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Risk, capital and financial crisis: Evidence for GCC banks☆

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Abstract

Employing data on over 100 GCC banks for 1996–2011, we test the relation between risk and capital. Given the interlinkage between these two variables, the model employs a 3SLS estimation that takes on board this simultaneity. Consistent with the literature, risk is measured by the *Z*-score, while capital is computed as the ratio of equity to asset. The findings indicate that banks generally increase 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 toward risk and capital. Additionally, Islamic banks increased their capital as compared to conventional banks. Besides, the evidence testifies to the fact that banks with higher dependence on wholesale funds and less diversified income profile have higher risk.

JEL classification: G21; G28

Keywords: *Z*-score; Capital; 2SLS; Banking; GCC

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-capitalized banks often experience significant declines in their capital position. An offshoot of this relationship is that capital regulation alone might not be sufficient to ensure the soundness of the banking system.

Given the significance of these results, it is not surprising that several researchers have attempted to dissect the relationship between risk-taking and capitalization of banks. This literature focuses on the well-known moral hazard problems in banking. Merton (1977) shows that, given banks limited liability, they might be inclined to decrease their capital and increase risk. Other studies however, demonstrate that the relationship is not necessarily negative if factors other than the option value are considered (Besanko & Kantas, 1996; Hellmann, Murdock, & Stiglitz, 2000; Kim & Santomero, 1988).

Akin to theoretical studies, empirical studies on this issue also do not appear to have a consensus view. On the one hand, several researchers (Boyd & Graham, 1996; Furlong, 1988; Keeley, 1990) uncover a negative relationship between risk and capitalization, others (Peek & Rosengren, 1997; Sheldon, 1995) find this relationship to be the opposite. One possible reason for the lack of consensus among these various studies could be the fact that they employ alternative risk measures as dependent variables. In this process, they do not take on board

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additional factors that affect the relationship between capitalization and bank risk.

The aim of this paper is to push forward the empirical literature by examining this issue for GCC banks. In particular, we examine the relation between capital and risk for GCC banks employing an extended sample period that encompasses the recent financial crisis. 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. On average, hydrocarbon accounts for nearly half of the region's GDP, contributes nearly 70% of these countries merchandise exports and over three-fifths of government revenues (IMF, 2013). 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. Non-oil GDP growth improved markedly, averaging nearly 7.5% during this period (IMF, 2010a, 2010b, 2011). 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, averaging close to 6% during 2010–12 (IMF, 2013).[1] 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.

Besides the interest in the research question, the paper also augments the literature in three distinct ways. First, we explore whether the behavior of well-capitalized banks differ from those that do not have adequate capital. Second, we examine how market discipline interacts with regulatory pressure to affect bank capital and risk-taking. Finally, we analyze the differential response of Islamic banks as compared to conventional banks on bank capital and risk.

As is well acknowledged, there are three entities that are primarily involved in the risk determination of a bank: the regulator, the shareholders and the management. Therefore, by categorizing banks into different groups, we are able to better understand which set of forces influence their risk-taking behavior. More specifically, for inadequately capitalized banks, it seems likely that regulatory forces will be paramount in determining their risk-taking, since they are at greater risk of failure. On the other hand, for well-capitalized banks, the managers would have greater discretion in choosing risky assets. Therefore, following the literature (Beatty & Harris, 1999; Ke, Petroni, & Saffieddine, 1999), we postulate that managers' incentives dominate for publicly traded banks. Finally, in case of Islamic banks, the interests of shareholders (as also depositors) would prevail, given the risk sharing principles embedded in their behavior. Our dataset of GCC banks contains a clear distinction along these lines and is therefore well-suited to analyze these research questions.

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. Most studies that have focused on this aspect are primarily based on US economy (Shrieves & Dahl, 1992) or for other developed (Heid, Porath, & Stolz, 2004; Rime, 2001; Stolz, 2007) and emerging markets (Ghosh, Nachane, Narain, & Sahoo, 2003; Godlewski, 2005). Even cross-country studies on this aspect pertain primarily to developed markets. Judged thus, we focus on a homogenous set of countries in a region which share similar economic, social and financial characteristics. Outside of the US, evidence for Turkish banks appears to suggest that regulatory policies exerted an uneven impact on the efficiency of commercial banks during the 2002–10 period (Ozcan-Gunay, Gunay, & Gunay, 2013).

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 (Abedifar, Tarazi, & Molyneux, 2013; Hasan & Dridi, 2010) suggest that there are no significant differences in the stability of Islamic and conventional banks. Focusing on MENA countries, Srairi (2013) finds that Islamic banks display a lower exposure to credit risk as commercial banks. Whether and to what extent do these findings carry over the periods of crisis remains a moot question, which we empirically explore in the present exercise. Employing an expanded cross-national database, Imam and Kpodar (2013) uncover that per capita income and greater integration with Middle East economies as major factors that explain the rise of Islamic banking around the globe.

Our paper also contributes to the literature that examines the relevance of funding structure for bank risk. The pre-crisis literature opined in favor 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 & Kahn, 1991). The recent financial crisis has however exposed the weaknesses of this argument. Huang and Ratnovski (2011) for example, show that banks that relied less on wholesale funding were able to better withstand the impact of the crisis. Demirgüc-Kunt and Huizinga (2010) found that banks' resilience on non-deposit funds increased their risk. Other studies show that banks that relied heavily on wholesale funds were more affected by the liquidity crunch, experienced a large abnormal decline in their share prices (Adrian & Shin, 2009; Raddatz, 2010). A parallel literature focuses on corporate funding costs. For instance, using data for 15 emerging markets over the period 1994–2004, Agca and Celasun (2012) report that banking sector reforms lead to lower corporate borrowing costs. This literature however, does not focus on banks, which is one of the major concerns of the paper.

[1] Much of the high growth during 2010–12 in the GCC countries can be traced to the high GDP growth of Qatar, which grew at 16.6 and 13% during 2010 and 2011, respectively. Excluding Qatar, the average growth rate of GCC during this period is around 4.7%.

Our paper also adds to the literature on the importance of income structure for bank risk. The global trend toward diversification of bank income sources has provided banks with additional sources of revenue. While such diversification, in principle, has helped foster stability in overall income, it is not altogether clear whether this overt reliance on non-interest income has helped to limit overall banking risk. In general, studies tend to conclude that the greater reliance on non-interest income does not lower earnings volatility in earnings (Stiroh, 2004) or lower bank systematic risk (De Jonghe, 2010). There is also evidence to suggest that diversification might not necessarily be value enhancing: diversified firms are found to trade at anywhere between 8 and 15% discount as compared to specialized peers (De Long, 2001; Laeven & Levine, 2007; Lang & Stulz, 1994).

The paper also adds to the literature that analyzes the impact of the recent financial crisis. Several studies have examined the behavior of U.S. banks during the crisis (Cornett, McNutt, Strahan, & Tehranian, 2011; Huang, 2010; Ivashina & Scharfstein, 2010; Santos, 2011) as well as for other countries, including Asia (Ree, 2011), African (Louis, Leonce, & Taoufik, 2009), EU (Gardo & Martin, 2010) and GCC (IMF, 2010a) banking systems. Kilinc, Kilinc, and Turhan (2012) explore the factors explaining the resilience of Turkish economy to the global crisis and find that proactive monetary and fiscal response to be important factors.[2] However, the interplay between bank risk taking and capital and its interplay with the crisis is an aspect that has not been investigated in prior empirical research.

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).

2. 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. Such a negative relationship has been advocated by other researchers as well (Diamond & Dybvig, 1986). A negative relationship between risk and capital can also occur when all deposits have a flat rate insurance, since in that case, the marginal cost of increasing risk or lowering capital is insignificant.

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 & Kantas, 1996; Hellmann et al., 2000).[3] 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.

Finally, the positive relationship between bank capital and risk can also be traced to agency theories. For example, Saunders, Strock, and Travlos (1990) hypothesize that managers who do not own their bank equity are prone to take lower risks, because they stand to lose much more when the bank becomes insolvent.

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 (Aggarwal & Jacques, 2001; Jacques & Nigro, 1997). Rime (2001) offered similar evidence for Switzerland, suggesting that regulatory pressure led banks to increase their levels of capital. Flannery and Rangan (2006) explain the capital build-up of US banks during the 1990s by increased capital requirements such as the FDIC Improvement Act, high profitability of the banking industry along with higher risk levels, and the withdrawal of implicit government guarantees. Cebenoyan and Strahan (2004) found that banks which used the loan sales market for risk management purposes held less capital and were more profitable but riskier than other banks. This evidence is in line with the Froot and Stein (1998) model that active risk management can allow banks to hold less capital and to invest in riskier assets.

In contrast to this positive relation, several studies have also reported an inverse relationship as well. For example, looking at UK banks over 1998–2003, Alfon, Argimon, and Bascunana-Ambros (2004) uncovered a negative relationship between capital and risk in U.K. banks and building societies. This contrasts with a previous study, which reports that banks

[2] Another literature considers the relevance of conventional risk management models (e.g., VaR) across a large sample of developed and developing countries during the crisis. The findings suggest that the performance of these models was much less convincing for advanced economies (Koksal & Orhan, 2012).

[3] Saunders and Wilson (2001) present evidence that charter value itself may derive from high-risk activities, indicating that minimizing risk-taking also would limit the value of the charter.

tend to overshoot the target in response to meeting the minimum capital standards. Other studies 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. Cross-country studies (Van Roy, 2008) also report a negative association between capital and risk.

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 and not just profit maximization alone. Early research on this aspect found that banks controlled by managers exhibited lower risk as compared to those in which shareholders had a controlling majority.

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 (Barth, Caprio, & Levine, 2004; La Porta, Lopez-de-Silanes, & Shleifer, 2002). For a large sample of European banks, Ianotta, Nocera, and Sironi (2007) document that government-owned banks are the least stable. Similarly, Cihak and Hesse (2007) report that cooperative banks are more stable as compared to commercial banks in OECD countries. Saunders et al. (1990) and Laeven and Levine (2009) confirm predictions of the theory that banks with large dominating shareholders take larger risks. For European banks, Barry, Lepetit, and Tarazi (2011) demonstrate that ownership structure is important in explaining risk differences in privately owned banks. In a similar vein, Iannotta, Nocera, and Sironi (2013) report that government-owned banks have lower default risk as compared to commercial banks. Unlike the existing literature, our paper considers bank stability across ownership types within GCC countries, holding constant the institutional and macroeconomic framework.

In contrast to these studies, analyses examining the risk behavior of Islamic banks are quite limited. Employing data for 1993–2004 on OECD economies, Cihak and Hesse (2008) document that small Islamic banks are more stable as compared to similar-sized conventional banks. Subsequent cross-country research (Abedifar et al., 2013; Beck, Demirguc-Kunt, & Merrouche, 2010) appears to suggest little difference in terms stability. Focusing primarily on the MENA countries, Hasan and Dridi (2010) find that pre-crisis profitability of Islamic banks to be higher than their conventional counterparts, although these differences petered out during the crisis, suggesting that higher pre-crisis profitability of the former was not driven by excessive risk-taking.

Closer to the region, Khamis (2010) provides an overview of the financial crisis on GCC countries. Al Hassan, Khamis, and Oulidi (2010) analyze the banking sector in the GCC economies, including trends in ownership, balance sheet exposures and risks. Espinosa and Prasad (2010) analyze the delinquent loans in GCC banks and finds that a decline in non-oil GDP growth by 3 percentage points would raise NPLs by roughly 0.3%. Arvai, Prasad, and Katayama (2014) discuss the macroprudential policies employed by GCC countries.

3. Database and variables

3.1. 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 to 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. In 2011, the final year of the sample, these banks accounted, on average, for roughly 75% of total banking assets in their respective countries. Table 1 provides the sample composition, while Table 2 describes the variable definitions, including summary statistics.

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).

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).

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

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 $1-(SH^2_{NET}+SH^2_{NON})$, 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

3.2. Measurement of risk

There is limited consensus in the literature as to the measurement of risk.[4] Researchers have employed various risk measures, such as risk-weighted assets to total assets (Avery & Berger, 1991; Jacques & Nigro, 1997; Shrieves & Dahl, 1992; Van Roy, 2008); non-performing loan ratio (Shrieves & Dahl, 1992), loan loss reserves (Altunbas, Carbo, Gardener, & Molyneux, 2007), while more recent research employs the *Z*-score (Barry et al., 2011; Bouwens & Verriest, 2014; Boyd & Graham, 1988; Laeven & Levine, 2009). In our analysis, consistent with recent research, we prefer to 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 & Levine, 2009). As is well known, norms for classification of delinquent loans differs markedly across GCC countries (see, for example, World Bank, 2012). As a result, we prefer not to employ the NPL variable or the loan loss provisioning variable.

[4] Since all banks are not listed and most of their assets being not marketable, it is 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.

3.3. 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.

3.4. Control variables

In the capital equation, the control variables include size and profitability. Size is measured as the natural logarithm of total assets. Bigger banks are likely to be able to access equity markets more easily and therefore, expected to have lower capital ratios. Alternately, given the concentrated banking systems that typify these economies, larger banks might be tempted to expand faster to fund asset growth and therefore, need higher capital levels. In the presence of asymmetric information, profitable banks might prefer to increase capital through retained earnings, suggesting an expected positive sign on this variable.

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. Larger banks carry out a wider set of activities, which should increase their ability to

diversify portfolios and lower credit risk. Second, banks with greater dependence on wholesale funds are likely to be perceived as more risky, as recent evidence would testify (Raddatz, 2010). On the other hand, it is not evident whether banks with diversified income stream are more or less risky, since the empirical evidence, both for the U.S. and around the world is mixed (Stiroh, 2004). Authors like Hughes, Lang, Mester, and Moon (1994) and Kwan and Eisenbis (1997) emphasize the importance of analyzing the impact of efficiency on bank risk taking. Using data on US banks, they uncover a negative relationship between inefficiency and bank risk.

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.

4. Empirical strategy

Following Shrieves and Dahl (1992) and Van Roy (2008), we employ the simultaneous equation setup wherein observed changes in banks' capital and risk-taking consist of two components, a discretionary adjustment and a change caused by factors exogenous to the bank, as given by Eqs. (1) and (2).

$$\Delta \mathrm{CAP}_{b,t} = \Delta \mathrm{CAP}^{d}_{b,t} + u_{b,t} \tag{1}$$

$$\Delta \mathrm{RISK}_{b,t} = \Delta \mathrm{RISK}^{d}_{b,t} + w_{b,t} \tag{2}$$

where ΔCAP and ΔRISK are the observed changes in capital and risk levels, respectively, for bank b at time t. The $\Delta \mathrm{CAP}^{d}_{b,t}$ and $\Delta \mathrm{RISK}^{d}_{b,t}$ variables are discretionary adjustments in capital and risk and u and w are exogenous random shocks in capital and risk levels, respectively.

Following Shrieves and Dahl (1992), the discretionary changes in capital and risk is modeled using a partial adjustment framework, such that:

$$\Delta \mathrm{CAP}^{d}_{b,t} = \alpha\left(\mathrm{CAP}^{*}_{b,t} - \mathrm{CAP}_{b,t-1}\right) \tag{3}$$

$$\Delta \mathrm{RISK}^{d}_{b,t} = \beta\left(\mathrm{RISK}^{*}_{b,t} - \mathrm{RISK}_{b,t-1}\right) \tag{4}$$

Substituting Eqs. (3) and (4) into Eqs. (1) and (2) and taking on board the simultaneous capital and risk decisions, the observed adjustments in capital and risk can be written as:

$$\Delta \mathrm{CAP}_{b,t} = \alpha\left(\mathrm{CAP}^{*}_{b,t} - \mathrm{CAP}_{b,t-1}\right) + u_{b,t} \tag{5}$$

$$\Delta \mathrm{RISK}_{b,t} = \alpha\left(\mathrm{RISK}^{*}_{b,t} - \mathrm{RISK}_{b,t-1}\right) + w_{b,t} \tag{6}$$

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 simultaneous equation setup of Eqs. (5) and (6), the empirical strategy has to account for the endogeneity of the regressors ΔCAP and ΔRISK. In contrast to the ordinary least squares, 2SLS and 3SLS estimators take the endogeneity into account, thereby producing consistent estimates. As Zellner and Theil (1962) have observed, 3SLS exploits the information that the disturbance terms in the two structural terms are contemporaneously correlated and thereby ensures consistent estimates.[5] Since the estimates under the two models are similar, we present the results using the 3SLS technique.

Before discussing the results, Table 3 sets out the descriptive statistics of the dependent and independent variables, both for the overall sample as well as for sub-samples, classified according to ownership and listing. The results indicate that, on average, Islamic banks are more stable (and therefore, less risky) as compared to conventional banks, broadly consistent with Cihak and Hesse (2008) who find large Islamic banks to be less stable as compared to their conventional counterparts. Profitability of Islamic banks is found to be half of those obtaining for conventional banks, on average. Both these differences are statistically significant at the 0.01 level. In contrast, the table suggests there are hardly any differences in either profitability or stability for listed versus unlisted banks.

The results also indicate significant differences between Islamic and conventional banks as also between listed versus unlisted banks in terms of major characteristics such as size, profitability, income composition, funding strategy and efficiency levels. In particular, Islamic banks are smaller in size and have less diversified income profiles as compared to conventional banks (see, for example, Kamaruddin, Safa, & Mohd, 2008). On the other hand, listed banks are observed to be bigger, more profitable, more diversified in terms of income, less efficient and exhibit lower wholesale dependence. All these differences are statistically significant at conventional levels.

Coming to regulatory pressure, conventional banks are observed to face higher regulatory pressure as compared to Islamic banks. The difference is statistically significant at the 0.05 level. In contrast, Islamic banks face lower regulatory pressure as do listed banks. This suggests that given their ability to access capital markets, listed banks encounter lower regulatory pressure as compared to unlisted ones.

Stability of Islamic banks is higher during non-crisis periods, although their capital levels appear to be lower during non-crisis times. This would imply that Islamic banks operate on higher leverage, although profitability levels are not significantly different across these two categories.

[5] The 3SLS methodology is sensitive to misspecification or measurement errors. As a result, a comparison with 2SLS estimates as a specification check becomes relevant. In the present case, estimation of equations (5) and (6) with 2SLS produces results similar to those obtained under 3SLS.

Table 3
Univariate tests of differences across bank characteristics.

	Full sample		Conventional banks		Islamic banks		Differences in mean (*t*-test)	Listed banks		Unlisted banks		Differences in mean (*t*-test)
	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Panel A: dependent variable												
Ln (1 + *Z*)	2.628	1.065	2.796	0.941	2.272	1.216	−6.831***	2.652	0.979	2.552	1.305	−1.109
CAR	0.101	0.163	0.127	0.112	0.069	0.206	−6.909***	0.106	0.127	0.092	0.221	−1.307
Panel B: independent variables												
Size	6.476	0.685	6.631	0.608	6.134	0.722	10.995***	6.563	0.617	6.188	0.808	−6.775***
RoA	0.019	0.058	0.018	0.035	0.019	0.089	−0.060	0.022	0.039	0.009	0.096	−2.046**
Funding	0.144	0.154	0.148	0.135	0.136	0.189	1.002	0.125	0.123	0.207	0.215	5.752***
Divers	0.364	0.131	0.397	0.092	0.289	0.169	10.702***	0.379	0.115	0.314	0.164	−5.801***
Cost/income	0.300	0.481	0.315	0.205	0.281	0.683	1.307	0.320	0.424	0.258	0.582	−2.192**
RPH	0.255	0.436	0.270	0.445	0.197	0.399	1.964**	0.262	0.439	0.232	0.424	−0.759
RPL	0.253	0.435	0.201	0.401	0.454	0.499	−5.789***	0.209	0.407	0.419	0.495	4.881***
Panel C: non-crisis												
Ln (1 + *Z*)	2.656	1.067	2.281	1.221	2.823	0.946	−6.669***	2.679	0.987	2.577	1.300	−1.056
CAR	0.096	0.155	0.125	0.113	0.061	0.189	7.849***	0.103	0.129	0.081	0.199	−2.243**
Crisis												
Ln (1 + *Z*)	2.362	1.017	2.479	0.829	2.221	1.198	1.223	2.355	0.839	2.377	1.342	0.084
CAR	0.177	0.245	0.158	0.083	0.200	0.355	0.782	0.139	0.086	0.262	0.414	1.636

5. Discussion of the results

5.1. Baseline results

Three sets of results are set out in Table 4. 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 4 (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 & Wessels, 1988; Van Roy, 2008). RoA has a highly statistically highly significant and positive impact on capital, consistent with previous research that banks with higher earnings can retain more capital (Aggarwal & Jacques, 2001; Rime, 2001; Van Roy, 2008).[6] 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 & 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: a 1% increase in income diversification lowers bank risk by 0.8 percentage points. Therefore, a 50% in income diversification from 0.31 to 0.47 − equal to a move from the 25th to the 75th percentile of the distribution − would lower bank risk by over 40% points (=0.8*51 = 41.2). The fact that bank funding structures might be relevant in influencing bank risk-taking has been acknowledged in recent empirical research (Adrian & Shin, 2009; Raddatz, 2010; Ratnovski & Huang, 2009).

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 & Nigro, 1997) and elsewhere (Das & Ghosh, 2004; Rime, 2001). The expected negative sign lies 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. In Model 1, the coefficient on capital adjustment is the highest (−0.66); the corresponding coefficient on risk adjustment is −0.46. The estimated speeds of

[6] Note that capital satisfies the following identity: Capital = Capital/Risk weighted assets (RWA)*RWA/Total assets (TA)*TA or, $K = R^*P^*$TA, where K = capital, R = (Capital/RWA); P = (RWA/TA). Re-arranging and denoting $\widehat{K} = \Delta K/K$, we obtain: $\widehat{R} = \widehat{K} - \widehat{P} - \widehat{TA}$, suggesting that the adjustment by banks to a change in risk-weighted capital can be effected in three possible ways: (a) raise capital (increase K); (b) lower risk weighted assets (lower P) or (c) lower total assets.

Table 4
3SLS estimation of capital and risk.

	Model 1		Model 2		Model 3	
	(1)	(2)	(3)	(4)	(5)	(6)
	ΔCAP	ΔRISK	ΔCAP	ΔRISK	ΔCAP	ΔRISK
Control variables						
Size	−0.102 (0.012)***	−0.089 (0.067)	−0.092 (0.012)***	−0.075 (0.068)	−0.106 (0.012)***	−0.099 (0.069)
RoA	0.939 (0.184)***		0.953 (0.178)***		0.963 (0.182)***	
Funding		−0.852 (0.257)***		−0.817 (0.256)***		−0.831 (0.259)***
Divers		0.847 (0.297)***		0.763 (0.298)***		0.846 (0.299)***
Cost/income		0.099 (0.124)		0.099 (0.123)		0.092 (0.131)
Regulatory pressure						
RPH	−0.040 (0.014)***	0.075 (0.078)	−0.013 (0.036)	−0.123 (0.215)	−0.007 (0.038)	−0.069 (0.216)
MREG	−0.035 (0.014)***	−0.192 (0.081)***	−0.049 (0.019)***	−0.023 (0.198)	−0.027 (0.021)	−0.114 (0.201)
Adjustment coefficients						
CAP ($t-1$)	−0.662 (0.035)***		−0.491 (0.042)***		−0.539 (0.044)***	
Risk ($t-1$)		−0.455 (0.034)***		−0.430 (0.059)***		−0.456 (0.059)***
Response of endogenous variables						
ΔCAP		0.651 (0.282)***		0.653 (0.266)***		0.683 (0.213)***
ΔRISK	−0.006 (0.013)		−0.005 (0.013)		−0.084 (0.023)***	
Interaction terms						
RPH*CAP ($t-1$)			−0.251 (0.229)		−0.299 (0.238)	
RPH*RISK ($t-1$)				0.075 (0.076)		0.057 (0.076)
MREG*CAP ($t-1$)			−0.381 (0.064)***		−0.346 (0.066)***	
MREG*RISK ($t-1$)				−0.063 (0.071)		−0.026 (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 (0.015)***	−0.134 (0.089)	0.037 (0.015)***	−0.141 (0.091)	0.038 (0.015)***	−0.125 (0.089)
Crisis	−0.003 (0.161)	0.342 (0.937)	−0.057 (0.157)	0.363 (0.939)	−0.002 (0.162)	0.245 (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.

adjustment mean that shocks to capital and risk are halved after 1.1 and 1.5 years, respectively. In essence, this implies that the speeds of adjustment are quite high, mirroring the fact that the average bank built up capital and risk over the adjustment period; the latter at a rate slightly faster as compared to the former. This is not surprising, given the rapid loan growth experienced by these GCC economies prior to the crisis.

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. The magnitude of the coefficient on ΔCAP gradually increases as the specification is buttressed with additional variables (see Models 1–3). In other words, after controlling for differences in the coordination of capital and risk adjustments, increases in capital is associated with decrease in risk, consistent with evidence obtaining for Japanese banks (Van Roy, 2008). In Model 3, the standardized beta coefficient suggests that an increase in capital by one standard deviation would lower risk by 0.11 standard deviation.

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). The impact of the regulatory pressure variable is extremely large. To see this, consider a bank with ΔCAP equal to 0.0003, the average for the sample. Ignoring the impact of RPH, the point estimates in Model 3 indicate that an increase in ΔCAP by the mean value would increase stability (i.e., lower ΔRISK) by 0.0002 (=0.683*0.0003) percentage points. Taking RPH into account, the point estimates in Model 3 yield an estimate of 0.0008 (=2.623*0.0003) percentage points, nearly 300% higher as compared to without RPH.

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. The effect is quantitatively important, indicating that capital increase for the average Islamic bank is roughly 0.04 percentage points higher as compared to an average conventional bank. Considering the average capital change in the sample however, this is not a sizeable difference.

5.2. Robustness checks

We undertake several robustness checks of the baseline results. First, following Van Roy (2008), we analyze the marginal effect that market discipline has on the relationship between regulatory pressure and ΔCAP and between regulatory pressure and ΔRISK. As observed by Jacques and Nigro (1997), banks with capital above or below the regulatory capital standards might respond in a different manner to the regulatory standards. Banks with capital below the stipulated standards will be under considerable pressure to improve capital ratios, by either increasing capital or by lowering risk weighted assets. On the other hand, banks with higher-than-stipulated capital levels might reduce their capital or increase portfolio risk. Taking these considerations on board, we separately analyze for each of these two bank categories the impact on capital and risk.

Second, we explore the impact of crisis on bank behavior, classified according to their capital levels. Intuitively, the crisis increased the quantum of delinquent loans, necessitating an increase in provisioning and thereby putting pressure on banks' capital and in particular, more on those banks with low levels of capital. How this interaction played out remains an open question (Table 5).

Finally, we examine the differential response of Islamic banks to changes in capital and risk, and in particular, how it evolved during the crisis. Observers have contended that the positive features embedded in these banks, including the close link between financial transactions and productive flows and the built-in dimensions of governance and risk management appeared to have cushioned them from the worst of the crisis (Akthar Aziz, 2009; Yilmaz, 2009). Whether and to what extent it impacted their capital and risk behavior remains to be empirically analyzed.

All regressions include the full set of controls and dummy variables, but these are not reported for purposes of brevity.

In Model 1, the coefficients on all three variables – RPH*(1 – MREG), RPH*MREG and (1 – RPH)*MREG – are statistically significant at the 0.01 level in the ΔCAP model. Take for example, RPH*(1 – MREG). The coefficient is negative in the ΔCAP equation with a point estimate −0.08. *Ceteris paribus*, banks which faced high regulatory pressure but no market pressure lowered their capital ratio by 0.08 percentage points more than banks that did not experience either form of pressure. Similar evidence is obtained for the other two interaction terms. In effect, this suggests that banks which experienced both regulatory and market pressures or for that matter, banks experiencing only market pressure and not regulatory pressure, lowered their capital ratios. However, the size of the effect in all cases is not very large, ranging from 0.05 to 0.09 percentage points.

On the other hand, as regards banks facing low regulatory pressure, the evidence indicates that, irrespective of whether they encountered market pressures or not, they increased their capital ratios. By way of example, banks experiencing both low regulatory and market pressure improved their capital by 0.1 percentage points, on average, as compared to those not facing any such pressures.

The evolution of regulatory and market pressures was, however, quite different during the crisis. The evidence appears to suggest that banks facing high regulatory pressure, but no market pressures raised their risk levels during the crisis, although there was no perceptible impact on their capital. On the other hand, banks facing low regulatory pressure, but no market pressure raised capital levels during the crisis. In essence, during the crisis, inadequately capitalized banks raised risks perhaps in order to garner market shares, whereas well-capitalized banks further buttressed their capital positions, indicating an asymmetry in their risk and capital adjustments. This is broadly consistent with the data which suggests that overall capital adequacy of banks in these countries has increased significantly after the crisis (IMF, 2013).

Finally, focusing on ownership, the evidence appears to suggest that Islamic banks increased their risk in response to an increase in capital (Model 4). The effect was also manifest during the crisis as well, wherein these banks further raised their risks. The effect of the crisis variable is quite large. To see this, consider the difference between an average Islamic bank and an average conventional bank when ΔCAP equals 0.00003, the average for the sample. Ignoring the impact of crisis, the point estimates in Col (6) yield an estimate of 0.002% points (=−6.672*0.0003 = −0.002). Taking into account the crisis impact, the point estimates in Col (8) yield a difference of approximately 0.6% points (=−6.672*0.0003 − 0.655 = −0.6). In contrast, the estimates in Model 4 indicate that there is no perceptible impact on capital of risk-taking by Islamic banks.

Table 5
3SLS estimation of capital and risk – robustness.

	Model 1		Model 2		Model 3		Model 4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔCAP	ΔRISK	ΔCAP	ΔRISK	ΔCAP	ΔRISK	ΔCAP	ΔRISK
RPH*(1 − MREG)	−0.083 (0.032)***	0.154 (0.181)						
RPH*MREG	−0.085 (0.021)***	−0.128 (0.126)						
(1 − RPH)*MREG	−0.052 (0.017)***	−0.081 (0.103)						
RPL*(1 − MREG)			0.229 (0.027)***	0.008 (0.154)				
RPL*MREG			0.115 (0.022)***	−0.043 (0.134)				
(1 − RPL)*MREG			0.016 (0.018)	−0.155 (0.109)				
RPH*(1 − MREG)*crisis					−0.004 (0.094)	−1.063 (0.488)**		
RPH*MREG*crisis					0.025 (0.084)	−0.445 (0.505)		
(1 − RPH)*MREG*crisis					0.024 (0.076)	−0.338 (0.459)		
RPL*(1 − MREG)*crisis					0.364 (0.081)***	0.086 (0.489)		
RPL*MREG*crisis					0.043 (0.035)	0.091 (0.058)		
(1 − RPL)*MREG*crisis					−0.013 (0.063)	−0.113 (0.384)		
ΔCAP*Islamic								−6.672 (1.658)***
ΔCAP*Islamic*crisis								−0.655 (0.296)**
ΔRISK*Islamic							−0.445 (0.698)	
ΔRISK*Islamic*crisis							0.035 (0.098)	
ΔCAP		1.128 (0.316)***		1.136 (0.293)***		1.221 (0.316)***		6.533 (1.674)***
ΔRISK	−0.047 (0.055)		−0.065 (0.054)		−0.035 (0.055)		−0.193 (0.715)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country*year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period	1996–2011	1996–2011	1996–2011	1996–2011	1996–2011	1996–2011	1996–2011	1996–2011
N. obs	683	683	683	683	683	683	914	914
R-squared	0.405	0.142	0.441	0.141	0.437	0.143	0.452	0.228

Standard errors in brackets.
***, *** and * Denote statistical significance at 1, 5 and 10%, respectively.

Under all cases, changes in capital are observed to exert a significant and negative impact on bank risk, and not *vice versa*, consistent with our baseline estimates.

6. 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. Efforts are underway by the Basel Committee to devise capital regulations consistent with banks' risk profile and business strategies (BCBS, 2012). However, whether and to what extent does higher capital level encourage or dissuade risk-taking by banks remains an empirical question. While there are several studies that examine this aspect for emerging and advanced economies, either from a country-specific context or from a cross-country standpoint, the evidence on this aspect for GCC banks is admittedly limited. Given that these countries are planning to implement the Basel III standards and are primarily bank-based economies, an analysis of the relationship between risk and capital for these economies remains an unaddressed area of research.

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 toward risk and capital. And third, Islamic banks increased their capital as compared to conventional banks.

These findings have useful implications for policy formulation. First, the positive relationship from capital to risk suggests that capital regulation alone may not be enough to ensure bank soundness and would need to be complemented with additional regulatory instruments. Secondly, the negative relationship between regulatory pressure and market discipline for banks with low-capital suggests that there is a need for closer and continuous monitoring. One possible way could be to give priority to risk-based supervision as a way to prevent those banks from gambling in excessively risky strategies. Third, the analysis suggests that ownership matters for bank capital. Importantly as well, the evidence points to risk taking by Islamic banks, especially during the crisis. Given the quasi-equity of Islamic banks in the form of mudarabah saving and investment (S&I) deposits, such risk-taking does not appear to have made a significant dent on their capital position. However, given the limited opportunities for diversification for Islamic banks in these economies, it becomes important to carefully monitor their capital position, especially in times of stress. Finally, the analysis makes an explicit distinction between changes in capital and risk brought about by not only regulatory, but also market pressures. Not much is known as to how market pressure interacts with regulatory pressure in influencing capital and/or bank risk-taking. This interaction of market pressure with regulatory pressure and its effect on capital is also important in light of the fact that minimum capital requirements and market discipline constitute two of the three pillars of the New Basel Accord.

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