CAPITAL REGULATION AND RISING RISK OF BANKING INDUSTRY: A FINANCIAL ACCOUNTING PERSPECTIVE

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ABSTRACT

Presently, it is almost blasphemous to speak unfavorably of bank capital regulation. Although some researchers were pointing out the ills of capital regulation, the voices are subdued now; capital regulation is taken for granted. Attention is shifted towards locating proximate causes of rising risks of banking industry. It is often forgotten that bank capital needs to be serviced by a certain market-determined ROE. When the assets-generation capacity of banks is restricted by regulatory capital-ratio, banks are induced to seek high-return-high-risk assets to satisfy the required ROE. By adopting a financial accounting approach we have shown that due to regulated capital-ratio assets generation capacity of US banks has been halved while, return on assets has doubled and loss on assets has increased by 2.5 times. Thus, capital regulation has increased the risk of banking industry, rather than reducing it.

Key words: Banking industry; Financial markets; Central bank policy; Capital regulation; Capital-assets Ratio; Risk; Time series models.

INTRODUCTION

Banking is the most regulated among all industrial sectors of the economy. Thirty years ago Buser, Chen and Kane (1981) remarked that, "a bank has traditionally been conceived as more than just another business firm; it operates under unusual regulatory restrictions …..". Since then the regulatory environment surrounding banks has not changed much. When financial market was deregulated in the early 1980s banks were reregulated by more stringent capital regulation which restricted their asset generation capacity. Banking is now the only industry that is subjected to international capital regulation supervised through Basle Capital Accords.

Banks may be special institutions but they are primarily business organizations whose ultimate aim is to generate enough profit to satisfy a market determined ROE. Capital structure (mix of equity and debt) of any business is an endogenous variable geared towards generating a required level of sales (which is also an endogenous variable) with a certain return from which to earn the required profit to satisfy the required ROE. For banks, sales are analogous to generating banking assets; everything else is same. Regulatory intervention seeking to alter the capital structure of banks, transforms the character of some of the endogenous variables (like leverage,

assets-capacity etc.) to exogenous variables. As capital regulation is administered through capital-assets ratio, a rise in the ratio lowers down the sales (banking assets) generation capacity of banks. A transition from a low capital regime (pre-regulation) to high capital regime (post-regulation) 'reduces the banks' future ability to pledge which can lead to a bank run because maturing deposits may exceed what the bank can pledge' (Diamond and Rajan, 2000). With fewer assets available banks may be forced to cross boundaries and reach for high-return-high-risk assets which has the potential of endangering the system as a whole.

In particular, the paper seeks to establish the following:

1. Bank capital regulation has reduced the rate of growth of assets of US banks substantially over the pre-regulation period. The reduced level of assets has motivated the banks to make investments in assets with higher rate of return in order to earn enough to satisfy required return on equity (ROE).
2. As higher rate of return on assets is associated with higher risk, capital regulation has ultimately resulted in increasing level of asset losses, thereby increasing the risk of the banking industry.

Unlike Saunders (2000) and Flannery and Rangan (2004) who prefer market value accounting, we have followed book value accounting as in Kopecky and VanHoose (2006). This approach appears to be more appropriate while presenting a critique of bank capital regulation which itself is based on book-value accounting. Moreover, closure decisions of bank regulators are also based on book value accounting. Definitions of variables are given in the Appendix.

The study is based on the data of US insured banks for the period, 1950-2004 as available from Historical Statistics on Banking published by Federal Deposit Insurance Corporation (http://www2.fdic.gov/hsob/hsobrpt.asp, accessed on June 26, 2011).

Prior to 1980 bank supervisors in the US did not impose specific numerical capital adequacy standards. Instead, the supervisors applied informal and subjective measures tailored to the circumstances of individual institutions. Since 1980, bank supervisors had placed much more emphasis on precisely defined numerical minimum capital standards. This was later firmed up with the passage of Institutional Lending and Supervision Act of 1983, which adopted a leverage ratio of primary capital (consisted mainly of Equity and Loan Loss Reserves), to average total assets (Besanko and Kanatas, 1996; Federal Deposit Insurance Corporation (FDIC), 2003). The first Basle capital accord, which was introduced in 1988, expanded the idea and brought in international convergence of capital standards. The data-period for the study is, therefore, divided in two parts: (1) Pre-regulation period (1950-1979) and (2) Post-regulation period (1980-2004).

The study is diagnostic in nature. Statistical models presented in the text are based on ordinary least square linear regression. In a time series model presence of serial correlation,

though does not cause bias in the estimate of the regression coefficients, may result in underestimation of standard errors (and overestimation of 't' values), which may question the validity of the model. We have, therefore, tested autoregressive models as prescribed in the Ochrane-Orcutt estimation procedure wherever serial correlation is found to be present at α=0.01. It has been observed that though the 't' values of regression equations have fallen as expected, they mostly remain significant (or otherwise) as in OLS estimations presented in the text.

We have not also detrended the data in the text, as our purpose is to capture the trends. However, in order to bring out the correct trends it may be necessary to eliminate any obscuring cyclical or random (irregular) fluctuations. Following Demirgüc-Kunt and Detragiache (2005) we have excluded unusual years from our data set, wherever found appropriate, to partially minimize the impact. Additionally, we have run regressions on three-year moving average data of the variables. Findings are similar to those in the text.

General assumptions

1. Cash flows from securitized assets are continuously invested in either balance sheet assets or other securitized assets. Income (loss) derived from such transactions is ultimately reflected in the return on (balance sheet) assets.

Risk is defined as the probability of loss of assets. As losses are materialization of risks, rise in assets loss is considered as an indicator of rising risk of the banking industry.

2. While calculating capital ratios subordinated debt is excluded; only Tier I capital (equity) is considered. This is in line with major studies cited above. For the period 1980-04 average subordinated debt is found to be only 11.5 percent of total 'regulatory capital' of US banks.

RELATED LITERATURE

There are arguments for and against capital regulation, which are summarized below. Some of the papers referred here have featured in both sets of arguments. This is either due to their being review articles or the author(s) is (are) referring an argument which may not be the main theme of the paper. Our intention is to divide the arguments between two groups, not the authors.

Arguments for Capital Regulation

1. Banks are more risky than any other business firm; capital reduces banks risk-taking ability, provides risk-mitigating incentive for bank managers (Ross, 1977, Harris and Raviv, 1990, Cebenoyan and Strahan, 2004).
2. Banks are vulnerable to runs due to provision of liquidity services; the depositors suffer from an asymmetry of information about bank's assets which may cause runs; an all deposit structure could lead to runs when real assets value falls; bank's capital, therefore, provides a kind of cushion against losses for depositors (Diamond and Dybvig, 1983, Jacklin and Bhattacharya, 1988, Bhattacharya and Thakor, 1993, Kashyap, Rajan and Stein, 2002, Morrison and White, 2005).
3. Increase in leverage increases the cost of financial distress; cost of financial distress rises with the decline of capital ratio (Cooke, 1990, Berger, Herring and Szego, 1995).
4. Banks are prone to take extra-ordinary risks; high risk-taking has almost become part of banking culture---a protective equity cushion should vary directly with a bank's risk exposure (Kerkhof and Melenberg, 2004; Lindquist, 2004,. Kopecky and VanHoose, 2006, Rajan, 2005, Kashyap, Rajan and Stein, 2002).
5. Capital regulation is necessary for long-term solvency and public credibility--- capital acts as a buffer against insolvency; maintenance of a sufficient capital cushion can solve the financial fragility problem and prevent liquidity crisis from occurring. (Dowd, 2000, Kashyap, Rajan and Stein, 2002, Barrios and Blanco, 2003).
6. In the absence of sufficient equity 'at stake' banks may make investment decisions which could be sub-optimal for the society, though optimal for the shareholders; banks are motivated to reduce assets risk on the face of higher capital requirement; it induces the banks to choose safer assets, thereby mitigating 'moral hazard' problem that depositors face. (Furlong and Keeley, 1989, 1990, Cooper and Ross, 2002).
7. Capital regulation has the desirable effect of discouraging unsound and undesirable institutions from setting up operations (Morrison and White, 2005).
8. Increasing the capital standards results in a contract adjustment that mitigates between the higher cost of required capital and the cost of probable bankruptcy, which lowers the risk of insolvency (Santos, 1999).

9. When monitoring costs are above a critical level, regulators are able to increase efficiency by imposing higher capital adequacy requirement (Morrison and White, 2005).
10. In a real world, only a small fraction of the banking system is typically constrained by capital requirements (VanHoose, 2007).
11. Capital regulation is necessary but, in a dynamic environment, it is not sufficient to protect banks from high risk-taking; it should be combined with deposit-rate controls (Hellman, Murdock and Stiglitz, 2000).

Arguments against Capital Regulation

1. Higher capital ratio does not always predict a lower probability of bank failure--- the relationship between the capital ratio and bank safety is often weak (Thomson, 1991).
2. Capital regulation decreases loan supply, dampens entrepreneurial activity, reduces the size of banking industry and quantity of intermediation; it may also exacerbate the business cycle and even accentuate systemic risk (Santomero and Watson, 1977, Crocket, 2000, Acharya, 2001, Kopecky and VanHoose, 2004, Estrella, 2004).
3. If it is too costly for a bank to raise equity to meet higher capital standards tomorrow, an alternative is to increase the risk today (Blum, 1999).
4. The countercyclical regulatory capital requirements are inconsistent with 'market capital requirements' prompting banks to escape stricter regulatory norms in good times by regulatory arbitrage, while providing little relief in bad times as banks are held to the higher market norms (Diamond and Rajan, 2009)
5. A higher capital requirement acts as a tax on depositors; it discourages risk-taking behavior of banks, which reduces inter-bank competition for deposits to the disadvantage of the depositors (Bhattacharya and Thakor, 1993).
6. When banks are forced to increase the capital ratio that lowers the expected return, they may respond by choosing assets portfolio with higher risk; higher capital requirement might induce banks to seek higher returns in areas that are high risk or outside their core business (Kim and Santomero, 1988, Rochet, 1992, Gennotte and Pyle, 1991).
7. Capital regulation, if not based on any consistent economic soundness standards, results in regulatory tax which drives the market to seek alternative ways to reach equilibrium like, regulatory capital arbitrage, innovative and often risky financial instruments etc. (Kane, 1997,

Gardner, 1988, Donahoo and Shaffer, 1991, Merton, 1995, Jones, 2000, Pauls and Lacour-Little, 2004).

8. Supervisory capital restrictions have become effectively irrelevant to the largest US banks since about 1992 as they have chosen their own (market valued) capital ratios in response to market pressure (Flannery and Rangan, 2004).
9. Capital regulation by requiring more capital affects the flow of credit and makes the bank riskier; it also increases the bank's effective cost of capital (Diamond and Rajan, 2000).

During recent times, advocates of capital regulation have marched over those against it. Current belief is that bank capital has special purposes not amenable to market laws; when risk goes up banks should increase capital because they need larger buffer. To echo a sarcastic Miller (1995), 'when it comes to banking the market cannot be left to their own devices'. In fact, bank capital regulation is based on this premise. Capital regulation is now taken for granted. The question now is not on the efficacy or otherwise of capital regulation but on the arithmetic of calculating capital-assets ratio and the algebra of risk models to determine what should be the appropriate ratio. None of the financial liberalization indexes developed by various researchers considers bank capital regulation as an indicator of financial repression (Abiad and Mody, 2005) though, capital regulation has the effect of reducing the size of financial intermediation. The Board of Governors of Federal Reserve System while presenting "The Supervisory Capital Assessment Program (SCAP): An Overview of Results" (2009) has aptly captured the essence of the current mood:

> "A banking organization holds capital to guard against uncertainty. Capital reassures institution's depositors, creditors and counterparties –and the institution itself – that an event such as an unexpected surge in losses or an unanticipated deterioration in earnings will not impair its ability to engage in lending to creditworthy borrowers and protect the savings of its depositors".

The report goes on to determine the amount of additional capital that the 19 largest BHCs are required to bring in. Although at the year-end 2008 all the 19 BHCs have exceeded minimum regulatory capital-ratios, the report has advocated increase of capital for about half of these BHCs……requiring banks to hold a capital buffer stems from the fear of costly regulatory actions including loss of charter if there is a violation of the minimum capital standards in future for reasons beyond the control of banks.

Literatures published in the aftermath of the recent financial and banking crisis have highlighted the existence of a culture of excessive risk-taking due to high performance pressure on the CEOs of banks resulting in huge investment of short-term fund in exotic mortgage backed

securities and other risky loans (see for example, Diamond and Rajan, 2009). Fahlenbrach and Stultz (2009) have found that CEOs took exposures that they felt were profitable for their shareholders *ex ante* but these exposures performed very poorly *ex post*.

The first point that is missed in the debate is why there is a change in banks' risk-taking behavior. Bankers are known to be conservative people. They are used to operate within a narrow risk band and do not normally accept greater risks for higher margins (Bourke, 1990). Why then during the past two decades they have crossed the boundary and reached for high-risk-high-return assets? What is the immanent cause behind such a high 'return pressure' on CEOs of banks?

The second point is the virtual unconcern about servicing the capital that banks hold, or are required to bring in to conform to the capital standards. As in any other firm it is the stock-holders who supply the risk-capital to banks. The required return on banks' capital depends on the market portfolio plus premiums for banks' exposure to default risk, liquidity risk, yield curve risk etc. (Dewnter and Hess, 1998). Banks' scale of business must be such as to meet the required return. When the scale of business is restricted banks may be forced to seek assets with higher yield to meet the required return.

It is often said that the banks should be subjected to market discipline. But equity holders are often not considered as constituents of the 'market'. For example, Flannery and Rangan (2004) define market as bank counterparties, which comprise 'depositors, guarantee beneficiaries, FX and derivative traders' but not the equity investors[1].

Some of the literatures mentioned above have cited financial deregulation, competition, financial market developments, impact of information technology and return to scale etc. while explaining dismal performance of banks that has led to the recent crisis. We have, instead put forward a single variable (capital regulation) explanation for the rising risk of banking industry.

Rest of the paper is organized as follows. In Section 3, we have analyzed the negative impact of regulated capital-assets ratio on the assets generation capacity of banks and rise in return on assets as a consequence of it. In Section 4, we have shown that increase in loss on assets is related to the rise in return on assets and, ultimately to the capital ratio. Conclusion is reached in Section 5.

INTER-RELATIONSHIP AMONG CAPITAL, ASSETS, ROA AND ROE

The basic equations that capture the relationship among equity capital(C), assets (A), net earnings (E), return on assets (ROA) and return on equity (ROE) are given by,

$$ROE = E/C \quad (1)$$

$$Or,\ E = ROE*C \quad (2)$$

E is further defined as A*ROA. Equation (1) can now be rearranged as,

$$A * ROA = ROE * C \quad (3)$$

The following equations are derived from EQ. 3

$$C = (A*ROA)/ROE \quad (4)$$
$$C/A = ROA/ROE \quad (5)$$
$$A = ROE\ (C/ROA) \quad (6)$$
$$ROA = (ROE * C)/A \quad (7)$$

Eq. 5 is an accounting identity the LHS of which is capital-assets ratio CAR). Hence,

$$ROA = ROE * CAR \quad (8)$$

Reciprocal of capital-assets ratio (CAR) is the capital multiplier which we denote as M. It determines the level of assets for a given amount of capital. Hence Eq. 6 can be rearranged and restated as

$$A = C * M \quad (9)$$

As income and assets strategies of a bank are determined *ex-ante* (explained below) henceforward, we shall be taking the income and assets variables at before income/assets loss like, Assets before loss (ABL), Earnings before loss (EBL), Return on assets before loss [ROA (B)], Return on equity before loss [ROE (B)] etc. These are more fully defined in the Appendix.

Return on Equity

ROE of an industry is market determined in a risk-return framework. ROE should remain constant or change slowly over a long period. When there is a substantial shift in the required ROE, it can be presumed that market has altered the risk-return characteristics of the industry[2]. In fact, growth rate of ROE (CAGR) of US banks has been a mere 0.46 percent for the period, 1950-2004.The null hypothesis that mean ROE of 1950-79 has remained same during 1980-04 [H_0: $\mu_1 - \mu_2 = 0$] cannot be rejected ($Z<1.96$) at $\alpha = 0.05$.

In this study we have used accounting ROE which may be different from a market determined ROI. We assume that accounting ROE is the book value return expected by the bank/investor to satisfy the required market return. Hence, accounting ROE is considered as a proxy for the market ROE.

ROE is not dependent on the amount of capital but on the risk characteristics of the business. It is, therefore, not advisable to establish a functional relationship between ROE and capital. However, variation in ROE (B) can be measured indirectly by establishing a functional relationship between EBL and capital as in EQ. 1. Regression results are shown in Table 1.

Table 1: Results of Regression Analysis: EBL vs. Capital		
Period	Constant	Coefficient of Capital
1950-1979	-1484.16 (-0.405)	0.179**** (56.91)
1980-2004	-5529.67 (-1.782)	0.177**** (22.07)
****significant at $\alpha < 0.001$.		

Table 1 shows that the coefficient of capital, which is actually the ROE (B) of the industry in terms of Eq. 2, has remained almost constant at around 18 per cent during both pre- and post-regulation periods.

Income strategy of banks

With the ROE thus fixed (and it is risky for a bank to alter the ROE as capital may move out or move in to the disadvantage of the bank) the earnings of a bank should rise or fall in response to the rise or fall in capital.

Income strategy of a bank in the absence of capital regulation should be as below:

Required **To be achieved**

C * ROE (B) = EBL = ROA (B) * ABL

where, ROE (B) is fixed and there is no restriction to assets growth.

When there is no restriction to assets growth, and assuming that there are enough investment opportunities available in the market at a given risk-tolerance rate, the required earnings can be achieved by increasing assets proportionately without altering the standard ROA(B). When regulatory capital-assets ratio (CAR) restricts the growth in assets by a certain capital multiplier (M), [which is the reciprocal of CAR], the bank has to increase earnings (EBL) by investing in assets with higher returns (which may fall beyond the existing risk-tolerance level of the bank). Income strategy of the bank, therefore, changes during the regulation period as shown below:

Required **To be achieved**

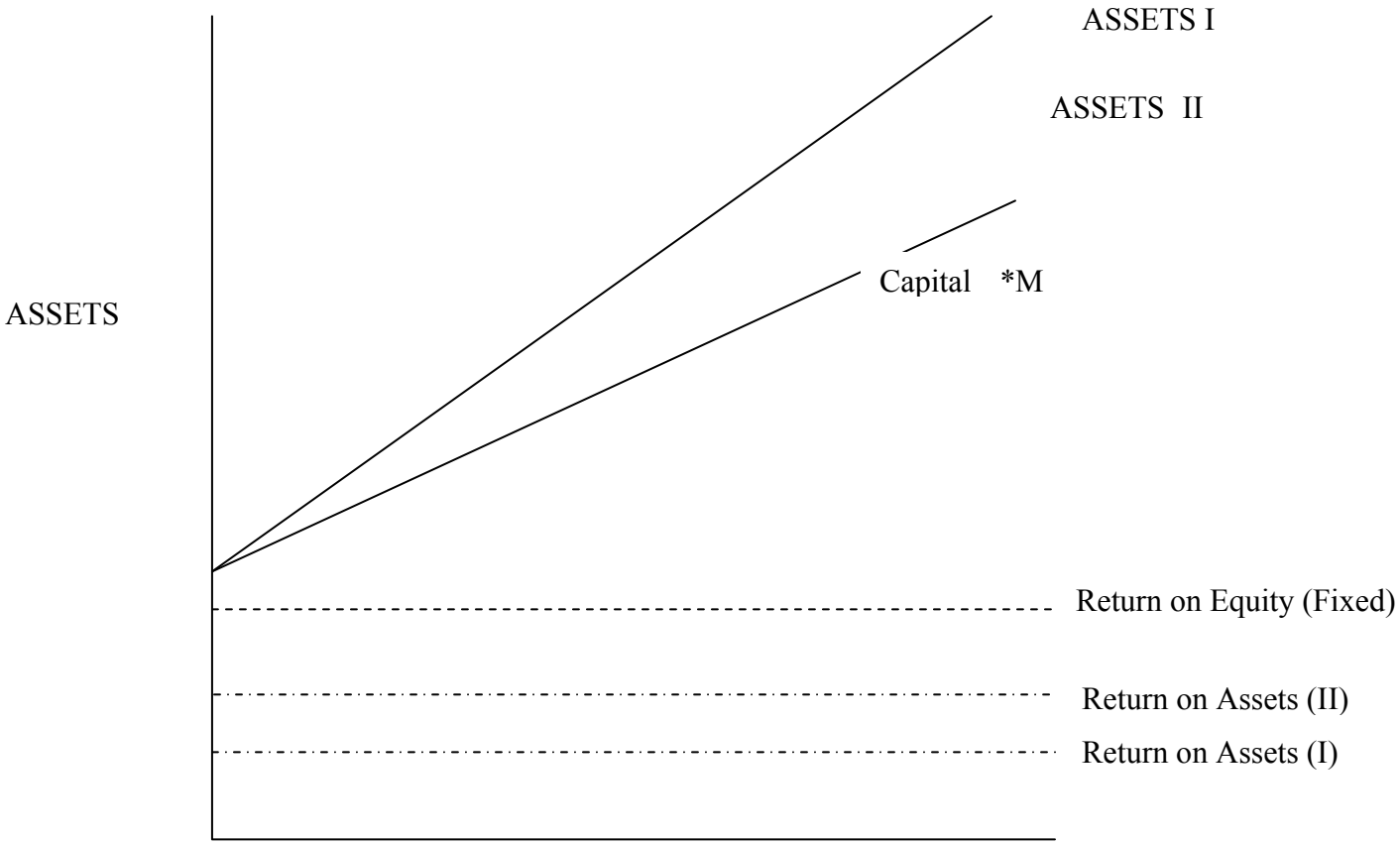
C * ROE (B) = EBL = ROA (B) * C * M

where, ROE (B) is fixed but there is restriction to assets growth.

In period I (pre-regulation) Assets (I) grow freely with the rise in capital at a given ROA(I). In period II (post-regulation), growth of assets is lower than in period I as it is restricted by the capital-multiplier (M). When capital increases in period II earnings shall increase to ROE

* C′, ROE remaining constant, but assets could be increased only up to C′ * M which is less than Asset I. Consequently, return on assets increases to level II.

Figure 1. Movement of Assets and Return on Assets during pre- and post-regulation periods.



Hence, ROA (II) = E′/ (C′ * M) or, (ROE * C′)/ (C′ *M) or, ROE/M.

We can now rewrite the pre-and post- regulation strategies of banks in terms of capital-multiplier (M) as follows:

Pre-Regulation

Required		**To be achieved**
C * ROE (B)	= EBL =	ROA (B) * C * M_u

Post-Regulation

Required		**To be achieved**
C * ROE (B)	= EBL =	ROA (B) * C * M_r

Subscripts $_u$and $_r$ denote unrestricted and restricted level respectively.

The following two propositions follow from this:

1. When $M_u/M_r > 1$, ROA_r will increase (decrease) by the same ratio, i.e.,

$<ROA_r = ROA_u * (M_u/M_r)$.

It follows from Proposition 1 that when $M_r = M_u$ there is no change in ROA. Banks have no incentive to go beyond their risk-tolerance level and contract assets with higher return (and higher risk) as they are able to meet the required ROE.

Impact on assets growth

Pre-regulation period

Equation 9 can be modified as below:

$$ABL_u = C * M_u \quad (10)$$

where $C>M_u$. Subscript $_u$ denotes 'unrestricted'. An examination of the equation indicates the following.

When both C and M changes, assets (ABL) will change by the following equation/rules.

$$a_u = C\, m_u + M_u\, c + m_u c \quad (11)$$

where a, m, and c are respective changes in assets (ABL), capital multiplier (M) and capital (C).

During the pre-regulation period there was no restriction to assets growth except what was endogenously determined by the banks. The level of capital was a matter of capital structure policy of a banking organization. Assets policy, on the other hand, was determined more independently of capital except that it must be sufficient to service the capital by a given ROE. M_u could be varied to achieve a desired level of assets growth without changing the level of capital ($\partial ABL_u/\partial M_u = C$).

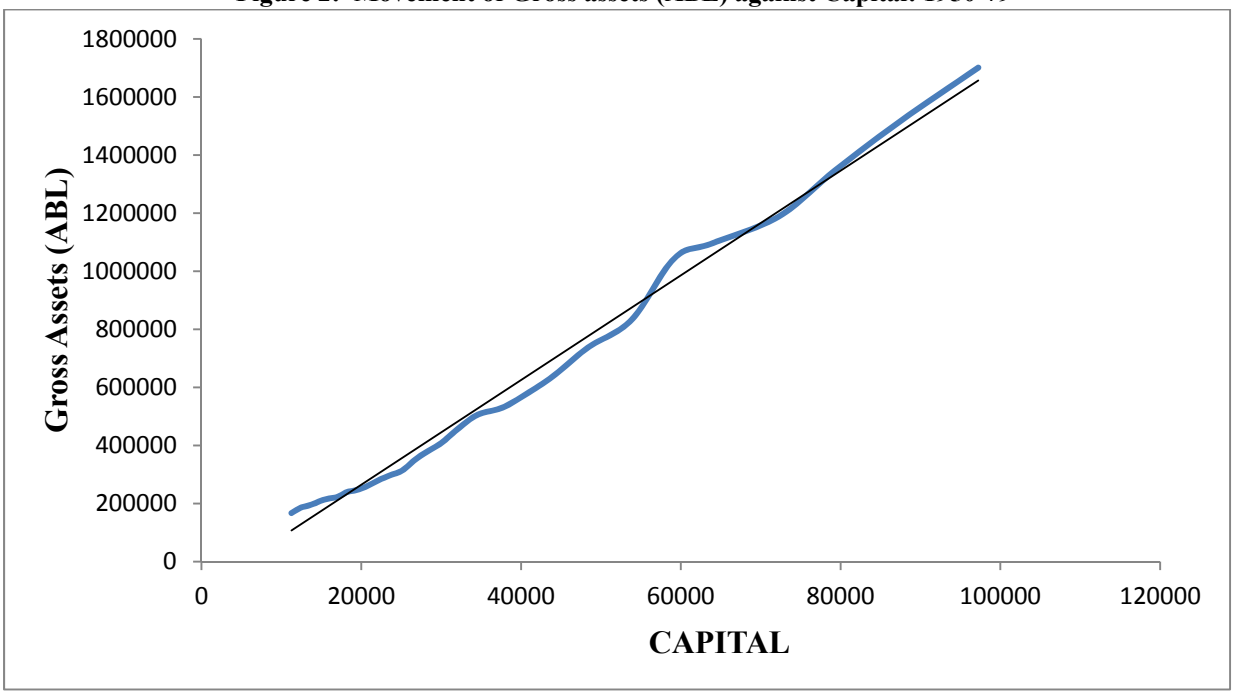
Equations 9, 10 and 11 also tell us that when there is a change in both C and M_u, even by the same percentage, change in ABL_uwill be more than proportional to change in C provided the change is in the same direction.

Banks also have the option not to change M_u while allowing capital to change in which case change in assets (ABL_u) will be proportional to change in capital. When banks change the M_u keeping capital fixed change in ABL_u will be proportional to the change in M_u.

It may be noted that all the options mentioned above were available only in the pre-regulation period.

In Figure 2 we have shown the movement of gross assets (ABL) against capital of US banks during the pre-regulation period (1950-79). The graph shows that assets growth vis-à-vis capital has followed the rules laid down above. The trend line suggests that growth of assets is proportional to the growth of capital during the first-half of this period but during the second-half assets have grown more than proportionately to the growth of capital.

Figure 2: Movement of Gross assets (ABL) against Capital: 1950-79



Post-regulation period

During this period Eq. 10 takes the following form:

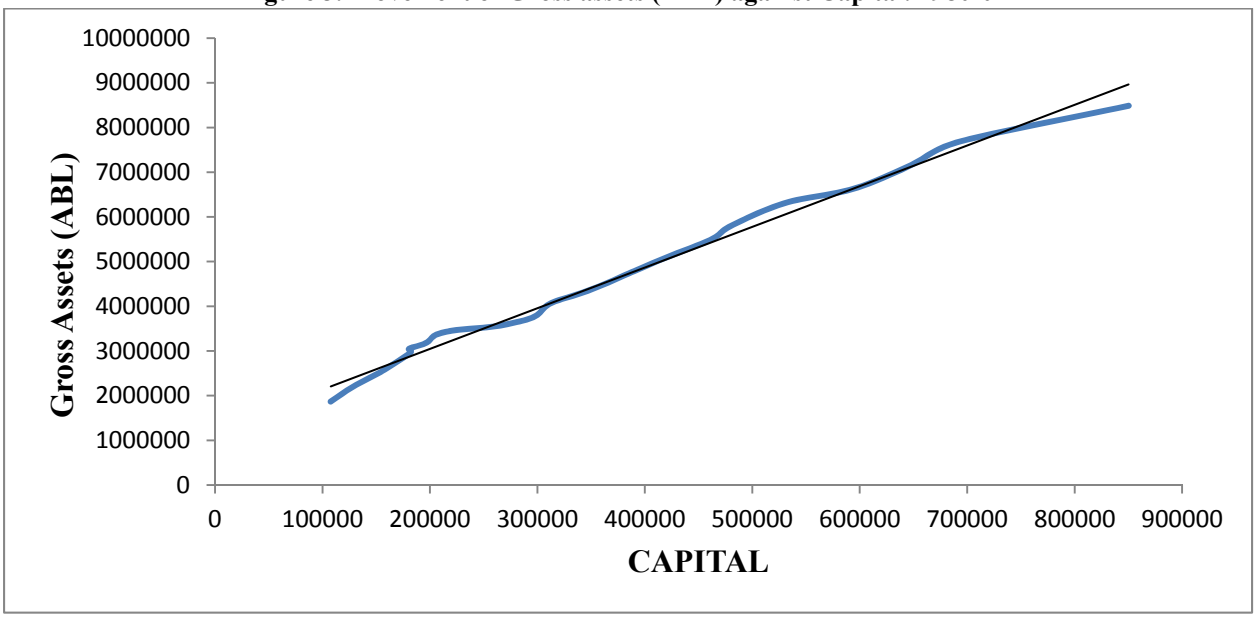
$$ABL_r = C * M_r \quad (12)$$

where, $C > M_r$. Subscript $_r$ and denotes 'restricted'. Eq. 11 becomes,

$$a_r = C\, m_r + M_r\, c + m_r\, c \qquad (13)$$

In the regulation period M is determined exogenously by the regulated capital-assets ratio which also remains fixed for a certain period. Banks can increase assets only by increasing capital. When M_r is fixed change in assets w.r.t change in capital is determined by $\partial ABL_r/\partial C = M_r$. Hence, growth of assets will be proportional to the growth of capital. Besides, when M_r is fixed the first and third term of the RHS of Eq. 13 will be zero. We also find from Table 2 that $M_r < M_u$ hence, $a_r < a_u$, which suggests that the growth of assets during the regulation period will be lower than the growth of assets during the pre-regulation period.

Figure 3. Movement of Gross assets (ABL) against Capital: 1980-04



In Figure 3 we have plotted movement of gross assets (ABL) against capital during the post-regulation period. When we compare Figure 3 with Figure 2 we observe that the growth curve has shifted downwards to almost 45^0 during 1980-04. This suggests that during the regulation period (1) growth of assets vis-à-vis capital has fallen substantially and (2) growth of assets is almost proportional to the growth of capital.

We have also done a regression analysis between ABL and capital for both the pre- and post-regulation period (Table 2).

Table 2 shows that the coefficient of capital [which is the capital-multiplier (M)] has almost been halved during the post-regulation period, which means lowering down the assets generation capacity of banks to almost half of what it was during the pre-regulation period. A lower M also indicates that banks are required to bring in additional capital to meet the regulatory requirements. In fact, during the regulation period mean percentage growth of capital

has increased to 9.1 as compared to 7.7 during the pre-regulation period. This additional capital has to be serviced at current ROE, which puts pressure on the profitability of bank assets. With fewer assets available for every rise in capital base there should be an upward pressure on ROA (B) during the regulation period.

Table 2: Results of Regression Analysis: Gross Assets (ABL) vs. Capital		
Period	Constant	Coefficient of Capital
1950-1979	-95102**** (-6.85)	18.01**** (55.84)
1980-2004	1225491**** (16.29)	9.11**** (46.88)
**** Significant at $\alpha < 0.001$.		

Impact on Return on Assets

Equation 8 explains the behavior of ROA. The modified form is given below.

$$ROA(B) = ROE(B) * C/ABL \quad (14)$$

The equation tells us that when ROE(B) is fixed (as we have observed before) the rate of change of ROA(B) depends upon the ratio, C/ABL. That is, if the ratio increases/decreases ROA (B) will also increase/decrease.

The ratio can be increased by

1. (a) increasing C keeping ABL constant;
   (b) decreasing ABL keeping C constant;
   (c) increasing both C and ABL but the rate of increase in C must be greater than the rate of increase in ABL;
   (d) decreasing both C and ABL but the rate of decrease in ABL must be greater that the rate of decrease in C.

The ratio can be decreased by

2. (a) decreasing C keeping ABL constant;
   (b) increasing ABL keeping C constant;
   (c) decreasing both C and ABL but the rate of decrease in C must be greater than the rate of decrease in ABL;
   (d) increasing both C and ABL but the rate of increase in ABL must be greater than the rate of increase in C.

In case of 1.(a) the rate of change of ROA(B) w.r.t C is given by ∂ROE(B)/∂C = ROE(B) * 1/ABL. But ABL cannot be held constant when capital changes because any change in C is reflected by a corresponding assets flow on the other side of the balance sheet. Similar is the case with 2.(a). As both 1.(a) and 2.(a) are not obtainable in real-life situation we are excluding them from our analysis.

Capital (C) is constant in both 1.(b) and 2.(b). With the ROE(B) already fixed, the rate of change of ROA(B) w.r.t ABL should be in the opposite direction of ABL i.e., [∂ROA(B) / ∂ABL] = -[ROE(B)*C] / ABL^2. That is, when ABL decreases/increases ROA(B) will increase/decrease; the rate of change however increases with the increase in ABL.

Options 1.(b) and 2.(b) were particularly available during the pre-regulation period but these were not typically exercised as such, though post-facto realization/observation might appear to be so, because in absence of regulated capital-assets ratio determination of the level of capital and assets was virtually independent of each other; the only consideration being servicing the capital by a given ROE.

During the regulation period banks might choose option 1.(b) to increase the ratio by pruning the assets instead of going for additional capital. When the assets base is thus lowered the ROA(B) would increase as indicated by the partial derivative shown above. During this period banks can also exercise options 1.(c) and 1.(d) which would have similar effect on the ROA(B).

The ratio could be decreased under options 2.(c) and 2.(d). Both the options were available during the pre-regulation period. But it appears from Fig. 2 that during this period banks had increasingly exercised option 2.(d)

In Figure 4 and 5, we have shown movement of return on gross assets [ROA(B)] against gross assets (ABL) of US banks for periods, 1950-79 and 1980-2004 respectively. It may be noticed that there is a rise in ROA(B) during 1980-2004 as compared to the previous period because the rate growth of assets during the regulation period is lower than what it was during the pre-regulation period.

Similar to the issue of determining the ROE(B), it is not advisable to establish a direct functional relationship between ROA(B) and ABL because a bank *ex-ante* decides the level of earnings (EBL) based on capital expansion and fixed ROE (B); it then decides a volume and a class of assets the average return of which would generate enough earnings to reach the targeted EBL. ROA(B) has, therefore, a chain relationship with all these variables. However, it is possible to determine the ROA(B) indirectly by establishing a functional relationship between EBL and ABL as we have done in Table 3.

Figure 4: Movement of Return on Gross Assets [ROA (B)] Vs. Gross Assets (ABL): 1950-79

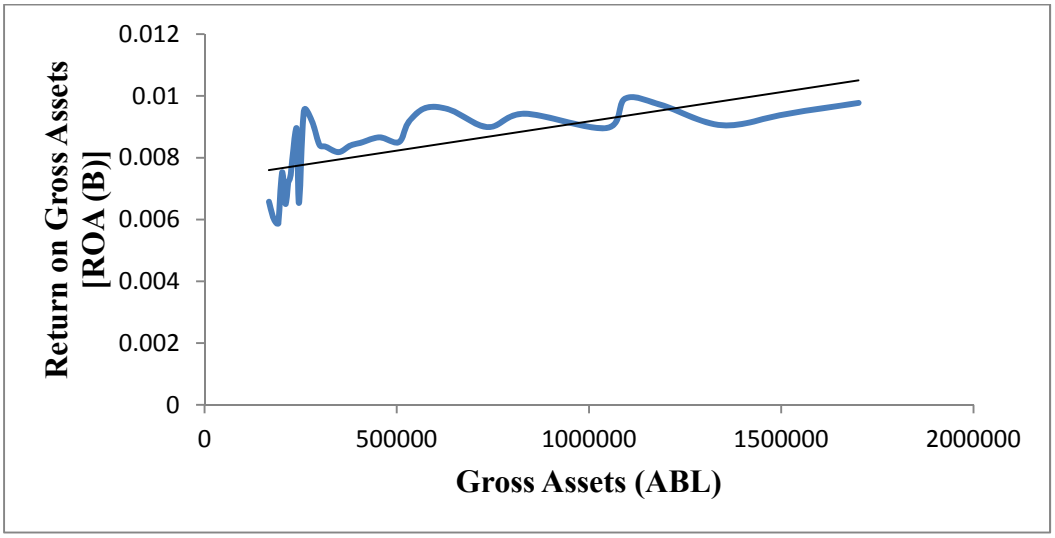
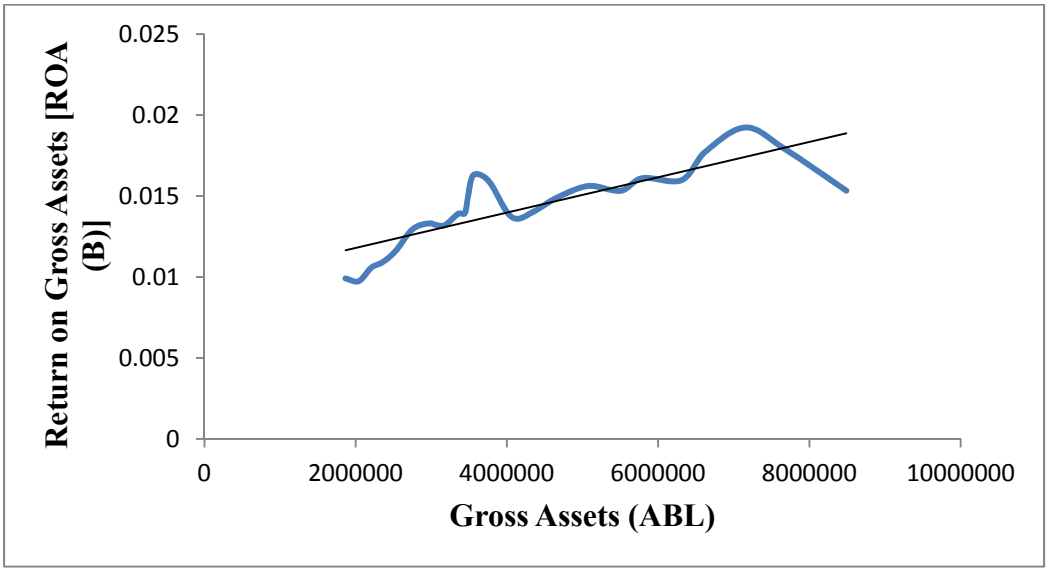


Figure 5: Movement of Return on Gross Assets [ROA (B)] Vs. Gross Assets (ABL): 1980-04



Above findings are corroborated further by regression analysis.

Table 3: Results of Regression Analysis: EBL vs. ABL		
Period	Constant	Coefficient of ABL
1950-1979	-527.69**** (-6.52)	0.010**** (85.60)
1980-2004	-18644.4**** (-6.08)	0.019**** (29.44)
**** Significant at $\alpha < 0.001$.		

Table 3 shows that coefficient of ABL, which is ROA(B) of US banking industry, has increased by almost hundred percent during the regulation period as compared to the pre-regulation period. However, ROA (B) derived from Table 3 indicates only the return on average assets; it does not indicate the average return on incremental assets. In Table 4, we have regressed incremental earnings (ΔEBL) against incremental assets (ΔABL) to find out ΔROA (B) as a coefficient of ΔABL. For this analysis, we have excluded seven years from the data set (1951, 1955, 1959, 1962, 1994, 2003, and 2004) where ΔEBL is negative.

Table 4 Results of Regression Analysis: Δ EBL vs. ΔABL (Excluding years: 1951, 1955, 1959, 1962, 1994, 2003, 2004)		
Period	Constant	Coefficient of ΔABL
1950-79	170.74 (1.55)	0.008**** (6.20)
1980-04	-114.78 (-0.076)	0.025**** (4.46)
**** Significant at $\alpha < 0.001$.		

Table 4 shows that coefficient of ΔABL or ΔROA(B) for 1980-04 is about three times the coefficient of the earlier period, and 30 percent higher than the ROA(B) of the same period. When same number of years are excluded from the calculation of regression coefficients as in Table 3, the coefficient of ABL i.e., ROA(B) is found to be 0.021 for 1980-04 (coefficients for other periods remain same). On this basis, ΔROA(B) of 1980-04 is 2.5 times the coefficient of the earlier period and 19 percent higher than ROA(B) of the same period.

Economics of accounting returns

It may be argued that all else equal, an increase in capital accompanied by a reduction in debt has the effect of increasing a bank's reported accounting return on assets as it reduces the cost of banks remaining liabilities. Hence, increase in accounting return on assets need not be due to investment in high-return assets. Extending this argument conventional models of cost of equity capital also suggest (again all else equal) that higher equity capital level should be associated with lower cost of equity (which benefits the banks). Unfortunately, all else are not equal during the regulation period as Table 5 would show.

Table 5: Interest Expenses and growth in Capital and Deposits		
	1950-79	1980-2004
Mean percentage growth of capital	7.7	9.1
Mean percentage growth of deposit	7.9	5.8
Total interest on assets (%)	1.47	3.88
Interest on deposits (%)	1.77	4.67
Interest on total borrowed funds (%) (deposits + borrowings + subordinated debts)	2.88	4.22

Table 5 shows that although growth of capital during the regulation period is higher and the growth of deposits lower than the pre-regulation period, competitive pressure has increased the cost of funds considerably during the regulation period negating any benefit that could have accrued to the banks due to a rise in capital levels. Besides, operating expenses of the banks as percentage of total income has also gone up by 1.5 percent during the regulation period. The twin pressure of rising cost of debts and operating expenses on the face of a fixed ROE might have motivated banks to contract high-return-high-risk assets during the regulation period. Hellman, Murdock and Stiglitz (2000) have also observed that with freely determined deposit rates and increased competition, banks have excessive incentive to compete for funds by offering higher rates, which in turn lowers the incentive for making good loans.

Impact of capital-assets ratio

The ratio C/A discussed in the earlier sub-section is the most talked about capital-assets ratio of the regulation period popularly known as CAR or CAR(B) for our purpose. Equation 8 defines ROA in terms of CAR. The modified form is as below.

$$ROA(B) = ROE(B) * CAR(B) \quad (14)$$

Above equation gives rise to following equation/rules.

1. When both ROE(B) and CAR(B) changes the change in ROA(B) is given by the following equation.

   $$r = ROE(B) *c + CAR(B) * e + c*e \quad (15)$$

   where, r, c and e are respective changes in ROA(B), CAR(B) and ROE(B).

   As ROE(B) is constant the second and the third term of RHS of Eq. 15 will be zero. Hence, the rate of change of ROA(B) w.r.t CAR(B) will be given by ROE(B). In other words, increase/decrease in ROA(B) will be proportional to increase/decrease in CAR(B).

2. When CAR(B) changes but ROA(B) has to be maintained at the previous level, ROE(B) should be ROA(B) / CAR(B). For example, if there is an increase in CAR(B), as is the case in the post-regulation period, then ROE(B) must fall by the above ratio so that banks are not required to contract assets with higher return (and higher risk). But it is difficult to do so because a fall in return on equity would have adverse reaction in the market.
3. When ROE(B) changes but ROA(B) has to be maintained at the previous level, CAR(B) should be ROA(B) / ROE(B). For example, when ROE(B) is increased but banks do not want to increase ROA(B) then CAR(B) must fall by the above ratio. While banks do not have the option to change CAR(B) in the regulation period, this option was exercisable by banks during the pre-regulation period in order to remain within the bounds of standard ROA(B).

Above analysis has established that there exists a causal relationship between ROA (B) and CAR (B), which we have tested in Table 6. While doing the regression analysis we have excluded data of some unusual years marked by major banking crisis following Kund and Detragiache (2005), as referred in Schaeck, Martin and Wolfe (2009)[3].

Table 6: Results of regression Analysis: ROA (B) vs. CAR (B)

Period	Constant	Coefficient of CAR(B)	R^2
1950-79 (Ex. 1976)	0.011**** (4.79)	-0.04 (-1.22)	0.05
1980-04 (Ex.1987-91)	0.001 (0.45)	0.18**** (7.40)	0.75
**** Significant at $\alpha < 0.001$.			

Regression parameters shown in Table 6 corroborate our earlier observation. Coefficient of CAR (B) and the R^2 (0.05) of the pre-regulation period are found to be insignificant meaning thereby that it has little influence on the determination of ROA (B) during the period. However, they are highly significant during the post-regulation period suggesting a strong influence of regulated capital ratio on the ROA (B) of this period.

A general conclusion that can be reached from the above findings is that the regulatory capital-assets ratio has contributed significantly to the high growth of ROA (B) during the post-regulation period.

We can now recall Proposition I and II.

Proposition I: When $M_u/M_r > 1$, ROA will increase by the same ratio or,

$ROA_r = ROA_u * (M_u/M_r)$.

$M_u = 18.01$; $M_r = 9.11$ (refer Table 2); $ROA_u = 0.01$; (refer Table 3).

Hence,

$ROA_r = 0.01 * (18.01/9.11) = 0.019$, which is same as derived in Table 3.

Proposition II: The system will be stabilized when, $M_r = M_u$.

That is, $\Delta C_{t(1)} * M_u * ROA\ (B)_u = EBL' = \Delta C_{t(1)} * ROE\ (B) = EBL''$

where $\Delta C_{t(1)}$ is the average incremental capital of the post-regulation period, which is 30945.

Putting other appropriate figures from Table 1, 2, and 3 in the above equation, we get 3095 * 18.01 * 0.01 = 5573 = 30945 * 0.18 = 5570. The small difference is due to approximation.

Above findings together with that of Table 2 suggest that but for capital regulation, average assets of US banks would have been higher by 100 percent. In that case, banks could have achieved the required ROE (B) without seeking higher return in areas that are high risk.

INCREASE IN ASSETS LOSS

In the last Section, we have shown that during the capital regulation period rate of return on assets, particularly the incremental rate of return, has increased substantially over the pre-regulation period. Apparently, this is in conformity with the established economic principles: when regulation lowers down the lending capacity of banks they tend raise the equilibrium return on financing until the required return on equity is achieved. But this does not explain why it should lead to banks taking riskier positions.

We are aware that higher expected return is associated with higher risk. When rate of return increases the probability of losses also increases (Eugene F. Fama and James D. MacBeth, 1973). Assume now that before capital regulation, when there was no restriction to assets growth, the equilibrium level of net earnings to satisfy the required ROE(B) could be achieved by selecting an assets portfolio with a certain ROA(B) and risk probability of say, σ1. During the regulation period, when assets-growth is limited by CAR, banks would attempt to raise the equilibrium return by rearranging their portfolio with a higher ROA(B) and risk probability of say, σ2. Assuming further that all risks mature *ex-post* at the estimated σ2, assets loss will be higher. Although theoretically banks can still meet the required ROE, the banking system moves to a higher risk level. Observing a rising trend in charge-offs FDIC (2003) has also noted that rising loan losses reflect a gradual shift to higher (credit) risk in US banking. Besides, when banks move to high risk areas there always remains a chance that the *ex-ante* estimation of σ of ROA(B) may turn out to be less or more in the *ex-post* realization (which we denote as ROA). In the former case, banks' reserve increases but in the later case the vulnerability of banks increases. If the difference between *ex-ante* σ and *ex-post* σ is very high it is likely that banks are moving towards a crisis. One of the strategies in such a situation is to reduce the ROE but bank managers are often reluctant to do so for fear of a backlash in the board room and in the market as well. This aggravates the crisis.

In Table 7 we have posted the mean and standard deviation of ROA(B) and ROA along with loss on assets (LOA) for both pre- and post-regulation period.

Table 7: Mean and Standard Deviation of ROA(B) and ROA and LOA of US Banks

Period	Mean	Standard deviation (%)
1950-79		
ROA(B)	0.00832	15.18
ROA	0.00732	12.10
LOA	0.00072	--
1980-2004		
ROA(B)	0.01425	17.24
ROA	0.00886	37.14
LOA	0.00482	--

We find from Table 7 that during the pre-regulation period the difference between planned return on assets [ROA(B)] and the actual return (ROA) is only 12 percent; the difference between their standard deviations is also not much. It also shows that σ of ROA is less than the σ of ROA(B) i.e., the actual (materialized) risk is less than the estimated risk level of ROA(B). But during the regulation period realized return (ROA) is about 38 percent lower than the estimated return [ROA(B)]. The standard deviation of ROA is also more than double the standard deviation of ROA(B).

We also observe that ROA(B) of regulation period is 71 percent higher than the ROA(B) of the pre-regulation period which is in conformity with our earlier finding. Although post-regulation ROA is 20 percent more than the pre-regulation ROA, the high standard deviation and large difference between ROA(B) and ROA indicate rising risk level of US banks. The following equation explains the situation analytically.

$$\text{Loss/ABL} = \text{LOA} = \text{ROA(B)} - \text{ROA} \qquad (16)$$

where, ABL and ROA(B) are *ex-ante* variables and ROA is *ex-post* variable.

Assuming that all variables are positive the following will hold.

ROA(B) > ROA , LOA is positive
ROA(B) < ROA , LOA is negative
ROA(B) = ROA , LOA is zero.

Equation 16 also tells us that larger the positive difference between ROA(B) and ROA the higher the LOA; the smaller it is the lower the LOA. Results of regression analysis posted in Table 8 show that LOA is negative in the pre-regulation period while it is (considerably) positive during the regulation period. The findings support the view taken by Fahlenbrach and Stultz

(2009) that bank CEOs took exposures that they felt were profitable for their shareholders ex *ante* but these exposures performed very poorly *ex post*.

Table 8: Results of Regression Analysis: LOA vs. ROA(B) and ROA				
Period	Constant	Coefficient of ROA(B)	Coefficient of ROA	R^2
1950-1979	0.002 (1.74)	1.147**** (7.707)	- 1.471**** (-6.933)	0.70
1980-2004	-0.001 (-0.384)	0.747**** (6.446)	-0.599**** (-6.928)	0.72
**** Significant at $\alpha < 0.001$.				

Impact of capital-assets ratio on assets loss of banks (ALOSS)

We have seen so far that capital regulation has lowered the assets growth of US banks which has induced them to seek assets with higher return (and higher risk), which has resulted in increasing level of losses. We now intend to establish a direct association between capital-assets ratio and assets loss of US banks. For this purpose we have regressed ALOSS against CAR(B) the results of which are given in Table 9.

Table 9 shows that the loss coefficient of CAR (B), which was negative during 1950-79, has turned out to be positive with a large value during 1980-04 signifying its positive association with the assets loss of US banks in the regulation period.

Table 9: Results of Regression Analysis: ALOSS vs. CAR (B)			
Period	Constant	Coefficient of CAR(B)	R^2
1950-79 (Ex. 1976)	8628**** (6.87)	-115105**** (-6.44)	0.61
1980-04 (Ex.1987-91)	-30661*** (-3.58)	657509 **** (5.89)	0.66
****Significant at $\alpha < 0.001$.; ***significant at $\alpha < 0.005$			

We have derived loss coefficient of ABL (i.e., LOA) and also of capital in Table 10 and Table 11 respectively to understand further the contribution of regulated capital-assets ratio towards assets loss of US banks.

Table 10: Results of Regression Analysis: ALOSS vs. ABL			
Period	Constant	Coefficient of ABL	R^2
1950-79 (Ex. 1976)	-617.15**** (-4.86)	0.002**** (12.10)	0.84
1980-04 (Ex.1987-91)	-1527.70 (-0.49)	0.005**** (7.23)	0.74
****Significant at $\alpha < 0.001$			

Table 11: Results of Regression Analysis: ALOSS vs. Capital			
Period	Constant	Coefficient of Capital	R^2
1950-79 (Ex. 1976)	-807.20**** (-5.06)	0.04**** (10.50)	0.80
1980-04 (Ex.1987-91)	3751.21 (1.45)	0.042**** (6.82)	0.72
****Significant at $\alpha < 0.001$.			

A comparison of Table 10 and Table 11 reveals that though the loss coefficient of capital has remained constant during the pre- and post- regulation period, loss coefficient of assets, which is nothing but LOA, has increased by 2.5 times during the post-regulation period. To get further insight, regression equations from Table 10 and Table 11 are written below ignoring the constant terms.

1950-79	1980-04
1. ALOSS = 0.002 ABL	1. ALOSS = 0.005 ABL
2. ALOSS = 0.04 Capital	2. ALOSS = 0.042 Capital

Rearranging and dividing we get,

1950-79	1980-04
ABL/Capital or, M = 20	ABL/Capital or, M = 8.4

Thus, we can conclude that higher assets loss during the regulation period is related to the lower assets expansion capacity of banks as denoted by a lower M.

All the findings of the study, as summarized in Table 12, indicate that during the regulation period the binding capital-assets ratio has lowered down the rate of assets growth which has motivated the banks to seek assets with higher return to meet the required ROE. As high-return assets is associated with high risk the assets loss of the banks has increased. Thus, while bank regulators attempt to regulate the quality of loans and investments as well as regulate risk through capital requirements, the empirical work presented in this article shows that banks successfully overcome regulation of loans and investments to acquire more risk in response to higher capital requirements. Hence, capital regulation has increased the risk of banking industry rather than reducing it.

Table 12: Summary of Findings				
Findings	***Period 1950-79***	***Period 1980-04***	***Remarks***	***T able reference***
ROE(B)	***0.18***	***0.18***	***Constant***	***1***
Capital Multiplier(M)	18.01	9.11	Decreased	2
ROA(B)	0.01	0.02	Increased	3
Growth of Deposits (%)	7.9	5.8	Decreased	5
Interest expenses on Deposits (%)	1.77	4.67	Increased	5
Interest expenses on Assets (%)	1.47	3.88	Increased	5
Coefficient of CAR(B) against ROA(B)	-0.04	0.18	Increased	6
Mean ROA(B)	0.00832	0.01425	Increased	7
	[15.18]	[17.24]		
Mean ROA	0.00732	0.00886	Increased	7
	[12.10]	[37.14]		
Mean LOA	0.00072	0.00482	Increased	7
Coefficient of ROA(B) against LOA	1.147	-1.471	LOA negative	8
Coefficient of ROA against LOA	0.747	-0.599	LOA positive	8
Coefficient of CAR(B) against ALOSS	-115105	657509	Increased	9
Coefficient of ABL against ALOSS	0.002	0.005	Increased	10
Note: Figures in [ ] denote Standard Deviations (%)				

CONCLUSION

Bank capital, like any other business capital, needs to be serviced by a certain ROE, which is determined by the market within a risk-return framework. Mean ROE remains more or less constant over a long period. Normally, the required ROE is satisfied by making investment in assets with rates of return determined within the risk-tolerance limits of banks. When the assets-generation capacity of banks is restricted by the regulatory capital-ratio banks are induced to go beyond their risk-tolerance level to seek assets or businesses that provide higher rates of return. As higher risk is associated with higher returns, the risk of the banking industry is increased.

In this paper, we have shown that during the post-regulation period the assets generation capacity of US banks has been halved while return on assets has doubled and loss on assets has increased by 2.5 times over the pre-regulation period. Capital regulation has, therefore, resulted in higher risk of US banking industry.

It appears that binding capital-assets ratio is based on 'gone concern' approach while banks operate as 'going concerns' with an eye to required profitability. They may go beyond their risk-tolerance level and take a riskier position if the scale of operation is restricted not necessarily by capital-assets ratio but by any other means. When capital-assets ratio is chosen as a regulatory tool it encourages rather than deters the banks from taking high risk positions, more so because banks are obliged to meet the required ROE for the stock holders. It is time that bank regulators reduce the incentive of bank managers to engage in high-return-high-risk banking by

freeing them from binding capital-assets ratio. Instead, the regulators should concentrate on developing monitoring tools for risk management so as to ensure that banks stay within the risk-tolerance level. Diamond and Rajan (2000) have rightly observed that diversification and risk management are substitutes for capital.

ENDNOTES

1. However some writers, while dealing with 'moral hazard' problem in a market discipline framework, do include shareholders along with depositors and other debt holders (see for example, Park and Peristiani, 2007).
2. Even during the new ROE-period, average ROE shall remain constant.
3. In fact, during the post World War II period through the early 1970s bank failures were few in number and the banking industry was generally considered strong (FDIC, 2003)

AUTHOR'S NOTE

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APPENDIX

Definition of variables

ASSETS LOSS (ALOSS)

This item is composed of credit/loan/lease loses plus securities losses

Credit/Loan/Lease losses

This figure is not available directly from the published accounts of the banks. Instead, we get the following two items:

Loan and Lease Loss Allowances: This item is available from the balance sheet. It is also called 'Loan Loss Reserves' which exists in recognition that some loans will not be paid. The reserve should increase with the growth in problem loans and decrease with the net loan charge-offs. This item is an estimation of probable losses in future, though it is notoriously subjective (Burke, 1984).

Provision for Loan and Lease Losses: This item is available from the Income statement. It is a deduction from income representing a bank's periodic allocation to its Loan Loss Reserves. Conceptually, management is supposed to allocate a portion of income to reserves to protect against potential loan losses. Provision for loan and lease losses differs from actual losses (charge-offs).The latter indicates loans and leases that a bank formally recognizes as uncollectable and charges off against Loan and Lease Loss Allowances. Consequently, assets are reduced to the extent of such write-offs (Koch and Macdonald, 2003)

Above two definitions can be reduced to the following arithmetical calculation to determine credit losses.

Credit losses:

Credit/loan/lease losses(net of recoveries)or simply Net credit losses = (Loan and Lease Loss Allowances at the end of last year + Provision for Loan and Lease losses & other adjustments of the current year) –(Loan and Lease Loss Allowances at the end of current year).

Securities Losses

This item is available from published Income Statement.

Assets Loss (ALOSS) is then given by: Net credit losses+ Securities losses.

Assets before loss (ABL): Net assets + Loan and Lease Loss Allowances.
Earnings before losses (EBL): Net income + Provision for Loan and Lease Losses.
Return on equity (ROE): Net income (E) / Total equity capital(C).
Return on equity before losses [ROE (B)]: EBL/Total equity capital.
Return on assets (ROA): Net income (E)/Net assets (A).
Return on assets before losses [ROA (B)]: EBL/ABL.
Loss on assets (LOA): ALOSS/ABL.
Capital-assets ratio (CAR): Total Equity Capital(C)/Net Assets.
Capital-assets ratio before assets losses CAR (B)]: C/ABL.