monitor losses from the bank's trading activities and, if necessary, to force reductions in the size of the bank's open positions. The interval might be three or six months, but a shorter interval would be possible if the regulator can effectively monitor trading activity at that frequency and if the relevant markets are sufficiently liquid that the trading positions could, if necessary, be closed out promptly without substantial market impact. At the end of the interval, the bank could either increase or decrease its capital commitment.

To ensure that the bank committed an amount of capital commensurate with the risks in its trading portfolio and its capacity to manage those risks, the regulator would need to provide appropriate incentives in the form of economic costs or ''penalties'' for failing to limit losses to less than the capital commitment. The magnitude of the penalties would depend on the regulatory objective. A bank that is managed as a going concern would be expected to choose a capital commitment that entailed a marginal cost of regulatory capital equal to the expected cost of the penalty for a violation. The more conservative the capitalization that the regulator desired, the larger would be the specified penalty.

Given these costs, the bank's choice of a capital commitment would be based on a self-assessment of its capabilities to measure and control the risks of its trading activities. The adequacy and reliability of its internal models for measuring risk would play an important role in the bank's determination. But, as recognized in the qualitative standards for risk management that are part of the internal models approach, there is more to risk management than risk measurement. In addition to internal models for risk measurement, sound risk management requires a detailed structure of limits on risk and a strong management information system for controlling, monitoring, and reporting risks.

The measurement of market risk is fraught with uncertainty.

The magnitude of the low probability events about which regulators are concerned (for example, the lower limit of a 99 percent confidence interval for trading gains and losses) simply cannot be estimated with much precision.[3] A corollary of this result is that ''back-tests'' of a null hypothesis that a bank's internal model is accurately estimating a 99 percent confidence limit have little statistical power against alternatives that would involve substantial underestimation of potential losses.

A further implication is that declines in the market values of portfolios beyond those anticipated by the models are inevitable. In such circumstances, what is critical—and what cannot be captured in standard risk measures—is the potential for losses to be contained through active portfolio management, and, conversely, the potential for catastrophic losses if such active management is not forthcoming. In choosing its capital commitment, a bank's management would incorporate its judgments about the combined effectiveness of all critical elements of the bank's risk management system—not only its internal models, but also its structure of risk limits and the management information systems and audit programs it has in place to ensure compliance with those limits. Furthermore, management would have a strong incentive to strengthen over time all elements of its risk management system to economize on capital while avoiding the penalties.

The bank's choice of a capital commitment for market risk could be subject to review by supervisory authorities. Bank management could be expected to explain how cumulative losses would be contained within the amount of the commitment. This necessarily would require documentation of how internal models are used to measure risks, how limits are applied to the measured risks, how compliance with limits is ensured, and how management would respond to unanticipated losses. Furthermore, supervisors could condition use of the pre-commitment alternative on the bank's meeting the same qualitative standards for market risk management systems that would be required for use of the internal models approach, or perhaps on even more stringent standards.

It would be important to emphasize, however, that any supervisory review of the commitment would in no way diminish the bank management's responsibility for setting aside adequate capital to cover its market risks. An attractive feature of the pre-commitment approach is that it would underscore the responsibility of bank management for maintaining adequate capital, even if the amount needed exceeds what otherwise might be regulatory minimum requirements.

The key to the feasibility and effectiveness of the pre-commitment approach is the specification of the penalties that would result from a failure to limit trading losses to an amount less than the commitment. Analysis suggests that the cost of the penalties should increase with the size of the gap between the losses incurred and the pre-commitment. These penalties could take various forms. Fines (monetary penalties) would be especially effective in creating appropriate incentives because of their transparency. (U.S. insured banks might be required to pay any fines into the Bank Insurance Fund.) As an alternative to fines, supervisors could impose punitive capital charges. The severity of fines or capital penalties could be reduced if they were accompanied by supervisory sanctions, such as restrictions on future trading activity. The costs of these restrictions would be measured by the loss of profitable trading activities in future periods. Such costs could be considerable; a bank that is unable to pursue profitable trading opportunities for an extended period would have difficulty covering overhead costs in its trading businesses and, over time, likely would suffer defections by its best traders to other firms.

For the pre-commitment approach to be credible, banks would need to be reasonably certain that supervisory authorities would impose the specified penalties when losses exceed the commitment. The certainty of the penalty would strengthen the incentive for the bank to make the initial capital commitment commensurate with the supervisor's desired coverage of potential losses. Nonetheless, supervisors would need to reserve the right to suspend the penalties in the event of extreme price movements that reflect macroeconomic instability. This would help ensure that banks could continue to provide liquidity to markets following such stressful episodes. But suspensions should not include situations in which a penalty would simply be very costly to an individual bank but without systemic consequences.

Market forces might also be utilized to provide banks with incentives to allocate adequate capital. If the capital commitment were publicly disclosed, the reporting of losses in excess of the commitment not only would imply that supervisory sanctions had been imposed on the bank, but could also cast doubts on the effectiveness of the bank's risk management capabilities. Together, these factors could adversely affect its share price and its funding costs. For this reason, some banks might actually be tempted to commit more capital than is necessary to meet regulatory

[3] This point is developed further in Paul H. Kupiec, ''Techniques for Verifying the Accuracy of Risk Measurement Models.'' Board of Governors of the Federal Reserve System, Division of Research and Statistics, staff memorandum, April 1995. This paper can be obtained from the Board's Freedom of Information Office.