The Effect of Mandated Market Risk Disclosures on Trading Volume Sensitivity to Interest Rate, Exchange Rate, and Commodity Price Movements

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ABSTRACT: We hypothesize that firms' 10-K market risk disclosures, recently mandated by SEC Financial Reporting Release No. 48 (FRR No. 48), reduce investors' uncertainty and diversity of opinion about the implications, for firm value, of changes in interest rates, foreign currency exchange rates, and commodity prices. We argue that this reduced uncertainty and diversity of opinion should dampen trading volume sensitivity to changes in these underlying market rates or prices. Consistent with this hypothesis, we find that after firms disclose FRR No. 48-mandated information about their exposures to interest rates, foreign currency exchange rates, and energy prices, trading volume sensitivity to changes in these underlying market rates and prices declines, even

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after controlling for other factors associated with trading volume. The observed declines in trading volume sensitivity are consistent with FRR No. 48 market risk disclosures providing useful information to investors.

**Keywords:** disclosure regulation; market risk disclosures; derivatives; trading volume; investors' uncertainty; diversity of opinion.

**Data Availability:** The data used in this study are publicly available from the sources indicated in the study. A list of sample firms is available from the authors.

**I. INTRODUCTION**

The Securities and Exchange Commission (SEC) recently issued Financial Reporting Release No. 48 (SEC 1997, hereafter “FRR No. 48”), mandating forward-looking, quantitative market risk disclosures in companies' 10-K reports. FRR No. 48 defines market risk as the risk of loss due to adverse changes in market rates or prices, such as interest rates, foreign currency exchange rates, and commodity prices. Following highly publicized derivative-related losses in the 1990s, FRR No. 48 responds to appeals from investors and other constituents for enhanced public disclosure of firms' exposures to market risk (Linsmeier and Pearson 1997). This study provides evidence relating to the SEC's (1997) claim that FRR No. 48 disclosures provide investors with useful information.

We posit that FRR No. 48 disclosures can be useful to investors in at least two ways. First, at the release of the 10-K report, investors can use the information contained in the disclosures to revise or confirm their expectations about a firm’s exposures to interest rate, foreign currency exchange rate, and/or commodity price changes. (Hereafter we refer to such changes collectively as "underlying market rate/price changes.") To the extent that disclosure alters market expectations, it can lead to a one-time change in the firm's stock price, systematic risk, or stock price sensitivity to underlying market rate/price changes. Second, investors can use their revised estimates of risk exposures to continuously assess the implications for firm value of underlying market rate/price changes that occur anytime after the 10-K release date. To the extent that this second, continuous use of the information contained in FRR No. 48 disclosures reduces investors' uncertainty and diversity of opinion about the implications of underlying market rate/price changes for firm value, Kim and Verrecchia's (1994) theoretical model suggests that we should observe less trading volume sensitivity to underlying market rate/price changes after the 10-K release date. Our analysis focuses on this second disclosure use.

As predicted, for a broad sample of nonfinancial firms, we document a decline in trading volume sensitivity to underlying market rate/price changes after disclosure of FRR No. 48 market risk information. We do not find a similar decrease in trading volume sensitivity after 10-K filings by two control samples: (1) the same firms in the prior fiscal year, before FRR No. 48 disclosures were required, and (2) a sample of different, nondisclosing firms in the same fiscal year in which the disclosing firms made their first FRR No. 48 disclosures. These results are consistent with the hypothesis that FRR No. 48 disclosures provide investors with useful information, which reduces their uncertainty and diversity of opinion about the implications of underlying market rate/price changes for firm value.

The paper continues as follows. The next section describes FRR No. 48 disclosures and cites *a priori* arguments for and against their usefulness. The remaining sections review related research, develop hypotheses, describe the research design, outline sample selection, and present empirical results. The paper concludes with an interpretation of results, a summary of limitations, and suggestions for future research.
II. FRR NO. 48 BACKGROUND AND DESCRIPTION

The introduction to FRR No. 48 states that the disclosures "are designed to provide additional information about market risk sensitive instruments, which investors can use to better understand and evaluate the market risk exposures of a registrant" (SEC 1997, 3). The SEC is concerned with providing full and fair disclosure to individual investors and ensuring that they "are on a level playing field with market insiders" (SEC 2000, 2) because "today's self-directed, online investors do not expect to rely exclusively on research and analysis performed by professionals" (SEC 2000, 3). In FRR No. 48, the SEC pledged to monitor the effectiveness of the disclosure requirements and to amend them if appropriate. It also promised Congress that it would conduct a review of the effects of market risk disclosures after three years had passed. While that review progresses, existing academic literature, reviewed below, is inconclusive about whether market risk disclosures are useful to investors.

Financial economics literature suggests that market risk disclosures can reduce information asymmetries between managers and investors, if firms manage risk for reasons that are not transparent to investors. In perfect capital markets, firm-level hedging of interest rates, foreign currency exchange rates, or commodity prices is inefficient because investors can better diversify these risks on personal account, according to their own risk preferences (DeMarzo and Dufﬁe 1991). In imperfect markets, however, firm-level risk management can enhance firm value in several ways. These include reducing anticipated tax payments, reducing the likely costs of financial distress, protecting investment, responding to managerial risk aversion, and increasing perceived ﬁrm value by preserving a trend of smoothly increasing earnings (Smith and Stultz 1985; Nance et al. 1993; DeMarzo and Dufﬁe 1995; Mian 1996; Tufano 1996; Barth et al. 1999). If investors do not directly observe ﬁrms' risk management activities, then quantitative, forward-looking disclosure of the exposures resulting from these activities has the potential to convey useful information to the market and enhance investors' understanding of firms' market risk exposures.

FRR No. 48 requires firms to disclose quantitative market risk information in their 10-K filings for each material category of market risk (e.g., interest rate risk, foreign currency exchange rate risk, commodity price risk). Within each risk category, FRR No. 48 allows companies to present quantitative market risk information using three alternative formats:

1) Tabular presentation of fair values and contract terms sufficient to determine market risk-sensitive instruments' future cash flow amounts by expected maturity dates.
2) Sensitivity analyses describing the possible effect on earnings, cash ﬂows, or fair values from selected, hypothetical changes in underlying market rates/prices.
3) Value-at-risk (VAR) disclosures expressing the potential loss in earnings, cash ﬂows, or fair values from underlying market rate/price changes with a selected probability of occurring.

Firms may use different quantitative disclosure formats across exposure categories.¹ The Appendix provides an example of each disclosure format.

Consistent with the goal of mandating disclosures relating to all market risk-sensitive instruments, FRR No. 48 requires 10-K disclosure of market risks inherent in derivatives and in all other, nonderivative financial instruments included within the scope of SFAS No. 107 (FASB 1991a), e.g., investments, loans, structured notes, and debt obligations. FRR No. 48 (SEC 1997, Section II) reminds SEC registrants that market risk exposures may

¹ FRR No. 48 also requires separate reporting for trading and nontrading instruments; however, this study focuses on nonﬁnancial ﬁrms, which generally do not hold signiﬁcant amounts of trading instruments.
arise from instruments and positions that are outside the explicit scope of the rule, such as commodity positions and cash flows from anticipated transactions. It encourages companies either to include such instruments and positions in their disclosures voluntarily or to discuss their exclusion as a disclosure limitation.

The SEC required two initial groups of firms, thought to be most familiar with measuring and managing market risk, to comply with FRR No. 48 in fiscal years ending after June 15, 1997: (1) bank and thrift institutions, and (2) nonfinancial enterprises with equity-market capitalization exceeding $2.5 billion on January 28, 1997. All other firms must comply with FRR No. 48 in SEC filings for fiscal years ending after June 15, 1998. We focus on the first 10-K disclosures of nonfinancial firms required to comply with FRR No. 48 in fiscal years ending after June 15, 1997.2

We evaluate the incremental effect of FRR No. 48 in light of the disclosure requirements that preceded it. By 1997, accounting standard setters had been considering firms’ financial reporting for financial instruments for nearly a decade.3 Several highly publicized derivative-related losses in 1994 accelerated the pace of accounting pronouncements (Baliga 1994; Loomis 1995). Yet, even after the publication of SFAS No. 119 (FASB 1994d),4 a pronouncement intended to enhance firms’ disclosures about derivatives, an internal review of approximately 500 10-K filings (SEC 1995) found two deficiencies in market risk disclosures:

1) *Qualitative deficiencies:* Prior to FRR No. 48, the only mandated, forward-looking market risk disclosures were qualitative, and they pertained only to derivative financial instruments issued for purposes other than trading. For these instruments, SFAS No. 119 required disclosure of “the entity’s objectives for holding or issuing the derivative financial instruments, the context needed to understand those objectives, and its general strategies for achieving those objectives” (FASB 1994d, para. 11a). However, by focusing on certain derivatives in isolation, these disclosures did not give investors a complete understanding of a firm’s risk management objectives and strategies. FRR No. 48 addresses this omission by requiring disclosure of similar qualitative information for a broader set of instruments, including non-derivative financial instruments and derivative commodity instruments.

2) *Quantitative deficiencies:* Prior to FRR No. 48, quantitative disclosures relating to market risk-sensitive instruments were very limited. SFAS No. 119 mandated disclosure of notional amounts of derivative financial instruments (FASB 1994d, para. 8b), while Rule 5-02 of Regulation S-X required disclosure of the nature and terms of debt obligations. The SEC noted, however, that such information:

(i) often is abbreviated, (ii) is presented piecemeal in different parts of the financial statements, and (iii) does not apply to all market-risk-sensitive instruments. Thus, investors often are unable to assess whether or how particular financial and commodity instruments affect a registrant’s net market risk exposure. (SEC 1995, section IIIIB1)

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2 We exclude financial service institutions because regulators required them to make similar disclosures before FRR No. 48 and prior studies have already examined them (e.g., Barth et al. 1996; McNally 1996; Collins and Venkataraman 1996; Venkataraman 1996; Schrand 1997).


4 SFAS No. 133 (FASB 1998) and SFAS No. 138 (FASB 2000) superseded SFAS No. 119.
Prior to FRR No. 48, then, investors had insufficient information to assess firms’ exposures to market risks.\(^5\) Quantitative information about the market risks inherent in non-derivative positions was very limited, making it difficult to assess how derivatives altered firms’ net exposures to underlying market rate/price changes. Reporting on a survey of investors and creditors, the AICPA’s Special Committee on Financial Reporting stated, “[u]sers...complain that business reporting is not answering important questions, such as: What [innovative financial] instruments has the company entered into, and what are their terms?...What risks has the company transferred or taken on?” (AICPA 1994, 76). FRR No. 48 seeks to redress these shortcomings by mandating the first forward-looking, quantitative disclosures about firms’ net exposures to market risks.

In contrast, critics of FRR No. 48 cite two main reasons that the disclosures are unlikely to be informative. First, managers can choose the format of quantitative disclosures and can base their disclosures on questionable assumptions about future events and actions. Even a January 1997 internal memo from the SEC chief economist suggests that subjectivity in quantitative risk measurement allows managers to misrepresent companies’ net market risk exposures, potentially misleading investors (Beckett 1997; Logan and Montgomery 1997). Second, investors are likely to have difficulty processing the quantitative, probabilistic information contained in some FRR No. 48 disclosures and comparing the exposures of companies making tabular, sensitivity, and VAR disclosures (Hodder et al. 2001). Therefore, critics of FRR No. 48 argue that the disclosures may not improve investors’ assessments of firms’ market risk exposures.

In July 1998, the SEC staff reported to Congress on first-year FRR No. 48 filings, including the results of a survey of a limited number of analysts and investors concerning their experiences with FRR No. 48. Responses suggest that the disclosures provide new and useful information. The SEC staff report stated, “Investors anticipate that in the future they will compare a registrant’s market risk disclosures to actual results, the registrant’s past disclosures and the disclosures of other registrants” (SEC 1998, 9–10). However, survey respondents also suggested that it was “too early to tell whether the disclosures are resulting in more efficient markets” (SEC 1998, 2).

We provide evidence relating to the divergent claims of FRR No. 48’s supporters and critics by developing and testing hypotheses about the effect of FRR No. 48 disclosures on the sensitivity of trading volume to underlying market rate/price changes. Before developing the hypotheses, we briefly review related market risk research.

III. MARKET RISK RESEARCH

Two streams of research on market risk exposures are germane to this study. Studies in the first stream establish that stock prices are sensitive to changes in interest rates, foreign currency exchange rates, and commodity prices. They also assess the degree of cross-sectional association between stock price sensitivities to these underlying market rate/price changes and limited amounts of market risk information available to researchers prior to FRR No. 48. The second stream specifically examines the usefulness of information mandated by FRR No. 48.

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\(^5\) SFAS No. 119 encouraged, but did not require, disclosure of quantitative information about market risk inherent in derivative financial instruments and other financial instruments. According to the SEC, prior to FRR No. 48, firms virtually never disclosed such information voluntarily (SEC 1995, Section III.B.1a).
Five studies in the first stream are pertinent here. Schrand (1997), using private, regulatory data, shows that savings and loan institutions' use of interest rate derivatives dampens their equity price sensitivity to interest rate changes. Tufano (1998), using analyst-generated private information, shows that commodity price hedging lowers gold mines' stock price sensitivity to gold-price changes. Jorion (1990), using public disclosures, finds that firms' stock price sensitivity to the U.S. dollar price of a trade-weighted basket of foreign currencies is greater for firms with more foreign operations. Bartov and Bodnar (1994) document that the market does not fully incorporate information about firms' sensitivity to foreign currency exchange rate fluctuations until that sensitivity affects reported accounting earnings. Their results suggest that extant public disclosures of the extent of foreign operations provided only incomplete measures of firms' sensitivities to currency risk. Finally, Wong (2000) documents weak and inconsistent evidence of an association between firms' stock price sensitivity to foreign currency exchange rate changes and their derivative positions reported according to the requirements of SFAS No. 119 (FASB 1994d).

Studies in this first research stream show that security returns are sensitive to changes in underlying market rates/ prices. They also show that, prior to FRR No. 48, firms' stock price sensitivities to changes in underlying market rates/ prices were associated with limited amounts of mostly private, industry-specific market risk information. However, consistent with the SEC review of public disclosures, they find that SFAS No. 119 information was not very useful to investors. None of these studies focus on the usefulness of FRR No. 48 information. However, Schrand (1997), who uses regulatory data similar to FRR No. 48 tabular disclosures, suggests that FRR No. 48 disclosures may be useful to investors. Similarly, Wong (2000) suggests that the more comprehensive disclosures required by FRR No. 48 would better portray firms' market risk exposures and overcome some of the deficiencies that he identified in SFAS No. 119 information.

The second stream of related literature includes four studies explicitly examining the usefulness of FRR No. 48 information. However, the first three do not employ actual FRR No. 48 information. Instead, they develop proxies for FRR No. 48 disclosures from information that oil and gas firms and banks disclosed before FRR No. 48 became effective. For a sample of oil and gas producers, Rajgopal (1999) constructs proxies for FRR No. 48's tabular and sensitivity disclosures from disclosures of reserve fair values (SFAS No. 69, FASB 1982) and derivative notional amounts (SFAS No. 119, FASB 1994d). He reports positive associations between FRR No. 48 disclosure proxies and firms' stock return sensitivities to oil and gas price changes. Rajgopal and Venkatachalam (2000), for a sample of 25 U.S. petroleum refiners, assess the cross-sectional relation between earnings sensitivities and returns sensitivities to oil prices. They find a positive relation between a proxy for FRR No. 48 earnings sensitivity disclosures and market perceptions of risk exposure. Ahmed et al. (2000) examine commercial banks' maturity gap disclosures, filed with regulators in call reports, as proxies for FRR No. 48 tabular disclosures. They find that these disclosures are useful in predicting changes in banks' net interest income. Finally, Thornton and Welker (2000) examine the effect of actual FRR No. 48 disclosures on market assessments of firms' equity price sensitivities to oil and gas price changes. They find that oil and gas producers disclosing sensitivity analyses or VAR experience greater post-FRR No. 48 changes in their equity price sensitivity to oil and gas price changes than do tabular disclosers and nondisclosers.

In sum, this second research stream suggests that FRR No. 48 market risk disclosures provide useful information to investors. However, the evidence to date is based mostly on proxies for FRR No. 48 information, and is limited to firms in the oil-and-gas and banking industries. In contrast, we examine the market effects of actual FRR No. 48 disclosures,
using a broad sample of nonfinancial firms. Moreover, existing research primarily examines the relation between stock price sensitivity to underlying market rate/price changes and market risk exposure information. In contrast, we examine the sensitivity of daily trading volume to underlying market rate/price changes. In the next section, we explain why we expect this volume sensitivity to be positively related to investors’ uncertainty and diversity of opinion about firms’ market risk exposures, and why we predict that this trading volume sensitivity declines after FRR No. 48 disclosures.

IV. HYPOTHESIS DEVELOPMENT


Kim and Verrecchia (1994)

Kim and Verrecchia’s (1994) model captures two salient features of the disclosure setting: uncertainty (defined as imprecision of public information) and diversity of opinion (defined as 1 minus the correlation between the information that any two information processors obtain). In the model, market participants receive a signal containing imprecise information about a firm’s uncertain future cash flows, and decide whether to incur costs in further processing the value-relevant information in the signal. Although Kim and Verrecchia (1994) (hereafter KV) apply their model to the earnings release signal containing information about the firm’s anticipated cash flows, we apply the model to the change in underlying market rates/prices signal (such as a change in interest rates, foreign currency exchange rates, or commodity prices). Movements in underlying market rates/prices per se are not firm-specific signals; however, prior literature suggests that they have firm-specific implications because they are associated with equity returns and earnings (Jorion 1990; Schrand 1997; Tufano 1998; Ahmed et al. 2000). We posit that the firm-specific implications of these movements for anticipated future cash flows were unclear prior to FRR No. 48, when investors had little or no information about firms’ net market risk exposures.

The signal in the KV model stimulates investors to engage in costly information processing because the implications of the signal for the firm’s anticipated cash flows are subject to interpretation. Investors therefore perceive that they can obtain an informational advantage through costly information processing. The number of investors choosing to incur costs to process information, in an attempt to profit through informed trade, increases with the informational advantage that they perceive they can obtain from processing information. Less precise public information increases the perceived returns to determining the firm-specific implications of a signal, increasing the number of investors willing to process the information and trade. The potential to profit from informed trade, and hence the likely benefit of costly information processing, also increases with the extent to which market participants disagree (i.e., have diversity of opinion) about the valuation implications of the signal.

Hypotheses

We posit that when investors learn of an underlying market rate/price change, such as a change in interest rates, they decide whether it is cost effective to seek an informational advantage by engaging in costly information processing to better determine the firm-specific cash flow implications of the rate/price change. The SEC’s initial review of the effects of
FRR No. 48 disclosures, described in Section II, suggests that before firms made the disclosures, there was a dearth of information about individual firms' net market risk exposures. Therefore, (1) the firm-specific cash flow implications of underlying market rate/price changes tended to be imprecise, and (2) because of this imprecision, investors who engaged in costly, private processing of the underlying market rate/price change information were likely to have diverse opinions about its implications for firm value. For example, prior to FRR No. 48 disclosures, investors seeing a ten-basis-point increase in interest rates would tend to have imprecise assessments of and diverse opinions about firm-specific implications of the change.

Smithson et al. (1995) argue that changes in interest rates, foreign currency exchange rates, and commodity prices generally follow a random-walk process. This suggests that, generally, investors view the most recent changes in underlying market rates/prices as permanent ones affecting the magnitude of a firm's expected future cash flows. The potential effect on firm value of an underlying market rate/price change, therefore, should increase with the magnitude of the rate/price change. Thus, for a given level of investors' uncertainty and diversity of opinion about the cash flow implications of the change, the perceived benefits from costly information processing should increase with the absolute value of the change. This implies that the number of investors deciding to process underlying market rate/price change information also increases with the absolute value of the rate/price change. Therefore, applying the KV model to signals about changes in interest rates, foreign currency exchange rates, and commodity prices, our first hypothesis, in alternate form, is:

**H1:** In the absence of FRR No. 48 information, trading volume is positively associated with the absolute value of underlying market rate/price changes.

We hypothesize that after FRR No. 48 information is available, investors' assessments of firms' exposures to underlying market rate/price changes are more precise and homogeneous than was the case in the pre-FRR No. 48 period. In the KV model, both the increase in precision and the reduction in diversity of opinion are likely to reduce the perceived benefits from information processing for any given level of underlying market rate/price change. Thus, the number of investors choosing to engage in costly information processing and trade is likely to be lower and our second hypothesis, in alternate form, is:

**H2:** Trading volume sensitivity to absolute changes in underlying market rates/prices is lower after FRR No. 48 disclosures than before the disclosures.

**Rationale for Focusing on Trading Volume**

The KV model implies that investors' uncertainty and diversity of opinion can affect price changes and measures of market liquidity, such as bid-ask spreads, in addition to trading volume. Moreover, Barron et al. (1998) suggest using properties of analysts' forecasts to examine the effects of disclosure on investors' uncertainty and diversity of opinion.

Our empirical tests focus on trading volume rather than these other metrics for the following reasons. First, prior literature (Bamber and Cheon 1995; Barron 1995; Kandel and Pearson 1995; Bamber et al. 1997, 1999) documents reliable associations between trading volume and investors' uncertainty and diversity of opinion (also called disagreement). This literature also documents that disagreement and/or the trading volume related to disagreement can occur in the absence of price changes. For example, Bamber and Cheon

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*We examine the absolute value of underlying market rate/price changes because we expect both positive and negative movements of a given magnitude to generate similar perceived information-processing opportunities.*
(1995) find that earnings announcements stimulating higher trading volume relative to the absolute magnitude of price change are associated with greater divergence in analysts’ pre-disclosure earnings forecasts. These findings suggest that investors’ uncertainty and/or diversity of opinion are likely associated more strongly with volume than with price changes. Second, bid-ask spreads quoted in eighths provide only coarse measures of market liquidity (Callahan et al. 1997).

Third, since analysts do not update earnings forecasts daily, it is infeasible to align earnings forecast revisions with daily changes in underlying market rates/prices, as is required in this research. Finally, underlying market rate/price changes can affect firm value and expected future cash flows without affecting next period’s earnings. For example, an underlying market rate/price change can alter the likely value of transactions forecasted to occur beyond the current year. Similarly, changes affecting the fair value of financial instruments accounted for at historical cost should not prompt near-term earnings forecast revisions unless analysts expect the firm to sell the instruments in the near term. These properties of the current accounting model further diminish the usefulness of analysts’ forecasts in our setting.

For these reasons, we believe that trading volume sensitivity to underlying market rate/price changes is the most appropriate metric for testing our hypotheses. We nonetheless recognize that trading volume is a noisy proxy for uncertainty and diversity of opinion. Prior research reveals that proxies for disagreement are significantly associated with trading volume; however, the explanatory power of these models is low, with R²s generally less than 20 percent (e.g. Barron 1995; Bamber et al. 1997, 1999). Moreover, investors trade for reasons other than investors’ uncertainty or diversity of opinion (e.g., portfolio rebalancing, liquidity). To the extent that prior research suggests proxies for these other factors stimulating trade, we control for them empirically, as described in the next section.

V. RESEARCH DESIGN

To test the hypotheses, we examine the relation between absolute changes in underlying market rates or prices and the percentage of firms’ shares traded before and after firms first issued the FRR No. 48-mandated disclosures. Equations (1)–(3) below specify the regression models used to test our research hypotheses for three subsamples of firms that provided first-time disclosures of exposures to interest rates, foreign currency exchange rates, and commodity prices, respectively.

\[
\text{SVQVOL}_t = \beta_0 + \beta_1 \text{SQMKTVOL}_t + \beta_2 \text{SQ[REI]}_t + \sum_{k=1}^{k=+1} \beta_{3,k} \text{SQ[ADIR]}_{t+k} + \sum_{k=-1}^{k=+1} \beta_{4,k} \text{POST}_t \times \text{SQ[ADIR]}_{t+k} + \epsilon_t
\]

\[
\text{SVQVOL}_t = \gamma_0 + \gamma_1 \text{SQMKTVOL}_t + \gamma_2 \text{SQ[REI]}_t + \sum_{k=1}^{k=+1} \gamma_{3,k} \text{SQ[AFX]}_{t+k} + \sum_{k=-1}^{k=+1} \gamma_{4,k} \text{POST}_t \times \text{SQ[AFX]}_{t+k} + \omega_t
\]

The R²s in our regression models range from 54.28 percent to 84.33 percent. Our research design, however, differs from prior research because, as described in the next section, we examine daily trading volume sensitivity to underlying market rate/price changes over an extended pre- and post-event period, whereas most prior research examines determinants of trading volume measured over a narrow event period.
\[
\text{SQVOL}_{it} = \delta_0 + \delta_1 \text{SQMKTVOL}_{it} + \delta_2 \text{SQ[RET]}_{it} \sum_{k=1}^{k=+l} \delta_3 \text{SQ[\%\Delta ENERGY]}_{it+k} \\
+ \sum_{k=1}^{k=+l} \delta_4 \text{POST}_{it} \times \text{SQ[\%\Delta ENERGY]}_{it+k} \\
+ \sum_{k=1}^{k=+l} \delta_5 \text{SQ[\%\Delta NONENERGY]}_{it+k} \\
+ \sum_{k=1}^{k=+l} \delta_6 \text{POST}_{it} \times \text{SQ[\%\Delta NONENERGY]}_{it+k} + \nu_{it}
\]

(3)

To adjust for skewness, we use square root transformations (SQ) for all continuous variables defined below:\(^8\)

\(i, t = \) firm and time subscripts, respectively;
\(\text{SQVOL} = \) square root of (number of shares traded divided by the number of outstanding shares);
\(\text{SQMKTVOL} = \) square root of (number of shares traded by Dow Jones Industrial Average firms divided by the number of shares outstanding for such firms);
\(\text{SQ[RET]} = \) square root of the absolute value of the stock return;
\(\text{SQ[\%\Delta IR]} = \) square root of the absolute value of the percentage change in long-term (10-year Treasury bond) interest rates;
\(\text{SQ[\%\Delta FX]} = \) square root of absolute value of the percentage change in the value of the U.S. Federal Reserve U.S. dollar-weighted index of foreign currency exchange rates;
\(\text{SQ[\%\Delta ENERGY]} = \) square root of absolute value of the percentage change in the Goldman Sachs Commodity Energy Sector Index times a dummy variable set equal to 1 for firms making a disclosure about an energy-related commodity, 0 otherwise;
\(\text{SQ[\%\Delta NONENERGY]} = \) square root of absolute value of the percentage change in the Goldman Sachs Commodity Non-Energy Sector Index times a dummy variable set equal to 1 for firms making a disclosure about a non-energy-related commodity, 0 otherwise;
\(\text{POST} = \) dummy variable equal to 1 on days following firms’ initial 10-K filing containing FRR No. 48 disclosures, 0 otherwise; and
\(\epsilon, \omega, \nu = \) random error terms.

We call the coefficients, \(\beta_3, \gamma_3, \delta_3, \) and \(\delta_5, \) “volume sensitivity coefficients” (VSCs) because they measure trading volume sensitivities to absolute percentage changes in underlying market rates/prices. The VSCs proxy for trading volume associated with investors’ uncertainty and diversity of opinion about the implications of underlying market rate or

\(^8\) Trading volume (VOL\%) has a positive skewness measure of approximately 12. Logarithmic and square root transformations reduce skewness to approximately 10 and 3.5, respectively, so the square root transformation is preferable. Previous studies (e.g., Bamber et al. 1999) used logarithms to partially correct for positive skewness. We tried this (after adding 1 to avoid taking the log of 0) and found that inferences were unaffected.
price changes for firm value. Hypothesis 1 is that in the absence of FRR No. 48 market risk information, the VSCs are positive.

Coefficients $\beta_4$, $\gamma_4$, $\delta_4$, and $\delta_5$ measure the shift in the VSCs from the pre-FRR No. 48 to the post-FRR No. 48 period. Hypothesis 2 is that these coefficients are negative, since the disclosures mandated by FRR No. 48 increase the precision of investors' assessments of the cash flow implications of underlying market rate or price changes and decrease the diversity of opinion in information processors' assessments. We test H2 by introducing a dummy variable, POST, which takes the value 1 for firm-days after firms' first 10-K disclosure of FRR No. 48 information, 0 for firm-days before disclosure. We interact POST with the absolute values of changes in underlying market rates/prices to isolate the shift in VSCs in the post-FRR No. 48 period.\(^9\)

To allow for the possibility that trading volume on day $t - 1$ occurs in anticipation of a day $t$ underlying market rate/price change, or that trading volume on day $t + 1$ represents additional reaction to the change that occurred on day $t$, the estimated regression models include a one-day lag and a one-day lead for each underlying market rate/price change. For brevity, the tables report coefficients aggregated across days $t - 1$, $t$, and $t + 1$.\(^10\)

We use ten-year Treasury bond yields to measure $|\%\Delta IR|$ because we expect the most significant interest rate risk exposures for nonfinancial firms to stem from long-term borrowings and related derivatives. We use the U.S. Federal Reserve's U.S. dollar, trade-weighted index for foreign currency exchange rate changes to measure $|\%\Delta FX|$ because the sample firms are typically large multinationals with broad international operations.

The sample firms provide disclosures relating to a variety of commodity price exposures, such as oil, gas, agricultural products, and precious metals; however, more than half the firms in the commodity sample report exposure to energy-related commodity prices. Therefore, we use two indices in Equation (3): the Goldman Sachs Energy Sector Index ($|\%\Delta ENERGY|$), and the Goldman Sachs Non-Energy Sector Index ($|\%\Delta NONENERGY|$).\(^11\) We multiply each index by a dummy variable set equal to 1 if firms indicate exposure to either an energy-related commodity or a nonenergy-related commodity, respectively, 0 otherwise.

Trading volume depends on factors besides investors' reactions to underlying market rate/price changes. We control for two of these factors by including additional regressors in Equations (1)–(3). First, like Bamber et al. (1997, 1999) and Tkac (1999), we control for market-wide trading volume, to abstract from trading due to investors' liquidity and portfolio-rebalancing needs. Second, as Abarbanell et al. (1995) advocate, and following Bamber et al. (1997, 1999), we include the absolute value of the rate of return on the firm's common stock, to control for trading volume stemming from the surprise associated with the average investor's belief revision on day $t$.\(^12\) Although the KV model does not suggest

\(^9\) We also replaced the square root transformation of the market rate/price change variables with a dummy variable equal to 1 on days when the underlying market rate/price changes exceed the median change, 0 otherwise. Our inferences are unchanged.

\(^10\) An aggregated coefficient is similar to a Dimson-adjusted beta, commonly used to calculate market betas for infrequently traded securities (Dimson 1979).

\(^11\) The Goldman Sachs Commodity Indices reflect changes in commodity prices. The energy index constituents are heating oil, unleaded gas, crude oil, and natural gas. The non-energy index constituents include various industrial metals, precious metals, livestock, and agricultural products.

\(^12\) Karpoff (1987) reviews literature indicating that trading volume increases with the absolute value of price changes. However, on average, the strength of this relation is greater when stock prices are increasing than when stock prices are decreasing. To allow for differential volume reactions when stock prices are increasing vs. decreasing, we repeat the analyses after including an additional independent variable that reflects the sign of the contemporaneous stock price change. Inferences are unaffected.
that controlling for either of these variables is necessary, we include them to control for factors that prior empirical research has shown to be correlated with trading volume.\textsuperscript{13} Consistent with this research, we predict a positive relation between SQVOL and both SQ\textit{RET|} and SQ\textit{MKTVOL}.\textsuperscript{14}

We estimate Equations (1)--(3) by pooling sample firms. The model estimation period spans 120 trading days before, and 120 trading days after, the release of 10-K reports containing the FRR No. 48 information. (A 90-day pre- and post-period window leads to identical inferences.) The estimation period excludes the 10-K report dates. The POST variable takes the value 1 for the 120 trading days beginning after 10-K filing, 0 otherwise. Firm-days in the estimation period span approximately two calendar years, providing ample variation in underlying market rates and prices to estimate the volume sensitivity coefficients efficiently.\textsuperscript{15} We use generalized least squares (GLS) estimation to control for first-order autocorrelation and heteroskedasticity in regression errors.\textsuperscript{16}

\textbf{VI. SAMPLE AND DESCRIPTIVE STATISTICS}

Data on returns, trading volume, and underlying market rates/prices come from DataStream. DataStream reveals 416 nonfinancial SEC registrants that, because their market capitalization exceeded $2.5 billion on January 28, 1997, were first subject to FRR No. 48 requirements for fiscal years ending after June 15, 1997. Data on market risk disclosures come from the SEC's EDGAR database. We cannot locate ten of the 416 firms on EDGAR. We eliminate an additional 16 firms that experienced takeovers before 10-K filing dates. Finally, we eliminate 12 firms undergoing structural changes, such as mergers, that can alter market risk exposures during the disclosure period. This sample selection procedure yields 378 nonfinancial firms first subject to FRR No. 48 disclosure requirements in the second half of 1997 and first half of 1998.

For 337 of these 378 firms, we can retrieve share return, share trading volume, and market capitalization data around 10-K filing dates. Of the 337 firms, 222 make quantitative FRR No. 48 disclosures; 115 do not, either because they are not \textit{materially} exposed to any category of market risk we examine (i.e., interest rates, foreign currency exchange rates, commodity prices) or they fail to provide disclosures and do not explain why.

Our primary empirical tests focus on three subsamples of the 222 disclosing firms:

1) The \textit{interest rate sample} includes 184 firms that make tabular, sensitivity, or VAR (value-at-risk) disclosures about interest rate risk exposures.

2) The \textit{foreign currency exchange rate sample} includes 141 firms that give tabular, sensitivity, or VAR disclosures about foreign currency exchange rate risk exposures.

\textsuperscript{13} To the extent that investors' uncertainty and diversity of opinion prompted by underlying market rate/price changes are associated with simultaneous increases in trading volume and absolute price change, controlling for \textit{SQ\textit{RET|}} biases the tests against finding a significant VSC. We also estimate regression equations excluding the control variables, \textit{SQ\textit{MKTVOL}} and \textit{SQ\textit{RET|}}. Inferences are unaffected.

\textsuperscript{14} The sample contains large firms with market capitalization exceeding $2.5 billion; this limits the variation in firm size. As a result, including the market value of equity as a separate control for firm size, as in previous research (e.g., Bamber et al. 1997), does not affect inferences.

\textsuperscript{15} Filing dates fall between July 23, 1997 and June 26, 1998, about 11 calendar months. Thus, the full sample test period spans the 468 trading days corresponding closely to the 1997 and 1998 calendar years. As expected, 10-K filing dates cluster in March 1998, the typical filing month for a calendar year-end firm. Specifically, 17.5 percent of the filing dates fall in 1997, 7.7 percent in January or February 1998, 65.2 percent in March 1998, and the remaining 9.6 percent fall in April--June 1998.

\textsuperscript{16} Durbin-Watson and White's Chi-square statistics indicate first-order autocorrelation and heteroskedasticity, respectively. We estimate the regression model coefficients using the PROC MODEL procedure in SAS to perform a full information maximum likelihood (FIML) estimation that uses both a GLS covariance matrix and a first-order autoregressive correction.
3) The commodity price sample includes 58 firms that disclose commodity price risk exposures.

The sum of the numbers of firms in the three subsamples exceeds 222 because some firms are exposed to multiple market risks. The relative numbers of disclosures in the three exposure categories are similar to those in Roulstone’s (1999) sample of 25 companies audited by the same Big 6 firm.

Panel A of Table 1 describes the industry composition of the sample and indicates the types of disclosures across industry groups. The 222 disclosing firms come from a variety of industries other than the intentionally excluded financial services industry. Interest rate and foreign currency exchange rate disclosures occur in all industries; however, firms with less internationally diverse operations (e.g., wholesale, retail, transportation, and communications firms) make fewer foreign currency disclosures. The commodity disclosures cluster in the oil and gas, mining, and utilities sectors where exposures to commodity prices, especially energy prices, are most pronounced. Like Roulstone (1999), we find that most disclosures (297 of 389) are sensitivity analyses or VAR.\(^7\)

Panel B of Table 1 provides descriptive statistics on selected variables for the pre- and post-FRR No. 48 periods. All statistics come from the distribution of firm-level averages for each variable, calculated over the 120-day pre- or 120-day post-FRR No. 48 period. Average sample firm trading volume does not differ significantly between the periods.\(^8\) The mean market volume, measured as the average of the daily percentage of shares outstanding traded by the Dow Jones Industrial Average companies, is higher in the post-FRR No. 48 period (0.415) than in the pre-FRR No. 48 period (0.411). The average absolute percentage rate of equity return is similar in the two periods, although the median is higher in the post-period (1.497) than in the pre-period (1.385).

The average percentage change in interest rates is slightly lower in the post-period (0.574) than in the pre-period (0.594). The mean percentage change in foreign currency exchange rates vs. the U.S. dollar is similar in the two periods, although the median percentage change is larger in the pre-period (0.288) than the post-period (0.278). The absolute value of the mean percentage change in the energy sector price index is somewhat higher in the post-period (1.374) than the pre-period (1.229). Finally, the absolute value of the mean percentage change in the non-energy sector price index is higher in the post-period (0.334) than the pre-period (0.303).

Panel C of Table 1 reports correlations among the explanatory variables. For consistency with later analyses, we report the correlations based on the square root of each variable. Although generally statistically significant, the magnitudes of these correlations suggest that pair-wise collinearity among these variables is not a significant problem.\(^9\) To further assess the effects of collinearity, we measure the condition index for each regression.

---

\(^7\) Elmy et al. (1998) and Roulstone (1999) note inconsistent compliance with the tabular disclosure requirements. We classify a firm as meeting the tabular requirements only if it indicates contract sizes and effective rates/prices by year of maturity. We consider firms that fail to provide at least this level of information as nondisclosers.

\(^8\) We delete 20 firm-day observations for which VOL exceeds 1. For all issues on the NYSE, the 1998 NYSE Fact Book reports average daily trading volume of about 0.3 percent. The sample firms are traded more actively, likely because they are larger. The insignificant decline in the level of trading volume on post 10-K filing days suggests a general decrease in trading volume after the 10-K filing for sample firms. However, for the square root form of this variable used in the empirical tests reported in Tables 2 through 4, the magnitude of this decline is much smaller (less than one-third as large). We do not observe a similar decline for the sample of 115 nondisclosing firms.

\(^9\) The stronger correlations among the post-period variables \((POST \times [%\Delta IR], POST \times [%\Delta SFX], POST \times [%\Delta ENERGY], \text{and } POST \times [%\Delta NONENERGY])\) occur because we set all their values to 0 during the pre-period.
TABLE 1
Descriptive Statistics and Correlation Matrix for Firms Providing FRR No. 48 Market Risk Disclosures

Panel A: Number of Firms Making Disclosure Choices

<table>
<thead>
<tr>
<th>Industry</th>
<th>Total</th>
<th>Interest Rate Exposure</th>
<th>Foreign Currency Exchange Rate Exposure</th>
<th>Commodity Price Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sensitivity or VAR</td>
<td>Tabular</td>
<td>Sensitivity or VAR</td>
</tr>
<tr>
<td>Oil and Gas, Mining, Utilities</td>
<td>44</td>
<td>19</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>Consumer Products</td>
<td>26</td>
<td>18</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Chemicals, Pharmaceuticals</td>
<td>29</td>
<td>24</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Industrial Products</td>
<td>65</td>
<td>41</td>
<td>14</td>
<td>42</td>
</tr>
<tr>
<td>Transportation, Communication</td>
<td>18</td>
<td>12</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Wholesale and Retail</td>
<td>12</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Services</td>
<td>18</td>
<td>12</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>222</strong></td>
<td><strong>134</strong>*</td>
<td><strong>56</strong>*</td>
<td><strong>111</strong></td>
</tr>
</tbody>
</table>

(Continued on next page)
TABLE 1 (Continued)

Panel B: Descriptive Statistics for Firms Providing FRR No. 48 Market Risk Disclosures (n = 222)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>(Pre–Post)$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOL (%) – PRE</td>
<td>0.843</td>
<td>0.403</td>
<td>1.760</td>
<td>1.24</td>
</tr>
<tr>
<td>VOL (%) – POST$^c$</td>
<td>0.675</td>
<td>0.371</td>
<td>0.994</td>
<td></td>
</tr>
<tr>
<td>MKTVOL (%) – PRE</td>
<td>0.411</td>
<td>0.407</td>
<td>0.014</td>
<td>-3.12</td>
</tr>
<tr>
<td>MKTVOL (%) – POST</td>
<td>0.415</td>
<td>0.417</td>
<td>0.013</td>
<td></td>
</tr>
<tr>
<td>[RET] (%) – PRE</td>
<td>1.516</td>
<td>1.385</td>
<td>0.589</td>
<td>-1.47</td>
</tr>
<tr>
<td>[RET] (%) – POST</td>
<td>1.598</td>
<td>1.497</td>
<td>0.586</td>
<td></td>
</tr>
<tr>
<td>[%ΔIR] (%) – PRE</td>
<td>0.594</td>
<td>0.597</td>
<td>0.029</td>
<td>3.76</td>
</tr>
<tr>
<td>[%ΔIR] (%) – POST</td>
<td>0.574</td>
<td>0.574</td>
<td>0.073</td>
<td></td>
</tr>
<tr>
<td>[%ΔFX] (%) – PRE</td>
<td>0.272</td>
<td>0.288</td>
<td>0.041</td>
<td>-1.55</td>
</tr>
<tr>
<td>[%ΔFX] (%) – POST</td>
<td>0.276</td>
<td>0.278</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>[%ΔENERGY] (%) – PRE</td>
<td>1.229</td>
<td>1.240</td>
<td>0.106</td>
<td>-15.75</td>
</tr>
<tr>
<td>[%ΔENERGY] (%) – POST</td>
<td>1.374</td>
<td>1.384</td>
<td>0.087</td>
<td></td>
</tr>
<tr>
<td>[%ΔNONENERGY] (%) – PRE</td>
<td>0.303</td>
<td>0.289</td>
<td>0.038</td>
<td>-9.86</td>
</tr>
<tr>
<td>[%ΔNONENERGY] (%) – POST</td>
<td>0.334</td>
<td>0.343</td>
<td>0.026</td>
<td></td>
</tr>
<tr>
<td>MVE ($billions) – PRE</td>
<td>199.99</td>
<td>7.591</td>
<td>32.232</td>
<td>-0.81</td>
</tr>
<tr>
<td>MVE ($billions) – POST</td>
<td>226.73</td>
<td>8.173</td>
<td>37.437</td>
<td></td>
</tr>
</tbody>
</table>

(Continued on next page)
### TABLE 1 (Continued)

Panel C: Pearson/Spearman Correlation Matrix (Spearman Correlation in Parentheses)

<table>
<thead>
<tr>
<th>Variable</th>
<th>( RET )</th>
<th>( % \Delta IR )</th>
<th>( % \Delta FX )</th>
<th>( % \Delta ENERGY )</th>
<th>( % \Delta NONENERGY )</th>
<th>( POST \times % \Delta IR )</th>
<th>( % \Delta FX )</th>
<th>( % \Delta ENERGY )</th>
<th>( % \Delta NONENERGY )</th>
<th>( POST \times % \Delta ENERGY )</th>
<th>( % \Delta NONENERGY )</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKTVOl</td>
<td>0.22</td>
<td>0.23</td>
<td>0.08</td>
<td>0.11</td>
<td>0.10</td>
<td>0.09</td>
<td>0.07</td>
<td>0.04</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( % \Delta IR )</td>
<td>(0.15)</td>
<td>(0.20)</td>
<td>(0.09)</td>
<td>(0.05)</td>
<td>(0.13)</td>
<td>(0.08)</td>
<td>(0.06)</td>
<td>(0.02)</td>
<td>(0.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( % \Delta FX )</td>
<td>(0.07)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.03)</td>
<td>(0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( % \Delta ENERGY )</td>
<td>0.24</td>
<td>0.04</td>
<td>( \mathbf{0.00} )</td>
<td>0.38</td>
<td>0.09</td>
<td>( -0.00 )</td>
<td>( -0.01 )</td>
<td>( -0.01 )</td>
<td>( -0.02 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( % \Delta NONENERGY )</td>
<td>(0.22)</td>
<td>(0.05)</td>
<td>(( \mathbf{0.00} ))</td>
<td>(0.27)</td>
<td>(0.06)</td>
<td>(( -0.01 ))</td>
<td>(( -0.01 ))</td>
<td>(( -0.01 ))</td>
<td>(( -0.01 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( % \Delta IR \times % \Delta FX )</td>
<td>( -0.03 )</td>
<td>0.03</td>
<td>0.11</td>
<td>0.37</td>
<td>0.02</td>
<td>( -0.01 )</td>
<td>( -0.01 )</td>
<td>( -0.01 )</td>
<td>( -0.01 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( % \Delta ENERGY \times % \Delta NONENERGY )</td>
<td>( 0.03 )</td>
<td>0.07</td>
<td>0.08</td>
<td>0.45</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( % \Delta NONENERGY \times % \Delta ENERGY )</td>
<td>( 0.03 )</td>
<td>0.04</td>
<td>0.05</td>
<td>0.48</td>
<td>0.48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( POST \times % \Delta IR \times % \Delta FX )</td>
<td>0.78</td>
<td>0.69</td>
<td>0.65</td>
<td>(0.84)</td>
<td>0.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( POST \times % \Delta ENERGY \times % \Delta NONENERGY )</td>
<td>0.72</td>
<td>0.68</td>
<td>0.63</td>
<td>(0.86)</td>
<td>(0.83)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( POST \times % \Delta NONENERGY \times % \Delta ENERGY )</td>
<td>0.67</td>
<td>0.72</td>
<td>0.69</td>
<td>(0.84)</td>
<td>(0.84)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Continued on next page)
TABLE 1 (Continued)

*The sum of the combined sensitivity and VAR and tabular disclosures for the interest rate sample (190) exceeds the total number of firms in the interest rate sample because six firms provide both a sensitivity or VAR disclosure and a tabular disclosure with respect to interest rates.

b t-statistic (Wilcoxon Z-statistic) relates to the test of difference in means (locations) between the pre- and post-10-K filing dates for the sample of disclosing firms. Figures in bold represent t-statistics and Wilcoxon Z-statistics that are significant at the 5 percent level (two-tailed).

c PRE and POST denote that the means and medians of the variables apply to trading days before and after firms filed their Forms 10-K containing their initial FRR No. 48 disclosures. The statistics are based on the distribution of firm-level averages for each variable, with the average for each variable calculated over the 120-day pre- or 120-day post-FRR No. 48 filing period.

d Figures in bold denote that correlation statistics are not significant at the 5 percent level (two-tailed). For consistency with the subsequent empirical analysis the correlation matrix reports results based on the square root of each variable.

Variables Definitions:

- \( \text{VOL} \) = number of shares traded divided by the number of outstanding shares;
- \( \text{MKT\text{VOL}} \) = market volume, measured as the number of shares traded for all firms included in the Dow Jones Industrial Index divided by the number of shares outstanding for all such firms;
- \( |\text{RET}| \) = absolute value of the rate of return on equity shares of firm \( i \);
- \( |\%\Delta \text{IR}| \) = absolute value of the percentage change in 10-year Treasury bond rates;
- \( |\%\Delta \text{FX}| \) = absolute value of the percentage change in the value of the U.S. Federal Reserve U.S. dollar-weighted index of foreign currency exchange rates;
- \( |\%\Delta \text{ENERGY}| \) = absolute value of the percentage change in the Goldman Sachs Commodity Energy Sector Index;
- \( |\%\Delta \text{NONENERGY}| \) = absolute value of the percentage change in the Goldman Sachs Commodity Non-Energy Sector Index;
- \( \text{POST} \) = dummy variable equal to 1 on days following a firm’s initial 10-K filing containing FRR No. 48 disclosures, 0 otherwise; and
- \( \text{MVE} \) = market value of common equity.
The largest condition index is less than 10, well below the critical value of 30 (Belsey et al. 1980).

**VII. RESULTS**

Table 2 reports regression results for the interest rate, foreign currency exchange rate, and commodity price samples in Panels A, B, and C, respectively. Consistent with the results of prior studies, we find that the coefficients of SQMKTVOL and SQ[RET] are positive and statistically significant in each panel at $p \leq 0.0001$. In interpreting our results, we use a statistical cutoff level of $p \leq 0.05$ to reject the null hypothesis.

**Primary Tests**

The coefficients, $\beta_4$, $\gamma_4$, $\delta_4$, and $\delta_5$ in Table 2 are the volume sensitivity coefficients (VSCs), which proxy for trading volume associated with investors' uncertainty and diversity of opinion about the implications of underlying market rate/price changes for firm value. Consistent with H1, Table 2 shows that each of these coefficients is positive and statistically significant at $p \leq 0.0002$. We interpret these findings as evidence that, in the absence of disclosure of FRR No. 48 information, investors' uncertainty and diversity of opinion about the firm-specific valuation implications of underlying market rate/price changes leads to positive trading volume sensitivity to absolute changes in interest rates, foreign currency exchange rates, and energy and non-energy commodity prices.

The coefficients $\beta_4$, $\gamma_4$, $\delta_4$, and $\delta_5$ measure the shift in the volume sensitivity coefficients from the pre- to the post-FRR No. 48 period. Hypothesis 2 predicts that these coefficients are negative. The results are consistent with H2 for the interest rate and foreign currency exchange rate samples. The post-FRR No. 48 change in the VSC is negative and statistically significant (at $p \leq 0.0001$) in both Panels A and B. Consistent with the KV model, we interpret the decline in trading volume sensitivity to changes in these rates/prices as suggesting that FRR No. 48 disclosures reduce investors' uncertainty and diversity of opinion about the implications of changes in interest rates and foreign currency exchange rates for firm value.

Panel C of Table 2 reports the results of estimating Equation (3) for the 58 firms disclosing commodity price exposures. We separately estimate coefficients for exposures to energy prices (33 firms) and non-energy prices (27 firms). As hypothesized, we find a marginal decline in the post-FRR No. 48 VSC for firms exposed to energy price changes ($p = 0.0585$); however, for non-energy firms, the VSC shift is not significantly different from 0 at conventional levels ($p = 0.1448$).

There are at least three plausible reasons for the weaker non-energy commodity sample results. First, the non-energy sample is somewhat smaller (27 firms) than the energy sample (33 firms). Second, the broad, non-energy price index is likely a noisy proxy for the specific commodity price exposures of these firms, especially given that non-energy commodity prices are likely to be weakly correlated (e.g., agricultural products and precious metals). In contrast, the energy price index includes fewer commodities (see note 11), and changes in the various energy prices comprising the index are likely more highly correlated. Third, as noted in Section II, FRR No. 48 does not require (although it encourages) the disclosure of quantitative information regarding underlying commodity price exposures. Most sample firms with commodity disclosures do not voluntarily include these exposures.

---

20 The total number of exposures (60) to energy and non-energy prices exceeds 58 because two firms report exposures to both energy- and non-energy-related commodities.
### Table 2
Generalized Least Squares Regression of Trading Volume on Interest Rate, Foreign Currency Exchange Rate, and Commodity Price Changes Pre- and Post-10-K Filings Containing the First FRR No. 48 Disclosures

**Panel A: Interest Rate**

\[
SQVOL_{it} = \beta_0 + \beta_1 SQMKTVOL_i + \beta_2 SQ|RET|_{it} + \sum_{k=-1}^{k=-1} \beta_{3+k} SQ|\%ΔIR|_{i+k} \\
+ \sum_{k=-1}^{k=-1} \beta_{4+k} POST_{it} \times SQ|\%ΔIR|_{i+k} + \epsilon_{it}
\]

\[(184 \text{ firms}; n = 42,360)\]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
<th>Wald Statistic (/p-value): Test $\beta_2 + \beta_3 = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0121</td>
<td>164.86</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQMKTVOL</td>
<td>+</td>
<td>0.7083</td>
<td>2,518.50</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQ</td>
<td>RET</td>
<td></td>
<td>+</td>
<td>0.0811</td>
<td>5,891.10</td>
</tr>
<tr>
<td>SQ</td>
<td>%ΔIR</td>
<td></td>
<td>+</td>
<td>0.0340</td>
<td>22.83</td>
</tr>
<tr>
<td>POST $\times$ SQ</td>
<td>%ΔIR</td>
<td></td>
<td>-</td>
<td>-0.0332</td>
<td>17.58</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td></td>
<td></td>
<td>78.32%</td>
<td></td>
</tr>
</tbody>
</table>

**Panel B: Foreign Currency Exchange Rate**

\[
SQVOL_{it} = \gamma_0 + \gamma_3 SQMKTVOL_i + \gamma_2 SQ|RET|_{it} + \sum_{k=-1}^{k=-1} \gamma_{3+k} SQ|\%ΔFX|_{i+k} \\
+ \sum_{k=-1}^{k=-1} \gamma_{4+k} POST_{it} \times SQ|\%ΔFX|_{i+k} + \omega_{it}
\]

\[(141 \text{ firms}; n = 32,470)\]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
<th>Wald Statistic (/p-value): Test $\gamma_3 + \gamma_4 = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0096</td>
<td>58.10</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQMKTVOL</td>
<td>+</td>
<td>0.8014</td>
<td>2,347.30</td>
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<td></td>
</tr>
<tr>
<td>SQ</td>
<td>RET</td>
<td></td>
<td>+</td>
<td>0.0907</td>
<td>5,641.80</td>
</tr>
<tr>
<td>SQ</td>
<td>%ΔFX</td>
<td></td>
<td>+</td>
<td>0.0795</td>
<td>22.19</td>
</tr>
<tr>
<td>POST $\times$ SQ</td>
<td>%ΔFX</td>
<td></td>
<td>-</td>
<td>-0.0913</td>
<td>35.89</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td></td>
<td></td>
<td>78.50%</td>
<td></td>
</tr>
</tbody>
</table>

(Continued on next page)
TABLE 2 (Continued)

Panel C: Commodity Price

\[
\begin{align*}
SQVOL_{it} = \delta_0 + \delta_t SQMKTVOL_t + \delta_s SQ\{RET\}_t + \sum_{k=-t}^{k=t} \delta_{t,k} SQ\{%\Delta ENERGY\}_t &+ \sum_{k=-t}^{k=t} \delta_{s,k} SQ\{%\Delta ENERGY\}_t \\
&+ \sum_{k=-t}^{k=t} \delta_{t,k} POST_t \times SQ\{%\Delta ENERGY\}_t + \sum_{k=-t}^{k=t} \delta_{s,k} SQ\{%\Delta NONENERGY\}_t + \nu_t
\end{align*}
\]

(58 firms; \(n = 13,369\))

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic (p)-value</th>
<th>Wald Statistic (p)-value: (\delta_1 + \delta_2 = 0)</th>
<th>Wald Statistic (p)-value: (\delta_3 + \delta_4 = 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0130</td>
<td>84.13</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQMKTVOL</td>
<td>+</td>
<td>0.5910</td>
<td>812.88</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQ{RET}</td>
<td>+</td>
<td>0.0537</td>
<td>933.76</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQ{%\Delta ENERGY}</td>
<td>+</td>
<td>0.0288</td>
<td>13.66</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>POST \times SQ{%\Delta ENERGY}</td>
<td>-</td>
<td>-0.0173</td>
<td>3.58</td>
<td>0.0585</td>
<td>2.14/(0.14)</td>
</tr>
<tr>
<td>SQ{%\Delta NONENERGY}</td>
<td>+</td>
<td>0.0845</td>
<td>25.95</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>POST \times SQ{%\Delta NONENERGY}</td>
<td>-</td>
<td>-0.0294</td>
<td>2.13</td>
<td>0.1448</td>
<td>10.13/(0.01)</td>
</tr>
<tr>
<td>Adjusted (R^2)</td>
<td></td>
<td></td>
<td>54.28%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wald statistics and \(p\)-values are two-tailed.

Variable Definitions:

\(i, t = \) firm and time subscripts, respectively;

\(SQVOL = \) square root of (number of shares traded divided by the number of outstanding shares);

\(SQMKTVOL = \) square root of (number of shares traded in the Dow Jones Industrial average firms divided by the number of shares outstanding for such firms);

\(SQ\{RET\} = \) square root of the absolute value of the stock return;

\(SQ\{%\Delta R\} = \) square root of the absolute value of the percentage change in long-term (10-year Treasury bond) interest rates;

\(SQ\{%\Delta FX\} = \) square root of the absolute value of the percentage change in the value of the U.S. Federal Reserve U.S. dollar-weighted index of foreign currency exchange rates;

\(SQ\{%\Delta ENERGY\} = \) square root of (absolute value of the percentage change in the Goldman Sachs Commodity Energy Sector Index) times a dummy variable set equal to 1 for firms making a disclosure with respect to an energy-related commodity, 0 otherwise;

\(SQ\{%\Delta NONENERGY\} = \) square root of (absolute value of the percentage change in the Goldman Sachs Commodity Non-Energy Sector Index) times a dummy variable set equal to 1 for firms making a disclosure with respect to a non-energy-related commodity, 0 otherwise; and

\(POST = \) dummy variable equal to 1 on days following firms’ initial 10-K filing containing FRR No. 48 disclosures, 0 otherwise.
in their FRR No. 48 disclosures, so 10-K readers obtain incomplete commodity price exposure data. Oil and gas firms in the energy sample are less prone to this omission because SFAS No. 69 (FASB 1982) provides industry-specific rules for reporting underlying oil and gas reserves.

Analysis of Post-FRR No. 48 Volume Sensitivity Coefficients

The results in Table 2 suggest that, in the absence of FRR information, there is a positive trading volume sensitivity to the absolute value of daily changes in interest rates, foreign currency exchange rates, and both energy and non-energy commodity prices. The results also show that trading volume sensitivity of firms exposed to changes in interest rates, foreign currency exchange rates, and energy commodity prices declines after the FRR No. 48 disclosures. An open question remains: How successful is FRR No. 48 in reducing investors’ uncertainty and diversity of opinion about the firm-specific implications of underlying market rate/price changes for firm value? To provide evidence on this question, we next compute post-FRR No. 48 disclosure VSCs for each of the four types of market rate/price changes, by summing the VSC coefficient estimated in the absence of FRR No. 48 information with the coefficient estimating the shift in VSC in the post-period. We then test whether each of the four post-FRR No. 48 period coefficients is statistically different from zero.

Panels A, B, and C of Table 2 show that we cannot reject the null hypotheses that \( \beta_3 + \beta_4 = 0 \), \( \gamma_3 + \gamma_4 = 0 \), or \( \delta_3 + \delta_4 = 0 \). Thus, after the FRR No. 48 disclosures, daily trading volume is no longer sensitive to changes in interest rates, foreign currency exchange rates, or energy commodity prices, respectively. However, for non-energy price exposures, consistent with the insignificant \( \delta_6 \) coefficient, the sum of \( \delta_3 \) and \( \delta_4 \) is positive and statistically significant (\( p = 0.01 \)), indicating that the VSC is still positive with respect to non-energy prices in the post-FRR No. 48 period. Based on our interpretation of the KV model, these results suggest that the FRR No. 48 disclosures reduce investors’ uncertainty and diversity of opinion sufficiently to eliminate the trading volume sensitivity to changes in interest rates, foreign currency exchange rates, and energy prices, but not to non-energy commodity prices, in the post-FRR No. 48 period.

Tests for Differences across Disclosure Types

Section II suggests that investors can glean different information from tabular, sensitivity, and VAR disclosures. For example, tabular disclosures provide sufficient information to determine the full distribution of potential future gains/losses in response to likely market rate/price changes, but the calculations involved in making such determinations are complex. In contrast, sensitivity and VAR disclosures are easier to process because they provide point estimates of potential losses. However, both of these disclosures give only one potential loss based on a single, hypothetical underlying market rate/price change scenario, so they are less informative about potential losses in other scenarios. Thus, the three disclosure formats can affect investors’ assessments of firms’ market risk exposures differently.  

Hodder and McAnally (2001) contend that one may glean sensitivity estimates from tabular disclosures, but they only consider interest rate exposures of financial items. It is sometimes possible to estimate the duration of financial instruments from tabular disclosures and derive a linear estimate of the sensitivity of their fair value to changes in interest rates. However, such approximations ignore the convexity of bond prices with respect to interest rates and other sources of nonlinearity, such as those introduced by options and prepayment provisions.
To explore this possibility, we augment the regression models to allow for differential post-FRR No. 48 shifts in VSCs for sensitivity and VAR disclosures, vs. tabular disclosures. We do not separate the effects of sensitivity vs. VAR disclosures because there are fewer than 30 VAR disclosures in each exposure category. Also, we do not test for differential effects of alternate disclosure formats for the commodity sample because there are only six tabular commodity disclosures. Thus, we focus on the interest rate and foreign currency exchange rate sample in estimating equations (1') and (2').

\[
\text{SQVOL}_{it} = \beta_0 + \beta_1 \text{SQMKTVOL}_{i} + \beta_2 \text{SQ[RET]}_{it} + \sum_{k=-1}^{k=+1} \beta_{3,k} \text{SQ[\%\DeltaIR]_{i+k}} \\
+ \sum_{k=-1}^{k=+1} \beta_{4,k} [\text{POST}_{it} \times \text{SQ[\%\DeltaIR]_{i+k}} \times \text{SENVAR}_i] \\
+ \sum_{k=-1}^{k=+1} \beta_{5,k} [\text{POST}_{it} \times \text{SQ[\%\DeltaIR]_{i+k}} \times \text{TAB}_i] + \epsilon_{it})
\]

(1')

\[
\text{SQVOL}_{it} = \gamma_0 + \gamma_1 \text{SQMKTVOL}_{i} + \gamma_2 \text{SQ[RET]}_{it} + \sum_{k=-1}^{k=+1} \gamma_{3,k} \text{SQ[\%\DeltaFX]_{i+k}} \\
+ \sum_{k=-1}^{k=+1} \gamma_{4,k} [\text{POST}_{it} \times \text{SQ[\%\DeltaFX]_{i+k}} \times \text{SENVAR}_i] \\
+ \sum_{k=-1}^{k=+1} \gamma_{5,k} [\text{POST}_{it} \times \text{SQ[\%\DeltaFX]_{i+k}} \times \text{TAB}_i] + \omega_{it}
\]

(2')

All variables are defined as in Equations (1)--(3) except:

SENVAR = dummy variable equal to 1 for firms providing sensitivity or VAR disclosures, 0 otherwise; and

TAB = dummy variable equal to 1 for firms providing tabular disclosures, 0 otherwise.

The results of this analysis appear in Table 3. Panels A and B report interest rate and foreign currency exchange rate sample results, respectively. As expected, in both panels the coefficients on control variables, SQMKTVOL and SQ[RET], are positive and statistically significant at \(p \leq 0.0001\). Moreover, in both panels, \(\beta_3\) and \(\gamma_3\), the VSCs that capture trading volume sensitivity to underlying market rate/price changes in the absence of FRR No. 48 information, are positive and statistically significant, as expected (\(p \leq 0.0001\)).

Panel A of Table 3 shows that the VSC declines in the post-FRR No. 48 period for firms disclosing interest rate exposures under the tabular alternative (\(p \leq 0.0001\)). The related post-FRR No. 48 period VSC, represented by sum \(\beta_3 + \beta_5\), is negative but not statistically different from 0 (\(p = 0.11\)). We find a smaller and statistically marginal downward shift in the VSC in the post-FRR No. 48 period for firms disclosing sensitivity analyses or VAR (\(p = 0.0505\)). Consistent with this marginal downward shift, the related post-FRR No. 48 period VSC represented by \(\beta_3 + \beta_4\) remains positive but again is not statistically significant from 0 (\(p = 0.10\)).

For the foreign currency exchange rate sample in Panel B of Table 3, we find a downward shift in the VSC in the post-FRR No. 48 period for firms disclosing sensitivity analyses
or VAR \((p \leq 0.0001)\). The related post-FRR No. 48 period VSC, represented by the sum \(\gamma_3 + \gamma_4\), is negative but not statistically different from 0 at \(p = 0.09\). In contrast, we do not find a significant downward shift in the VSC in the post-FRR No. 48 period for firms disclosing foreign currency exchange rate exposures under the tabular alternative. The related post-FRR No. 48 period VSC represented by the sum \(\gamma_3 + \gamma_4\), is positive and significantly different from 0 \((p = 0.03)\).22

Based on our interpretation of the KV model, these results suggest that tabular disclosures are more effective than sensitivity and VAR disclosures in reducing investors’ uncertainty and diversity of opinion with respect to interest rate exposures. In contrast, sensitivity

22 We also estimated Equations (1’) and (2’) separating the sensitivity and VAR disclosures. Although the tests have low power due to the small number of VAR disclosures, we find evidence that the VAR disclosures are associated with VSC reductions in the post-FRR No. 48 period.

### TABLE 3

**Generalized Least Squares Regression of Trading Volume on Interest Rate and Foreign Currency Exchange Rate Changes Pre- and Post-10-K Filings Containing the First FRR No. 48 Disclosures, Including Interactive Dummy Variables for Sensitivity/VAR Disclosures and Tabular Disclosures**

**Panel A: Interest Rate**

\[
SQVOL_t = \beta_0 + \beta_1 SQMKTVol_t + \beta_2 \text{SQ}[RET]_t + \sum_{k=1}^{k-j} \beta_{3,k} \text{SQ}[^{\%}\Delta IR]_{t+k}
\]

\[
+ \sum_{k=1}^{k-j} \beta_{4,k} \left[ \text{POST}_t \times \text{SQ}[^{\%}\Delta IR]_{t+k} \times \text{SENVAR}_{-}\right]
\]

\[
+ \sum_{k=1}^{k-j} \beta_{5,k} \left[ \text{POST}_t \times \text{SQ}[^{\%}\Delta IR]_{t+k} \times \text{TAB}_{-}\right] + e_t
\]

\((184\text{ firms; } n = 42,360)\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
<th>Wald Statistic / (p-value): Test</th>
<th>Wald Statistic / (p-value): Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0121</td>
<td>165.36</td>
<td>0.0001</td>
<td>\beta_1 + \beta_2 = 0</td>
<td>\beta_1 + \beta_3 = 0</td>
</tr>
<tr>
<td>SQMKTVol</td>
<td>+</td>
<td>0.7081</td>
<td>2,513.90</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQ[RET]</td>
<td>+</td>
<td>0.0811</td>
<td>5,878.80</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQ[^{%}\Delta IR]</td>
<td>+</td>
<td>0.0320</td>
<td>20.34</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST \times SQ[^{%}\Delta IR] \times SENVAR</td>
<td>−</td>
<td>−0.0056</td>
<td>3.83</td>
<td>0.0505</td>
<td>2.66/(0.10)</td>
<td></td>
</tr>
<tr>
<td>POST \times SQ[^{%}\Delta IR] \times TAB</td>
<td>−</td>
<td>−0.0559</td>
<td>14.90</td>
<td>0.0001</td>
<td></td>
<td>2.56/(0.11)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td>78.32%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Continued on next page)
TABLE 3 (Continued)

Panel B: Foreign Currency Exchange Rate

\[
SQVOL_{it} = \gamma_0 + \gamma_1 SQMKTVOL_{it} + \gamma_2 SQ[RET]_{it} + \sum_{k=-1}^{k-i} \gamma_{3k} SQ[\%\Delta FX]_{i,k} + \sum_{k=-1}^{k-i} \gamma_{4k} [POST_{it} \times SQ[\%\Delta FX]_{i,k} \times SENVAR_{it}] + \sum_{k=-1}^{k-i} \gamma_{5k} [POST_{it} \times SQ[\%\Delta FX]_{i,k} \times TAB_{it}] + \omega_{it}
\]

(141 firms; n = 32,470)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
<th>Wald Statistic / (p-value): Test</th>
<th>( \gamma_2 + \gamma_3 = 0 )</th>
<th>Wald Statistic / (p-value): Test</th>
<th>( \gamma_2 + \gamma_3 + \gamma_4 = 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0096</td>
<td>58.32</td>
<td>0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQMKTVOL</td>
<td>+</td>
<td>0.8013</td>
<td>2,346.70</td>
<td>0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQ[RET]</td>
<td>+</td>
<td>0.0908</td>
<td>5,513.20</td>
<td>0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQ[%\Delta FX]</td>
<td>+</td>
<td>0.0791</td>
<td>21.99</td>
<td>0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST \times SQ[%\Delta FX] \times SENVAR</td>
<td>-</td>
<td>-0.1108</td>
<td>45.49</td>
<td>0.0001</td>
<td>2.95/(0.09)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST \times SQ[%\Delta FX] \times TAB</td>
<td>-</td>
<td>-0.0157</td>
<td>0.31</td>
<td>0.5796</td>
<td>4.51/(0.03)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td>78.51%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wald statistics and p-values are two-tailed.

Variable Definitions:

SENVAR = dummy variable equal to 1 for firms providing sensitivity or VAR disclosures, 0 otherwise;
TAB = dummy variable equal to 1 for firms providing tabular disclosures, 0 otherwise.

All other variables are as defined in Table 2.

and VAR disclosures are more effective than tabular disclosures in reducing investor uncertainty and diversity of opinion for foreign currency exchange rate exposures. Investors, in general, are likely familiar with using tabular interest rate disclosures because financial institutions have long provided regulators with similar information (sometimes called “gap analysis” because tabular interest rate displays focus on the gap between the duration of financial assets and liabilities). In contrast, regulators have not required similar disclosures to describe foreign currency exchange rate exposures. Thus, simple point estimates are likely more effective than extensive tabular disclosures for reducing investors’ uncertainty and diversity of opinion for complex foreign currency exchange rate exposures.
Control-Sample Tests

To rule out alternate explanations for our results, we examine the possibility that the observed downward shifts in the post-FRR No. 48 VSCs are associated not with the market risk disclosures, per se, but with the disclosure of other information in firms' 10-K reports (Cready and Mynatt 1991; Walther 1997). To determine whether there is any basis for this "10-K effect" interpretation, we repeat the analyses around the 10-K filing dates of two control samples:

1) *Disclosure sample/prior year.* This sample consists of the 222 disclosing firms in the year before their first FRR No. 48 disclosures.

2) *Nondisclosure sample/current year.* This sample consists of 115 firms that did not provide mandated quantitative market risk information in their 10-K reports, even though they were subject to FRR No. 48's requirements during the first year it was effective.

If information other than the market risk disclosures is driving the results, then we expect to observe downward VSC shifts in the post-10-K filing period for both control samples.

Table 4 reports the results of these analyses. In short, we find no significant declines in the VSCs for either control sample (all p > 0.23), and the coefficients of other variables are generally consistent with expectations. We therefore conclude that the downward VSC shifts are attributable to FRR No. 48 information, not to other 10-K information.

Model Specification Check

As a final model specification check, we repeat the regression analysis including POST as an additional, separate, explanatory variable. A significant coefficient on this new intercept-shift variable would reflect a post-FRR No. 48-disclosure shift in trading volume unrelated to underlying market rate/price changes, whereas H2 states only that FRR No. 48 should cause a decline in trading volume sensitivity to absolute changes in underlying market rates/prices. An important, data-related concern hinders this analysis: the post-period intercept-shift and VSC-shift variables are highly collinear, with Pearson correlation statistics greater than 0.75 for each sample.

The results of this robustness check (untabulated) are as follows. Coefficients of both the post-period intercept-shift and VSC-shift variables are uniformly insignificant for the nondisclosing control sample. In contrast, in the disclosing samples, coefficients of the POST intercept variable are negative and statistically significant for the interest rate and

---

23 We still predict that the coefficients of the control variables, SQRET and SQMKTVOL, are positive. However, our predictions for the VSCs (β_o, γ_0, δ_o, and δ_0) vary across control samples and types of exposure. For the disclosure sample/prior year, we predict positive VSCs because we expect that firms' market risk exposures were similar to those in the disclosure year. In the nondisclosure sample, we predict zero VSCs for interest rate or foreign currency exchange rate changes because the absence of disclosure suggests that these firms are not materially exposed to interest rate or foreign currency exchange rate changes. However, we predict either positive or zero VSCs for commodity price changes in the nondisclosure sample, because nondisclosure indicates only that their derivative instruments are not materially exposed to commodity price changes. Recall that because FRR No. 48 encourages but does not require disclosure of underlying commodity positions, it is still possible that nondisclosing firms are exposed to material commodity price changes. If so, and if investors' uncertainty and diversity of opinion about the implications of commodity price changes for the underlying commodity positions exists, then we predict positive VSCs. If not, then we predict zero VSCs. Results in Table 4 are consistent with these predictions, with one exception: The β_o coefficient for the interest rate disclosure/prior year sample is not statistically different from zero.
TABLE 4
Generalized Least Squares Regression of Trading Volume on Interest Rate, Foreign Currency Exchange Rate, and Commodity Price Changes Pre- and Post-10-K Filings for the Disclosure Sample in the Year Prior to FRR No. 48, and for a Sample of Nondisclosing Firms in the Year FRR No. 48 Became Effective

Panel A: Interest Rate

\[ SQVOL_{it} = \beta_0 + \beta_1 SQ_{it} + \beta_2 SQ|RET|_{it} + \sum_{k=-1}^{k=+1} \beta_{3,k} SQ|\%\Delta IR|_{t+k} + \sum_{k=-1}^{k=+1} \beta_{4,k} POST_{it} \times SQ|\%\Delta IR|_{t+k} + \epsilon_{it} \]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Disclosure Sample* Prior Year (184 firms; n = 42,484)</th>
<th>Non-disclosure Sample* Mandated Disclosure Year (115 firms; n = 26,610)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Predicted Sign</td>
<td>Coefficient Estimate</td>
</tr>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0183</td>
</tr>
<tr>
<td>SQMTKTVOL</td>
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<td>0.6655</td>
</tr>
<tr>
<td>SQ</td>
<td>RET</td>
<td></td>
</tr>
<tr>
<td>SQ</td>
<td>%\Delta IR</td>
<td></td>
</tr>
<tr>
<td>POST \times SQ</td>
<td>%\Delta IR</td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td>83.51%</td>
</tr>
</tbody>
</table>

(Continued on next page)
TABLE 4 (Continued)

Panel B: Foreign Currency Exchange Rate

\[ SQVOL_{it} = \gamma_0 + \gamma_1 SQMKTVOL_t + \gamma_2 SQ[REI]_{it} + \sum_{k=1}^{t-1} \gamma_{1,k} SQ[\%DX]_{i,t-k} + \sum_{k=1}^{t-1} \gamma_{2,k} POST_{it} \times SQ[\%DX]_{i,t-k} + \omega_t \]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0156</td>
<td>141.84</td>
<td>0.0001</td>
</tr>
<tr>
<td>SQMKTVOL</td>
<td>+</td>
<td>0.7541</td>
<td>1,845.80</td>
<td>0.0001</td>
</tr>
<tr>
<td>SQ[REI]</td>
<td>+</td>
<td>0.0946</td>
<td>3,331.90</td>
<td>0.0001</td>
</tr>
<tr>
<td>SQ[%DX]</td>
<td>+</td>
<td>0.0839</td>
<td>9.72</td>
<td>0.0018</td>
</tr>
<tr>
<td>POST \times SQ[%DX]</td>
<td>?</td>
<td>-0.0198</td>
<td>0.78</td>
<td>0.3771</td>
</tr>
</tbody>
</table>

Adjusted R² 84.33%

| Disclosure Sample\(^a\) | (141 firms; n = 32,646) | | | |
|--------------------------|-------------------------|----------------|---------|
| | Predicted Sign | Coefficient Estimate | Wald Statistic | p-value |
| Intercept | ? | 0.0179 | 120.42 | 0.0001 |
| SQMKTVOL | + | 0.7242 | 1,103.60 | 0.0001 |
| SQ[REI] | + | 0.0997 | 8,135.10 | 0.0001 |
| SQ[\%DX] | 0 | -0.0192 | 0.75 | 0.3855 |
| POST \times SQ[\%DX] | ? | -0.0086 | 0.20 | 0.6528 |

(Continued on next page)
TABLE 4 (Continued)

Panel C: Commodity Price

\[ SQVOL_t = \delta_0 + \delta_1 SQMKTVOL_t + \delta_2 SQ[RET]_t + \sum_{k-t}^{k-t+1} \delta_{3,k} SQ[\%\Delta ENERGY]_{t+k} + \sum_{k-t}^{k-t+1} \delta_{4,k} POST_t \times SQ[\%\Delta ENERGY]_{t+k} + \sum_{k-t}^{k-t+1} \delta_{5,k} SQ[\%\Delta NONENERGY]_{t+k} + \sum_{k-t}^{k-t+1} \delta_{6,k} POST_t \times SQ[\%\Delta NONENERGY]_{t+k} + \nu_0 \]

Disclosure Sample\(^a\)

\begin{tabular}{lcccccc}

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted</th>
<th>Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
<th>Predicted</th>
<th>Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>?</td>
<td>0.0179</td>
<td>150.11</td>
<td>0.0001</td>
<td></td>
<td>?</td>
<td>0.0144</td>
<td>84.07</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQMKTVOL</td>
<td>+</td>
<td>0.5057</td>
<td>683.75</td>
<td>0.0001</td>
<td></td>
<td>+</td>
<td>0.6926</td>
<td>938.39</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQ[RET]</td>
<td>+</td>
<td>0.0587</td>
<td>1053.10</td>
<td>0.0001</td>
<td></td>
<td>+</td>
<td>0.0997</td>
<td>7,596.50</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SQ[%\Delta ENERGY]</td>
<td>+</td>
<td>0.1151</td>
<td>12.30</td>
<td>0.0001</td>
<td>+/0</td>
<td>0.0185</td>
<td>3.94</td>
<td>0.0470</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST \times SQ[%\Delta ENERGY]</td>
<td>?</td>
<td>0.0735</td>
<td>1.08</td>
<td>0.2979</td>
<td>?</td>
<td>-0.0036</td>
<td>0.09</td>
<td>0.7638</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQ[%\Delta NONENERGY]</td>
<td>+</td>
<td>0.1114</td>
<td>0.66</td>
<td>0.4157</td>
<td>+/0</td>
<td>0.0865</td>
<td>25.24</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST \times SQ[%\Delta NONENERGY]</td>
<td>?</td>
<td>0.1483</td>
<td>0.55</td>
<td>0.4569</td>
<td>?</td>
<td>-0.0178</td>
<td>0.69</td>
<td>0.4053</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R(^2)</td>
<td></td>
<td>54.85%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>74.74%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\end{tabular}

The sample consists of companies that made 10-K market risk disclosures in the first year they were mandated. We test for significant changes in volume sensitivity coefficients in the prior year when these companies filed 10-K reports that did not contain FRR No. 48 market risk disclosures.

Nondisclosure Sample\(^b\)

\begin{tabular}{lcccccc}

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted</th>
<th>Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
<th>Predicted</th>
<th>Sign</th>
<th>Coefficient Estimate</th>
<th>Wald Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(115 firms; n = 26,610)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wald statistics and p-values are two-tailed.

\(^a\) The sample consists of companies that did not make 10-K market risk disclosures in the first year they were mandated. We test for significant changes in volume sensitivity coefficients when they filed 10-K reports in that year.

\(^b\) The sample consists of companies that did not make 10-K market risk disclosures in the first year they were mandated. We test for significant changes in volume sensitivity coefficients when they filed 10-K reports in that year.

Variables are as defined in Table 2.
foreign currency samples, but not for either of the commodity samples. In addition, coefficients on interactions between POST and changes in underlying market rates/prices remain negative for the interest rate, foreign currency exchange rate, and energy price samples. However, consistent with the high collinearity between the post-period intercept-shift and VSC-shift variables, we observe a reduction in statistical significance for the VSC-shift variables under this specification. The coefficients on the VSC-shift variables are statistically significant at $p \leq 0.0001$ for the foreign currency sample, but not statistically significant at $p < 0.16$ for the interest rate and commodity samples. Importantly, however, the VSC-shift coefficients remain negative and statistically significant at $p \leq 0.0001$ in both the interest rate and foreign currency subsamples where FRR No. 48 disclosures have the strongest effect—the tabular interest rate disclosers and the sensitivity/VAR foreign currency exchange rate disclosers. Thus, even under this alternative specification, the results continue to suggest that FRR No. 48 disclosures are useful to investors; however, the FRR No. 48 effect manifests itself econometrically in both the post-period intercept-shift and VSC-shift variables for the disclosing firms.

**VIII. CONCLUSIONS AND LIMITATIONS**

We posit that before FRR No. 48 required firms to disclose information about their exposures to changes in interest rates, foreign currency exchange rates, and commodity prices, investors exhibited uncertainty and diversity of opinion about the likely effects on firm value of changes in these market rates/prices. Drawing on Kim and Verrecchia’s (1994) analytical model, we argue that this uncertainty and diversity of opinion stimulated trading in firm’s equity securities. Specifically, we hypothesize that trading volume sensitivity to absolute percentage changes in underlying market rates/prices is positive in the absence of FRR No. 48 information (H1). We also hypothesize that this trading volume sensitivity declines after FRR No. 48 information facilitates investors’ assessments of firms’ market risk exposures (H2).

Consistent with H1, absent FRR No. 48 market risk information, we find positive trading volume sensitivity to absolute changes in interest rates, foreign currency exchange rates, and commodity prices. Consistent with H2, after the disclosure of FRR No. 48 information, we find declines in the trading volume sensitivity to changes in interest rates, foreign currency exchange rates, and energy prices. We also find that tabular disclosures are more effective in reducing trading volume sensitivity to interest rate movements, whereas sensitivity and VAR disclosures are more effective in reducing trading volume sensitivity to foreign currency exchange rate movements. We conjecture that the latter finding is consistent with market participants’ prior experience in using tabular disclosures to analyze firms’ exposures to interest rate movements. In contrast, sensitivity and VAR point estimates more effectively convey complicated foreign currency exchange rate exposures.

To rule out the possibility that downward shifts in trading volume sensitivity are associated with 10-K disclosures in general, and not FRR No. 48 disclosures, we repeat the analyses for a sample of nondisclosing firms and for the sample of disclosing firms in the year prior to the mandated provision of FRR No. 48 market risk information. We detect no reduction in trading volume sensitivity in either control sample. This suggests that our results are attributable to the FRR No. 48 disclosures and not to other information in 10-K filings.

A limitation of the study is that trading volume sensitivity to changes in interest rates, foreign currency exchange rates, or commodity prices may capture phenomena other than trading attributable to investors’ uncertainty and diversity of opinion about the firm-specific
value implications of such underlying market rate/price changes. Because the theoretical and empirical determinants of trading volume are not completely understood, our interpretation of the results may be vulnerable to the omission of as-yet-unidentified determinants of trading volume. Finally, the results pertain only to very large firms making their initial FRR No. 48 market risk disclosures in 10-K reports, and may not generalize to other firms or other time periods.

The results suggest two additional avenues for future research. First, future studies could examine disclosures after the first compliance year to determine whether subsequent disclosures, especially those confirming or conflicting with information revealed in the initial disclosures, affect trading volume sensitivity to underlying market rate/price changes. Second, as the financial reporting of derivatives and hedging activities continues to evolve, one could extend the analysis to examine the market effects of SFAS Nos. 133 and 138 disclosures, which report the financial statement impact of actual (as opposed to hypothetical) changes in underlying market rates and prices.

APPENDIX

Within each risk category, FRR No. 48 allows companies to present quantitative market risk information using one (or more) of the following three formats:

1. Tabular presentation of fair values and contract terms sufficient to determine market risk-sensitive instruments’ future cash flow amounts by expected maturity dates. For example, Kellogg’s Company provides the following tabular information with respect to interest rate risk in its 1997 10-K report:

Interest Rate Risk

The Company is exposed to interest rate volatility with regard to future issuances of fixed-rate debt and existing issuances of variable-rate debt. Primary exposures include movements in U.S. Treasury rates, London Interbank Offered Rates (LIBOR), and commercial paper rates. The Company uses interest rate caps, and currency and interest rate swaps, including forward swaps, to reduce interest rate volatility and funding costs associated with certain debt issues, and to achieve a desired proportion of variable-rate fixed-rate debt, based on current and projected market conditions.

The tables below provide information on the Company’s significant debt issues and related hedging instruments at year-end 1997. For foreign-currency-denominated debt, the information is presented in U.S. dollar equivalents. Variable interest rates are based on effective rates or implied forward rates as of year-end 1997. Refer to Note 6 within Notes to Consolidated Financial Statements for further information.

<table>
<thead>
<tr>
<th>Significant Debt Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Debt Characteristics</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Euro Canadian Dollar</td>
</tr>
<tr>
<td>fixed rate</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Euro Dollar</td>
</tr>
<tr>
<td>fixed rate</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>effective rate*</td>
</tr>
</tbody>
</table>
Euro Dollar
fixed rate
6.625%
effective rate\(a\)
6.354%
U.S. commercial paper\(b\)
$744.2
Weighted av. variable
5.75%

\(a\) Effective fixed interest rate paid, as a result of settlement of forward interest rate swap at date of debt issuance.

\(b\) $400 million of commercial paper classified in long-term debt as of year-end 1997. Refer to Note 6 within Notes to Consolidated Financial Statements for further information.

<table>
<thead>
<tr>
<th>Instrument Characteristics</th>
<th>Year of Maturity (Millions)</th>
<th>Fair Value (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed swap - currency/interest - pay/receive fixed - hedge of existing debt issue</td>
<td>Notional amt.</td>
<td>Pay</td>
</tr>
<tr>
<td>Interest rate swap - pay variable/receive fixed - hedge of existing debt issue</td>
<td>Notional amt.</td>
<td>Pay</td>
</tr>
<tr>
<td>Interest rate swap - pay variable/receive fixed - hedge of existing debt issue</td>
<td>Notional amt.</td>
<td>Pay</td>
</tr>
<tr>
<td>Interest rate forward swap - pay fixed/receive variable - hedge of future debt issue</td>
<td>Notional amt.</td>
<td>Pay</td>
</tr>
<tr>
<td>Interest rate cap - pay fixed if 30-day C.P. rate rises to strike rate - hedge of U.S. commercial paper (b)</td>
<td>Notional amt.</td>
<td>Strike</td>
</tr>
</tbody>
</table>

\(a\) Under the terms of this swap, if three-month LIBOR falls to 4.71% or below, the swap will expire. At year-end 1997, three-month LIBOR was 5.81%.

\(b\) Under the terms of this cap, if the Federal Reserve AA composite rate on 30-day commercial paper increases to 7.83% or above, the cap will expire. At year-end 1997 the rate was 5.65%.

2. Sensitivity analyses describing the possible effect on earnings, cash flows, or fair values from selected hypothetical changes in underlying market rates or prices. For example, Time Warner Inc. disclosed in its 1997 10-K filing that:

[B]ased on Time Warner’s variable-rate debt and related interest rate swap contracts outstanding at December 31, 1997, each 25 basis point increase or decrease in the level of interest rates would respectively increase or decrease Time Warner’s annual interest expense and related cash payments by approximately $16 million, including $6 million related to interest rate swap contracts. Such potential increases or decreases are based on certain simplifying assumptions, including a constant level of variable-rate debt and related interest rate swap contracts during the period and,
for all maturities, an immediate, across-the-board increase or decrease in the level of interest rates with no other subsequent changes for the remainder of the period.

3. **Value-at-risk (VAR)** disclosures expressing the potential loss in earnings, cash flows, or fair values from underlying market rate or price changes with a selected likelihood of occurrence. For example, Ford Motor Company made the following disclosure in its 1997 10-K filing:

The VAR analysis calculates the potential risk, with a 99% confidence level, on firm commitment exposures (cash flows), including the effects of foreign currency derivatives. (Translation exposures were not included in the VAR analysis.) The model assumes currency prices are generally normally distributed and draws volatility data from the currency markets. Estimates of correlations of market factors primarily are drawn from the JP Morgan RiskMetrics™ dataset as of December 31, 1997. Based on the overall Company currency exposure at December 31, 1997, including derivative positions, currency movements are projected to affect pre-tax cash flow by less than $250 million, with a 99% confidence level.

**REFERENCES**


