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Abstract

Existing literature has focused attention on the impact of Basle I and similar capital requirement regulations on developed countries where such regulations were found to be effective in increasing capital ratios and reducing portfolio credit risk of commercial banks. In the present study, we study the impact of such capital requirement regulations on commercial banks in 11 developing countries around the world within a cross-section framework with the widely popular simultaneous equations model of Shrieves and Dahl (1992). Surprisingly, we find that such regulations did not increase the capital ratios of banks in the developing countries. This implies that particular attention should be given to the business, environmental, legal, cultural realities of such countries while designing and implementing such policies for developing countries. However, we find evidence that such regulations did reduce portfolio risk of banks. We also find that capital ratios and portfolio risk are inversely related in contrast to the predictions of "buffer capital theory", "managerial risk aversion theory", and "bankruptcy cost avoidance theory." Our, evidence also shows that level of financial development and credit risk are inversely related implying that as the financial sector of a country develops it opens up avenues for alternative sources of finance, which results in reduced risk.

Basel Capital Requirements and Bank Credit Risk Taking
In Developing Countries

One of the most important developments of the banking industry in both developed and developing countries all over the world, during the past decade or so, has been the implementation of minimum capital standards for internationally active banks under the Basle Capital Accord[1] and under similar national guidelines[2].

Following the successful implementation of the accord and similar national guidelines in the 10 OECD countries during the 1988-1992, many developing countries also started to implement their national version of the Basle-like capital regulations in order to: (i) promote the soundness of their banking system, (ii) to overcome the weaknesses that became apparent during the wave of financial crisis in several developing countries; and (iii) to counteract the moral hazard problem of newly introduced deposit insurance programs in several countries, during the 1990s.

Indeed, recent research[3] has confirmed that even though the Basle Accord I was designed to apply to the internationally active banks of mostly OECD countries, but its impact was rapidly felt more widely and by 1999 formed part of the regime of prudential regulation not only for international banks but also for strictly domestic banks in more than 100 countries, including developing countries. Notwithstanding the debate on the effectiveness of such rules in reducing credit risk and other unfavorable consequences of such regulations[4], such rules have become an important part of the national commercial

[1] Purpose of the original 1988 accord was twofold: first, it aimed at creating a "level playing field" among banks by raising capital ratios, which were generally perceived as too low in many countries; and second, it also aimed at promoting financial stability by adopting a relatively simple approach to credit risk with the potential to distort incentives for bank risk-taking. The guidelines of Basle accord were originally adopted by the central banking authorities from 12 developed countries (all G-10 countries plus Luxembourg and Switzerland) in July, 1988. Their implementation started in 1989 and was completed four years later in 1993.

[2] Example of Basle like accord in the US is Prompt Corrective Action (PCA) guidelines under Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991.

[3] Andrew Cornford, 2004.

[4] Many experts in the field believe that the slow growth of the US economy during the late 1980s and early 1990s could be attributed, at least partially, by the capital regulations imposed on commercial banks, which results in a decline in credit flow from banks to the private sector.

banking policies worldwide and there are indications that such rules will evolve but remain in place in the foreseeable future as well (Basle II, 1996).

In spite of such wide popularity and wide adaptation, Basle I Accord[5] was criticized by bankers, scholars and policymakers all over the world. These criticisms are a. its failure to make adequate allowance for the degree of reduction in risk exposure achievable through diversification; b. the possibility that it would lead banks to restrict their lending, which would lead to pro-cyclicality of bank lending; c. its arbitrary and undiscriminating calibration of certain credit risks. Several issues of special interest to developing countries emerged in the aftermath of East Asian Financial Crisis, which include: first, effectiveness of capital regulations in contributing to financial stability in developing countries; and second, impact of such accord on short-term inter-bank lending, which was one of the major factors causing the crisis to begin with[6].

Fifteen years after the adoption of the Basle I Accord and amidst the new regulations that is being currently made in both developed and developing countries around the world, empirical research is far from answering the following questions: what is the net outcome of such regulations on bank's behavior towards credit risk? Can such regulations help raise capital in banks that fall short the minimum requirement? What was the bank's response to such rules, i.e. did they increase the level of their capital, forego risky projects or sell off assets? Did the guidelines modify the credit risk of their portfolio and if yes, to which risk categories did they reallocate their assets? How can the impact of these rules vary with the level of economic development of different countries? Many other important questions remain answered.

In addition to the unanswered questions as mentioned above, most of the studies on the subject to date were conducted on the U.S. banking sector and other developed countries.

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[5] Basle Committee on Banking Supervision has already responded by introducing the New Framework for Capital Adequacy in June 1999 with major emphasis put on promoting stability of the international financial stability. However, the new accord was also criticized on: (1) problems of formulating effective guidelines for the surveillance of banks' capital adequacy; (2) possible obstacles to improved transparency; (3) recourse to the ratings of the credit rating agencies may damage flow of external financing into developing countries, specially in times of emergency;

[6] Andrew Cornford, 2004.

Studies analyzing the impact of the implementation of Basle like regulations and guidelines in the emerging and developed countries within the framework of cross-sectional analysis remain surprisingly limited[7]. Moreover, under Basle II new regulations[8] and some changes to the existing regulations were made in 1996. Signatories to the new Accord are expected to implement the provisions by 2006. It is absolutely essential that policy makers of the developed countries as well as their development partners (foreign governments, IMF, the World Bank etc.) understand the special needs of the host countries in order to enable the latter to reap the benefit of such regulations.

In the present article, an attempt is made to study the impact of Basle-like capital regulations on the credit risk taking in a selected number of developing countries and extends previous empirical analysis in several directions. First, a larger dataset comprising of 11 developing countries[9], which have adopted and enforced capital regulation in the last decade, are studied. Second, instead of studying countries in isolation, we study them in a cross-section framework. Third, instead of using aggregate data we use data on individual banks. Forth, framework of this study accommodates both shocks to bank capital arising from external sources – such as business cycle and shocks originating from regulatory sources – such as in the case of an increase in capital ratios. Fifth, we set up the framework so as to trace out the reaction of banks that fall short of the minimum capita required.

The evidence gathered in the paper points to the following empirical findings. First, capital ratios and bank portfolio risk are negatively related to each other. Second, capital regulations reduced portfolio risk of commercial banks, but it did not have the desired impact of increasing capital ratios. Finally, liberalization and financial development seems to have reduced port folio risk of banks. However, they do not seem to have any impact on capital ratios.

[7] Previous empirical work on the impact of capital requirements on bank lending in developing countries includes Ferri et al. (1999), Chiuri et al. (2001) and Ito (2000).
[8] Basle II: New Accord: 1996.
[9] India, Argentina, Hungary, Turkey, Venezuela, Slovenia, Brazil, Korea, Malaysia, Thailand, Chile.

The remainder of the paper is organized as follows. Section 2 reviews the theoretical and empirical literature dealing with the effects of capital requirements on bank's portfolio risk, in the context of the Basle Accord. Section 3 presents the data used in the study, while section 4 outlines the empirical methodology. Results of regression analysis are discussed in section 5 and some conclusions and policy directives for developing countries are presented in section 6.

2. Bank Capital Regulation and its impact on banks' risk-taking in theory and in practice

2.1 Review of Theory Literature

According to the existing theories, the main justification for capital regulations of banks is often given in terms of "moral hazard" problem. The problem states that in the presence of a mis-priced deposit insurance scheme, bank managers may not do enough to reduce risk. Instead they will opt for risky projects that are accompanied by higher return, which if not stopped in time, may compromise banks' solvency in the long run. Therefore, the theoretical reason for capital adequacy regulations is to counteract the risk-shifting incentives originating from deposit insurance.

Till date several strands of theoretical literature have emerged on the topic. A first strand uses the portfolio approach of Pyle (1971) and Hart and Jaffee(1974), where banks are treated as utility-maximizing units. Within such a framework adopted for mean-variance analysis to compare banks' portfolio choice with and without a capital regulation Koehn and Santomero (1980) showed that the introduction of higher leverage ratios will lead banks to shift their portfolio to riskier assets. As a solution to such a situation, Kim and Santomero (1988) suggested that this problem can be overcome if the regulators use correct measures of risk in the computation of solvency ratio.

Subsequently, Rochet (1992) extended the work of Koehn and Santomero and found that effectiveness of capital regulations depended on whether the banks were value maximizing or utility maximizing. In the former case, capital regulations could not

prevent risk taking actions by banks. In the later case, capital regulations could only be effective if the weights used in the computations of the ratio are equal to the systematic risk of the assets. A further theoretical ground argued that banks chose portfolio with maximal risk and minimum diversification.

The second strand of literature on the topic utilizes option models. Furlong and Keeley(1989) and Keeley and Furlong (1990) developed several models under this framework and showed that higher capital requirements reduce the incentives for a value-maximizing bank to increase asset risk, which is opposite to the conclusions of first generation studies as discussed previously. They criticized that the utility-maximizing framework, which comes to opposite conclusions, is inappropriate because it mischaracterizes the bank's investment opportunity set by omitting the option value of deposit insurance and the possibility of the bank failure. However, this evidence of the option models was weakened by the findings of Gennottee and Pyle (1991). They relaxed the assumption that banks invest in zero net present value assets and found that there are now plausible situations in which an increase in capital requirements results in an increase of asset risk.

Using a dynamic framework (multiple periods), as opposed to the static framework discussed in the preceding paragraphs, Blum (1999) found that capital regulation may increase banks' riskiness due to an intertemporal effect. Using a two-period model, he showed if banks find it too costly to raise additional equity to meet new capital requirements tomorrow or are unable to do so, they will increase risk today. He also pointed out that this second effect will reinforce the well-known risk-shifting incentives due to the reduction in profits.

Subsequently, Marshal and Prescott (2000) showed that capital requirements directly reduced the probability of default and portfolio risk and suggested that optimal bank capital regulations could be made by incorporating state-contingent penalties based on bank's performance. At the same time, Vlaar (2000) found that capital requirements acted

as a burden for inefficient banks when asset of banks is assumed to be fixed. However, such regulations increased the profitability of efficient banks.

In short, whether imposing harsher capital requirements leads banks to increase or decrease the risk structure of their asset portfolio is still a debated question and, al least for now, it seems, there is no simple answer to this question.

2.2 An example

In the following example[10] we attempt to clarify the risk effect of capital regulation by briefly restating the key rules of 1988 Basle Accord and discussing the alternative approaches that the banks can take to comply with them.

The 1988 Basle Accord standards are almost entirely focused on credit portfolio risk, the risk of loss due to borrower or counterparty default. [11]The central regulation to the 1988 Accord is the obligation for internationally active banks of the signatory countries to continually meet two capital adequacy ratios, the so called tier 1 capital and total capital ratios. Both ratios share the same denominator, which is a risk-weighted sum of banks' on-balance sheet and off-balance sheet activities. A simplified formula of the risk-weighted asset (RWA) of a bank is given by[12]:

RWA = 0*(bucket1) +0.2*(bucket2) +0.5*bucket3) +1.0*(bucket4) …… [i]

[10] Adopted from Patrick Van Roy, 2003.

[11] Subsequent amendments were made to take account of other types of risks. The Basle Committee on Banking Supervision announced Basle II New Accord in 1996, which is based on three mutually enforcing pillars (minimum capital requirements – supervisory review – market discipline) that allow banks and supervisors to evaluate additional types of risks, like operations risks and interest rate risk in order to avoid treating credit risk in isolation. Implementation of the New Accord (though probably not by all adopting countries) is expected by the year-end 2006.

[12] Strictly speaking, formula [1] is only valid for on-balance sheet assets. Off-balance sheet items are also assigned to the four risk buckets but they involve additional weights reflecting the nature of their operation.

Where bucket 1[13] consists of assets with zero default risk, bucket 2 of assets with a low rate of default, bucket 3 of medium-risk assets and the remaining assets fall into bucket 4. The denominator of both capital adequacy ratios thus represents risk weighted assets. However, the tier 1 capital ratio and total capital ratio differ with respect to their numerator, where the former consist of only tier 1 capital while the latter consists of both tier 1 and tier 2 capitals[14].

Banks that wish to raise their capital adequacy ratio (either to obey the minimum requirements or for other non-regulatory reasons) have three alternatives / options available, which include: first, they can increase their capital level (depending on the regulatory ratio concerned, this can be done in several ways); second, decrease their risk-weighted assets as proportion of total assets; and / or third, decrease their total assets. Equation [ii][15] decomposes the growth rate of the capital adequacy ratio into three terms, the growth rate of capital, the growth of the credit risk, and the growth rate of assets.

$$\frac{\Delta CAR(t)}{CAR(t)} = \frac{\Delta K(t)}{K(t)} - \frac{\Delta RISK(t)}{RISK(t)} - \frac{\Delta A(t)}{A(t)} \quad \text{.....[ii]}$$

[13] Examples of bucket 1 capital are cash, government bonds / securities, bucket 2 are loans to banks, bucket 3 are essentially residential mortgage loans) and bucket 4 are the remaining assets, in particular, loans to non-banks.

[14] Tier 1 capital, also called core capital, consists mainly of stockholder equity capital and disclosed reserves, whereas tier 2 capital or "supplementary capital" includes elements like undisclosed reserves and subordinated debts (provided that their maturity do not exceed five years). The difference between tier 1 and tier 2 capital thus emphasized the extent to which capital of a bank is permanent or explicit.

[15] Equation [5] is derived as follows $CAR(t) = K(t).[RWA(t)]^{-1}$ and $RISK(t) = RWA(t)/A(t)$. Substituting we get, $CAR(t) = K(t).[RISK(t).A(t)]^{-1}$. Taking logs and differentiating w.r.t time

$$\Rightarrow \frac{d\log(CAR(t))}{dt} = \frac{d\log(K(t))}{dt} - \left[\frac{d\log RISK(t)}{dt} + \frac{d\log A(t)}{dt}\right]$$

$$\because \frac{d\log(X(t))}{dt} = \frac{1}{X(t)} \times \frac{dX(t)}{dt} = \frac{\dot{X}(t)}{X(t)}$$

$$\therefore \frac{\dot{CAR}(t)}{CAR(t)} \Rightarrow g_{CAR} = \frac{\dot{K}(t)}{K(t)} = g_K - \frac{\dot{RISK}(t)}{RISK(t)} - g_{RISK} - g_A \frac{\dot{A}(t)}{A(t)}$$

Where $CAR = K / RWA =$ [16]capital adequacy ratio (either Tier 1 or Total K ratio); K=capital (either Tier 1 K or Total K); $RISK = RWA / A =$ Credit risk ratio; and A=Total assets. We discuss these measures also in section 4.

From the above equation, it can be seen that a (mandatory) increase in the capital adequacy ratio does not prevent banks from raising the credit risk of their portfolio provided that the growth rate of the credit risk is lower than the growth rate of capital holding total assets constant. As a result, the Basle Accord, which aimed at imposing a higher capital buffer against insolvency, may well have encouraged banks to take on more credit risk, thereby having an ambiguous effect on their financial stability. In the following sections we analyze the relationship between change in capital ratios (ΔCAR) and change in risk ($\Delta RISK$)[17] to investigate the true relationship.

2.3 Empirical Literature Review

Empirical work in the area concentrates on two aspects of capital regulations, first, to investigate whether banks fulfill the capital requirements by increasing capital or by altering the risk weighted assets; and second, to test if the enforcement of capital requirements can result in a contraction in banks' supply of loans or best described as credit crunch. In the present paper we deal with the first aspect.

Some of the major empirical papers on the impact of capital regulations on risk taking and capital ratios of commercial banks are listed in Table 1 for both U.S. and outside the U.S. banks. However, we do not discuss all of them in the following review.

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[16] Alternate definitions of capital adequacy ratios include: ratio of capital to total assets, ratio of capital to risk weighted assets etc. given in Rime (2000). Similarly, for risk alternative definitions are total risk weighted assets as percentage of total assets and nonperforming loans as percentage of total assets used in Aggarwal and Jacqures (1998).

[17] Several strands of empirical literature exist in this connection. We focus on the relationship between ΔCAR and $\Delta RISK$. Other strands include: the effect of capital requirements on capital levels, K; on total assets A; and also on the macro-economy through reductions in bank lending, which is also called "credit crunch literature".

Many of these papers utilize a simultaneous equations approach, which allows comparing the behavior of undercapitalized and adequately capitalized banks with respect to changes in risk and capital ratios. This is developed fully in section 4.

The literature begins with Shrives and Dahl (1992), who use several periods of cross-section data on commercial banks in the U.S. under the simultaneous equations framework mentioned before. They found that the effectiveness of risk-based capital regulations depended on how well the regulations reflected the true risk exposure of banks.

Results of U.S. studies are not easy to interpret as the implementation of the second stage of the Basle Accord, between end-1990 and end-1992, which coincided with the passage of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) in December 1991. Section 131 of FDICIA, Prompt Corrective Action (PCA), went one step further than the Basle Accord by defining three regulatory ratios (the Basle capital standards plus a leverage requirement) and five categories in which banks are classified according to their compliance with the three ratios. Thus, it is hard to ascribe the findings of the two papers by Aggarwal and Jacques (1997, 2001) to the Basle Accord as opposed to FDICIA, as U.S. banks' behavior is likely to have been affected by both regulations over the period that they consider. They found that banks in the undercapitalized categories increased their capital target ratios more quickly than other banks with higher initial capital. But, if one is interested in the impact of capital regulations in a broad sense then this does not remain a big problem.

The study by Jacqus and Nigro (1997) deals exclusively with the consequences of the Basle Accord, as it concentrates on the years 1990-91, which is the period before FDICIA was passed. They found that capital regulation has a significant impact on risk and vice versa. But the problem of this study is the very low number of undercapitalized institutions in Jacques and Nigro's sample – less than 2 percent of the total number of banks, which may have reduced the reliability of some of their estimates.

Two papers present some non-U.S. evidence regarding the relationship between capital ratios and credit risk. Ediz, Michael, and Perraudin (1998) employ confidential U.K. data including detailed information about the balance sheet and profit and loss account of all British banks, during the 1989-1995 periods whereas Rime (2001) uses Swiss data for the period 1989-1996, where the former used a limited information technique different from the simultaneous equations framework mentioned earlier. Their study used a sample for the period 1989-1995 and applied random effects model and found that capital regulations were effective in increasing the capital to meet the minimum standard. Unfortunately, Ediz et al.'s model leads to the puzzling result that banks are adjusting their capital levels each year by more than the difference between the current level and the target they have in mind, which means that banks are overshooting the target (and by more and more each year). The study by Rime (2001) is interesting because it provides the first application of the simultaneous-equations model reviewed in section 4 to non-U.S. banks. His results indicated that Swiss banks were reacted to capital regulations by increasing their capital but this did not change banks' risk-taking. One of the problems with this study might be the fact that Rime adopted the PCA regulatory classification to measure regulatory pressure on Swiss banks, which might be inappropriate given that the additional requirements set by PCA have not been adopted formally by any other country than the U.S.

Sheldon (1996) used an option-pricing framework to analyze the risk effects of capital adequacy on eleven G-10 countries. He found that the Basle Accord did not have a risk-increasing impact on banks' portfolio. But this result is not easy to interpret as he did not control for regulatory and non-regulatory influences. Moreover, sample coverage of this study is not representative for the countries they represent.

Roy (2003) studied the impact of capital requirement on risk taking by commercial banks of seven OECD countries within the framework of the simultaneous equations framework. He found that changes in capital and credit risk were negatively related over the period studied, which supported the argument that stringent capital requirements went hand in hand with greater financial stability in addition to imposing a higher capital

buffer against unexpected credit risk losses. However, they also found evidence indicating that the regulation was ineffective in raising the capital ratio of undercapitalized banking institutions in France and in Italy, which leaves room for the validity of the argument presented above.

We summarize the finding of the articles discussed in the review section as follows: these articles generally supported the idea that undercapitalized banks increased their capital adequacy ratios in the first half of the 1990s. A similar trend was observed for well capitalized banks but to a lesser extent. However, there is little consensus among the papers reviewed that banks, whether adequately capitalized or not, engaged in riskier activities as a result of capital regulations. Finally, according to these papers, changes in capital adequacy ratios and in risk ratios appeared to be mostly unrelated.

Therefore, the main contribution of this study is to extent the empirical literature on the effects of the Basle Accord like national capital regulations by using a simultaneous equations model (Shrives and Dahl (1992)) for 11 different countries along with a representative data set whose construction is detailed in the next section.

3. Sample Description

We used the Basle like capital accord implementation year / dates prepared by Chiuri et al (2001) and also presented in Table 2. For each country we extracted bank specific variables data for five years from Bankscope[18], 2004 following the year of adoption of capital requirement regulations. We examined a five-year data span to find for changes in the relationship between capital adequacy and risk. We also include only large commercial banks in the analysis due mainly to two reasons: first, capital adequacy ratios are generally implemented on larger banks that are active internationally whereas smaller domestic banks are kept outside the jurisdiction of such regulations; and second, data for smaller banks are less complete in Bankscope. Initially we get 1500 observations for bank-years. But all variables are not available for all year and hence the number of

[18] Bankscope is a database of banking account figures which is a joint product of Fitch IBCA and Bureau Van Dijk, a major rating agency and a publisher of financial databases on CD-ROM. We use the CD-ROM for 2004.

observations declines to about 300 as we estimate the models. For country specific variables, we use annual data from World Bank Data available in the World Development Indicators via the internet.

4. Empirical Methodology

4.1 The Model

As we have mentioned already, capital ratios (CAR) and capital levels (K) for both tier 1 and total capital were extracted from Bankscope[19] to compute the credit risk ratio (RISK) using the following formulas:

$$\frac{K}{CAR} = \frac{K}{\frac{K}{RWA}} = RWA \text{ ..... [1]}$$

$$\frac{RWA}{A} = RISK \text{ ..... [2]}$$

Following Shreieves and Dahl (1992), we started with the following to basic equations.

$$\Delta CAR_{i,t} = \Delta^d CAR_{i,t} + E_{i,t} \text{ ..... [3]}$$

$$\Delta RISK_{i,t} = \Delta^d RISK_{i,t} + S_{i,t} \text{ ..... [4]}$$

Where, $\Delta CAR_{i,t}$ and $\Delta RISK_{i,t}$ are the observed changes in captal and risk ratios, respectively for bank i in period t. The $\Delta^d CAR_{i,t}$ and $\Delta^d RISK_{i,t}$ variables represent discretionary adjustments in capital and risk, and the last two terms are exogenously determined factors.

In accordance with Shrieves and Dahl (1992), discretionary adjustment in capital and risk are defied next using a partial adjustment procedure.

[19] CAR and K were extracted from Bankscope and formulas [1] and [2] were used to compute the credit risk ratio.

$$\Delta^d CAR_{i,t} = \alpha(CAR^*_{i,t} - CAR_{i,t-1}) \ldots\ldots\ldots\ldots\ldots\ldots [5]$$

$$\Delta^d RISK_{i,t} = \beta(RISK^*_{i,t} - RISK_{i,t-1}) \ldots\ldots\ldots\ldots\ldots\ldots [6]$$

Where, $CAR^*_{i,t}$ and $RISK^*_{i,t}$ are the target capital and risk ratios for the i th commercial banks in year t. Next substituting equations [5] and [6] in equations [3] and [4], respectively we get the following expressions

$$\Delta CAR_{i,t} = \alpha(CAR^*_{i,t} - CAR_{i,t-1}) + E_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots [7]$$

$$\Delta RISK_{i,t} = \beta(RISK^*_{i,t} - RISK_{i,t-1}) + S_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots [8]$$

The above two equations show that the observed changes in capital in period t are a function of the differences between the target level of capital in period t and previous period's actual capital, and any exogenous shock. Similar, argument applied for risk.

Shrieves and Dahl (1992) pointed out that the target level of capital and risk are not observable and, hence, could not be measures directly. As a result, they measured the two variables indirectly with the help of a set of variables, which in turns are observable and, therefore, are measurable directly. We follow the same approach. Exogenous shocks included in the two equations, captures unexpected shocks to the bank due to both external factors (changes in the macroeconomic conditions) and internal factors (unexpected changes in bank's financial conditions).

In the next step, we create the set of variables that influence the target levels of capital and risk, some of which have already been used for the same purpose in previous studies of the relationship between bank capital and risk[20].

4.2 Bank Specific Variables

i. Natural Logarithm of Banks Total Assets (SIZE):

[20] Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwal and Jacques (2001), Rime (2001), and Aggarwal, Jacques and Rice (2000).

Aggarwal and Jacques (2001) pointed out that larger banks may be willing to hold less capital owing to the fact that they have better ability to raise capital if needed compared to the other banks. It can also be pointed out that, due to diversification benefit, larger bank will have lower risk. Therefore, we assume that SIZE has negative relation with both the target level of capital and risk. Such expected signs for all variables are presented below.

Table: Expected Signs of Bank Characteristics Variables

Name of the Variable	Change in Capital Ratio	Change in Risk
SIZE	-	-
LLOSS	+	-
ROA	+	.
BONDS	-	-
LIQUIDITY	-	+

ii. Bank's Profitability (ROA):

More profitable banking institutions may be able to increase their level of capital through retained earnings. Therefore, we assume that there is a positive relationship between profit and capital.

iii. Current loan loss provisions to potential bad loans (LLOSS)

We include these variables in the risk equation based on the assumption that banks with higher level of loan losses will exhibit lower future levels of risk-adjusted assets. As a result, a negative relation should exist between target risk and loan loss provisions for bad loans. Alternately, for capital we argue that the relationship with loan loss should be positive, since banks with more expected loss could be assumed to raise their levels of capital to comply with regulatory requirement and to mitigate solvency risk.

iv. Ratio of government securities to total assets (BONDS)

Banks with a higher percentage of government securities can be expected to have higher capital ratios through sales of securities. Aggarwal and Jacques (2001) point out, if banks with large holdings of government securities retained, rather than sold, these securities during a falling rate environment, then they may have lower levels of capital to comply with existing regulations. At the same time, banks with high ratios of government securities in their asset portfolios will be exhibiting lower levels of risk. Thus we proceed with the assumption that both capital and risk are inversely related with bank's holding of government securities and bonds.

v. Ratio of liquid reserves to total assets (LIQUIDITY)

Banks with higher liquidity ratios are faced with less risk and, hence, need to hold less capital, whereas, such banks may be willing to increase their levels of risk. Therefore we assume that a negative relationship should exist between the ratio of liquid reserves to total assets and the level of a bank's capital and a positive relationship between this ratio and the level of a bank's portfolio risk.

4.3. Country Specific Variables

vi. MacroEconomic Variables[21]*,*

We include the following three variables: inflation and per capita GDP growth rate to control for the changes in macro-economic conditions that also influences the relationship between risk and capital adequacy. We assumed that a lion's share of country specific heterogeneity were controlled for by these variables in regression equations, so that what remains left should be negligible. So, we do not include country specific dummy variables.

vi. Foreign Investment as Proxy for Liberalization:

It should be pointed out that all of the countries included in the sample have undergone considerable privatization (reducing government ownership) and liberalization (allowing foreign entry) throughout the 1990s, as part of structural their adjustment program.

[21] Chiuri et al., 2001

However, liberalization in the financial services obviously took different forms in different countries. Notwithstanding these diverse liberalization measures, allowing entry of foreign banks and ownership by foreign banks were a key component of the liberalization programs. Such measures have led to changes in the structure, operation and competition in the domestic financial services industry. Such changes may have affected the relationship between risk and capital adequacy requirements, hence, to control for this change we include annual foreign investment as percentage of gross domestic product as one of the variables in the model. Coefficient of this variable will show us the impact of changes in foreign investment on capital ratios and risk of commercial banks.

vii. Level of financial development

In accordance with the existing literature, we use domestic credit as percentage of GDP as measure of the level of financial development in a country. Because we use a pooled dataset, we are able to infer how the relationship between risk and capital adequacy changes with changes in the level of development of the financial sector. This is important in the context of developing countries, were we can not take the existence of a well developed and sustainable financial sector for granted.

xi. Regulatory Pressure Variable (REG)[22]

Following Partick Van Roy (2003), we create the regulatory pressure variable to identify the undercapitalized banks as follows

$$REG = \begin{cases} THR - CAR & if CAR < THR \\ 0 & otherwise \end{cases}$$

Where, THR represents some threshold level that will have to be chosen. Such measure enjoys twofold advantages: first, it shows the level below which a bank should be regarded as 'undercapitalized' and second, it also shows the size of the gap that separates

[22] Patrick Van Roy, 2003. Aggarwal and Jacques (1998) gave an alternative definition of this variable adapted for Prompt Corrective Action (PTA) of FDICIA, 1991. But we did not use that approach.

the bank's capital ratio from this level[23]. In accordance with the existing literature, the threshold level is the minimum regulatory requirement or the minimum plus one standard deviation of the bank's own capital ratio[24]. In our study we assume that this is 8 percent for simplicity and also because almost all of the 10 developing countries made 8 or similar figure the target ratio.

x. Year Dummy[25]

Dummy variables for four year of the reference period (five years after the implementation of capital adequacy regulations) were used to detect the changes in the relationship between risk and capital adequacy with time. However, we used the first year following the implementation of capital adequacy as the base year and did not put dummy for the first year to avoid multicollinearity.

5. Econometric Results

Relationship between capital adequacy and risk

As already mentioned, we used both simultaneous equations model, called full information estimation and single equation estimates, called limited information estimations to determine the relationship between capital adequacy and risk with GMM and 3SLS to check the robustness of our results across alternative estimation settings and methods. These estimation results are presented in Table 4 through 7 for both the CAR and RISK equations[26]. Table 4 and 6 shows result of full information estimation, whereas table 5 and 7 shows result of limited information. GMM estimation results are shown in columns 1 and 3, whereas 3SLS results are shown in columns 5 and 7 in each of these tables. Each of these tables show results in panel a for total capital and panel b for tier 1 capital.

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[23] In several studies the second aspect was overlooked due to simplification, where a dummy variable was created that took value of one whenever capital adequacy ratios were below some threshold level and zero otherwise.

[24] The later approach captures the idea that banks generally maintain a buffer above the minimum requirements.

[25] Patrick Van Roy, 2003.

[26] As we have already pointed out, if the simultaneous equations model is not properly specified, then all parameter estimates of the model will be biased, which can be avoided by estimating the equations one by one separately. Limited information estimation estimates these equations individually.

At the same time, we carry out this analysis based several alternative model specifications. In columns 1 and 5 we present results of a basic model with only year dummy and bank specific characteristics. But in columns 3 and 7, we add four country specific variables to the basic model. Furthermore, we add regulatory pressure dummy to both of the model specifications variable in Table 6 and 7 only.

In columns 1 and 5 of panel a of Table 4, we present results for the simple model with only bank characteristics variables and year dummies in the equation based on GMM full information method. But in columns 3 and 7 we present estimate after adding four country specific variables to the basic model. In column 1, our estimates show a negative relation between DCAR and DRISK from both the CAR and RISK equations. The coefficient is equal to -100.474 in the CAR equation and -0.032 in the RISK equation both significant at the 1 percent level. Similarly, in column 5, we re-estimate the basic model based on 3SLS, and again get similar negative result. In column 3, we get the same negative relationship after adding four country specific variables to the basic model of column 1. Again the relationship does not change when we re-estimate it via 3SLS and present output in column 7. All the coefficients of CAR and RISK variables are significant at the 1 percent level in all eight models. Therefore, we find strong support of the negative relationship between RISK and CAR from full information estimates.

In panel b of Table 4 we present estimates for tier 1 capital. We present estimates of similar basic models in column 1 and 5 with bank characteristics variables and year dummies only. In columns 3 and 7, we add the four country specific variables to it. In the CAR equation of column 1, we find the negative relation between CAR and RISK. In the other models these coefficients are not significant. Therefore, we get weak evidence in support of the inverse relationship.

In panel a of Table 5, we follow the same format of table 4 with respect to model specification and use limited information estimation method. We again find that CAR and RISK are inversely related in all the eight models of panel a. All the relevant

coefficients are significant at the 1 percent level. However, in panel b, we only find significant coefficient in column 1.

So far, we get empirical support in favor of the hypothesis that capital and risk are inversely related in the selected countries. Evidence is stronger when we use full information estimates and also when we consider total capital. These results lead to a strong rejection of the theories providing a rationale for a positive relationship between changes in capital and risk and also to some of the existing empirical literature. It also does not support Koehn and Santomero's[27] conclusion that banks will try to compensate for the loss of utility due to higher capital ratios by switching to higher risk. Higher capital ratios did not lead to higher credit risk, and did not endanger financial stability of these developing countries. It also contradicts the predictions of a positive relationship by "buffer capital theory", "managerial risk aversion theory", and "bankruptcy cost avoidance theory".

Impact of the Regulatory Dummy Variable

As we have pointed out Table 6 and 7 present results when the regulatory dummy variable in included in the models. In column 1 and 3 of panel a of Table 6, we find that the coefficient of interest is only significant and negative in the RISK equations alone. This implies that minimum capital regulations did not increase risk of the undercapitalized banks. However, in column 5 and 7 we find that the coefficient is significant and negative in both the CAR and RISK equations. In column 1 and 3 of panel b, we observe that the coefficient is significant and negative only in CAR equations. Again, in column 5 and 7, we find that the coefficients are significant and negative in CAR equations. This seems to imply that banks that were undercapitalized decreased their capital ratios in response to regulations, which we can not explain and is opposite to our expectations. This is opposite to the provided by Van Roy (2003) for 10 OECD countries. In 10 OECD countries capital regulations successfully increased in capital ratios of undercapitalized banks.

[27] This is also in line with evidence provided by Dahl and Shrieves (1992), Aggarwal and Jacques (1997), Jacques and Nigro (1997) etc.

In Table 7, we present estimation results of the same models based on limited information method. In column 1 and 3 of panel a, coefficient of regulation dummy is significant and negative in both the equations. But in column 5 and 6, they are only significant in CAR equations. In column 1 and 3 of panel b, the coefficient is only significant in CAR equations. Similarly, in column 5 and 6, the coefficient is significant and negative in CAR equations only.

This implies that stringent capital requirements were accompanied by a reduction in credit risk, which ultimately contributed to greater stability of the banking sector. But we could not explain our empirical findings that capital regulations and capital ratios of undercapitalized banks were negatively related. One interpretation may be that in most of these developing countries, such regulations were undertaken in the aftermath of financial crisis or bank crisis and at those state banks were relatively more concerned with managing risk as opposed to increasing capital ratios. For example, the regulatory forbearance of Indonesian[28] government towards the failing and financial weak banks in the aftermath of Asian Crisis can be mentioned. During this period of time, regulatory minimum capital ratios during this interim regime were lower than eight percent and this may have stopped the capital ratios from increasing. As a result of such policies, capital ratios did not increase in response to regulations.

Impact of the level of Financial Development

In most of the CAR equations under the various models we find that the coefficient of financial development variable is insignificant, which indicates that there is no clear relationship between the level of financial development and CAR.

With regards to RISK equation, in many cases we find that there is significant and negative relationship of this variable and RISK. It implies that the higher the level of development of financial development in a country, the lower the level of risk. This makes intuitive sense. More developed financial system implies that there are relatively

[28] Donsyah Yudistira, 2003.

more alternatives to commercial banks to manage the impact of higher capital requirements. As a result, they do not need to resort to investing in higher risk projects to increase their income to meet stricter capital regulations.

Impact of the Liberalization Proxy

In the CAR equations of the models, the coefficient of annual foreign investment as percentage of gross domestic product is insignificant most of the time. This implies that there is no significant impact of liberalization policies on changes in capital ratios.

In the RISK equations, we find several negative and significant relations for the foreign investment equations. This implies that liberalization has reduced portfolio risk of banks in the developing countries[29]. However, it may be argued that the attempt to strengthen the regulatory environment in developing countries may have created incentives to avoid risk even in the wake of increasing competition.

6. Conclusion

In this paper, we provided some evidence on the effects that a stricter enforcement of minimum capital discipline can have on bank intermediation in less developed financial systems. Notwithstanding the general recognition that capital regulations may have different effects on bank behavior according to diverse institutional and developmental features of each economy, still we observe that bank capital regulation did not achieve the primary goal of increasing capital ratios of undercapitalized banks, which contradicts the existing empirical evidence of several developed countries during early 1990s. However, we find that capital regulations did reduce portfolio risk of banks, in spite of fear that banks would involve in riskier projects as a result of such regulations.

We also find strong empirical support that capital ratios and portfolio risk are inversely related in the selected developing countries, which contradicts the predictions of a

[29] This is contrary to the evidence provided by Pedro Elosegui et al (2002), who found that following privatization and foreign entry, banks did increase their asset portfolio risk as a result of increased competition.

positive relationship by “buffer capital theory”, “managerial risk aversion theory”, and “bankruptcy cost avoidance theory”.

Our results also suggest that financial development is inversely associated with bank risk. One reason for this may be that as financial development occurs it opens up new opportunities / alternatives for the banks to deal with capital regulations without resorting to investing in riskier projects.

We also find evidence that liberalization is inversely associated with bank risk, which is contrary to the existing empirical evidence that foreign entry increases competition in the domestic banks sector and thus domestic banks resort to riskier projects to retain their income. We argue that, in spite of competition, banks become more concerned about making risky loans and respond by reducing risk weighted assets in their portfolio. We believe that strengthened regulatory environment had this impact on risk taking behavior of banks.

Finally, we would like to state that this paper contributes to the on going discussion on the new Capital Accord. However, our findings reveal important differences regarding the effectiveness of such policies between the developed and developing countries regarding the failure of increasing capital adequacy ratios in the latter countries. As a result, we propose that particular attention should be paid to the process of enforcement of a stricter bank capital discipline in developing countries. Presence of a variety of institutional, legal, cultural, business environmental, and developmental constraints need not be read as an alibi for not modernizing capital regulations. We strongly believe that it should be used to motivate a timely removal / mitigation of such constraints, on the part of the domestic authorities, and more differentiated regulatory option on the part of the international authorities setting regulatory standards, which will effectively cater to the special needs of problems associated with diversity.

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Table 1: Previous Studies on the behavior of banks regarding capital ratios and risk taking

Name of the Authors	Sample Period	Main Objectives	Findings	Related Studies
George Pinteris (2001)	U.S. commercial banks with assets of more than 5 million during 1994-1999	Examine the recent impact of the recent financial crisis in East Asia and Russia on the behavior of large commercial banks with respect to choices of capital and risk.	Large U.S. banks did alter their behavior towards capital requirement but not towards risk. "Megabanks" and less adequately capitalized banks respond to the crisis by raising their levels of capital.	Shrieves and Dahl (1992), Jacques and Nigro (1997). Baltagi's (1981) error-component 2SLS
Pedro Elosegui and George Pinteris (2002)	1996-1999 On Argentine Banks	Examines the impact of privatization and foreign entry on the choices of risk of various types of banking institutions in the Argentine banking system during.	Do not find any differences in the behavior of various institutions in terms of capital. However, find evidence that both existing foreign banks and privatized banks did increase their asset portfolio risk following privatization and foreign entry.	Shrieves and Dahl (1992) Baltagi's (1981) error-component 2SLS
Patrick Van Roy (2003)	1988-1995 Seven G-10 countries. Canada France Italy Japan Sweden United Kingdom United States	Examines the impact of the 1988 Basle Capital Accord on the behavior of banks of seven G-10 countries toward capital and risk.	Findings indicate that changes in capital and credit risk were negatively related over the period under studied. However, also found that the regulations were ineffective in raising the capital ratio of undercapitalized banking institutions in France and Italy.	Shrieves and Dahl (1992) 3 Stage SLS

Table 1: Previous Studies on the behavior of banks regarding capital ratios and risk taking (Contd.)

Name of the Authors	Sample Period	Main Objectives	Findings	Related Studies
Maria Concetta Chiuri, Giovanni Ferri, Giovannni Majnoui (2001)	Years centered around the adoption of capital standard 16 emerging market countries[30]. Crisis Countries include: Argentina, Brazil, Hungary, Korea, Malaysia, Mexico, Paraguay, Thailand, Turkey, Venezuela Non Crisis Country Chile Costa Rica Poland Slovenia	Examines if the enforcement of bank capital asset requirements (CARs) curtails the supply of credit. This was already verified for G-10 countries.	Found that CAR enforcement significantly trimmed credit supply, particularly at less well capitalized banks. The negative impact has been larger for countries enforcing CAR in the aftermath of currency crisis. Also found that CARs impact has been smaller for foreign banks.	Peek and Rosengren (1995) Identifies CAR enforcement in the countries included in the sample.
Jacques and Nigro (1097)	2,570 US commercial banks, with assets more than $100 million over two years 1990-91	Access the impact of regulatory pressure variables on capital ratios and risk.	Regulatory pressure has a positive impact on CAR and negative impact on RISK for adequately capitalized banks. But it has zero or negative impact on CAR and zero impact on RISK for undercapitalized banks.	Shrieves and Dahl (1992)
Aggarwal and Jacques(1997)	2,849 US commercial banks with assets more than $100 million over three yeas 1991-1993.	Do	Regulatory pressure had a positive impact on CAR of adequately and inadequately capitalized banks. Whereas, it has positive impact on RISK in 1991 but negative impact in 1992 and 1993 for both types of banks.	Shrieves and Dahl (1992)

[30] We followed the same convention. We also used an subset of the samples used in this study as well as the dates of implementation of capital regulations presented in Table 2.

Table 1: Previous Studies on the behavior of banks regarding capital ratios and risk taking (Contd.)

Name of the Authors	Sample Period	Main Objectives	Findings	Related Studies
Ediz, Michael and Perraudin (1998)	94 UK banks, 4th quarter 1989-4th quarter 1995.	Do	Regulatory pressure has positive impact on CAR and no impact on RISK of undercapitalized banks.	Shrieves and Dahl (1992)
Rime (2001)	154 Swiss banks over 6 years from 1990-95	Do	Regulations had not impact on CAR of adequately capitalized banks and positive impact on CAR of undercapitalized banks. No impact on RISK of capitalized and undercapitalized banks.	Shrieves and Dahl (1992)
Aggarwal and Jacques(2001)	1,685 US banks with assets more than $100 million over 6 years from 1991-96.	Do	Regulations had positive impact on adequately and undercapitalized banks in 1991. Had positive impact on RISK in 91 and zero impact on RISK in 92. Had negative impact in 93-96 for adequately capitalized and undercapitalized banks.	Shrieves and Dahl (1992)

Note: Last four rows were taken from Patrick Van Roy (2003). The rest were collected by us.

Table 2: Date of implementing capital requirement regulations similar to Basle Acts

Year	Country
1994	Argentina Hungary Turkey Venezuela Slovenia
1996	India
1997	Brazil, Korea Malaysia Thailand Chile

Source: Maria Concetta Chiuri, Giovanni Ferri, Giovannni Majnoui (2001)

Table 3: Selected Countries and Number of Banks from each country

	No of Banks	Percentage of Total
Argentina	16	5.33
Hungary	14	4.67
Turkey	26	8.67
Venezuela	6	2.00
Slovenia	7	2.33
India	50	16.67
Brazil	53	17.67
Korea	37	12.33
Malaysia	51	17.00
Thailand	24	8.00
Chile	16	5.33
Total	300	100.00

Table 4: Full Information Estimates: Simple Model

We estimated the two simultaneous equations jointly with GMM and 3SLS methods. In GMM estimates we made provisions to include only DRISK as an instrument in the CAR equation only and DCAR was used as an instrument in the RISK equation of the system. But this is not the case in 3SLS. In the 3SLS estimates all exogenous variables are used to get predicted value of the dependent variables for the first stage least square, which was used in the instrumental variable estimation in the second stage. Finally, SUR was used at the last stage of 3SLS to take account of cross-equation relation of the error terms.

Variables	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value
Panel a: Total Capital								
	GMM				**3SLS**			
CAR Equation								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	2.81319	.940	-10.992	0.660	28.1434**	0.037	26.533**	0.039
DRISK	-100.474***	.000	-85.093***	0.000	-33.6209***	.000	-37.038***	0.000
LNASSETS	-0.47675	.843	0.631	0.707	-1.79759**	0.041	-1.960**	0.018
ROA	-2.09194	.195	-1.753*	0.092	0.937879**	0.022	0.538	0.117
GOVASS	-4.58583	.233	-7.911*	0.084	-0.40158	0.813	-2.344	0.141
Year2	-10.7631*	.089	65.840**	0.019	-4.91376	0.153	49.963***	0.001
Year3	-3.62541	.610	-10.822	0.124	-1.60094	0.62	-10.442**	0.011
Year4	-7.11076	.304	-10.924*	0.090	-0.84287	0.792	-6.487*	0.058
Year5	-2.97916	.639	4.232	0.530	0.047117	0.986	4.436	0.200
Domestic Credit			-0.177	0.176			-0.063	0.135
Foreign Investment			0.372	0.757			0.474	0.419
GDP Per Capita			4.503**	0.024			3.447***	0.001
Inflation			-2.197**	0.019			-1.846***	0.002
RISK Equation								
Intercept	0.15135	.545	0.282	0.276	-0.11189	0.378	0.041	0.803
DCAR	-0.03261***	.001	-0.028***	0.000	-0.01506***	.000	-0.017***	0.000
LIASSETS	0.103384	.625	0.051	0.728	-0.10293*	0.081	-0.096*	0.053
LLOSS	-1.55E-03	.319	-0.003*	0.068	9.64E-05	0.889	-0.001	0.148
GOVASS	-0.064	.447	-0.125**	0.019	-0.01148	0.738	-0.074**	0.018
Year2	-0.25619*	.065	1.692**	0.009	-0.11849	0.104	0.881**	0.011
Year3	-0.05971	.559	-0.317**	0.054	-0.03282	0.638	-0.140	0.125
Year4	-0.07455	.475	-0.197**	0.075	-0.05083	0.455	-0.103	0.161
Year5	-0.0286	.763	0.139	0.173	-0.04056	0.476	0.045	0.542
Domestic Credit			-0.003**	0.050			-0.003***	0.003
Foreign Investment			-0.013	0.600			0.001	0.961
GDP Per Capita			0.093	0.920			0.058**	0.015
Inflation			0.039	0.944			-0.033**	0.013

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 4: Full Information Estimates: Simple Model (Cont.)
We estimated the two simultaneous equations jointly with GMM and 3SLS methods. In GMM estimates we made provisions to include only DRISK as an instrument in the CAR equation only and DCAR was used as an instrument in the RISK equation of the system. But this is not the case in 3SLS. In the 3SLS estimates all exogenous variables are used to get predicted value of the dependent variables for the first stage least square, which was used in the instrumental variable estimation in the second stage. Finally, SUR was used at the last stage of 3SLS to take account of cross-equation relation of the error terms.

Variables	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value
Panel b: Tire 1 Capital								
	GMM				**3SLS**			
CAR Equation								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	37.8999***	0.007	42.076	0.001	37.9341***	0.005	42.414	0.003
DRISK	-0.10749*	0.076	-0.064	0.438	-0.14865	0.307	-0.154	0.337
LNASSETS	-2.19249**	0.038	-2.897	0.005	-2.19109**	0.015	-2.953	0.003
ROA	1.05491**	0.048	1.331	0.017	1.01467*	0.085	1.223	0.080
GOVASS	1.95223	0.314	2.423	0.250	1.96254	0.196	2.675	0.123
Year2	2.27298	0.538	2.971	0.838	2.21379	0.531	3.973	0.819
Year3	-3.67816	0.373	-4.124	0.369	-3.69667	0.207	-4.619	0.308
Year4	-0.47655	0.836	-1.273	0.609	-0.52667	0.853	-1.725	0.653
Year5	0.783922	0.732	1.025	0.744	0.645201	0.79	1.226	0.756
Domestic Credit			0.008	0.829			0.022	0.701
Foreign Investment			0.928	0.088			0.791	0.265
GDP Per Capita			0.093	0.920			0.223	0.859
Inflation			0.039	0.944			0.024	0.971
RISK Equation								
Intercept	8.04724*	0.054	7.657	0.084	8.19123*	0.073	7.574	0.216
DCAR	-0.09908	0.145	-0.070	0.299	-0.12794	0.209	-0.117	0.194
LIASSETS	0.878081	0.577	-1.401	0.485	0.907254	0.711	-1.449	0.547
LLOSS	-0.10799**	0.035	-0.109	0.028	-0.10665***	.000	-0.107	0.000
GOVASS	0.62846	0.203	2.173	0.054	0.688339	0.603	2.311	0.092
Year2	0.534018	0.555	9.701	0.265	0.555441	0.843	9.751	0.467
Year3	-0.09739	0.906	-2.917	0.247	-0.24496	0.92	-3.136	0.359
Year4	-0.52735	0.613	-1.548	0.312	-0.59043	0.797	-1.706	0.526
Year5	-2.32851	0.178	0.303	0.817	-2.33568	0.232	0.368	0.895
Domestic Credit			0.083	0.079			0.085	0.015
Foreign Investment			-1.589	0.056			-1.576	0.001
GDP Per Capita			0.839	0.198			0.851	0.358
Inflation			-0.323	0.331			-0.307	0.550

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 5: Limited Information Estimates: Simple Model

To test the robustness of the full information in Table 6, we re-estimate the parameters by dealing with the CAR and RISK equations individually. Results are presented below.

Variables	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value
Panel a: Total Capital								
	GMM				**2SLS**			
CAR Equation								
Intercept	27.8936	0.018	21.765	0.067	42.0683***	0.009	42.754***	0.009
DRISK	-16.9592***	0.000	-18.145***	0.002	-19.9542***	0.000	-22.999***	0.000
LNASSETS	-1.44545*	0.062	-1.680*	0.068	-2.67384**	0.012	-3.123***	0.005
ROA	2.16293***	0.000	1.995***	0.000	1.51668***	0.002	1.211***	0.008
GOVASS	2.21755	0.152	0.218	0.906	0.299882	0.873	-0.653	0.727
Year2	1.72211	0.624	17.688	0.454	-3.65533	0.330	44.669**	0.012
Year3	-1.64897	0.515	-4.415	0.448	-0.99527	0.777	-10.295**	0.026
Year4	-2.04976	0.547	-4.705	0.357	0.61146	0.860	-5.198	0.182
Year5	0.267063	0.909	1.567	0.671	0.990472	0.735	4.639	0.237
Domestic Credit			-0.051	0.420			-0.026	0.594
Foreign Investment			1.475	0.108			0.583	0.385
GDP Per Capita			1.077	0.554			3.110**	0.011
Inflation			-0.367	0.657			-1.714**	0.011
RISK Equation								
Intercept	-0.28274	0.439	0.059	0.702	0.027999	0.942	0.065	0.734
DCAR	-8.41E-03***	0.000	-0.014***	0.000	-9.95E-03***	0.000	-0.013***	0.000
LIASSETS	0.011874	0.611	-0.137***	0.003	-4.75E-03	0.850	-0.179***	0.007
LLOSS	-0.02426**	0.028	-0.002*	0.101	-0.02082**	0.072	-0.002*	0.059
GOVASS	-0.04867	0.117	-0.052*	0.077	-0.04564	0.269	-0.064*	0.073
Year2	-0.04341	0.475	0.878**	0.023	-0.10712	0.198	0.565	0.158
Year3	0.033356	0.623	-0.163*	0.077	-0.03608	0.645	-0.056	0.593
Year4	-0.02738	0.684	-0.101	0.204	-0.07077	0.358	-0.052	0.539
Year5	-8.26E-03	0.899	0.062	0.463	-0.02965	0.649	0.007	0.931
Domestic Credit			-0.002**	0.019			-0.003***	0.002
Foreign Investment			-0.002	0.848			-0.001	0.958
GDP Per Capita			0.057	0.036			0.035	0.208
Inflation			-0.032**	0.011			-0.021	0.156

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 5: Limited Information Estimates: Simple Model (Contd.)

To test the robustness of the full information in Table 6, we re-estimate the parameters by dealing with the CAR and RISK equations individually. Results are presented below.

Variables	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value
Panel b: Tire 1 Capital								
			GMM			**2SLS**		
CAR Equation								
Intercept	41.3367***	0.003	48.969***	0.000	37.8999***	0.011	42.076***	0.010
DRISK	-0.085636*	0.053	-0.031	0.616	-0.10749	0.5	-0.064	0.728
LNASSETS	-2.78663***	0.005	-3.687***	0.000	-2.19249**	0.027	-2.897***	0.010
ROA	8.43E-01*	0.087	1.168**	0.021	1.05E+00	0.102	1.331*	0.097
GOVASS	-4.98E-01	0.742	0.075	0.962	1.95E+00	0.24	2.423	0.222
Year2	-0.417308	0.91	-9.799	0.428	2.27298	0.556	2.971	0.881
Year3	-2.85E+00	0.505	-2.283	0.620	-3.67816	0.25	-4.124	0.426
Year4	0.126818	0.956	-1.189	0.631	-0.47655	0.878	-1.273	0.772
Year5	0.064412	0.976	-1.232	0.637	0.783922	0.767	1.025	0.821
Domestic Credit			0.008	0.814			0.008	0.907
Foreign Investment			1.121***	0.008			0.928	0.254
GDP Per Capita			-0.508	0.521			0.093	0.949
Inflation			0.410	0.414			0.039	0.959
RISK Equation								
Intercept	4.2237	0.068	3.360	0.032	8.04724	0.107	7.657	0.275
DCAR	-0.038235*	0.07	-0.015	0.462	-0.099079	0.374	-0.070	0.501
LIASSETS	-0.238374	0.618	-1.384**	0.048	0.878081	0.743	-1.401	0.612
LLOSS	-0.054993**	0.04	-0.048***	0.005	-0.107988***	0.001	-0.109***	0.001
GOVASS	0.74655*	0.066	1.018	0.024	0.62846	0.664	2.173	0.166
Year2	0.425878	0.414	4.243	0.103	0.534018	0.862	9.701	0.527
Year3	0.258753	0.563	-0.812	0.240	-0.097393	0.971	-2.917	0.456
Year4	-0.17222	0.747	-0.682	0.186	-0.527348	0.833	-1.548	0.615
Year5	-0.528367	0.223	0.343	0.508	-2.32851	0.276	0.303	0.925
Domestic Credit			0.026**	0.031			0.083**	0.037
Foreign Investment			-0.618***	0.009			-1.589***	0.004
GDP Per Capita			0.329*	0.085			0.839	0.428
Inflation			-0.130	0.153			-0.323	0.582

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 6: Full Information Estimates: Regulator Pressure Dummy Included

We estimated the two simultaneous equations jointly with GMM and 3SLS methods. In GMM estimates we made provisions to include only DRISK as an instrument in the CAR equation only and DCAR was used as an instrument in the RISK equation of the system. But this is not the case in 3SLS. In the 3SLS estimates all exogenous variables are used to get predicted value of the dependent variables for the first stage least square, which was used in the instrumental variable estimation in the second stage. Finally, SUR was used at the last stage of 3SLS to take account of cross-equation relation of the error terms.

Variables	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value
Panel a: Total Capital								
	GMM				**3SLS**			
CAR Equation								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	-1.396	0.971	-22.737	0.402	12.148	0.355	9.899	0.503
DRISK	-94.188***	0.000	-79.714***	0.000	-27.432***	0.000	-32.265***	0.000
RegDummy	-0.188	0.626	-0.288	0.419	-0.564***	0.000	-0.438***	0.008
LNASSETS	-0.270	0.911	1.344	0.423	-1.006	0.228	-0.974	0.306
ROA	-2.173	0.159	-2.074*	0.062	0.198	0.653	-0.018	0.968
GOVASS	-4.394	0.207	-7.836*	0.062	-0.505	0.737	-2.406	0.111
Year2	-10.845	0.063	64.998**	0.010	-6.038**	0.048	48.723***	0.001
Year3	-3.946	0.539	-11.157*	0.086	-3.000	0.297	-10.925***	0.004
Year4	-6.847	0.293	-10.741*	0.062	-1.174	0.677	-6.425**	0.043
Year5	-2.779	0.644	4.937	0.446	0.152	0.949	5.520*	0.088
Domestic Credit			-0.159	0.221			-0.041	0.303
Foreign Investment			-0.155	0.915			-0.253	0.683
GDP Per Capita			4.533**	0.013			3.493***	0.001
Inflation			-2.131**	0.012			-1.723***	0.002
RISK Equation								
Intercept	-0.343*	0.076	-0.019	0.929	-0.171	0.206	0.007	0.965
DCAR	-0.052**	0.046	-0.040***	0.001	-0.018***	0.000	-0.019***	0.000
RegDummy	-0.042	0.109	-0.026**	0.044	-0.007*	0.075	-0.006*	0.093
LIASSETS	-0.087	0.387	-0.080	0.362	-0.135**	0.031	-0.121**	0.025
LLOSS	0.000	0.851	-0.002	0.142	0.000	0.993	-0.001	0.114
GOVASS	-0.007	0.854	-0.090**	0.042	-0.001	0.974	-0.067**	0.033
Year2	-0.353**	0.050	1.880***	0.005	-0.133*	0.070	0.898***	0.010
Year3	-0.165	0.204	-0.412***	0.002	-0.053	0.453	-0.155*	0.093
Year4	-0.049	0.685	-0.203*	0.076	-0.049	0.470	-0.101	0.172
Year5	-0.013	0.893	0.220*	0.088	-0.037	0.513	0.061	0.411
Domestic Credit			-0.002	0.279			-0.003***	0.005
Foreign Investment			-0.040	0.107			-0.006	0.647
GDP Per Capita			0.134***	0.005			0.060**	0.012
Inflation			-0.069***	0.006			-0.033**	0.013

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 6: Full Information Estimates: Regulator Pressure Dummy Included (Contd.)
We estimated the two simultaneous equations jointly with GMM and 3SLS methods. In GMM estimates we made provisions to include only DRISK as an instrument in the CAR equation only and DCAR was used as an instrument in the RISK equation of the system. But this is not the case in 3SLS. In the 3SLS estimates all exogenous variables are used to get predicted value of the dependent variables for the first stage least square, which was used in the instrumental variable estimation in the second stage. Finally, SUR was used at the last stage of 3SLS to take account of cross-equation relation of the error terms.

Variables	**Parameter Estimates**	**P-value**	**Parameter Estimates**	**P-value**	**Parameter Estimates**	**P-value**	**Parameter Estimates**	
Panel b: Tire 1 Capital								
	GMM				**3SLS**			
CAR Equation								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	-7.317	0.503	-14.321	0.320	-7.044	0.556	-13.087	0.340
DRISK	-0.091**	0.033	-0.099*	0.069	-0.138	0.196	-0.158	0.191
RegDummy	-0.849***	0.000	-0.974***	0.000	-0.849***	0.000	-0.966***	0.000
LNASSETS	0.181	0.824	0.779	0.474	0.166	0.824	0.669	0.470
ROA	0.508	0.196	0.625	0.193	0.461	0.295	0.558	0.297
GOVASS	0.434	0.685	-0.750	0.530	0.441	0.698	-0.557	0.688
Year2	1.717	0.364	1.645	0.882	1.646	0.526	2.353	0.856
Year3	-3.454	0.262	-2.377	0.454	-3.472	0.107	-2.731	0.423
Year4	-0.389	0.839	1.384	0.396	-0.443	0.832	1.053	0.717
Year5	1.233	0.468	-0.026	0.991	1.080	0.544	0.144	0.961
Domestic Credit			-0.031	0.276			-0.021	0.640
Foreign Investment			-0.295	0.467			-0.371	0.511
GDP Per Capita			-0.173	0.805			-0.080	0.933
Inflation			-0.032	0.940			-0.042	0.932
RISK Equation								
Intercept	7.231*	0.061	6.747	0.104	6.768	0.151	6.145	0.315
DCAR	-0.172	0.131	-0.178*	0.097	-0.244	0.106	-0.247*	0.060
RegDummy	-0.114	0.261	-0.186	0.137	-0.177	0.314	-0.250	0.130
LIASSETS	1.054	0.480	-1.270	0.449	1.049	0.669	-1.262	0.596
LLOSS	-0.110**	0.034	-0.112**	0.030	-0.108***	0.000	-0.109***	0.000
GOVASS	0.476	0.359	1.754*	0.063	0.487	0.716	1.723	0.220
Year2	0.621	0.502	10.253	0.237	0.682	0.808	10.378	0.434
Year3	-0.291	0.744	-3.122	0.197	-0.560	0.819	-3.354	0.322
Year4	-0.513	0.629	-1.242	0.408	-0.569	0.803	-1.261	0.637
Year5	-2.094	0.203	0.498	0.710	-1.995	0.314	0.589	0.832
Domestic Credit			0.079*	0.081			0.079**	0.023
Foreign Investment			-1.669*	0.053			-1.679***	0.000
GDP Per Capita			0.841	0.193			0.846	0.355
Inflation			-0.351	0.278			-0.345	0.497

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 7: Limited Information Estimates: Regulator Pressure Dummy Included

To test the robustness of the full information in Table 6, we re-estimate the parameters by dealing with the CAR and RISK equations individually. Results are presented below.

Variables	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value
Panel a: Total Capital								
	GMM				**3SLS**			
CAR Equation								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	-16.107	0.102	-19.094	0.155	19.030	0.220	12.175	0.519
DRISK	-2.516	0.437	-10.756**	0.046	-16.593***	0.001	-21.282***	0.000
RegDummy	-1.000***	0.000	-0.869***	0.000	-0.637***	0.000	-0.562***	0.006
LNASSETS	0.766	0.263	1.060	0.306	-1.481	0.137	-1.198	0.336
ROA	0.312	0.354	0.263	0.529	0.436	0.403	0.165	0.774
GOVASS	0.409	0.579	-1.402	0.179	-0.139	0.934	-1.534	0.389
Year2	1.431	0.571	-4.776	0.762	-5.518	0.102	46.022	0.006
Year3	-3.953*	0.056	-0.249	0.952	-2.671	0.398	-11.025**	0.011
Year4	-0.809	0.696	0.726	0.823	-0.218	0.944	-5.651	0.121
Year5	-0.176	0.897	-0.721	0.767	0.784	0.763	5.959	0.108
Domestic Credit			-0.073*	0.074			-0.012	0.790
Foreign Investment			0.562	0.173			-0.478	0.516
GDP Per Capita			-0.502	0.684			3.366	0.004
Inflation			0.381	0.499			-1.653	0.009
RISK Equation								
Intercept	-0.160	0.233	0.054	0.738	-0.186	0.228	0.067	0.737
DCAR	-0.013***	0.000	-0.014***	0.000	-0.011***	0.000	-0.013***	0.000
RegDummy	-0.004**	0.070	-0.001	0.800	-0.001	0.860	0.000	0.972
LIASSETS	-0.180***	0.000	-0.147***	0.000	-0.189**	0.011	-0.179**	0.011
LLOSS	-0.001	0.187	-0.002	0.134	0.000	0.875	-0.002*	0.064
GOVASS	0.012	0.677	-0.056*	0.060	0.006	0.883	-0.064*	0.079
Year2	-0.063	0.359	0.823	0.036	-0.098	0.227	0.564	0.164
Year3	-0.020	0.765	-0.156	0.108	-0.027	0.729	-0.056	0.603
Year4	-0.047	0.479	-0.093	0.272	-0.046	0.538	-0.052	0.543
Year5	-0.029	0.674	0.055	0.513	-0.046	0.458	0.007	0.936
Domestic Credit			-0.003**	0.014			-0.003***	0.003
Foreign Investment			0.000	0.992			-0.001	0.968
GDP Per Capita			0.053	0.061			0.035	0.217
Inflation			-0.030	0.019			-0.021	0.161

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 7: Limited Information Estimates: Regulator pressure Dummy Included (Contd.)
To test the robustness of the full information in Table 6, we re-estimate the parameters by dealing with the CAR and RISK equations separately. Results are presented below.

Variables	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value	Parameter Estimates	P-value
Panel b: Tire 1 Capital								
	GMM				**3SLS**			
CAR Equation								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	5.995	0.568	4.820	0.689	-6.097	0.643	-14.321	0.368
DRISK	-0.088**	0.014	-0.055	0.204	-0.117	0.323	-0.099	0.482
RegDummy	-0.776***	0.000	-0.810***	0.000	-0.875***	0.000	-0.974***	0.000
LNASSETS	-0.898	0.254	-0.685	0.451	0.016	0.984	0.779	0.468
ROA	0.490	0.178	0.624	0.064	0.651	0.179	0.625	0.314
GOVASS	-1.439*	0.100	-1.954*	0.065	0.180	0.887	-0.750	0.641
Year2	0.202	0.909	-2.303	0.765	2.233	0.437	1.645	0.913
Year3	-4.574	0.134	-3.690	0.225	-3.364	0.158	-2.377	0.547
Year4	-0.335	0.841	1.006	0.389	0.253	0.913	1.384	0.681
Year5	-0.386	0.767	-1.281	0.479	0.626	0.751	-0.026	0.994
Domestic Credit			-0.029	0.242			-0.031	0.543
Foreign Investment			0.109	0.739			-0.295	0.652
GDP Per Capita			-0.331	0.525			-0.173	0.874
Inflation			-0.012	0.970			-0.032	0.955
RISK Equation								
Intercept	3.961*	0.067	2.549*	0.054	6.903	0.198	6.747	0.341
DCAR	-0.062	0.120	-0.031	0.194	-0.173	0.293	-0.178	0.242
RegDummy	-0.038	0.388	-0.043	0.180	-0.125	0.539	-0.186	0.331
LIASSETS	-0.267	0.566	-1.286**	0.047	1.064	0.695	-1.270	0.646
LLOSS	-0.054**	0.039	-0.043**	0.018	-0.108***	0.001	-0.112***	0.001
GOVASS	0.784	0.062	0.798**	0.048	0.423	0.777	1.754	0.281
Year2	0.454	0.392	4.212*	0.077	0.662	0.831	10.253	0.505
Year3	0.331	0.481	-0.682	0.224	-0.300	0.912	-3.122	0.426
Year4	-0.062	0.907	-0.382	0.384	-0.440	0.862	-1.242	0.689
Year5	-0.395	0.330	0.494	0.311	-2.181	0.314	0.498	0.877
Domestic Credit			0.023**	0.063			0.079**	0.049
Foreign Investment			-0.595**	0.027			-1.669***	0.003
GDP Per Capita			0.322*	0.068			0.841	0.427
Inflation			-0.127	0.112			-0.351	0.551

Note: '*' is significant at 10 percent, '**' is significant at 5 percent, and '***' is significant at 1 percent.

Table 8: Substitution Effect of Capital Regulations

Author	Country and Period	Capital Approach	Capital vs. Risk Taking
Shrieves and Dhal (1992)	US 1984-86	1981 Standards	Positive Relationship
Wall and Peterson (1995)	US 1989-92	Basle Accord	Constrained Capital
Calem and Rob (1996)	US 1984-93	Basle Accord	Positive Relationship
Jacques and Nigro (1997)	US 1990-91	Basle Accord	Positive Relationship
Aggarwal and Jacques (1998)	US 1991-93	Basle Accord and Prompt Corrective Action of	Positive Relationship
Ediz et al (1998)	UK 1989-95	Basle Accord	Positive Relationship
Rime (2000)	Switzerland 1989-95	Basle Accord and Prompt Corrective Action of	No Effect to Risk

Source: Donsyah Yudistira, 2003.