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Public Disclosure and Risk-adjusted Performance at Bank Holding Companies

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Abstract

This article examines the relationship between the amount of information disclosed by bank holding companies (BHCs) and the BHCs' subsequent risk-adjusted performance. The key finding is that more disclosure is associated with higher risk-adjusted returns. This result is strongest for BHCs where trading represents a large share of overall firm activity. More disclosure does not appear to be associated with higher risk-adjusted performance during the financial crisis, however, implying that the findings are a "business as usual" phenomenon. These findings suggest that greater disclosure is associated with more efficient risk taking and thus improved risk-return trade-offs, a channel for market discipline that has not been emphasized previously in the literature.

1 This article is republished with the permission of the Economic Policy Review and the Federal Reserve Bank of New York. Full reference of the original article is: Hirtle, B., 2016, "Public disclosure and risk-adjusted performance at bank holding companies," Federal Reserve Bank of New York Economic Policy Review 22:1, https://www.newyorkfed.org/research/epr/2016/epr_2016_public-disclosures_hirtle The author thanks Sarita Subramanian, Matthew Botsch, Ging Cee Ng, Peter Hull, Vitaly Bord, Eric McKay, and Bryan Yang for excellent research assistance in constructing the dataset used in this article and Robert DeYoung, Mark Flannery, Donald Morgan, Christophe Pérignon, Philip Strahan, and Til Schuermann for helpful comments and suggestions. The views expressed in this article are those of the author and do not necessarily reflect the views of the Federal Reserve Bank of New York or the Federal Reserve System.

INTRODUCTION

Market discipline has occupied an increasingly prominent position in discussions of the banking industry in recent years. Market discipline is the idea that the actions of shareholders, creditors, and counterparties of banking companies can influence the investment, operational, and risk-taking decisions of bank managers [Flannery (2001); Bliss and Flannery (2002)]. Bank supervisors have embraced market discipline as a complement to supervisory and regulatory tools for monitoring risk at individual banks and for limiting systemic risk in the banking system. For instance, the Basel Committee on Banking Supervision says "the provision of meaningful information about common risk metrics to market participants is a fundamental tenet of a sound banking system. It reduces information asymmetry and helps promote comparability of banks' risk profiles" [Basel Committee on Banking Supervision (2015)].[2]

For market discipline to be effective, market participants must have sufficient information to assess the current condition and future prospects of banking companies. This fact has prompted a range of proposals for enhanced public disclosure by banks. Many of these proposals have focused on disclosure of forward-looking risk information, such as value at risk (VaR) for trading portfolios or model-based estimates of credit risk exposure. In the words of a major international supervisory group, disclosure of VaR and other forward-looking risk measures is a means of providing "a more meaningful picture of the extent and nature of the financial risks a firm incurs, and of the efficacy of the firm's risk management practices" [Multidisciplinary Working Group on Enhanced Disclosure (2001)].

But to what extent does such information result in meaningful market discipline? Is risk taking or performance affected by the amount of information banks provide about their risk exposures and risk management systems? This article explores these questions by examining whether the amount of information disclosed by a sample of large U.S. bank holding companies (BHCs) affects the future risk-adjusted performance of those banking firms. We focus, in particular, on disclosures made in the banks' annual reports about market risk in their trading activities. Following previous work on disclosure [Baumann and Nier (2004); Nier and Baumann (2006); Pérignon and Smith (2010); Zer (2013)], we construct a market risk disclosure index and ask how differences in this index affect future performance. Drawing on data from the banking companies' regulatory reports, we examine each BHC's returns from trading activities and, using equity market data, we examine returns for the firm as a whole.

The main finding of this analysis is that the disclosure of more information is associated with higher risk-adjusted trading returns and higher risk-adjusted market returns for the bank overall. This result is strongest for BHCs whose trading represents a large share of overall firm activity. The results are both statistically significant and economically meaningful, with a one standard deviation increase in the disclosure index leading to a 0.35 to 0.60 standard deviation increase in risk-adjusted returns. The positive relationship between disclosure and risk-adjusted performance is much less evident during the financial crisis period, however, suggesting that the findings reflect business-as-usual behavior. Finally, while higher values of the disclosure index are associated with better future performance, being a leader or innovator in disclosure practices seems to be associated with lower risk-adjusted market returns. This finding suggests that there may be a learning process in the market such that disclosure "first movers" – those banks that provide new types of information – face a market penalty.

Overall, the results suggest that increased disclosure may be associated with more efficient trading and an enhanced overall risk-return trade-off. These findings seem consistent with the view that market discipline affects not just the amount of risk a BHC takes, but how efficiently it takes that risk. This interpretation highlights the importance of examining returns, as well as risk, when assessing the effectiveness of market discipline.

An important question in interpreting these results is whether greater disclosure leads to enhanced market discipline and thus better performance, or whether some other channel is at work. Specifically, banks with better risk management systems may be able to trade more efficiently and, in a more general sense, be able to achieve a better risk-return trade-off. The same risk management systems that produce better risk-adjusted performance may also generate the information needed to make more detailed risk disclosures, which may be used by the bank as a public signal of its superior risk management abilities. Fang (2012) finds a correlation between VaR disclosures and measures of effective corporate governance, consistent with this channel. While this conclusion may not be the traditional view of market discipline, it is in keeping with the idea that the role of public information is to provide incentives for managers to optimize overall performance. This interpretation suggests that there are many potential channels for the exercise of market discipline on firms.

2 The Basel II/III regulatory capital regime incorporates market discipline as the "third pillar," along with minimum capital standards and supervisory oversight [Basel Committee on Banking Supervision (2004)].

The remainder of this article is organized as follows. Section 2 reviews previous work on the impact of disclosure in the banking industry and discusses how this article fits into that literature. Section 3 describes the empirical approach and data used in this analysis, with particular emphasis on the market risk disclosure index. The results are presented in Section 4, while the final section contains a summary and conclusions.

DISCLOSURE AND BANK PERFORMANCE

A number of previous papers have examined the impact of disclosure in the banking industry. The key idea is that disclosure of information about banks' current condition and future prospects will facilitate market discipline of risk-taking behavior. As argued in Flannery (2001) and Bliss and Flannery (2002), market discipline requires that investors and creditors have the ability to monitor and assess changes in bank condition and to influence management behavior. Both components are affected by the amount and quality of information disclosed. In theory, greater disclosure provides investors and creditors with more information on which to base their assessments of firm condition, which in turn makes a significant market reaction to an adverse change in condition – and subsequent management response – more likely and immediate.

The influence of market discipline on bank behavior may occur not only through a bank's response to a market reaction but also its anticipation of one. That is, market discipline may also work by affecting management behavior ex-ante so as to prevent a negative outcome and consequent market reaction. In this sense, greater disclosure can serve as a kind of commitment device by providing sufficient information to the market about a bank's condition and future prospects that the bank is constrained from altering its risk profile in a way that disadvantages either investors or creditors [Cumming and Hirtle (2001)]. Banks' ability to shift assets and risk positions quickly has been cited as one of the key sources of opaqueness in the banking industry [Meyers and Rajan (1998)]. In fact, several studies have found evidence of greater opaqueness at banks with higher shares of liquid assets, including, especially, trading positions [Morgan (2002); Iannotta (2006); Hirtle (2006)].[3] In a related vein, Bushman and Williams (2012) find that loan loss provisioning practices intended to smooth earnings inhibit risk-taking discipline by making banks more opaque to outsiders.

Underlying much of this discussion is the idea that greater disclosure and enhanced market discipline will lead to reductions in bank risk. Enhanced market discipline would mean that the costs of increased risk would be more fully borne by the bank and would, therefore, presumably play a larger role in its risk-taking decisions. More risk-sensitive market prices could also provide signals to regulators that might induce or influence supervisory action [Flannery (2001)]. While greater disclosure is likely to lead to a reduction in bank risk, it might also have some offsetting negative outcomes. More information reduces the likelihood that the bank would face an excessive (undeserved) risk premium or that market prices would overreact to news about the firm because of uncertainty about its true condition and prospects – an effect that could lower the bank's funding costs and increase the range of viable (positive net present value) investments, some of which could be riskier than its current portfolio. The net impact of all of these influences is an empirical question.

Most of the previous empirical work on market discipline has focused on how disclosure affects bank risk taking. For instance, several papers examine market price reaction to changes in bank condition or to differences in risk profiles across banks. Some of these papers have found that bond spreads increase with bank risk exposure, especially following the early 1990s reforms associated with the Federal Deposit Insurance Corporation Improvement Act. Morgan and Stiroh (2001) find that banks with riskier assets (such as trading assets) pay higher credit spreads on newly issued bonds. Similarly, Covitz et al. (2004a, b) and Jagtiani et al. (2002) find evidence that subordinated debt spreads increase with banking company risk. In related work, Goyal (2005) finds that riskier banks are more likely to have restrictive debt covenants in their publicly issued debt. However, more recent work [Balasubramnian and Cyree (2011); Acharya et al. (2014); Santos (2014)] suggests that the bonds of the largest banking companies are less sensitive to risk than bonds issued by smaller BHCs, presumably because the larger firms are regarded by market participants as "too big to fail." These papers call into question the efficacy of market discipline, at least for the very largest and most complex BHCs.

3 In contrast, Flannery et al. (2004) find no evidence that bank assets are more opaque than the assets of nonfinancial firms.

Performance variables	Mean	Median	Standard deviation	Minimum	Maximum
Risk-adjusted trading return	3.063	2.330	3.033	-5.428	21.501
Risk-adjusted market return	0.083	0.082	0.138	-0.333	0.0371
Alpha	0.046	0.025	0.483	-1.992	4.034
Disclosure variables					
Disclosure leader	0.072	0	0.260	0	1
Aggregate disclosure index	5.769	5	4.653	0	15
First principal component	0.014	-0.650	2.660	-3.018	5.692
BHC characteristics					
Asset size	415.2	169.7	573.3	25.1	2457.9
Risk-weighted assets divided by total assets	0.758	0.795	0.174	0.309	1.144
Common equity divided by total assets	8.271	8.248	1.950	3.235	15.696
Trading assets divided by total assets	0.073	0.029	0.103	0.001	0.490
Non-interest income divided by operating income	0.524	0.466	0.160	0.018	0.996
Revenue source concentration	0.406	0.404	0.063	0.249	0.654

Sources: Federal Reserve Board, Consolidated Financial Statements of Bank Holding Companies (FR Y-9C data); Center for Research in Security Prices (CRSP); Securities and Exchange Commission EDGAR database; company websites.

Notes: The sample consists of 293 annual observations for a sample of thirty-six BHCs with trading assets exceeding U.S.$1 billion (in 2013 dollars) at some point between 1994 and 2012. BHC characteristics and trading revenue data are from the Federal Reserve Y-9C reports. Disclosure data are from the BHCs' annual reports. Market price data are from CRSP. Risk-adjusted trading return is annual trading revenue divided by the annual standard deviation of quarterly trading revenue. Risk-adjusted market returns is the annual average of weekly equity price returns divided by the standard deviation of weekly returns. Alpha is the intercept term from a three-factor market return model using Fama-French factors. Trading return is annual trading revenue divided by trading assets. Market return is the annual average of weekly equity price returns. Disclosure leader is a dummy variable that indicates whether a BHC is the only one to report a given disclosure item in a given year. Aggregate disclosure index is the value of the market risk disclosure index. First principal component is the first principal component of the eighteen individual data items that comprise the aggregate index.

Table 1 – Basic statistics of the regression sample

In a somewhat different vein, several papers have examined the impact of disclosure on risk taking using equity trading characteristics – such as bid-ask spreads or price volatility – as proxies for risk.[4] Many of these studies focus on nonfinancial firms [for example, Bushee and Noe (2000); Luez and Verrecchia (2000); Linsmeier et al. (2002)], but some examine the link between disclosure and market volatility in the banking industry. Baumann and Nier (2004) and Nier and Baumann (2006) construct a disclosure index based on the number of balance sheet and income statement items reported by a cross-country sample of banks. They find that stock price volatility decreases and capital buffers increase as the amount of information disclosed increases, consistent with the idea that greater disclosure enhances market discipline. Zer (2013) constructs a disclosure index using balance sheet information from BHC 10-K filings submitted to the U.S. Securities and Exchange Commission and shows that BHCs with higher values of the index have lower option-implied default probabilities and stock price volatility.

Fewer papers have examined the relationship between disclosure and performance – that is, whether banking companies that disclose more information have better subsequent operating or stock market performance. Several papers have examined this relationship for nonfinancial firms. Eugster and Wagner (2011) construct an index of voluntary disclosure by Swiss companies and demonstrate that firms with higher voluntary disclosure have higher abnormal stock returns, though this effect is evident predominantly for more opaque companies. Barth et al. (2013) find that firms with more transparent earnings have a lower cost of capital.

In the banking industry, Ellul and Yerramilli (2013) find that

4 Using a very different approach, Kwan (2004) examines the impact of market discipline on bank risk taking by comparing the risk profiles of publicly traded and non-publicly traded BHCs. He finds that publicly traded banks take more risk than non-publicly traded institutions, which he interprets as being contrary to market discipline.

banks with stronger risk management have higher operating profits (return on assets) and stock return performance. While that paper focuses on risk management rather than disclosure per se, it measures risk management strength based on an index constructed from 10-K filings – an approach similar to the one used in this article and others focusing on disclosure. Ellul and Yerramilli is also relevant because risk management and disclosure are linked, in that enhanced risk management systems generate the kind of forward-looking risk information disclosed by some BHCs. Consistent with this idea, Fang (2012) finds a positive correlation between the amount of information BHCs disclose about VaR and measures of effective corporate governance. Fang also finds that more disclosure is correlated with a lower cost of capital, when cost of capital is measured using equity analyst forecasts.

The analysis in this article is complementary to previous work on disclosure in that it examines the impact of enhanced disclosure on both operating and stock market performance for large U.S. bank holding companies. In particular, it investigates whether enhanced disclosure is associated with higher subsequent risk-adjusted performance. The analysis thus assesses whether disclosure affects the efficiency of risk taking, rather than whether enhanced disclosure is associated with higher or lower risk per se. As noted above, the theoretical relationship between disclosure and risk taking is not straightforward and there likely is considerable endogeneity between disclosure and subsequent risk.[5] While the extent of both risk taking and disclosure are decisions made by each banking company, risk-adjusted performance is an outcome that is less directly under a firm's control. By examining performance, we gain an additional window into the ways that market discipline may play out at banking companies, because investors and creditors presumably care not only about the level of risk but also about how efficiently a bank translates its risk exposures into profits and returns.

Like much of the prior work, the analysis in this article is based on a disclosure index constructed from information reported by these banks in their annual reports or 10-K filings with the SEC. However, rather than constructing a disclosure index based primarily on balance sheet and income statement variables – which tend to be backward-looking – the disclosures we track are forward-looking risk estimates made by the banking companies.[6] The index focuses specifically on disclosures concerning the market risk in banks' trading and market-making activities.

We focus on market risk in trading activities because trading is a well-defined banking business activity with distinct regulatory and financial statement reporting. BHC annual reports have specific sections for reporting about market risk, and regulatory reports contain trading return information that can be linked directly to these activities. Thus, we can examine the impact of disclosure on overall firm performance and on the specific activities that are the focus of the disclosures. Previous work has also found that trading activities are associated with greater opaqueness and risk, so this is an area of banking for which disclosure might be particularly influential.

DATA AND EMPIRICAL APPROACH

Because we are interested in determining the impact of disclosure on BHC risk and performance specifically as it relates to market risk in trading activities, we begin by constructing a sample of U.S.-owned BHCs that appear to be active traders. We limit the sample to BHCs with significant trading activities because those are the firms that are most likely to make disclosures related to market risk in their annual reports. BHCs that are relatively active traders are also more likely to be engaged in purposeful risk management of their trading positions than they are to be using the trading account simply to book a limited number of mark-to-market positions.

To identify those BHCs with significant trading account assets, we use information from the Consolidated Financial Statements for Bank Holding Companies, the FR Y-9C quarterly reports filed by BHCs with the Board of Governors of the Federal Reserve System.[7] Overall, relatively few BHCs report holding any assets in the trading account: at year-end 2013, only 164 (of more than 1,000) large BHCs reported holding any trading account assets, and only 18 of these held trading assets exceeding U.S.$1 billion. Our sample consists of all U.S.-owned BHCs with year-end trading account assets exceeding U.S.$1 billion (in 2013 dollars) at some point between 1994 and 2012.[8] We include a BHC in the sample starting with the first year in

5 Ellul and Yerramilli (2013) and Zer (2013) use instrumental variable techniques to address this endogeneity.

6 As explained in Section 3, the index is similar to the one constructed in Pérignon and Smith (2010).

7 The FR Y-9C reports are available at https://www.chicagofed.org/applications/bhc/bhc-home.

8 We exclude foreign-owned BHCs because the U.S. activities of these institutions represent only a part of the banks' overall activities and because many of them do not submit 10-K filings with the SEC, which we need to construct the market risk disclosure index. In addition, two U.S. BHCs whose activities are primarily nonbanking in nature – MetLife and Charles Schwab – are omitted from the sample.

which its constant-dollar trading assets exceed U.S.$500 million. The resulting sample consists of 293 observations from 36 BHCs over the years 1994 to 2012.[9]

The estimates consist of a series of regressions of risk-adjusted performance measures in year t + 1 on BHC characteristics and disclosure during year t:

$$Y_{i,t} + 1 = \beta_1 \text{ Disclosure}_{i,t} + x_{i,t}\Gamma + \varepsilon_{i,t+1},$$

where $Y_{i,t+1}$ is the risk-adjusted performance measure (discussed below), $\text{Disclosure}_{i,t}$ is the index of market risk disclosure, and $X_{i,t}$ is a vector of BHC control variables. Both the disclosure index and the control variables are lagged one year to avoid endogeneity with the performance measures. Thus, disclosure data and control variables from 1994 to 2012 are paired with performance data from 1995 to 2013.

The control variables include measures of institution size (the log of assets), risk profile (the ratio of risk-weighted assets to total assets and the ratio of common equity to total assets), revenue composition (non-interest income as a share of operating income), and revenue concentration (Herfindahl-Hirschman Indexes based on sources of revenue).[10] The regressions also include the ratio of trading assets to total assets as a measure of the extent of the institution's trading activities. All BHC data are from the Y-9C reports. The regressions also include BHC fixed effects and year dummies. Table 1 reports the basic statistics of the regression data set.

The key variables in the estimates are the measures of risk-adjusted performance and the market risk disclosure index. The risk-adjusted performance measures are based on two distinct sets of information. The first is derived from accounting data on BHCs' trading activities. Specifically, BHC regulatory reports contain information on quarterly trading revenues: the gains and losses on the firms' trading activities, including commission, fee, and spread income. We collect trading performance data from the first quarter of 1995 to the fourth quarter of 2013. Using these data, we calculate quarterly trading returns as trading revenues in a quarter as a percentage of beginning-of-quarter trading assets. Trading volatility is then calculated as the standard deviation of quarterly trading returns within a year, and trading returns are calculated as the annual average of quarterly trading returns. Finally, we compute risk-adjusted trading returns as trading returns divided by trading volatility (essentially, the trading revenue "Sharpe ratio"). Since this measure reflects risk and return on the BHCs' trading activities, it is tied directly to the disclosure information covered in the market risk disclosure index.

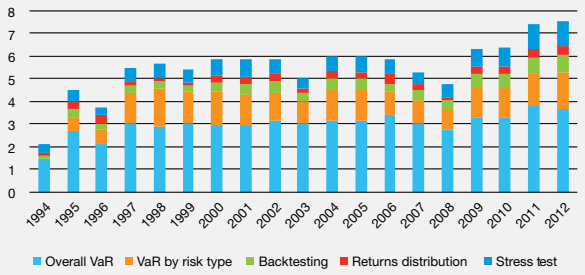
Category	Data items
Overall value at risk (VaR)	Holding period and confidence interval
	Annual average VaR
	Year-end VaR
	Minimum VaR over the year
	Maximum VaR over the year
	VaR limit (dollar amount)
	Histogram of daily VaR
VaR by risk type	Annual average VaR by risk type
	Year-end VaR by risk type
	Minimum VaR by risk type
	Maximum VaR by risk type
Backtesting	Chart of daily trading profit and loss versus daily VaR
	Number of days that losses exceeded VaR
Returns distribution	Histogram of daily trading profit and loss
	Largest daily loss
Stress-testing	Mention that stress-tests are done
	Describe the stress-tests qualitatively
	Report stress-test results

Table 2 – The market risk disclosure index

The second set of measures is derived from firm-wide equity prices. Specifically, we use stock return data from the University of Chicago's Center for Research in Security Prices (CRSP) for the BHCs in our sample. For each year between 1995 and 2013, we cumulate daily returns from CRSP to form weekly returns, and then calculate annual average weekly returns, expressed at an annual rate. We also calculate the standard deviation of weekly returns within each year, and generate risk-adjusted market returns as the ratio of average returns to the standard deviation of returns. As a second measure of risk-adjusted market performance, we include in the dataset the "alpha" (intercept term) from the three-factor Fama-French model, where the model is estimated annually for each BHC using weekly return data and risk factors.

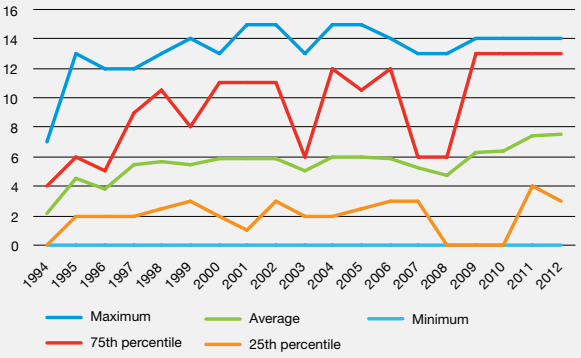
9 The sample is an unbalanced panel, owing mainly to the impact of mergers. During the sample period, several of the BHCs were acquired, generally by other BHCs in the sample. In addition, some BHCs in the sample acquired large BHCs that were not part of the sample. In estimates, we treat the pre- and post-merger acquiring BHCs as separate entities. Observations for the year in which a given merger was completed are omitted. Finally, some BHCs enter the sample midway through the sample period because their trading assets crossed the U.S. $500 million threshold or because they converted to BHCs during the 2007-09 financial crisis.

10 The revenue concentration index is based on the shares of net interest income, fiduciary income, deposit service charges, trading revenue, and other non-interest income in overall operating income. Stiroh (2006) shows that revenue concentration is a significant determinant of BHC equity price volatility.



Sources: Securities and Exchange Commission EDGAR database; company websites.
Note: The figure shows the average number of market risk data items reported by bank holding companies with real trading assets exceeding U.S.$1 billion between 1994 and 2012.

Figure 1 – Average market risk disclosure index, 1994-2012



Sources: Securities and Exchange Commission EDGAR database; company websites.
Note: The figure shows the distribution of values of the market risk disclosure index for bank holding companies with real trading assets exceeding U.S.$1 billion between 1994 and 2012.

Figure 2 – Distribution of market risk disclosure index, 1994-2012

Basic statistics for all of the risk and performance measures are reported in Table 1.

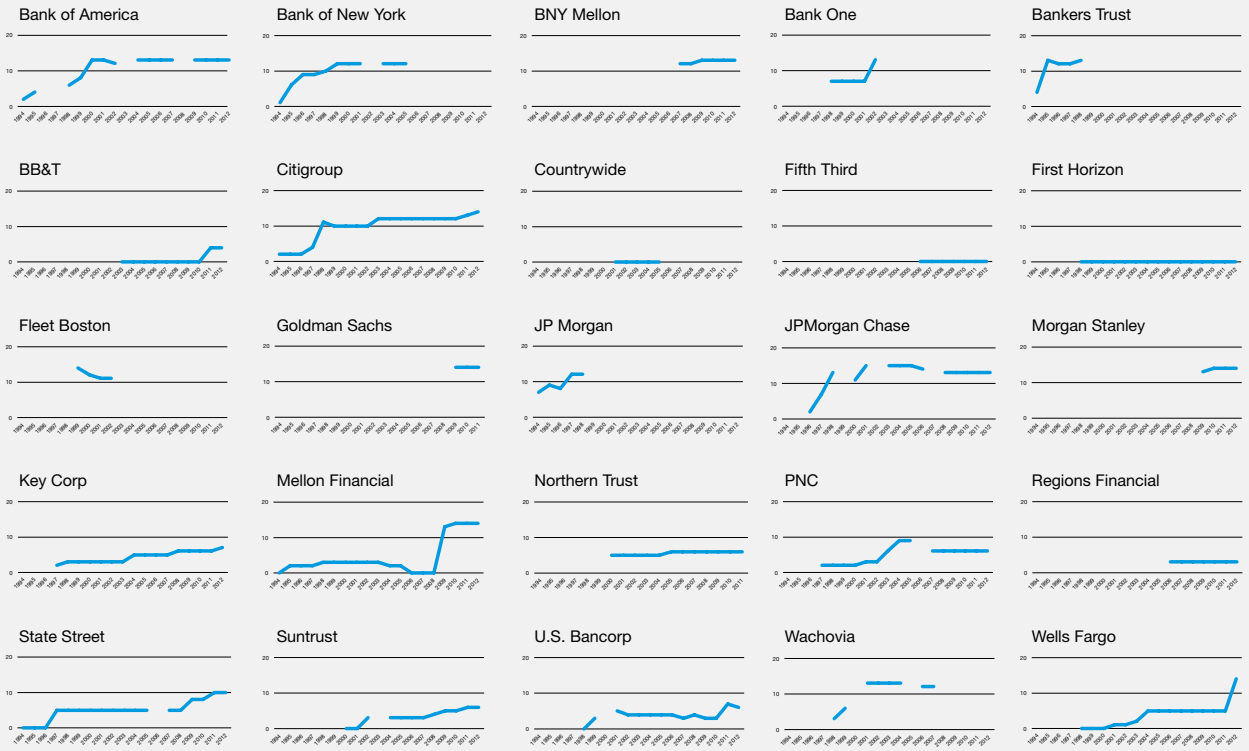
The market risk disclosure index is the other key variable in the analysis. As explained above, this index captures the amount of information that banks disclose about their forward-looking estimates of market risk exposure in their annual reports or 10-K filings with the SEC.[11] The index covers eighteen specific types of information that BHCs could provide in their filings, primarily related to their value-at-risk (VaR) estimates.

VaR is a very commonly used measure of market risk exposure from trading activities. VaR is an estimate of a particular percentile of the trading return distribution, assuming that trading positions are fixed for a specified holding period. VaR estimates made by banks in the sample are typically based on a one-day holding period, generally at the 95th percentile and above.[12] VaR estimates form the basis of banks' regulatory capital requirements for market risk [Hendricks and Hirtle (1997)] and have been the focus of disclosure recommendations made by financial industry supervisors [Multidisciplinary Working Group on Enhanced Disclosure (2001); Basel Committee on Banking Supervision (2015)].

The eighteen items covered in the market risk disclosure index include information about a BHC's VaR estimates for its entire trading portfolio ("overall VaR"), VaR by risk type (for example, risk from interest rate or equity price movements), the historical relationship between VaR estimates and subsequent trading returns ("backtesting"), the distribution of actual trading outcomes ("returns distribution"), and stress-testing. The specific items included in the index are listed in Table 2. These items were selected based on a review of a sample of BHC disclosures to determine which items were disclosed with enough frequency to be meaningfully included in the index, and also by benchmarking the individual items and the five broader categories against those listed in a rating agency evaluation of banks' disclosure practices [Moody's Investors Service (2006)].

The market risk disclosure index measures the amount of information that BHCs disclose about their market risk exposures, not the content of that information. It is a count of the number of data items disclosed, not an indicator of the amount or nature of market risk exposure undertaken by the BHC. In that sense, it is similar to the disclosure indexes constructed by Nier and Baumann (2006) and Zer (2013), though it is based on different types of data. It is also quite similar to a VaR disclosure index developed independently by Pérignon and Smith (2010).[13] The Pérignon and Smith (2010) index covers much of the same information as the index in this article, though the

11 We used the SEC's EDGAR database to access the 10-K filings. The EDGAR database is available at: http://www.sec.gov/edgar.shtml.
12 See Jorion (2006) for an extensive discussion of VaR modeling, and Moody's Investors Services (2006) for a description of typical VaR parameter choices at banks and securities firms.
13 Fang (2012) uses a disclosure index similar to the one used in this article, in Hirtle (2007), and in Pérignon and Smith (2010).



Sources: Securities and Exchange Commission; EDGAR database; company websites.
Notes: The figure includes BHCs with trading assets greater than U.S.$1 billion for at least four years between 1994 and 2012. The data reflect the BHCs' corporate identities in 2012 or the last year in which they are in the sample, with no adjustments for mergers.

Figure 3 – Disclosure index for large BHCs

authors use their index primarily to make cross-country comparisons of disclosure practices rather than to examine the link between the index and future risk and performance.[14]

Figure 1 shows the average value of the market risk disclosure index between 1994 and 2012. The average value of the index increases from just over 2 in 1994 to nearly 8 in 2012. Most of this increase occurs during the early part of the sample, between 1994 and 1998.

The growth through 1998 reflects two significant regulatory developments. First, following the international agreement in Basel, U.S. risk-based capital guidelines were amended in 1998 to incorporate minimum regulatory capital requirements for market risk in trading activities, with the requirements taking full effect in January of that year [Hendricks and Hirtle (1997)]. The market risk capital charge introduced through this amendment is based on the output of banks' internal VaR models, and the need to comply with the new capital requirements spurred the development of VaR models in the banking industry. On a separate track, SEC Financial Reporting Release (FRR) 48 required all public firms with material market risk exposure to make enhanced quantitative and qualitative disclosures about these risks, starting in 1997 [U.S. Securities and Exchange Commission (1997)]. FRR 48 included three options for forward-looking, quantitative market risk disclosures, one of which was VaR.[15] Together, these two regulatory developments spurred disclosure of VaR estimates and related information.

14 Pérignon and Smith (2010) examine the link between VaR estimates and subsequent trading volatility, a question that is related to, but distinct from, the one we address. They find that VaR estimates contain little information about future trading volatility. This finding is similar to that in Berkowitz and O'Brien (2002) but stands in contrast to the results in Jorion (2002), Hirtle (2003), and Liu et al. (2004), all of which find that VaR measures contain information about future trading income volatility.

15 The Pérignon and Smith (2006) index also grows through 1998, and the authors cite the influence of FRR 48 in this finding for the U.S. banks in their sample. See Roulstone (1999) for an assessment of the impact of FRR 48 on nonfinancial firms.

	Market risk disclosure index	Average real assets	Average real trading assets	Average trading assets divided by total assets
Market risk disclosure index	1.000			
Average real assets	0.627 (0.000)	1.000		
Average real trading assets	0.653 (0.000)	0.881 (0.000)	1.000	
Average trading assets divided by total assets	0.605 (0.000)	0.464 (0.000)	0.705 (0.000)	1.000

Sources: Federal Reserve Board, Consolidated Financial Statements of Bank Holding Companies (FR Y-9C data); Securities and Exchange Commission EDGAR database; company websites.

Notes: Figures in the table reflect average values for the thirty-six BHCs that have trading assets of more than U.S.$1 billion at some point between 1994 and 2012. Total assets and trading assets are in 2013 dollars and are averaged across the years that a BHC is in the sample. P-values are shown in parentheses.

Table 3 – Correlation between market risk disclosure index and BHC asset size and trading activity

Data Item	Share of observations		
Overall value at risk	**All observations**	**1994**	**2012**
Holding period and confidence interval	0.749	0.538	0.737
Annual average VaR	0.624	0.308	0.789
Year-end VaR	0.475	0.154	0.474
Minimum VaR over the year	0.488	0.154	0.737
Maximum VaR over the year	0.536	0.231	0.789
VaR limit (dollar amount)	0.115	0.000	0.053
Histogram of daily VaR	0.058	0.076	0.105
VaR by risk type			
Annual average VaR by risk type	0.342	0.000	0.421
Year-end VaR by risk type	0.217	0.000	0.316
Minimum VaR by risk type	0.315	0.000	0.421
Maximum VaR by risk type	0.319	0.000	0.421
Backtesting			
Chart of daily profit and loss versus daily VaR	0.112	0.077	0.211
Number of days losses exceeded VaR	0.349	0.077	0.579
Returns distribution			
Histogram of daily profit and loss	0.220	0.154	0.368
Largest daily loss	0.075	0.000	0.053
Stress-testing			
Mention that stress-tests are done	0.420	0.308	0.579
Describe stress-tests	0.231	0.077	0.473
Report stress-test results	0.017	0.000	0.000

Sources: Securities and Exchange Commission EDGAR database; company websites.

Notes: Figures are from1994 to 2012 10-K reports of the thirty-six bank holding companies in the market risk sample. These companies each have trading assets exceeding U.S.$1 billion (in 2013 dollars) at some point between 1994 and 2012.

Table 4 – Frequency of individual data items in the market risk disclosure index

Figure 1 shows the average value of the market risk disclosure index, but the average masks considerable diversity across BHCs in the sample. Figure 2 illustrates the range of disclosure index values by year. Specifically, the figure shows the minimum and maximum values of the index by year and the 25th and 75th percentiles, along with the averages reported in Figure 1. The maximum value of the index grows from 7 in 1994 to 15 in the mid-2000s, falls back to 13, and then settles at 14 near the end of the sample period. At least one BHC in each year reported no market risk information (in other words, generated an index value of zero). As the average value of the disclosure index increases, the dispersion within the sample BHCs grows. The interquartile range (25th to 75th percentile) more than doubles over the sample period, owing mainly to growing differentiation in the top half of the distribution after 1998. Over the full period, the distance between "top reporting" BHCs and those nearer to the average widened considerably.

Figure 3 shows the market risk disclosure index at the individual BHC level. The BHCs shown in the figure are those that are in the sample for at least four years, traced backward from the BHCs' corporate identity at the end of the sample period without adjusting for mergers. Not surprisingly given the average results, the index tends to increase over the sample period at the individual BHC level. The typical pattern is for the index to rise in steps over time, though there are certainly cases in which the index declines.

Disclosure Variables	Risk-adjusted market return		Alpha		Risk-adjusted trading return	
Disclosure leader	-0.058[b]	-0.057[c]	-0.193[c]	-0.189	1.997[c]	2.050[b]
	(0.029)	(0.029)	(0.111)	(0.114)	(1.000)	(0.972)
Aggregate disclosure index	0.010[a]		0.044[a]		0.332[b]	
	(0.002)		(0.013)		(0.154)	
First principal component		0.018[a]		0.077[a]		0.687[b]
		(0.004)		(0.023)		(0.307)
BHC characteristics						
Log (asset size)	-0.061[a]	-0.064[a]	-0.404[a]	-0.412[a]	0.001	-0.165
	(0.018)	(0.019)	(0.111)	(0.116)	(0.964)	(0.926)
Risk-weighted assets divided by total assets	-0.085	-0.072	-0.073	-0.014	7.322[c]	7.790[b]
	(0.098)	(0.098)	(0.716)	(0.715)	(3.789)	(3.776)
Common equity divided by total assets	-0.011[b]	-0.011[b]	-0.089[a]	-0.090[a]	0.106	0.103
	(0.005)	(0.005)	(0.033)	(0.033)	(0.198)	(0.194)
Trading assets divided by total assets	-0.646[b]	-0.652[b]	-2.060[c]	-2.084[c]	17.346	17.102
	(0.243)	(0.245)	(1.174)	(1.175)	(11.585)	(11.553)
Non-interest income divided by operating income	-0.060	-0.060	0.168	0.168	5.807[b]	5.771[b]
	(0.093)	(0.093)	(0.762)	(0.763)	(2.302)	(2.303)
Revenue source concentration	0.089	0.084	0.141	0.113	14.656[b]	14.733[b]
	(0.146)	(0.145)	(0.941)	(0.937)	(6.343)	(6.491)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	293	293	293	293	295	295
R-squared	0.781	0.781	0.314	0.313	0.177	0.186
P-Value: Disclosure Variables = 0?	0.000	0.000	0.000	0.000	0.021	0.017

Sources: Federal Reserve Board, Consolidated Financial Statements of Bank Holding Companies (FR Y-9C data); Center for Research in Security Prices (CRSP); Securities and Exchange Commission EDGAR database; company websites.

Notes: Risk-adjusted market return is the annual average of weekly equity price returns divided by the standard deviation of those returns. Alpha is the intercept term from a three-factor market return model using Fama-French factors. Risk-adjusted trading return is annual trading revenue divided by the annual standard deviation of quarterly trading revenue. BHC characteristics are from the Federal Reserve Y-9C reports. Disclosure information is from the BHCs' annual reports. Stock data are from CRSP. Disclosure leader is a dummy variable indicating that a BHC is the only BHC to disclose a particular data item in a given year. Aggregate disclosure index is the market risk disclosure index. First principal component is based on the eighteen individual data items that comprise the aggregate index. The sample consists of all U.S.-owned BHCs that have trading assets greater than U.S.$1 billion (in 2013 dollars) at any time between 1994 and 2012, starting with the year that trading assets exceed U.S.$500 million. The regressions include BHC fixed effects and year dummy variables. Residuals are clustered at the BHC level.

a Significant at the 1% level, b significant at the 5% level, c significant at the 10% level.

Table 5 – Disclosure and risk-adjusted returns

On a cross-sectional basis, the index tends to be higher at larger BHCs and at BHCs with more trading activity, on both an absolute and relative level. Table 3 reports the correlation between the value of the market risk disclosure index and real (2013 dollar) assets, trading assets, and trading asset share, where values are averaged across the years that a BHC is in the sample. Reading down the first column of the table, the correlation coefficients between the disclosure index and the measures of BHC and trading activity scale are large and positive.

Finally, Table 4 reports the frequency with which the individual data items in the market risk disclosure index are reported. The first column reports the frequency across all observations between 1994 and 2012, while the next two columns report the frequency at the beginning and end of the sample period. The most commonly reported data element is the holding period and confidence interval of the VaR estimate, reported for about 75% of the BHC-year observations. This data item is a close proxy for whether a BHC disclosed any information about VaR at all. About 30% of the observations include some information about VaR by risk type, while information about back-testing and the distribution of returns is reported in 10 to 35% of the observations. About 40% of the observations indicate that the BHC does some kind of stress-testing, but

Disclosure variables	Risk-adjusted market return		Alpha		Risk-adjusted trading return	
Disclosure leader	-0.049	-0.047	-0.199	-0.192	1.741	1.823
	(0.033)	(0.033)	(0.125)	(0.128)	(1.190)	(1.163)
Aggregate disclosure index	0.010[a]		0.040[a]		0.302[c]	
	(0.003)		(0.014)		(0.155)	
First principal component		0.018[a]		0.070[a]		0.635[b]
		(0.005)		(0.026)		(0.308)
BHC characteristics						
Log (asset size)	-0.058[b]	-0.060[c]	-0.330[b]	-0.337[b]	-0.590	-0.737
	(0.029)	(0.030)	(0.156)	(0.164)	(1.382)	(1.341)
Risk-weighted assets divided by total assets	-0.022	-0.009	-0.174	-0.123	7.500[b]	7.852[b]
	(0.116)	(0.115)	(0.638)	(0.636)	(3.483)	(3.483)
Common equity divided by total assets	-0.011[c]	-0.011	-0.043	-0.043	0.062	0.071
	(0.006)	(0.006)	(0.031)	(0.032)	(0.351)	(0.337)
Trading assets divided by total assets	-0.625[b]	-0.631[b]	-1.401	-1.417	25.188[c]	24.891[c]
	(0.242)	(0.246)	(1.067)	(1.081)	(13.429)	(13.262)
Non-interest income divided by operating income	-0.109	-0.109	-0.466	-0.464	8.281[a]	8.164[a]
	(0.109)	(0.108)	(0.603)	(0.603)	(2.771)	(2.708)
Revenue source concentration	0.149	0.140	0.273	0.231	13.418[b]	13.467[b]
	(0.193)	(0.191)	(0.807)	(0.802)	(6.174)	(6.273)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	247	247	247	247	249	249
R-squared	0.782	0.783	0.424	0.424	0.160	0.170
P-Value: Disclosure variables = 0?	0.000	0.000	0.002	0.002	0.070	0.057

Sources: Federal Reserve Board, Consolidated Financial Statements of Bank Holding Companies (FR Y-9C data); Center for Research in Security Prices (CRSP); Securities and Exchange Commission EDGAR database; company websites.

Notes: Risk-adjusted market return is the annual average of weekly equity price returns divided by the standard deviation of those returns. Alpha is the intercept term from a three-factor market return model using Fama-French factors. Risk-adjusted trading return is annual trading revenue divided by the annual standard deviation of quarterly trading revenue. BHC characteristics are from the Federal Reserve Y-9C reports. Disclosure information is from the BHCs' annual reports. Stock data are from CRSP. Disclosure leader is a dummy variable indicating that a BHC is the only BHC to disclose a particular data item in a given year. Aggregate disclosure index is the market risk disclosure index. First principal component is based on the eighteen individual data items that comprise the aggregate index. The sample consists of all U.S.-owned BHCs that have trading assets greater than U.S.$1 billion (in 2013 dollars) at any time between 1994 and 2012, starting with the year that trading assets exceed U.S.$500 million. Observations for the years 2007, 2008, and 2009 are omitted. The regressions include BHC fixed effects and year dummy variables. Residuals are clustered at the BHC level.

a Significant at the 1% level, b significant at the 5% level, c significant at the 10% level.

Table 6 – Disclosure and risk-adjusted returns omitting the financial crisis period

only a tiny share – less than 2% – report the results of these efforts. As a comparison of the columns with data from 1994 and 2012 makes clear, the frequency of reporting increased over the span of the sample period for nearly every data item.

In the regressions, we use the overall market risk disclosure index as the baseline measure of disclosure, but we also construct the first principal component of the cross-sectional variation in reporting of the eighteen individual data items in the index. The basic index is a simple linear weighting (sum) of the individual elements. The first principal component provides an alternate linear combination, with weights that reflect the common variation across BHC-year observations. It captures about 40% of this variation, suggesting a meaningful common component of reporting across the individual data items. Finally, we create an indicator variable if a given BHC is the only one in the sample to disclose a particular data item in a particular year ("disclosure leader"), to assess the impact of innovations in disclosure practice.[16]

16 The typical pattern is that once one BHC discloses a particular kind of information, others follow in subsequent years. In that sense, BHCs that are the only ones to report an item in a given year are leaders or innovators.

DISCLOSURE AND RISK-ADJUSTED PERFORMANCE

Table 5 presents the basic results of the estimates relating market risk disclosure to subsequent risk-adjusted returns on trading activities and for the firm as a whole. The first set of columns of the table present the results for risk-adjusted market returns, the second set of columns present the results for alpha, and the final set of columns contain the results for trading returns.

The estimates uniformly suggest that increased disclosure is associated with higher risk-adjusted returns, both for trading activities and for the BHC as a whole. The coefficients on the aggregate market risk disclosure index and the first principal component variable are positive and statistically significant in each specification. Aside from being statistically significant, the results are economically important: an increase of one standard deviation in the disclosure index or the first principal components measure is associated with a 0.35 to 0.45 standard deviation increase in risk-adjusted market returns and alpha and a 0.50 to 0.60 standard deviation increase in risk-adjusted trading returns.

The coefficient estimates on the disclosure leader variable (indicating that the BHC is the only company to disclose a particular index item in a given year) are less robust across specifications. The coefficients are negative and weakly statistically significant in the equations using the market-based measures, but positive and statistically significant in the equations for risk-adjusted trading returns. These results suggest that being a first mover in disclosure is associated with better risk-adjusted performance in the trading activities associated with the disclosure but is less strongly associated with market-based returns for the firm as a whole. One potential explanation for these seemingly inconsistent results is that there are learning costs for investors in understanding and putting into context new types of information.

The sample period for the performance data, 1995 to 2013, includes the 2007-09 financial crisis. Since the crisis was a period of extraordinary volatility in financial markets and for the banking sector, one question to ask is how does including this period in the sample affect the results. To explore the impact of the unusual market conditions during the financial crisis, we re-estimated the equations omitting observations from the peak crisis years, 2007 to 2009. These results are reported in Table 6.

On the whole, omitting the financial crisis period does not significantly alter the results concerning the relationship between disclosure and subsequent risk-adjusted performance. The coefficients on the disclosure variables continue to be positive and statistically significant, with little change in magnitude. The primary difference is that the disclosure leader variable no longer enters the equations with a statistically significant coefficient, though the signs and approximate size of the coefficients are similar to those in the basic results. Thus, the exceptional market and banking sector volatility during the financial crisis does not appear to be driving the overall results.

A related question is whether BHCs that disclosed more risk information experienced higher risk-adjusted returns during the financial crisis. The ideal way to answer this question would be to generate completely separate estimates for the crisis period, but this is not possible owing to limited annual observations. To provide some insight, however, we re-estimate the equations allowing the coefficients on the disclosure index variables to differ between the non-crisis and crisis periods (with the crisis period again defined as 2007 to 2009). Note that the disclosure leader variable is not estimated separately for the two time periods because there is insufficient variation during the crisis period to separately identify the impact. These results are reported in Table 7.

The results differ across the three measures of risk-adjusted performance. For risk-adjusted market returns, the coefficients on the disclosure index and the first principal components variables are positive and statistically significant in both the crisis and non-crisis periods. The hypothesis that the coefficients are the same cannot be rejected (see the last row of the table, which reports p-values for tests of equality of the coefficients). In contrast, for alpha and for risk-adjusted trading returns, the coefficients are positive and statistically significant only during the non-crisis period. These findings suggest that BHCs that disclosed more trading risk information did not have better (or worse) risk-adjusted trading performance during the financial crisis, while the evidence about overall firm performance is mixed.

Overall, the results in Tables 5 to 7 suggest that increased market risk disclosure is associated with higher risk-adjusted returns. If this link is achieved through market discipline on trading activities, then we might expect that the effect would be stronger for BHCs that are more heavily engaged in trading. To explore this question, we examine results where the coefficients on the disclosure variables are allowed to differ between BHCs that are "intense traders" and the rest of the sample. These results are shown in Table 8. "Intense traders" are defined as the ten BHCs in the sample with trading assets greater than or equal to U.S.$20 billion, where trading assets represent at least 10% of total assets. Note that by construction, all BHCs in the sample have large trading accounts in absolute dollar terms,

Disclosure variables	Risk-adjusted market return		Alpha		Risk-adjusted trading return	
Disclosure leader	-0.058[c] (0.029)	-0.056[c] (0.029)	-0.283[b] (0.139)	-0.274[c] (0.141)	1.719[c] (0.985)	1.783[c] (0.965)
Crisis period (2007-09)						
Aggregate disclosure index	0.010[a] (0.003)		-0.005 (0.023)		0.169 (0.179)	
First principal component		0.019[a] (0.006)		-0.000 (0.043)		0.428 (0.347)
Non-crisis period						
Aggregate disclosure index	0.010[a] (0.002)		0.046[a] (0.013)		0.337[b] (0.153)	
First principal component		0.018[a] (0.004)		0.079[a] (0.024)		0.691[b] (0.306)
BHC characteristics						
Log (asset size)	-0.061[a] (0.018)	-0.063[a] (0.019)	-0.439[a] (0.115)	-0.435[a] (0.117)	-0.114 (0.987)	-0.244 (0.950)
Risk-weighted assets divided by total assets	-0.085 (0.098)	-0.071 (0.098)	-0.103 (0.671)	-0.073 (0.665)	7.218[c] (3.808)	7.590[c] (3.807)
Common equity divided by total assets	-0.011[b] (0.004)	-0.011[b] (0.004)	-0.102[a] (0.033)	-0.100[a] (0.033)	0.066 (0.215)	0.069 (0.210)
Trading assets divided by total assets	-0.648[b] (0.249)	-0.661[b] (0.250)	-1.449 (1.494)	-1.490 (1.490)	19.438[c] (11.004)	19.137[c] (10.955)
Non-interest income divided by operating income	-0.060 (0.093)	-0.059 (0.093)	0.119 (0.686)	0.112 (0.692)	5.636[b] (2.165)	5.575[b] (2.199)
Revenue source concentration	0.088 (0.147)	0.078 (0.147)	0.645 (0.933)	0.566 (0.947)	16.251[b] (6.165)	16.186[b] (6.321)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	293	293	293	293	295	295
R-squared	0.781	0.781	0.338	0.332	0.185	0.193
P-Value: Disclosure Variables = 0?	0.000	0.000	0.000	0.000	0.010	0.009
P-Value: Crisis = Non-Crisis?	0.947	0.760	0.011	0.027	0.071	0.082

Sources: Federal Reserve Board, Consolidated Financial Statements of Bank Holding Companies (FR Y-9C data); Center for Research in Security Prices (CRSP); Securities and Exchange Commission EDGAR database; company websites.

Notes: Risk-adjusted market return is the annual average of weekly equity price returns divided by the standard deviation of those returns. Alpha is the intercept term from a three-factor market return model using Fama-French factors. Risk-adjusted trading return is annual trading revenue divided by the annual standard deviation of quarterly trading revenue. BHC characteristics are from the Federal Reserve Y-9C reports. Disclosure information is from the BHCs' annual reports. Stock data are from CRSP. Disclosure leader is a dummy variable indicating that a BHC is the only BHC to disclose a particular data item in a given year. Aggregate disclosure index is the market risk disclosure index. First principal component is based on the eighteen individual data items that comprise the aggregate index. The sample consists of all U.S.-owned BHCs that have trading assets greater than U.S.$1 billion (in 2013 dollars) at any time between 1994 and 2012, starting with the year that trading assets exceed U.S.$500 million. The regressions include BHC fixed effects and year dummy variables. Residuals are clustered at the BHC level.

a Significant at the 1% level, b significant at the 5% level, c significant at the 10% level.

Table 7 – Disclosure and risk-adjusted returns' separate impact during the financial crisis

so this partition identifies not only BHCs with especially large trading portfolios but also BHCs for which trading represents a particularly large share of firm-wide activity.[17]

As the results in Table 8 illustrate, a statistically significant relationship exists between disclosure and risk-adjusted returns for both intense traders and other large traders, but this relationship is more material for intense trading firms. In every case, the coefficient estimate for the intense traders is larger than that for the other large traders, though these differences

17 "Intense traders" have trading assets that range between 11 and 42% of total assets (with a median of 18%), as compared to a range of 0.1 to 12.0% (with a median of 1.6%) for the other large traders in the sample.

Disclosure variables	Risk-adjusted market return		Alpha		Risk-adjusted trading return	
Intense traders						
Disclosure leader	-0.061 (0.045)	-0.062 (0.045)	-0.191 (0.148)	-0.201 (0.148)	4.203[a] (1.021)	4.000[a] (0.980)
Aggregate disclosure index	0.015[a] (0.003)		0.070[a] (0.026)		0.436[c] (0.224)	
First principal component		0.027[a] (0.005)		0.123[a] (0.044)		0.736[c] (0.399)
Other large traders						
Disclosure leader	-0.035 (0.034)	-0.033 (0.033)	-0.094 (0.115)	-0.087 (0.113)	-0.557 (1.132)	-0.440 (1.138)
Aggregate disclosure index	0.008[a] (0.002)		0.033[a] (0.010)		0.308[c] (0.169)	
First principal component		0.013[a] (0.004)		0.054[a] (0.018)		0.685[c] (0.365)
BHC characteristics						
Log (asset size)	-0.058[a] (0.019)	-0.059[a] (0.019)	-0.387[a] (0.117)	-0.388[a] (0.120)	0.106 (0.963)	-0.100 (0.953)
Risk-weighted assets divided by total assets	-0.071 (0.101)	-0.065 (0.101)	0.001 (0.746)	0.020 (0.747)	7.146[c] (3.858)	7.438[c] (3.801)
Common equity divided by total assets	-0.011[b] (0.005)	-0.011[b] (0.005)	-0.088[a] (0.032)	-0.089[a] (0.033)	0.098 (0.198)	0.093 (0.194)
Trading assets divided by total assets	-0.580[b] (0.242)	-0.583[b] (0.244)	-1.734 (1.166)	-1.751 (1.164)	15.129 (11.727)	14.293 (11.593)
Non-interest income divided by operating income	-0.039 (0.099)	-0.036 (0.100)	0.277 (0.804)	0.288 (0.809)	5.982[b] (2.293)	5.675[b] (2.286)
Revenue source concentration	0.115 (0.153)	0.105 (0.152)	0.271 (0.976)	0.212 (0.970)	14.589[b] (6.432)	14.315[b] (6.567)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	293	293	293	293	295	295
R-squared	0.783	0.784	0.318	0.318	0.191	0.199
P-Value: Disclosure variables = 0?	0.000	0.000	0.003	0.003	0.002	0.001
P-Value: Intense = other large?	0.048	0.018	0.159	0.119	0.606	0.913

Sources: Federal Reserve Board, Consolidated Financial Statements of Bank Holding Companies (FR Y-9C data); Center for Research in Security Prices (CRSP); Securities and Exchange Commission EDGAR database; company websites.

Notes: Risk-adjusted market return is the annual average of weekly equity price returns divided by the standard deviation of those returns. Alpha is the intercept term from a three-factor market return model using Fama-French factors. Risk-adjusted trading return is annual trading revenue divided by the annual standard deviation of quarterly trading revenue. BHC characteristics are from the Federal Reserve Y-9C reports. Disclosure information is from the BHCs' annual reports. Stock data are from CRSP. Disclosure leader is a dummy variable indicating that a BHC is the only BHC to disclose a particular data item in a given year. Aggregate disclosure index is the market risk disclosure index. First principal component is based on the eighteen individual data items that comprise the aggregate index. The sample consists of all U.S.-owned BHCs that have trading assets greater than U.S.$1 billion (in 2013 dollars) at any time between 1994 and 2012, starting with the year that trading assets exceed U.S.$500 million. Intense traders are those with trading account assets greater than 10% of total assets and greater than U.S.$20 billion in 2013 dollars, while other large traders are the remainder of the sample. The regressions include BHC fixed effects and year dummy variables. Residuals are clustered at the BHC level.

a Significant at the 1% level, b significant at the 5% level, c significant at the 10% level.

Table 8 – Disclosure and risk-adjusted returns by extent of trading activity

are not always significant (see the last row of the table). The coefficient estimates suggest that an increase of one standard deviation in the disclosure index metrics is associated with a 0.40 to 0.65 standard deviation increase in risk-adjusted returns for intense traders, but just a 0.20 to 0.45 standard deviation increase for other large trading BHCs. Further, the impact of being a disclosure leader is evident only for the intense traders: these BHCs have higher risk-adjusted trading returns, whereas there is no significant impact from being a disclosure leader among the other larger traders. Thus, the impact of disclosure on risk-adjusted returns is much stronger for those firms with a concentration in trading activity.

Robustness

One potential criticism of these findings is that the disclosure variables may be capturing unobserved characteristics of the BHCs' trading portfolios. For instance, information on VaR by risk type is clearly more relevant for BHCs with trading positions that span multiple risk factors (such as interest rates, exchange rates, equity prices, or commodities) than for those with simple portfolios. Multi-risk-factor portfolios that span riskier or less widely held risk exposures, such as commodities, could have different risk-return characteristics than portfolios composed of positions exposed primarily to interest rates, which are held in nearly all trading portfolios. Alternatively, BHCs that report more information about stress-testing may do so because they hold portfolios with "tail risk" that would not necessarily be realized in annual risk-adjusted returns (that is, risk-adjusted returns could be overstated because "tail risk" is not captured) but for which stress-testing is an important risk management tool. It could be, therefore, that the disclosure variables are capturing differences in underlying risk and return across BHCs rather than the impact of differential disclosure practices.

We performed a series of robustness checks to assess this concern. First, the specification includes BHC fixed effects, so any differences in risk-adjusted returns across BHCs that are related to permanent differences in disclosure should be absorbed by those controls. As a further check, we repeated the regressions including additional variables to control for the composition of BHCs' trading activity. In particular, BHC regulatory reports contain information on trading revenues derived from different types of risk factors, such as interest rates, exchange rates, equity prices, and commodity prices. Nearly all of the BHCs in the sample (91%) report trading revenue from interest rate and foreign exchange positions, but fewer report revenue from equity- or commodity-based positions (64% and 48%, respectively). We re-estimated the regression including dummy variables to capture the impact of these less common trading risk factors. Regulatory reports also include information on the different types of securities held in the trading account, and we estimated a second alternative specification with variables that captured the composition of trading positions based on these data.[18] Since this information is available only beginning in 1995, we excluded observations from 1994 from these estimates.

As a final test, we used a measure of the trading portfolio risk: the BHC's market risk capital requirement (scaled by trading account assets). As detailed above, minimum regulatory capital requirements for market risk are based on BHCs' internal VaR estimates. In that sense, they are related to the information disclosed in public financial statements about market risk exposure. Unfortunately, market risk capital data are available only beginning in 1998, when the market risk capital requirements were first imposed, and even in the years since then, some BHCs in our sample were not subject to the requirements in every sample year.[19] Overall, the sample size is reduced by about a third when the market risk capital requirement is included as a control variable.

Results of the estimates including these three sets of additional control variables are reported in Tables 9A, 9B, and 9C, respectively. Including the additional control variables does not change the basic results. There continues to be a positive relationship between disclosure and risk-adjusted returns, though, as before, this relationship is stronger for the market-based measures than it is for accounting-based trading returns. The coefficients on the additional control variables are jointly statistically significant in most of the specifications, especially for the market-based return measures. The most consistent result is that higher market risk exposure, as measured by the ratio of market risk capital to trading assets, is associated with lower risk-adjusted returns (see Table 9C). The variables controlling for trading risk factors (commodity- and equity-based revenue) tend to have the least explanatory power, though the results suggest that equity-based revenue is associated with

18 The specification included variables reflecting the share of trading account assets composed of U.S. Treasury and agency securities, state and local government securities, mortgage-backed securities, other debt securities, trading positions held in foreign offices, revaluation gains on derivatives positions, and other trading account assets.

19 Only banks and BHCs with trading account assets exceeding U.S.$1 billion or 10% of total assets are subject to the market risk capital requirement. In addition, supervisors have the option to exempt a bank or BHC that would otherwise be subject to the requirements if its trading risk is shown to be minimal, or to require a bank or BHC to be subject to the requirements if it has significant trading risk, even if it is below the numerical thresholds [Hendricks and Hirtle (1997)].

Disclosure variables	Risk-adjusted market return		Alpha		Risk-adjusted trading return	
Disclosure leader	-0.060[b] (0.029)	-0.059[c] (0.030)	-0.194[c] (0.112)	-0.190 (0.114)	1.982[b] (0.988)	2.038[b] (0.957)
Aggregate disclosure index	0.010[a] (0.003)		0.042[a] (0.014)		0.363[b] (0.155)	
First principal component		0.018[a] (0.004)		0.076[a] (0.025)		0.720[b] (0.307)
Additional control variables						
Risk factor dummy variables						
Equity-based revenue	0.039[b] (0.018)	0.041[b] (0.017)	0.146 (0.144)	0.155 (0.143)	-1.323[c] (0.731)	-1.250[c] (0.714)
Commodity-based revenue	-0.018 (0.023)	-0.017 (0.023)	-0.013 (0.128)	-0.009 (0.129)	-0.397 (0.686)	-0.398 (0.694)
BHC characteristics						
Log (asset size)	-0.065[a] (0.016)	-0.067[a] (0.017)	-0.405[a] (0.108)	-0.413[a] (0.112)	-0.096 (0.769)	-0.250 (0.752)
Risk-weighted assets divided by total assets	-0.133 (0.098)	-0.122 (0.098)	-0.226 (0.702)	-0.178 (0.701)	8.450[b] (3.672)	8.879[b] (3.696)
Common equity divided by total assets	-0.010[c] (0.005)	-0.010[c] (0.005)	-0.083[b] (0.031)	-0.082[b] (0.032)	0.028 (0.205)	0.030 (0.202)
Trading assets divided by total assets	-0.633[a] (0.235)	-0.638[a] (0.237)	-1.956 (1.191)	-1.971 (1.192)	15.779 (11.595)	15.613 (11.582)
Non-interest income divided by operating income	-0.073 (0.091)	-0.074 (0.091)	0.114 (0.765)	0.109 (0.765)	6.330[a] (2.096)	6.271[a] (2.082)
Revenue source concentration	0.088 (0.148)	0.086 (0.147)	0.162 (0.915)	0.145 (0.909)	14.181[b] (6.472)	14.193[b] (6.579)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	293	293	293	293	295	295
R-squared	0.786	0.787	0.319	0.319	0.192	0.201
P-Value: disclosure variables = 0?	0.000	0.000	0.001	0.001	0.014	0.013

Table 9, Panel A – Robustness check – control for trading risk factors

higher risk-adjusted market returns (but lower risk-adjusted trading returns).

Risk-adjusted performance and market discipline

The finding that increased disclosure is associated with higher future risk-adjusted performance suggests that BHCs that disclose more information face a better risk-return trade-off. This finding is consistent with a broad interpretation of market discipline. Much discussion of market discipline has focused on the idea that market participants are concerned primarily about risk, so that enhanced disclosure serves mainly to discipline bank managers in terms of risk taking. However, it is reasonable to assume that investors, creditors, and other stakeholders might also be concerned with efficient risk taking and the relationship between risk and return. In this broader interpretation, enhanced disclosure facilitates market discipline not merely by affecting risk but by making risk taking and trading activities more efficient and productive.

A related point is that the link between greater disclosure and better performance may not necessarily stem from the impact of market discipline as traditionally defined. Specifically, the same risk management systems that produce better risk-adjusted performance may also generate the information needed to make more detailed risk disclosures, which may be used by the bank as a public signal of its superior risk management abilities. Fang (2012) finds evidence broadly consistent with this hypothesis, as he documents a contemporaneous correlation between enhanced VaR disclosure and corporate governance characteristics. In this view, enhanced disclosure is a by-product of better performance, rather than a cause.

Disclosure variables	Risk-adjusted market return		Alpha		Risk-adjusted trading return	
Disclosure leader	-0.052 (0.031)	-0.051 (0.032)	-0.173 (0.114)	-0.169 (0.117)	1.318 (1.010)	1.320 (0.968)
Aggregate disclosure index	0.009[a] (0.003)		0.048[a] (0.015)		0.283 (0.175)	
First principal component		0.016[a] (0.005)		0.086[a] (0.028)		0.611[c] (0.353)
Additional control variables						
Trading portfolio asset shares						
Treasury and agency securities	0.083 (0.059)	0.082 (0.059)	0.253 (0.319)	0.246 (0.318)	-0.178 (2.528)	-0.263 (2.458)
State and local government securities	0.160[c] (0.087)	0.159[c] (0.088)	0.769 (0.622)	0.766 (0.628)	-3.250 (3.131)	-3.564 (3.204)
Mortgage-backed securities	0.129[a] (0.036)	0.127[a] (0.038)	0.465[c] (0.259)	0.457[c] (0.268)	-1.750 (2.479)	-1.834 (2.376)
Other debt securities	0.081 (0.079)	0.085 (0.079)	0.995 (0.926)	1.017 (0.930)	-4.866 (3.011)	-4.643 (2.988)
Derivatives revaluation gains	0.050[c] (0.027)	0.050[c] (0.027)	0.066 (0.150)	0.064 (0.149)	-0.429 (1.258)	-0.492 (1.253)
BHC characteristics						
Log (asset size)	-0.070[a] (0.017)	-0.071[a] (0.017)	-0.469[a] (0.111)	-0.476[a] (0.116)	0.278 (1.013)	0.119 (0.985)
Risk-weighted assets divided by total assets	-0.075 (0.096)	-0.064 (0.095)	0.036 (0.687)	0.091 (0.686)	6.622 (4.097)	6.987[c] (4.099)
Common equity divided by total assets	-0.012[b] (0.005)	-0.012[b] (0.005)	-0.102[b] (0.040)	-0.102[b] (0.040)	0.113 (0.246)	0.110 (0.242)
Trading assets divided by total assets	-0.534[b] (0.254)	-0.543[b] (0.254)	-2.407[c] (1.236)	-2.451[c] (1.225)	18.258 (13.203)	17.550 (13.146)
Non-interest income divided by operating income	-0.044 (0.078)	-0.045 (0.078)	0.344 (0.688)	0.339 (0.690)	4.651[c] (2.481)	4.608[c] (2.499)
Revenue source concentration	0.066 (0.140)	0.062 (0.139)	0.393 (0.968)	0.368 (0.967)	9.344 (6.364)	9.559 (6.505)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	280	280	280	280	282	282
R-squared	0.777	0.777	0.340	0.340	0.174	0.182
P-Value: disclosure variables = 0?	0.001	0.000	0.001	0.002	0.123	0.101

Table 9, Panel B – Robustness check – control for trading portfolio composition

That said, enhanced disclosure nonetheless provides market participants with important information about the bank that could influence investor actions, which seems consistent with a broad view of market discipline.

One last interesting finding concerns BHCs that are "first movers" in disclosure, in the sense of being the first to disclose a particular type of information. These firms appear to have lower future risk-adjusted market returns, but higher risk-adjusted trading returns. This finding suggests that there may be learning costs for investors in assessing and putting into context new types of information about risk. To the extent that this is the case, policymakers advocating new and innovative disclosures should also consider the role that the public sector could play in educating investors and market analysts about these new disclosures. This outreach could reduce any negative market reaction to unfamiliar information and thus better align the incentives of firms and policymakers about enhanced disclosure.

Disclosure variables	Risk-adjusted market return		Alpha		Risk-adjusted trading return	
Disclosure leader	-0.109[a]	-0.104[a]	-0.390[a]	-0.350[a]	0.602	0.675
	(0.024)	(0.026)	(0.132)	(0.125)	(1.584)	(1.473)
Aggregate disclosure index	0.010[b]		0.072[a]		0.297	
	(0.004)		(0.020)		(0.197)	
First principal component		0.018[b]		0.122[a]		0.578
		(0.007)		(0.035)		(0.393)
Additional control variables						
Market Risk Exposure						
Market risk capital divided by trading assets	-0.085[b]	-0.080[b]	-0.468[b]	-0.434[b]	-2.554	-2.435
	(0.035)	(0.035)	(0.195)	(0.197)	(1.647)	(1.569)
BHC Characteristics						
Log (asset size)	-0.082[a]	-0.082[a]	-0.629[a]	-0.623[a]	-0.206	-0.262
	(0.029)	(0.030)	(0.164)	(0.169)	(1.082)	(1.061)
Risk-weighted assets divided by total assets	0.015	0.025	0.849	0.916	8.971[b]	9.337[b]
	(0.099)	(0.101)	(0.709)	(0.720)	(3.912)	(3.883)
Common equity divided by total assets	-0.009[c]	-0.009[c]	-0.104[a]	-0.103[a]	0.112	0.110
	(0.005)	(0.005)	(0.034)	(0.035)	(0.263)	(0.259)
Trading assets divided by total assets	-0.799[b]	-0.795[b]	-3.038[c]	-3.004[c]	11.608	11.449
	(0.336)	(0.337)	(1.712)	(1.715)	(17.558)	(17.517)
Non-interest income divided by operating income	-0.108	-0.106	0.084	0.096	4.455[b]	4.523[b]
	(0.101)	(0.101)	(0.791)	(0.795)	(1.847)	(1.888)
Revenue source concentration	0.020	0.010	0.871	0.793	18.829[b]	18.905[b]
	(0.186)	(0.186)	(1.213)	(1.217)	(7.155)	(7.264)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	198	198	198	198	199	199
R-squared	0.779	0.779	0.332	0.329	0.216	0.220
P-Value: Disclosure Variables = 0?	0.000	0.000	0.000	0.000	0.175	0.168

Sources: Federal Reserve Board, Consolidated Financial Statements of Bank Holding Companies (FR Y-9C data); Center for Research in Security Prices (CRSP); Securities and Exchange Commission EDGAR database; company websites.

Notes: Risk-adjusted market return is the annual average of weekly equity price returns divided by the standard deviation of those returns. Alpha is the intercept term from a three-factor market return model using Fama-French factors. Risk-adjusted trading return is annual trading revenue divided by the annual standard deviation of quarterly trading revenue. BHC characteristics are from the Federal Reserve Y-9C reports. Disclosure information is from the BHCs' annual reports. Stock data are from CRSP. Disclosure leader is a dummy variable indicating that a BHC is the only BHC to disclose a particular data item in a given year. Aggregate disclosure index is the market risk disclosure index. First principal component is based on the eighteen individual data items that comprise the aggregate index. The sample consists of all U.S.-owned BHCs that have trading assets greater than U.S.$1 billion (in 2013 dollars) at any time between 1994 and 2012, starting with the year that trading assets exceed U.S.$500 million. The regressions include BHC fixed effects and year dummy variables. Residuals are clustered at the BHC level.

a Significant at the 1% level, b significant at the 5% level, c significant at the 10% level.

Table 9, Panel C – Robustness check – control for market risk exposure

SUMMARY AND CONCLUSION

Disclosure plays an important role in market discipline because market participants need to have meaningful information on which to base their judgments of risk and performance. Disclosure is particularly important in the banking industry, given that outsiders generally view banks as being opaque. As a result, banking supervisors and other public sector officials have encouraged banking companies to engage in enhanced disclosure, particularly of forward-looking estimates of risk. This article aims to assess whether these kinds of disclosures provide useful information to market participants that can help foster market discipline.

In particular, the article examines disclosures related to market risk in trading and market-making activities. The key variable is an index of market risk disclosure that captures the amount of market risk information banking companies disclose in their annual reports. The index is constructed for a sample of BHCs with significant trading activities over the years 1994 to 2012. The article estimates the extent to which this disclosure affects future risk-adjusted returns on trading activities and returns for the BHC overall, as proxied by the firm's equity price behavior.

The main findings are that increases in disclosure are associated with higher risk-adjusted returns, both for trading activities and for the firm overall. These results are economically meaningful as well as statistically significant. The findings are robust to alternative specifications that include additional controls for the composition of the BHCs' trading portfolios and the sources of trading revenue, and are stronger for BHCs whose trading activity represents a larger share of firm-wide activity. The results are not driven by the 2007-09 financial crisis and, in fact, the relationship between disclosure and risk-adjusted performance appears to be significantly weaker during the crisis period. Overall, the results suggest that as disclosure increases, BHCs experience an improved risk-return trade-off.

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