Beverly J. Hirtle

What Market Risk Capital Reporting Tells Us about Bank Risk

- Since 1998, U.S. bank holding companies with large trading operations have been required to hold capital sufficient to cover the market risks in their trading portfolios. The capital amounts that each institution must hold, disclosed in publicly available regulatory reports, appear to offer new information about the market risk exposures undertaken by these institutions.
- An empirical analysis suggests that the market risk capital figures do, in fact, provide information about the evolution of individual institutions' risk exposures over time that is not found in other regulatory report data. In particular, changes in an institution's capital charges prove to be a strong predictor of changes in the volatility of its future trading revenue.
- By contrast, the market risk capital figures provide little information about differences in market risk exposure *across* institutions beyond what is already conveyed by the relative size of an institution's trading account.

1. Introduction

In recent years, financial market supervisors and the financial services industry have placed increased emphasis on the role of public disclosure in ensuring the efficient and prudent operation of financial institutions. In particular, disclosures about financial institutions' risk exposures have frequently been cited as an important way for debt and equity market participants to get the information necessary to exercise "market discipline" on the risk-taking activities of these institutions. Such market discipline is often viewed as an important means of influencing the behavior of financial institutions, especially with regard to their risk-taking activities.

For instance, a 1994 report by the Euro-currency Standing Committee of the Bank for International Settlements stated that "financial markets function most efficiently when market participants have sufficient information about risks and returns to make informed investment and trading decisions."[1] Similarly, in recent proposed amendments to the minimum regulatory capital requirements for internationally active banks, the Basel Committee on Banking Supervision included market discipline as a primary pillar, and the proposals themselves contained extensive recommendations for disclosures about banks' risk exposures (see Basel Committee on Banking Supervision [2001]). Finally, a group of senior officials of large financial institutions recently

Beverly J. Hirtle is a vice president at the Federal Reserve Bank of New York. <beverly.hirtle@ny.frb.org>

The author thanks Michael Gibson, Jim O'Brien, Kevin Stiroh, Philip Strahan, and two anonymous referees and for helpful comments and suggestions. David Fiore and Adrienne Rumble provided excellent research assistance in preparing the data set used in this article. The views expressed are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

issued a report acknowledging the role of public disclosure, among other practices, in maintaining market discipline and shareholder value (see Working Group on Public Disclosure [2001]).

This emphasis on disclosure and market discipline rests on the assumption that the disclosures made by financial institutions provide meaningful information about risk to market participants. Various recommendations have been made by supervisors and the financial services industry about the types of information that would be most effective in conveying an accurate picture of financial firms' true risk exposures as they evolve over time. This article assesses one particular source of information about the risk facing certain large U.S. banking companies to see how well it captures variation in risk exposures, both across institutions and over time.

The data examined are derived from publicly disclosed regulatory report information on minimum regulatory capital requirements. Since 1998, banks and bank holding companies (BHCs) in the United States have been subject to a new set of regulatory minimum capital standards intended to cover the market risk in their trading portfolios. Market risk is the risk of loss from adverse movements in financial rates and prices, such as interest rates, exchange rates, and equity and commodity prices.

The market risk capital standards were introduced as a supplement to the existing capital standards for credit risk for institutions with large trading portfolios. The innovative feature of the market risk capital standards is that they are based on the output of banks' internal risk measurement models, rather than on a standardized set of regulatory risk weights. In theory, relying on banks' internal models means that regulatory capital requirements should be more closely tied to the actual risks facing these institutions. By extension, examining the required capital amounts for different banking organizations could provide new insight into the nature and extent of market risk in the U.S. banking industry.

Banks and bank holding companies subject to the new capital standards have been required to disclose their market risk capital requirements on publicly available regulatory reports since the first quarter of 1998. This article examines the market risk capital amounts reported by BHCs to determine what, if any, new information they provide about the market risk exposures undertaken by these institutions and how those exposures evolve over time. The goal of the analysis is not to ascertain whether the required minimum capital amounts are sufficient to provide a "prudent" level of coverage against the risks these institutions face. Such an analysis would require examining the objectives of supervisors in calibrating the capital standards and how banks have reacted to the incentives imposed by them.[2] Instead, the analysis focuses on assessing the extent to which the regulatory report disclosures provide new information that would allow market participants to assess differences in market risk exposure accurately across institutions and for a given institution over time.

Our first finding is that regulatory capital for market risk represents a small share of the overall amount of minimum regulatory capital for most institutions subject to the market risk capital requirements. Market risk capital represented less than 2 percent of overall minimum regulatory capital for the median bank subject to the new capital standards. Although there has been some amount of quarter-to-quarter variation, the median share of regulatory capital accounted for by market risk capital has remained fairly constant since the standards came into effect at the beginning of 1998.

Our second set of findings concerns the extent of new information contained in the market risk capital amounts included in the regulatory reports. We assess the correlation between the market risk capital figures and regulatory report information on trading account size and composition as well as independent measures of market risk exposure based on daily trading profit and loss information for selected bank holding companies. The assessment is made both across banks using average values for each firm over the sample period, and, using a fixed-effects specification, for individual banking organizations over time.

Our analysis suggests that, when we look across banks, the market risk capital figures provide little additional information about the extent of an institution's market risk exposure beyond that conveyed by simply knowing the relative size of the trading account. In contrast, when we look at individual banks over time, the market risk capital requirements do appear to provide information that is not available from other data contained in regulatory reports. These findings suggest that the market risk capital figures reported by bank holding companies are most useful for tracking changes in market risk exposures at individual banks over time.

The remainder of the article is organized as follows: the next section provides an overview of the market risk capital charges and the banking organizations that are subject to them. Following that, we present some basic facts about the market risk capital figures and what they imply about the share of overall bank holding company minimum regulatory capital accounted for by market risk. The analysis next assesses the degree of new information contained in the market risk capital figures; we then expand this discussion to compare the market risk capital figures with independent measures of bank holding company market risk exposure.

2. Overview of the Market Risk Capital Standards

The market risk capital standards are intended to ensure that banks hold capital sufficient to cover the market risks in their trading portfolios. While market risk can arise from the full range of banking activities, it is most prominent in trading activities, where positions are marked-to-market daily. Thus, the market risk capital standards concentrate on positions in banking organizations' trading portfolios.[3]

The standards implemented in the United States are based on ones adopted internationally by the Basel Committee on Banking Supervision, a group made up of bank supervisors from the Group of Ten countries.[4] In both settings, the market risk standards were intended to supplement the existing capital standards for credit risk, which were established with the adoption of the 1988 Basel Accord. Both standards established methods for calculating the minimum amount of capital that banks would be required to hold against various on- and off-balance-sheet positions. A banking institution's overall minimum regulatory capital requirement equals the sum of its requirements for credit and market risk.

The market risk capital requirements are calculated in two steps, reflecting two different aspects of overall market risk. *General market risk* is the risk arising from movements in the general level of market rates and prices. *Specific risk*, in contrast, is defined as the risk of adverse price movements in the price of an individual security resulting from factors related to the security's issuer. The market risk capital standards include separate minimum capital requirements for each of these elements, which are combined to form the overall market risk capital charge.

As we observed, the innovative feature of the market risk capital standards is that the minimum capital requirements are based on the output of banks' internal risk measurement models. In particular, the capital requirement for general market risk is based on the output of banks' internal value-at-risk models, calibrated to a common supervisory standard. A value-at-risk model produces an estimate of the maximum amount that a bank can lose on a particular portfolio over a given holding period with a given degree of statistical confidence. These models are widely used by banks and other financial institutions with large trading businesses and typically play an important role in these institutions' risk management processes.

The general market risk capital requirement is based on value-at-risk estimates calibrated to a ten-day holding period and a 99th percentile degree of statistical confidence.[5] In particular, the minimum capital requirement is equal to the average value-at-risk estimate over the previous sixty trading days (approximately one-quarter of the trading year) multiplied by a "scaling factor," which is generally equal to three.

The scaling factor can be higher than three—up to a maximum of four—if a bank experiences enough trading portfolio losses that exceed its daily value-at-risk estimates to call the accuracy of the model into question. This determination is made through a process known as "back-testing," in which daily value-at-risk estimates are compared with next-day trading results.[6] If trading losses exceed the value-at-risk estimates too many times over a given period, then the presumption that the model is providing an accurate measure of the 99th percentile of losses is rejected and a higher scaling factor is applied as a very approximate means of compensating for this underestimation. This assessment is performed quarterly, which means that changes in the scaling factor can introduce quarter-to-quarter variation in minimum regulatory capital requirements beyond that implied by variation in the underlying value-at-risk estimates. Supervisors also have the discretion to increase the scaling factor because of qualitative concerns about the accuracy of a bank's model.

The minimum capital requirements for specific risk may be based either on internal models—to the extent these models incorporate specific risk estimation—or on a set of standardized supervisory risk weights. Estimates of specific risk based on internal models are generally subject to a scaling factor of four. As stated above, the overall minimum capital requirement for market risk equals the sum of the requirements for general market risk and specific risk.

Since the focus of the market risk capital standards is on trading portfolio positions, only those U.S. banks and bank holding companies with significant amounts of trading activity are subject to these capital requirements. In particular, the U.S. standards apply to banks and BHCs with trading account positions (assets plus liabilities) exceeding $1 billion, or 10 percent of total assets. Supervisors also have the discretion to impose the standards on institutions that do not meet these criteria if such a step appears necessary for safety and soundness reasons, or to exempt an institution that otherwise meets the criteria if it is believed that its actual market risk exposure is small. Finally, banks may choose to "opt in" to the market risk standards, with supervisory approval.

Although the institutions meeting these criteria are relatively few in number, they hold the vast majority of trading positions in the U.S. banking system. As of December 2001, the nineteen bank holding companies that were subject to the market risk capital requirements accounted for 98 percent of the trading positions held by all U.S. banking organizations. All of these organizations are among the largest in the U.S. banking system (Table 1). Since the implementation of the market risk capital

Table 1

Bank Holding Companies Subject to Market Risk Capital Standards
December 2001

Banking Organization	Market Risk Capital Requirement (Billions of Dollars)	Total Assets (Billions of Dollars)	Asset Size Rank
Citigroup Inc.	2.510	1,051	1
J.P. Morgan Chase & Co.	1.929	694	2
Bank of America Corporation	2.355	622	3
Wachovia Corporation	0.370	331	4
Wells Fargo & Co.	0.164	308	5
Bank One Corporation	0.156	269	6
Taunus Corporation	0.261	227	8
FleetBoston Financial Corporation	0.257	204	9
ABN Amro North America Holding Co.	0.093	172	10
U.S. Bancorp	0.038	171	11
HSBC North America Inc.	0.138	110	12
Suntrust Banks, Inc.	0.023	105	14
The Bank of New York Company, Inc.	0.043	81	15
Keycorp	0.017	80	16
State Street Corporation	0.056	70	19
PNC Financial Services Group	0.017	70	20
Countrywide Credit Industries, Inc.	0.001	37	30
Mellon Financial Corporation	0.050	36	32
CIBC Delaware Holdings Inc.	0.134	32	35

Source: Federal Reserve FR Y-9C Reports.

Note: The commercial bank holding companies listed are those that reported positive market risk equivalent assets on Schedule HC-I of the Federal Reserve FR Y-9C Reports in December 2001.

standards at the beginning of 1998, the number of BHCs subject to the market risk standards has ranged between sixteen and twenty per quarter. The number has tended to decline over time, due mostly to the effect of mergers between the large banking organizations subject to the capital standard.

3. Market Risk Capital Requirements: Basic Findings

One of the key benefits of basing the market risk capital standards on the output of banks' internal risk measurement models is that the resulting minimum capital requirements should more closely track the actual risks facing banking organizations. While this risk sensitivity is an important feature from a capital perspective, it also has significant implications for the ability of supervisors and others to monitor the risk profiles of these institutions. The banking organizations subject to the market risk capital standards are required to report their minimum regulatory capital requirements for market risk in their regulatory reports.[7] These reports are publicly available, so information on market risk capital is widely accessible. Thus, the market risk capital figures disclosed in the regulatory reports are a potentially important source of new information about the risks facing these institutions.

As a first exercise, we can use the regulatory report data to develop a better understanding of the contribution that market risk makes to banks' overall minimum regulatory capital requirements. This exercise helps provide a basic sense of the importance of market risk capital in banks' overall regulatory capital structure and may also provide a very rough sense of the contribution of market risk to banks' overall risk profiles.[8]

Table 1 reports the minimum regulatory capital requirements for market risk for the nineteen bank holding companies subject to the market risk capital standards as of December 2001. Market risk capital requirements ranged between $1 million and $2.5 billion for these institutions, with the majority reporting minimum required capital amounts of less than $250 million. There is some correlation with overall

asset size: the institutions with the largest overall assets report the highest market risk capital requirements. These large institutions also tend to have the most extensive trading activities, so this association is not surprising.

To explore the role of minimum regulatory capital for market risk in these institutions' overall required capital amounts, we calculate the ratio of required minimum capital amounts for market risk to overall required minimum capital for each bank holding company for each quarter that it is subject to the market risk capital standards. There is a maximum of sixteen observations per bank holding company (based on quarterly reporting from 1998:1 to 2001:4), although in practice, most institutions have fewer than sixteen observations, largely as the result of mergers that cause companies to enter and leave the sample. We handle mergers by treating the pre- and post-merger organizations as different bank holding companies, even if they retain the same name and regulatory identification numbers following the merger. Finally, we limit our sample to top-tier U.S. bank holding companies, that is, to bank holding companies that are not themselves owned by a foreign banking organization. We exclude the foreign-owned organizations because the trading activities and capital figures reported for these banks are not independent of the activities of the parent banking organization. Our final sample consists of 215 quarterly observations for twenty-seven bank holding companies.

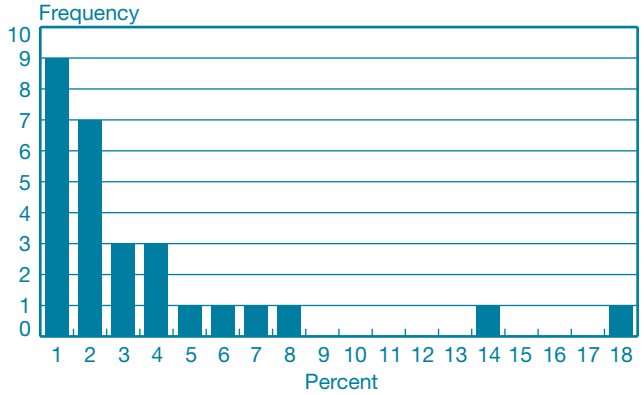
Market risk capital figures disclosed [by banks with large trading operations] in regulatory reports are a potentially important source of new information about the risks facing these institutions.

The first observation we can make is that, for the typical banking organization in our sample, the share of overall risk derived from market risk is relatively small. The median ratio of market risk capital to overall required capital is just 1.8 percent. As illustrated in Chart 1, most bank holding companies subject to the market risk standards have ratios that fall below 5 percent on average, while a handful of companies have average ratios significantly above this level. For this latter group of institutions, the ratio of market risk to overall minimum required capital ranges between 5.5 percent and 22.0 percent on a quarterly basis. Not surprisingly, these companies tend to have large trading portfolios and a concentration in trading activities.

Aside from looking across banking organizations, it is also interesting to examine how the contribution of market risk to overall risk has changed over time. Chart 2 reports the median value of the ratio of market risk capital to overall minimum required capital for each quarter between the beginning of 1998 and the end of 2001. This period includes the market turbulence in the third and fourth quarters of 1998, when markets reacted sharply to the Russian debt default and many banks reported significant losses in their trading portfolios.[9]

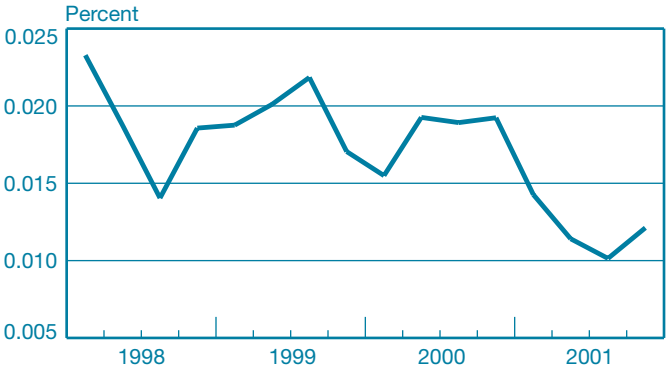
Overall, the median value of this ratio has remained fairly stable over the sample period, ranging between 1.0 percent and

Chart 1
Distribution of Bank Holding Companies by Average Market Risk Capital Share



Source: Federal Reserve FR Y-9C Reports.

Chart 2
Median Market Risk Capital Share



Source: Federal Reserve FR Y-9C Reports.

2.3 percent, with a slight downward trend, especially during 2001. Surprisingly, there is no evidence of an increase in the ratio during the financial market turbulence at the end of 1998. In fact, as illustrated in Chart 2, the median value of the ratio fell sharply from the second to third quarters of that year. Although some companies had ratios that rose sharply over this period, nine of the sixteen BHCs that reported market risk capital amounts in both the second and third quarters of 1998 had ratios that fell or remained relatively stable.

4. Market Risk Capital: New Information?

Although the analysis presented above helps us to understand the contribution that market risk makes to these institutions' overall minimum regulatory capital requirements, it does not answer the question of whether the regulatory reports are a source of useful new information about risk exposures. To be useful sources of new information, regulatory report data would have to fulfill two basic requirements. First, the data would have to represent a source of public information not available elsewhere. Second, the data would have to provide accurate information about the extent of market risk exposure across different institutions and for individual institutions over time. We examine each of these questions in turn.

Turning first to whether the market risk capital figures contain new public information, it is helpful to review the timing and characteristics of the regulatory report information. As stated above, the regulatory reports containing the market risk capital figures are filed on a quarterly basis by bank holding companies. These figures are included in a broader set of reports that contain balance-sheet and income-statement information, as well as information about regulatory capital and other variables of interest to supervisors. The reports are reviewed by Federal Reserve staff and, in some cases, by examiners as part of the examination process. The reports must be submitted to the Federal Reserve by the bank holding companies within forty-five days of the end of the quarter, and are available to the public shortly after that date (following review and analysis by Federal Reserve staff).

Aside from information in the regulatory reports, there are additional sources of information available on banks' market risk exposures. Supervisors, for instance, have access to information about banking organizations' risk profiles through the examination process. The information available through this process includes the daily risk reports prepared by a bank's risk management unit, assessments of model structure and accuracy prepared by a bank's internal and external auditors, and direct assessments of the institution's risk exposures by risk management units and by senior management. This information is likely to be superior to the market risk capital information contained in regulatory reports, both because it is more detailed and because it is more timely.

These supervisory sources of information are confidential, however, and thus do not contribute to the information available to the broader public. Aside from the market risk capital figures, public sources of information about banks' market risk exposures include disclosures made by banking organizations in their annual reports and filings with the Securities and Exchange Commission (SEC). Most of the institutions that are subject to the market risk capital standards also report value-at-risk figures in their 10-K and 10-Q filings with the SEC.[10] The quarterly 10-Q filings are available on a schedule that is generally consistent with the timing of the quarterly regulatory reports containing the market risk capital information.

The disclosures contained in the SEC filings generally include information about firmwide value-at-risk estimates similar to those that form the basis of the minimum regulatory capital requirement for market risk. In many cases, however, the SEC filings also contain a more detailed breakdown of risk exposures—for instance, value-at-risk estimates by different risk factors, such as interest rates, exchange rates, and equity prices—than is available in the regulatory reports.

To be useful sources of new information, regulatory report data would have to . . . represent a source of public information not available elsewhere . . . [and] provide accurate information about the extent of market risk exposure across different institutions and for individual institutions over time.

While this greater level of detail suggests that the information in the SEC filings may be superior in some ways to the data contained in the bank regulatory reports, other features suggest that the market risk data in the two sources are complementary. Specifically, the data in the SEC filings vary significantly across institutions along a number of dimensions, including loss percentile used in the value-at-risk estimates and the way the figures are averaged over time.[11] These differences complicate

comparisons both across institutions and over time, as institutions sometimes change the way their figures are calculated and reported.[12] In contrast, the market risk data contained in regulatory reports are reported on a consistent basis.

Differences across companies in the nature of the information contained in SEC filings make a direct empirical comparison of the SEC and regulatory report data difficult. Instead, we address a somewhat narrower question by examining the extent to which the new capital figures provide information about market risk not already contained in the regulatory reports. In other words, we examine the marginal contribution of the market risk capital disclosures over and above other market risk information contained in the regulatory reports.

In particular, we examine the market risk capital amounts reported by the sample bank holding companies and ask whether variation in these figures over time and across institutions reflects any new information about the extent of market risk exposure. As a first step, we compare the market risk capital data with a very broad measure of risk exposure—the size of the trading accounts at the institutions that are subject to the new market risk standards.

The goal of this exercise is to determine whether variation in market risk capital across banks and over time contains any information not already reflected in the size of the trading account. That is, how highly correlated are variations in market risk capital with variations in the size of the trading account? To what extent would differences in market risk capital across banks, or changes in this figure for a given bank over time, provide a different sense of the extent of market risk exposure than variation in the size of the trading account? If the two variables are not highly correlated, we can take this as some initial evidence that the market risk capital figures contain some information not reflected in trading account size.[13]

We begin this analysis by regressing the market risk capital figures on trading account size (trading assets plus liabilities), and other variables contained in the regulatory reports that might shed light on the extent of market risk exposure. All variables are scaled by the institution's total assets.[14] Summary information about the market risk capital and the trading account size variables are reported in Table 2.

The results of these regressions are reported in Table 3. We run these regressions across bank holding companies using average values for each firm over the sample period (across-BHC regressions) and, using a fixed-effects specification, we run them for individual banking organizations over time (within-BHC regressions). The within-BHC sample can be interpreted as capturing the average degree of correlation between the market

Table 2
Summary Statistics for Principal Variables

Variable	Mean	Standard Deviation	Minimum	Maximum	Number of Observations	Number of BHCs
Overall sample						
Market risk capital	0.0216	0.0219	0.0010	0.1120	215	27
Trading	0.0820	0.1094	0.0010	0.5241	215	27
Derivatives	7.1190	9.6393	0.0000	35.2025	215	27
Within BHCs						
Market risk capital	0.0000	0.0058	-0.0239	0.0296	215	27
Trading	0.0000	0.0192	-0.0670	0.0992	215	27
Derivatives	0.0000	1.6794	-8.1888	5.9283	215	27
Across BHCs						
Market risk capital	0.0224	0.0220	0.0025	0.0824	27	27
Trading	0.0807	0.1086	0.0049	0.4249	27	27
Derivatives	6.9494	9.4359	0.0000	32.2537	27	27

Source: Federal Reserve FR Y-9C Reports.

Notes: The variables are defined as follows: market risk capital equals minimum regulatory capital for market risk divided by total bank holding company (BHC) assets. Trading equals trading account assets plus liabilities divided by total BHC assets. Derivatives equal the gross notional amount of derivatives contracts divided by total BHC assets. Overall sample results reflect the variables as defined. Within-BHC results have BHC-specific means removed from each observation. Across-BHC results are based on BHC-specific mean values.

risk capital figures and trading account size for individual banking companies over time. The across-BHC sample can be interpreted as capturing the degree of correlation by looking across the different banking companies in the sample.

Turning to the first two columns of Table 3, we see that there is a positive and significant correlation between the required amount of capital for market risk and the size of the trading account. The regression coefficients are positive and statistically significant for both the across-BHC and within-BHC specifications,[15] suggesting that there is some amount of common information in the two variables. That said, the R^2s of the regressions—which reflect the extent to which variation in the market risk capital figures is captured by variation in the trading account size variable—suggest that some amount of the variation in the market risk capital remains unexplained. As indicated in the bottom row of Table 3, variations in trading account size represent 70 percent of the variation in the market risk capital figures looking across bank holding companies (column 1) and just 4 percent of the variation for individual bank holding companies over time (column 2).

These results are not meaningfully changed when additional regulatory report variables are added to the regression specification. Adding a second variable to control for the size of the BHCs' derivatives positions has little impact on the results for either the across- or within-BHC results (columns 3 and 4 of Table 3). Further, for the within-BHC specification, we can break trading account positions into several broad asset and liability categories and classify derivatives positions according to whether they are based on interest rates, exchange rates, equity prices, or commodity prices.[16] While this augmented

Table 3
Market Risk Capital and Trading Account Size

	Across BHCs (1)	Within BHCs (2)	Across BHCs (3)	Within BHCs (4)
Trading	0.1720**	0.0601**	0.2324**	0.0599**
	(0.0215)	(0.0216)	(0.0338)	(0.0217)
Derivatives			-0.0009*	0.00005
			(0.0004)	(0.00025)
R^2	0.718	0.040	0.766	0.040

Source: Author's calculations.

Notes: The dependent variable is the ratio of required minimum capital for market risk to total bank holding company (BHC) assets. Trading is defined as the ratio of trading account assets plus trading account liabilities to total assets for the bank holding company. Trading account assets and liabilities are adjusted so that revaluation gains and losses enter on a net basis. Derivatives are defined as the sum of the gross notional principals of interest rate, foreign exchange, equity, and commodity derivatives held in the trading account to total assets of the bank holding company. Across-BHC regressions are based on the average of the dependent and independent variables for each of the twenty-seven bank holding companies in the data set. Within-BHC regressions are estimated using fixed effects for each bank holding company.

**Statistically significant at the 1 percent level.
*Statistically significant at the 5 percent level.

Table 4
Market Risk Capital and Trading Account Composition

	Within BHCs
Trading assets in domestic offices	
Treasury securities	0.5142**
	(0.0879)
U.S. government agency securities	-0.2378
	(0.1612)
Municipal securities	0.8415
	(0.5143)
Mortgage-backed securities	-0.2182*
	(0.0984)
All other debt securities	0.1626*
	(0.0810)
Other trading assets	0.4304**
	(0.1047)
Trading assets in foreign offices	-0.0188
	(0.0239)
Net revaluation gains	-0.2841**
	(0.0904)
Short positions	0.4699**
	(0.0602)
Derivatives contracts	
Interest rate	0.0015**
	(0.0003)
Foreign exchange	0.0027*
	(0.0012)
Equity	-0.0262**
	(0.0065)
Commodity	-0.0996**
	(0.0229)
R^2 (within)	0.563

Source: Author's calculations.

Notes: The dependent variable is the ratio of required minimum capital for market risk divided by total assets for the bank holding company (BHC). The independent variables are divided by the total assets of the bank holding company. The sum of Treasury securities, U.S. government agency securities, municipal securities, mortgage-backed securities, all other debt securities, other trading assets, trading assets in foreign offices, net revaluation gains, and short positions variables equals "trading" in the regressions in Table 3. The sum of the variables interest rate, foreign exchange, equity, and commodity equals "derivatives" in the regressions in Table 3. The regression is estimated using fixed effects for each of the twenty-seven BHCs in the data set.

**Statistically significant at the 1 percent level.
*Statistically significant at the 5 percent level.

regression specification raises the R^2 of the within-BHC regression considerably (Table 4), it still leaves nearly half the variation in market risk capital unexplained.

These results suggest that the market risk capital figures disclosed in the regulatory reports may contain information about changes in individual institutions' risk exposures over time that is not available from other regulatory report information. Nonetheless, it is possible that these findings could to some extent be driven by factors other than changes in risk exposure. In particular, the scaling factor used to convert value-at-risk estimates into regulatory capital charges could account for some of the differences in the market risk capital and trading account size variables. Because the scaling factor can change over time, variation in the reported market risk capital figures reflects both changes in an institution's risk profile (that is, changes in the underlying value-at-risk measures) and variation in the scaling factors.

It is possible, therefore, that the unexplained variance in the market risk capital figures could be driven by changes in the scaling factor rather than by new information contained in the market risk capital figures. This is particularly likely to be true for the within-BHC specification, which captures changes for individual bank holding companies over time. More specifically, scaling factor changes would affect the quarter-to-quarter variation in observations for the within-BHC regressions, but this noise could largely be averaged out in the across-BHC regressions.

To assess the extent of this problem, we rerun the within- and across-BHC regressions in Table 3, omitting all observations where the scaling factor used for value-at-risk estimates differs from the baseline value of three. These results are reported in Table 5.[17] Clearly, the results are very similar to those in Table 3. Although not reported here, the results of the augmented within-BHC regression from Table 4 are also very similar when these observations are omitted. Thus, the results presented above do not appear to be driven by changes in the scaling factor.

Table 5
Market Risk Capital and Trading Account Size: Robustness Checks for Scaling Factor Changes

	Across BHCs (1)	Within BHCs (2)	Across BHCs (3)	Within BHCs (4)
Trading	0.1787**	0.0739**	0.2450**	0.0683**
	(0.0230)	(0.0205)	(0.0322)	(0.0205)
Derivatives			-0.0010*	0.0005*
			(0.0004)	(0.0002)
R^2	0.706	0.070	0.774	0.093

Source: Author's calculations.

Notes: The dependent variable is the ratio of required minimum capital for market risk to total assets for the bank holding company (BHC). All observations where the market risk capital figures are calculated with a scaling factor other than three are omitted. Trading is defined as the ratio of trading account assets plus trading account liabilities to total assets for the bank holding company. Trading account assets and liabilities are adjusted so that revaluation gains and losses enter on a net basis. Derivatives are defined as the sum of the gross notional principals of interest rate, foreign exchange, equity, and commodity derivatives held in the trading account to total assets of the bank holding company. Across-BHC regressions are based on the average of the dependent and independent variables for each of the twenty-seven bank holding companies in the data set. Within-BHC regressions are estimated using fixed effects for each bank holding company.

**Statistically significant at the 1 percent level.
*Statistically significant at the 5 percent level.

5. Market Risk Capital and Actual Risk Exposures

The analysis in the previous section suggests that the minimum regulatory capital figures for market risk may contain information about market risk exposures that is not reflected in other sources of information in regulatory reports. However, the mere fact that in some instances the market risk capital figures are less than perfectly correlated with other sources of regulatory information does not, in and of itself, mean that the information in the market risk capital figures is valuable. The lack of correlation could, for instance, reflect random noise in the market risk capital figures that is unrelated to actual changes in risk exposure. Thus, an important question is whether the market risk capital figures contain accurate information that would allow us to distinguish true differences in market risk exposure, either between bank holding companies or for given bank holding companies over time.

In other words, an important assumption in all the analysis described above is that the market risk capital figures are accurate measures of bank holding companies' true market risk exposures. There are a number of reasons to question this assumption. First, the market risk capital figures will provide an accurate indication of the true risk profile of a banking organization only to the extent that the underlying value-at-risk model is accurate. While an independent assessment of the accuracy of these models is beyond the scope of this article, it is important to note that the market risk capital standards include an extensive set of qualitative standards intended to

ensure that the models used for regulatory capital purposes are conceptually sound and implemented with integrity.[18] While no guarantee of model accuracy, these qualitative standards provide a rigorous framework for detecting models that are significantly flawed.

In addition, it is notable that the market risk capital figures reported to supervisors are not direct measures of risk exposures. As noted above, the reported market risk capital figure equals the sum of the general market risk and specific risk components, each multiplied by a scaling factor.[19] While the general market risk portion is always derived from value-at-risk model estimates, the specific risk figures may be based on a risk measurement model or may be calculated using standardized regulatory weights. In the latter case, there is reason to question the extent to which they reflect true risk exposure. Finally, since the general market and specific risk figures are summed to form the overall capital charge, the charge will overstate actual risk exposures to the extent that these two forms of risk are less than perfectly correlated.

Empirical work to date presents somewhat conflicting evidence of the accuracy of the value-at-risk models that underlie the market risk capital requirements. Berkowitz and O'Brien (2002) examine the performance of value-at-risk models for a sample of large U.S. bank holding companies using confidential supervisory data that permit comparison of daily value-at-risk estimates with next-day trading results (profit and loss). They find substantial variation in the performance of value-at-risk models across bank holding companies, although on average the models appear to provide conservative estimates of the tail (99th percentile) of the profit and loss distribution. They also find that a simple GARCH model based on daily trading results is better at predicting changes in daily profit and loss volatility than are the value-at-risk estimates.

An important assumption in all the analysis . . . is that the market risk capital figures are accurate measures of bank holding companies' true market risk exposures. There are a number of reasons to question this assumption.

These results stand somewhat in contrast to the findings in Jorion (2002), who concludes that value-at-risk models are good predictors of future trading revenue variability. Jorion examines the value-at-risk disclosures made by large U.S. bank holding companies between 1995 and 1999. He finds that these figures are strongly significant predictors of the variability of the banks' future trading revenues and that this predictive power continues to hold even after controlling for the extent of the institutions' derivatives exposures. His conclusion is that the value-at-risk measures appear to contain useful information about banks' future market risk exposures.

The difference in findings may lie in the implicit observation periods used in the two studies: Jorion (2002) focuses on trading variability over a quarterly horizon, while Berkowitz and O'Brien (2002) focus on the day-to-day variation in profit and loss. Christofferson, Diebold, and Schuermann (1998) find that the ability of GARCH-type models to produce superior forecasts of future volatility declines substantially as the holding period lengthens. The difference between the Jorion and Berkowitz and O'Brien findings could therefore reflect the different holding periods used in the two papers.

In the ideal, we would evaluate the accuracy of the market risk capital figures—in terms of their ability to distinguish differences in risk across institutions and over time—by comparing them with independent measures of bank holding companies' market risk exposures. Unfortunately, such independent measures are not generally available. We can, however, derive reasonable proxies for market risk exposures using data on bank holding companies' daily trading profits and losses. The Federal Reserve collects data on the daily profits and losses from trading operations for selected bank holding companies subject to the market risk capital standards.[20] Using these data for a subset representing just under half the bank holding companies in the full sample, we calculate two different risk measures to proxy for the true extent of the bank holding companies' market risk exposures.

We consider two distinct market risk proxies to capture different concepts of risk exposure. The first proxy is the quarterly volatility (standard deviation) of the daily profit and loss figures. Volatility is a widely accepted measure of risk exposure that captures the general dispersion of the distribution of profits and losses. Such a risk measure would be relevant for those concerned about the potential for day-to-day change in trading revenue, perhaps in the context of daily management of a trading desk.

In contrast, our second risk proxy is intended to capture the likely size of losses in the tail of the profit and loss distribution. Specifically, we calculate the average of the three largest daily losses in each quarter. This "tail risk" measure captures the potential extent of loss given that an extreme event occurs.[21] Such tail risk measures have been advocated as being an appropriate measure of risk in situations where the likely size and impact of extreme events is of particular concern.[22] Note that if the daily

profit and loss figures were normally distributed, volatility would be a sufficient statistic for both risk exposure concepts—general dispersion and likely tail losses—since the standard deviation of the profit and loss distribution would be all that is necessary to describe the size and shape of the tail. In that event, results using our two risk measures would be very similar.[23]

In considering these risk proxies, note that the underlying daily trading profit and loss data may themselves not be ideal measures of the true underlying risk of a bank's trading operations. These profit and loss figures are composed of a variety of elements, including changes in the marked-to-market value of overnight trading positions, margin income and fees from customer activity, and income or losses from intraday positions. Some portion of this activity—especially those positions that may be marked-to-market using models rather than market prices—may be handled differently at different firms. That may lead to cross-firm differences that are unrelated to true underlying risk exposures. Nonetheless, even if flawed, these data represent arguably the best source of information about the variability in banks' realized trading revenue, and we will use them in our proxy measures of BHCs' "true" market risk exposure.

To test the degree of new information contained in the market risk capital figures, we regress the two risk proxies on the market risk capital and on regulatory report variables describing the size and composition of the trading account. All variables are scaled by total end-of-quarter bank holding company assets. Summary statistics for the primary regression variables are reported in Table 6.

Similar to our previous analysis, the primary goal of this analysis is to assess the degree of *correlation* between the minimum regulatory capital figures for market risk and our proxies for BHCs' true market risk exposure. If we find that a positive and significant correlation exists, even after controlling for other regulatory report variables that are intended to convey information about banks' market risk

Table 6

Summary Statistics for Principal Regression Variables

Variable	Mean	Standard Deviation	Minimum	Maximum	Number of Observations	Number of BHCs
Overall sample						
Trading volatility	0.0004	0.0004	0.00004	0.0023	87	12
Trading tail risk	0.00003	0.00005	0.00000	0.00029	87	12
Market risk	0.0026	0.0018	0.0003	0.0070	87	12
Trading	0.1182	0.1192	0.0117	0.4754	87	12
Derivatives	10.854	11.078	0.0035	35.203	87	12
Within BHCs						
Trading volatility	0.0000	0.0002	-0.0005	0.0010	87	12
Trading tail risk	0.0000	0.00004	-0.0001	0.0002	87	12
Market risk	0.0000	0.0005	-0.0018	0.0017	87	12
Trading	0.0000	0.0157	-0.0571	0.0605	87	12
Derivatives	0.0000	2.332	-7.806	6.312	87	12
Across BHCs						
Trading volatility	0.0004	0.0003	0.0001	0.0013	12	12
Trading tail risk	0.00004	0.00004	0.00000	0.00012	12	12
Market risk	0.0024	0.0017	0.0006	0.0056	12	12
Trading	0.0987	0.1095	0.0131	0.4149	12	12
Derivatives	8.896	10.236	0.0036	30.469	12	12

Source: Federal Reserve FR Y-9C Reports.

Notes: Variables are defined as follows: trading volatility equals the one-quarter-ahead quarterly volatility of daily trading profits and losses divided by total bank holding company (BHC) assets. Trading tail risk equals the one-quarter-ahead average of the three largest daily trading losses in a quarter divided by total BHC assets. Market risk equals minimum regulatory capital for market risk divided by total BHC assets. Trading equals trading account assets plus liabilities divided by total BHC assets. Derivatives equal the gross notional amount of derivatives contracts divided by total BHC assets. Overall sample results reflect the variables as defined. Within-BHC results have BHC-specific means removed from each observation. Across-BHC results are based on BHC-specific mean values.

exposures, then we interpret this as evidence that the minimum regulatory capital figures contain valuable new information about market risk exposures.

In this regard, it is important to note that the results are mainly directional, in the sense that we are examining the tendency of the market risk capital figures and the market risk proxies to move together. However, our analysis will not really address the question of whether or not the *level* of market risk capital is appropriate given these institutions' true market risk exposures.[24] That is, we are not attempting to conduct a back-testing exercise in which we would establish whether the underlying value-at-risk figures are providing accurate measures of a given percentile of the loss distribution.

In the results presented below, we examine the correlation between the market risk capital figures and *future* values of the two market risk proxies. That is, we pair end-of-quarter market risk capital amounts with risk proxies based on daily profit and loss figures for the following quarter. Because the market risk capital figures are based on the average value-at-risk figures over the previous sixty trading days, this specification means that we are testing the ability of the market risk capital figures to provide forward-looking information about BHCs' market risk exposures.[25]

As discussed in Jorion (2002) and Berkowitz and O'Brien (2002), there are a number of reasons to suspect that market risk capital figures based on lagged, average value-at-risk estimates might not contain much information about future market risk exposure. For one, positions within the trading account can change rapidly over time, particularly when markets have been volatile. Thus, lagged value-at-risk estimates may reflect a trading account composition that is very different from the positions generating current and future trading profits and losses. Second, even if positions are held fixed, market conditions themselves may have changed, so that the volatility of the overall portfolio is different. To the extent that either of these factors comes into play, market risk capital figures based on past value-at-risk estimates may not be particularly strong predictors of future trading volatility.

The results of this analysis are reported in Tables 7 and 8. Table 7 contains results looking across bank holding companies, while Table 8 presents results looking within individual institutions over time. In each table, the top panel contains the results for the market risk proxy based on trading revenue volatility. The bottom panel contains the risk proxy based on trading revenue tail estimates.

Turning first to Table 7, we note that the results in the first column suggest that the market risk capital figures are positively correlated with the future market risk proxies when looking across bank holding companies. That is, banks with higher market risk capital figures on average tend to have higher future market risk exposures, although the coefficient is statistically significant only for the regression based on trading revenue volatility. As the results in the next column indicate, bank holding companies with larger trading accounts on average also tend to have higher future market risk, although again this result is statistically significant only for the regression based on the trading revenue volatility risk proxy.

The information contained in the market risk capital variable, however, appears to be much more limited when both trading account size and market risk capital are included in the

Table 7
Market Risk Capital and Future Market Risk across Bank Holding Companies

	(1)	(2)	(3)	(4)
Future trading volatility				
Market risk	0.1047^{+}		-0.0189	-0.0006
	(0.0501)		(0.0642)	(0.0724)
Trading		0.0023**	0.0025*	0.0017
		(0.0006)	(0.0010)	(0.0016)
Derivatives contracts				0.0000
				(0.00013)
R^2 (between)	0.304	0.584	0.588	0.607
F-test (p-value)			0.019	0.297
Future trading tail risk				
Market risk	0.0062		-0.0007	-0.0004
	(0.0064)		(0.0103)	(0.0118)
Trading		0.0001	0.0001	0.0001
		(0.0001)	(0.0002)	(0.0003)
Derivatives contracts				0.0000
				(0.0000)
R^2 (between)	0.087	0.158	0.159	0.165
F-test (p-value)			0.459	0.835

Source: Author's calculations.

Notes: The dependent variable in the top half of the table is trading volatility, defined as the one-quarter-ahead quarterly volatility of daily trading profit and loss for each bank holding company. The dependent variable in the bottom half of the table is trading tail risk, the one-quarter-ahead average of the three largest daily trading losses in each quarter for each bank holding company. Market risk equals required market risk capital. Trading is trading account assets plus liabilities. Derivatives equal the total gross notional principal of all derivatives contracts held in the trading account. All variables are scaled by total bank holding company assets. The regression results are based on average values for each bank holding company over the quarters that it is in the sample (between regression results). F-test p-values are from a test of the hypothesis that the coefficients on market risk and trading are both equal to zero.

**Statistically significant at the 1 percent level.
*Statistically significant at the 5 percent level.
$^{+}$Statistically significant at the 10 percent level.

Table 8

Market Risk Capital and Future Market Risk within Bank Holding Companies

	(1)	(2)	(3)	(4)	(5)
Future trading volatility					
Market risk	0.1027*		0.1143**	0.1223**	0.1215*
	(0.0392)		(0.0380)	(0.0378)	(0.081)
Trading		-0.0028*	-0.0032*	-0.0027*	
		(0.0013)	(0.0012)	(0.0012)	
Trading components					Yes
Derivatives contracts				-0.00001+	
				(0.00001)	
Derivatives components					Yes
R^2 (within)	0.370	0.352	0.424	0.447	0.652
F-test (p-value)			0.002	0.002	
Future trading tail risk					
Market risk	0.0129+		0.0147+	0.0179*	0.0184+
	(0.0077)		(0.0076)	(0.0071)	(0.014)
Trading		-0.0004+	-0.0005*	-0.0003	
		(0.0002)	(0.0002)	(0.0002)	
Trading components					Yes
Derivatives contracts				-0.0000**	
				(0.0000)	
Derivatives components					Yes
R^2 (within)	0.428	0.432	0.460	0.542	0.768
F-test (p-value)			0.084	0.100	

Source: Author's calculations.

Notes: The dependent variable in the top half of the table is trading volatility, defined as the one-quarter-ahead quarterly volatility of daily trading profit and loss for each bank holding company. The dependent variable in the bottom half of the table is trading tail risk, the one-quarter-ahead average of the three largest daily trading losses in each quarter for each bank holding company. Market risk equals required market risk capital. Trading is trading account assets plus liabilities. In the rows labeled trading components, trading is divided into its component pieces (Treasury securities, U.S. government agency securities, municipal securities, mortgage-backed securities, all other debt securities, other trading assets, trading assets in foreign offices, net revaluation gains, and short positions). To keep the table concise, we do not report the coefficients on these variables separately. Derivatives equal the total gross notional principal of all derivatives contracts held in the trading account. In the rows labeled derivatives components, derivatives are divided into the component pieces (interest rate, foreign exchange, equity, and commodity). To keep the table concise, we do not report the coefficients on these variables separately. All variables are scaled by total bank holding company assets. The regressions are estimated using fixed effects for each of the bank holding companies in the data set and include a dummy variable for 1998:3. F-test p-values are from a test of the hypothesis that the coefficients on market risk and trading are both equal to zero.

**Statistically significant at the 1 percent level.
*Statistically significant at the 5 percent level.
+Statistically significant at the 10 percent level.

regressions. The third column of Table 7 contains these results. When both variables are included in the specification, the market risk capital variable becomes negative and is no longer statistically significant. In contrast, the coefficient on trading account size remains positive and continues to be statistically significant in the regression using trading revenue volatility as the risk proxy. These results are further reinforced when a variable controlling for the bank holding companies' derivatives exposures is included (the last column of Table 7).[26]

These findings suggest that when we look across bank holding companies, there appears to be little additional information in the market risk capital figures beyond that conveyed simply by knowing the average size of the trading account. However, the results in Table 8 suggest that market risk capital figures contain valuable new information about banks' market risk exposures when we look within an individual bank holding company over time. The results in the first column of the table demonstrate a positive and statistically

significant correlation between market risk capital and both future market risk proxies.[27] The estimation results further suggest that this correlation is economically important: the point estimates suggest that a 1-standard-deviation change in a BHC's market risk capital figure (relative to the BHC-average value) would lead to a 0.25-standard-deviation change in future trading revenue volatility and a 0.15-standard-deviation change in future tail losses.

Interestingly, although there is a statistically significant correlation between each of the market risk proxies and trading account size, the coefficients are negative (column 2 of Table 8). When both market risk capital and trading account size are included in the specification (column 3), the coefficient on market risk capital continues to be positive and statistically significant. This finding does not change when controlling for the size of the banks' derivatives exposures (column 4), or

When we look across bank holding companies, there appears to be little additional information in the market risk capital figures beyond that conveyed simply by knowing the average size of the trading account.

when trading account and derivatives positions are broken out into more detailed categories (column 5). Furthermore, the economic importance of changes in market risk capital is actually strengthened in these specifications: a 1-standard-deviation change in market risk capital is associated with a 0.30-standard-deviation change in future trading revenue volatility and a 0.20 change in future tail losses in these enhanced specifications.

These results suggest that the market risk capital figures provide meaningful information about variation in bank holding companies' market risk exposures over time that is not reflected in information available elsewhere in the banks' regulatory reports. The results in Table 8 suggest that market risk capital figures contain useful information about future trading volatility even after controlling for the composition of the trading account and derivatives positions. These results hold despite theoretical arguments suggesting that lagged value-at-risk estimates might not have much predictive power for future trading profit and loss—and despite the relatively small sample size used to produce the estimates (fewer than ninety observations, once future market risk proxies have been created). The analysis suggests that the market risk capital figures

Market risk capital figures contain valuable new information about banks' market risk exposures when we look within an individual bank holding company over time.

contained in bank holding company regulatory reports provide new information that can help us understand the evolution of market risk exposures at individual banks over time.[28]

6. Conclusion

The market risk capital figures disclosed in bank holding companies' regulatory reports are potentially an important source of new information about risks undertaken by large banking organizations subject to the market risk capital standards. Our results support that conclusion. More specifically, the capital figures seem to contain information about these exposures that is not reflected in other data in the regulatory reports.

Our analysis suggests that, compared with information already available in regulatory reports, market risk capital figures are most useful for tracking changes in individual organizations' risk exposures over time. Despite a number of theoretical and practical reasons to doubt the ability of market risk capital figures to predict future market risk, the regulatory report figures do appear to contain valuable information about future risk exposures. Thus, the figures provide a forward-looking indicator of the evolution of market risk exposures over time.

Across institutions, in contrast, the capital figures appear to provide little information beyond what is already indicated by the average size of an organization's trading account. That is, we can tell a lot about the relative importance of market risk at an institution simply by knowing the size of its trading account in relation to its overall asset size.

These conclusions have to be tempered by the recognition that the required capital figures are noisy proxies for the actual

risk exposures facing these institutions. In addition, this analysis focuses primarily on the data available in regulatory reports and does not quantitatively assess the value of information available from other sources, such as SEC filings. Nonetheless, the regulatory report data provide a unique source of consistently defined market risk exposure measures for a relatively wide range of institutions. As we move forward and as more data become available, there will be additional opportunities to assess the usefulness of the market risk capital figures for understanding the risks facing large bank holding companies.

Endnotes

1. Euro-currency Standing Committee (1994, p. 1).

2. For a discussion of the goals of supervisors in calibrating the market risk capital standards, see Hendricks and Hirtle (1997).

3. Specifically, the market risk capital standards apply to all positions in the trading portfolio, as well as to all commodity and foreign exchange positions, whether held inside or outside the portfolio. Positions in the trading portfolio are not subject to the credit risk capital standards, with the exception of derivatives, which are also subject to capital requirements for counterparty credit risk exposures. See U.S. Department of the Treasury et al. (1996) for a complete discussion.

4. See Basel Committee on Banking Supervision (1996) for a full description of the international market risk capital standards. The U.S. version of these standards can be found in U.S. Department of the Treasury et al. (1996).

5. See Hendricks and Hirtle (1997) for a discussion of the rationale behind the use of value-at-risk models for regulatory capital requirements and the choice of supervisory parameters specified in the capital standards. See Jorion (2002) for a fuller description of value-at-risk models.

6. See Hendricks and Hirtle (1997) for a fuller description of these "back-testing" procedures.

7. These data are reported on Schedule HC-I of Form FR Y-9C, the quarterly balance sheet and income statement reports filed by all large bank holding companies to the Federal Reserve, and on Schedule RC-R of the Call Reports filed by commercial banks.

8. Note that it is difficult to interpret the ratio of market risk capital to total capital as a proxy for the share of a bank holding company's risk accounted for by market risk, because the minimum regulatory capital amounts are potentially very imprecise proxies for the levels of credit and market risk exposures. This is particularly apt to be true for the credit risk capital requirements, which are currently under revision largely because of their failure to be appropriately risk-sensitive.

9. For a description of losses suffered by banks at this time, see Kraus (1998).

10. For instance, of the twelve U.S.-owned BHCs that reported market risk capital figures in their June 2000 regulatory reports, eleven also reported value-at-risk figures in their quarterly SEC filings.

11. Of the eleven U.S.-owned bank holding companies that reported market risk capital figures in their 2000 quarterly SEC filings, three presented the figures as quarterly averages of daily value-at-risk estimates, five presented the figures as cumulative averages for the calendar year, and three presented the figures as twelve-month lagged averages.

12. In a recent statement, the Working Group on Public Disclosure, a group composed of senior representatives of large, internationally active banking institutions, concluded that cross-company differences in risk reporting appropriately reflect differences in the approach to risk management across institutions. See Working Group on Public Disclosure (2001).

13. We examine in the following section whether the additional "information" contains true information about risk exposures, or is simply random noise.

14. The results of this analysis are not substantially affected if the market risk capital figure is expressed as a share of total minimum regulatory capital—that is, if the market risk variable is constructed as the ratio of market risk capital to the sum of minimum regulatory capital for market plus credit risk. In addition, the results are quite similar if the regression is estimated using a log-log specification (that is, if the regression is conducted using the logs of market risk capital and trading account size).

15. To account for any time-series correlation that could cause observations across bank holding companies to be correlated, we ran two additional variations of the within-BHC regressions. The first variation included a correction for first-order serial correlation in the regression error terms. The results of these regressions were not qualitatively different from the simpler regression specification reported in Table 3. Second, we ran a specification including dummies for each calendar quarter in the sample period. The results are not affected by the inclusion of these variables; the within R^2 increases somewhat (from 4 percent to 12 percent), but none of the individual dummy coefficients is statistically significant and an F-test cannot reject the hypothesis that the coefficients on the dummies are jointly equal to zero (the p-value of the test is .402). Thus, the results reported in the text are those excluding the quarterly dummy variables.

16. These data are reported in Schedules HC-B and HC-F of the FR Y-9C Reports filed by BHCs and in Schedules RC-D and RC-L of the Call Reports filed by commercial banks. These variables were included in the regulatory reports starting in the mid-1990s to provide information about the nature of banks' trading businesses, including the extent of market risk exposure. While the breakdown of trading account positions into these categories might provide a general sense of the relative riskiness of banks' trading portfolios, the data do not include a number of key risk attributes—such as maturity, national market origin, and whether derivatives positions are long or short—that are important determinants of the actual risks arising from trading activities. Thus, there is reason to think that market risk capital figures based on banks' risk measurement models may provide additional information on the market risks facing banking institutions.

17. Since the scaling factor used to calculate regulatory capital charges is not publicly available, these regressions are based on confidential data provided by the Federal Reserve Board of Governors. The results in Table 5 are presented so that neither the identity of the BHCs in question nor the number of BHCs subject to higher scaling factors is revealed.

18. See Hendricks and Hirtle (1997) for a fuller description of the qualitative standards.

19. Technically, each institution reports a "market risk equivalent assets" figure, which equals 12.5 times the sum of the general market risk and specific risk components, each multiplied by its own scaling factor. The 12.5 conversion factor is applied to put the market risk capital figure on a comparable basis with the credit-risk-weighted assets figure that arises from the credit risk capital standards. These two figures are summed to form the denominator of the risk-based capital ratios (12.5 is the inverse of 8 percent, the minimum total capital requirement).

20. These data are collected by the Federal Reserve on a confidential basis as part of the supervisory process. The results in this article are presented in such a way as to maintain the confidentiality of the BHC-level data and the identities of the particular BHCs in the sample. I would like to thank Jim O'Brien, Jim Embersit, and Denise Dittrich of the Federal Reserve Board of Governors for making the data available. These data are an expanded version of those used in Berkowitz and O'Brien (2002).

21. With approximately sixty daily observations per quarter, the three largest losses represent the 95th percentile.

22. See, for instance, Crouhy, Galai, and Mark (2001), who suggest a version of such tail risk measures termed "extreme VAR."

23. Aside from the tail risk proxy reported in the text, we also constructed several alternatives intended to provide different estimates of the tail of the daily profit and loss distribution. Specifically, we constructed tail risk proxies based on: 1) the single largest daily loss during a quarter, 2) the single largest daily change (either profit or loss) during a quarter, and 3) the average of the three largest losses and three largest gains during the quarter. We also calculated each of the four tail risk measures and subtracted the quarterly average profit and loss (which was nearly always positive). The regression results reported in this section were not qualitatively affected by the particular choice of tail estimate or by the treatment of the average quarterly profit and loss amount.

24. This question is the focus of much of the analysis in Berkowitz and O'Brien (2002).

25. Jorion (2002) strongly argues that such a future risk specification is the key test of the information contained in value-at-risk disclosures. The regressions in that paper are all structured to test the forward-looking information content of the value-at-risk estimates disclosed in banks' annual reports.

26. We do not report across-BHC results breaking out the trading and derivatives variables into their component parts because the limited number of observations in the across-BHC specification (just one per BHC in the sample) precludes using that many independent variables.

27. As a broad control for differences across quarters during the regression sample period, the regressions were estimated using dummy variables for each calendar quarter in the sample period. These results suggest that only the dummy variable for 1998:3 was statistically significant. The hypothesis that the coefficients on the other dummy variables were jointly equal to zero could not be rejected. Thus, the results reported here include just the dummy variable for 1998:3.

28. One caveat to this conclusion is that because our analysis pools data across bank holding companies, the results reflect the average experience of the institutions in the sample. It is quite possible that for some individual firms, the correlation between market risk capital figures and actual market risk exposures is much weaker than it is for others.

References

Basel Committee on Banking Supervision. 1996. "Amendment to the Capital Accord to Incorporate Market Risks." January. Basel: Bank for International Settlements.

———. 2001. "Overview of the New Capital Basel Accord." January. Basel: Bank for International Settlements.

Berkowitz, Jeremy, and James O'Brien. 2002. "How Accurate Are Value-at-Risk Models at Commercial Banks?" Journal of Finance 57, no. 3 (June): 1093-1111.

Christoffersen, Peter F., Francis X. Diebold, and Til Schuermann. 1998. "Horizon Problems and Extreme Events in Financial Risk Management." Federal Reserve Bank of New York Economic Policy Review 4, no. 3 (October): 109-18.

Crouhy, Michel, Dan Galai, and Robert Mark. 2001. Risk Management. New York: McGraw-Hill.

Euro-currency Standing Committee. 1994. "A Discussion Paper on Public Disclosure of Market and Credit Risks by Financial Intermediaries." September. Basel: Bank for International Settlements.

Hendricks, Darryll, and Beverly Hirtle. 1997. "Bank Capital Requirements for Market Risk: The Internal Models Approach." Federal Reserve Bank of New York Economic Policy Review 3, no. 4 (December): 1-12.

Hirtle, Beverly J. 1998. Commentary on "Methods for Evaluating Value-at-Risk Estimates," by Jose A. Lopez. Federal Reserve Bank of New York Economic Policy Review 4, no. 3 (October): 125-8.

Jones, David, and John Mingo. 1998. "Industry Practices in Credit Risk Modeling and Internal Capital Allocations: Implications for a Models-Based Regulatory Capital Standard." Federal Reserve Bank of New York Economic Policy Review 4, no. 3 (October): 53-60.

Jorion, Phillipe. 2001. Value at Risk: The New Benchmark for Controlling Market Risk. Chicago: Irwin.

———. 2002. "How Informative Are Value-at-Risk Disclosures?" Accounting Review 77, October: 192.

Kraus, James R. 1998. "Russia's Crisis Has More Room on the Downside, Bankers Say." American Banker, October 8, p. 21.

U.S. Department of the Treasury (Office of the Comptroller of the Currency), Board of Governors of the Federal Reserve System, and Federal Deposit Insurance Corporation. 1996. "Risk-Based Capital Standards: Market Risk." Federal Register 61, no. 174: 47357-78.

Working Group on Public Disclosure. 2001. "Letter to the Honorable Laurence H. Meyer." January 11.