Risk, capital and financial crisis

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Risk, Capital and Financial Crisis: Evidence for Gulf Cooperation Council (GCC) Banks[1]

1. Introduction

The relationship between bank capital and risk-taking is one of the key issues in the banking literature. The minimum capital standards advocated by the Basel Committee which are sought to be implemented are premised on the rationale that increased capital enhances bank safety. However, this premise might often turn out to be less than relevant. By way of example, increased capital might induce a bank to assume greater risks. If this effect outweighs the buffer effect of capital, highly capitalized bank might experience a higher probability of failure. Such risk-taking behavior explains why otherwise well-capitalised banks often experience significant declines in their capital position.

The aim of this paper is to push forward the empirical literature by examining the relation between capital and risk for GCC banks. Our study seeks to shed light on the association between these two variables and how it was affected during the financial crisis.

The GCC banking system provides a reasonable laboratory to examine this issue in a holistic fashion. These countries share similar economic and social characteristics and are essentially dependent on a single primary commodity for exports.. Following the oil boom, real GDP growth in these countries averaged over 6.5% during 2003-08 as compared to less than 4% during the preceding five year period. The economic crisis and its after-effects, including the headwinds of the Arab Spring slowed down these economies considerably, with real GDP growth dwindling to 0.3% in 2009, although growth has since turned a corner (IMF, 2013). The fiscal and external positions also witnessed an upturn, providing headroom to the authorities for greater economic diversification, while allowing the surpluses to be invested for productive purposes.

We contribute to the literature in a few important ways. First, to the best of our knowledge, this is one of the early studies for GCC countries to examine the interlinkage between capital and risk. Second, our paper extends the literature on ownership and bank risk by focusing on the response of Islamic and commercial banks for an extended period. Several studies (Hasan and Dridi, 2010; Abedifar et al., 2013) suggest that there are no significant differences in the stability of Islamic and conventional banks. The paper also contributes to the literature that examines the relevance of funding structure for bank risk. The pre-crisis literature opined in favour of market funding, arguing that the 'market discipline' embedded in such funding coupled with its relatively low cost could enable banks to fund their asset expansion in a swift and cost-effective manner (Calomiris and Kahn, 1991). The recent financial crisis has however exposed the weaknesses of this argument. Huang and Ratnovski (2008) for example, show that banks that relied less on wholesale funding were able to better withstand the impact of the crisis.

1 The views expressed and the approach pursued are entirely personal.

The rest of the analysis continues as follows. Section 2 provides an overview of the relevant literature. This is followed by the database and variables employed in the study, followed by the empirical strategy (Section 4), results (Section 5) and concluding remarks (Section 6).

II. Relevant literature

The literature on the relationship between bank capital and risk can be classified into theoretical and empirical components. As regards the former, Kim and Santomero (1988) have observed that less risk-averse banks will prefer low levels of capital.

The other line of thinking that contends a positive association between bank capital and risk has emphasized the unintended effects of implementing minimum regulatory capital standards. Koehn and Santomero (1980) and Kim and Santomero (1988) observe that constraints on a bank's leverage due to minimum regulatory standards may cause banks to view leverage and risk as substitutes. As a result, in response to regulatory requirements, a bank that is forced to lower its leverage might end up raising its risk level. As a result, we will observe a positive relationship between bank capital and risk for those banks that have levels of capital near the minimum regulatory requirements.

Another line of argument derives from the fact that higher capital requirements lower the charter value of banks, in turn, compelling them to assume higher risks (Besanko and Kantas, 1996; Hellmann et al., 2000). An additional reason for the positive capital-risk relationship follows from the bankruptcy cost avoidance hypothesis of Orgler and Taggart (1983). According to the authors, banks operating with high levels of portfolio risk tend to hold higher capital levels due to the fact that their probability of bankruptcy is higher.

Several empirical studies have tested the above hypotheses on the relationship between changes in bank capital and changes in risk. Most of those studies have employed data from U.S. banks. In an early attempt, Shrieves and Dahl (1992) emphasized the endogenous determination of a bank's capital and risk. Within a simultaneous equations framework, they found that the majority of banks mitigate the effects of increases in capital by increasing exposure to asset risk.

Following from this research, several studies have investigated the capital-risk relationship, with mixed results. In case of US, studies found that banks responded to the new capital standards by increasing risk (Jacques and Nigro, 1997; Aggarwal and Jacques, 2001). Rime (2001) offered similar evidence for Switzerland, suggesting that regulatory pressure led banks to increase their levels of capital. Flannery and Rangan (2004) explain the capital build-up of US banks during the 1990s by increased capital requirements such as the FDIC Improvement Act and the withdrawal of implicit government guarantees.

In contrast, several others have also reported an inverse relationship. For example, looking at UK banks over 1998-2003, Alfon et al. (2004) uncovered a negative relationship between capital and risk in U.K. banks and building societies. Others that report a negative association

include Rime (2001) for Swiss banks, Das and Ghosh (2004) for Indian state-owned banks, Stolz (2007) for German banks.

Another strand of the literature links risk taking to bank ownership. This link is best exemplified by considering the objective function of shareholders and the potential principal-agent problems between shareholders and management. While privately-owned banks tend to focus on profit maximization, government-owned banks might have additional considerations.

Beginning with the line of research, several authors have investigated the interlinkage between ownership and bank risk. On the one hand, cross-country studies consistently highlight that higher government ownership could jeopardize bank stability (La Porta et al., 2002; Barth, Caprio and Levine, 2004). In contrast, analyses examining the risk behavior of Islamic banks are quite limited. Employing data for 1993-2004 on OECD economies, Čihák and Hesse (2010) documents that small Islamic banks are more stable as compared to similar-sized conventional banks. Focusing primarily on the MENA countries, Hasan and Dridi (2010) finds that pre-crisis profitability of Islamic banks to be higher than their conventional counterparts, although these differences petered out during the crisis.

III. Database and variables

III.1 Database

The analysis employs a detailed bank-level dataset. The core of the data is the information on bank's balance sheet and income statement details as published by Bankscope, a comprehensive, global database containing information on nearly 30,000 public and private banks globally, maintained by International Credit Analysis Limited (IBCA).

We use a sample comprising of an unbalanced panel of annual report data from 1996-2011 for the GCC banking system, comprising commercial and Islamic banks. The sample initially contained nearly 120 banks, but subsequently we deleted the finance and investment companies, including investment banks, providing us with 112 banks. Several banks also do not report data on the dependent variables employed in the analysis, which we exclude from the sample. After this filtering, we have observations on 103 banks at an average of 10.3 years of observations, yielding a maximum of 1065 bank-years. To moderate the influence of outliers, we winsorized the top and bottom 1% of observations for the dependent variable.

Table 1: Composition of banks by country

Country	Conventional banks	Islamic banks	Listed	Avg no. of years of observations	Total observations
Bahrain	11	20	11	7.8	243
Kuwait	6	9	14	9.3	139
Oman	6	0	5	13.3	80
Qatar	7	3	8	11.5	115
Saudi Arabia	9	4	11	13.2	172
UAE	18	10	21	11.3	316
Total	57	46	70	10.3	1065

The summary statistics suggest that, on average, banks are well-capitalized with equity-to-asset in excess of 10%, the regulatory minimum stipulated by most countries. Banks also appear to exhibit high stability, as evidenced from their high Z-scores. Contextually, it may be mentioned that in 2011, Z-scores of banks in major developed economies such as US, UK, Germany, France and Sweden ranged from a low of 0.9 in UK to a high of 1.45 as in US (World Bank, 2013).

Table 2: Variable definition and summary statistics

Variable	Definition	Mean (SD)	p.25	p.75
Dependent variables				
CAP	Capital/Total asset	0.144 (0.202)	0	0.164
Z-score	log(1+Z), where Z=(CAP+RoA)/SD(RoA), where RoA=return on asset and SD(RoA) is the rolling standard deviation of RoA based on observations in year *t*, *t-1* and *t-2*	2.628 (1.065)	1.938	3.228
Control variables				
Size	Log (total asset)	6.475 (0.685)	6.027	6.995
RoA	Profit/Total asset	0.019 (0.058)	0.013	0.028
Loans	Loans/Total asset	0.515 (0.210)	0.403	0.658
Funding	Short-term funding/Total asset	0.144 (0.154)	0.031	0.207
Cost/Income	Cost-to-income ratio	0.300 (0.481)	0.000	0.432
Divers	Index of income diversification, defined following Stiroh(2004) as $1-(SH_{NET}^2 + SH_{NON}^2)$, where $SH_{NET} = \frac{NET}{NET + NON}$ $SH_{NON} = \frac{NON}{NET + NON}$ NET=net interest income; NON=non interest income	0.364 (0.131)	0.306	0.465
RPH	Dummy=1 if for a bank the ratio of its regulatory to actual capital belongs to the top 25 percentile of the distribution, else zero	0.255 (0.436)	0	1
RPL	Dummy=1 if for a bank the ratio of its regulatory to actual capital belongs to the bottom 25 percentile of the distribution, else zero	0.253 (0.435)	0	1
MREG	Dummy=1 if a bank is listed, else zero	0.679 (0.467)	0	1
Islamic	Dummy=1 if a bank is Islamic, else zero	0.447 (0.497)	0	1
Crisis	Dummy=1 for 2009, else zero	0.061 (0.239)	0	1

Among others, 15% of banks funding are short-term in nature, although their cost-to-income are among the lowest. The average bank is fairly small in size with high profitability levels, close to 2% of total assets. These profitability numbers are comparable to, and in some cases, even better than those obtaining for advanced economies (See,for example, BIS 2013).

III.2 Measurement of risk

There is limited consensus in the literature as to the measurement of risk.[2] Researchers have employed various risk measures, such as risk-weighted assets to total assets (Shrieves and Dahl, 1992; Jacques and Nigro, 1997; Avery and Berger, 2001; Van Roy, 2008); non-performing loan ratio (Shrieves and Dahl, 1992), loan loss reserves (Altunbas et al., 2007), while more recent research employs the Z-score (Boyd and Graham, 1988; Laeven and Levine, 2009; Barry et al., 2011; Bouwens and Verriest, 2014). Consistent with recent research, we use the Z-score. The Z-score indicates the distance from insolvency and combines accounting measures of leverage, profitability and volatility. As Barry et al. (2011) remark, the Z-score comprises of two elements: the first component - RoA/SD(RoA) - measuring asset risk and the second (K/A)/SD(RoA) measuring leverage risk. A higher Z-score indicates that the bank is more stable. Since the Z-score is positively skewed, we use the natural logarithm of Z-score, which is normally distributed (Laeven and Levine, 2009).

III.3 Measurement of capital

Capital is measured as the ratio of capital to asset. In effect, total capital comprises of all the capital components permitted under the relevant Acts in each country and is comparable to the definition employed in the Basel accord.

III.4 Control variables

In the capital equation, the control variables include size and profitability. In addition, we include two sets of interaction terms. The first - CAPREG*CAP and CAPREG*ΔRISK - ascertains how regulatory pressure responds to capital and changes in risk.

The capital pressure variable (CAP) is defined as the ratio of capital ratio stipulated by the regulatory authorities in respective countries to the bank's actual capital adequacy ratio, a higher ratio implying greater regulatory pressure. The second - MREG*CAP and MREF*ΔRISK - focuses on how banks with market pressure respond to capital and risk.

The control variables in the risk equation include size, funding, index of income profile, inefficiency and the interaction terms, akin to those earlier.

Besides, we include dummy to distinguish between Islamic and conventional banks, in addition to a dummy for crisis. All the specifications control for country and year shocks by including an interaction term between country and year effects.

IV. Empirical Strategy

Following Shrieves and Dahl (1992) and Van Roy (2007), we employ the simultaneous equation setup for bank *b* at time *t* as given by (1) and (2)

Since all banks are not listed and most of their assets being not marketable, it s difficult to compute the volatility for the market price of bank's assets. Likewise, since all banks are not rated and have not received any external support, computing sophisticated measures of risk are not possible.

$$\Delta RISK_{b,t} = \alpha (RISK^{*}_{b,t} - RISK_{b,t-1}) + w_{b,t} \quad (2)$$

$$\Delta CAP_{b,t} = \alpha (CAP^{*}_{b,t} - CAP_{b,t-1}) + u_{b,t} \quad (1)$$

In effect, the observed changes in capital and risk are a function of the target capital and risk levels, the lagged capital and risk levels and any random shocks. The target capital and risk levels are not directly observable, but are assumed to depend on a set of observable variables describing the bank's financial condition and country and year characteristics.

The target capital ratio is assumed to depend on bank size, measure of profitability, changes in risk (ΔRISK) and crisis, ownership and regulatory dummies, as discussed earlier. The variables used to proxy the target risk ratio are bank size, income diversification index, funding profile and several dummies, as discussed above.

Given the setup, the empirical strategy has to account for the endogeneity of the regressors ΔCAP and ΔRISK. In contrast to the ordinary least squares, 3SLS estimators take the endogeneity into account, thereby producing consistent estimates.

V. Discussion of the results

Three sets of results are set out in Table 3. Specification 1 estimates the baseline model wherein adjustments in capital and risk differ according to the extent of regulatory and market pressure. Specification 2 allows for differential speeds of adjustment in capital and risk. Finally, specification 3 additionally allows for differences in the coordination of capital and risk adjustments.

We first discuss the control variables. Table 3 (Model 1) indicates that bank size has a negative and significant effect on capital. The negative effect on capital is in line with the empirical literature and means that larger banks increase capital by a magnitude that is lower as compared to smaller banks. A possible explanation for this is that larger banks have easier access to capital markets or alternately, they prefer to undertake more monitoring rather than hold higher levels of expensive capital (Titman and Wessels, 1988; Van Roy, 2008). RoA has a highly statistically highly significant and positive impact on capital, consistent with previous research (Aggarwal and Jacques, 2001; Rime, 2001; Van Roy 2008). This positive relation is also consistent with the pecking order hypothesis, which supports the bank's preference for internal funding owing to lower costs (Myers and Majluf, 1984).

In the risk equation, the coefficient on both *Funding* is negative while that on *Divers* is positive. Both these coefficients are statistically significant. In other words, banks with higher wholesale dependence exhibit lower stability (i.e., higher risk): a 1% increase in wholesale dependence lowers bank stability by 0.8 percentage points. Banks with more diversified income streams are observed to be less risky. The fact that bank funding structures might be relevant in influencing bank risk-taking has been acknowledged in recent empirical research (Adrian and Shin, 2009; Ratnovski and Huang, 2009; Raddatz, 2010).

Table 3: 3SLS estimation of capital and risk

	Model 1		Model 2		Model 3	
	ΔCAP	ΔRISK	ΔCAP	ΔRISK	ΔCAP	ΔRISK
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
RPH	-0.040	0.075	-0.013	-0.123	-0.007	-0.069
	(0.014)***	(0.078)	(0.036)	(0.215)	(0.038)	(0.216)
MREG	-0.035	-0.192	-0.049	-0.023	-0.027	-0.114
	(0.014)***	(0.081)***	(0.019)***	(0.198)	(0.021)	(0.201)
Adjustment coefficients						
CAP (t-1)	-0.662		-0.491		-0.539	
	(0.035)***		(0.042)***		(0.044)***	
Risk (t-1)		-0.455		-0.430		-0.456
		(0.034)***		(0.059)***		(0.059)***
Response of endogenous variables						
ΔCAP		0.651		0.653 (0.266)***		0.683
		(0.282)***				(0.213)***
ΔRISK	-0.006		-0.005		-0.084	
	(0.013)		(0.013)		(0.023)***	
Interaction terms						
RPH*CAP(t-1)			-0.251		-0.299	
			(0.229)		(0.238)	
RPH*RISK(t-1)				0.075		0.057
				(0.076)		(0.076)
MREG*CAP (t-1)			-0.381		-0.346	
			(0.064)***		(0.066)***	
MREG*RISK (t-1)				-0.063		-0.026
				(0.071)		(0.072)
RPH*ΔRISK					0.027	
					(0.016)*	
MREG*ΔRISK					0.076 (0.021)***	
RPH*ΔCAP						2.623 (1.371)**
MREG*ΔCAP						-0.577
						(0.562)
Dummy variables						
Islamic	0.040	-0.134	0.037	-0.141	0.038	-0.125
	(0.015)***	(0.089)	(0.015)***	(0.091)	(0.015)***	(0.089)
Crisis	-0.003	0.342	-0.057	0.363	-0.002	0.245
	(0.161)	(0.937)	(0.157)	(0.939)	(0.162)	(0.733)
Country*Year	YES	YES	YES	YES	YES	YES
Period	1996-2011	1996-2011	1996-2011	1996-2011	1996-2011	1996-2011
N.Obs	683	683	683	683	683	683
R-squared	0.451	0.328	0.479	0.326	0.461	0.334

Standard errors in brackets

***, *** and * denote statistical significance at 1, 5 and 10%, respectively

As regards the impact of regulatory pressure, the results in model 1 suggest that, banks with high regulatory pressure increase capital by less¸ than banks with high buffers, although their response to risk appears to be limited. On the other hand, banks with higher market pressure lower their capital and raise risk as compared to those with no market pressure.

The parameter estimates of lagged capital and risk are statistically highly significant, consistent with previous research for the US (Jacques and Nigro, 1997) and elsewhere (Rime, 2001; Das and Ghosh, 2004). The expected negative sign lie in the [0,1] interval. Hence, these can be interpreted as speed of capital and risk adjustments. In general, the speed of capital adjustment is roughly 1.2-1.5 times higher than the speed of risk adjustment.

As regards the response of endogenous variables, the parameter estimate of ΔRISK in the capital equation is insignificant, whereas the parameter estimate of ΔCAP in the risk equation is positive and highly significant. Van Roy (2008) also reports similar evidence for European and Canadian banks in the cross-country study, although their US sample banks did not exhibit any discernible response of either capital or risk.

While the coefficient on the interaction term of RPH with lagged capital and risk variables are insignificant, the coefficient on MREG*Cap(t-1) is negative and statistically significant in Models 2 and 3, indicating that banks facing market discipline adjust capital thrice as fast as compared to banks with no such discipline.

Further, we find that the estimated coefficients on RPH*ΔRISK is significant and positive, while the estimated coefficient of RPH*ΔCAP is significant, positive and nearly four times larger than the coefficient on ΔCAP. This finding indicates that capital and risk adjustments are negatively correlated for banks with high regulatory pressure. These positive coefficients are in line with recent evidence for US market (Shim, 2010).

Looking at ownership, when significant, the coefficient on *Islamic* is positive and significant in the ΔCAP equation, indicating that, after controlling for bank specific and country-year characteristics, *changes* in capital are higher for Islamic as compared to conventional banks.

VI. Concluding remarks

The role of minimum capital requirements in the context of modern banking regulation has been a widely discussed and debated topic in the literature. However, whether and to what extent does higher capital level encourage or dissuade risk-taking by banks remains an empirical question. The evidence on this aspect for GCC banks is admittedly limited.

In this context, the present paper employs data on an extended sample of GCC banks to examine this issue in detail. Three major findings emerge. First, banks generally lower capital in response to an increase in risk, and not *vice versa*. Second, there is an uneven impact of regulatory pressure and market discipline on banks attitude towards risk and capital. And third, Islamic banks increased their capital as compared to conventional banks.

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