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Impact of Size and Market Competition on Risk-taking and Profitability of GCC Bank. - An Empirical Study through GMM Estimator

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Abstract

Investigation of size and competition on risk-taking and profitability in growing markets draws the attention of researchers like the GCC region, which is primarily a banks-based economic system. This study investigates the impact of size and market competition addressed through assets and deposit concentration on the risk and profitability of GCC banks over 2010-2017. The empirical findings of the Two-Step System Generalized Method of Moments (2GMM) estimators of dynamic panel data point out some important insights. A significant asset base actively manages risk and enhances the profitability and stability of GCC banks. Market competition is positively associated with the profitability and risk-taking of banks. The risk and profitability of GCC banks are negatively related in both directional relationships. The nonlinear relationship between risk and size in the competitive market is valid and follows an inverted U-shaped curve. However, there is little evidence of the nonlinear relationship between profitability and size in the competitive market situation of GCC banks. Finally, there is a homogeneous effect of size on risk-taking and a heterogeneous effect on profitability. The capital of banks acts positively in the risk-taking and profitability of GCC banks.

Keywords: *GGC Banks, GMM estimators, Market competition, Dynamic panel data, Risk and profitability*

1. Introduction

Gulf Cooperation Council (GCC) is an economic and political association comprising six Arabian Peninsula countries. Superior stability to others during the global financial crisis and recent reforms in financial sectors have attracted many researchers to look into the financial system of GCC countries. The bank-based economic system of GCC countries relies much on the performance of the banks as non-bank financial institutions, and the financial market is relatively underdeveloped. Reforms in the financial sector, increasing globalization, and technological innovation observed growing competition in the GCC banking system. This

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might affect the profitability of GCC banks by increasing the risk of failure. This study aims to analyze the impact of size and market competition in explaining the relationship between the risk and profitability of GCC banks.

The risk-return trade-off has always been debated and is a central point of discussion in evaluating management performance. The general assumption is that with the increase in risk, the profitability of banks decreases. Zheng, et al. [1] asserts that credit risk impedes bank profitability. However, a growing number of banks, increasing assets, and deposit exposures influence banks' market power, affecting risk-taking and profitability [2]. The impact of competition on the performance and risk-taking of the bank is a controversial issue among researchers [3]. Two opposite views on bank stability have emerged in the previous literature. According to the competition fragility view, increasing competition decreases banks' profitability and forces them to take more risks [4]. On the other hand, the stability view argues that competition forces banks to lower their interest rate, reducing moral hazard and adverse selection of the borrower, reducing default risk, and bringing stability [5]. Studies also address the presence of the Structure conduct hypothesis (SCP) and efficient structure hypothesis. The traditional SCP hypothesis argues that market structure leads to higher profitability, whereas the efficient structure hypothesis contends that bank profitability depends on efficiency. GCC countries' economic circulation is mainly bank-based, and the financial system is not as mature as fast-growing developing and developed countries [6]. And the economy of GCC is also largely dependent on hydrocarbon management. Literature associates the oil price movement and value of balance sheet items, including banks' assets [7]. This phenomenon stimulates us to investigate how asset exposure of banks and concentration over deposits and other investments impact the risk and performance of banks of the GCC region.

Therefore few questions are yet to answer on the GCC banking system. Does the growing size of banks influence the GCC region's risk-taking, stability, and profitability? Do large asset-based banks have an additional benefit over lower counterparts in more profit gains and better risk management? Are the relationship between risk, stability, and profitability over different sizes and competition homogeneous? To encounter the questions in this study, we attempt to focus on a few aspects—first, the impact of size and competition in explaining the relationship between risk and profitability of GCC banks. Next, we examine the nonlinear and quadratic effect of market competition and size on the risk and profitability of GCC banks. Finally, we evaluate the behavior pattern of different-size banks, i.e., do they behave in a homogeneous or heterogeneous manner in a competitive market?

The remaining parts of the study are designed as follows. Section 2 presents an overview of GCC countries and their financial system. The relevant literature of the study shows in section 3. Section 4 & 5 explains the data & variable description and the empirical methodology of the study, respectively. Section 6 presents the empirical findings explaining the relationship between risk and profitability and the impact of size and market competition with nonlinear and quadratic effects. Finally, the conclusion of the study presents in Section 7.

2. Overview of GCC Country and financial system

Gulf Cooperation Council (GCC) is an economic and political coalition of six countries located in the Arabian Peninsula. The GCC bloc comprises Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. It was established in an agreement completed on 25 May 1981 in Riyadh, Saudi Arabia. The member countries share common characteristics

as hydrocarbon-based economies, which largely depend on the oil and gas industry. But over the last decade, the GCC countries have been trying to move their dependency from the energy sector to other sectors such as tourism, construction, and finance. GCC countries have recently implemented many economic agendas and social reforms.

Though GCC countries are trying to shift their dependency on oil, the continuous descending oil price significantly affects its GDP growth. Ollero, et al. [8] find that GCC countries overall real GDP growth dropped to 0.8% in 2019 from 2% in 2018. The vast oil reserve makes the GCC region a critical factor in the world economy. GCC countries use a dollar peg, which fixes the home currencies' exchange rate to the dollar. The GCC bloc is thinking about dropping the dollar peg. If they do so, it will cause the dollar price to decline.

On the other hand, remittances from GCC countries are a significant external resource for many Asian and North African countries. De, et al. [9] reports that about $100 billion in remittances are sent by immigrants working in GCC countries. Oil price reduction also points out one of the possible reasons for that.

The financial sector of GCC countries is heavily bank-based, with relatively underdeveloped financial markets [6]. Both conventional and Islamic banks offer financial services in GCC. The latter is highly concentrated in GCC countries. Among the GCC region, Bahrain only operates both wholesale and retail banking.

The total amount of Islamic banking assets is USD 704.8 billion in 2018, about 44.9% of the global Islamic banking assets [10]. Saudi Arabia holds the highest share (20.2%) of Islamic banking assets in the world among the other countries of this region. As of 2018, the Islamic banking share in total banking assets is 51.5% for Saudi Arabia, 40.6% for Kuwait, 25.2% for Qatar, 20.6% for UAE, 14.3% for Bahrain, and 13.1% for Oman [10].

Predominant domestic ownership in banking reflects the entry barrier and regulatory limits on foreign banks. Except for Bahrain, all GCC countries have restrictions on foreign ownership. GCC region banks depend heavily on government-backed businesses, especially in the energy sector. However, Bahrain's banking system depth is significantly better than others. According to the IMF [11] report, Bahrain, the smallest economy in the region, ranks first with a ratio of banking system assets to non-oil GDP of 820%. In contrast, Saudi Arabia, the largest economy in the region, has a ratio of 131%.

NBFIs have a small presence in the GCC, with several exceptions. Investment funds increased in some countries but remain predominantly concentrated on domestic equity and real estate. Nevertheless, NBFI 's growth is around 10.7% annually compared to about 7.8% for the banking sector [11]. Moreover, GCC stock markets are not as developed as many developing and developed countries. However, in the last decade, a significant development in the stock market is observed. Saudi stock market accounts for about 50% of the total market capitalization in this region [11]. Thus stock market exposure is also highly concentrated. The domestic debt market is relatively underdeveloped in this region.

3. Literature review

This section concentrates on the relevant literature of the study. We divide this section into literature relating to bank competition and risk, competition, and profitability, and risk and profitability for ease of readership.

3.1. Bank competition and risk

Most of the empirical literature explaining the relationship between bank competition and risk (stability) focus on two hypotheses. These are the competition-fragility and competition-

stability hypotheses. As per the traditional competition fragility theory, greater competition in the financial services industry forces financial institutions to lose market power, which decreases their profitability. Thus, they intend to take risks to cope with competition and maintain their profit share, eventually sometimes threatening stability [4]. The single-country study by Salas and Saurina [12], Bofondi and Gobbi [13], Craig and Dinger [14], Kasman and Kasman [3], and Tan, et al. [15], among others, support the competition fragility view. Whereas cross-country empirical studies like Beck, et al. [16], Anginer, et al. [17], and Leroy and Lucotte [18] also advocate the same view. Kabir and Worthington [19] argue that both conventional and Islamic banks support the competition fragility hypothesis. Albaity, et al. [20], in a recent study, opine that the competition-fragility effect is more dominant for Islamic banks than conventional banks.

Boyd and De Nicolo [21] propose the "Competition-Stability" view and argue that competition increases the stability of financial institutions. Higher competition in the banking industry brings interest rates down, and loan servicing becomes easy for borrowers. Eventually, this leads to reduced default risk and brings bank stability. Boyd, et al. [22]; Liu, et al. [23]; Schaeck and Cihák [24]; Fiordelisi and Mare [25], and Goetz [26] explore consistency with competition stability view.

Some studies advocate both the competition fragility view and the competition stability view. Berger, et al. [27], Jeon and Lim [28], Liu and Wilson [29], Jiménez, et al. [30], and Fu, et al. [31], among others, support both views. Louhichi, et al. [32] opine that both views prevail on conventional and Islamic banks. A recent study on GCC banking, Saif-Alyousfi, et al. [33], also evidence both perspectives. They opine that a single measure of competition is insufficient to analyze the role of competition on bank stability.

Several empirical studies have investigated the impact of competition on bank risk and reported both positive and negative associations. For instance, Jiang, et al. [34], and Craig and Dinger [14] explore US banks and opine that an increase in competition boosts bank risk. Similar findings were also supported by Agoraki, et al. [35], Leroy and Lucotte [18] on European banks, Gupta and Moudud-Ul-Huq [2], and Moudud-Ul-Huq and Biswas [36] on BRICS banks, Tan, et al. [15] on Chinese banks, Kabir and Worthington [19] on developing countries, Albaity, et al. [20] on MENA countries, and Beck, et al. [37] in a cross-country sample 69 countries over 1980 to 1997.

However, Liu and Wilson (2013) opine that regional banks of Japan are taking more risks than city banks in a competitive situation. Ownership also has a significant association with competition and risk association. Alam, et al. [38] postulate that risk is positively associated with market competition of commercial banks; however, the relationship is inverse in the Islamic banks' data set of GCC. Tan and Floros [39] also find an inverse relationship between competition and credit risk, competition and insolvency risk, and a positive association with competition and liquidity risk.

In contrast, some studies find a negative relationship between competition and risk. Goetz [26], using a large sample of 7,830 US commercial banks between 1978 and 2006, find a significant negative relationship between competition and bank risk. Schaeck and Cihák [24] and Fiordelisi and Mare [25] also witness a negative association between competition and risk in European banks. A similar finding also observes by Kasman and Kasman [3] on Turkish banks and Soedarmono, et al. [40], Liu, et al. [23] on Asian banks, Fu, et al. [31] in 14 Asia Pacific economies from 2003 to 2010, Bitar, et al. [41] on MENA region, and Saif-Alyousfi, et al. [33] in GCC banking over the period 1998-2016.

Theoretically, banking literature advocates the nonlinear relationship between risk and bank competition. Martinez-Miera and Repullo [42] evidence U shape relationship between

competition and risk, which depicts that an increasing number of participants and competition increases the probability of bank default initially, then declines in the long run. The nonlinear effect of competition and risk is also shown by Jeon and Lim [28], Tabak, et al. [43], Liu, et al. [44], and Jiménez, et al. [30]. Tabak, et al. [43] argue that, with the increase in competition, stability decreases in the short run but increases in the long run. In recent work, Kasman and Kasman [3], Albaity, et al. [20], and Gupta and Moudud-Ul-Huq [2], among others, confirm the presence of a nonlinear relationship between competition and risk.

3.2. Bank competition and profitability

The empirical literature mainly uses two approaches to analyze the relationship between competition and performance in the banking sector: structural and non-structural approaches. Under the structural approach, two hypotheses dominate the empirical research, the Structure-Conduct-Performance (SCP) hypothesis and the Efficient-Structure hypothesis.

According to the SCP hypothesis, bank collusion in a more concentrated market can earn more profit. A concentrated market creates a monopolistic environment that enhances the chances of more gain. So, the SCP hypothesis depicts that bank profitability is influenced by market structure or competition. Tan [45] summarizes the argument of SCP by representing a negative association between market competition and the profitability of banks. Existing literature on the banking industry provides many empirical supports for the SCP hypothesis. For example, Sufian [46], Lee and Hsieh [47], Tan and Floros [48], Mohammed, et al. [49], Tan [45], Tan, et al. [50], Moudud-Ul-Huq [51], among others. In contrast, Seelanatha [52], Apergis and Polemis [53], Tan [54], Hu and Xie [55], and Sarpong-Kumankoma, et al. [56] find inconsistency in this hypothesis.

The efficient structure hypothesis proposed by Demsetz [57] illustrates that superior efficiency leads to higher profitability in banking. Seelanatha [52], and Sarpong-Kumankoma, et al. [56] evidence the relevance of the efficient structure hypothesis. In contrast, Apergis and Polemis [53] reject the efficient structure hypothesis examining MENA banks. Tan, et al. [50] opine that the efficient structure hypothesis does not hold in the Chinese banking industry. However, Moudud-Ul-Huq [58] also opine that large banks are superior to their counterparts in competitive market performance. The author also preaches that the impact of size and competition on the risk and profitability of banks is heterogeneous.

The association between profitability and completion is not also out of the debate. Few empirical studies point out a positive relationship between competition and profitability in the banking sector. For example, Goetz [26] examines 7,830 commercial banks in the US from 1978 to 2006 and opines that greater competition increases banks' profitability. The finding of Petria, et al. [59], Schaeck and Cihák [24], examining European banks, and Hu and Xie [55] on Chinese banks, also observe similar findings.

However, studies also report negative integration between competition and profitability. Albaity, et al. [20] examine 276 banks across eighteen MENA countries and find a significant negative relationship between competition and profitability. Chronopoulos, et al. [60], and Jiang, et al. [34] on US banks also support similar findings. Chronopoulos, et al. [60] opine that a competitive banking sector eliminates abnormal profitability. According to Jiang, et al. [34], competition reduces profitability. The study of Tan and Floros [48], Tan, et al. [50] on Chinese commercial banks, and Sarpong-Kumankoma, et al. [56] on banks of 11 countries in Sub-Saharan Africa also reports a negative relationship between competition and profitability.

Tan [45] tests the impact of competition in different Chinese banking markets (deposit market, loan market, and the non-interest income market) on bank profitability. The results

show that higher levels of competition in the loan market lead to higher profitability for Chinese commercial banks. In contrast, the findings suggest that a higher competitive deposit market leads to a decline in bank profitability.

3.3. Relationship between risk and profitability

The performance of the bank is the prime concern of regulators and stakeholders. However, while discussing the performance in profitability, the risk becomes a significant consideration for achieving the profitability target. Many researchers across the globe observe the relationship between risk and profitability in banking. The general expectation is that with the enhancement of risk, profitability decreases. A negative relationship is expected to observe, but different outcomes are also found in the literature regarding this.

For instance, Naceur and Omran [61], in the study of African banks, find a significant positive impact of credit risk on banks' profitability. Boahene, et al. [62] also come up with a similar conclusion for Ghana. Mamatzakis and Bermpei [63] also find a positive association between risk and performance for G7 countries and Switzerland.

On the other hand, Kwan and Eisenbeis [64] analyzed US banks from 1987 to 1995 using a simultaneous equation framework. Their result supports the Moral Hazard Hypothesis (MHH), which depicts that low-profit banks are more vulnerable to risk-taking than higher-profitability banks. The negative relationship between risk and profitability also observe in the study of Lin, et al. [65], Sufian [46], Zhang, et al. [66], and Tan, et al. [50]. Zhang, et al. [66] stress that banks with lower-level risk perform better than banks with a high risk. Chen, et al. [67], using 2SLS on twelve advanced economies, come up with an interesting finding. They find that liquidity risk is negatively related to bank performance in a market-based financial system; however, it does not affect bank performance in a bank-based financial system.

The size of the bank also affects profitability and risk. The conventional belief prevails that the larger the bank is, the higher the profit. The findings of Boahene, et al. [62] align with these conventional beliefs and state that bank size influences bank profitability positively and significantly. The study of Sufian [46] and Chen, et al. [67] also support similar findings. Trad, et al. [68] opine that systematic risk grows with bank size. However, an inverse association between size and profitability is also observed in the study of Yadav, et al. [69]. The authors opine that although initially, with the increase of size, profitability increases, the relationship becomes inverse in the long run. A positive association between size and risk is also observed in the study of Zheng, et al. [70].

4. Description of data and variables

4.1. Description of data

This study uses macroeconomic, industry-level, and bank-level control variables. Macroeconomic data collect from the World Bank database, and bank-level data collect from the Orbis bank focus database (https://bankfocus.bvdinfo.com/). Industry-level data was compiled by the authors by aggregating each country's data. The monetary units express at a constant price in the US dollar. Finally, we have 830 bank years of data, excluding all missing data from the dataset of six countries from 2010-2017. Details of the collected data are as follows:

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates	Total
No. of Banks	33	22	19	14	18	36	142
Period	2010-2017	2010-2017	2010-2017	2011-2017	2011-2017	2010-2017	2010-2017
No. of observations	170	134	116	83	106	221	830

4.2. Definition of Variables

4.2.1. Competition measures

Concentration is the inverse proxy measure of competition. We adopt 5-Banks asset concentration and 5-Banks deposit concentration to address the industry level variable, market concentration as an opposite proxy measure of competition. Although Boone Indicator and Lerner Index are widely used proxy measures of competition and concentration of the market, Boone Indicator and Lerner Index information are not available in the World Bank data set after 2014 against GCC countries. To have more degrees of freedom, we use asset and deposit concentration measures to proxy market concentration and inverse proxy of competition.

5-Banks asset concentration:

Following the study of Uddin and Gupta [71], Belobrov [72], and Fohlin and Jaremski [73], among others, we also determine the concentration ratio by summing up the proportionate asset of the 5 largest banks concerning assets.

$$5 - Bank\ assets\ concentration = \sum_{i=1}^{5} Pi$$

Where P_1 –P5 refers to the 1^{st}, 2^{nd}, ….,5^{th} largest bank assets proportion to total industry assets.

5-Banks deposit concentration:

Following the same strategy, we also determine the 5-Banks deposit concentration by adding proportionate deposits to the total industry deposit of the 5 largest banks concerning their deposit size.

$5 - Bank\ Deposit\ concentration = \sum_{i=1}^{5} Qi$Where Q1-Q5 refers to the 1st, 2nd,…..,5th largest bank's deposit proportion to total industry deposit.

4.2.2 Risk Measures

NPLTL: Following the research of Liang, et al. [74], Farruggio and Uhde [75], Zheng, et al. [76], Moudud-Ul-Huq, et al. [77], Gupta and Moudud-Ul-Huq [2], we determine the bank risk using the ratio of Non-Performing Loan to Gross Loans (NPLTL) of the sample banks over the period. The higher the ratio of NPLTL, the higher the credit risk, i.e., the risk of loan defaults.

$$NPTL = \frac{Total\ Non-performing\ Loan}{Total\ Loan}$$

Z-score: We also use an inverse proxy of credit risk in a robust check. The Z-score addresses stability. The ratio of the sum of Capital adequacy ratio (CAR) and return on asset (ROA) to the standard deviation of ROA denotes the Z-score.

$$\text{Z-score} = \frac{(CAR+ROA)}{\delta(ROA)}$$

In measuring the Z-score, we use the standard deviation of ROA of three successive years of each bank. Following the study of Gupta and Moudud-Ul-Huq [2], Zheng, et al. [78], Jeon and Lim [28], Craig and Dinger [14], Abedifar, et al. [79], we also use the Z-score to encounter the stability risk of banks. The higher ratio depicts superior stability and lowers insolvency [80].

4.2.3 Size

By taking the logarithm of total assets, we address the variable size. To examine the size and market competition's effect on risk and profitability, we extend our model and address size into large banks and small banks. Variable 'Large bank' presents the gap between the bank's assets and average industry assets, and 'Small bank' refers to the deviation between average industry assets and the bank's assets.

Description of all variables uses in the regression presents in Table 1

Table 1: Description of variables of the study

Classification	Variable	Description	Source/literature references
Dependent Variables:			
Risk measures	NPLTL	Non-performing loan to total assets	Farruggio and Uhde [75], Abedifar, et al. [79], Zheng, et al. [76], Gupta and Moudud-Ul-Huq [2].
	Z-score	Z-score= $(\frac{(CAR+ROA}{\delta(ROA)})$ where ROA refers to the annual average return on assets, and CAR is the capital adequacy ratio reported in the annual reports. The standard deviation of ROA=$\delta(ROA)$ is calculated over three consecutive years.	Gupta and Moudud-Ul-Huq [2], Farruggio and Uhde [75], Pan and Wang [81], Abedifar, et al. [79], Craig and Dinger [14].
Profitability measure			
Return on Assets	ROA	Return on average assets	Bank focus data [82] (web: https://bankfocus.bvdinfo.com/)
Return on Equity	ROE	Return on average equity	Bank focus data [82] (web:https://bankfocus.bvdinfo.com/)

Independent Variables:			
Competition measures			
5-Banks asset concentration	Con. A	Con. A = $\sum_{i=1}^{5} Pi$ Where, P_1 = Largest bank assets / Total industry assets $P_{2=}$ 2nd largest bank assets/Total industry assets.……. P5= 5th largest bank assets/ Total industry assets.	Author's calculation using focus data.
5-Banks deposit concentration	Con.D	Con. D = $\sum_{i=1}^{5} Qi$ Where, P_1 = Largest bank deposit / Total industry deposit $P_{2=}$ 2nd largest bank deposit/Total industry deposit.……. P5= 5th largest bank deposit/ Total industry deposit.	Author's calculation using bank focus data.
Macroeconomic variables:			
Growth of gross domestic products	GGDP	The growth of real gross domestic product	World bank data: World development indicators [83] (web:http://databank.worldbank.org)
Inflation	Inflation	Inflation, GDP deflator (annual %)	World bank data: World development indicators[83] (web:http://databank.worldbank.org)
Bank-level control variables:			
Equity to total assets	ETA	The ratio of equity to total assets	Tan and Floros [84], Lee and Chih [85], Athanasoglou, et al. [86], Amidu and Hinson [87], and Gupta and Moudud-Ul-Huq [2].
Total asset exposure	Size	The logarithm of total assets	Zheng, et al. [78], Goddard, et al. [88], Akhavein, et al. [89], Molyneux and Thornton [90],
Revenue diversification	RD	The ratio of non-interest revenue to total operating income.	Zheng, et al. [70], [91].
Deposit to total assets	DTA	The ratio of deposit to total assets	The author's calculation is based on bank focus data.
Source: Authors compilation using the literature/source mentioned in the fourth column of the table			

5. Empirical research framework

In this research, we use the Two-step System Generalized Method of Moments (2GMM) approach to investigate the impact of size and market competition on the risk and profitability of GCC banks. We opt for unbalanced panel data not to lose degrees of freedom. Moreover, unbalanced panel data supports more observation by-products of cross-section 'i' and time 't' [92]. Following Gupta and Moudud-Ul-Huq [2], Baselga-Pascual, et al. [93], Zheng, et al. [76], and Moudud-Ul-Huq, et al. [91], among others, this study uses the system GMM suggested by Arellano and Bover [94], and Blundell and Bond [95] for our dynamic panel

data to address the endogeneity, autocorrelation, and unobserved heteroscedasticity. Our diagnosis tests support the GMM estimator to address endogeneity, autocorrelation, and heteroscedasticity and get unbiased panel estimators. The empirical model of the study is structured as:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 Con. + \sum_{m=3}^{4} \beta_m \ X_{i,m,t} + \sum_{n=5}^{7} \beta_n \ X_{i,n,t} + \ \varepsilon_{i,t} \quad (1)$$

Where $Y_{i,t}$ represents the risk and profitability of the dependent variable. Risk is measured through a non-performing loan to total loans in baseline and Z-Score in robust check, and profitability is measured through ROA and ROE. The subscript 'i' refers to the cross-sectional dimension across banks, and subscript m, n indicates macro-economic, and bank-level control variables respectively. 't' denotes the time dimension (i.e., t = 2010, 2011, 2012,….., 2017). One year lagged dependent variable represented by Yi, t-1.

Con. refers to the industry-level variable concentration. The concentration ratio is addressed through 5-Banks assets concentration and 5-Banks deposit concentration. $X_{i,m,t}$ represents the macroeconomic control variables, GGDP (growth of gross domestic products), and inflation. The $X_{i,n,t}$ presents bank-level control variables. ETA(equity to total assets), size (logarithm of total assets), and DTA (deposit to total assets) are the bank-level control variables of the risk equation. And bank-level control variables in profitability equations are ETA, Size, and RD (revenue diversification).

In equation (1), the presence of lagged dependent variables makes the panel dynamic. Thus the OLS regression estimation will produce bias and inconsistent measures [2].

The diagnostic tests, White test of heteroscedasticity, Durbin-Wu-Hausman test of endogeneity, and Breusch-Godfrey serial correlation LM test, restrict the use of regression and evidence the presence of endogeneity, serial correlation, and heteroscedasticity. Hausman Specification test [96] also advocates the use of fixed-effect in the regression models. To get unbiased estimators, we opted for system GMM and addressed discrepancies unobserved [94, 95]. Again, the second-order autocorrelation AR (2) in residuals is supposed to be statistically insignificant to address the time-dependent variance of the output.

To address the size and nonlinear effect of competition, we extend our baseline model. Assuming the heterogeneous behavior of banks in a competitive environment and size, the extended model is as follows:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 \ Con._{i,t} + \sum_{q=3}^{4} \beta_q S_{u,i,t} \ + \sum_{r=5}^{6} \beta_r S * Con_{i,o,t} \ + \sum_{p=7}^{8} \beta_p \ S * Con._{i,p,t}^{2} \quad (2)$$
$$+ \sum_{0=9}^{10} \beta_o \ X_{i,m,t} + \sum_{l=11}^{12} \beta_l \ X_{i,n,t} + \ \varepsilon_{i,t}$$

Where the variables *Con.* and $Con_{i,t}^2$ refers to market concentration and the squared term of concentration. $S_{u,i,t}$ Indicates a large bank and a small bank. Product of size and market concentration (nonlinear effect of concentration) denotes by, $S * Con_{i,o,t}$ ($S * Con_{i,p,t}^2$). The large coefficients of Con., i.e., market concentration, refers to the less competitive market situation.

6. Empirical findings of the study

This section presents summary statistics of the study variables shown in [Table 2] and the Correlation matrix in [Table 3]. Then we turn to address the empirical results concerning the impact of bank size and market competition on the risk and profitability of GCC banks.

To delve into the nonlinear and quadratic effect of size and competition, we extend our baseline models' results and present them in [Tables] 6 and [Table 7]. Models 1,3,5,7 and Models 2,4,6,8 of Tables 6 and 7 depict the impact of size, i.e., large banks and small banks, respectively. To have a robust check, we alternate the measure of risk and present the robust results in Table 8 to Table 11. The results of the two-step system GMM are present in Tables 4-11 to examine the effect of size and market competition on the risk-taking and profitability of GCC banks.

6.1. Descriptive statistics and correlation

[Table 2] demonstrates the summary statistics of the variables. After excluding missing data, we have 830 bank-year observations for 142 banks over the 8-years sample. In risk consideration, the average figure of the non-performing loan over the total loan is 0.0886. Whereas profitability indicators, ROA, and ROE depict average values of 1.6965 and 9.0021, respectively. The competition measure 5-Bank Asset Concentration and 5-Bank Deposit Concentration show an average value of 0.7096 and 0.7261, respectively, which means that the market is more concentrated in the GCC region. The average value of the size of GCC banks is 15.4456, which is higher compared to 10.9784 of the emerging economy [1]. On the macroeconomic level, the average growth rate of GCC countries is 3.68, which is comparatively lower than emerging Asian countries' 7.47 [78] and higher than EU countries' 0.66 [18]. The average inflation rate of GCC is -0.4266, which is better than the EU at 1.95 [18] and BRICS at 6.43 [2].

Table 2. Descriptive statistics of the variables

Variable	Mean	Median	Maximum	Minimum	Std. Dev.
NPLTL	0.0886	0.0389	1.0000	0.0000	0.1459
ROA	1.6965	1.5770	33.5750	-14.2900	2.9715
ROE	9.0021	9.6660	96.3690	-25.3110	8.5241
ETA	25.1308	15.2255	99.6550	3.6920	21.7489
Size	15.4456	15.7173	19.2219	9.9131	1.8496
DTA	0.6568	0.7659	0.9092	0.0026	0.2363
RD	0.1590	0.1703	1.2872	-27.2349	1.0257
Con. A	0.7096	0.7188	0.8500	0.5978	0.0742
Con. D	0.7261	0.7544	0.8605	0.6062	0.0803
Inflation	-0.4266	-0.1985	18.2702	-25.9584	9.8989
GGDP	3.6583	3.8035	13.3752	-4.7123	2.7934

Note(s): Table 1 presents the mean, Standard deviation, minimum, and maximum values of the variables we use in the regressions. NPLTL is the proxy measure of dependent variable Risk, ROA, and ROE is the proxy measure of dependent variables profitability. 5-Banks asset concentration and 5-Banks deposit concentration are referred to as the proxy of market competition and denoted by Con. A and Con. D respectively.

The mean value of equity to total assets is about 25.1308, which depicts that GCC banks are ahead in the capitalization of EU markets at 7.45 [44] and BRICS at 19.16 [2]. The mean value of the other two bank-level variables DTA and RD are 0.6568 and 0.1590, respectively.

We also perform the Pearson correlation coefficients between variables used in the study and present in Table 3. The highest correlation coefficient between 5-bank asset concentration and deposit concentration is 0.982. We observe no coefficient value possesses a high degree of correlation between the independent variables. As we are not using two concentration measures in the same model, we can assume that our models are free from significant multicollinearity problems.

Table 3. Correlation matrix

	NPLTL	ROA	ROE	ETA	SIZE	DTA	RD	Con. A	Con. D
NPLTL	1								
ROA	0.080	1							
ROE	-0.170	0.674	1						
ETA	0.493	0.115	-0.290	1					
SIZE	-0.481	-0.075	0.294	-0.727	1				
DTA	-0.409	-0.164	0.187	-0.761	0.681	1			
RD	0.046	0.158	0.082	-0.079	0.041	-0.012	1		
Con.A	-0.034	-0.048	-0.066	0.054	-0.068	-0.041	-0.003	1	
Con.D	-0.016	-0.057	-0.097	0.071	-0.112	-0.062	-0.022	0.982	1

Risk (NPLTL-nonperforming loan to total loans) and Profitability (ROA-return on asset and ROE-return on equity) are used as dependent variables in the regression models. 5-Asset Con & 5-Dep. Con refers to 5-Banks asset concentration and 5-Banks deposit concentration as a proxy of market competition. ETA means equity to total assets, and DTA and RD refer to deposit to total asset and revenue diversification, respectively.

6.2. Effect of size and market competition on risk and profitability

In this section, we describe the regression results obtained by estimating equation 1. [Table 4] to [Table 5] presents the effect of size and market competition on the risk and profitability of GCC banks. We have found that the coefficient of the lagged dependent variable of risk [Table 4] and profitability [Table 5] is significant; it indicates the dynamic nature of the models and implies that dependent variables are persistently determined from one year to the following year. In table 4-5, we observe that the relationship between risk and profitability is significant and negative, which means with the increase in risk, profitability decreases and vice versa. This result is in line with Lin, et al. [65], Sufian [46], Zhang, et al. [66], Tan, et al. [50], and in contrast to Naceur and Omran [61], Boahene, et al. [62], and Mamatzakis and Bermpei [63].

In [Table 4], we observe that with the increase in competition (decrease of concentration), the risk of GCC banks increases. This outcome is in line with Jiang, et al. [34], Craig and Dinger [14], Agoraki, et al. [35], Leroy and Lucotte [18], Gupta and Moudud-Ul-Huq [2], Moudud-Ul-Huq and Biswas [36], Tan, et al. [15], Kabir and Worthington [19], Albaity, et al. [20] and validate the competition fragility view. It contradicts Boyd and De Nicoló (2005) stability view and a previous study on GCC banking by Al-Khouri [97]. Findings of the profitability equation in Table 5 show that the profitability of GCC banks increases with the increase in competition. It means that in a competitive market environment, the performance of GCC banks enhances and opposes the argument of the SCP hypothesis. Goetz [26], Petria,

et al. [59], Schaeck and Cihák [24], and Hu and Xie [55] found a similar positive association. The negative (positive) association of size with risk (profitability) in Table 4-5 means incremental asset exposure lowers the risk and enhances GCC banks' profitability. Trad, et al. [68], and Zheng, et al. [70] depicted similar findings of a negative association between size and risk.

Table 4: Risk equation examining the effect of size and market competition

Variable	Model 1	Model 2	Model 3	Model 4
NPLTL (-1)	0.6272***(11.91)	0.5418***(10.1)	0.6136***(11.75)	0.53662***(10.04)
ROA	-0.0118***(-3.29)		-0.0109***(-3.04)	
ROE		-0.0063***(-3.11)		-0.00583***(-2.95)
Con. A	-0.0694**(-2.21)	-0.0807*(-1.68)		
Con. D			-0.0804**(-2.61)	-0.07879*(-1.76)
DTA	0.0241(1.15)	0.0534*(1.68)	0.0283(1.39)	0.055599*(1.76)
Size	-0.0062**(-2.35)	-0.0017(-0.38)	-0.0064**(-2.37)	-0.00233(-0.53)
ETA	0.0011**(2.16)	0.0011**(2.09)	0.0011**(2.29)	0.00108**(2.17)
Inflation	0.0003(1.45)	0.0003(1.28)	0.0002(1.26)	0.000225(1.08)
GGDP	0.0009(1.47)	0.0025***(2.64)	0.0009(1.49)	0.002358**(2.54)
Constant	0.1475**(2.59)	0.1061(1.32)	0.1286**(2.54)	0.084808(1.20)
Hansen Test (P-value)	0.427	0.475	0.468	0.479
AR(1) (P-value)	0.130	0.094	0.134	0.098
AR(2) (P-value)	0.270	0.269	0.272	0.269
Observations	688	688	688	688

*Note: The values in parentheses are t-value; *, **, *** refer to significance at 0.10, 0.05, and 0.01 levels, respectively. The dependent variable is NPLTL denotes the proxy measure of risk. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano–Bond order 1 (2) are tests for first (second) order correlation, asymptotically N (0, 1). These test the first-differenced residuals in the system GMM estimation. Model 1 & Model 2 present market competition proxy by 5-Banks asset concentration, and Model 3 & Model 4 denote market proxy by 5-Banks deposit concentration ratio. Model 1 & Model 3 use ROA as a proxy measure of profitability, and Model 2 & Model 4 use ROE as a proxy measure of profitability.*

In explaining the other control variables, we found that ETA is significantly positively related to risk and profitability. It means that the capitalization of banks increases profitability, and banks are taking more risks than their counterparts. A positive association between DTA in Table 4 indicates that banks with a high deposit ratio to assets induce more risks. In Table 5, the coefficient of RD illustrates that diversification in revenue generation can earn higher profit. This result postulates that a portfolio of income generation can play a role in gaining more profits.

In [Table 4] and [Table 5], the macroeconomic variable GGDP depicts that both bank risk and profitability increase with economic growth—this finding contrasts with Kasman and Kasman [3], Zheng, et al. [78]. One of the possible reasons for such association is that with economic progression, the demand for banking sector loans increases loan exposure, risk, and banks' profitability. The other macroeconomic variable, inflation, is insignificant in the risk equation but significant and positively related to profitability. One possible reason for such a relationship is that in an inflationary period, the actual cost of loan servicing is low, increasing the regular payment of the loan and increasing profitability[78]. This outcome is in line with Trad, et al. [68], and Tan, et al. [50].

Table 5. Profitability equation examining the effect of size and market competition

Variable	Model 1	Model 2	Model 3	Model 4
ROA(-1)	0.3513***(6.68)		0.3533***(6.64)	
ROE(-1)		0.3298***(5.67)		0.3300***(5.67)
NPLTL	-7.7037***(-6.34)	-22.7349***(-3.75)	-7.6517***(-6.26)	-22.4144***(-3.74)
Con.A	-1.2895*(-1.75)	-2.6711(-0.84)		
Con. D			-1.3858**(-2.00)	-2.8820(-0.95)
RD	2.1149***(4.03)	6.3418***(3.51)	2.1342***(4.09)	6.2877***(3.52)
Size	-0.0131(-0.20)	0.6969**(2.6)	-0.0160(-0.24)	0.6929**(2.57)
ETA	0.0345***(5.33)	-0.0110(-0.39)	0.0342***(5.21)	-0.0114(-0.40)
Inflation	0.0152***(3.26)	0.0283(1.62)	0.0153***(3.24)	0.0284(1.62)
GGDP	0.0266(1.16)	0.2086**(2.57)	0.0280(1.24)	0.2134***(2.68)
Constant	1.5129(1.02)	-3.1725(-0.57)	1.6405(1.11)	-2.9313(-0.52)
Hansen Test (P-value)	0.757	0.442	0.772	0.439
AR(1) (P-value)	0.215	0.003	0.214	0.003
AR(2) (P-value)	0.544	0.770	0.544	0.762
Observations	688	688	688	688

*Note: The values in parentheses are t-value; *, **, *** refer to significance at 0.10, 0.05, and .01 levels, respectively. The dependent variable is ROA in Model 1 & Model 3 and ROE in Model 2 & Model 4 as a proxy measure of profitability. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano–Bond order 1 (2) are tests for first (second) order correlation, asymptotically N (0, 1). These test the first-differenced residuals in the system GMM estimation. Model 1 & Model 2 present market competition proxy by 5-Banks asset concentration, and Model 3 & Model 4 denote market proxy by 5-Banks deposit concentration ratio.*

6.3. The Nonlinear and quadratic effect of size & market competition

Previous studies of Moudud-Ul-Huq [51], Gupta and Moudud-Ul-Huq [2], Albaity, et al. [20], Kouki and Al-Nasser [98], Kasman and Kasman [3], Fu, et al. [31], Jeon and Lim [28], Tabak, et al. [43], Berger, et al. [27] used quadratic (squared) term of competition to check the nonlinearity issue. Including the squared term of asset concentration and deposit concentration in equation 2, we extended our baseline model to examine the nonlinear effect of size and market competition on risk and profitability. Table 6-7 portrays the GMM estimators of equation (2).

Table 6. Risk equation examining the effect of size and market competition

Variable	Profit proxy ROA				Profit proxy ROE			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
NPLTL(-1)	0.6571*** (16.21)	0.6854*** (14.44)	0.6589*** (15.71)	0.6857*** (14.25)	0.5668*** (13.11)	0.5733*** (13.45)	0.5708*** (13.17)	0.5702*** (13.23)
ROA	-0.0136*** (-4.50)	-0.0163* (-4.71)	-0.0137*** (-4.72)	-0.0157*** (-4.55)				
ROE					-0.0056*** (-3.33)	-0.0053*** (-3.32)	-0.0058*** (-3.45)	-0.0057*** (-3.43)
Con asset	-0.0227 (-0.81)	-0.0164 (-0.78)			-0.0361 (-0.73)	-0.0922 (-1.54)		

Con deposit			-0.0129 (-0.45)	-0.0133 (-0.68)			-0.0242 (-0.52)	-0.0855 (-1.50)
DTA	0.0216 (1.30)	0.0064 (0.34)	0.0215 (1.30)	0.0050 (0.26)	0.0508* (1.74)	0.0441 (1.57)	0.0521* (1.80)	0.0466 (1.62)
Large Bank	0.0141* (1.96)		0.0159** (2.40)		0.0287 (1.36)		0.0303 (1.63)	
Small Bank		0.0512* (1.74)		0.0589* (1.80)		-0.0175 (-0.65)		-0.0271 (-0.92)
Large×Con.A	-0.0407** (-2.01)				-0.0793 (-1.34)			
Large×Con.A^2	0.0289** (2.03)				0.0544 (1.32)			
Small×Con.A		-0.1404* (-1.72)				0.0453 (0.60)		
Small×Con.A^2		0.0952* (1.70)				-0.0289 (-0.56)		
Large×Con.D			-0.0449** (-2.44)				-0.0823 (-1.61)	
Large×Con.D^2			0.0311** (2.44)				0.0553 (1.58)	
Small ×Con.D				-0.1607* (-1.79)				0.0714 (0.88)
Small×Con.D^2				0.1083* (1.78)				-0.0466 (-0.85)
ETA	0.0017*** (3.91)	0.0014*** (2.73)	0.0017*** (4.03)	0.0014** (2.62)	0.0014*** (3.39)	0.0013*** (3.18)	0.0014*** (3.29)	0.0013*** (3.07)
Inflation	0.0002 (0.97)	0.0002 (0.97)	0.0002 (1.04)	0.0002 (0.83)	0.0002 (1.00)	0.0003 (1.43)	0.0002 (0.99)	0.0003 (1.50)
GGDP	0.0006 (1.03)	0.0004 (0.63)	0.0007 (1.19)	0.0004 (0.58)	0.0021** (2.49)	0.0023** (2.50)	0.0023*** (2.66)	0.0026*** (2.72)
Constant	0.0074 (0.29)	0.0201 (0.80)	0.0007 (0.03)	0.0192 (0.77)	0.0346 (0.84)	0.0789 (1.53)	0.0282 (0.69)	0.0774 (1.53)
Hansen Test (P-value)	0.265	0.209	0.218	0.229	0.291	0.274	0.352	0.345
AR(1) (P-value)	0.117	0.111	0.117	0.113	0.093	0.094	0.093	0.094
AR(2) (P-value)	0.263	0.263	0.263	0.262	0.264	0.262	0.264	0.264
Observations	688	688	688	688	688	688	688	688

*Note(s): Empirical results of the GMM panel estimator are present in the table by using equation (2). Risk is the dependent variable measured through NPLTL. Con. Asset & Con. Deposit refers to the 5-Banks asset concentration & 5-Banks deposit concentration, respectively, as a proxy measure of market competition. The size of banks is categorized into small and large size of banks. Large × Con. (Small ×Con.) and Large × Con.2(Small × Con.2) denotes the quadratic term of size and market competition. The values shown in parenthesis are t-values, ***, **, and * indicating significance at 1%, 5%, and 10% levels respectively. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano-Bond order 1(2) is tested for the first(second)order correlation, asymptotically N (0,1). These test the first-differenced residuals in the system GMM estimation*

[Table 6] shows the quadratic effect of competition and size on the risk of banks. Our empirical findings of Table 6 are in line with the Gupta and Moudud-Ul-Huq [2], Albaity, et al. [20], Kasman and Kasman [3], Tabak, et al. [43] that show a significant nonlinear effect of competition in bank risk-taking. The findings of Table 6 prove that large banks are initially taking more risks, but their risk-taking tendency decreases in the long run. Small banks follow the same approach. So, we can say that the risk-taking propensity of GCC banks is following an inverted U-shaped curve in a competitive market. These findings are opposite to the U-shape relationship opined by Martinez-Miera and Repullo [42].

Table 7. Profit equation examining the effect of size and market competition

	Profit proxy ROA				Profit proxy ROE			
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
ROA (-1)	0.3195*** (6.95)	0.3239*** (7.37)	0.3020*** (7.28)	0.3050*** (7.66)				
ROE(-1)					0.3436*** (6.60)	0.3692*** (6.81)	0.3596*** (6.88)	0.3581*** (6.63)
NPLTL	-6.7117*** (-6.6)	-6.7609*** (-6.43)	-6.4803*** (-6.81)	-6.4642*** (-6.54)	-26.1439*** (-4.61)	-23.6343*** (-4.60)	-22.5281*** (-4.38)	-23.8813*** (-4.63)
Con asset	-0.6484 (-0.69)	-1.7316** (-2.32)			-1.1146 (-0.28)	-8.2286 (-1.66)		
Con deposit			-0.5934 (-0.69)	-1.6855** (-2.44)			-1.9902 (-0.54)	-8.3774* (-1.77)
RD	1.8364*** (4.31)	1.7923*** (3.99)	1.7343*** (4.45)	1.6184*** (3.89)	6.3989*** (3.31)	5.7854*** (3.24)	5.3004*** (3.28)	5.6036*** (3.27)
Large Bank	0.1837 (0.64)		0.1361 (0.53)		7.3522 (1.65)		1.2623 (0.74)	
Small Bank		-0.4382 (-0.92)		-0.7903* (-1.61)		0.1876 (0.10)		-1.8357 (-0.95)
Large×Con.A	-0.4760 (-0.6)				-20.2981 (-1.62)			
Large×Con.A^2	0.2938 (0.54)				13.9262 (1.60)			
Small×Con.A		1.1790 (0.88)				-1.0630 (-0.20)		
Small×Con.A^2		-0.7717 (-0.84)				1.0678 (0.29)		
Large×Con.D			-0.3346 (-0.48)				-3.1157 (-0.65)	
Large×Con.D^2			0.1919 (0.41)				1.9429 (0.59)	

Small ×Con.D				2.1493* (1.58)				4.6479 (0.87)
Small×Con.D^2				-1.4337* (-1.54)				-2.9239 (-0.8)
ETA	0.0337*** (6.32)	0.0338*** (6.26)	0.0329*** (6.15)	0.0332*** (6.25)	-0.0391* (-1.77)	-0.0406* (-1.83)	-0.0386* (-1.74)	-0.0402* (-1.83)
Inflation	0.0151*** (3.38)	0.0158*** (3.48)	0.0139*** (3.04)	0.0151*** (3.29)	0.0208 (1.07)	0.0312* (1.72)	0.0282 (1.56)	0.0358* (1.97)
GGDP	0.0265 (1.24)	0.0298 (1.40)	0.0322 (1.52)	0.0388* (1.86)	0.1630** (2.03)	0.1711** (2.31)	0.1861** (2.46)	0.1989*** (2.75)
Constant	0.9564 (1.48)	1.6377*** (3.08)	0.9488 (1.57)	1.6576*** (3.35)	7.3991** (2.63)	12.6034*** (3.56)	7.7738*** (2.96)	12.9015*** (3.77)
Hansen Test (P-value)	0.907	0.919	0.806	0.871	0.529	0.828	0.800	0.796
AR(1) (P-value)	0.222	0.220	0.229	0.226	0.004	0.003	0.004	0.004
AR(2) (P-value)	0.497	0.498	0.483	0.476	0.814	0.813	0.771	0.789
Observations	688	688	688	688	688	688	688	688

*Note(s): Empirical results of the GMM panel estimator are present in the table by using equation (2). Profitability is the dependent variable measured through ROA and ROE. Con. Asset & Con. Deposit refers to the 5-Banks asset concentration & 5-Banks deposit concentration, respectively, as a proxy measure of market competition. The size of banks is categorized into small and large size of banks. Large × Con. (Small ×Con.) and Large × Con.^{2}(Small × Con.^{2}) denotes the quadratic term of size and market competition. The values shown in parenthesis are t-values, ***, **, and * indicating significance at 1%, 5%, and 10% respectively. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano-Bond order 1(2) is tested for the first(second)order correlation, asymptotically N (0,1). These test the first-differenced residuals in the system GMM estimation*

[Table 7] depicts the nonlinear effect of size and market competition on the profitability of banks. There is little evidence of a nonlinear relationship between size and market competition over the profitability of GCC banks. Only small banks in the ROA model of profitability show a significant result at a 10% level of significance. That means the profitability of small banks decreases initially; later on, it creases in a competitive market situation. Therefore, it is clear that large and small size banks' behavior in the competitive market is homogenous in risk-taking.

6.4. Robustness check

6.4.1. Robustness check of baseline results

We perform a robust check of the model by alternating the proxies of variables. We change the risk proxies NPLTL to Z-score to check the robustness of the model. NPLTL is the direct measure of credit risk, whereas Z-score is the inverse proxy of credit risk and direct measurement of stability risk. Table 8 & Table 9 present the robust check of baseline results of risk and profitability (Equation 1) of [Table 4] and [Table 5], respectively. Subsequently, Table 10 & Table 11 depict the robustness of the nonlinear extended model of Equation 2.

Table 8. Risk equation examining the effect of size and market competition

Variable	Model 1	Model 2	Model 3	Model 4
Z-Score(-1)	0.9771***(107.09)	0.9788 ***(117.43)	0.9776***(139.28)	0.9890***(118.38)
ROA	0.2252*(1.68)		0.1526**(2.02)	
ROE		0.1007**(2.49)		0.1144***(3.03)
Con. A	-45.5396***(-3.23)	-33.0721**(-2.31)		
Con. D			-8.5016**(-2.12)	-10.9832**(-2.48)
DTA	-1.0356(-0.43)	-1.8404(-0.86)	-0.1717(-0.10)	9.9133*(1.91)
Size	1.1318**(2.49)	0.9000**(2.15)	1.2366***(4.23)	0.4622(1.13)
ETA	0.0917***(2.65)	0.0889***(2.73)	0.1051***(4.14)	0.1652***(3.95)
Inflation	0.0529*(1.83)	-0.0216(-0.74)	0.0029(0.12)	-0.0525(-1.47)
GGDP	0.0878(0.81)	-0.6973***(-2.86)	0.0553(0.48)	-0.7665**(-2.28)
Constant	13.1347(0.89)	10.4380(0.77)	-17.9950***(-3.72)	-11.6319**(-2.05)
Hansen Test (P-value)	0.831	0.605	0.663	0.778
AR(1) (P-value)	0.006	0.006	0.007	0.006
AR(2) (P-value)	0.842	0.885	0.798	0.881
Observations	688	688	688	688

*Note: The values in parentheses are t-value; *, **, *** refer to significance at 0.10, 0.05, and 0.01 levels, respectively. The dependent variable is Z-Score denotes the proxy measure of stability. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano–Bond order 1 (2) are tests for first (second) order correlation, asymptotically N (0, 1). These test the first-differenced residuals in the system GMM estimation. Model 1 & Model 2 present market competition proxy by 5-Banks asset concentration, and Model 3 & Model 4 denote market proxy by 5-Banks deposit concentration ratio. Model 1 & Model 3 use ROA as a proxy measure of profitability, and Model 2 & Model 4 use ROE as a proxy measure of profitability.*

The robust model of the risk equation depicts that with the increase in market concentration stability of banks decreases. Therefore, compared with the baseline model, it is clear that with the rise in market competition, the risk-taking and stability of banks increase in the GCC region. Other variables also show a similar result to the baseline risk model. For example, with the increase in size, banks' risk decrease is also evident in the stability models. Similarly, a large capital base shows a growing tendency for risk-taking. However, capitalization also enhances the stability of banks. The coefficient of GGDP and Inflation are in line with the baseline result depicting the opposite sign of credit risk.

Table 9. Profitability equation examining the effect of size and market competition

Variable	Model 1	Model 2	Model 3	Model 4
ROA(-1)	0.2853***(7.00)		0.2797***(6.87)	
ROE(-1)		0.3777***(6.81)		0.3778***(6.82)
Z-Score	0.0014*(1.89)	0.0070**(2.33)	0.0017**(2.27)	0.0069**(2.28)
Con.A	-0.6420(-0.86)	1.7186(0.62)		
Con. D			-1.5176*(-1.88)	1.3554(0.51)
RD	1.7742***(4.01)	3.4144***(2.79)	1.4518***(2.99)	3.4044***(2.79)
Size	0.0824(1.48)	0.9776***(4.48)	0.1310**(2.13)	0.9778***(4.45)
ETA	0.0138***(2.73)	-0.0407***(-2.71)	0.0155***(3.00)	-0.0408***(-2.73)
Inflation	0.0106**(2.16)	0.0281(1.64)	0.0362***(2.76)	0.0289*(1.68)
GGDP	0.0409**(2.04)	0.2154***(2.82)	0.0690***(2.92)	0.2143***(2.81)
Constant	-0.5680(-0.46)	-11.9935***(-2.75)	-0.7502(-0.58)	-11.7527***(-2.68)
Hansen Test (P-value)	0.244	0.756	0.973	0.743
AR(1) (P-value)	0.208	0.001	0.212	0.001
AR(2) (P-value)	0.404	0.53	0.376	0.532
Observations	688	688	688	688

*Note: The values in parentheses are t-value; *, **, *** refer to significance at 0.10, 0.05, and 0.01 levels, respectively. The dependent variable is ROA in Model 1 & Model 3 and ROE in Model 2 & Model 4 as a proxy measure of profitability. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano–Bond order 1 (2) are tests for first (second) order correlation, asymptotically N (0, 1). These test the first-differenced residuals in the system GMM estimation. Model 1 & Model 2 present market competition proxy by 5-Banks asset concentration, and Model 3 & Model 4 denote market proxy by 5-Banks deposit concentration ratio.*

The robust result of profitability is similar to the baseline result. However, only a few exceptions are observed. ETA is insignificant in Model 2, but in robust check, ETA is significant in Model 2 also. Macroeconomic variable GGDP (Inflation) is significant in all Models (Model 4) in robust check, whereas insignificant in Model 1 & Model 3 (Model 4) of baseline results.

6.4.2 Robustness check of extended nonlinear models

Robustness of the nonlinear and extended models is performed by alternating the Credit risk proxies into stability risk measures through Z-Score.

Table 10. Risk equation examining the effect of size and market competition

Variable	Profit proxy ROA				Profit proxy ROE			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Z-Score(-1)	0.9905*** (106.69)	0.9843*** (118.59)	0.9909*** (111.48)	0.9847*** (118.75)	0.9869*** (74.48)	0.9851*** (96.48)	0.9892*** (88.58)	0.9819*** (105.83)
ROA	0.2192** (2.04)	0.2968*** (2.87)	0.2031* (1.93)	0.3105*** (2.90)				
ROE					0.1493** (2.39)	0.2194* (1.83)	0.1231** (2.24)	0.2924** (2.19)
Con asset	-6.7715 (-1.15)	-1.1689 (-0.11)			0.3390 (0.04)	-0.3880 (-0.04)		
Con deposit			-5.8692 (-1.05)	-2.2403 (-0.24)			-2.0137 (-0.29)	3.6837 (0.46)
DTA	1.2699 (0.63)	-0.3135 (-0.15)	1.6977 (0.83)	-0.2438 (-0.12)	21.5257*** (3.21)	0.0410 (0.02)	18.3349*** (2.73)	13.479*** (2.86)
Large Bank	22.3003* (1.91)		38.0714** (2.35)		3.7297 (0.17)		11.8904 (0.49)	
Small Bank		4.6937* (1.76)		4.7154* (1.79)		2.1358 (0.94)		1.6927 (0.74)
Large×Con. A	-63.1033* (-1.91)				-10.8524 (-0.17)			
Large×Con. A^2	44.3722* (1.91)				7.9498 (0.18)			
Small×Con. A		-13.1063* (-1.77)				-5.6248 (-0.91)		
Small×Con. A^2		8.8329* (1.73)				3.4673 (0.82)		
Large×Con. D			-106.304** (-2.34)				-33.1084 (-0.49)	
Large×Con. D^2			73.5257** (2.34)				22.8609 (0.48)	
Small ×Con.D				-13.0795* (-1.8)				-4.1951 (-0.67)
Small×Con. D^2				8.7575* (1.75)				2.5287 (0.58)
ETA	0.0707*** (3.08)	0.0686*** (3.20)	0.0726*** (3.21)	0.0683*** (3.19)	0.2461*** (3.60)	0.0725* (2.65)	0.2133*** (3.17)	0.18442*** (3.53)
Inflation	-0.0352 (-1.08)	-0.0572 (-1.72)	-0.0403 (-1.26)	-0.0578* (-1.72)	-0.0941 (-1.15)	0.0354 (0.62)	-0.0863* (-1.84)	-0.0252 (-0.86)
GGDP	-0.1906 (-0.71)	-0.6019** (-2.23)	-0.1268 (-0.48)	-0.6047** (-2.21)	-1.1184** (-2.47)	-0.0568 (-0.38)	-0.8786** (-2.01)	-0.1191 (-0.88)

Constant	2.1591 (0.44)	2.3588 (0.32)	1.0552 (0.22)	3.0535 (0.44)	-17.9952** (-2.09)	-1.9251 (-0.26)	-14.0609* (-1.75)	-17.8338** (-2.23)
Hansen Test (P-value)	0.458	0.594	0.482	0.601	0.438	0.869	0.591	0.825
AR(1) (P-value)	0.007	0.007	0.008	0.007	0.005	0.008	0.006	0.008
AR(2) (P-value)	0.751	0.992	0.527	0.994	0.87	0.938	0.968	0.944
Observations	688	688	688	688	688	688	688	688

*Note(s): Empirical results of the GMM panel estimator are present in the table by using equation (2). The dependent variable is Z-Score denotes the proxy measure of stability. Con. Asset & Con. Deposit refers to the 5-Banks asset concentration & 5-Banks deposit concentration, respectively, as a proxy measure of market competition. The size of banks is categorized into small and large size of banks. Large × Con. (Small ×Con.) and Large × Con.2(Small × Con.2) denotes the quadratic term of size and market competition. The values shown in parenthesis are t-values, ***, **, and * indicating significance at 1%, 5%, and 10% respectively. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano-Bond order 1(2) is tested for the first(second)order correlation, asymptotically N (0,1). These test the first-differenced residuals in the system GMM estimation*

Robust results are in line with baseline results, with few exceptions. For example, inflation in all models is insignificant in Table 6. However, we observe inflation as significant in Model 4 and Model 7 in robust check. Similarly, GGDP is also found significant in Model 2 and Model 4 in the robust check.

Table 11. Profit equation examining the effect of size and market competition

	Profit proxy ROA				Profit proxy ROE			
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
ROA (-1)	0.2436*** (5.71)	0.4691*** (12.33)	0.2427*** (5.50)	0.2843*** (7.59)				
ROE(-1)					0.3423*** (5.53)	0.3884*** (6.53)	0.3886*** (6.79)	0.4285*** (7.52)
Z-Score	0.0089** (2.05)	0.0115** (2.21)	0.0089* (1.92)	0.0014* (1.67)	0.0625*** (2.91)	0.0418*** (2.82)	0.0485** (2.58)	0.0267* (1.95)
Con asset	0.1682 (0.17)	0.0562 (0.03)			3.1149 (0.67)	1.2707 (0.20)		
Con deposit			0.2342 (0.26)	-2.0220** (-2.50)			2.5921 (0.65)	-3.0393 (-0.56)
RD	1.7737*** (4.40)	1.7943*** (4.60)	1.8050*** (4.46)	1.4963*** (3.89)	5.0787*** (3.46)	4.7017*** (3.49)	4.9601*** (3.48)	4.3769*** (3.21)
Large Bank	0.7532** (2.12)		0.5508* (1.69)		1.0100 (0.22)		2.8450 (1.50)	
Small Bank		-0.1548 (-0.23)		-1.1434** (-2.32)		0.2363 (0.12)		-0.9528 (-0.52)
Large×Con.A	-2.1390** (-2.09)				-2.9608 (-0.23)			

Large×Con.A^2	1.4791** (2.03)				2.1188 (0.24)			
Small×Con.A		0.3810 (0.21)				-0.7736 (-0.14)		
Small×Con.A^2		-0.2207 (-0.18)				0.6303 (0.17)		
Large×Con.D			-1.5213 (-1.65)				-7.7700 (-1.45)	
Large×Con.D^2			1.0148 (1.57)				5.2398 (1.40)	
Small ×Con.D				3.0706** (2.24)				2.2218 (0.44)
Small×Con.D^2				-2.0265** (-2.15)				-1.2646 (-0.36)
ETA	0.0094*** (2.69)	0.0095** (2.48)	0.0088** (2.55)	0.0087*** (2.68)	-0.1031*** (-7.42)	-0.0953*** (-7.52)	-0.0944*** (-7.33)	-0.0844*** (-7.40)
Inflation	0.0079 (1.59)	0.0263** (2.20)	0.0075 (1.44)	0.0135*** (2.83)	0.0260 (1.28)	0.0321* (1.76)	0.0274 (1.55)	0.0345* (1.94)
GGDP	0.0349* (1.81)	0.0695*** (2.64)	0.0363* (1.88)	0.0367** (1.98)	0.1737** (2.00)	0.1931** (2.55)	0.1719** (2.18)	0.2108*** (2.94)
Constant	-0.0491 (-0.07)	-0.7001 (-0.42)	-0.0999 (-0.14)	1.9272** (3.25)	0.3855 (0.13)	2.3893 (0.48)	1.0610 (0.40)	6.1919 (1.41)
Hansen Test (P-value)	0.332	0.302	0.321	0.25	0.666	0.857	0.578	0.778
AR(1) (P-value)	0.229	0.169	0.232	0.207	0.001	0.001	0.002	0.001
AR(2) (P-value)	0.387	0.462	0.387	0.395	0.495	0.544	0.541	0.576
Observations	688	688	688	688	688	688	688	688

*Note(s): Empirical results of the GMM panel estimator are present in the table by using equation (2). Profitability is the dependent variable measured through ROA and ROE. Con. Asset & Con. Deposit refers to the 5-Banks asset concentration & 5-Banks deposit concentration, respectively, as a proxy measure of market competition. The size of banks is categorized into small and large size of banks. Large × Con. (Small ×Con.) and Large × Con.^{2}(Small × Con.^{2}) denotes the quadratic term of size and market competition. The values shown in parenthesis are t-values, ***, **, and * indicating significance at 1%, 5%, and 10% respectively. J-statistic refers to the p-value of the Hansen test. The null hypothesis of the Hansen test depicts that the instruments used are not correlated with residuals (over-identifying restrictions). Arellano-Bond order 1(2) is tested for the first(second)order correlation, asymptotically N (0,1). These test the first-differenced residuals in the system GMM estimation*

The robust model of equation 2 depicts that the profitability of large banks initially decreases then increases in the long run as per Model 1. The remaining outcomes are similar to the baseline models of the study. Therefore, the empirical results are plausible, considering few exceptions between the actual results and robust check results.

7. Conclusion

Investigating the relationship between risk and profitability of GCC banks, and examining the effect of size and market competition, depict some significant insights. We use a sample of 142 banks of six GCC countries from 2010-2017; excluding missing data, we have 830 bank years observations. From the mid of 2000s, GCC countries saw an acceleration in credit

growth in the private sector Calice, et al. [99]. As a bank-based economy, the importance of GCC countries' banking sector risk and profitability increased substantially. In this study, we find a significant negative association between the risk and profitability of GCC banks in both directional relationships. It means that with the increase of risk, the risk-taking price means banks' profitability decreases. This finding confirms the previous results of Rakshit and Bardhan [100], Mujtaba, et al. [101], and Yesmin [102]. However, banks with low profits are taking more risks than their other counterpart.

Significant lagged dependent variables evidence the dynamic nature of models. Because of reforms in the financial sector, the banking sector of GCC is witnessing increasing competition, and we have found its effect on performance and risk. The results of 2GMM show that increasing competition in the GCC banking sector increases the risk, supporting the competition fragility view, which reinforces the findings of Gupta, et al. [103], and Yesmin [102], among others. The SCP hypothesis does not hold for GCC banks as profitability increases with the increase of competition. There is also a significant impact of size on the risk and profitability of GCC banks. The profitability equation supports the portfolio investment to maximize return. On the macroeconomic level, GDP growth increases both the risk and profitability of GCC banks. Again, although inflation has a positive effect on profitability, there is no significant association of inflation at risk of GCC banks. In examining the nonlinear impact of size and market competition on risk and profitability, we observe no heterogeneous effect of size in the competitive market over the risk-taking of GCC banks, and it follows an inverted U-shape curve. This finding parallels the finding of Moudud-Ul-Huq [58] on BRICS. It refers to GCC banks, irrespective of size, initially taking more risk and subsequently taking the calculative risk in a competitive market. From the observation of baseline and robust results, it is clear that large and small-size banks' behavior in the competitive market is homogenous in risk-taking; however, it is heterogeneous in profitability concern. As GCC accounts for 44.9% of the global Islamic banking assets (Islamic Financial Services Board, 2019), further investigation of the study can be carried out, showing how Islamic and conventional banking differ in risk-taking and profitability explanatory variable size and market competition.

8. Data availability statement:

All the data used in this study are accessed from the Orbis Bank Focus database and World bank data set. The data is available at https://bankfocus.bvdinfo.com & http://databank.worldbank.org Furthermore, the final data set after excluding missing data can be available upon request to the authors.

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