The Impact of Basel Risk Based Capital Requirement (Accord I) on Bank Performance in the Context of a Small Service-Based Island Economy.

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Abstract

This paper tests the effect of the Basel Risk Based Capital Requirements (Basel Accord 1) on Mauritian banks' behaviour, using a sample of 9 commercial banks. In the absence of any simultaneity between change in capital ratio and change in credit risk following the application of 3SLS to an extension of the model proposed by Shrieves and Dahl (1992) , the study applies the Arellano-Bond GMM technique to provide unbiased and more efficient estimates by taking into account dynamic framework. The main result emanating from this research reveals that banks' response to the Basel Risk -Based Capital Accord I requirement, is weak in the Mauritian context and under the period of study.

Key Word: Capital Ratio, Risk Ratio, GMM

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1.0 Introduction

In 1988, supervisory bodies of the G-10 countries decided to adopt the Basel Accord and some 100 countries around the world have adopted it. The Basel Accord was intended to enhance soundness and stability of the international banking system by allowing banks to meet a common solvency ratio of 8%. The Basel committee defines capital as a cushion that enables banks to absorb unexpected losses. Assets are weighed by a risk factor r ($0 < r > 1$) and are then aggregated to give total risk adjusted assets. Banks should then observe a ratio of capital to these risk adjusted assets. The aim of the Basel I committee was to promote banking stability across the world by coordinating regulatory definition of capital, risk evaluation, and capital requirement standards, to link banks' capital requirements to their activities, including risky off balance sheet activities.

However, the Basel I Capital Accord, in addition to disregarding other risks that banks faced, it also did not serve as a good signal of bank total risks since it relied profoundly on the historical-cost accounting system (Hogan & Sharpe, 1990). Furthermore, it ignored soundness factors such as asset quality, management, internal control system, regular onsite and offsite surveillance as well as liquidity problems and assumed homogeneity of commercial loans. These weaknesses led to the emergence of the Basle II Capital Accord which brings in, more classy ways for measuring credit risk capital requirements, and seeks to trim down the scope for regulatory capital arbitrage. It also permits for systems to mitigate credit risks, to establish a capital charge for operational risks as well as enhances greater transparency through comprehensive disclosure requirements.

Although there are prominent arguments in favour of the Basel Accord, there are doubts about its effectiveness in the allocation and distribution of financial resources in developed countries. More precisely there are doubts concerning the impacts of the Basel Risk Based Capital Requirements on banks' behaviour. For instance, according to the option pricing model, capital requirements are intended to trim down moral hazard problems by obliging owners of banks to increase capital so as not to wipe off the capital base of the banks in case of large losses and as such lead to lower profitability (Benston et al., 1986; Furlong and Keeley, 1989 and Keeley and Furlong, 1990). On the other hand, using a mean-variance setting, Koehn and Santomero (1980), Kim and Santomero (1988) and Rochet (1992) find that if capital is comparatively expensive, the

enforced diminution in leverage will lead to a fall in the expected returns of banks. Accordingly, the bank's shareholders will have a tendency to opt for a higher point on the efficiency frontier, with a higher return and a higher risk. In some cases, the enhanced risk for the bank offsets the rise in capital and may increase the bank's default probability. Moreover, in a dynamic setting (multiple periods), Blum (1999) postulates that due to an intertemporal effect, banks' riskiness may increase following capital regulation. While Vlaar (2000), assuming banks' assets are fixed, points out that capital requirements act as a heavy weight on banks which are incompetent, while those who are competent may even experience an increase in profitability following such requirements.

Moving to empirical studies in the case of US commercial banks, Shrieves and Dahl (1992) using a simultaneous equation model conclude that the effectiveness of the risk based capital requirement depends firmly on whether the requirements reflect the true exposure of the banks to risk. Jacques and Nigro (1997) applying a model similar to that of the former authors postulate that regulatory pressure is positively related to capital adequacy ratios and negatively related to credit risk ratios for adequately capitalised banks while Aggarwal and Jacques (1997) demonstrate a similar result in the case of both sufficiently and insufficiently capitalised banks. In addition, Jackson et al. (1999) claim that in the short run, banks react mainly to stringent capital regulations by reducing their advances and there is insignificant indication that tight capital requirements have encouraged banks to keep higher capital to total assets ratios that they would have in the absence of such requirements.

Furthermore, Furlong (1992), Haubrich and Wachtel (1993) and Lown and Peristiani (1996) put forward that the introduction of the capital adequacy ratio led to a reduction in the ability of banks to create credit, which contributed a post-capital requirements credit crunch in the U.S. Wagster (1999) comes up with the same result for Canada and the UK, though in the case of Germany, Japan and U.S.A, he highlights that credit crunch was due to other factors. Bertrand Rime (2000) by extending the model of Shrieves' and Dahl's (1992) state that Swiss banks which are close to the minimum regulatory capital requirement, have a tendency to raise their capital to risk weighted assets, thereby implying that regulatory pressure has the expected effect on banks' behaviour.

In the context of 16 emerging market countries, Concetta et al. (2001) find that capital adequacy implementation reduced the supply of credit, especially for less well-capitalised banks. This negative effect is found to be more significant for countries applying capital adequacy ratios after the currency crisis. Hussain and Hassan (2005) assert that in 11 developing countries (India, Argentina, Hungary, Turkey, Venezuela, Slovenia, Brazil, Korea, Malaysia, Thailand and Chile), though capital regulation reduces the risk of the portfolio of the commercial banks, it does not increase capital ratios, while Murinde and Yaseen (2006), using data from the Middle East and North African region, postulate the opposite in the sense that capital requirements significantly influence bank decisions regarding capital ratios.

Using a dynamic panel data model, Robert Mullings (2003) concludes that capital requirements are notably taken into account by banks in Jamaica, in their quest for maximising profits,. Moreover, Nag and Das (2002) using data for 28 Indian public sector banks for the period 1996 to 2000 affirm that the implementation of more stringent risk management practices regarding bank lending and its interaction with minimum capital requirements has the effect of reducing overall supply of credit.

From the above background, the impact of capital requirements on banks' behaviour seems mixed and depends on a case to case basis. At the same time, most studies seem to have been conducted in the context of developed and industrialised economies (an exception is the study by Murinde and Yaseen, 2006). Hence the very aim of this paper is to assess banks' response to the Basel Risk -Based Capital requirement in Mauritius, a middle income Sub-Saharan African country where the financial sector acts as one of the main pillars of the economy.

The rest of the paper is organised as follows: the following section discloses the methodology and its application to the Mauritian case, the next section discusses the first step GMM results and the final section concludes the paper.

2.0 Methodology

2.1 The Shrieves and Dahl (1992) Model

To test the effect of the Basel risk based capital requirements, we shall develop a model similar to that of Shrieves and Dahl (1992). However, we depart from his model to include variables that are considered most important for the Mauritian Banks.

According to the authors, capital and risk are simultaneously determined as shown below:

$$\Delta Cap_{i,t} = \Delta^{d} Cap_{i,t} + E_{it} \quad [1]$$

$$\Delta Risk_{i,t} = \Delta^{d} Risk_{i,t} + F_{it} \quad [2]$$

Where ΔCap and $\Delta Risk$ are the observed changes in capital and risk ratios, respectively for bank i in period t. The $\Delta^{d} Cap_{i,t}$ and $\Delta^{d} Risk_{i,t}$ variables are changes in capital and credit risk determined by the banks, and the terms E_{it} and F_{it} depict other exogenous factors. According to Shrieves and Dahl (1992), banks adjust their capital and risk using a partial adjustment procedure.

$$\Delta^{d} Cap_{i,t} = \alpha(Cap^{*}_{i,t} - Cap_{i,t-1}) \quad [3]$$

$$\Delta^{d} Risk_{i,t} = \Pi(Risk^{*}_{i,t} - Risk_{i,t-1}) \quad [4]$$

Where $Cap^{*}_{i,t}$, and $Risk^{*}_{i,t}$ show the targeted capital and risk ratios set for the i^{th} commercial bank in year t respectively. Substituting equations [3] and [4] in equations [1] and [2], respectively we get

$$\Delta Cap_{i,t} = \alpha(Cap^{*}_{i,t} - Cap_{i,t-1}) + E_{it} \quad [5]$$

$$\Delta Risk_{i,t} = \Pi(Risk^{*}_{i,t} - Risk_{i,t-1}) + F_{it} \quad [6]$$

Equation 5 means that the observed changes in capital for bank i in period t depends on the differences between capital targeted in period t and actual capital in period t-1, and any exogenous factors. In the same way, equation 6 means that the observed changes in risk for bank

i in period t depends on the differences between risk targeted in period t and actual risk in period t-1, and any exogenous factors. α and Π measure the speed of adjustment, that is the speed at which banks adjust their prevailing capital or risk to the targeted levels.

They then proceeded to develop equation 5 and 6 into regression models for observed changes in capital and risk and are specified as follows:

$$\Delta Cap_{i,t} = \beta_0 + \beta_1 \ \mathrm{Re}g_{i,t-1} - \alpha Cap_{i,t-1} + \phi_1 \ x_{i,t} + \lambda_1 \Delta Risk_{i,t} + \varepsilon_{i,t} \quad [7]$$

$$\Delta Risk_{i,t} = \beta_0 + \beta_2 \ \mathrm{Re}g_{i,t-1} - \Pi Risk_{i,t-1} + \phi_2 \ x_{i,t} + + \lambda_2 \Delta Cap_{i,t} + \xi_{i,t} \quad [8]$$

The above equations [7] and [8] have been derived based on the following assumptions:

- $Risk^*_{it}$ and Cap^*_{it} are unobserved and need to be approximated;
- measures of capital and risk are included on the right hand side of the risk and capital equations respectively for the reason that these variables are assumed to be chosen simultaneously by banks;
- some banks which are under pressure to meet the regulatory limits set by the regulator regarding capital requirements, can either increase or reduce risk more than adequately capitalized banks. In this respect an additional regressor, Reg_{it-1}, an indicator for regulatory pressure is included in both equations. The variable equals 1 of the bank i at time t-1 is facing pressure and zero otherwise;
- exogenous shocks included in the two equations, capture 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).

2.2 Application to the Mauritian Context

We will depart from the model proposed by Shrieves and Dahl (1992) by including in our model, variables which are considered the most important for Mauritian Banks. First and foremost, contrary to Shrieves and Dahl (1992), Aggarwal and Jacques (1997) and Ediz, Michael and Perraudin(1998), we will not include regulatory pressure as an explanatory variable for the mere reason that banks taken in the sample, on average meet the 10% solvency ratio prescription set by the Bank of Mauritius. Second, following Jimenez and Saurina (2006) and contrary to Shrieves and Dahl (1992), Aggarwal and Jacques (1997,2001) and Ediz, Michael and Perraudin(1998), we will make use of the ratio of non-performing loans to represent our risk variable. This is because credit risk still represents the main source of risk for banks in our context.

We proceed below by identifying the variables which explicitly affect changes in Mauritian Banks' Capital and Risk, some of which have already been used by Shrieves and Dahl (1992), Aggarwal and Jacques (1997,2001) and Ediz, Michael and Perraudin(1998).

Table 1.1: Expected Signs and Measurement of Explanatory Variables

Explanatory Variables	***Measured by***	***Expected sign on capital***	***Expected sign on risk***
Current profits	Return on assets (ROA)	+	+
Ratio of investment in securities to total assets	ratio of investment in securities to total assets (ITA)	-	-
Macroeconomic Shocks	• credit growth rate (CG) • GDP growth rate (GRGDP)	- -	+ +

At the same time, taking into account the interdependence of banks' capital and risk choices (For instance, an increase in capital ratios is expected to increase risk by enabling banks to increase their loans and advances and still be within the credit concentration limits set by the Bank of Mauritius. Similarly, an increase in risk, increases profitability of banks and enables banks to increase their capital ratios accordingly), our equations are given by:

$$\Delta Cap_{i.t} = \alpha_0 - \alpha_1 CG_{i,t} - \alpha_2 ITA_{i,t} + \alpha_3 ROA_{i,t} - \alpha_4 GRGDP_{i,t} + \alpha_5 \Delta RISK_{i,t} - \alpha_6 Cap_{i,t-1} + E_{i,t} \quad [9]$$

$$\Delta RISK_{i.t} = \prod_0 - \prod_1 CG_{i,t} - \prod_2 ITA_{i,t} + \prod_3 ROA_{i,t} - \prod_4 GRGDP_{i,t} + \prod_5 \Delta Cap_{i,t} - \prod_6 RISK_{i,t-1} + F_{i,t} \quad [10]$$

As far as the dependent variables are concerned, in the case of capital, there exist two definitions in the literature: (i) The ratio of total capital, comprising of Tier 1 and Tier 2 capital to risk-weighted assets and (ii) the ratio of capital to total assets. The first definition is most widely used and have been used by Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwal and Jacques(1998), Aggarwal and Jacques (1998) and Ediz, Micheal and Perraudin (1998). Therefore, we shall use Cap to represent the ratio of total capital to risk weighted assets.

On the other hand, the definition and measurement of risk has been subject to disparagements. While some authors like Shrieves and Dahl (1992), Jacques and Nigro (1997) and Aggarwal and Jacques(1998), opted for the ratio of risk weighted assets to total assets, others like Jimenez and Saurina (2006) used the non-performing loans ratio. In the Mauritian context, since credit risk is still the main source of risk for banks, we shall use the non-performing loans ratio.

Data sources emanate from the Registrar Of Companies, from the Annual Reports of the banks taken in the sample, from The Central Statistical Office and from the Bank of Mauritius Annual reports and monthly bulletin. Most of the banks in our sample became operational as from 2000, so our period of study emanates from 2000 to 2008.

2.3 Tests for Robust Estimates

First using the Breusch-Pagan/ Cook-Weisberg Test, it was found that in both the capital and risk equations there is the presence of heteroscedasticity (for capital equation $\chi^2(1)=4.52$, prob> $\chi^2=0.0335$ and for risk equation $\chi^2(1)=14.98$, prob> $\chi^2=0.0001$), implying that the standard errors are not only biased but also inefficient. This was expected given that banks of different sizes were taken in the sample.

The next test was for the presence of multicollinearity and this was done using the 'Variance Inflating Factor' (VIF). The results shown in Table 1.2 reveal that the there is no multicollinearity since the VIFs for all variables are less than 10.

Table 1.2 : Test for Multicollinearity- VIF for both Equations

Variables	VIF for Δ Cap Equation	1/VIF for Δ Cap Equation	VIF for Δ Risk Equation	1/VIF for Δ Risk Equation
ROA	1.34	0.75	1.23	0.81
Lagged Capital	1.28	0.78	-	-
ITA	1.22	0.82	1.15	0.87
ΔRisk	1.21	0.83	-	-
Credit Growth	1.08	0.93	1.02	0.98
Growth in Real GDP	1.01	0.99	1.01	0.99
Lagged Risk	-	-	1.23	0.81
ΔCapital	-	-	1.04	0.96

As far as testing for model specification is concerned, the RAMSEY RESET test was applied and as demonstrated in Table 1.3 since the P value is very low, it indicates that the model we use in our analysis is well specified.

Table 1.3: Ramsey Reset Test Results

Variables	**for fitted values of Δ Cap ratio**	**for fitted values of Δ Risk ratio**
F(3,116)	1.64	13.00
Prob>F	0.1839	0.0001

3.0 Arellano-Bond GMM estimates and associated diagnostics

Since we have included lag in our model, the use of dynamic panel data approach, such as the GMM estimators (first step or two steps GMM)[2] of Arellano and Bond (1991), first proposed by Holtz-Eakin, Newey and Rosen (1988), becomes relevant. The GMM technique eliminates the fixed effects through the use of first differences instead of the actual level of the variables. This is then followed by an instrumental variable estimation of the differenced equation. The lagged level values of the endogenous variables and those of the variables which are correlated with the differenced error term are used as instruments for the concerned variables. This approach starts with lag two and with the aptitude of going back to the beginning of the sample.

We apply the difference GMM (first step GMM), given that although in the two step estimation the standard covariance matrix is robust to panel-specific autocorrelation and heteroscedasticity, the standards errors are downward biased (Blundell and Bond, 1998).

3.1 GMM Results

The results from using the Arellano-Bond (1991) first step GMM estimator are shown in Table 1.4. Whether the estimates are consistent or not depends on whether the lagged values of the regressors are valid instruments or not in our specified model and for the testing the latter hypothesis we have recourse to two tests, namely the test for autocorrelation and the Sargan test. Under the Arellano-Bond test for autocorrelation, the null hypothesis is that there is no autocorrelation and is applied to the differenced residuals and this test validates the use of lagged endogenous variables as instruments and hence supports correct model specification. Given that first differencing of variables usually generates first order autocorrelation, we apply the 2nd

[2] We also used 3SLS to test for the existence of simultaneity between change in capital ratios and credit risks of the sampled commercial banks and the result was negative. This is in line with the practice of the banks where capital decisions are taken separately from credit risk decisions.

order autocorrelation which detects autocorrelation in levels. The Sargan test, on the other hand, has a null-hypothesis of 'the instruments as a group are exogenous' and as such the higher the p-value of the Sargan statistic (reported by the Hansen J statistic in robust estimation) the better.

Table 1.4: GMM Results for Change in Capital Equation

Variables	**Coefficient**
Constant	-1.045*** (-4.29)
cap_{t-1}	-0.505*** (-9.72)
d cap	5.668*** (12.70)
d Δ RISK	0.129 (0.36)
d CG	-0.131 (-0.23)
d ITA	-0.469*** (-3.39)
d GRGDP	-0.469 (-1.50)
d ROA	-0.6012 (-1.03)
<u>Diagnosis tests</u> Sargan Test of Overidentifying restrictions Arellano-Bond test of 1st order autocorrelation Arellano-Bond test of 2nd order autocorrelation	 *prob>chi2=0.85* *prob>chi2= 0.22* *prob>chi2= 0.21*

*significant at 10%, ** significant at 5%, ***significant at 1%

The heteroskedastic-robust z-values are in parentheses

Based on the Sargan Test for over identifying restrictions, it can be noted that there is no evidence of over identification (the statistic is close to 1).

The first step GMM results reveal that the lagged capital, which indicates that the speed of capital adjustment, is statistically significant and such a result is in line with Jimenez and Saurina (2006). This finding discloses that banks incurring losses in the previous period, had to recapitalize in the next period and the subsequent capital injection was insufficient to absorb the recurring larger losses thus wiping off their capital base, and hence their capital ratios.

Furthermore, contrary to Rime (2001), Shrieves and Dahl (1992), change in risk, that is credit risk in the previous period, is insignificant in explaining changes in the capital ratios of the commercial banks. This is because the NPL (Non-Performing Loans ratio) has on average been on the downward trend for most banks, especially with experienced recovery officers and stringent risk management policies adopted by the banks.

At the same time, in line with Aggarwal and Jacques (2001), Hussain and Hassan (2005), the ratio of investment to total assets proves to be significant in explaining changes in the capital ratio under the first step GMM regression. The significant coefficients of credit growth (in line with Chiuri et al., 2001; Rime, 2001) signal that credit growth significantly explain changes in the capital ratios of the major commercial banks in Mauritius. In other words, this may mean that banks in the sample made use of retained earnings to grant loans and advances and such a practice reduced the accumulated reserves and hence the capital ratios of the banks.

Moreover, in contrast to Bertrand Rime (2001), Hussain and Hussain (2005), Chiuri et al, growth in real GDP is statistically insignificant in explaining changes in the change in capital ratios. Growth in real GDP in Mauritius has been brought about mainly by manufacturing sector (more explicitly the textiles sector) although tourism, financial services and construction sectors also

contributed a lot to growth during the last two decades. However, in the post 2000 period, many textile firms went bankrupt and had to close down. As a result, some banks had to face huge losses because of high non-performing loans which had to be written off by these banks. Subsequently, these banks made losses, which eroded their capital base and thus reduced their capital ratios. However, most banks had a well-diversified portfolio of assets including loans such that on average growth in real GDP did not significantly affect the capital ratios of the banks.

Return on assets, in contrast to Rime (2001), is also insignificant in explaining changes in capital ratios of the banks, albeit around 60% of changes in capital is explained by return on assets. This means that an increase in profitability does not go to increase the capital ratio, as banks employ the increase in profitability to invest in government bills to finance the growing budget deficits or, as mentioned earlier, to give loans and advances.

Table 1.5: GMM Results for Change in Risk Equation

Variables	**Coefficient**
Constant	-1.244** (-2.17)
$RISK_{t-1}$	-0.338*** (-3.96)
d RISK	3.312*** (4.31)
d Δ cap	0.0035 (0.03)
d CG	0.0564 (0.39)
d ITA	0.199 (0.50)
d GRGDP	0.341

	(0.35)
d ROA	-14.62*** (-3.07)
Diagnosis tests	
Sargan Test of Overidentifying restrictions	*prob>chi2=0.79*
Arellano-Bond test of 1st order autocorrelation	*prob>chi2= 0.25*
Arellano-Bond test of 2nd order autocorrelation	*prob>chi2= 0.27*

A first look at Table 1.5, reveals that if in the last period banks were credit risky then in the current period they would tend to be less risky as they would have taken the measures to hedge themselves against the risks and learned from previous period mistakes. Moreover, change in capital is insignificant in explaining changes in the risk ratios of the commercial banks. A change in capital does not induce Mauritian banks to give bad loans, although they are induced to give more loans with regards to their capital levels (per the Credit Concentration Guideline of the Bank of Mauritius). Instead banks are found to be more biased towards regulation by observing higher solvency ratios than those prescribed by the Basel Committee and the Bank of Mauritius.

Conversely to Chiuri et al (2001), credit growth is insignificant in explaining change in risk. This result may imply that the banks in the sample adopted more stringent risk management policies and employed experts in the recovery of debts. Also, most banks were able to employ qualified and experienced credit analysts to give loans and advances to good credit rated customers, albeit some unexpected economic events such that the decline of the local Textile Sector, which led to some banks having their non-performing loans more concentrated in that sector. Yet, on the whole, the latter is considered insignificant in proportion to portfolio of loan assets they hold.

The insignificance of ITA, consistent with the findings of Aggarwal and Jacques (2001), Hussain and Hassan (2005), means that the ratio of Investment to total assets cannot explain changes in credit risk in Mauritius. Moreover, in contrast to Bertrand Rime (2001), Hussain and Hassan (2005), Chiuri et al, growth in real GDP is statistically insignificant in explaining changes in the change in risk ratios. Growth in real GDP in Mauritius has been brought about mainly by manufacturing sector (more explicitly textiles sector) although tourism, financial services and construction sectors also contributed a lot to growth during the last two decades. However, in the post 2000 period, many textile firms went bankrupt and had to close down. As a result, the non-performing loans of some banks increased as a proportion of their total advances as most of their advances were concentrated in the textile sector. However, most banks had a well-diversified portfolio of assets including loans such that on average growth in real GDP did not significantly affect the risk ratios of the banks.

The significance of return on assets in the change in risk equation (consistent with Rime 2001) means that increases in credit risk is mainly associated with increases in retained earnings. This reflects that as profitability increases, the banks are able to employ experts in the field of credit analysis and recovery of debts.

4.0 Conclusion

In spite of the broad-spectrum confession that capital regulations may have different effects on bank behaviour, we observe that bank capital regulation did not achieve the primary goal of increasing capital ratios of banks (given most of the explanatory variables were insignificant), which contradicts the existing empirical evidence of several developed countries during early 1990s. Nor does it have an influence on risk of banks, notwithstanding the fear that banks would involve in riskier projects as a result of such regulations. The only factor that explained significantly changes in risk ratios was return on assets as banks were using a greater proportion of their profitability to reduce their credit risks by employing experts in credit risk management.

However, the results must be interpreted with caution, first because the number of banks taken stands at only 9 in the sample. This may not be much effective in examining the effect of the capital requirement on the behaviour of Mauritian banks. If we were to include other banks

including the offshore banks, a more appropriate examination of the results would have been gained. Nevertheless, it must be noted that the behaviour of offshore banks would differ significantly on account of different accounting practices and we would have to include other variables in the equation, which would have led to misspecification error.

This study has focussed on the effect of capital accord I (Basel II came into effect much after-first quarter of 2009) on the behaviour of Mauritian Commercial banks' capital and credit risk ratio only. Taking into account the cut throat competition prevailing in the Mauritian financial services sector with the emergence of new banks and Non-Bank Financial Institutions, future research should be geared towards examining the Basel effect on deposit growth. Moreover, since Basel II, which is an extension of Basel I and includes market risk and operational risk, future research should also examine the behaviour of banks regarding market and operational risks as well.

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