Comments on George Sheldon «Capital Adequacy Rules and the Risk-Seeking Behavior of Banks: A Firm-Level Analysis»

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1. WHICH ARE THE MAIN ARGUMENTS?

The rationale for bank regulation is always seen in the assumption and belief that a regulated bank is safer than an unregulated institution. But do capital adequacy rules in fact alter the portfolio selection of a bank such that it is exposed to fewer risks? Or are instead capital adequacy rules just another form of constraints? Constraints which hinder banks to select portfolios optimally, such that in the end banks are inclined to take more risks than they would without the constraint?

Bankruptcy occurs when a stated decline ΔA in the value of the assets A of a bank exceeds the equity, measured by its book value C – leave any correlated changes in the liabilities of a bank aside. Thus, in relative terms, bankruptcy occurs when

$$-\Delta A/A > C/A \tag{1}$$

occurs between two successive times of reporting. The left side is, apart from the sign, equal to the return on assets $ROA = \Delta A/A$. The right side is the capital-to-assets ratio CAR = C/A. Capital adequacy rules constrain the leverage ratio, requiring banks to hold a minimum, fixed percentage of equity against their assets. Hence capital adequacy rules attempt to control the capital-to-assets ratio CAR. By forcing CAR to become larger it seems less probable that the return on assets ROA during a certain time interval can be such negative that all the equity C gets wiped out.

Therefore it seems to be obvious that regulation, leading to a larger CAR, should reduce the probability of bankruptcy. Nothing however is said about any effects regulation might exercise upon the riskiness of the portfolio A. The riskiness of assets can be measured by the volatility of ROA, σ_{ROA} . If regulation, attempting to enlarge CAR, at the same moment increases the riskiness σ_{ROA} with which the bank invests her assets A, it could well be the case that the event (1) becomes more likely.

Following these lines of argumentation it becomes understandable that theoretical models of portfolio selection indicate that there is no clear answer whether the desired

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effects on CAR are outset by the adverse effects on the riskiness of assets or not (see also KEELEY/FURLONG [1990]). Since the theory is unclear, GEORGE SHELDON promotes his main message: The answer must be found by empirical research.

In order to decide in which direction capital adequacy rules alter the risk behavior of banks, he analyzed time series for a sample of 219 banks drawn from 11 Basle Committee member countries for the eight years from 1987–1994. This period covers well the years 1989 through 1993 during which the capital requirements – issued in 1988 by the Basle Committee on Bank Supervision – were adopted. So the eight years analyzed should very well indicate any changes in the risk behavior related to the stricter capital requirements which then took effect.

What makes empirical research more complicated is the fact that the volatility of returns on bank assets σ_{ROA} are not directly observable. Observable is the book value of equity, *C*, as well as the market value of equity (share prices), *E*. In particular, the return on equity ROE and its volatility σ_{ROE} can easily be calculated from time series of share prices. What is required is a link between the ROE and the ROA, or between σ_{ROE} and σ_{ROA} .

Here SHELDON uses a methodology which is based on former work of FURLONG (1988) and RONN/VERNA (1986). The relation between the market value of equity E and the wanted value of assets A is nonlinear. Equity must be viewed as an option to buy assets at the exercise price of current liabilities. To value the call option E, the BLACK-SCHOLES formula can be used. This formula implies that absolute changes in the call price E are related to absolute price changes of the underlying A through the option delta $N(-d_1)$. Hence the volatility of the ROE is λ times the volatility of ROA,

$$\sigma_{\rm ROE} = \lambda \cdot \sigma_{\rm ROA} , \qquad (2)$$

where $\lambda = N(-d1) \cdot A/C$ is the *lambda* which measures relative changes of the value of a call E in reaction to relative changes of the value of the underlying A. This relation is non-linear because λ depends on various variables such as the current value of A.

On the basis of the revealed volatility of assets σ_{ROA} and the capital-to-assets ratios CAR it is possible to determine probabilities of bank failure. Under assumptions which are also consistent with the BLACK-SCHOLES formula (the value of assets follows a geometric Brownian motion), the return ROA will be normally distributed for every time interval. Let μ_{ROA} denote the mean of ROA and get

$$Prob(default) = N (-CAR - \mu_{ROA}) / \sigma_{ROA}$$
(3)

as the probability of all book value of equity C being wiped out at the end of the period upon which ROA refers.

You may ask whether the probabilities of bank failure are not directly observable via ROE. Is bankruptcy not equivalent to the event ROE < -100%, as assumed by FURLONG

(1988)? Rather than that, SHELDON links bankruptcy, via (3), to the book value of equity C and to the return on assets. This corresponds to the legal practice.

The empirical findings are mixed. Capital adequacy rules led to larger capital-toassets ratios CAR only in very few member countries (USA, Japan, France, the Netherlands), while the Basle guidelines had little impact on the relation between book value of equity C and assets A in other countries. SHELDON explains this by the former status quo of the bank regulation in particular in the US and in Japan. There is however empirical evidence that tougher regulation tends to reduce the probability of bank failure, and only for the banks in the USA and in Japan the riskiness of assets increased during the period of the implementation of the Basle accord.

2. WHEN DOES A BANK GO BANKRUPT?

It is a pleasure to read a good paper and it is more difficult to make comments on a good piece of research. SHELDON convinces by linking bankruptcy to the event that the book value of equity is wiped out – not the market value of equity. Since the leverage of banks is usually larger than that of non-financial firms, it is also important to take the non-linear relation (2) between the volatility of ROE and ROA into account. The paper also convinces in the empirical approach based upon the large sample which covers 219 banks over eight years.

Here we can add only three points to the question which conditions can yield to bankruptcy: What also matters is the riskiness of liabilities, the time length between reporting dates, and the governance structure. These three factors may overlay the riskiness of assets, and thereby distorting somewhat the approach to assess the default probability by exploring the volatility of return on assets alone.

First it remains to mention that the riskiness of a bank is not only given by the riskiness of assets. After the default of given loans the major risk factor which drives the market value of a bank's equity is interest rate risk. Both assets and liabilities are exposed to interest rate risk. In the framework presented, only the non-hedged part of interest rate risk is revealed: SHELDON's analysis attributes all the volatility of ROE to the riskiness of assets alone. Thus it could be that the true riskiness of bank assets could have been even larger than stated, but that some of that risk was hedged by a positively correlated volatility of liabilities. There could be implications of considering only «net» risk, though, but the paper does not mention similar effects.

A second point which deserves further consideration is the time horizon. SHELDON measures the riskiness of a bank by the probability that the equity will be wiped out at the end of a period with a certain length (here one year). No question about what could happen in between. Consider two policies to invest assets, one riskier than the other, but the riskier one also promises a larger expected ROA. For a very short time interval, the riskier policy shows a larger default probability, but – given today's information – it also promises a lower default probability in the long run because of the larger expected return.

It could well be the case that the two policies exhibit the same shortfall risk at a particular point of time T in the future, i.e., the same probability of default at T. Certainly, for any reporting dates before T the more volatile policy leads to larger shortfall risks, while for reporting dates *after* T the less volatile policy (due to the lower expected return) exhibits a larger default probability. This effect is due to differences in the expected return on assets, which are not considered in the analysis. The figure might serve as an illustration.



The figure shows, for two policies, the respective range of asset values as time elapses. The indicated range is for each policy the respective interval in which the asset value will fall with probability 95.44%, i.e., the width of the range is 2 times sigma around the expected value. In logarithmic scale the expected value of A_t is a linear function of time t (straight line), while the standard deviation of the return till time t increases with the square root of t. At the particular point of time T the two policies have the same probability (i.e., 2.28%) that assets fall below liabilities L. A_0 denotes the starting value of assets.

In analytic terms, denote by $\mu_1 > \mu_2$ the expected values and by $\sigma_1 > \sigma_2$ the standard deviations of ROA₁ and ROA₂ of both investment policies 1 and 2. Under policy *i*=1,2, for any point of time *t* > 0 the value of assets A_t will fall with probability N(-k) below the boundary A_{min} where

$$\ln A_{\min} = \ln A_0 + t \cdot \mu_i - k \cdot \sqrt{t} \cdot \sigma_i,$$

(4)

where, e.g., N(-1) = 15.87%, N(-2) = 2.28%, and N(-3) = 0.14%. Formulae (4) is based on the fact that the standard deviation of a return increases with the square root of the length of period while the expected value increases linear in time. Now set the liabilities L equal to A_{min} . Then both policies 1,2 have the same default probability, N(-k), at time T if

$$\ln L - \ln A_0 = T \cdot \mu_1 - k \cdot \sqrt{T} \cdot \sigma_1 = T \cdot \mu_2 - k \cdot \sqrt{T} \cdot \sigma_2.$$
(5)

This remark should say that there is an effect of the expected value of returns. If risk is measured by the default probability, the risk to fall short of liabilities, then riskier investments are «safer» in the long run, while less volatile investments are «safer» in the short term, but riskier in the long run. The paper presented, which assumes an annual reporting frequency, does not say whether these effects could have importance or not.

The third point is governance. As many cases of bank failure indicate, the often assumed mechanics between poor investment results and failure becomes less rigid if the governance structure of the bank permits wise decision-making in a crucial moment of her existence. Thus, a wisely governed bank could turn out to be less risky (in terms of the probability of bankruptcy) compared to a bank which has the same investments but a poor governance.

These three points should be understood as possible directions of future research but certainly not as a reduction of the value of GEORGE SHELDON's fine paper.

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