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Unintended consequences of the market risk requirement in banking regulation

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ABSTRACT

We analyze a bank that operates under the Basel credit and market risk requirements, and that maximizes its value through recapitalizations, dividends, and liquid asset investments. According to our model, the market risk requirement may postpone recapitalization and this way increase the bank's default probability. We show that this is indeed the case if the expected return and volatility of the liquid asset portfolio are high, i.e., then the market risk requirement raises the default probability of the bank. In this sense the market risk requirement is inefficient.

1. Introduction

The Basel Accord's purpose is to "strengthen the soundness and stability of the international banking system" (Basel Committee Accord, 1988). It tries to achieve this goal by setting different capital requirements. First, there is a credit risk requirement for all banks that fall under its jurisdiction. This is the requirement for the risk of loss due to borrower or counterparty default, and it states that the minimum capital[1] that the banks must hold is at least 8% of their risk weighted assets (RWA). Second, in 1996 an amendment on market risk requirement (MRR) was added to the Basel Accord (Basel Committee on Banking Supervision, 1996a, 1996b, 1996c). By the amendment, banks must maintain extra capital to account for their market risk and the extra capital is given by the market investment's 10-day value-at-risk (VaR).[2] Hence, the higher the volatility of the market investment the higher the capital requirement. Further, if a bank does not invest in risky traded assets then the VaR is zero and the minimum capital requirement equals the credit risk requirement, i.e., in this case the minimum requirement is 8%.

Basel II has extended the banking regulation to consider also operational risk (see e.g. Hull, 2007). It also tries to set international rules for the supervisory review process and to increase market discipline by requiring banks to disclosure

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[1] Here capital means Tier 1 capital plus Tier 2 capital. Hence, consistent with common bank parlance, our use of the term bank capital refers to banks' book equity. This is the relevant measure of capital in an analysis of bank capital adequacy since minimum capital requirements under the Basel Accord apply to book equity.

[2] VaR is the maximum loss of a portfolio over a given horizon, at a given confidence level.

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more information about their capital allocations and risks. However, the subprime mortgage crisis has shown that the Basel II is far from perfect and that new regulation rules have to be created (see e.g. discussions in Roubini (2008) and *Financial Times*, May 6 2008, "Seven habits finance regulators must acquire" by Martin Wolf). Basel II is outside the scope of this paper and we focus only on the credit and market risk regulations that are used today and assume naively perfect information between banks, regulators, and investors.[3] There are clearly major information problems between these participants (see e.g. the above Financial Times article) and we hope the next regulation addresses these. In our perfect information model we analyze the optimal behavior of a bank that operates under the credit and market regulations. The MRR not only affects the optimal portfolio choice of the bank but also its recapitalization (equity issuance) and dividend policies. Therefore, the market risk regulation can have unintended consequences and we illustrate an example where the MRR raises the bank's liquidation probability through the bank's changed recapitalization decision. That is, even without the problems in Basel II discussed lately in the press, there is a risk that the current banking regulation has some negative consequences on the banking industry.

Within static settings[4] risk-based capital requirements lower the probability of default and this way also the expected liability of the deposit insurance. However, static models do not consider the banks' franchise value (expected future income) and, therefore, they give an incomplete explanation of banks' capital. Dynamic models that consider the franchise value and the trade-off between the lower cost of debt finance and the marginal increase in the expected deadweight cost of liquidation are analyzed, e.g., in Milne and Whalley (2001), Milne (2002), and Pelizzon and Schaefer (2003). Peura and Keppo (2006) illustrate that this class of models explain the realized buffer capitals (capital excess the 8% requirement) reasonably well. In the present paper, we continue this dynamic modeling and create a realistic but stylized model of a bank and analyze the effects from MRR. In our model, a bank maximizes its value by taking the Basel minimum capital requirements as constraints. The bank collects gains and losses from two sources: basic banking business and investments in liquid financial assets. The basic banking business corresponds to selling loans and mortgages, while the liquid assets refer to stocks, bonds, and other traded financial instruments. Although during the last few years major US banks have made a significant part of their earnings by securitizing mortgages, about 47% of all their assets are real estate related (see Roubini, 2008). Thus, even after the widespread securitization US banks hold today a significant fraction of the mortgage credit risk on their balance sheets. The liquid asset investment is bounded since most of the bank's RWA are devoted to the basic banking business and since MRR sets constraints on the investment strategy. The bank also has a recapitalization option, but there exist a recapitalization delay and a fixed cost. The recapitalization delay is important since it implies a strictly positive default probability, and thus it makes sense to regulate banks in order to minimize their default probabilities.

We solve the optimal policy for recapitalizations, dividends, and liquid asset investments in a single optimization model. This is important since these decisions affect each other and, hence, cannot be analyzed separately. The bank maximizes the expected discounted dividends. If the buffer capital violates the market or the credit risk requirement the bank is liquidated. By dynamic programming, the value function satisfies a set of ordinary differential equations that we solve semi-analytically.

The market risk requirement affects the bank behavior and liquidation probability in several ways. First, it lowers the cash flow volatility, which naturally decreases the liquidation probability. Second, the requirement postpones recapitalization which raises the liquidation probability, because then the bank starts the recapitalization process closer to liquidation. Since the MRR lowers the liquid risky asset holdings, it also raises the marginal utility from the capital invested in the market. Therefore, the bank finds it optimal to start the recapitalization at a lower buffer capital level, where the marginal utility from that action is also high. Naturally this decreases the average buffer capital and this way the MRR may raise the liquidation probability. We show that when the liquid risky asset expected return and volatility are high this is indeed the case. Hence, MRR may cause both positive (fall in the cash flow volatility) and negative (fall in the recapitalization level) effects on the liquidation probability. This negative effect is due to the fact that the MRR ignores the recapitalization option. As indicated earlier, when the liquid risky asset expected return and volatility are high then the negative effect is stronger. In order to analyze the total effect from the MRR all the bank's actions have to be considered.

1.1. Prior literature

Several papers have analyzed banks' capitalization decision as a function of the buffer capital. Froot and Stein (1998) demonstrate that a bank investing in illiquid products may adjust its capital structure in order to accommodate the illiquid risks it chooses to bear. They show that equity capital is used as hedge against future losses from illiquid assets. Estrella (2001) uses a variant of the classical inventory or cash management models to study cyclicality of bank capital. By Heid et al. (2003), banks with low capital buffers build an appropriate capital buffer by raising capital and lowering risk. In contrast, banks with high capital buffers try to maintain their capital buffer by increasing risk. This is consistent with our model since in the present paper recapitalization is done at a low buffer capital level and the liquid risky asset investment

[3] Bhattacharya et al. (2002) and Marshall and Prescott (2006) studied situations where regulators have imperfect information.
[4] See Merton (1977), Furlong and Keeley (1989), and Sharpe (1978).