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Remarks by
Alan Greenspan
Chairman, Board of Governors of the Federal Reserve System
at a
Research Conference
on
Risk Measurement and Systemic Risk
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I am pleased to be able to address this international audience drawn from the staffs of G-10 central banks and other government organizations, from firms involved in trading and risk management, and from several of the world's most prestigious universities. I am particularly gratified that the Federal Reserve Board is the site of this conference. The topics of risk measurement and systemic risk are part of a newly evolving area of research in finance and economics -- an area that is more than just an intellectual exercise. In the next few years, the fruits of these research efforts will no doubt help to determine the way business is done, both in central banks and in the private sector. Yet it is not entirely clear, at this stage, which lines of inquiry are the most promising and useful. Currently, there are several points of view from which one could frame the relevant questions, as well as multiple strategies for approaching the issues once they have been defined. Thus, it is imperative that the work be fostered by free and open communication among researchers in financial firms, academe, and government agencies, and across international borders. To that end, I hope that this conference will make a constructive contribution.

The related problems of risk measurement and systemic risk are of crucial importance to central bankers. We know that there is more to central banking than monetary policy, narrowly defined. One aspect of our mandate is to act as a "lender of last resort," providing needed liquidity to the financial system when it is appropriate.

The possibility of panics or market disruption motivated the formulation of a principle for lender-of-last-resort policy, known as Bagehot's Rule, after the prominent 19th century British economist. The rule dictates that the central bank "lend freely at a high rate," as long as the bank is solvent and can post collateral that would be unquestionably sufficient during normal periods. Bagehot also was a century ahead of his time in advocating that the central bank should voice a

pre-announced commitment to such a policy. Of course, following this rule will require the central bank to make difficult judgments. In practice, one cannot risklessly serve as a lender of last resort.

In Bagehot's world, as was the case until fairly recently, bank balance sheets were simple in structure -- deposits, capital, loans, and reserves -- and the predominant event in which Bagehot's Rule might be applied was that of a fear-induced run on a bank by depositors. However, the largest banks are now gradually moving away from their traditional role as originators and holders of relatively simple debt instruments, financed by deposits, to using a more diverse set of instruments in ways that constitute new forms of financial intermediation. Banks increasingly serve as a medium through which risks -- both market risks and credit risks -- can be allocated so as to be borne by whoever is most willing or able to bear the exposure. Banks today are providing customized contingent payoffs for their clientele, rather than just an extension of credit or a fixed-yield investment opportunity. Instead of a low-risk asset, bank customers now have access to contracts that can actually lower their overall risk. Liquid international markets and rapid price discovery, brought on in part by innovations in information technology, permit banks to pursue complicated dynamic trading strategies and to revalue their portfolios almost instantaneously in light of new information. Accordingly, a larger proportion of banks' portfolios consists of assets that are actively traded and are marked-to-market on accounting statements. The historical threat of deposit runs has faded as a concern, to be replaced by more complex threats to the financial system, increasingly driven by ever more sophisticated financial products. The definition of a bank run surely needs to be updated, as deposits represent a declining share of the contractual obligations of the largest banks.

Modern information and accounting systems may help impose market discipline upon banks and reduce the risk of creditor flight, provided traders and risk managers are able to react quickly. The effective acceleration of financial events also complicates the task of central banks. Judgments concerning the sufficiency of bank capital are a principal element in supervisory actions but are

important, as I shall point out shortly, to the lender-of-last-resort function, as well. Such judgments involve comparing the level of capital to the risk of the activity that it supports. Given that capital is measured as the residual of assets less liabilities, capital adequacy can be an elusive concept for portfolios that are turning over rapidly. Measurement of capital may be muddied by a dependence on complex judgments in valuing, for example, over-the-counter derivative contracts and structured notes. Moreover, it is unlikely that an occasional snapshot of a portfolio's composition can serve as a basis for evaluating the riskiness of a dynamic strategy. With instruments trading that represent highly leveraged exposures, a large chunk of capital can disappear, and then reappear, all within the trading day. Supervisors may have to resort to basing their analyses chiefly on assessments of managerial capabilities rather than of the portfolio held at a given instant.

Perhaps the greatest challenge facing central banks is the question of how their role as the lender of last resort must be transformed so that it can be carried into the financial environment of the twenty-first century. With the increasingly global nature of their activities, the national identity of many of the largest banks is fading away. With a monetary authority for each country in which a bank operates, or at least one for each currency, which one is the lender of last resort? The only tenable answer is that it is all of the central banks, collectively. As long as there is a need for this function to be performed it is crucial that central banks be able to cooperate -- both on a one-to-one basis and through the multilateral organizations. In the past year or so, there has been more than one episode that either underscored the advantages of sharing crucial information among financial authorities in different countries, or illustrated the perils of failing to do so.

A natural consequence of the existence of a lender of last resort is that there will be some sort of allocation of the burden of risk of extreme outcomes. Thus, central banks are led to provide what essentially amounts to catastrophic financial insurance coverage. Such a public subsidy should be reserved for only the rarest of disasters, triggered, at most, a handful of times per century. If banks

were to anticipate being propped up frequently by government support, it would only encourage reckless and irresponsible management practices. In theory, the allocation of responsibility for risk-bearing between the private sector and the central bank depends upon an evaluation of the private cost of capital. In order to attract, or at least retain, capital, a private financial institution must earn at least the overall economy's rate of return, adjusted for risk. In competitive financial markets, the greater the leverage, the higher the rate of return, before adjustment for risk. If private financial institutions have to absorb *all* financial risk, then the degree to which they can leverage, of necessity, will be limited, the financial sector small, and its contribution to economic growth, minimal. On the other hand, if central banks effectively insulate private institutions from the largest potential losses, however incurred, increased laxity could threaten a large drain on taxpayers or produce inflationary instability as a consequence of excess money creation. In practice, the policy choice of how much, if any, of the extreme market risk that central banks should absorb is fraught with many complexities. Yet we central bankers make this decision every day, either explicitly or by default. It does seem clear, however, that under the currently structured international financial system, if we do not choose to absorb the most extreme risks, there is a danger that private financial institutions will be overly daunted by the specter of unlikely, but enormous and unhedgable losses. The result might be that banks would adopt an attitude of excessive caution that stifles the health of the overall economy. Nonetheless, it is essential, of course, that with these limited and extreme exceptions, all risk remain within the private financial system.

One might ask why, if there is a need for catastrophic financial insurance, private markets could not provide it upon their own initiative. Voluntary risk-pooling arrangements among banks, with mutual monitoring to deter free riders, arose in more than one country in the nineteenth century. Regrettably, they did not always prove to be stable in the face of imperfect monitoring.

At root, we must recognize that if we are to operate a leveraged financial system, it will not be

without cost. There will always exist a remote possibility of a chain reaction, a cascading sequence of defaults that will culminate in financial implosion, if it is allowed to proceed unchecked. Only a central bank, with unlimited power to create money, can guarantee that such a process will be thwarted before it becomes destructive. If the vicious cycle can encompass more than one currency, more than one central bank may be necessary. In decades past, the stacking of currency in the window of a bank generally stopped a bank run. In today's complex financial system, the stack of currency may never be large enough, and thus, there appears to be little alternative to central banks acting as lenders of last resort.

With central banks taking on the risks of serving as lenders of last resort, research on financial risk that is done by central banks properly places disproportionate focus on the most extreme outcomes. Conversely, financial risk analysis in the private sector rationally concentrates on outcomes other than the most extreme.

The concerns of central banks and the private financial community generally intersect in a preoccupation with the analysis of risk in general and in an interest in the development of risk management models. The session later this afternoon on "Internal Models" will serve as a progress report on the models and the Value-at-Risk (VaR) measures that they generate. It is worth keeping in mind that the task of risk management has some pitfalls and fundamental limitations. A long list of simplifying mathematical assumptions are necessary to keep risk management models tractable. As a representative example, when pricing OTC options and measuring the risk of positions in them, the valuation is typically based on a dynamic trading strategy formulated under an assumption of a continuous price path and sufficient liquidity all along that path. Such an assumption may be quite reasonable in most instances. However, it is in times of market stress, when banks are relying most heavily on their risk management capabilities, that it is most likely that there will be large discrete jumps in asset prices and that markets will be thin. This explains the recent tendency for risk

managers to conduct so-called "stress tests," in which the impact of larger-than-usual price changes on profits and risk exposure is appraised

But even stress tests are necessarily limited by the implicit conjecture that relationships among asset prices that are observed over some past period will continue to hold in the future. Typically, risk management models use estimated variances and correlations computed over a recent historical sample. If the underlying environment is static, the most precise estimates of these statistics would be obtained by using all of the available historical data. However, the financial world is surely changing. Thus, risk management practices might be improved by explicitly modeling the *evolution* of the riskiness of assets. Given the multitude of models of conditional variance that econometricians have developed over the past decade, such innovations are clearly technically feasible. In fact, several of the presentations this morning offered possible strategies for modeling changes in risk.

Another dimension in which there is room for improvement in risk measurement is in the statistical distributions that asset returns are presumed to follow. Most VaR calculations are based on multivariate normal distributions, despite compelling evidence that many of the data are drawn from distributions functions with heavier tails. From the point of view of the risk manager, inappropriate use of the normal distribution can lead to an understatement of risk, which must be balanced against the significant advantage of simplification. From the central bank's corner, the consequences are even more serious because we often need to concentrate on the left tail of the distribution in formulating lender-of-last-resort policies. Improving the characterization of the distribution of extreme values is of paramount concern.

Although a large portion of the process of risk management is highly quantitative, the most effective approach to risk management surely involves a blend of qualitative and quantitative insights. Successful risk managers will find a way to reconcile high-tech, but possibly naive, mathematical modeling with low-tech market experience. In such an approach, market experience must temper key

model assumptions, or the consequences can be dire

Some of the more difficult research questions we are facing pertain to systemic risk. It would be useful to central banks to be able to measure systemic risk accurately, but its very definition is still somewhat unsettled. It is generally agreed that systemic risk represents a propensity for some sort of significant financial system disruption. Nevertheless, after the fact, one observer might use the term "market failure" to describe what another would deem to have been a market outcome that was natural and healthy, even if it was harsh. Even with agreement on what constituted a realization of a systemic crisis in financial markets, descriptions of the symptoms of systemic risk cannot be disentangled from theories of how financial crises come to pass. Until we have a common theoretical paradigm for the causes of systemic stress, any consensus on how to measure systemic risk will be difficult to achieve.

Nevertheless, there are other avenues that can be explored that may help us grapple with systemic risk. One key empirical question is whether the structure of bilateral credit exposures is conducive to a chain reaction of defaults. Work that characterizes the statistical distribution of extreme events would be useful, as well. It would also be useful to see future research that considers how structural or policy changes might reduce the exposure of the financial system to systemic risk, and at what cost. Just as knowledge of the finer points of risk measurement at the individual bank level can make us better supervisors, a clearer understanding of systemic risk will allow central banks to be more effective in their role as guarantors of the integrity of the financial system -- the lenders of last resort.