Clearing and Settling Financial Transactions, Circa 2000

Edward J. Green*

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ABSTRACT: The convenience, safety and trust required for national and global markets to function are largely provided by clearing and settlement arrangements. Well designed settlement arrangements can address the most serious risk of loss of the entire principal value of an asset being traded. A spectrum of risk-control arrangements and procedures at the clearing stage of a transaction provide further benefits. The recent and current development of clearing and settlement practices exemplifies the re-engineering and continuous-improvement approaches that have been of proven value throughout the economy, and that particularly have facilitated the advantageous adoption of new technologies. The resulting strength and flexibility of current practices have contributed to financial markets' responsiveness to three major challenges and opportunities: the invention of financial derivatives (e.g., futures, options and swaps) and the establishment of exchanges to trade many of them; the availability of computing and telecommunication technology that can simultaneously link a large, geographically dispersed group of traders, and the consequent feasibility of conducting trading by means other than open outcry on a trading floor; and the explosive growth of transaction volume on a number of exchanges.

* Federal Reserve Bank of Chicago. (E-mail: edward.green@chi.frb.org) The views expressed in this article are solely those of the author, and do not necessarily represent the views of the Federal Reserve Bank of Chicago or of the Federal Reserve System. The author is a lay person in the law. Where some discussion of legal issues in general terms has been necessary in the article, it should not be regarded as an authoritative statement of law. The author has benefitted from discussions with Sujit Chakravorty, Robert Eisenbeis, John McPartland, William Roberds, Robert Steigerwald, and Staffan Viotti.

Introduction

In order for a market to exist, a mechanism must exist to convey whatever is traded conveniently and safely transferrable from the seller to the buyer. Moreover, the scope of the market can only be as large as the community of traders who have access to such means of transfer. In a large market, traders who do not know one another have to rely on each other's promises to deliver goods and money to complete the trades that they negotiate. This trust must be supported by formal, institutionalized safeguards,.

In the context of financial transactions, the convenience, safety and trust required for national and global markets to function are largely provided by clearing and settlement arrangements. The process of making a transaction can be divided roughly into three stages consisting of a) execution, b) clearing, and c) settlement. Only the initial, execution stage typically requires the active attention of the traders or their clients.[1] The execution stage may involve submission of trading orders to an exchange, as well as matching (that is, ensuring that the buyer's and seller's trading orders are mutually consistent), and possibly registration and confirmation of contract between the buyer and seller to trade. The third and final stage of a transaction, settlement, is the transfer of funds from buyer to seller in return for the transfer of ownership of the asset from seller to buyer. Clearing, which is significant because it typically involves risk controls such as modifying sales contracts to guarantee settlement and cancel offsetting claims, is the second, intermediate stage of the

[1] There are issues of convenience, safety and trust at this stage, as well as at the subsequent stages that are the subject of this article. As traders increasingly deal with one another and with clients fairly anonymously via electronic networks, new and significant issues are raised. In large part, the issues seem parallel to those that arise in other areas of electronic commerce. Cf. Rutstein et al. (1999).

transaction. Some clearing operations are typically part of a financial transaction, but not always so. Execution and settlement, but not clearing, are essential stages of a transaction.

Financial clearing and settlement services are continuously being improved, and also extended to new assets. This progress reflects both the high priority that the securities industry autonomously places on clearing and settlement and also the further stimulus that securities-market commissions and central banks provide. In contrast to the situation three or four decades ago, when deficiencies in the U.S. securities clearing and settlement arrangements reached crisis proportions, these systems today perform admirably under normal market conditions and have survived--and seem to have contributed to stability during--episodes of moderate market stress in 1987 and 1998.[2] The arrangements' strength and flexibility arguably have been essential to financial markets' responsiveness to three major challenges and opportunities: the invention of financial derivatives (e.g., futures, options and swaps) and the establishment of exchanges to trade many of them; the availability of computing and telecommunication technology that can simultaneously link a large, geographically dispersed group of traders, and the consequent feasibility of conducting trading by means other than open outcry on a trading floor; and the explosive growth of transaction volume on a number of exchanges.[3]

This article is a broad, introductory survey of how clearing and settlement are typically accomplished in financial markets today. Primary securities (such as debt and equity), exchange-

[2] Nevertheless, the 1987 episode revealed some weaknesses and stimulated subsequent improvements. The Group of Thirty, an organization of senior bankers and financial executives, central bankers, and academics, played a prominent role in suggesting and promoting reforms.
[3] The National Securities Clearing Corporation (NSCC) is the clearing organization for the major U.S. exchanges for stocks and corporate and municipal bonds, and for transactions of mutual funds and pension funds. Its peak-day transactions volumes (counting a matched pair of purchase and sale orders as a single transaction) have grown from approximately 3 billion in 1998 to 5 billion in 1999

traded derivative securities, and assets and contracts traded outside exchanges (i.e., over-the counter, or OTC, trades) will all be discussed. This survey should convey an understanding of the crucial role of clearing and settlement arrangements in facilitating the highly visible, current responses to the challenges and opportunities mentioned in the preceding paragraph, and an appreciation of the business and public-policy objectives that motivate the arrangements' ongoing development. The survey is not comprehensive. For instance, discussion of issues regarding cross-market and cross-jurisdiction transactions (and especially international transactions) is notably absent. Nevertheless this article should provide sufficient background to facilitate reading of the industry and supervisory policy documents that are guiding the evolution of these arrangements.[4] Clearing and settlement are discussed primarily in the context of U.S. laws, institutions, and practices. There are broad similarities, but numerous differences in detail, between this U.S. context and those of other industrialized countries.

Principal Risk, Replacement Cost Risk, and Delivery Versus Payment[5]

Consider a transaction in which a security, such as corporate equity, is exchanged for money. Assume that payment of money is final, that is, that the money cannot be taken back by the payor or taken away by third parties (e.g., in the event that the payor had obtained it by theft). Suppose that the security is issued in bearer form, that is, that ownership is evidenced by possession of a transferrable certificate that was given by the issuer to the original purchaser of the security, and that has been handed over to the new owner every time the security has been sold. In the present

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to 9 billion in the first half of 2000. (Depository Trust & Clearing Corporation (DTCC) press release, 7 April 2000.)

[4] In particular, CPSS (1995) deals with cross-border securities settlements.

[5] This section draws on on CPSS (1992).

transaction, as well, ownership of the security will be transferred by handing over the certificate. Furthermore, as with money, transfer of the security is final.

Specifically, suppose that the owner of the security contracts to sell it to a buyer at a specified price. That is, they make a legally binding agreement that the seller will hand the certificate over to the buyer in exchange for the money as soon as they can retrieve the certificate and the money from their respective vaults. Making this contract constitutes the execution stage of the transaction. After execution, the seller still owns the security because the certificate is still in the seller's vault. That is, the transaction still has to be settled.

Consider now how the delivery of the security and the settlement of the transaction might take place. The seller typically sends the certificate to the buyer by courier, expecting the buyer to pay money in return. Suppose instead, the buyer has an urgent and unanticipated need for money--both the amount in the vault and the additional amount that could be gotten by reselling the security--such as might happen in catastrophic circumstances such as insolvency. Subject to this force majeur, the buyer does resell the security and pays all the money--both the amount in the vault and the proceeds of the sale--as is compelled. Because both the sale and the payment are final, the seller can neither take back the security from its new owner nor take money from the person to whom the buyer paid it. The seller has lost the entire value of the security. All that the seller can do is to sue the buyer for breach of contract. Given the buyer's unfortunate situation, though, a judgment that the buyer must pay the seller is unlikely to be enforceable. This loss of the principal value of the security is essentially the worst outcome that the transaction could possibly have for the seller.[6]

[6] Given the symmetry between the buyer and the seller (since transfers of both money and securities are final), a story could alternatively be told that the buyer lost the money but did not gain the security, and had no effective recourse through contract enforcement. Again, this would be essentially the worst possible outcome of the transaction.

Alternatively, the buyer and the seller could mitigate their risks by agreeing to meet face-to-face at a specified time and place to exchange the security and the money.[7] Such an agreement exemplifies a delivery-versus-payment (DVP) settlement arrangement, that is, an arrangement by which the security and the money paid for it are transferred simultaneously and neither transfer can occur without the other.[8]

Consider how a DVP settlement arrangement mitigates risks. The worst possible outcome for the seller would be for the buyer to default by showing up empty-handed (or by not showing up at all). Then the seller would have the option to sell the security to someone else at prevailing market terms, and might acquire less for it than the amount contracted with the buyer if the market price had fallen since the previous day. If the seller urgently needed the proceeds of the sale to make a payment on the intended settlement day, and would have to make a loan or pay a penalty for lateness because the new sale could not be settled immediately, that would be a further loss attributable to the buyer's default. Under usual circumstances, these two losses do not add up to anything so catastrophic as loss of the principal value of the security.[9]

This description of DVP settlement suggests that securities delivery and funds payment are accomplished with exact simultaneity. In the interest of convenience and cost effectiveness, many actual systems are designed to achieve only approximate simultaneity. The risks inherent in such a

[7] The U.S. Securities and Exchange Commission (SEC) currently requires that equity trades should be settled by the third business day after the contract for sale has been executed.
[8] The following discussion assumes that payment is immediately final. That is, it cannot later be cancelled by the buyer or dishonored by the buyer's bank. Funds transfer systems that provide immediate finality are almost universally used for securities settlement.
[9] The two risks described here are often called replacement-cost risk and liquidity risk, respectively, To say that they are typically less severe than principal risk is not to dismiss the problem. Assuredly there are instances in which value of the a security has fallen appreciably within the time that it takes to complete a sale. For some financial derivatives and other assets that have volatile prices, replacement-cost risk is especially salient.

design, and also the ways of controlling and insuring that risk, are similar to those associated with settlement after netting in a clearing system, which will be discussed later in this article.

Mechanics and Legal Foundations of DVP Settlement, and Legal Risk[10]

Separate transfer of securities and payment funds, by procedures that essentially coincided with the high-risk arrangement depicted at the beginning of the preceding section, was the norm for settling securities transactions until the 1970s. Even then, when the daily NYSE transaction level was in the range of 20—100 million shares rather than today's level of a billion, settlement by means of face-to-face meetings was out of the question as a routine practice.[11] Two alternative means to achieve DVP came into widespread use: (1) issuance of uncertificated (or dematerialized) securities that an owner must hold directly by being registered as owner by the issuer and (2) a tiered holdings structure, that is, a hierarchical account structure of indirect security holdings.[12] In the United States, the correct ways of using both of these means of settlement (including the rights and responsibilities of all principals and agents in the transaction) are set forth in Article 8 of the 1994 revision of the Uniform Commercial Code (UCC). UCC Article 8 governs most securities transactions because it has been adopted by the states in which the transactions occur, because parties to transactions in other states agree explicitly to adopt it and the law makes such an

[10] This section draws on the prefatory note to the 1994 revision of the Uniform Commercial Code, Article 8 – Investment Securities. ALI and NCCUSL (1994).

[11] The sources for former and current NYSE share volumes are http://www.nyse.com/about/about.html and the August 18, 2000 Wall Street Journal, page C3, respectively. Note that these are share volumes, not transactions volumes.

[12] Today mutual funds issue shares are held directly in uncertificated form, but most equity and debt securities continue to be issued in certificated form and held indirectly. Sales of the latter securities are settled by transferring securities entitlements between accounts. The Federal Reserve issues Treasury securities in dematerialized form through its Treasury Direct system, but most Treasury securities are owned and traded via a hierarchical system of accounts. Sales at the top level of the hierarchy are settled via the Fedwire Book Entry Security System, which effects DVP transfers

agreement enforceable, or--in the case of sales of Treasury securities--because the federal regulations governing those sales are based on Article 8.

A security is said to be issued in uncertificated form if the issuer does not provide a physical certificate to document ownership, but only maintains a database (that is, a set of accounts) called a book-entry system that definitively registers who owns how much of the security.[13] Change of ownership is effected by instructing the issuer to record the change in the database. An intermediary can accomplish DVP settlement by a three-stage process. First, the intermediary obtains authorization from the seller to act as agent to instruct the issuer to change ownership after payment from the buyer has been received. Second, the intermediary obtains confirmation that the buyer has made payment. (The most straightforward way is for the intermediary to control the bank account into which payment is made.) Third, the intermediary submits to the issuer an instruction to make the buyer the new owner of the security, along with documentation that the intermediary is submitting a valid instruction as agent of the seller.

According to the foregoing settlement procedure, the issuer must take an action (namely, to amend the database) every time a security is sold. In markets where sales are ordinarily made through brokers, and where these brokers also maintain records of their customers' portfolios for business purposes, duplicate records of ownership are actually being kept. If the involvement of the issuer in secondary-market securities transactions is inconvenient or expensive, then it can be minimized by stipulating the broker's record that the customer owns a security or other financial asset as evidencing an essentially identical property right of the customer as the issuer's record would

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between financial intermediaries' reserve accounts and their Treasury-securities accounts with the Fed.

[13] Either a certificated or uncertificated security can be issued in registered, or book-entry, form. In practice, the issuer’s tasks described in this section are almost always delegated to an agent.

evidence. In the language of UCC Article 8, the account owner has a security entitlement to the financial asset in the account. Incidentally, the class of financial assets that can give rise to security entitlements is somewhat broader than the class of assets that are characterized as securities in Article 8. This extra breadth permits derivative securities, as well as equity and debt securities, to be traded as security entitlements within the scope of the UCC. A security entitlement should not be confused with the similarly named and more broadly invoked legal concept of a security interest. In a legal system where such a stipulation has been made, the issuer's record can indicate that the broker owns the security, while the broker's record indicates that the customer owns the security. If one customer of the broker sells the security to another, then the broker's database must be amended to reflect the change of ownership but no change needs to be made in the issuer's database. That is, as far as the issuer is concerned, the same broker remains the owner of the security. Only the broker and the customer need to know, and the customer needs to be able to prove, that the customer is the beneficial owner--that is, the person who exercises the rights and enjoys the benefits of ownership--of the security. Only when a customer of one broker sells the security to a customer of a different broker does the issuer need to record a change of ownership--from one broker to another.

In many cases, further economy has been achieved by inserting a special-purpose intermediary, a securities depository company, between the issuers and the brokers. This intermediary achieves an economy of scope by, in effect, holding all certificates and maintaining the databases of all issuers. (The certificates held by the depository company are said to be immobilized.) Each issuer maintains a trivial database, in which the depository company is recorded as being the owner of all

the securities that have been issued.[14] The depository company keeps a set of accounts for its participants (i.e., customers), which in practice are mostly brokers and banks. Each of those intermediary participants, in turn, maintains a set of accounts for its customers, most of which are the non-intermediaries who are the beneficial owners of the securities.

The account structure of this indirect-holdings system is closely analogous to that of a banking system, where nonbank entities hold accounts at banks, which may hold accounts at correspondent banks, which may in turn hold accounts at the central bank. The bank takes funds deposited by the customer and deposits them with the correspondent bank. The bank's customer is unknown to the correspondent bank, and despite being the ultimate source of the funds deposited at the correspondent bank, the customer cannot withdraw them directly from there. The proper analogy is actually between the hierarchical system based on UCC Article 8 and a banking system with a 100% reserve requirement. That is, Article 8 requires an intermediary to own securities to cover the security entitlements owned by its customers by virtue of their accounts. The intermediary can satisfy this requirement either by being the direct holder of the security (i.e., by possessing the certificate and/or being the registered owner in the issuer's book-entry system) or by having a security entitlement by virtue of owning an account at another intermediary.

Another requirement that the 1994 draft of Article 8 places on intermediaries is that customer securities must be in a separate account from securities of which the intermediary itself

[14] Technically, this is an overstatement with respect to the U.S. markets. For example, the Depository Trust Company (DTC) is the depository trust company for most U.S. equities, as well as corporate and municipal bonds and other types of security. The DTC was estimated in 1994 to be the direct holder of only between 60% and 80% of shares of U.S. equity. However, it holds nearly all of the actively traded equity. About 99% of equity trades are cleared through the NSCC and then settled through the DTC, so the need for issuers to be involved in settlement is very greatly reduced. (The DTC and the NSCC are both subsidiaries of the DTCC.)

(specifically, a broker-dealer) is the beneficial owner.[15] This requirement gives teeth to a protection afforded to customers, that their security entitlements cannot be used to satisfy claims against the intermediary. In addition, the 1994 draft provides protection to holders of security entitlements against adverse claims (e.g., that ownership must be relinquished because the security entitlement was purchased, albeit in good faith, from a seller who had obtained it illegally.) that is analogous to the protection that direct holders of securities had already enjoyed. Consider what might otherwise happen to such a buyer holding the security in an account at a broker where the broker was the direct holder of the security. The original owner from whom the seller had illegally obtained the security could not sue the broker to get it back, because the broker would be protected from adverse claims as direct holder. However, the original owner could sue to force the buyer (i.e., the customer of the broker) to relinquish the security entitlement. The effect of a successful suit would be to establish an account of the original owner at the broker and to transfer the buyer's security to it without compensating the buyer. That is, this might be done in spite of the protection against adverse claims that the broker would enjoy as direct holder, since the buyer's security entitlement would be a distinct right from the broker's property right to the security, and only the latter would be protected by Article 8 prior to adoption of the 1994 draft by the jurisdiction, the law of which governed the sale.

These features of the 1994 draft of UCC Article 8 are good illustrations of the importance that both participants in, and supervisors of, securities markets attach to ensuring that market practices have clear, predictable, and enforceable legal foundations. The practice of indirect holding of securities through accounts was well established by 1994. Securities intermediaries and their customers who elected to hold their securities indirectly in accounts did not consider imperfections, such as

[15] Article 8 does permit a broker-dealer to maintain just two accounts at the depository company,

potential exposure to adverse claims, to be a serious enough problem to warrant the inconvenience to the account owner of holding the security directly instead. There may have been alternative legal arguments that could ground protections for securities-account owners on other parts of the law than Article 8, or perhaps simply on the basis that courts really have no alternative but to grant the assumptions required to make an essential industry practice viable. However, such alternative grounding might have to be provided by a patchwork of arguments that would be supportable in various jurisdictions. The arguments might be untested in court and subject to differences of expert opinion regarding whether they would be accepted. If these arguments were to be tested for the first time (or if scattered supporting opinions by jurists not highly expert in securities-transaction law were to be challenged) in the aftermath of a market breakdown, the resulting uncertainty and delay in resolving conflicts might possibly exacerbate problems in the market and even in economy in general. Regardless of whether there were ever a market breakdown or whether the legal arguments were ever tested, many of the owners who did elect to hold their securities directly may have based their choices, at least in part, on concerns about the legal status of indirect holding. The abstention of these owners from holding their securities indirectly arguably made the settlement system less efficient than it would have been if all securities were immobilized. For all of these reasons, the integrity of securities settlement was strengthened when the practice of holding and transferring security entitlements was codified with explicit safeguards and specifications of rights and responsibilities, and when this codification was widely adopted, during the past decade.

An episode of market stress is precisely the type of situation that is prone to bring to light unanticipated ambiguities in a legal code or questions about the relationship of the concepts in the code to actual commercial practice. For this reason, supervisors acknowledge that attempts to

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one for its own holdings and the other for its customers' collective holdings.

achieve sound legal underpinnings are doomed to fall short of certainty.[16] Nevertheless such attempts are regarded as being highly productive, and it is good public policy to foster them. Reviewing and improving the legal foundations of clearing and settlement systems has become a continuous process in the United States and other countries.[17] Besides the law of payments and securities transactions, legal frameworks for making contracts, pledging and liquidating collateral, and managing insolvencies receive close scrutiny.

Settlement and the electronic execution of trades

Arrangements for electronic execution of trades are currently receiving much attention. These arrangements include both exchange-sponsored systems and also systems that function as brokers. An electronic communications network (ECN) for securities trading can be structured either as an exchange or a broker. These new execution systems fit well with the regime of securities ownership and transfer that has just been described. In fact, the improvement that the revised UCC Article 8 has made in the legal foundation of this regime may well have been one of the factors that has promoted the development of electronic trade execution.

Electronic execution of trades will make it more common for trades to be executed across national borders, for a security to be listed on several exchanges, and so forth. Such circumstances can create some problems of coordinating disparate industry practices and regulations, such as differences across jurisdictions regarding how promptly settlement must occur after a transaction. Industry participants and policy makers have an impressive track record of harmonizing such

[16] Cf. CPSS (2000), Part II, Section 7.1.3.

[17] A current (as of August, 2000) example is the proposed amendment of 17 CFR Part 35 of the rules of the Commodity Futures Trading Commission (CFTC, 2000), which would resolve legal uncertainty noted by the President's Working Group on Financial Markets (1999) about the availability of clearing for financial derivatives that are not traded on exchanges.

practices and regulations, by a process growing out of informal consultation, where such needs have arisen over time.

Electronically executed transactions often exemplify transactions in which the parties do not know one another and find it costly or difficult to assess the risks to which they expose themselves by trading with one another. Parties to such transactions benefit especially from various risk-management measures in the clearing process, which will be discussed below.

Electronically executed trades can be quickly and accurately matched. For this reason, electronic execution may eventually facilitate a reduction in the time lag between execution and settlement.

Clearing as Risk Management by Contract Alteration[18]

Clearing is often defined as computation of the obligations to be settled. This definition seems to ignore willfully the important risk-management activities that are characteristically performed at the clearing stage of a transaction. These often include economically significant rearrangement of the obligations themselves by means that may include obligation netting, settlement guarantee (or substitution of counterparty), posting of collateral or margin, and the creation of new contingent obligations in the form of mutualization of losses. These four practices, which are classic examples of a general risk-management techique of contract modification that today is employed in many forms, are now discussed.

Netting is the most familiar clearing operation. For each asset (including money) and each trader, all quantities of the asset due to the trader are added, and all quantities of the asset due from the trader are added, and the total of the due-from quantities is subtracted from the total of the due-to

[18] CPSS (1997, 1998) provide some further detail regarding the topics discussed in this section.

quantities. If that difference for a particular asset is positive, then the difference is the amount of that asset that the counterparty (or counterparties, if multilateral netting is being done) should transfer to the trader. If the difference is negative, then the absolute value of the difference is the amount of the asset that the trader should transfer to the counterparty.

Consider an example of bilateral netting. If A has sold B 2,000 shares of stock in a particular corporation for $70,000, and B has sold A 1,000 shares of stock in that corporation for $50,000 (with the price evidently having changed between the times when the two contracts of sale were negotiated), then the transactions between A and B can simultaneously settle by A transferring 1,000 shares to B and B paying $20,000 to A.

The cancellation of offsetting transfers may be only a convenience to reduce the number of transfers of securities and funds required to achieve settlement. In that case, it is called payment netting. However netting may take a more consequential form, called obligation netting, in which the legal relationship between A and B is modified. Specifically, if obligation netting has occurred, then the original, separate contractual claims for gross amounts of securities and money between the parties to a set of transactions are voided. They are replaced by new contractual claims for the netted amounts.

The numerical example above illustrates the general fact that bilateral netting reduces the amount of each asset that a trader needs to possess in order to settle. Bilateral netting also reduces the exposure of a trader to default by the counterparty. Suppose that the equity traded in the example becomes worthless after the transactions have been netted but before settlement has occurred. Suppose A becomes insolvent, is put into receivership, and its receiver attempts to obtain $70,000 from B in return for 2,000 shares of now worthless stock. (Note that, while B could attempt to

obtain $50,000 in return for 1,000 shares of worthless stock, such an attempt would be futile unless B were a sufficiently senior creditor of A.) If payment netting is all that has taken place, then this is a valid, legally enforceable claim. However, obligation netting involves A and B having figuratively torn up their original contracts and substituted a new contract for a 1,000-share transfer in return for a $20,000 payment. Thus $20,000 is the most that A's receiver will be able to obtain from B. That is, obligation netting involves a genuine amendment of legal obligations between the parties, and in this case the amendment has reduced B's exposure to A from $70,000 to $20,000.

The mathematical formula for netting stated above is a general formula that can be applied multilaterally. That is, it can be applied when there are more than two traders whose transactions are being netted together. For each trader and each asset, the liability of the trader to transfer the asset to others is no greater after netting than was the largest liability specified by any of the original contracts. This mathematical fact might seem to suggest that netting always mitigates risk for all traders in the way indicated by the preceding example. However such an impression is misleading because, in the case of multilateral netting, the mathematical formula does not completely characterize the netting arrangement. Suppose, for example, that bilateral contracts between A and B, B and C, and C and A are netted, and that the formula determines that A should pay $100,000 and should receive 2,000 shares of stock. As before, suppose that the stock becomes worthless and that A becomes insolvent after netting, but before settlement. From an ex post perspective, B and C are collectively worse off by $100,000 than they would have been if no trades had occurred. Who is how much worse off, though? Should the entire burden of A's insolvency fall on B, or on C, or how should it be apportioned between them? If A's payment obligations had not been netted, there would have been clear answers. After netting, however, the sharing of the burden

is indeterminate unless a loss-sharing arrangement has been specified. For this reason, a fully specified net-settlement clearing system must incorporate such an arrangement.

When they commit themselves to a loss-sharing arrangement from an ex ante perspective, risk-averse traders may unanimously prefer to mutualize, or commit to sharing their losses, from default of counterparties. Specifically, mutualization makes sense when three conditions are satisfied: a) traders are risk averse; b) they have little ability to monitor or control the propensity of their respective counterparties to default (so that the "free rider" problem that mutualization would erode incentives to monitor, control, or warn other traders about counterparties' default propensities--so that the other traders can avoid or minimize their own exposure to a risky counterparty--is moot); and c) a pattern of widespread, relatively small losses among the traders who do not initially default would be less likely to produce a "domino effect" or chain reaction of defaults than a pattern of concentrated, large losses suffered by the counterparties of whatever one of the traders would initially default.

The structure of a loss-sharing arrangement matters for two reasons. The obvious reason is that it determines the allocation of losses that would result from a given set of gross trades. If there is a particular trader who tends to be selected to absorb a large fraction of the losses from default of many other participants, then that trader can be at high risk of default as a consequence. Because of such a potential to concentrate losses in a way that might set off a chain reaction of defaults, it is conceivable that an inappropriately designed multilateral net settlement system could be more liable to widespread default than a gross settlement system would be in the same market environment.[19]

[19] Yamazaki (1996) studies this problem. On the other hand, Kahn, McAndrews and Roberds (1999) formulate and analyze a model of collateralized payments in which net settlement is less

A second, more subtle reason why the structure of a loss sharing arrangement matters is that mutualization--a form of insurance among the participants in the arrangement--can erode the participants' incentives to control risk. This problem is analogous to the classic problem of a group of owners of lumber warehouses who agree to mutualize their losses from fires. If a warehouse so insured does burn down, then its owner will then individually suffer a loss that is smaller than the cost of installing a sprinkler system to extinguish fires. Thus no warehouse will have a sprinkler system if losses are mutualized, and many warehouses will burn down. Ex post, the owners will all be worse off than if they had been required to bear the full losses from fires at their respective warehouses. Without any mutualization, each would have installed a sprinkler system at fairly low cost and no fire would have grown to a costly scale. In a clearing arrangement, the analog of installing sprinkler systems is for traders to avoid exposure to risky counterparties, to make efforts to acquire sufficient information about counterparties to determine which ones are risky, and to share that information with other participants so that they, too, can use it to control their risks.[20]

Not only can new contracts replace old ones as in netting, but a new party to contracts can be introduced. The entity that conducts clearing operations, typically called a clearinghouse, can become the counterparty to all of the newly issued contracts.[21] By being substituted in this way as

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liable to occurrences strategic default than gross settlement under some conditions. Their key idea is that available collateral may be worth less than the value of netted payments but more than the value of the gross payments that are netted. In circumstances where buyers would have incentive not to make payments that would exceed the value of collateral, net settlement would avoid such strategic default.

[20] Fujiki, Green, and Yamazaki (1999) study the influence of mutualization rules on incentives to provide information about the riskiness of a counterparty. They show that there can be incentives either to understate or to overstate the level of risk, depending on the specific circumstances of the market in which the arrangement will function and the intended allocation of benefits from the arrangement to the various participants. Thus the design of a loss sharing arrangement to control these incentives must take such specific circumstances into account.

[21] Sometimes this state of affairs is described by stating that the clearinghouse has a principal-to-principal relationship with each participant.

counterparty, the clearinghouse guarantees settlement to each of the original contract parties.[22] By doing so, the clearinghouse assumes the replacement cost risk that either party would fail to perform.

In the simplest case, if A has sold B 2,000 shares for $70,000, then the contract of sale is replaced by two contracts: for a sale of 2,000 shares by A to the clearinghouse and a sale of 2,000 shares by the clearinghouse to B. A and B each make the same trades as they would have made before, but now they both have the clearinghouse as counterparty (i.e., trading partner) rather than having one another. In effect, the clearinghouse has guaranteed to both A and B that the trade for which they have contracted will be settled. This guarantee is beneficial if the clearinghouse is better able, or more willing, to bear or control risks than either A or B is. This is often the case, as will be explained below. Analogously to multilateral netting, substitution of the clearinghouse as counterparty to contracts can occur simultaneously between the clearinghouse and several traders. In fact, multilateral netting and substitution of the clearinghouse as counterparty are often done in conjunction.

Settlement generally takes place some time after the execution of a trade has concluded. The seller can be required to post collateral to avoid exposing the buyer to replacement-cost risk in the interim. Such a risk-control measure can be regarded as part of clearing. When there is a clearinghouse, often it acts as the third party that holds the collateral in escrow. Some derivative contracts settle after the passage of a considerable time or, as in the case of swaps of revenue streams (e.g., between fixed- and floating-rate interest payments), over a course of time. It is likely that the level of replacement risk of such a contract will fluctuate with market conditions between

[22] In the case of a participant who is a party to several contracts, the guarantee may be for net settlement.

execution and settlement.[23] This fluctuation can be countered by marking the contract to market, that is, by having the parties frequently pay variation margin, in addition to the initial margin or collateral paid at the commencement of the contract. A common arrangement is for the clearinghouse to manage this activity and even to serve as escrow agent for the margin funds.[24]

Mutualization of losses--in the form of loss sharing arrangements among market participants in the event of default--is exemplified by multilateral netting, as has been discussed above. Guarantee of settlement by a clearinghouse provides further ways to accomplish this. For example, losses can be indemnified from a clearinghouse fund that is capitalized by dues assessed on clearinghouse members. Moreover, clearinghouse membership may be structured to involve a contractual obligation to pay an ex post assessment to recapitalize the fund if a large loss exhausts or exceeds it. A clearinghouse can also have credit lines with banks in order to manage liquidity risk.

The approaches to risk management discussed here are implemented in a variety of ways in the clearing and settlement arrangements for different assets. Two things should particularly be borne in mind, in thinking about the import of risk management in a particular arrangement. First, risk can be managed by providing incentives that deter activities that undertake disproportionate risk to the benefit, from the viewpoint of the market and the public as a whole, that the risky activities provide. Sometimes, as in the case of moral hazard, there is a trade-off between providing these ex ante incentives and sharing losses as broadly as possible ex post. Thus it should not be assumed that

[23] Of course, the value of a bond also fluctuates with market conditions between the time it is issued and the time it matures. What distinguishes a derivative contract in this respect is exposure to a counterparty whose credit risk is superimposed for an extended period on the riskiness of the asset on which the contract is written.

[24] For further discussion of margining, see CPSS (1997, 1998). The choice between paying variation margin directly to the counterparty or holding it in an escrow account has some implications for risk management.

complete mutualization of losses is always the best strategy for managing risk, or that there is a particular degree of mutualization that is the optimum for all markets.

Second, the operational and financial details of risk management operate in the context of the legal relationships among the participants and between the participants and the clearinghouse, and must be understood in that context. Use of a clearinghouse fund in the event of default is a case in point. If the seller of an asset defaults after the clearinghouse has guaranteed settlement, then the clearinghouse simply settles with the buyer by purchasing the asset from the clearinghouse fund. If the asset has appreciated since the contract of sale was executed, so that the purchase costs the clearinghouse more than the buyer pays it, then the clearinghouse absorbs the loss. The clearinghouse has standing to sue the seller for breach of contract to recover the loss. The seller no longer has any contractual relationship with the seller in connection with the transaction, since the clearinghouse has been substituted as the seller's counterparty, so the buyer has no cause for legal action against the seller. It would appear that the buyer has lost legal recourse against the seller even in the case that the loss would exceed the resources of the clearinghouse. In that case the buyer could only sue the clearinghouse (to compel it to levy an assessment on members to reimburse the full loss, for instance).

A clearinghouse that does not have a principal-to-principal relationship with its participants might nevertheless provide money or securities to a buyer in the event of the seller's default. Such a transaction would typically be structured as a loan. Its function would be to protect the buyer against liquidity risk, but not against replacement-cost risk. Because default has occurred on the original contract of sale between the seller and the buyer, the buyer can sue the seller to compel delivery of the security. The terms of the loan from the clearinghouse to the buyer will presumably entail that, at some point, the clearinghouse can also sue the buyer for repayment of the loan.

The upshot is that it is only part of the story that a clearinghouse may maintain a fund to aid participants against whom default has occurred. The precise use to be made of the fund, and the pattern of legal claims that can exist despite its existence or can be triggered by drawing on it, are also important. Part of the cost of a severe market disruption, from both a public and private perspective, is the uncertainty and cost in its aftermath that is generated by legal disputes. The outcomes of these disputes may be difficult to predict, and they may be reached only after long delay. It is therefore preferable to manage risks in a way that minimizes the prospect of complex, prolonged litigation. On the whole, making the clearinghouse the counterparty in all transactions is thought to accomplish this. For example, when a seller defaults against several buyers, the claims against the seller are concentrated in the clearinghouse so the prospect of a class action suit against the seller, which might be particularly complex, is removed. This consideration complements one that is more often cited--that a clearinghouse can be structured in a way that makes it more creditworthy than most individual participants are--as a rationale for placing the clearinghouse in a principal-to-principal relationship with all participants. Nevertheless, as mentioned above, it would be going too far to suppose that establishing this relationship must invariably be best.

Banking Relationships of a Clearinghouse

Securities settlement involves interaction between a system for transferring securities and one for transferring funds. Because of the need to transfer funds, a clearinghouse must either be a bank or else maintain a very close institutional relationship with one or more banks.[25] Even where a clearinghouse is a bank, participants may prefer to use other banks as intermediaries to deal with it.

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[25] `Bank' is used here in the generic sense of a depository institution. In the U.S., the DTC is a New York State chartered member of the Federal Reserve System, while several other important

Moreover, in general, the need of the clearinghouse to avoid risk precludes it from providing a full spectrum of corporate banking services.

A clearinghouse typically enters into five types of relationships with banks. Let us call the bank parties to these relationships participants' settlement banks, clearinghouse settlement banks, correspondent banks, agent banks, and standby-credit banks. While a bank might play only one of these roles, they are all compatible. Given that providing credit and services to clearinghouses is a specialized line of business, the competency to engage in which is applicable to all of the four roles, this economy of scope provides a bank with incentive to play multiple roles. If the clearinghouse is chartered as a bank, then it may play some or all of these roles directly.

A participant's settlement bank is the bank at which a participant holds an account, to and from which payments for settlement are made. A clearinghouse may require each participant to hold an account at one of a designated group of banks, and it may place special requirements on those banks. For example, to be designated a settlement bank, a bank might be required to make an irrevocable commitment to make payments on the basis of instructions from the clearinghouse, without regard to whether or not the account holder confirm those instructions.

If the clearinghouse becomes the counterparty to all transactions, then it must also hold an account at a settlement bank.

Payment to settle a transaction between two clients of a settlement bank can be accomplished as an on-us transaction. However, payment between clients of distinct settlement banks requires an interbank funds transfer. Such a transfer is typically made on the books of a correspondent bank at

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settlement arrangements are not chartered as depository institutions. Cf. DTC (1997) and Annex 2 of CPSS (1997).

which all of the settlement banks hold accounts, by means of a funds transfer system of very high integrity and security. A central bank is capable of playing this role. The extent to which it should do so is an aspect of public policy that varies across countries. In some countries, the discretion of the central bank to create money to satisfy nominally denominated claims is a decisive consideration in favor of using its services to settle transactions on securities markets that could be loci of systemic risk. In other countries, securities brokers are ineligible--on grounds that have been given careful thought--to hold accounts at the central bank, so commercial banks must play the correspondent role.

Whether or not the clearinghouse makes and receives payments to its own account to achieve settlement, it requires various banking and trust services. Holding of participants' collateral and investment of the clearinghouse fund are examples of such services that a bank can provide as agent of the clearinghouse.

Because holding participants' collateral and clearinghouse assets entirely as cash or in other highly liquid form would have substantial opportunity cost, those resources are typically held partly in forms that could perhaps not be immediately liquidated in the event of a default. Moreover, if the clearinghouse has authority to assess its members to provide further resources, that process cannot be completed immediately. For these reasons, a clearinghouse typically arranges with banks for standby lines of credit, against which it is authorized to draw on extremely short notice.

The ability of a clearinghouse to manage risk depends on these banking relationships functioning smoothly under conditions of market stress, as well as during normal times. Both market and supervisory pressures limit eligibility for these relationships to highly creditworthy, well managed banks. It is possible for even such banks to face challenges in meeting their commitments during

periods of severe market stress, however. Once again, a precise understanding of the legal relationships incorporated in the settlement system is key to risk assessment. For example, an "irrevocable commitment" from a bank to make a payment on demand from the clearinghouse may not literally force the bank to transfer everything in its reserve account to the clearinghouse if that were necessary to meet its obligation, although description of a contractual obligation in such terms might predispose a court to treat the bank harshly if it refused to do so. As was emphasized in the earlier discussion of legal certainty, it is important to design settlement arrangements in such a way that such commitments will be as ironclad as possible, even though absolute certainty will be impossible to attain.

The Clearinghouse as a Provider of Public Goods, and its Supervision and Regulation

Certainty of settlement is a public good in a market where the ability of one trader to meet commitments often depends benefiting from the fulfilment of others' commitments. The role of a clearinghouse as a provider of a public good is particularly evident when the clearinghouse becomes the counterparty to all transactions and provides protections such as have been discussed above. The contracts that result from substitution of the clearinghouse as counterparty to all trades meet a high, uniform standard of insulation from risk that has widespread benefits to traders.

The general argument why some degree of submission to a central authority is efficient in an environment with a public good applies, therefore to settlement of securities transactions. Clearinghouses serve as central authorities in numerous ways, some of which involve exerting regulatory authority over their participants. For example, a clearinghouse may set, monitor, and enforce standards of creditworthiness and fitness on participants. Having done so, it may require

participants to transfer securities and funds to one another in reliance on its judgment, rather than exercising their independent judgment of the creditworthiness of counterparties. The clearinghouse may set and compute participants' margin requirements, hold participants' collateral in escrow, maintain (either directly or by contracting out) the telecommunications and computing equipment that could pose operational risk, manage the liquidation of defaulting participants' positions, and so forth. Participants' willingness to authorize the clearinghouse to perform these functions, conditional on all other participants delegating that same authority, is appropriate in view of the public-goods problem that they collectively face.[26]

It is intrinsically difficult to design institutions that, when their participants make rational decisions in equilibrium, result in the provision of efficient levels (that is, neither insufficient nor excessive) of public goods. Historical experience and economic theory suggest that neither the molding of such institutions by the forces of laissez-faire nor the imposition of an institution by government fiat is a panacea. Despite a century of intensive study by economists, the design of effective public-goods institutions can best be characterized as an art that receives some guidance from scientific understanding. The institution that is most effective in a particular environment is likely to have to be tailor made to make best use of specific, idiosyncratic features of that environment for its effectiveness.

In this circumstance, common sense recommends a pragmatic, continuous, collaborative effort of market participants and supervisors to monitor and improve clearing and settlement systems. It would be anticipated that supervisors will tend to exert influence on settlement arrangements to operate in a more risk averse manner than market incentives alone would dictate. For their part, wise supervisors should respect the generally effective performance that market practices and

[26] Cf. Baer, France and Moser (1996).

institutions of long standing have achieved, refrain from imposing requirements that would be so burdensome as to discourage market participants from making use of beneficial risk-management techniques, and support well conceived innovations that arise in the market. Such a harmonious and productive relationship seems to have been maintained for more than a decade and to have become well established at this time.

Conclusion

Arrangements for the clearing and settlement of financial transactions have improved dramatically and continuously during the past several decades. Regarding the relationship of "e-finance"--the topic of this conference--to this improvement, there is some role of e-finance to be acknowledged if e-finance is narrowly conceived, and a large role if it is broadly conceived.

Regarding the narrow concept, simply to keep track of the immense volume and variety of financial transactions executed today would be impossible without the intensive use of new computing and telecommunications technology. Another example is that the capacity to compute appropriate margin requirements on derivatives contracts--especially on OTC derivatives that are beginning to be cleared and settled centrally--depends crucially on the ability to obtain computational solutions of theoretical pricing models, which are formulated as stochastic differential equations that generally do not possess closed-form solutions.[27]

However, e-finance (and, more generally, e-commerce) is better understood as a synecdoche for a constellation of mutually supporting business practices, technologies, and strategic managerial approaches that, when jointly adopted, can dramatically enhance the efficiency of market institutions. It is the financial-sector analog of "flexible manufacturing" in the goods-producing

sector of the economy. What these revolutions in business practice have in common is that "they are not a matter of small adjustments made independently at each of several margins, but rather have involved substantial and closely coordinated changes in a whole range of the firm's activities. The full benefits are achieved only by an ultimately radical restructuring."[28]

A quantum leap in the capacity to clear and settle financial transactions, and in the integrity with which those operations are accomplished, has been part of a radical restructuring of the way that financial markets in the industrialized countries operate. Other aspects of this restructuring include the invention of financial derivatives (e.g., futures, options and swaps) and the establishment of exchanges to trade many of them; the availability of computing and telecommunication technology that can simultaneously link a large, geographically dispersed group of traders, and the consequent feasibility of conducting trading by means other than open outcry on a trading floor; and the explosive growth of transaction volume on a number of exchanges. None of these innovations would have been feasible, or commercially feasible, by itself. In particular, the high fixed costs of infrastructure for the way that transactions are cleared and settled today would probably have been uneconomical at the transaction volumes that were typical until the 1970s, and by the same token, the development of this way of clearing and settling transactions was a prerequisite for exchanges to handle a volume of transactions beyond those traditional levels. To the extent that one believes that the transformation of financial markets has been--and continues to be--among the causes of improvement in the macroeconomic performance of the U.S. economy, the dramatic advances that have occurred in clearing and settlement deserve a full share of the credit.

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[27] Cf. CPSS (1997)
[28] Milgrom and Roberts (1990) p. 513.

References

American Law Institute and National Conference of Commissioners of Uniform State Laws. 1994. Uniform Commercial Code Article 8 – Investment Securities (Revised). http://www2.law.cornell.edu/cgi-bin/foliocgi.exe/ucc8.

Baer, Herbert L., Virgina G. France, and James T. Moser. 1996. "Opportunity Cost and Prudentiality: An Analysis of Futures Clearinghouse Behavior." University of Illinois. http://w3.aces.uiuc.edu/ACE/ofor/wp0196/wp96-01.htm.

Committee on Payment and Settlement Systems. 1992. "Delivery Versus Payment in Securities Settlement Systems." http://www.bis.org/publ/index.htm.

Committee on Payment and Settlement Systems. 1995. "Cross-Border Securities Settlements." http://www.bis.org/publ/index.htm.

Committee on Payment and Settlement Systems. 1997. "Clearing Arrangements for Exchange-Traded Derivatives." http://www.bis.org/publ/index.htm.

Committee on Payment and Settlement Systems and the Euro-currency Standing Committee. 1998. "OTC Derivatives: Settlement Procedures and Counterparty Risk Management." http://www.bis.org/publ/index.htm.

Commodity Futures Trading Commission. 2000. "17 CFR Part 35 Exemption for Bilateral Transactions." Federal Register 65 FR 39033.

Depository Trust Company. 1995. "Response to the Disclosure Framework for Securities Settlement Systems." http://www.bis.org/publ/index.htm.

Fujiki, Hiroshi, Edward J. Green, and Akira Yamazaki. 1999. "Sharing the Risk of Settlement Failure." Federal Reserve Bank of Minneapolis. http://www.minneapolisfed.org/research/wp/wp594.html.

Kahn, Charles M., James McAndrews, and William Roberds. 1999. "Settlement Risk Under Gross and Net Settlement." Federal Reserve Bank of New York. http://www.ny.frb.org/rmaghome/staff_rp/sr86.html.

President's Working Group on Financial Markets. 1999. "Over-the-Counter Derivatives Markets and the Commodity Exchange Act." http://www.treas.gov/press/releases/docs/otcact.pdf.

Rutstein, Charles, Carl D. Howe, Christopher Voce, Steven Kim, and Meaghan Cussen. 1999. "Managing eMarketplace Risks." The Forrester Report (December).

Yamazaki, Akira. 1996. "Foreign Exchange Netting and Systematic Risk." Hitotusbashi University, mimeo.