is less diversified than prior to the move.

A priori, it is not possible to determine which effect dominates. That is, the scope economies lost may exceed the scale economies gained. The loss of scope economies can explain why dealers may be reluctant to support moving even relatively "vanilla" products to a clearinghouse. It also implies that mandating clearing for some products can actually reduce efficiency.

Clearing and Cash Management

Clearinghouses typically require both members and customers to post collateral in cash or highly liquid instruments such as Treasury bills and to adjust collateral on a daily basis.⁴⁹ This can result in highly volatile cash flows for customers. Moreover, it can lead to cash-flow mismatches for hedgers. Even if the price of a particular cleared product is highly correlated with the price risk a firm is hedging, price changes necessarily generate cash flows for the cleared product but may not do so for the position being hedged.

Furthermore, the amount of cash or other liquid instruments that derivatives users would have to post as initial margin would be dramatically higher under a clearing mandate. The International Monetary Fund has estimated that an additional \$150 billion in bank capital may be required as a result of clearing mandates.⁵⁰ An IMF economist estimates that the total could be as high as \$200 billion for major derivatives dealing banks.⁵¹ Organizations representing end users have stated that the

amounts will be even larger. For instance, in a letter to Senators Reid, Lincoln, and Chambliss, the Natural Gas Supply Association and the National Corn Growers Association estimate that a clearing mandate would require an additional \$900 billion in collateral in the United States. Goldman Sachs estimates that clearing will require CDS participants to post an additional \$75 billion in initial margin, and will require interest-rate-swap participants to post \$570 billion.⁵²

In contrast, collateralization mechanisms in OTC markets are typically more flexible, and dealers can customize the products and the collateralization mechanism so as to mitigate the cash flow volatility and mismatches that daily mark to market can produce.⁵³

Customers, therefore, may have a preference for contracts with lower cash flow volatility and mismatches, even if these products are nonfungible, and even if they pose higher default risk. Put differently, from a customer's perspective, cash-flow risks are a cost of fungibility, and this cost may exceed the benefits. This helps explain why many users of derivatives are strongly opposed to mandated clearing of their trades, even though the simple risk-sharing analysis on the effect of clearing on risk bearing, detailed earlier in this paper, implies that these users would be the main beneficiaries of clearing.

The fact that some customers have a preference for bilateral contracts with customized collateralization mechanisms implies that, absent some legislative or regulatory diktat, some dealers will offer bilateral, noncleared contracts. As discussed earlier, this in turn implies that clearing other contracts can reduce the scope economies across the contracts that will remain bilateral, as well as those moved to the clearing mechanism.⁵⁴

The Resolution of Defaults

The foregoing analysis focuses on the ex ante incentive and information effects of alternative ways of managing counterparty risk. The basic conclusion of the analysis is

An additional \$150 billion in bank capital may be required as a result of clearing mandates.

Several aspects of a cleared system tend to mitigate market disruptions associated with a large default.

that bilateral mechanisms can have decided advantages on these dimensions. But there are other factors that need be considered. In particular, it is also necessary to undertake a comparative analysis of how different mechanisms resolve defaults.

When a trader defaults, its counterparties must replace the defaulted positions.⁵⁵ For instance, someone who has sold a derivative contract to the defaulter is likely to desire to find a new counterparty to whom he can sell this type of contract or a close substitute.

In a cleared market, the CCP is the counterparty to defaulted positions. Prior to the default, it had no exposure to market-price risk, because it was the buyer to every seller, and vice versa. After the default, the CCP has a market-price exposure that it must offset. The CCP knows the positions it has to replace. It can either cover those positions through trading on the open market, or cover them by an alternative method. A common alternative method is to arrange an auction in which other clearinghouse members bid to replace the defaulter as a counterparty. For instance, immediately prior to the Lehman bankruptcy, the Chicago Mercantile Exchange clearinghouse solicited bids from five big member firms to assume Lehman's proprietary positions. After the Lehman bankruptcy, LCH Swapclear, which clears interest rate swaps, engaged in a similar process.

When customer accounts are cleared, CCPs typically move the defaulter's customer accounts to other clearing members. Thus, the counterparties of these contracts are effectively replaced without any market transactions.

Things are different in a bilateral OTC market. In such a market, there is no centralized mechanism to coordinate, through market transactions or otherwise, the replacement or hedging of defaulted positions. Instead, the defaulter's counterparties use the ordinary trading mechanisms to replace/hedge.

In the event of a large default, like Lehman's (or like Long Term Capital Management's in 1998), the surge of replacement transactions can overwhelm traditional market mechanisms. There is a spike in the

demand for liquidity. Moreover, this spike may well occur when liquidity is already low because of the direct effect of the default of a large market participant that had been an active liquidity supplier, because periods of market stress that can trigger default-inducing losses are typically associated with high uncertainty and low liquidity. It is also because market liquidity shocks can be one factor that precipitates the default of a large market participant.⁵⁶ Moreover, these replacement trades typically take place when market participants are radically ignorant of the defaulter's positions.

The need to replace large numbers of defaulted positions in a short time in an illiquid market can lead to extremely elevated price volatilities, asset price correlations, and large price moves. These price shocks arising from the rush to replace defaulted trades can impose substantial losses, in cash, and on a mark-to-market basis, that can threaten the solvency of other market participants.

It was the very fear of the disruptive effects of the replacement of a large number of trades that precipitated the extraordinary measures by a number of financial institutions (often mischaracterized as a bailout), coordinated by the Federal Reserve Bank of New York, to rescue Long Term Capital Management.⁵⁷ The consequences of the Lehman default were also a destabilizing factor at the climax of the financial crisis in September 2008.

This is not to say that the replacement of defaulted cleared positions is not immune from price impacts. The experience of the CME in handling the Lehman default illustrates that CCPs face challenges in replacing defaulted positions in stressed market conditions.⁵⁸ LCH Swapclear also faced some difficulties in handling Lehman's defaulted interest rate swap positions.

However, several aspects of a cleared system tend to mitigate market disruptions associated with a large default. The multilateral netting inherent in clearing reduces the positions that have to be replaced relative to a bilateral market. Moreover, customer positions are transferred, rather than replaced, via

market transactions. Furthermore, a coordinated auction-type mechanism can mitigate price impacts, whereas an uncoordinated process as in the OTC market can result in larger price volatility and bigger price shocks.

Some research that grew out of the 1987 crash sheds light on this last issue. An interesting paper by Greenwald and Stein shows that normal, continuous trading mechanisms can exhibit poor performance during periods of market stress caused by a large shock to the volume of transactions, especially when this shock is accompanied by an increase in fundamental uncertainty.⁵⁹ In essence, there are execution price risks in these circumstances that create negative externalities. Potential replacement counterparties are reluctant to trade in these circumstances because of the extreme uncertainty about execution prices during periods of large volume shocks. This tends to reduce liquidity, which tends to exacerbate the execution price risk.

This means that the uncoordinated replacement of large numbers of defaulted positions by a large number of firms through the use of ordinary, continuous market mechanisms, whether OTC or exchange, can lead to substantial price changes that are not fundamentally driven but are microstructural in origin. This can have further knock-on effects, as these distorted market prices affect collateral/margin calls, can induce asset fire sales, and more. To mitigate these effects, Greenwald and Stein recommend the suspension of ordinary continuous market trading during times of stress, and reliance instead on periodic call auctions that batch orders.

There is a colorable case that the combination of multilateral netting and the existence of a central counterparty that can coordinate the transfer and replacement of defaulted positions can reduce the cost, conditional on a default occurring. Multilateral netting reduces the magnitude of the positions that need replacing. This reduces the stress on market liquidity resulting from a default. Moreover, clearing facilitates the transfer of customer positions to solvent

clearing members, thereby avoiding the necessity of replacing these positions via market transactions, further reducing stress. Furthermore, the information that a CCP possesses about total positions, and its ability to coordinate the hedging/replacement of the defaulted risks, can reduce uncertainty and mitigate price impact. It should be noted, however, that the experience of the CME with the Lehman problem demonstrates that this is, at best, a relative statement. Difficulties in unwinding these positions have been documented by the Valukas report, and are corroborated by what I have learned from informed sources; namely, that the LCH Swapclear unwind of the Lehman positions was not as breezy as LCH SwapClear has suggested.

Thus, a plausible characterization of a key trade-off between bilateral and cleared structures is that many counterparty risks are more efficiently priced and shared in a bilateral setting, and hence moral hazards and adverse-selection problems are less acute in that setting. As discussed in more detail in the next section, hub-and-spoke clearing networks create concentrated points of failure that are more problematic than more distributed (but still concentrated) bilateral networks, but a cleared system reduces replacement cost risks/price impacts conditional on default.

This raises a question: is it possible to obtain the information benefits associated with bilateral arrangements for some transactions, while mitigating the price impact of an uncoordinated replacement of defaulted positions?

Put differently, clearing is a bundle of functions including, among others, the pricing of counterparty risks, the mutualization of losses not covered by collateral, and the management of risk associated with defaulted positions and the replacement of these positions. I argue that for many transactions and transactors, bilateral mechanisms are superior for pricing counterparty risks and mutualizing losses; I recognize that CCPs may manage risk better. Is there any way to get the benefits of

A key trade-off between bilateral and cleared structures is that many counterparty risks are more efficiently priced and shared in a bilateral setting.

Clearing can actually increase the exposure of firms to counterparty risk.

managed risks without incurring the disadvantages that CCPs arguably face with pricing counterparty risks and mutualizing losses? Later, I will outline a policy proposal intended to achieve this objective.

Systemic Risk

Obama administration officials, notably Treasury Secretary Timothy Geithner and CFTC chair Gary Gensler, as well as some congressional leaders, have advocated that the government require as many contracts as possible be cleared by CCPs. The thrust of their argument is that central clearing would reduce systemic risk and greatly lower the likelihood of a repeat of the 2007–2009 financial crisis.

Many of the arguments these advocates have advanced are fundamentally flawed, both conceptually and in terms of the anecdotes that they invoke to justify their case. For example, such advocates have repeatedly stated that the interconnected nature of the financial system makes it vulnerable to contagion, in which the failure of one large financial institution brings down others with which it has traded. They state further that clearing “greatly reduces” these interconnections.⁶⁰ Advocates have also claimed that CCPs eliminate counterparty risk and guarantee all payments owed under derivatives contracts.⁶¹

These claims are both patently false. As noted above, a CCP is an interconnection among financial firms. At most, creation of CCPs changes the topology of the network of connections among firms, but it does not eliminate these connections. Indeed, inasmuch as large financial intermediaries are typically members of CCPs, the same firms that trade in OTC markets would also be interconnected via clearinghouses; moreover, as discussed below, clearing can actually increase the exposure of these firms to counterparty risk. And as I will discuss in detail below, CCPs are concentrated points of potential failure that can create their own systemic risks. CCPs also do not eliminate counterparty risk. The finan-

cial capacity of CCPs to absorb default losses is limited, and somebody—namely, financial institutions—has to capitalize them, and absorb default losses not covered by collateral.

Moreover, the anecdotes routinely (and tiresomely) cited in support of central clearing are inapposite and, indeed, misleading. AIG is constantly invoked to show what can happen in the absence of clearing. This example is deeply misleading because, for reasons discussed above related to product complexity, the instruments that brought down AIG would never have been clearable. It is also misleading because of hindsight bias. It is commonly claimed that if AIG had been required to collateralize its trades, it never would have been able to assume the huge risks it did. But firms did not require AIG to post initial margin because they perceived, given the information and beliefs prevailing at the time, that the default risks posed by the trades and by AIG itself were small: why would one expect a CCP operating in the same intellectual environment to arrive at a different conclusion—especially inasmuch as credit rating agencies did not?⁶² Furthermore, even if the AIG positions had been cleared, the firm’s financial implosion would have imposed default losses on the CCP—which would have imposed costs on its members—which would have almost certainly have included the same firms at risk of default on its OTC positions.⁶³

It is also by no means self-evident that the financial crisis in 2008 was, in the first instance, an example of contagion; it may instead have resulted from a common shock hitting many financial institutions simultaneously.⁶⁴

The case for clearing on the basis of its systemic-risk-reducing effects is therefore nonexistent, at least as the case has been stated by its most fervent advocates. So just what is the effect of clearing on systemic risk? The answer to that question is complicated and ambiguous. But it suffices to say that clearinghouses can increase, as well as reduce, systemic risk.

The analysis from earlier in this article provides a framework for understanding how

clearing can affect systemic risk. First, the analyses from the sections on the effect of clearing on the efficiency of risk bearing and other factors affecting costs and benefits show that clearing can affect the magnitudes of positions taken and the amount of risk exposure taken. Specifically, by widening the allocation of default risk, clearing tends to induce hedgers and speculators to take larger positions. This effect tends to increase the total amount of risk exposure, including counterparty risk exposure. Moreover, as noted in the section on factors affecting costs and benefits, position netting tends to free up capital and collateral, which allows firms to take on bigger positions.⁶⁵ This can be beneficial, but it also increases the total counterparty risk exposure, which affects the level of systemic risk. Furthermore, to the extent that CCPs do not price counterparty risk as effectively as is done in OTC markets, moral-hazard and adverse-selection problems tend to induce an increase in risk exposure. Thus, for a variety of reasons, clearing can encourage risk taking which, *ceteris paribus*, can increase default risk and, hence, contagion risk.

Second, clearing also changes the allocation of performance risk in ways that do not clearly further systemic risk reduction. Recall that clearing transfers some default losses from customers to CCP members, who are more likely to be systemically important financial institutions. Moreover, the introduction of multilateral netting inherent in clearing changes creditor priorities. This change in priorities is not obviously systemically risk reducing; it tends to reduce the exposure of CCP members that are likely to be systemically important financial institutions, but it increases the exposure of others who might themselves be systemically important. For instance, unsecured creditors like commercial paper buyers may lose as a result of the change in priorities. Events in 2008 suggest that this is indeed a problem. For instance, losses on Lehman commercial paper threatened money market mutual funds. Fear of a run on these funds spurred the Federal Reserve to guarantee them.

Relatedly, many of the arguments claiming that clearing reduces systemic risk do not consider the equilibrium responses of market participants to a clearing mandate. For instance, it is often claimed that since OTC deals often involve no posting of initial margin (independent amount), and cleared deals always require initial margin, default losses on cleared derivatives transactions are smaller, *ceteris paribus*.

It must be recognized, however, that this does not imply that clearing reduces the risk of failure of a financial firm (with possible systemic consequences). Collateralization reduces the credit/leverage in a derivatives transaction. But if firms are forced to reduce leverage in one set of transactions, they can increase it in others. If a firm has a given debt capacity, or a target leverage, it will almost certainly respond to a mandated reduction of leverage in one set of transactions by using the freed-up debt capacity to increase leverage elsewhere. Nor is it obvious that the type of leverage the firm uses for a substitute for the reduced derivatives leverage will reduce its vulnerability to a run. A firm's pre-mandate capital structure implies a certain probability of a run, and since it was chosen by the firm, it is presumably a maximizing choice given the firm's knowledge. The mandate is likely to induce substitution towards other forms of leverage that result in a similar probability of a run. Given that the capital structure that will result from the mandate differs from the one freely chosen by derivatives transactors, the mandate will make them worse off. It is essential to recognize that market participants are likely to make adjustments that undo or offset the effects of imposed increases in collateralization on overall firm leverage.

This means that increasing derivatives collateralization through clearing may not substantially reduce the probability of bankruptcy, or runs, as its advocates claim. The main effect will be to redistribute losses consequent to a bankruptcy or run. Derivatives counterparties may suffer smaller losses, but other counterparties suffer commensurately more. One cannot determine, *a priori*, that this real-

Clearing can encourage risk taking which, *ceteris paribus*, can increase default risk and, hence, contagion risk.

Clearinghouses create concentrated nodes that interconnect financial firms—and these nodes can fail.

location of default losses is more efficient or reduces systemic risk. If there are externalities associated with credit and leverage, why should credit exposure in a derivatives transaction create a more harmful externality than a credit exposure inherent in some other transaction? Since firms will almost certainly adjust capital structures in the aftermath of a clearing mandate so that the mandate will not substantially affect its overall leverage or its financial fragility, the effect of a mandate on leverage-induced systemic risk is likely to be small. If firms take on excessive leverage, that needs to be addressed through the elimination of, among other things, the tax subsidy for debt and the implicit subsidization of creditors of “too-big-to-fail” firms. In the presence of these inducements to borrow, a clearing mandate is likely to result mainly in a shift in the *form* of leverage, rather than its amount.

But the most potentially serious systemic effect of the mandated introduction of CCPs is that clearinghouses create concentrated nodes that interconnect financial firms—and these nodes can fail. That is, CCPs are concentrated points of potential failure that are systemically important and whose failure could cause a contagion effect—precisely what current reformers are anxious to avoid.

This is more than a theoretical possibility. Clearinghouses have failed. The Kuala Lumpur CCP failed in 1983. The French Caisse de Liquidation clearinghouse failed in 1974. The Hong Kong Futures Exchange failed in 1987, and was bailed out by the government.

But the most modern, well-documented, and sobering example is the near failure of major derivatives CCPs in the immediate aftermath of the 1987 crash. On October 19–20, 1987, the clearinghouses of the Options Clearing Corporation, Chicago Mercantile Exchange, and the Chicago Board of Trade were on the verge of failure. Arguably, only prompt action by the Federal Reserve prevented such a catastrophe.⁶⁶

In a nutshell, because of the large moves in stock prices on October 19, 1987, the magnitude of margin calls were far larger than on typical days. Moreover, there were serious doubts

about the solvency of several members of major clearinghouses, including the Chicago Mercantile Exchange clearinghouse, the Board of Trade Clearing Corporation, and the Options Clearing Corporation. In these circumstances, normal clearing and payment mechanisms were on the verge of breakdown.

Under normal conditions, banks typically extended short-term credit to clearing members to permit them to meet margin calls and to deal with the mismatch between the time that members had to post variation margin with the clearinghouse and the time that customers paid variation margin to the members. Given the huge amount of margin payments pending, and the uncertainty about the effect of the crash in prices on the financial condition of clearing members, many banks were reluctant to extend credit as normal. Absent credit, some CCPs members would have been unable to meet margin calls, and the margin shortfalls would have exceeded the ability of the clearinghouses to meet their obligations to those with winning trades, thereby forcing the closure of the clearinghouses—and of the markets. Moreover, concerns about the solvency of clearing members sparked rumors about the solvency of the CCPs. These rumors sparked additional panic selling that contributed to the magnitude of the crash.⁶⁷

Disaster was averted at the last minute due, in large part, to the intervention of the Federal Reserve. The Fed assured the market that it would supply sufficient liquidity to market members. It pressured banks to lend to securities firms and clearing members. It also permitted a large bank to absorb the liabilities of a subsidiary that was a major clearing firm, thereby preventing its default. In the end, it was a close-run thing.⁶⁸

As an academic, current Fed chairman Ben Bernanke wrote of the lessons of the crash for the clearing system:

The malfunctioning of the banking side of the clearing and settlements systems during this period is *indisputable*. The official reports and other observers generally agree that the Federal Re-

serve's attempts to alleviate the crisis were very constructive. On the morning of Tuesday, October 20, the Fed issued a brief statement: "The Federal Reserve, consistent with its responsibilities as the nation's central bank, affirmed today its readiness to serve as a source of liquidity to support the financial and economic system." This statement was backed up by three types of actions: first, the Fed reversed its tight monetary stance of the previous weeks and flooded the system with liquidity. Second, the Fed "persuaded" the banks, particularly the big New York banks, to lend freely, promising whatever support was necessary. (The 10 largest New York banks nearly doubled their lending to securities firms during the week of October 19.) Finally, the Fed monitored the situation and took some direct actions where necessary, notably in the case of First Options of Chicago. When that large clearing firm was in danger of defaulting, Fed chairman Greenspan acted quickly to enable its parent firm, Continental Illinois, to inject funds into its subsidiary; according to some observers, this action may have helped avoid the closing of the options exchange.

In retrospect we may ask, what really were the dangers to the integrity of the financial markets posed by the crash? And what were the benefits of the Federal Reserve's actions? The technological problems of communications and information availability that plagued the system, while serious, did not in and of themselves threaten to bring down the markets. For the most part, information availability was a critical issue during the crash only in the sense that illiquidity is essentially a problem of imperfect information. (Clearly, though, improvements in these technologies should be made.)

It was the financial problems—the possibility of insolvency by major

players—that were potentially more serious. As we have emphasized, financial problems impaired the market's functioning in at least two ways. First, concerns about solvency impeded the operation of the payments and clearing systems, contributing to financial gridlock. Second, the fear that major brokers, FCMs, or clearinghouses might default created uncertainty about the contract performance guarantee. Both aspects reduced market liquidity and disrupted trading. Conceivably these problems could have forced a market shutdown.

In response to this situation, the Federal Reserve, in its lender-of-last-resort capacity, performed an important protective function. The Fed's key action was to induce the banks (by suasion and by the supply of liquidity) to make loans, on customary terms, despite chaotic conditions and the possibility of severe adverse selection of borrowers. In expectation, making these loans must have been a money-losing strategy from the point of view of the banks (and the Fed); otherwise, Fed persuasion would not have been needed. But lending was a good strategy for the preservation of the system as a whole.

The principal effect of the loans was to transfer some trader default risk from the clearinghouses and their members to money-center banks. Under the presumption that the money-center banks were well capitalized, and that in any event their solvency would be guaranteed by the government, this transfer of risk reduced the overall threat of insolvencies in the system. This allowed the payments process to begin to normalize; it also restored confidence in the clearinghouse's guarantee of futures contract performance. The resulting stabilization of the markets served the interest of the banks and the Fed in a wider sense, by avoiding any potential costs that a market breakdown might

Illiquidity is essentially a problem of imperfect information.

The very mechanism that is commonly asserted as the way that clearing reduces systemic risk can be the mechanism that creates systemic risk.

have imposed on the banking system and the general economy.

In performing its lender-of-last-resort function, the Fed redistributed risks in the system in a socially beneficial way. Conceptually, it is as if the Fed had provided ex post insurance to the clearinghouse against a shock that it seemed possible would exhaust the insurance capability of the clearinghouse itself. Thus the Fed became the “insurer of last resort.”⁶⁹

Several lessons are clear. First, as Bernanke noted, there is an intimate interconnection between the banking and clearing systems; it is an absurdity to assert, as Geithner, Gensler, and others have, that clearing substantially reduces the interconnectivity of the derivatives and banking markets. Bernanke specifically states:

A prominent part of the institutional structure is the interconnection of the clearing and settlement systems with the banking system. This interconnection exists at several points. First, banks are operationally a part of the clearing process. Clearinghouses typically maintain accounts at a number of clearing banks. Member FCMs are required to maintain an account at a minimum of one of these banks and to authorize the bank to make debits or credits to the account in accord with the clearinghouse’s instructions. This facilitates the settling of accounts and the making of margin calls. Note that the bank’s role may exceed simple accounting if, for example, it must decide whether to permit an overdraft on an FCM’s account

Second, banks are a major source of credit, especially very short-term credit, to all of the parties, including the customers, the FCMs, and the clearinghouse itself. As was noted above, bank letters of credit can in some cases be used as initial margin. Customers and FCMs often rely on

bank credit to facilitate the speedy posting of variation margin, and FCMs would typically have to turn to banks to finance payments made necessary by customers’ defaults or slow payment. In equity markets, banks are often the ultimate source of credit for the purchase of securities on credit. Finally, it should be noted that while, in the conventional language, most margin postings and settlement payments are made in cash, these transactions are, of course, not really made in cash but by the transfer of bank deposits. Thus, the smooth operation of the financial market clearing and settlement system is based at all times on the presumption that the banking system is sound and can satisfy demands for withdrawals of funds (emphasis added).⁷⁰

Second, and crucially, the very mechanism that is commonly asserted as the way that clearing reduces systemic risk—rigid and frequent collateralization in cash—can be the mechanism that creates systemic risk. Large price moves result in large margin calls. In normal conditions, banks routinely finance margin calls, but during exceptional conditions, they may be unwilling to do so. In any event, large price moves that trigger large margin calls substantially increase demand for liquidity precisely during periods when liquidity is often constrained. Furthermore, the need to raise cash to meet margin calls, or to reduce positions because of the inability to meet margin calls, can lead to fire sales that exacerbate price movements.

Third, clearinghouses can fail, particularly in the aftermath of large price movements, and their failure would impair the ability of financial markets to operate, likely for some time.

Fourth, merely the fear that a clearinghouse is insolvent can trigger destabilizing trading.

It should be noted, moreover, that all of these effects are quite similar to those that could accompany the failure of a major OTC

dealer. Indeed, central clearing mainly replaces one set of interconnections with another. What's more, because of the various incentive, information, and costs issues discussed throughout, there is considerable room to doubt that the new interconnections will be more robust to systemic shocks than the existing ones.

The effect of a clearing mandate on systemic risk, and economic efficiency generally, will depend on the configuration of CCPs that it engenders. There are extensive economies of scale and scope in clearing, arising from diversification and information effects. This would tend to favor the formation of a small number of large, multiproduct CCPs. But these CCPs would be densely interconnected with virtually all major financial intermediaries and financial markets, and consequently their failure would have catastrophic effects.

It cannot be ruled out, however, that a larger number of smaller, more specialized CCPs will develop, at least initially. Jurisdictional considerations alone may lead to this result: the United States, Europe, and Asian countries all desire CCPs to domicile in their countries. But multiple CCPs would likely require—not surprisingly—a dense web of interconnections that could serve as a channel of contagion.

In brief, regardless of the configuration of CCPs post-mandate, there will be systemically important interconnections. Contrary to the assurances of regulators and legislators, the mandate will not banish systemically risky interconnections among financial firms and markets.

It is not clear, a priori, which configuration is superior. Moreover, the evolution of market structure in response to a mandate is difficult to predict. Given the scale and scope of economies, it is unlikely that the market for CCPs will be competitive. In the presence of such indivisibilities and network effects, competitive processes do not necessarily result in the evolution of an efficient market structure. Furthermore, the distributional effects of the formation of CCPs, private information about these effects, and the ability of market participants to influence the regulatory process in

order to achieve distributive gains makes it likely that the process of coordination and cooperation needed to create and structure CCPs will be plagued with inefficiencies.

To say that these issues have received inadequate analysis would be a huge understatement. They have barely been mentioned. Advocates of mandates have no clue how these regulatory fiats will play out. As a result, the potential for huge unintended consequences—a systemic risk of its own—is commensurately huge.

A Policy Recommendation

Central counterparty clearing, as noted above, is a bundle of services. It arguably performs some of the functions thus bundled less effectively than bilateral market mechanisms, and it arguably performs other functions better.

A clearing mandate imposes the entire bundle on market participants. But there is no necessary reason that the separate functions cannot be unbundled in a way that is more efficient than either a largely cleared market, or a bilateral one. It is worthwhile, therefore, to consider whether there is a way to provide some of the functions performed by CCPs while eschewing the often problematic incentive and information problems that mutualization of risk entails.

The most troubling feature of bilateral OTC markets is the process of replacing trades in the event of a large default, or hedging the exposures created by the loss of defaulted positions. As discussed in the section on resolution of defaults, practical experience and theory both suggest that reliance on ordinary market mechanisms in the aftermath of a large OTC derivatives default is inefficient, and that a coordinated auction-type mechanism would be more efficient. This is the essence of the Greenwald–Stein recommendation for circuit breakers that replace continuous trading with a call auction. The key difference is that the Greenwald–Stein circuit breakers are price contingent, which has some problematic fea-

Central clearing mainly replaces one set of interconnections with another.

**One alternative
would be to
auction the
actual defaulted
positions.**

tures, whereas what I am proposing is default contingent.

To work effectively, such an auction mechanism would require access to comprehensive information about the defaulter's positions. Therefore, a predicate for the operation of such a mechanism is the creation of a central trade reporting repository.⁷¹ All of the major legislative proposals relating to derivatives markets mandate reporting of all trade and position information to a repository. To be effective, a single repository containing all positions is desirable. Alternatively, multiple repositories combined with a robust method for aggregating the information that they contain could provide the information required to conduct the resolution of defaulted positions.

One alternative would be to auction the actual defaulted positions. This is problematic for a variety of reasons. First, the portfolio of a large financial institution (e.g., a dealer or a large hedge fund) is typically complex, consisting of large numbers of heterogeneous contracts. Some of these contracts are relatively standardized (e.g., vanilla interest rate swaps), but they are large in number and there can be considerable diversity even among these contracts (e.g., payment dates differ). Auctioning portfolios or shares of portfolios even of the relatively standard instruments would raise issues of matching counterparties, and the potential that a single deal would be split among multiple counterparties. Another complication is that under U.S. bankruptcy law, upon default, counterparties have the right to terminate positions; upon termination, there would be no contract to auction off.

Another alternative would be to hold auctions for standardized products that market participants could participate in to replace defaulted positions. These auctions would permit the matching of counterparties. In the case of a defaulting dealer with a roughly matched book, the buyers and sellers would have roughly matching double coincidence of wants, and an auction process could facilitate matching them in a coordinated fashion that would avoid the externalities and price disrup-

tions of the type identified by Greenwald and Stein.

For instance, there could be auctions of standard interest rate swaps in major currencies (including the U.S. dollar, euro, Japanese yen, and Great Britain's pound sterling), which together account for about 90 percent of outstanding swaps; major cross-currency swaps; major equity index swaps; important credit indices and individual name CDS; and leading commodity swaps such as crude oil, natural gas, and gold. Similarly, since many firms need to replace or hedge options and volatility exposures, auctions of major options products, such as interest-rate swaptions, currency options, and equity index options, would be highly desirable. More challenging, but worth consideration, would be auctions on important correlation-sensitive products like spread options, which would permit hedging and replacement of major correlation exposures.

Auction design is a complex issue that requires an extended treatment beyond the scope of this article. I therefore limit my remarks to a few salient issues.

First, whether the auctions are done simultaneously or sequentially is an important issue that needs detailed analysis.

Second, the types of orders that can be submitted will affect the efficiency of the auction. One possibility would be to permit the submission of limit orders (i.e., orders that specify a price and a quantity), but also to permit the submission of unpriced noncompetitive orders that are crossed at the winning auction price. Uninformed, price-taking participants may choose to utilize such orders.

Third, who is allowed to participate in the auction requires close attention. Different market participants differ in their creditworthiness, and a single-price auction mechanism would work poorly if participants varied widely in their creditworthiness. One way to address this issue would be to utilize a more elaborate buyer-seller matching mechanism, which permits participants to specify counterparty credit exposures. These credit limits would impose constraints on the matching of

buyers and sellers. Existing trading and trade-reduction systems include such constraints, and these systems/capabilities can be adapted to address this issue.⁷²

Information about the exposures of the auction participants to the defaulter is likely to be material to participants when setting their counterparty credit limits. The existence of a data repository containing this information makes this information available, but its disclosure may be quite controversial. Nonetheless, given the deleterious effects of private information on the operation of markets, especially under conditions of great uncertainty, disclosure of such information in the exceptional circumstances of the default of an important OTC derivatives market participant is likely to be essential for the efficient operation of the auction process.

Furthermore, given that there may be a large number of counterparties (e.g., end users) who need to replace positions or hedge exposures created as a result of a default, it may be impractical to permit direct participation by any and all. Instead, it is likely to be preferable that qualified dealer firms represent customer orders in the auctions.

Fourth, the auctioneer must be determined. The auction could be run by a regulator or a private organization. For instance, the International Swaps and Derivatives Association, whose members include all the major OTC dealers, could organize and run the auction. This association already serves a variety of self-regulatory functions. In particular, under its aegis, the major swap dealers designed and implemented a new auction protocol for the settlement of credit default swaps written on companies that experienced credit events. The process has not worked perfectly, but it has improved on the settlement of CDS.

Again, the details of the auction mechanism will require intense study and attention. But there are several advantages of this approach that make such effort worthwhile. Crucially, it should mitigate the uncertainty and concomitant price volatility associated with the replacement and hedging of defaulted exposures. This will ease the disruptions

associated with a large default and reduce the potential for knock-on effects resulting from large price changes. By contributing to price discovery, it will also reduce the transactions costs (including the legal dispute costs) associated with valuing terminated defaulted positions. Such valuations are a contentious issue in bankruptcy, and the existence of reliable market prices that can be used as the basis for such valuations would reduce substantially the potential for costly dispute.⁷³

In sum, using auction-like mechanisms to coordinate the replacement and hedging of defaulted OTC derivative positions would mitigate one of the most problematic features of bilateral trading, while retaining bilateral trading's desirable ex ante incentive effects. The logic behind this approach is very straightforward. Whenever things are bundled, the immediate question should be: can efficiency be enhanced by unbundling them? Much of what goes on in finance involves unbundling things and allocating the pieces in a value-enhancing way. Sometimes you can't: so be it. But sometimes you can.

Clearinghouses bundle counterparty risk pricing, counterparty risk management (including the collateralization mechanism), mutualization, position information collection, and default resolution. There is no logic that says that those functions have to be bundled. Repositories can collect and aggregate information, perhaps more effectively than CCPs, because they can incorporate information on noncleared positions and because information on all positions that would be scattered among different CCPs. CCPs are not always the best at counterparty risk pricing and collateralization mechanics. Mutualization can have some extremely problematic features. So why not an approach that unbundles functions and allows specialization in these various functions?

Once repositories are created, the development of a robust, coordinated defaulted contract hedging/replacement auction mechanism would go a long way to improving the efficiency of the OTC derivatives market, while permitting it to continue to do what it does

Whenever things are bundled, the immediate question should be: can efficiency be enhanced by unbundling them?

A clearing mandate forces a bundle of functions on the market that is likely suboptimal.

best. This would be a relatively easier process than what will be set in motion by the vast expansion of CCPs as contemplated in the pending legislation. CCPs will have to develop resolution procedures in any event. Moreover, it is desirable to develop procedures to deal with contracts that are not cleared (which will be the most challenging ones in any event). But force-fed CCPs will also have to grapple with challenging pricing, risk management, risk sharing, and governance issues as well. And if there are multiple CCPs, there is the potential that the resolution of the default at one CCP will have undesirable spillover effects at other CCPs; coordination in resolution procedures would therefore be advisable. So, a mandated and extensive expansion of CCPs will have to solve all of the same problems as would the resolution mechanism alone, and some more in addition.

This means that a policy that focuses first on designing a robust post-default auction mechanism offers many advantages over a clearing mandate. A clearing mandate forces a bundle of functions on the market that is likely suboptimal. Moreover, even if clearing is mandated, default resolution issues will still loom large and need be addressed regardless. Addressing the resolution mechanism should be policymakers' first concern and should take precedence over any clearing mandate.

The foregoing is merely a sketch in broad strokes of a concept for improving the replacement and resolution of cleared positions. Auction design and details are crucial and complex. Cooperative efforts between major market participants and regulators in the United States and other jurisdictions should be commenced immediately to analyze the issues and develop a robust resolution mechanism.

Conclusion

The past 30 years have witnessed the dramatic growth of OTC derivatives markets. From their birth in the early 1980s, these markets have grown to a massive size, mea-

sured in notional value in the hundreds of trillions of dollars, or, more conservatively, by market value in the tens of trillions. OTC derivatives instruments have vastly expanded the interest rate, currency, equity, and commodity-risk-management choices available to financial institutions, manufacturing, and service firms alike, in the United States and the world at large. Traditional exchange-traded derivatives markets have grown too, but through the freely exercised choices of market participants, OTC markets have come to dominate derivatives.⁷⁴

The emergence of these markets from nothing was an undirected, spontaneous process.⁷⁵ The current structure of derivatives markets, with OTC derivatives markets, derivatives exchanges (in a relationship that is both competitive and symbiotic), and other financial markets, provides diverse market participants with a similarly diverse array of alternative ways to transfer financial risks, execute financial transactions, and importantly, to price and allocate the counterparty risks that are inherent in all financial contracts.

There was always some unease with these markets. Warren Buffet famously characterized them as “weapons of financial mass destruction”—which didn't prevent his company, Berkshire Hathaway, from becoming a major trader of OTC derivatives. In the early 1990s, former CFTC chair Brooksley Born identified them as a threat to the financial system that needed thorough regulation. Legislators and regulators have routinely excoriated them as risky “dark markets.”

In the aftermath of the financial crisis, this unease has morphed into widespread fear and loathing. Nowhere is this fear and loathing more intense than on Capitol Hill and within the Obama administration. There, this almost visceral distrust of OTC markets has translated into concrete policy proposals. The most important of these is a mandate (included in Obama administration policy proposals and in all of the derivatives regulation measures under consideration) that most OTC derivatives be cleared by central counterparties. This mandate would replace bilateral mechanisms

for allocating and pricing the risk of default on derivatives transactions with a mutualized risk-sharing mechanism. This measure is widely touted as an efficacious way to reduce dramatically the systemic risk purportedly inherent in bilateral OTC derivatives markets dealing.

The clearing mandate would transform derivatives markets. Unfortunately, the advocacy of this initiative has been glaringly devoid of serious economic analysis of the economics of counterparty risk in derivatives markets. The arguments have been superficial and supported primarily by the tiresome repetition of inapposite anecdotes.

Clearing is a risk-sharing mechanism, and the fundamental economic factors affecting the costs and benefits of risk sharing have been the subject of considerable research since World War II. A major implication of this research is that even though in the absence of informational and contracting frictions it is efficient to share risks widely, the existence of such frictions can constrain the benefits of risk sharing. The fact that many risks are not shared, and that those that are shared are typically shared incompletely, demonstrates the practical importance of this insight. Even the deductible on an automobile insurance policy serves as a very prosaic example of partial risk sharing.

In this article I presented an analysis of counterparty risk-allocation mechanisms that focuses on the factors that the economics literature has identified as crucial in determining the (constrained) efficient way to allocate risk. Indeed, in the absence of economic frictions, mutualization of counterparty risk through clearing does improve welfare. But these informational and contracting frictions are not absent in the real world. Mutualization induces moral hazard, which is costly to control. Moreover, informational considerations and institutional constraints imply that bilateral mechanisms like those observed in the OTC derivatives markets are likely to be more efficient than mutualized mechanisms, like clearing, for some transactions and some traders. Large dealer banks,

which are, after all, information intermediaries that specialize in the evaluation of credit risks, likely have a comparative advantage in pricing and bearing some counterparty risks.

This is not to say that bilateral markets cannot be improved. In particular, the uncoordinated replacement of defaulted transactions when a large dealer fails can have highly disruptive effects on market prices.

When it comes to systemic risks, that is, the risks that derivatives markets can be a channel of financial contagion, it is by no means clear that cleared markets are less vulnerable than bilateral dealer markets. Cleared markets present their own particular systemic risks—risks that policymakers have studiously ignored.

The upshot of the analysis is that a wholesale re-engineering of the structure of derivatives markets via legislative fiat is fraught with danger. There is a compelling economic case that the bilateral OTC derivatives markets provide a superior way of pricing and allocating the counterparty risks associated with certain transactions, and that market participants have the appropriate information and incentives to select the appropriate way to allocate these risks. A clearing mandate would prevent the exploitation of the desirable information and incentive properties of OTC derivatives transactions.

Legislative and regulatory attention would be more constructively directed to facilitating the crafting of a superior means of replacing and hedging OTC derivatives positions in the aftermath of a major default. This is the Achilles' heel of the OTC derivatives markets, but improving it does not necessitate the mandatory sharing of counterparty risks (via clearing) that are not efficiently shared due to information and contracting frictions.

There are institutions in place, such as the International Swaps and Derivatives Association, that could serve as a means of coordinating the development of an improved resolution and replacement mechanism. This association has already proved instrumental in improving the settlement of credit default

Cleared markets present their own particular systemic risks.

**A clearing
mandate by itself
would not
address the need
for an improved
means of
replacing and
resolving
defaulted trades.**

swaps. It has also worked constructively with the New York Fed to improve the process of confirming trades, which was another source of vulnerability in the market.

That said, the process of developing a robust auction mechanism will not be simple. But even a clearing mandate by itself would not address the need for an improved means of replacing and resolving defaulted trades; CCPs will perforce grapple with this issue, and the potential for coordination failure is very real if, as is likely, multiple clearinghouses exist. Consequently, it is highly advisable that policymakers focus intensely on this issue, and soon.

It is worth remembering that the imposition of a particular standard on all market participants and the vast bulk of all transactions is inherently systemic in its effects. Moreover, any flaw in or failure of that standard structure will have systemic consequences. A mandate that is ill-adapted to the fundamental economic circumstances of the derivatives markets (notably, the informational conditions in the market) creates a systemic risk because ill-adaptation makes failure more likely, and the expansiveness of the mandate means that the effects of the failure will be systemwide in scope.

The policy recommendations made herein—that clearing mandates be jettisoned, and policy makers focus on improving the resolution of defaults—is clearly contrary to the overwhelming consensus in Washington. I would note, however, that the view I express here has the virtue of being consistent with the evolution, rapid growth, and survival of a diverse set of counterparty-risk-allocation mechanisms. In contrast, the view implicit in clearing mandates, namely that market participants have systematically chosen grossly inefficient arrangements, raises the question of how such inefficient mechanisms could grow to such an immense size. This is not to say that such an outcome is theoretically impossible. It is only to say that advocates of a mandate have certainly not advanced any remotely plausible argument, bolstered by reliable evidence, to explain it. Given that (appealing to Coase) such a massive inefficiency would necessarily require

the existence of similarly massive transactions costs, it should be possible to identify the sources of these costs. This, the advocates of mandated central clearing have not done.

Awaiting a convincing demonstration of the inefficiency of the market order that has developed since the early 1980s, and given the existence of an analysis firmly based on an understanding of risk sharing that can explain the advantages of the received self-ordered arrangement, considerable caution is warranted before embarking on a radical experiment to completely reshape the derivatives market structure. This is all the more true given the availability of a less radical alternative that can address the most problematic aspects of this structure.

Notes

1. Bank of International Settlements data give some idea of the growth of these markets. From 1998 (the first year for which data are available) through June 2009, gross notional value of OTC derivatives rose from \$72 trillion to \$604 trillion, a nearly 800 percent increase. By comparison, exchange traded futures notional values slightly more than doubled during this period. Net market values of outstanding OTC contracts rose almost tenfold, from \$2.6 trillion to \$25.4 trillion. Gross credit exposure rose from \$1.2 trillion to \$3.7 trillion.

2. See, for instance, the European Commission, Commission Staff Working Paper Accompanying the Commission Communication on Ensuring Efficient, Safe and Sound Derivatives Markets, 2009, <http://ec.europa.eu/internalmarket/financial-markets/docs/derivatives/report-en.pdf>.

3. It has been hypothesized, by Ed Kane in remarks at a Federal Reserve Bank of Atlanta conference in May 2009, for instance, that the modern-day reluctance of large financial institutions to embrace clearing is because of the “too-big-to-fail” phenomenon. That is, to the extent that clearing would constrain risk taking by large financial institutions subject to implicit or explicit government guarantees, they would oppose its introduction. Too-big-to-fail cannot explain the resistance of either the CBT or the LME to clearing. The CBT case is particularly illuminating, as there was no government financial safety net in existence in the 1890–1925 period, and indeed, many large brokerage firms had failed during this period without triggering any bailouts. It should also be noted that clearinghouses dominated by large banks arguably too-big-

to-fail (e.g., ICE Trust) have little incentive to act contrary to the interests of the individual members.

4. The risks of default may be asymmetric. For instance, CDS protection sellers are typically more likely to default than protection buyers.

5. 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.

6. A derivatives industry group, the International Swaps and Derivatives Association, recently devised and implemented an auction and cash settlement mechanism to settle CDS contracts on defaulting names. Under this mechanism, there is an auction of securities that can be delivered under the CDS contract, and those who choose not to settle their obligation via delivery settle their positions in cash based on the price determined in this auction.

7. Historically, most futures commission merchants (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.

8. It should be noted, but often is not, that AIG's failure was not due to derivatives alone. It also suffered large losses on investments in securities related to subprime mortgages.

9. Moreover, some derivatives exposures, such as options, are nonlinear functions of some underlying price. Furthermore, since derivatives expose the intermediary to customer default risk, and this risk exposure is nonlinear, there are other sources of nonlinearity that must be considered in evaluating default exposure.

10. See J. Coval, J. Jurek, and E. Stafford, "Economic Catastrophe Bonds," working paper, Harvard University, 2008. Their analysis of CDOs shows that the market price of claims that are effectively short options with considerable systematic exposure can be substantially lower than their expected value would suggest.

11. There is no necessary relation between the method of trading derivatives contracts and the risk-sharing relationship. The term over-the-counter (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. See United States Federal Trade Commission, *Report on the Grain Trade* (Washington: Government Printing Office, 1920).

12. For descriptions of centralized clearing, see Franklin Edwards, "The Clearing Association in Futures Markets: Guarantor and Regulator" *Journal of Futures Markets* 3 (1983): 369-92; and H. Baer, V. France, and J. Moser, "What Does a Clearinghouse Do?" *Derivatives Quarterly* 1 (1995): 39-46.

13. All futures central counterparty clearing (CCP) members are FCMs, but not all FCMs are CCP members. Non-member FCMs must have their contracts guaranteed by members.

14. This is an overstatement. As demonstrated by Jordan and Morgan, a default by a clearing member's customer can impose losses on other customers if the default is sufficiently large to make the clearing member insolvent. Thus, customers' incentives to monitor the creditworthiness of a clearing member is not zero, but it is reduced relative to the incentive in a bilateral market. See James Jordan and George Morgan, "Default Risk in Futures Markets: The Customer-Broker Relationship." *Journal of Finance* 45 (1990): 909-33.

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

16. In 2009, according to a survey conducted by the International Swaps and Derivatives Association, 70 percent of all OTC derivatives trades were subject to collateral agreements, and collateral covers 69 percent of all OTC derivatives exposure and 78 percent of bank and broker-dealer exposures See International Swaps and Derivatives Association, "ISDA Margin Survey," 2010.

17. 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. See International Swaps and Derivatives Association, "Counterparty Credit Exposure among Major Derivatives Dealers," 2007.

18. N. Arora, P. Gandhi, and F. Longstaff, "Counterparty Credit Risk and the Credit Default Swap

Market,” working paper, University of California Los Angeles, 2010.

19. ISDA, “ISDA Margin Survey.”

20. 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. I discuss this issue in the section on controlling moral hazard.

21. C. Pirrong, “The Economics of Clearing in Derivatives Markets: Netting, Asymmetric Information, and the Sharing of Default Risks Through a Central Counterparty,” working paper, University of Houston, 2010.

22. These costs deserve some discussion. They are not default costs; I assume that the hedgers never default. The costs can be viewed as the cost of bearing price risk. The hedgers transfer price risk to the dealers. Larger hedger positions imply that the dealers have more risk. If the dealers are risk averse (due to costly risk capital, for instance), they will take on more risk only if compensated through a higher return. If they are buying the derivative, the higher return is realized through a purchase at a lower price. The cost can also be interpreted as an operational cost. If the marginal cost of handling a trade increases with the volume of trade, dealers will take on larger positions from hedgers only if they receive a price concession to compensate for the resultant larger marginal cost.

23. Market participants sometimes make the distinction between a “survivor pays” system and a “defaulter pays” system of managing performance risk. In a pure survivor-pays system, firms post no collateral, and default losses are shared among non-defaulting firms. Under a defaulter-pays system, firms post collateral, and a defaulter’s obligations are met in the first instance from this collateral. The moral hazard considerations discussed here make a pure survivor-pays system extremely problematic, and unlikely to be observed in practice. Moreover, absent collateralization of deals to the maximum possible loss, a pure defaulter-pays system is impossible; some counterparty bears a default loss with positive probability. Furthermore, maximum collateralization is almost certainly economically inefficient in a world of costly collateral. Thus, any actual system is likely to be a hybrid between a survivor-pays and a defaulter-pays system. That is, it will involve collateralization (the defaulter-pays aspect) and sharing of the loss over the collateral (the survivor-pays aspect).

24. Again, as noted by Jordan and Morgan, when a

customer default leads to a clearing member default, its other customers can suffer a default loss. See James Jordan and George Morgan, “Default Risk in Futures Markets: The Customer-Broker Relationship,” *Journal of Finance* 45 (1990): 909–33.

25. Telser emphasizes the role of clearing in making futures contracts fungible instruments that are perfect substitutes, independent of the identities of the original buyer and seller, in contrast to bilateral forward contracts, which are not fungible because performance risk is not standardized and depends on the creditworthiness of the contracting parties. See L. Telser, “Why There Are Organized Futures Markets,” *Journal of Law and Economics* 24 (1981): 1–22.

26. Of course, when all members behave in this way, the risk of the clearinghouse will increase. This will affect the prices at which customers are willing to trade. But this degradation in the dealers’ terms of trade affects all dealers equally. That is, no individual dealer internalizes the cost of its risk-taking decisions.

27. Moral hazard can still arise in bilateral markets, because, for instance, firms can trade over time. If A enters into a hedging trade with B today, it can enter into subsequent deals with C, D, E, etc., that affect the counterparty risk that B faces. This is a risk, as emphasized by Acharya et al. I show however, that repeat dealing and the short maturity liability structure of dealer firms imposes costs on firms that attempt to exploit this potential moral hazard. See V. Acharya et al., “Centralized Clearing for Credit Derivatives.” in *Restoring Financial Stability: How to Repair a Failed System*, ed. V. Acharya and M. Richardson (New York: Wiley Finance, 2010).

28. In fact, the International Organization of Securities Commissions (IOSCO) has recommended that CCPs not be allowed to expose their members to unlimited obligations to cover losses in the event of a default. See International Organization of Securities Commissions, “Recommendations for Central Counterparties,” 2004.

29. For instance, the Chicago Mercantile Exchange clearinghouse requires each clearing member to post a security deposit. The minimum deposit is \$500,000; larger firms are required to make larger deposits. The clearinghouse can draw on this deposit fund to meet its obligations. In addition, the CME can assess members for additional funds. However, each member’s maximum additional assessment is limited to 275 percent of its original deposit. See Chicago Mercantile Exchange Financial Safeguards, 2009, <http://www.cmegroup.com/clearing/files/financialsafeguards.pdf>. Members of ICE Trust must make a deposit (initially \$20 million, which may be raised) to the Trust’s Guaranty Fund. In the event that charges arising from de-

faults exhaust the Guaranty Fund, each member may be assessed for the amount required to raise its collateral on deposit to the fund back to the original level. This implies that each member's additional assessment exposure is limited to the size of its initial deposit. ICE Trust, Clearing Rules, 2009, www.theice.com/publicdocs/clear_us/ICE_Trust_Rules.pdf.

30. Informational considerations are extremely important. I give them extended treatment below.

31. See L. Telser, "Margins and Futures Contracts," *Journal of Futures Markets* 1 (1983): 225–53; Duffie and Zhu.

32. By evaluating the sufficiency of margin, I mean that the CCP can accurately estimate the likelihood that a firm will suffer a loss on its cleared position that exceeds the amount of margin posted. This is a necessary condition for a firm default on that position to impose a loss on the other clearing members.

33. C. Pirrong, "Mutualization of Default Risk, Fungibility, and Moral Hazard: The Economics of Default Risk Sharing in Cleared and Bilateral Markets," working paper, University of Houston, 2010.

34. P. Milgrom and J. Roberts, *Economics, Organization and Management* (Englewood Cliffs, NJ: Prentice Hall, 1992).

35. 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.

36. Acharya and Bisin highlight the importance of informational considerations and inadvertently demonstrate why bilateral markets may be a more efficient way to allocate default risk, although they claim the opposite. They show that efficient allocation of counterparty risk requires that all trading prices be conditioned on complete information about all market participants' positions, either through public disclosure of positions and trades or through a Walrasian auctioneer who sets prices conditional on positions. They claim that clearing can achieve this outcome, but only because their definition of clearing is an inversion of clearing as it actually exists. They define clearing as complete disclosure of all positions and no sharing of default risk, whereas clearing, in fact, involves no disclosure of positions and sharing of default risk. Moreover, markets that offer fungibility through clearing do not set prices that vary based on balance-sheet risks and positions risks, which is the crucial condition for efficiency in the Acharya–Bisin model. In contrast, in bilateral markets with-

out fungibility prices and risk prices vary with estimates of counterparty risk, and dealers have private information on these risks that they use to set prices. CCPs are unlikely to have this information, and are institutionally constrained in using it. See V. Acharya and A. Bisin, "Centralized versus Over the Counter Markets," working paper: New York University and NBER, 2010.

37. Acharya et al., "Centralized Clearing for Credit Derivatives."

38. Barnea et al., Rajan and Winton, Leland and Toft, and Stulz all show that short-term debt can reduce incentives to engage in asset substitution and other risk-increasing strategies. See A. Barnea et al., "A Rationale for Debt Maturity Structure and Call Provisions in the Agency Theoretic Framework," *Journal of Finance* 35 (1980): 1223–34; R. Rajan and A. Winton, "Covenants and Collateral as Incentives to Monitor," *Journal of Finance* 50 (1995): 1113–46; H. Leland and K. Toft, "Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads," *Journal of Finance* 51 (1996): 987–1019; and R. Stulz, "Does Financial Structure Matter for Economic Growth? A Corporate Finance Perspective," working paper, Ohio State University, 2000.

39. Douglas Diamond and R. Rajan, "Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking," *Journal of Political Economy* 109 (2001): 287–327.

40. For instance, assume A has sold 10 contracts to B, B has sold 10 contracts to C, and C has sold 10 contracts to A. These parties can "ring out" the offsetting deals, because each has bought and sold 10 contracts. Even if C had not sold to A, then A, B, and C could mutually agree to eliminate B from the chain of contracts and match A and C as principals.

41. Duffie and Zhu.

42. C. Pirrong, "The Clearinghouse Cure," *Regulation* 31 (2009): 44–51 and C. Pirrong, "The Economics of Clearing in Derivatives Markets."

43. Chris Cook kindly reminded me of this phenomenon.

44. Duffie and Zhu.

45. C. Pirrong, "Rocket Science, Default Risk and the Organization of Derivatives Markets," working paper, University of Houston, 2008 and C. Pirrong, "The Economics of Clearing in Derivatives Markets."

46. R. Merton, "Theory of Rational Option Pricing," *Bell Journal of Economics and Management*

Science 4 (1973): 141–83.

47. Pirrong, “Rocket Science.”

48. Duffie and Zhu; Pirrong, “Rocket Science” and “The Economics of Clearing in Derivatives Markets.”

49. The LME is an exception in that it does not require customers to post margins in cash. Customer margin arrangements are a contractual matter between each customer and its clearing firm.

50. International Monetary Fund, “Making Over-the-Counter Derivatives Safer: The Role of Central Counterparties,” 2010.

51. M. Singh, “Collateral, Netting and Systemic Risk in the OTC Derivatives Market,” IMF working Paper, 2010.

52. Goldman Sachs, “Overview of Regulatory Reform,” analysts’ presentation, 2010. Many OTC derivatives do not require the posting of initial margin (called “independent amount”), and effectively entail the extension of credit. Forcing collateralization of derivatives transactions will reduce the amount of credit implicit in derivatives trades. It is likely, however, that market participants will utilize the debt capacity freed up as a result of mandatory collateralization to add leverage in other forms. Thus, the figures in the text likely give an exaggerated picture of the capital structure and financing impacts of a clearing mandate. Revealed preference implies, however, that market participants preferred to obtain credit/leverage through derivatives trades rather than by other means. Thus, the mandate imposes a cost on them, but one that is smaller than the estimates of initial margins cited in the text.

53. Rigid daily mark to market can also contribute to systemic risk.

54. OTC deals implicitly extend credit to the extent that they are not fully collateralized. Full collateralization through a clearinghouse could be accommodated by the explicit extension of credit to finance initial and variation margin payments. If this were the preferred arrangement, it would be observed in practice, which means that mandated clearing would impose costs on some market participants. Put differently, dealers bundle trading and financing services in OTC deals. Clearing requires that these services be supplied separately. Many market participants evidently have a strong preference for the bundled service.

55. They are not obligated, of course, to replace defaulted positions. But a default affects their risk exposure, and traders will typically respond to

this change by executing transactions that tend to offset the effect of the default.

56. For instance, Long-Term Capital Management (LTCM) was a large liquidity supplier. It bought illiquid instruments and sold liquid ones. When there was a flight to quality and liquidity in the aftermath of the Russian government’s de facto default on its bonds, the prices of the illiquid instruments fell and the prices of the liquid ones rose. The resulting losses triggered LTCM’s financial distress.

57. Franklin Edwards and Edward Morrison, “Derivatives and the Bankruptcy Code: Why the Special Treatment?” *Yale Journal on Regulation* 22 (2005): 91–122.

58. See specifically the report of the Lehman bankruptcy examiner, which documents the difficulties that CME faced in resolving Lehman’s proprietary positions, and which demonstrates that these transactions were executed at prices that were substantially different from market-clearing prices on the prior day. A. Valukas, Lehman Brothers Holdings Inc., Chapter 11, Proceedings Examiners Report, 2010.

59. B. Greenwald and J. Stein, “Transactional Risk, Market Crashes, and the Role of Circuit Breakers,” *Journal of Business* 64 (1991): 443–62.

60. See, for instance, Gary Gensler, “Clearinghouses Are the Answer,” *Wall Street Journal*, April 21, 2010.

61. Gary Gensler, “How to Stop Another Derivatives Inferno,” *Financial Times*, February 24, 2010.

62. In the OTC markets, original margin is typically referred to as the independent amount. Moreover, it should be noted that AIG did have to post variation margin, and had in fact made billions of dollars of collateral payments prior to its collapse.

63. I discuss other myths surrounding AIG in my article “It’s a Wonderful Life: AIG Edition,” at <http://www.streetwiseprofessor.com/?p=1665>, and in C. Pirrong, “Comment on Stout,” *Regulation* 32 (2009): 38–40.

64. J. Helwege, “Financial Firm Bankruptcy and Systemic Risk,” *Regulation* 32 (2009): 24–29.

65. Interestingly, in the debates over whether to adopt clearing at the Chicago Board of Trade in the early 1900s, one argument was that the netting inherent in clearing tended to lead smaller, riskier traders to trade more, and that bilateral mechanisms “favor[ed] conservatism.” United States Federal Trade Commission, *Report on the Grain Trade*.

66. For more detailed descriptions of the operation of clearing and settlement during the Crash, see Bernanke, "Clearing and Settlement during the Crash" *Review of Financial Studies* 3, no. 1 (1990): 133–51; Presidential Task Force on Market Mechanisms, *Report of the Presidential Task Force on Market Mechanisms* (Washington: Government Printing Office, 1988); M. Carlson, "A Brief History of the Stock Market Crash with a Discussion of the Federal Reserve Response," working paper, Finance and Economic Discussion Series, Federal Reserve Board, 2007; and J. Kress, "Credit Default Clearinghouses and Systemic Risk: Why Centralized Counterparties Must Have Access to Central Bank Liquidity," working paper, Harvard Law School, 2010.

67. Presidential Task Force on Market Mechanisms.

68. As I can attest personally, I worked for a futures commission merchant at the time of the Crash. The CEO of that firm was a member of the CME board of directors, and a former chairman of the exchange. When I went into his office on the morning of the 20th, I told him that he looked exhausted. He replied by saying that he had been up all night trying frantically to ensure the clearinghouse would open, and that without the intervention of the Fed, he doubted it would have.

69. Bernanke, "Clearing and Settlement during the Crash."

70. *Ibid.*

71. I advocated the creation of such a repository in an article in *Regulation* in 2009. See Pirrong, "The Clearinghouse Cure."

72. The sequencing of options affects this issue because counterparty exposures would build if auctions for different products were conducted sequentially.

73. For instance, the Lehman Brothers bankruptcy trustee is contesting \$50 billion in settlement amounts claimed by derivatives counterparties, arguing that the valuations are highly unfair.

74. Nearly all foreign exchange derivatives are traded OTC, and over 90 percent of linear interest derivatives are traded this way. Smaller fractions of commodity, interest-rate option, and equity derivatives are traded OTC. The cross-sectional variation in the market shares of OTC derivatives is a challenge for advocates of central clearing to explain.

75. This is not to say that law and government regulation has been immaterial to their growth and development. Some derivatives products, and some uses of these products, are a direct response to various government regulations. Moreover, changes in law, including contract law and bankruptcy codes, have played an important role in their evolution.

RELEVANT STUDIES IN THE POLICY ANALYSIS SERIES

- 660. **Lawless Policy: TARP as Congressional Failure** by John Samples (February 4, 2010)
- 655. **Three Decades of Politics and Failed Policies at HUD** by Tad DeHaven (November 23, 2009)
- 648. **Would a Stricter Fed Policy and Financial Regulation Have Averted the Financial Crisis?** by Jagadeesh Gokhale and Peter Van Doren (October 8, 2009)
- 637. **Bright Lines and Bailouts: To Bail or Not To Bail, That Is the Question** by Vern McKinley and Gary Gegenheimer (April 20, 2009)
- 634. **Financial Crisis and Public Policy** by Jagadeesh Gokhale (March 23, 2009)
- 528. **Fannie Mae, Freddie Mac, and Housing Finance: Why True Privatization Is Good Public Policy** by Lawrence J. White (October 7, 2004)

RECENT STUDIES IN THE POLICY ANALYSIS SERIES

- 664. **The DISCLOSE Act, Deliberation, and the First Amendment** by John Samples (June 28, 2010)
- 663. **Defining Success: The Case against Rail Transit** by Randal O'Toole (March 24, 2010)
- 662. **They Spend WHAT? The Real Cost of Public Schools** by Adam Schaeffer (March 10, 2010)
- 661. **Behind the Curtain: Assessing the Case for National Curriculum Standards** by Neal McCluskey (February 17, 2010)
- 660. **Lawless Policy: TARP as Congressional Failure** by John Samples (February 4, 2010)
- 659. **Globalization: Curse or Cure? Policies to Harness Global Economic Integration to Solve Our Economic Challenge** by Jagadeesh Gokhale (February 1, 2010)