

# Value-at-Risk Disclosure, Cost of Equity Capital, and Investor Reaction

Hanmei Chen

Commercial banks disclose their exposure to market risks in the form of value-at-risk (VAR), potential maximum losses under a certain confidence level. Using a sample of 24 U.S. commercial banks, we examine the relation between VAR of banks' trading activities and their cost of equity capital. We show that the implied cost of equity capital and the bid-ask spread, both proxying for the cost of equity capital, are positively related to VAR, as well as a quality indicator based on bank technical sophistication. The results are consistent with the claims that VAR effectively captures bank trading risk, and that investors care about banks' risk-taking activities. We next examine whether investors fully understand the implication of VAR to future volatility in trading revenues and utilize it in the pricing process. Our test cannot reject the null hypothesis that banks' stock prices have fully incorporated the predictability of VAR to future market risks.

**Keywords:** Banking, Value-at-risk, Market risk disclosure, cost of equity capital,

## I. INTRODUCTION

The unprecedented financial crisis of 2007-2008 reveals a disturbing fact of banks' reckless risk-taking and the catastrophic consequence of that. It also highlights an ongoing debate on whether the current market risk disclosure regime under SEC FRR 48 (1997) is adequate to inform investors of the real picture of banks' risk-taking. The value-at-risk (VAR) approach is one of the three disclosure methods endorsed by FRR 48 (1997), which reports the maximum potential loss, within a certain confidence level, that management expects to occur in normal market conditions.

The main goal of this study is to empirically document the relationship between publicly disclosed VAR and banks' cost of equity capital. A secondary goal is to examine whether investors fully understand the implications of VAR in relation to banks' future trading revenues and use that knowledge in the pricing process.

Market risk disclosure offers a gauge of risk exposure through which investors form their judgment regarding a company's risk taking. Ideally, risk measures should faithfully depict management's risk taking activities as well as their own assessment of future adverse conditions. Rational investors should demand high compensation in return for companies' risk taking upon learning it through risk measures. We measure the cost of equity capital in two ways. One is to infer the implied cost of equity capital from market expectation and concurrent price (e.g., Claus and Thomas (1998), Easton (2004)). The other is the bid-ask spread. While the latter is sometimes interpreted as directly measuring information asymmetry or liquidity, it is well known that information asymmetry and illiquidity command a high cost of equity capital (Amihud and Mendelson (1989), Brennan and Subrahmanyam (1996)).

Our sample includes 24 US commercial banks which report VAR for their trading activities over various time spans between 1998 and 2008. The sample banks initiated VAR disclosure at

various points in time and most continue to do so quarterly.

The main empirical results are as follows. In testing the relationship between VAR and the cost of equity capital, we find that VAR is positively related to both measures: the implied cost of equity capital and the bid-ask spread. The results remain significant even after controlling for various firm characteristics. Specifically, the relationship between VAR and the implied cost of equity capital suggests the effectiveness of VAR as a risk measure as well as the apparent interest of investors in market risk exposure. Whereas the relationship between VAR and the bid-ask spread is consistent with the scenario in which banks' excessive appetite for risk, results in anxiety among investors and divergence in their opinions. We find that the relationship is much stronger in pre-crisis period than in crisis period.

We conduct supplementary analyses to examine whether the quality of VAR is incorporated into the cost of equity capital. We achieve this by including a measure for technical sophistication of banks (Basel Committee on Banking Supervision (2002), Liu et al. (2004)). Our premise is that banks with high technical sophistication are more likely to provide high quality VAR estimates and high quality VAR leads to a lower cost of equity capital. The results confirm our conjecture, although one needs to interpret them with caution due to the fact that technical sophistication is highly correlated with bank size.

Our study is relevant to regulators who are faced with the challenge of improving the risk disclosure by banks and other financial institutions, as part of the broader regulatory reformation effort that is intended to ensure the soundness of the global financial system. The findings that stock markets react to VAR disclosure in an economically sensible way adds further support to the current call for improved risk disclosure. They are also relevant to investors who are now probably more eager to understand banks' risk-taking activities: despite criticisms, VAR as a risk measure still conveys valuable information regarding banks' risk taking and should be fully exploited to improve investors' decision making.

The rest of the paper proceeds as follows. Section II discusses the institutional background and prior literature. Section III develops the hypotheses. Section IV describes the research design and models. Sample selection and data description are presented in Section V. Section VI reports the empirical results. Section VII concludes.

## **II. BACKGROUND AND PRIOR LITERATURE**

### **VAR and market risk disclosure by banks**

Value-at-Risk (VAR) as a statistical concept and technique was initially developed as a risk management tool in the financial sector back to the early 1990s. It was then endorsed as one of the three disclosure approaches under Securities and Exchange Commission (SEC) Financial Reporting Release No. 48 (FRR 48, 1997). Nevertheless, due to its limitations in depicting risk and complexity in computation, its use is largely limited to reporting risk exposure of trading activities by banks and other financial institutions even today.

VAR as a risk disclosure approach must be understood in the context of market risk disclosure. Mandated by FRR 48 (1997), all public companies are required to disclose in annual reports their exposures to market risk, which are broadly defined as changes in interest rates, exchange rates, commodity prices, equity prices, and other market prices. The regulation intends to address wide spread concern about the adequacy of then existing disclosures in business environments where companies are increasingly using market risk sensitive instruments.

The VAR approach is one of the three disclosure approaches allowed by FRR 48. Under this approach, companies provide a dollar amount estimate of potential loss that management can expect not to exceed in normal market conditions over a certain holding period with a certain

confidence level.

Banks and other financial institutions use the VAR approach to report market risk exposure for trading activities. We argue that banks' trading activities are of economic significance to shareholders in today's business environment. Due to escalated competition and narrowing margins offered by traditional business lines, banks are increasingly engaged in trading activities to boost their earnings and maintain stock performance.

### **Related literature**

This study examines the relationship between publicly disclosed VAR and banks' cost of equity capital and whether investors fully incorporate the implication of VAR in the pricing process. In this respect, it adds to a growing body of research that uses firms' market risk disclosure as a setting to address issues related to economic consequences of disclosure.

We discuss empirical research on market risk disclosure in the line of research of *ex post* volatility (thanks to a specific type of market risk). The logic underlying the research is straightforward: if companies faithfully communicate their *correct* assessment of market risk through *ex ante* risk measures, such as VAR, *ex ante* risk measures ought to relate to *ex post* realization of market movements. Berkowitz and O'Brien (2001) compare nonpublic VAR with trading revenues by six large banks and conclude that VAR only partially measures banks' actual risk. Using trading VAR publicly disclosed by eight large banks, Jorion (2002) finds it predicts surprise in subsequent trading revenues. Using a larger sample of banks, Liu et al. (2004) find that the predictive power of trading VAR increases with technical sophistication and over time. Ahmed et al. (2004) shows that risk disclosure via the tabular format predicts subsequent volatility in net interest income. Hirtle (2007) finds that the risk information disclosed by banking holding companies would impact the equity market returns. Building on these studies, our research reasons that rational investors ought to recognize the predictability, and proceeds to test whether investors fully recognize such attribute of VAR.

Evidence also exists that VAR is related to companies' systematic risk and/or total risk. For example, Liu et al. (2004) show that bank trading VAR predicts return volatility and betas, while Bali and Cakici (2004) find that VAR explains the cross-section of expected returns. Aware of the limitation of realized returns, our study examines the implied cost of equity capital which is inferred from analyst forecasts and concurrent prices. We also use the bid-ask spread to account for the information asymmetry component in the cost of equity capital. We reason that large risk exposure would allow divergence in investor opinions and thus increase the bid-ask spread.

### **III. HYPOTHESIS DEVELOPMENT**

We expect a positive relationship between VAR and the cost of equity capital. As a risk measure, trading VAR purports to capture downside risk (potential loss) a bank may suffer from trading financial instruments on its own accounts. Recent research suggests that such information may be closer to the concept of uncertainty that investors use when pricing equity. In today's financial sector, with continually thinning profit margins for traditional business lines and low entry barriers, banks often find it attractive to take more risk because, if strategically managed, high risk will bring enhanced payoffs to banks.

We want to point out that in considering the relationship between risk and the cost of equity capital, it is more important to examine "relative risk appetite," that is, the amount of risk a bank assumes relative to its capital base, rather than absolute amount of risk. After years of active consolidation in the financial sector, it is likely that even though some banks decide to take higher levels of risk, the scale of excessively risky trading remains limited when the size of overall trading activities or the whole company is taken into account. In contrast, trading risk

disproportionate to a bank's capital and risk management capability certainly presents a major negative factor for investors. They should thus demand high compensation for bearing high potential of loss.

Prior literature mostly examines the capital market consequence of market risk disclosure from an informational viewpoint. That is, these studies examine whether stock markets recognize market risk disclosure as an information event and respond accordingly (e.g., Rajgopal (1998), Linsmeisr et al. (2000)). Liu et al. (2004) is close to ours in spirit by examining whether trading VAR as a risk proxy relates to realized returns.

#### IV. RESEARCH DESIGN AND MODEL

To test the relationship between VAR and cost of equity capital, we use the following model

$$Cost\ of\ Capital_t = \alpha_0 + \alpha_1 \times VaR_t + controls + \varepsilon_t \quad [1]$$

where:

Cost of equity capital = (i) the implied cost of equity capital (*COE*); (ii) the bid-ask spread (*BAS*) (Refer to the next section for details);

*VAR* = the trading VAR reported by banks in financial reports for quarter *t*.

A variety of proxies have been proposed for the cost of equity capital in the literature. In this study, we choose as proxies (1) the implied cost of equity capital based on market price or analyst forecast and (2) the bid-ask spread.

##### Model for the implied cost of equity capital

The model with the implied cost of equity capital as the dependent variable is

$$COE_t = b_0 + b_1 \times VAR_t + b_2 \times NOT_t + b_3 \times GAP_t + \varepsilon_t \quad [2]$$

The specification largely follows Liu et al. (2004), which is based on the division between two distinct activities of banks -- trading and non-trading activities. Since the measured cost of equity capital for banks is aggregated over the two activities, it is necessary to account for risk from banks' non-trading activities. The specification in [2] however, ignores the correlation between trading and non-trading activities, which currently can not be satisfactorily addressed. The notional amount of banks' derivatives (*NOT*) is included because it is another control for market risk exposure. But with the same hedging tools, the greater amount of derivatives will still bring higher risk to banks. Following Liu et al. (2004), we include the short-term repricing gap (*GAP*) as a control for this purpose because interest risk is the primary exposure of non-trading activities.

##### Model for the bid-ask spread

The bid-ask spread reflects for real transaction costs for investors and should determine a bank's cost of equity capital. Liquidity or lack of it certainly should influence a bank's cost of equity capital because illiquid assets are less desirable and must offer higher returns.

With the bid-ask spread being as a proxy for the cost of equity capital, the model is

$$BAS_{t+1} = c_0 + c_1 \times VAR_t + c_2 \times SIZE_{t+1} + c_3 \times VOLUME_{t+1} + c_4 \times VOLATILITY_{t+1} + \varepsilon_{t+1} \quad [3]$$

Following the prior literature, we choose size (*SIZE*), trading volume (*VOLUME*) and return volatility (*VOLATILITY*) as control variables (e.g., Stoll (1978), Chiang and Venkatesh (1988), and Glosten and Harris (1988)).

When estimating Model [2] and [3], we include a technical sophistication measure as do Liu et al. (2004). The dummy variable *TS* is equal to one if a bank is classified as high in technical sophistication according to the survey by Basel Committee on Banking Supervision (2002). With

high technical sophistication, banks are able to provide sophisticated models to calculate VAR and capture many risk factors. Thus, those banks with high technical sophistication are supposed to provide high-quality VAR which has high predictability of the volatility of future trading revenue.

## **V. SAMPLE, VARIABLE DEFINITIONS, AND DATA DESCRIPTION**

### **Sample**

Our sample includes 24 commercial banks over the period between 1998 and 2008. The banks in our sample choose Value at Risk (VAR) as the means to disclose their market risk exposure related to trading activities, as required by FRR No. 48 (1997). We collect their trading VARs from the Management Discussion and Analysis section of their 10-K or 10-Q forms. Trading revenues, trading assets, the notional amounts of derivatives, and repricing gaps are obtained from Y9C, which banks filed with the Federal Reserve as a part of banking regulation requirement.

Descriptive statistics from Table 2 show that our sample contains the large-size banks. Those banks have a substantial amount of trading assets. The notional amounts of derivatives are much greater than their equity, which means managing the risk derived from trading activities is important for those banks.

### **Value-at-Risk (VAR) and implied volatility**

We use either the quarter-end trading VAR or the average trading VAR for the quarter in this paper. We also calculate forecasted volatility of quarterly trading revenue