Derivatives clearing and settlement: A comparison of central counterparties and alternative structures

Robert R. Bliss and Robert S. Steigerwald

Introduction and summary

The past several decades have seen fundamental transformations in the size, structure, and liquidity of world financial markets. Equity markets have fluctuated in value (currently about $17 trillion for U.S. equities) and have introduced new products such as exchange-traded funds (mutual funds that trade like equities). Increasingly, structured equity products combine derivatives and cash market positions to manage equity risks. Debt markets have grown rapidly (currently about $26 trillion for the U.S.[1]), with the greatest growth coming from mortgage- and asset-backed securitizations. Recently, credit derivatives (currently $26 trillion in notional value[2]) have begun to supplement and even, in some instances, replace cash markets in debt. Derivatives markets, of which over-the-counter (OTC) interest rate swaps are by far the largest component, have grown to $284 trillion in notional value.[3]

These changes have facilitated economic growth. Where banks once held the loans and mortgages they originated, these are now routinely securitized and sold to domestic and foreign investors, thus increasing the pool of capital that banks intermediate. The continuing exponential growth of derivatives markets; the development of new derivatives instruments; their impact on financial markets generally; the rapid transformation of traditional institutional arrangements; and occasional operational, liquidity, and credit problems have all focused attention on what happens *after the trade*—the post-trade practices, structures, and arrangements that ensure the smooth and efficient functioning of these markets.[4]

After a trade involving a financial instrument such as a derivatives contract is executed, it must be "cleared" and ultimately "settled." These terms may have different meanings in the context of different market practices, which vary from country to country, as well as from market to market. Nevertheless, clearing typically involves post-trade operations, such as trade matching, confirmation, registration, as well as risk-management functions, such as netting, collateralization, and procedures (including "variation settlement" or "variation margin") that mitigate or eliminate some forms of credit risk. Settlement, by contrast, involves the transfer of money or assets necessary for the counterparties to perform (and, in legal terms, "discharge") their obligations.

Clearing and settlement systems are critical to the stability of the financial system, a system that is increasingly interconnected and global in scope. The significance of these systems, however, is at times incompletely appreciated by observers. For example, these functions are sometimes referred to as mere "plumbing." In a recent speech, President Michael Moskow of the Federal Reserve Bank of Chicago took issue with this usage:[5]

> Post-trade clearing and settlement are sometimes referred to as the *plumbing* of the financial system. This term may suggest that clearing and settlement systems are of secondary importance. In fact, however, they are more like the *central nervous system* of the financial system. Clearing and settlement systems provide vital linkages among components of the system, enabling them to work together smoothly. As such, clearing and settlement systems are critical for the performance of the economy.

Robert R. Bliss is the F. M. Kirby Chair in Business Excellence at the Calloway School of Business and Accountancy, Wake Forest University. Robert S. Steigerwald is a senior professional in the Financial Markets Group of the Federal Reserve Bank of Chicago. *The authors thank David Marshall and seminar participants at the Federal Reserve Bank of Chicago.*

This article explores the functions performed by clearing and settlement institutions for financial markets, with a particular focus on *derivatives*, as opposed to *securities*, clearing and settlement. The nature of the counterparty credit risks that arise prior to settlement are essentially the same in both secondary securities markets and derivatives markets. The risk that either the buyer or seller of the security will be unable to perform its obligation (to pay for or deliver the security, respectively) is conceptually indistinguishable from the risk that the counterparties to a derivatives contract will be able to perform their obligations as they fall due.

However, securities transactions also involve functions that have no analogues in derivatives markets. Securities, unlike derivatives, are financial assets. Securities settlement, therefore, involves the transfer of the asset against the corresponding payment. This involves the services of institutions, such as custodians, transfer agents, and others, which have no role in typical derivatives markets and necessitates risk-management procedures that are not typically present in derivatives markets. For example, risk-management operations for securities transactions and other linked payment transactions have been developed to ensure that both legs of the transaction (that is, the transfer of the asset and the corresponding payment) are completed or, if there is a failure, to ensure that neither leg is completed. The risk that one leg of the transaction may be completed but not the other is known as "settlement risk."[6] The kinds of risk-management operations that have been developed to mitigate or eliminate this risk are typically called "delivery versus payment" (or DvP) or "payment versus payment" (or PvP).

Derivatives contracts are agreements to make payments or transact (buy/sell something) at some time in the future, ranging from a few days (for example, futures contracts nearing expiry) to many years (for example, long-dated interest rate swaps), based on the value of some underlying asset or index and, in the case of options, the decision of one of the counterparties. As a result, post-trade processing of derivatives can involve complexities that are typically missing from securities clearing and settlement. Box 1 lists many of the separate functions that may need to be performed over the life of a typical derivatives contract.

In securities clearing and settlement, the length of time between the execution of a transaction (in which the counterparties undertake reciprocal obligations to deliver a security against payment) is dictated primarily by operational constraints. The parties do not bargain for deferred delivery and payment in a typical cash securities transaction—they seek the transfer of a particular quantity of securities in exchange for an agreed payment. The economic purpose of the transaction would be fulfilled if the transfer and payment took place immediately, without any delay. Time lags between the execution of a trade and settlement, whether that lag is one or three or five days in duration, result from the complex and interrelated operations necessary to complete both legs of the transaction.

With derivatives, however, the length of time between the execution of a transaction and settlement is *essential to the contract.* Put another way, the fundamental economic purpose of a derivatives transaction involves the reciprocal obligations of the parties over the life of the contract. Of course, the creditworthiness of the parties to a derivatives contract can fluctuate in the interim. This is also true in securities transactions.[7] However, unlike long-dated derivatives transactions, the obligations of the buyer and seller of a security are settled within a few days, typically no more than three or five days, depending upon the security and the market involved.

As a result, the parties to a derivatives contract are principally dependent upon each other's creditworthiness to assure future performance in the absence of mechanisms to transfer that risk. The combination of a much longer time horizon for completing transactions, greater uncertainty as to the value (and even direction) of the ultimate transfer obligations, and the unavoidable significance of counterparty credit risk in derivatives transactions means that substantial performance (that is, credit) risk is an integral factor in the completion of derivatives transactions, compared with securities or payments transactions.

Derivatives markets have evolved practices and institutional arrangements to deal with these special characteristics.[8] These in turn have affected the development and structure of derivatives markets. Today, broadly speaking, two parallel systems exist for clearing and settling derivatives: *bilateral* clearing and settlement and *central counterparty* (CCP) clearing and settlement. Most OTC derivatives are settled bilaterally, that is, by the counterparties to each contract. Risk-management practices, such as collateralization, are also dealt with bilaterally by the counterparties to each contract.[9]

In contrast, most exchange-traded derivatives and some OTC derivatives are cleared and settled through a CCP. In the case of centrally cleared derivatives markets, the original contract entered into by two counterparties is automatically replaced by two contracts, each of which arises between one of the original counterparties and the central counterparty.

BOX 1

Example of the functions required to clear and settle a derivative

Consider a ten-year interest rate swap with a notional value of $10 million and a fixed rate of 5 percent against a reference rate of six-month London Interbank Offer Rate (LIBOR), with semiannual payments in arrears. This contract calls for 20 semiannual payments to be computed at the beginning of each payment interval by taking the difference between the prevailing six-month LIBOR and 5 percent and then multiplying that number by $10 million. This payment is then made at the end of the six-month interval, at which time the next period's payment is also being determined. If the six-month LIBOR at the beginning of the period is greater than 5 percent, the payment is made by the "variable payer" to the "fixed payer" and vice versa.

Clearing and settling this swap involves all of the following:

- Confirming the terms of the contract at its inception;
- Determining the payment obligation at the beginning of each six-month interval and notifying the parties;
- Settling payments due at the end of each six-month interval;
- Maintaining the following records: terms of contract, payments made/received by the counterparties, and names, addresses, and account numbers of the counterparties;[1]
- Preparing reports needed for tax, financial, position, risk-exposure reporting, and so on;
- Valuing the swap for purposes of determining collateral requirements;
- Monitoring counterparty creditworthiness;
- Determining collateral requirements (this usually involves all positions documented under a master agreement);
- Valuation and monitoring of securities posted as collateral, and determination of "haircuts" to be applied to securities posted;[2]
- Monitoring counterparties for compliance with the terms of the contract, in particular credit events defined under the contract;
- Determining whether to exercise closeout rights when credit events occur; and
- Pursuing legal remedies for recovering net amounts owed under closed out positions, or making net final payments owed and ensuring legal finality of closeout obligations.

[1]Even if the swap is not assigned to a new counterparty, this information can easily change over ten years.
[2]Haircuts are discounts applied to the market value of securities posted as collateral. Thus, a bond with a market value of $10 million may only count as $9 million worth of collateral. Haircuts protect the collateral holder against any fluctuation in the value of the collateral.

Critical risk-management functions are typically carried out by the clearinghouse.

In the remainder of this article, we discuss a number of interrelated functions typically performed by derivatives clearing and settlement arrangements—regardless of whether they are centralized (as in markets that utilize CCPs) or not—including:

- Counterparty credit-risk-management techniques, such as netting, collateralization, procedures (such as DvP and PvP) to mitigate settlement risk, procedures (such as variation settlement) to mitigate replacement cost (or so-called forward) risk, and other risk-management mechanisms;
- Market access restrictions, ongoing credit evaluation, and monitoring;
- Crisis management and user default administration;
- Loss mutualization, insurance, and other measures that supplement the CCP's risk-management mechanisms; and
- Related information collection and administrative functions necessary to the operation of the clearing and settlement arrangement.

We then consider how the clearing and settlement structure (for example, bilateral versus CCP) can affect the functioning of markets. However, our comparison between bilateral and centrally cleared alternatives does not imply that one is a better model than the other. Bilateral and centrally cleared systems have coexisted for almost a century and are likely to continue to do so. This has occurred due to the heterogeneous nature of derivatives products and their evolution. Each clearing method has its pros and cons, and these vary with the characteristics of the derivative being cleared.

Structure of central counterparties

A CCP can be defined as "... [a]n entity that interposes itself between counterparties to contracts traded in one or more financial markets, becoming the buyer to every seller and the seller to every buyer."[10] In other words, a CCP becomes a substituted principal to

contract obligations originating with other members of a financial market. Because it stands between market buyers and sellers, the CCP bears no net market risk exposure—such risk remains with the original counterparties to the trade. Credit risk, on the other hand, is centralized in the CCP itself. As a result, there is no need for the original counterparties to initially evaluate or continuously monitor each other's creditworthiness. In fact, in a market that utilizes a CCP, the original parties to a trade may be entirely unknown to each other.

The legal process whereby the CCP is interposed between buyer and seller is known as novation.[11] Novation is the replacement of one contract with another or, in this case, one contract with two new contracts. The viability of novation depends on the legal enforceability of the new contracts and the certainty that the original counterparties are not legally obligated to each other once the novation is completed. As a result of novation, the contract between the original counterparties is discharged and the CCP becomes the "buyer to every seller and the seller to every buyer."

A CCP is legally obligated to perform on the contracts to which it becomes a substituted counterparty in place of the original counterparties. However, because the CCP enters into two offsetting positions as a result of each novation, the CCP is "market neutral"—the number of long positions will equal the number of short positions to which the CCP is a party, just as the number of long and short positions across the market as a whole cancel out. Thus, a CCP normally bears no market risk.[12] But as counterparty to every position, the CCP bears credit risk in the event that one of its counterparties fails. Similarly, the CCP's counterparties bear the credit risk that the CCP might fail.

CCPs mitigate their credit risk exposure through a number of reinforcing mechanisms, typically including *access restrictions*, *risk-management tools* (such as collateralization), and *loss mutualization*. These mechanisms simultaneously serve to make market participants indifferent to the actual creditworthiness of the parties with which they trade on the centrally cleared market. They also have a number of ancillary effects that reduce costs to the CCP counterparties and increase liquidity in the market.

Access restrictions (such as membership requirements) are central structural components of the CCP arrangement. CCPs only deal with parties that meet the CCPs' standards for creditworthiness and operational capability and may revoke access privileges for those who fail to maintain their creditworthiness and meet their other obligations to the CCPs. This permits the CCPs to limit their risk exposure to those parties they are able to monitor.

In addition, CCPs typically impose some or all of the counterparty credit-risk-management techniques described above. For example, trading obligations (positions) and payment requirements are multilaterally netted, increasing operational efficiency and reducing the amount at risk. CCPs also typically impose collateral requirements (sometimes known as initial margin) on those that have direct access to the CCP. Margining systems are designed to ensure that in the event that a clearing member fails to meet a margin call, sufficient funds remain readily available to close out the member's positions without loss to the CCP in most market conditions. As a complementary risk-management mechanism, the gains and losses from open positions are posted to a clearing member's margin account on a regular (usually daily) basis and result in calls for variation settlement (or variation margin). The variation settlement reflects periodic mark-to-market fluctuations and is an important mechanism for assuring the collateral held by the CCP is likely to be sufficient to meet the needs of the CCP in the event of a default.

Another mechanism becomes operative if the posted collateral is not sufficient to offset a loss resulting from the failure of a counterparty. After exhausting the counterparty's collateral, CCPs typically provide that any remaining loss will be shared among all (or certain classes of) clearing members. The details of such "loss mutualization" arrangements vary, but generally include a clearing or capital fund that is either paid in by clearing members or built up through accumulated undistributed profits or transaction fee rebates.

The result of the credit standards and margining systems employed by CCPs and enforced on the market is twofold. Firstly, credit risk is homogenized; and secondly, credit risk monitoring is delegated. Both of these effects tend to reduce the costs to market participants. Credit risk is homogenized through standardized margining and member capital requirements. In addition, the CCP's risk-management mechanisms are supplemented by mutualization or loss sharing and other measures, such as third-party insurance. Since every clearing member's counterparty is the CCP, it does not matter which member a market participant enters into a trade with. Informational costs and asymmetries may also be reduced by having a central counterparty. Instead of a market where participants must assess the creditworthiness of their counterparties individually and then act on that assessment, either through trading decisions or pricing, every clearing member is required to satisfy well-understood requirements. The CCP then monitors and enforces these requirements, relieving the market participants of the

need to do so. Market participants need only have confidence in the creditworthiness of the CCP, which may be ascertained in various ways, such as public ratings.

Because members are collectively liable for losses, up to a predetermined level, and more importantly perhaps because they have a collective interest in the survival of the CCP, they have a strong incentive to work with and through the CCP to resolve issues. Since the CCP is the only direct counterparty of a clearing member, it effectively acts on behalf of the other, nondefaulting clearing members in pursuing legal remedies against any clearing member that defaults. In a bilaterally cleared market, each counterparty of a failed market participant would have to look out for its own interests, which, in principle, would significantly raise legal and administrative costs.

Effects of CCP structure

Novation and the credit-risk-mitigation mechanisms utilized by CCPs have a number of important effects on how centrally cleared derivatives markets function. The first and perhaps most important is that credit risk becomes homogenized, at least as far as clearing members are concerned. All clearing members meet identical credit requirements and are subject to the same oversight. The homogenization of credit risk and the structure of mutualized loss sharing facilitate anonymous trading among market participants. This greatly reduces the informational costs of trading. Unlike bilaterally cleared markets—where assessments of counterparty credit risk influence the decisions of which counterparties will trade with which and which must post collateral and in what amount—in a centrally cleared market using a CCP, everyone is equal and the CCP ensures that obligations are met.

Clearing derivatives through a CCP also facilitates liquidity in another way. Recall that a derivatives contract is established between two particular parties. In the absence of a CCP, the contract could not easily be exited except by agreement of both parties (unlike a security that can simply be sold to a third party). Entering into an offsetting contract with a different counterparty may eliminate the market risk of the combined positions, but credit risk remains. We'll call the counterparty to both contracts A and the other two counterparties B and C. If B or C defaults, then A may be left with a loss on that position and an unhedged position in the remaining contract. Furthermore, since A has two positions, it may need to hold collateral against both positions. Only by entering into an identical offsetting contract with the original counterparty and then getting the counterparty to agree to cancel the offsetting positions (as is usually embodied in the relevant master agreements) can a market participant exit a position with legal certainty**.**

The result is that positions tend to be left "on," although they have become economically redundant. Furthermore, redundant positions can easily be built up across networks of participants. Redundant positions increase administrative burdens but, more importantly, increase the number of positions that would need to be resolved were a member of the network to fail. The solution, multilateral netting, requires knowledge and analysis of all the positions of all members in the network—however, the information needed to accomplish multilateral netting may include proprietary information that the traders involved may not wish to share with outsiders. That concern may inhibit the cooperation and disclosure needed in the bilateral markets to accomplish multilateral netting.

In a centrally cleared derivatives market with a CCP, the rules of the clearinghouse typically provide for the automatic netting and cancellation of offsetting contracts. Market participants can easily exit positions by entering into an offsetting trade with the CCP. The ability to easily enter into positions (which comes from credit risk homogenization and delegated monitoring) and the ability to easily exit positions (by having a single common counterparty) greatly increase the liquidity of the market.

While liquidity is a great benefit of a CCP-cleared market, CCPs are themselves dependent upon a sufficient level of liquidity to be of value to a particular market. Many OTC derivatives contracts are too specialized to develop the necessary volume to make central clearing feasible. However, as markets for particular contracts mature and as standardized forms of transacting and standardized contract terms are adopted (as has happened in interest rates swaps, for instance), CCP clearing of OTC derivatives becomes more and more feasible.

Alternatives to CCPs

In the previous section, we explained that CCPs bring a bundle of interrelated services to the market, including credit risk management, delegated monitoring, and liquidity enhancement. However, a CCP is only one of a number of alternative structures that could be used to provide these services.[13] Next, we consider how the OTC derivatives markets face the same issues addressed by these CCP services.

As we discussed earlier, netting and position closeout are natural outcomes of a CCP, so long as the legal system recognizes novation (or the applicable legal mechanism for effecting counterparty substitution). Through the efforts of trade organizations, such

as the International Swaps and Derivatives Association (ISDA), central banks, and others, legislatures have provided legal protection for netting and collateral under covered master agreements for derivatives transactions. Thus, OTC derivatives market participants may enjoy netting and collateral benefits vis-à-vis a single counterparty similar to those enjoyed by CCP members with respect to their sole counterparty, the CCP. As noted above, there are practical constraints upon the ability of OTC market participants to multilaterally net their positions, payments, and other obligations. However, these markets have developed other innovations to facilitate multilateral netting. An example is TriOptima.[14] Subscribers to TriOptima's web-based service input their positions. TriOptima then runs algorithms to detect redundant positions and notifies subscribers of the early termination trades needed to eliminate redundancies.

Organizations such as ISDA have also worked to reduce legal uncertainty through the use of standardized contract language and terms. As a result, some types of OTC derivatives contracts have become standardized in all but their economic specifics. This increases liquidity and reduces the costs of transacting. Likewise, the standardization of collateral arrangements reduces the costs of managing collateral. Moreover, recent movements to standardize the process for the assignment of contracts—that is, mutually agreed substitution of one counterparty with another—and greater market acceptance of assignments have the potential to enhance market liquidity.[15]

Mutualized loss sharing occurs in many forms in the economy. The most common mechanism is insurance. Customers pay nonrefundable fees to the insurance company, which in turn agrees to cover customers' losses. Insurance, in the form of third-party guarantees, is routine in fixed income, securitization, and some derivatives markets. While insurance and performance guarantees rely on a single guarantor, rather than a pool of members, the business model effectively spreads the cost across the client base (or the company would not make a profit). Unlike mutualized loss sharing across a CCP's member base, expected losses in an insurance arrangement are paid ex ante through premiums, rather than being assessed ex post through attachment of member funds and additional assessments. A CCP member only shares the losses after they have occurred and after the defaulting member's funds have been exhausted. Meanwhile, the members may retain a legal interest in the funds from which losses are to be paid. Insurance customers, on the other hand, have no right to excess premiums they pay in and rely on market competition to keep these to an appropriate minimum. As with CCPs, the insurance company also centralizes risk assessment, pricing, mitigation, legal standing to pursue claims, collection and processing of payments, and so on.

Another function performed by CCPs is centralized bookkeeping. A similar function is performed in securities markets by securities depositories, which track beneficial ownership of securities, record changes in ownership, provide mailing lists for proxies and dividend payments, and so forth. These mundane functions occur on such an enormous scale that centralization provides overwhelming economies.[16] Securities depositories are expanding their range of securities and the ancillary functions they perform. A recent proposed innovation by the Depository Trust and Clearing Corporation (DTCC) working with major dealers was to set up a database of "golden copies" of all credit derivatives in the U.S. This is to serve as the repository of the legally binding copy in the event of disagreement. In the case of credit default swaps, the DTCC also assists in the determination of credit events by collecting information from individual counterparty actions and, when these reach a critical level for a particular underlying reference entity, informing the market.

Conclusion

The CCP structure we know today is, to a certain extent, an artifact of the origins of exchange-traded contracts. At the same time, OTC markets have evolved other means of dealing with similar problems of credit risk management and efficiency.

Today both CCP and bilaterally cleared market structures are evolving rapidly. Much of the attention has focused on CCPs, in part because they represent identifiable legal entities. The historical linkages between CCPs and specific exchanges have sometimes been viewed as important to the competitiveness of those exchanges and to the countries in which the CCPs and exchanges are located. Pressures to consolidate CCPs across exchanges, to free CCPs to clear OTC products, and to clear across borders continue to be controversial. Bilateral clearing is a market practice rather than a legally identifiable institution. Nonetheless, the sheer size of the dealers at the center of the OTC market, the relative opacity of the markets, and some operational problems have begun to draw attention to clearing in these markets as well.[17]

While CCP and bilaterally cleared markets deal with similar issues, they also have dissimilarities. OTC market products tend to be customized, to be less liquid, and to involve less turnover of positions. In contrast, derivatives cleared through a CCP tend to be

highly standardized and highly liquid. While it is too strong to say that the two systems are converging, it is the case that both are evolving and in the process adapting ideas from each other: increasing scope and coverage on the part of CCPs and increasing efficiencies through standardization on the part of the OTC derivatives market.

An important public policy issue is whether and how to encourage these developments. In considering these questions it is important to distinguish the benefits from the structures. Economies of scale can be achieved both by cross-border consolidation of CCPs and by cross-border consolidation of dealers. Credit risk management can be done by CCPs or by insurance companies. Operational efficiency can be obtained by centralizing processing in CCPs or in securities depositories. It is true that CCPs perform all these functions in a single institution. There may be some synergies to doing so, though this is not necessarily obvious. As the discussion proceeds, it is important to note that markets have generally been successful in evolving mechanisms for dealing with collective risks. Both CCPs and the structures and practices of bilateral clearing were, for the most part, developed by markets and not mandated by regulators. If the goal of policymakers is to create an environment in which market mechanisms can evolve to provide greater societal benefits while containing systemic risks, it may be useful to recognize the multiplicity of possible approaches to any given problem. The CCP, where it has the necessary market depth to function, may turn out to be the most attractive and efficient solution. But, then again, in some cases it may not.

NOTES

[1]The Bond Market Association (www.bondmarkets.com).

[2]International Swaps and Derivatives Association (www.isda.org). The "notional value" of a financial contract is the principal amount involved in the transaction. For example, an option to buy 100 barrels of oil at $65/barrel would have a notional value of $6,500. Derivatives contracts typically call for periodic payments over the life of the contract of amounts that may be based upon the principal amount, but not the principal itself. Thus, the parties' credit exposure is typically measured by the "replacement cost" of the contract, not the notional value.

[3]According to the most recent semiannual survey of derivatives market statistics published by the Bank for International Settlements, the outstanding notional value of OTC derivatives contracts (including both futures and options) was $284 trillion (Bank for International Settlements, 2006b, table 19). By comparison, exchange-traded derivatives exceeded $83 trillion (Bank for International Settlements, 2006a, table 23A). Data are for December 2005 and June 2006, respectively.

[4]See, *inter alia*, Bliss and Papathanassiou (2006), Bank for International Settlements (2001), Bank for International Settlements (1997), Bank for International Settlements (1998), Bank for International Settlements (2004), Counterparty Risk-Management Policy Group II (2006), Kroszner (1999), Moser (1998), Moskow (2006), Murawski (2002), Ripatti (2004), and Russo, Hart, and Schönenberger (2002).

[5]See Moskow (2006).

[6]Settlement risk, sometimes referred to as "Herstatt risk," is the risk that arises because of a temporal disjunction between two related payments or other financial transactions. It is not unique to foreign currency transactions, as it arises whenever two linked payments or financial transactions occur sequentially. The 1974 failure of Herstatt Bank has become the classic illustration of settlement risk. See, for example, Steigerwald (2001).

[7]In recent years, securities markets have begun to use mechanisms (such as central counterparties) to mitigate the counterparty credit risks associated with securities transactions prior to settlement. See, for example, Bank for International Settlements (2004).

[8]See Moser (1998) and Kroszner (1999).

[9]In the late nineteenth century, a third arrangement existed on some futures exchanges known as ring clearing, but this evolved into central counterparty clearing. Ring clearing involved agreement by a group of market participants to treat each other's contracts as more or less interchangeable, allowing transfer and termination of offsetting positions. The recent development and acceptance of standardized procedures to assign derivatives (substitute counterparties) and their use on a regular basis has some of the characteristics of ring clearing. See Moser (1998) for history and details.

[10]Bank for International Settlements (2004).

[11]An alternative approach to establishing a central counterparty relation, known as open offer, is used in some European countries. In this case, the CCP makes an offer to enter into pairs of contracts on terms agreed upon by two markets participants, under certain rules. The market participants agree upon the terms but never formally enter into a contract vis-à-vis each other. Instead, they report their agreement to the CCP, which then enters into the two contracts.

[12]Were a counterparty to default, the CCP's position would become unbalanced and exposed to market risk until the CCP reverses out the defaulting member's positions.

[13]See, for example, Hills et al. (1999), pp. 122–124.

[14]See www.trioptima.com.

[15]The assignment of a contract, if legally effective, results in the substitution of a new counterparty for one of the original parties to a financial transaction.

[16]With the exception of securities derivatives and government bonds, most securities in the U.S. are processed through a single depository, the Depository Trust Corporation (DTC) and its affiliates, which provide a variety of risk-management functions.

[17]See Counterparty Risk Management Policy Group II (2005), Bliss and Kaufman (2006), and Bliss and Papathanassiou (2006).

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