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Remarks by

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I am pleased to have an opportunity to address the very distinguished group that the Federal Reserve Bank of Atlanta has gathered here to discuss changes in global financial markets and their implications for public policy. When I consider the changes that have occurred during the last few decades, what impresses me most is the ever-increasing speed with which information can be disseminated and with which market participants can act on it. Without these gains in communications and information technology, the various derivative instruments that some regard as the most important financial innovation of recent decades simply could not have been developed. They could not be priced properly, and the hedging strategies on which they are based could not be implemented effectively.

As a result of these changes in technology and the new instruments and risk management techniques they have made possible, financial markets undoubtedly are far more efficient today than ever before. In particular, an ever wider range of financial and nonfinancial firms today can manage their financial risks quite effectively, allowing them to concentrate on managing the economic risks associated with their primary businesses. Still, for those of us with responsibilities for financial market stability, the new technologies and new instruments have presented new challenges. Some argue that market dynamics have been altered in ways that increase the likelihood of significant market disruptions. Whatever the merits of this argument, there is a clear sense that the new technologies, and the financial instruments and techniques they have made possible, have strengthened interdependencies between markets and market participants, both within and across national boundaries. As a result, a disturbance in one market segment or one country is likely to be transmitted far more rapidly throughout the world economy.

This morning, I plan to share with you some thoughts on what needs to be done to limit the potential for systemic crises in this environment. I have concluded that the key to containing potential systemic problems from these new instruments and techniques is maintaining the liquidity of the underlying markets on which market participants rely for adjusting their exposures. If the liquidity of underlying markets is preserved, risk management failures at individual institutions are unlikely to give rise to systemic problems. For example, the recent failure of Barings PLC has not created systemic problems because it has not significantly impaired the liquidity of the underlying markets for Japanese stocks and bonds.

Given this perspective, I see two broad sets of initiatives as offering the most promise of containing systemic threats to global financial markets. First, both policymakers and market participants should seek to foster sound risk management by individual firms, emphasizing careful assessments of limits to market liquidity and the avoidance of practices that could place excessive strains on markets. Second, we should work together to enhance the capacity of financial markets to absorb shocks, paying special attention to modernization of the legal framework for financial transactions and to the design and operation of key intermediaries involved in clearance and settlement.

**Fostering Sound Risk Management**

The availability of new technology and new derivative financial instruments clearly has facilitated new, more rigorous approaches to the conceptualization, measurement, and management of risk. A milestone in this process was the publication by the Group of Thirty in July 1993 of the study entitled *Derivatives: Practices and Principles*. The centerpiece of this study was a set of twenty

recommendations to dealers and end-users of derivatives that constituted comprehensive guidance on sound practices for measuring and controlling the risks associated with derivatives and, more generally, with trading and risk management activities

The G-30 study is especially valuable because its recommendations underscore that there is considerably more to risk management than risk measurement. Risk management must also include a system of institution-wide limits on risk-taking and internal controls that ensure that all positions are recorded and are consistent with these limits. Although statistical models of risks are important, and indeed critical, I am concerned that if management does not recognize the limitations of these models, firms could rely too heavily on them in making financial decisions, with adverse consequences for the firms and perhaps also for financial markets.

In the case of market risk, the G-30 study concluded that it is best measured by value-at-risk, that is, by an estimate of the maximum loss on a portfolio from an adverse market movement with a specified probability over a particular period of time. For example, value-at-risk often is defined operationally as the maximum loss over one day that would result from an adverse market movement expected to occur only once in twenty days--a 95 percent confidence interval--or once in one hundred days--a 99 percent confidence interval.

The study provided little guidance on how to calculate value-at-risk, no doubt reflecting a lack of consensus on the details. In practice, its calculation requires many critical assumptions. First, the underlying risk factors that can influence the value of the portfolio must be identified. This may sound straightforward, but determining the number of factors needed to characterize movements in the term structure of interest rates is not a trivial exercise.

Second, individual instruments must be decomposed into their constituent cash flows and the cash flows related to the risk factors. Again, this is problematic for instruments, like options, whose values are related to the risk factors in complex ways. The values of such instruments are frequently assumed to be linear or, at best, quadratic functions of the risk factors. Third, the volatilities of risk factors and the correlations between them must be estimated from historical data. Assumptions must be made about how much past data is an appropriate proxy for the future. Fourth, an estimate of the portfolio's standard deviation is transformed into a loss estimate, typically by assuming that changes in risk factors conform to a normal distribution. Finally, value-at-risk usually is measured over a one-day time horizon. Potential losses over longer horizons are sometimes estimated by multiplying the one-day estimate by the square root of time, which implicitly assumes that daily changes in risk factors are uncorrelated.

In the case of credit risk, the G-30 study emphasized the need to measure potential future credit exposures of derivative contracts over the remaining life of the contract. The generation of such estimates involves many of the same assumptions used in calculating value-at-risk. Moreover, once an estimate of potential future credit exposure is obtained, an estimate of potential losses is often derived by multiplying the exposure by the expected probability of default. This procedure implicitly assumes that the probability of a counterparty's default is statistically independent of the events that caused a change in the replacement value of the contract. For example, it assumes that the probability of a default on an interest rate swap is independent of the level of interest rates.

Senior managers and boards of directors of market participants need to understand that financial markets seldom conform to these assumptions and that violations of the assumptions can produce significant unanticipated losses. Risk factor volatilities are extremely sensitive to the historical period over which they are estimated and correlations between risk factors are even more unstable. Furthermore, actual statistical distributions of financial variables tend to be fat-tailed, that is, extreme price shocks tend to occur far more frequently than indicated by a normal distribution, which, as I have noted, is often used by risk managers as a mathematically convenient way to describe the behavior of markets. For a variety of reasons, value-at-risk estimates for portfolios with significant short options positions, including options imbedded in instruments such as mortgage-backed securities, may underestimate potential losses significantly. In the case of estimates of credit risk, correlations between default rates and risk factors appear to be significant. Ignoring these correlations can significantly understate or overstate risks.

When these limitations of statistical models are recognized, what becomes apparent is the critical importance in risk management of human judgments, based on analytically looser but far more realistic evaluations of what the future may hold. As the G-30 study recommended, market participants must conduct stress tests of their statistical models to uncover the models' limitations and the potential consequences for their firms. Although a sophisticated understanding of statistical modeling techniques is important in designing such tests, I believe that an intimate knowledge of the markets in which the firm trades and of the customers it serves is far more important.

Market risk is most usefully defined as the risk of a potential decline in the market value of a portfolio before the portfolio can be liquidated or its risk exposures offset. By definition, then, a critical part of market risk management is making judgments about the liquidity of the markets that the firm relies upon to adjust its risk exposures. Assessing potential market liquidity, especially during turbulent periods, requires a great deal of practical experience. The large losses suffered by investors that relied on portfolio insurance strategies during the stock market break in 1987 illustrate the consequences of unwarranted optimism about market liquidity. Likewise, as market participants begin to manage their credit exposures on derivatives contracts more actively, judgments of how promptly contracts can be assigned or terminated or how effectively the credit risks can be hedged will take on increasing importance. Again, unrealistic assumptions about liquidity could result in substantial unanticipated losses.

In one sense, risk management systems were exposed to a very severe real-life stress test in 1994, when sharp increases in interest rates created large losses in fixed income markets. I assume that as a consequence firms' models and judgments are sounder than those that prevailed in early 1994. But the Barings episode suggests that further improvements to internal risk management systems are needed, in some instances very significant improvements.

#### Strengthening the Infrastructure of Financial Markets

Given the limitations of statistical models and the resulting importance of the human element in risk management, we must expect and prepare for risk management failures by individual institutions. However, as I noted earlier, I believe that such failures are unlikely to result in systemic crises, so long as the liquidity of the

underlying markets is preserved. My experience with financial crises has convinced me that the greatest threat to the liquidity of our financial markets is the potential for disturbances to the clearance and settlement processes for financial transactions. Several studies of the 1987 stock market crash concluded that the greatest danger during that turbulent period was the potential for a default by a major participant in the settlement systems for equities or equity derivatives. Again in 1990, the most serious threats to the orderly liquidation of the Drexel Burnham Lambert Group were posed by weaknesses in settlement arrangements.

As in the case of risk management, a Group of Thirty initiative has served as the catalyst for significant improvements in settlement arrangements during the last few years. In March 1989 the G-30 published a report entitled *Clearance and Settlement Systems in the World's Securities Markets*. That report set out nine recommendations for strengthening and harmonizing settlement arrangements for corporate securities in the world's principal markets. In brief, the recommendations called for a reduction in the interval between trade and settlement to three business days (T+3), and for settlement on a delivery-versus-payment basis in same-day funds.

The report called for implementation of the recommendations by 1992, which was a very tight timetable given the complexity of the issues and the need to reconcile divergent economic interests among providers of settlement services. Many countries, including the United States, found it impossible to meet this schedule. Nonetheless, the efforts put forth have been extraordinary and in most major markets implementation now appears assured in the next few years. In the United States, the most controversial issue has been

T+3 settlement With strong leadership from the Securities and Exchange Commission and key contributions by self-regulatory organizations and industry groups such as the Bachmann Task Force, T+3 is scheduled to become the standard settlement interval for corporate securities trades as of June 1 of this year. Meanwhile, the Depository Trust Company and the National Securities Clearing Corporation have been leading efforts to abandon the use of checks for wholesale money settlements in favor of Fedwire payments that are same-day funds. They currently expect to convert to use of same-day funds late this year or early next year.

With the G-30 settlement study now five years old and implementation completed or within sight in the major markets, various groups have begun studying further steps to strengthen settlement arrangements. Several of these efforts have been motivated by special concerns about cross-border settlements. The volume of such settlements appears to have grown enormously in recent years, especially in Europe. In June 1993 Morgan Guaranty Trust Company, which operates the Euroclear system, published a report focusing on cross-border settlements. Reports on the same topic will be published soon by the Bank for International Settlements and by the Payments Risk Committee, a private-sector group sponsored by the Federal Reserve Bank of New York.

While these groups have different perspectives and their studies have had different objectives, they have identified some common issues and concerns relating to national securities settlement systems, both for corporate and government securities. Perhaps the most important set of concerns relates to the legal and institutional foundations of book-entry settlement systems. The G-30 study recommended the development in each country of a securities depository

that would operate a book-entry accounting system that would permit the transfer of securities without the physical movement of certificates. However, the G-30 study did not discuss legal issues in securities settlements. Nor did it provide much guidance on the design and operation of such depositories, beyond the recommendation that they be linked to a payment system in a way that achieves delivery versus payment.

Concerns about the legal foundations of book-entry systems stem from the fact that, in many countries, laws governing the ownership, transfer, and pledge of securities remain based on concepts that assume the existence of certificates and the transfer of securities through physical delivery. Legal uncertainties often arise when these concepts must be applied to modern systems in which rights to securities are evidenced by entries on the books of securities depositories and other intermediaries and such rights are transferred by book-entry.

In the United States, concerns about such legal uncertainties have prompted a major effort to revise fundamentally the model versions of Articles 8 and 9 of the Uniform Commercial Code, which govern the transfer of securities and their use as collateral. Many other countries have made similar efforts to modernize their laws. Nonetheless, I believe market participants should seriously consider extending the Group of Thirty's work on securities settlements by conducting a systematic review of the law governing the transfer and pledge of securities in each of the world's major markets. The objective would be to identify remaining uncertainties that place settlement systems at risk and, where necessary, make recommendations to clarify and harmonize the relevant laws to reduce or eliminate those risks.

The design and operation of securities depositories was explored in detail by a study entitled *Delivery Versus Payment in Securities Settlements* that was prepared by a G-10 central bank study group and published by the BIS in September 1992. A key conclusion of the study was that even if a securities depository achieves delivery versus payment, other risks arise in securities settlements that can be sources of systemic problems. In particular, the study noted that nearly all depositories extend intraday credit to their participants, and that a key issue is how well a depository could cope with the failure of one or more participants to repay such credit extensions. Special concerns were expressed about systems in which securities transfers are provisional until the corresponding funds transfers are settled on a net basis at the end of the business day. In such systems, if a participant fails to meet its money settlement obligations, some or all transfers involving that participant are "unwound," the money settlement obligations of other participants are then recalculated, and a new settlement is attempted. As this study and other more recent studies have noted, because such unwinds have the potential to place substantial unanticipated liquidity demands on the other participants, they could transform the liquidity problem of a single institution into a systemic liquidity crisis.

Concerns about unwinds prompted the Federal Reserve to issue a policy statement in June 1989 that strongly discourages reliance on unwinds by privately operated securities depositories that settle funds transfers on a net, same-day basis and that use Fedwire directly or indirectly. The policy statement requires the implementation of liquidity safeguards that would enable such a system to complete settlement on time even if one of its major participants defaults. The Depository Trust Company's proposal for implementing same-day

funds settlement seeks to address the Board's concerns about liquidity safeguards by imposing binding real-time net debit caps on each of its participants. No participant's net debit cap would be allowed to exceed DTC's total liquidity sources in the form of cash and committed, secured lines of credit. Thus, even if the very largest DTC participant were to default, it could complete settlement without resorting to an unwind.

Here again, the issues and concerns are not unique to U.S. settlement systems. In fact, net settlement with unwinds is more the rule than the exception in the world's securities markets. In many countries, the settlement of securities transfers on a net end-of-day basis has been strongly influenced by the fact that the large-volume funds transfer systems are net end-of-day settlement systems. However, significant changes in payment systems are on the horizon. In particular, the central banks of the European Union countries are publicly committed to developing real-time gross settlement systems for large-volume payments as soon as possible. This will create new opportunities for depositories in those countries to redesign their securities transfer systems as real-time gross settlement systems or as net settlement systems with multiple settlements throughout the day. If depositories wish to take advantage of these opportunities, however, they will need to rethink fundamentally the design and operation of their systems, including appropriate liquidity safeguards. This is another area in which market participants should seriously consider conducting analysis and developing recommendations to extend the Group of Thirty's existing work.

## Summary

To sum up, I believe that the best way to address concerns about systemic risks to financial markets from new technologies and new financial markets is for policymakers and market participants to focus on fostering sound risk management and modernizing the infrastructure of financial markets. I have sounded a cautionary note regarding excessive reliance on statistical models in risk management and emphasized the importance of judgments about market liquidity. With regard to modernizing the infrastructure of financial markets, I have suggested that market participants should seriously consider extending the Group of Thirty's work on securities settlements to address the legal foundations of book-entry transfer systems and the design and operation of securities depositories, especially the design of liquidity safeguards.

In these and other ways, we must assure that our rapidly changing global financial system retains the capacity to contain market shocks. This is a never-ending process which will require vigilance on the part of both private market participants and public regulatory authorities.