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Monitoring the "invisible" hand of market discipline: Capital adequacy revisited ☆

Iftekhar Hasan [a,b], Akhtar Siddique [c], Xian Sun [d,*]

[a] Fordham University, United States
[b] Bank of Finland, Finland
[c] Office of the Comptroller of the Currency, Washington, DC 20219, United States
[d] Carey Business School, Johns Hopkins University, Baltimore, MD, United States

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ABSTRACT

The recent U.S. financial crisis and governmental bailout of financial institutions have intensified the debate on the need for effectively measuring and monitoring the financial institutions' risks. This paper contributes to this discussion by introducing a market-based capital measurement that better captures the dynamics of bank risk and returns. Evidence confirms that these market-based capital adequacy metrics are much more sensitive to risk factors and more responsive to economic events than the traditional accounting/regulatory report based capital models, which often underestimate the true capital needs. The CDS premia, another market-bases solvency measure, seems to overreact to declines in capital adequacy.

1. Introduction

Market discipline of financial risk has been a long-standing concept for publicly traded corporations. As a result of the tradeoff between the tax benefits of debt financing and the costs of financial distress, markets impose discipline on companies by monitoring their financial risk (Miller, 1977; DeAngelo and Masulis, 1980; Berger et al., 1995).

In the banking industry, however, because of the "safety net", market discipline on banks' financial risk is weaker. Since the enactment of the National Bank Act of 1863 and the establishment of various government agencies,[1] financial risk has been substantially transferred from individual financial institutions to the government (via insurance funds)[2] and the level of debt has increased significantly (Berger et al., 1995)[3] and the monitoring of banks has been transferred to the government as well (Rime, 2001; VanHoose, 2007). Not surprisingly, Billett et al. show that the insured deposit financing shield banks from the full cost of market discipline.[4] The market, however, does react to bad news and sometimes, in an extreme fashion that causes stock market crashes as experienced in the financial crisis of 2008.

The 2008 financial crisis also showed the importance of measuring and monitoring risk in the banking sector for the health of the entire economy. Since market discipline appears to remain

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* Corresponding author. Address: 100 International Drive, Baltimore, MD, 21202, United States. Tel.: +1 410 234 9425; fax: +1 410 659 8210.
E-mail address: xian.sun@jhu.edu (X. Sun).

[1] For example, Federal Reserve was created in 1913 and FDIC in 1933.

[2] Due to explicit guarantees such as deposit insurance and implicit guarantees such as "too big to fail" and/or "too many to fail".

[3] Berger et al. (1995) show that the average bank's capital ratio was about 55% in 1840. After the National Bank Act of 1863, capital ratios declined rapidly over the next 50 years to approximately 17% in 1913, when the Federal Reserve was created. Capital ratios continued to decline noticeably again after Congress created the FDIC in 1933, to approximately 8% in 1945, and they remained between 6% and 8% for the next half century. Not until 1990 did U.S. regulators impose a minimum Tier I capital ratio of 4%. Therefore, contemporary capital structure appears to reflect the "safety net" more than regulatory requirements because banks' minimum capital ratios were higher before explicit laws and regulations such as 1989 FIRREA and 1991 FDICIA.

[4] Crabbe and Post (1994) show that deposit insurance may have removed market discipline from the CD market.

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"invisible" during normal times for banks and becomes visible but severe during crises and banks play a much more important role in transmitting shocks than other financial institutions (Billio et al., 2012), how to monitor banks' financial risk effectively and timely is an important question for governments, regulators and investors.

An important element of banks' risk is their capital adequacy which depends on both the capital required as well as the capital resources to meet those requirements. We address this question by using an alternate method relying on market information to estimate banks' capital requirements and construct a capital-adequacy ratio by comparing them to available capital resources. By comparing the market-implied capital adequacy with the regulatory reporting-implied capital adequacy, we find banks' equity returns and volatilities (in conjunction with regulatory data) can be used to construct an effective indicator of banks' total risk. The primary function of capital is to absorb unanticipated losses with enough margins to inspire confidence and enable the financial institution to continue as a going concern (Cornett and Saunders, 1999; Heid, 2007; Jokipii and Milne, 2008). Therefore, by monitoring the changes of market-implied capital adequacy, one can get insights into the level of financial risks in banks individually and in the industry.

Despite extensive regulation of the banking sector, obvious limitations of the prevalent risk models exist, particularly relating to the measurement of capital supply and the measurement of risk. The recent financial crisis highlighted a great disparity between the market and regulatory measures of risk and the capital needed to absorb the risk. At the height of the crisis, for example, shares of Wachovia and Citigroup were under tremendous pressure even though both banks were well-capitalized under the regulatory rules.[5] Problems in measuring capital adequacy using historical data are apparent: the estimation of losses is based on historical experience and asset value used in estimating the amount of capital in place may be overestimated when the asset quality deteriorates. For example, Perignon and Smith (2010) show that VaR computed using Historical Simulation contains very little information about future volatility. In addition to the limitation of the data relevance, traditional risk management uses a bottom-up approach that adds up[6] different types of independently estimated risks (Rosenberg and Schuermann, 2006). The concern of this modular and correlation-based approach is that it misses the complex interaction between various risk types (Alessandri and Drehmann, 2010) and may significantly underestimate true total risk (Breuer et al., 2010; Kretzschmar et al., 2010). Hartmann (2010) also highlights in particular the errors that can occur in the aggregation of market and credit risk and the strong relationships between them that suggest caution in the use of pragmatic distinctions between them.

Because effective risk management of financial institutions depends on measurement of risk and capital, we believe that the use of market information can mitigate the limitations of the prevalent risk models discussed above. Although accounting measure of risk is related with market measure of risk (Agusman et al., 2008), they offer significantly different insights. Specifically, unlike returns calculated using accounting data, the information contained in stock prices is typically forward-looking. Several studies use equity returns in estimating the expected capital shortfall in the future (e.g. Brownlees and Engle, 2011; Acharya et al., 2012a,b). More importantly, stock prices reflect investors' perceptions about a firm's future profitability, which reflects the difference between the expected return on all assets and debt. Therefore, we avoid dealing with risk aggregation in estimating the enterprise capital. Last but not the least important, the literature shows that stock information can be an effective indicator of solvency risk (Bongini et al., 2002; Ito and Harada, 2004; Campbell and Taksler, 2003; Zhang et al., 2005; Di Cesare, 2006; Norden and Weber, 2007).

The general approach we use in this study is to compute econometrically derived risk measures for banks using both stock prices and call report data, respectively, in a time-varying factor framework. We translate risk measures into capital demands and then analyze how these capital demands relate to the capital resources banks hold (both book-based and market-based). For a few institutions, we also compare our "modeled" measures of capital adequacy to directly observed measures of capital adequacy in the CDS markets.

Specifically, we use an asset-pricing approach to decompose banks' total risk into various components. We use pre-specified variables to compute conditional means and variances from equity returns and from returns constructed from regulatory data. We estimate the factor sensitivities for these conditional moments in a generalized method of moments (GMM) framework. We then compare the factor sensitivities for the market-based returns to the factor sensitivities for the returns derived from the regulatory data.

Next, we simulate the 1 month ahead distribution of the risk factors based on the information available each month. We then combine the distribution of the risk factors (common across all the banks) with the factor sensitivities to derive both the market and regulatory data implied capital requirements at the 99th and 99.9th percentile confidence levels. This is akin to a 99%/99.9% Value at Risk measure for the bank. We repeat this procedure for all 468 months. Finally, the estimated capital demands are combined with capital resources that banks hold, measured by book value and market value respectively, to construct several capital adequacy measures. Therefore, the capital adequacy measure is impacted by two factors, the estimates of risk and the consequent capital demand and the measures of capital supply. A high capital adequacy ratio could be driven by higher risk and/or lower measure of capital available.

We use stock prices for 1673 U.S. banks from February 1974 to February, 2013 and their accounting data from quarterly call reports during the sample period. Not surprisingly, when analyzing the risk factors that impact trading returns and credit returns separately, we find that the factors driving returns from trading risk and credit risk do not fall neatly into distinct categories. That is, the risk factors "cross" risk lines and affect both trading returns and credit returns. When risk models ignore this fact and calculate risks separately and aggregate to obtain a total measure of risk, they may underestimate the amount of capital banks need. For example, the aggregated capital estimated to cover 99% financial loss at the beginning of 2008 by using regulatory data and the "bottom-up" approach[7] is about $200 billion. This estimation appears to be an underestimation.

By contrast, the market-implied capital demand differs significantly from the regulatory data-implied capital demand especially in the years after 1997. Market-implied capital demand is more

[5] Wachovia's core capital ratio (its Tier 1 capital) was 8% for the second quarter of 2008 (before the announcement of its merger with Wells Fargo) and 7.5% for the third quarter of 2008 (after the announcement). Similarly, Citigroup's core capital ratio was 8.19% by the end of September 2008 and 11.8% for the fourth quarter of 2008. Because the regulatory threshold for "well-capitalized" banks is 6%, both banks looked like strong institutions. Investors, however, had a different opinion and frequently expressed worries that the banks did not have enough capital to weather the credit crunch. And both institutions' stock prices plummeted.

[6] There are several ways to aggregate risks: Add-VaR: assumes an elliptical distribution and perfect correlation between risk types (regulatory approach); Normal-VaR: assume multivariate normal distribution and therefore each of the risk types is normal; and Copula-VaR: a joint distribution of loss can be estimated by the shape/location of each of the risk distributions and a dependence function (Rosenberg and Schuermann (2006)).

[7] That is to estimate trading loss and credit loss separately and sum them up.