Authors:
AKTHAM I. MAGHYEREH, Department of Economics and Finance, United Arab Emirates University, Al Ain, UAE

BANK COMPETITION, CONCENTRATION AND RISK-TAKING IN THE UAE BANKING INDUSTRY*

ABSTRACT

This paper investigates the impact of competition and concentration on bank stability or risk-taking behavior in the UAE banking industry over the period 2006 to 2015. The Herfindahl–Hirschmann (HHI) index is used as an inverse measure of competition, while the nonperforming loans (NPL) ratio and Z-scores are used as proxies for bank risk-taking. The impact of competition is derived from a dynamic panel specification that accounts for bank-level factors (size, efficiency, liquidity, and capitalization). Using the two-step system Generalized Method of Moments (GMM) estimates, our empirical results suggest that the increase in competition erodes banks' charter value and increases their tendency to assume additional risks with associated negative repercussions on financial stability. These results strongly support the competition-fragility hypothesis for UAE banks.

Keywords: Bank Competition, Bank Stability, Herfindahl–Hirschmann Index, UAE Banks
JEL Classification: G18, G21, G32, G38

RIASSUNTO

Concorrenza, concentrazione ed assunzione del rischio nel sistema bancario degli Emirati Arabi Uniti

Lo scopo di questo studio è analizzare l'impatto della concorrenza e della concentrazione sulla stabilità o sul comportamento *risk-taking* nel settore bancario degli Emirati Arabi Uniti nel periodo 2006-2015. L'indice Hirschmann-Herfindahl (HHI) è usato come misura inversa di competizione, mentre i prestiti inesigibili e gli indici Z-scores sono utilizzati come indicatori del rischio bancario. L'impatto della competizione deriva da una specificazione panel dinamica che tiene conto dei fattori bancari (dimensioni, efficienza, liquidità, capitalizzazione). Utilizzando le

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stime a due livelli del Generalized Method of Moments (GMM), i risultati empirici ottenuti suggeriscono che l'aumento della competitività erode l'attivo delle banche ed aumenta la loro tendenza ad assumere ulteriori rischi con conseguenti ripercussioni negative sulla stabilità finanziaria. Questi risultati supportano fortemente l'ipotesi che la competizione vada di pari passo con la fragilità nel sistema bancario degli Emirati Arabi Uniti.

1. INTRODUCTION

A substantial body of research has been intended to answering the question "*how does competition affect bank risk-taking?*". Most studies have examined this issue in samples of banks from developed countries, typically the United States and Europe. Nevertheless, more recently, several studies have extended their geographical scope and investigated the influence of competition on financial stability or risk-taking behavior in international samples covering banks from different countries. Examples of such studies are Levy-Yeyati and Micco (2007) and Kasman and Carvallo (2014) for Latin American countries, Agoraki *et al.* (2011) and Leroy and Lucotte (2017) for Eastern Europe countries, Berger *et al.* (2009), Turk-Ariss (2010) and Kabir and Worthington (2017) for a group of developing banking systems, and Soedarmono *et al.* (2011), Liu *et al.* (2013), Fu *et al.* (2014), and Noman *et al.* (2017) for Asian countries, Maghyereh and Awartani (2016) for a group of banks operating in the Gulf Cooperation Council (GCC) countries. A close look into these studies suggests a major observation. The country-level factors play a significant role in determining the relationship between competition and bank risk-taking behavior. In particular, the quantitatively and qualitatively nature of a country's regulatory framework and institution (the effectiveness of certain laws such as the protection of the intellectual property rights) affect the competition-stability relationship (Maghyereh and Awartani, 2016). Furthermore, it has been shown that banks behave differently under different institutional settings (e.g. see Haselmann and Wachtel, 2010; Bonin *et al.*, 2015), which implies that the results obtained for one country may not apply to other countries.

Over the last decade, the United Arab Emirates (UAE) have undertaken substantial reforms that aimed to encourage banks competition and stability. For instance, the Central Bank of the UAE (CBUAE)[1] has introduced a comprehensive and standardized risk assessment approach which

[1] The UAE is a federation of seven emirates: Abu Dhabi, Dubai, Sharjah, Ajman, Umm Al Qaiwain, Ras Al Khaimah and Fujairah. Under the Federal Law 10, all banks incorporated in the UAE are licensed by the central bank and all are

was implemented under Basel II in December 31, 2007. By 2006, the CBUAE has begun to open up the banking sector to greater competition after a long moratorium on licensing new banks. In 2008, the CBUAE opened the banking market for more participants by allowing several foreign banks to operate in the UAE to set up new branches. In November 2011, the CBUAE introduced the International Bank Account Numbers (IBAN) system for use by all bank customers in the country. During 2014, the CBUAE has improved and updated the Financial Stability Trend Index (FSTI) which measures risks to financial stability. At the beginning of 2015, the CBUAE introduced a new regulation framework in accordance with Basel III. The new regulatory framework is designed to prudential management of banks in terms of liquidity portfolio governance and risk management and practices of market risk, interest rate risk in the banking book, operational risk, and country and transfer risk.

The influence of competition on bank stability is debated. Although it may have a positive influence through financial depth, growth and efficiency, it could also lead to excessive risk taking activities and hence, it may end up unintentionally threatening financial stability. Therefore, it is important to investigate the competition-stability relationship in the evaluation of banking sector deregulation in the UAE, and this is the objective of the paper. In particular, our aim is to provide additional insights into the influence of market structure on bank risk-taking behavior and financial stability in UAE.

In this paper, we extended the existing literature and provide new evidence on relationship between competition and stability using data from the UAE commercial banks over the period 2006–2015. The sample period helps examine the association between banks' competition and risk taking in the light of the turbulent aftermath of the Global financial crisis. This period also allows identifying whether changes in the degree of bank competition have affected banks' risk behavior over time. To the best of our knowledge, this is one of few studies that investigate banking competition-risk taking relationship in a single banking sector. In view of the findings, we should be able to draw some policy implications that may be useful for bank management and policymakers in the UAE.

subject to the central bank's requirements and regulations. Therefore, banking regulations and licensing requirements are homogenous across the emirates.

In sum, the contributions of this paper are twofold. First: we added insights to the international evidence from a country that was not covered before. To the best of our knowledge competition-risk taking relationship was not tested in UAE banks. Second, the paper provided a direct examination of the potential effects of the 2007-2008 financial crises on the competition-risk taking relationship, which is noticeably ignored in recent literature.

The rest of the paper is organized as follows. Section 2 reviews briefly the recent literature on bank stability. We describe the data set, the explanatory variables and the methodology in Section 3. The empirical results are contained in section 4. Finally, section five includes some concluding remarks.

2. Literature review

The theoretical predictions on the relationship between competition and financial stability are unclear. Some arguments and country comparisons suggest that competition in the banking market leads to higher risk taking (see Allen and Gale, 2000, 2004; and Allen *et al.*, 2011). First, market power enhances profits which in turn build up reserves in the banking sector. These reserves protect banks against adverse shocks. Second, the high profits and the big reserves will reduce incentives for assuming excessive risks and hence, the chance of systemic banking distress is lower compared to a competitive market (see Boot and Greenbaum, 1993; Matutes and Vives, 2000). Third, the monitoring will be more efficient. Monitoring a few large banks in a concentrated system is more effective than observing many small banks in a diffuse banking system. The effective supervision will reduce the chance of systemic distress and will enhance financial stability.

At marked contrast to these, theoretical reasoning is that a more concentrated banking system is bad for financial stability. According to the competition-stability hypothesis, which has been developed more recently by Boyd and De Nicoló (2005), market power in the banking market induces borrowing firms to assume greater risks to cover the increased cost of borrowing. This raises the systemic risk in the whole banking market due to the increase in the chance of default. Similarly, the study by Caminal and Matutes (2002) found that market power increases systemic risk, through less credit rationing and larger and more concentrated lending. Other arguments have been provided by Mishkin (1999), who pointed out that in the case of a few large banks,

moral hazard is substantial and this raises systemic risk. According to Mishkin, the too big to fail argument that shape the public intervention decision in bailing out troubled firms will induce banks to take excessive risk and this increases financial instability. From the recent literature, the support for a reverse causality between competition and financial stability was provided by Boyd and De Nicoló (2005), Boyd *et al.* (2006), Schaeck *et al.* (2009), Schaeck and Cihák (2012), Liu *et al.* (2013), and Diallo (2015).

Until recently, most studies have focused on the US and EU banks (see Keeley, 1990; Demsetz *et al.*, 1996; Beck *et al.*, 2006, 2013; Uhde and Heimeshoff, 2009; Liu *et al.*, 2013; Fiordelisi and Mare, 2014; Leroy and Lucotte, 2017, among others). However, there was an increased attention to studying bank's risk following the East Asian and Latin American financial crises that occurred in the late of 1990s. For instance, Levy-Yeyati and Micco (2007) and Kasman and Carvallo (2014) have investigated systemic risk in Latin America. Agoraki *et al.* (2011) studied financial stability in Eastern Europe. Berger *et al.* (2009) and Turk-Ariss (2010) investigated financial stability in a group of developing banking systems. Similarly, Soedarmono *et al.* (2011), and Fu *et al.* (2014) studied stability in Asian countries. Maghyereh and Awartani (2016) investigated relationship between competition and financial stability in the GCC countries.

The results of these works are controversial. For instance a negative influence of competition on bank-risk taking has been recorded by Levy-Yeyati and Micco (2007), Berger *et al.* (2009), Turk-Ariss (2010), Agoraki *et al.* (2011), Soedarmono *et al.* (2011), and Maghyereh and Awartani (2016). Opposing evidence were the results of Boyd *et al.* (2006), De Nicolo and Loukoianova (2007), Schaeck *et al.* (2009), Liu *et al.* (2013), Fu *et al.* (2014), Diallo (2015), and Leroy and Lucotte (2017).

From above, we can observe that effect of competition and bank stability have been extensively examined for advanced countries (predominantly for the U.S. and Euro area). These studies showed that country-level factors play a significant role in determining the relationship between competition and bank risk-taking behavior. Furthermore, it has been shown that banks behave differently under different institutional settings (e.g. see Haselmann and Wachtel, 2010; Bonin *et al.*, 2012), which implies that the results obtained for a country may not apply to other countries.

3. METHODOLOGY AND DATA

3.1 The Empirical Model

In this paper, the impact of competition on stability of the UAE banking industry is investigated using dynamic panel data methodology. In model specification, we add lagged bank stability to control for persistence of banks' risk-taking behavior over time. The model is specified as follows:

$$Risk_{i,t} = \beta_0 + \beta_1 Risk_{i,t-1} + \beta_2 Competition_{i,t} + \beta_3 \mathrm{BS}_{\mathrm{i,j,t}} + \beta_4 \mathrm{EG}_{\mathrm{j,t}} + \beta_5 Crises + \varepsilon_{it},$$
$$\varepsilon_{\mathrm{it}} = \mathrm{v_i} + \mathrm{u_{it}}, \quad (1)$$

where i, t stand respectively for bank and time. $Risk_{\mathrm{i,t}}$ is the risk measure (i.e., NPL ratio or Z-score) and $Risk_{i.t-1}$ is the one-period lagged risk measure. $Competition_{i.t}$ is the bank measure of competition (i.e., The Herfindahl-Hirschman index) which varies with time and at the bank level. The Herfindahl-Hirschman index is used as an inverse measure of competition. $BS_{i,j,t}$ is a vector of bank specific variables: size, liquidity, cost efficiency, and capitalization. $\mathrm{EG_t}$ represents the economic growth measured by the annual real growth GDP *per capita*. $\mathrm{D_t}$ is a dummy variable that captures the influence of the recent global financial crisis. The disturbance term, ε, consists of a fixed effect $\mathrm{v_i}$, and an identically and independently distributed idiosyncratic error term, $\mathrm{u_{it}}$.

In above specifications, we used two different risk exposure indicators as dependent variables to proxy for bank stability: the nonperforming loans to total loans (NPL ratio, indicates the riskiness of the loan portfolio held by the bank), and the Z-score (an inverse measure of overall bank risk).

The Z- Score is defined as $\frac{\overline{\mathrm{ROA_i}}+\mathrm{CAP_i}}{\sigma_{\mathrm{ROAi}}}$, where $\overline{\mathrm{ROA_i}}$ and σ_{ROAi} are the average and the volatility of returns on assets and $\mathrm{CAP_i}$ is the equity ratio. A four-year rolling time window for the standard deviation of ROA is used to allow for time variation in the denominator of the Z-score.

We examined the impact of competition on bank stability using the Herfindahl-Hirschman index (HHI) as a proxy for concentration. The rationale behind using this measure is the belief that in concentrated markets banks benefit from low competitive pressure, which allowing them to exercise market power and thus earn monopolistic profit by e.g., offering lower deposit rates

and charging higher loan rates. Thus, competition could be measured by the inverse degree of concentration using the HHI index.

The HHI index is calculated by squaring the market share of each banks competing in the banking sector. The HHI index is expressed as follows:

$$HHI = \sum_{i=1}^{N} S_i^2 \,,\ \forall_i = 1, \ldots, N \tag{2}$$

where N is the total number of banks in the market. The HHI index ranges between 1/N (for equal-sized banks) and 1 for monopolies. According to current screening guidelines in the USA, the banking industry is regarded to be a competitive market if the HHI is less than 0.10, a HHI index between 0.01 and 0.1 belongs to un-concentrated market, a HHI index ranged from 0.1 to 0.18 indicates moderate concentration, while HHI index above 0.18 comes from highly concentrated banking sectors.

In line with the previous literature[2], we also controlled for four bank characteristics that may affect bank risk-taking: size, liquidity, cost efficiency, and capitalization. The natural logarithm of real total assets is used to represent bank size; the ratio of total cost to total income as a measure of cost efficiency; the ratio of liquid assets to total assets as measure of liquidity, and the equity to assets ratio for capitalization.

We include the annual growth GDP *per capita* to capture the macroeconomic conditions that are likely to affect banks' investment opportunities and their assets quality[3]. Finally, in order to investigate the impact of 2007–2008 financial crisis on competition-risk taking nexus, we used a dummy variable that takes a value of one for the years 2007–2008 and zero otherwise. A detailed description of these variables is included in Table 1.

To estimate (1), we used a two-step generalized method of moments approach[4]. This estimator is robust to any possible endogeneity by selecting the most appropriate instruments. A Sargan test indicated the validity of the used instruments, as we failed to reject the null of correct

[2] These variables were controlled for by Bath *et al.* (2004), Turk-Ariss (2010), Houston *et al.* (2010), Agoraki *et al.* (2011), Jeon *et al.* (2011), Beck *et al.* (2013), Nguyen *et al.* (2012), Tabak *et al.* (2012), Liu *et al.* (2013), Louzis *et al.* (2012), Soedarmono *et al.* (2011), Maghyereh and Awartani (2016), among many others.
[3] Higher economic growth improves the business environment and increases the capacity of the borrower to pay its debts and this contributes to reduce bad debts (nonperforming loans) which in turn raises the banks' asset quality.
[4] It is a system–GMM consistent estimator as in Arellano and Bover (1995), Blundell and Bond (1998).

specification. The diagnostic of the model also indicates that errors are not serially correlated. Thus, we conclude that the model used is appropriate to make inference and that the GMM generated estimates are consistent.

TABLE 1 - *Description of Variables and Sources*

Variable	Description	Source
Financial Stability		
Z-Score	The ratio of the sum of the means of ROA and equity capital to the standard deviation of ROA	Fitch-IBCA BankScope and authors' calculations
NPLs	Ratio of non- performing loans to total loans	Fitch-IBCA BankScope
Competition		
Herfindahl-Hirschman index	Squaring the market share of each banks competing in the banking sector	Authors' calculations
Bank-level Variables		
Bank Size	Logarithm of bank total assets	Fitch-IBCA BankScope
Cost Efficiency	Ratio of total cost to total income	Fitch-IBCA BankScope
Liquidity	Ratio of liquid assets to total assrts	Fitch-IBCA BankScope
Capitalization	Book value of equity to total assets	Fitch-IBCA BankScope
Country-level Variables		
Economic Growth	Annual growth real GDP *per capita*	IMF's International Financial Statistics (IFS)
Global Financial Crisis	Dummy variable takes on values of 1 for crisis years (2007–2008) and 0 otherwise	

Notes: This table details the definitions of variables used in our regression analysis.

3.2 Data Set and Summary Statistics

The sample is composed of annual observations that cover all commercial banks in UAE between 2006 and 2015[5]. The bank data set was obtained from *Bank Scope* database provided by *Fitch-*

[5] As of December 2015, the banking sector in the UAE was made up of 51 banks (23 local banks including eight Islamic banks and 28 foreign banks).

IBCA. The sample contains 24 banks (Appendix A contains a list of the sample banks considered in the analysis). The data for the annual real growth GDP *per capita* was collected from the IMF International Financial Statistics.

TABLE 2 - *Summary Statistics of the Regression Variables*

	Mean	St.Dev	Min	Max	Skewness	Kurtosis
Financial Stability						
Z-Score	2.5819	2.139	-1.58	12.520	1.4836	7.1254
NPLs	0.0680	0.0653	0.0001	0.3770	1.8730	7.0806
Competition						
Herfindahl-Hirschman index	0.0060	0.0118	3.91E-06	0.0715	2.7904	11.4587
Bank-level Variables						
Bank Size	7.5000	1.2205	3.0558	10.2070	-0.2177	3.1734
Cost Efficiency	0.3813	0.2897	0.0976	3.9399	9.8310	120.1123
Liquidity	0.2023	0.1127	0.0069	0.6859	1.6736	7.1987
Capitalization	0.1579	0.0528	0.0634	0.3342	0.8712	3.2578
Country-level Variables						
Annual growth real GDP *per capita*	-2.3313	6.7429	-15.1458	4.2928	-0.6376	1.9215

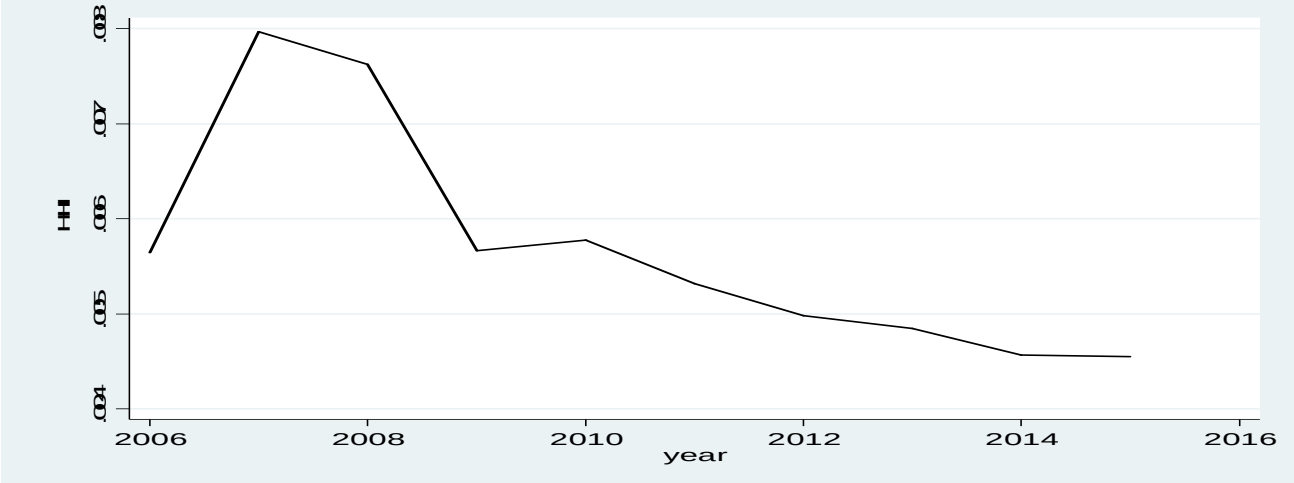
Notes: see Table 1 for detailed definition of each variable. Computed by authors using data from *Fitch-IBCA BankScope* and IMF's International Financial Statistics (IFS).

Table 2 presents the summary descriptive statistics for all our variables. The dependent variable, Z-Score, has a mean of 2.514%. The other risk variables, NPL has a mean of 6.4%. The relatively high ratio of non-performing loans points to the poor quality of underwritten loans in the UAE. This may be confirmed by the logarithm of the Z-Score, which indicates higher risk compared to developed, developing and transitional economies (see for example Casu and Girardone, 2009; Turk-Ariss 2010; Agoraki *et al.*, 2011; and Liu *et al.*, 2013). With the mean of 0.00564, the Herfindahl-Hirschman Index indicates that the UAE banking market is low concentrated and with relatively high competition. The values of the dependent and independent variables indicate that, in general, our data are skewed. To approximate normality, we transform all variables using the natural logarithmic transformation.

Figure 1 presents the time series graph of the HHI index. The figure shows that bank competition has improved over time. The figure also shows that the recent global financial crisis

led to a significant increase in the average HHI index during 2007-2008. Therefore, we can conclude that the level of competition in the UAE banking has undergone a significant decline during the recent financial crisis. The increased market concentration during the crisis can be explained by mergers and acquisitions among banks. The figure also clearly indicates that competition has increased during years 2009 and 2015. This was not surprising, given that UAE during this period has implemented significant financial reforms, which aimed at promoting financial markets and increasing competition (Maghyereh and Awartani, 2016).

FIGURE 1: *Development of HHI during 2006 -2015*



Source: own calculations.

The correlation matrix in Table 3 shows that the HHI index is positively correlated with the Z-Score and negatively correlated with NPLs. Thus, the preliminary investigation of simple correlations indicates that competition system is bad for financial stability. Less competition is associated with less credit losses, more solvent banks and hence, higher stability.

Note that except for the correlation between the Z-Score and the NPLs; all other cross correlations weak indicating that the chosen explanatory variable constitutes independent sources of information. It also indicates that inference on significant variables will not be contaminated by multicollinearity. Finally, the relatively high correlation between the Z-Score and the NPLs indicates that the two measures are good substitutes to proxy bank stability.

TABLE 3 - *Correlation Matrix of the Regression Variables*

	Z-Score	NPLs	HII	Bank Size	Cost Efficiency	Liquidity	Capitalization	Annual growth real GDP *per capita*
Z-Score	1.0000							
NPLs	-0.6128*** (0.0000)	1.0000						
HHI	0.2016*** (0.0037)	-0.2114*** (0.0108)	1.0000					
Bank Size	0.3133*** (0.0000)	-0.1562** (0.0250)	0.7000*** (0.0000)	1.0000				
Cost Efficiency	0.2670*** (0.0001)	-0.0329** (0.0415)	-0.0827** (0.0408)	0.0979 (0.1648)	1.0000			
Liquidity	0.0725 (0.3019)	0.0927 (0.1852)	-0.1308* (0.0610)	-0.3302*** (0.0000)	-0.0515 (0.4659)	1.0000		
Capitalization	0.0183** (0.0342)	-0.0285* (0.0840)	-0.3626*** (0.0000)	-0.4878*** (0.0000)	0.1904*** (0.0000)	0.1511** (0.0301)	1.0000	
Annual growth real GDP *per capita*	0.0637** (0.0364)	-0.2907*** (0.0000)	-0.0737 (0.2927)	0.0483 (0.4909)	0.0472 (0.5037)	0.0212 (0.7626)	0.0026 (0.9707)	1.0000

Note: P-values are in parentheses. The *, **, and *** denote statistical significance at the 10, 5, and 1% level, respectively.

4. EMPIRICAL RESULTS

Tables 4 presents the estimation results for equation (1) using the two-step system GMM of Arellano and Bover (1995) and Blundell and Bond (1998). In Model (1), we used the bank-level Z-Score, Model (2) contains the results when the NPLs is used to proxy bank stability, and in the both models we use HHI index as an inverse measure of competition. The independent variables were all lagged by one period to check their predictability. These models were estimated using 10 years of data for each of the 24 banks in the sample. Any potential endogeneity in the variables were accounted for by using lagged and first-differenced values of the same variables as instruments. As can be seen in Table 4, the Sargan test does not reject the null of suitable instruments and specification. Moreover, the lack of second-order serial correlation in the residuals provides further support for the models.

Column 1 in Table 4 shows that the coefficient of the lagged Z-Score is positive and statistically significant. This indicates that stability persists to a moderate extent. The result also shows that the parameter associated with the HHI index is statistically significant (at the 1% level) and has a positive effect on Z-Score. Thus, a greater concentration, measured by HHI index (i.e. higher

value signifies less competition) makes the UAE more stable, and unlikely to be insolvent in the future. We conclude that a low competition system is more likely to have a positive effect on UAE bank stability. As mentioned previously, our results are robust to the choice of the stability proxy. For example, in column 2 we used the nonperforming loans to total loans (NPLs) instead of the Z-Score to proxy bank stability. As can be seen the parameter associated with HHI index is negative and statistically significant. Thus, an increasing competition may induce banks to write bad loans in the credit market with significant repercussions on their stability.

Overall the above results suggest that an increase in bank competition has a negative impact on financial soundness. Thus, we may conclude that the competition-fragility hypothesis is more likely to prevail in the UAE banks (see Allen and Gale, 2000, 2004; Martinez-Miera and Repullo, 2010; and Allen *et al.*, 2011). This theory argues that an increase in competition erodes the franchise value of banks, and encourage them to take further risks with significant repercussions on financial stability. From the recent evidence, which are consistent with Berger *et al.* (2009) and Beck *et al.* (2012), of Turk-Ariss (2010), Jiménez *et al.* (2010), Agoraki *et al.* (2011), and Maghyereh and Awartani (2016) who found that competition is bad for the health of banks. The results also contradict earlier studies which found a positive influence of competition on bank-risk taking (see Boyd *et al.*, 2006; De Nicolo and Loukoianova, 2007; Schaeck *et al.*, 2009; Liu *et al.*, 2013; Fu *et al.*, 2014; and Diallo, 2015).

The influence of other controls was homogenous. For example, bank size is good for bank stability. This result is consistent with González (2005), Jiménez *et al.* (2010), Houston *et al.* (2010), and Agoraki *et al.* (2011). A possible explanation is that large banks are more diversified and more skilly managed compared to small banks, thereby they are more stable (Lehar, 2005). Furthermore, bank cost efficiency was positive and statistically significant on financial stability. Thus, the more efficient banks are, the more financially sound and less prone to both credit risk and overall risk. Moreover, the liquidity variable was positive and significant. Similarly was the impact of equity asset ratio, and hence, the more capitalized banks are, the less their tendency to assume risk and the higher the financial stability. Not surprisingly, annual growth GDP *per capita* was found to be good for promoting bank stability[6]. Finally, the global financial turmoil in

[6] We have also checked that basic results do not change when we use the annual percentage growth rate of real GDP to measure economic growth instead of the annual percentage growth rate of real *per capita*. To conserve space, the

2007-2008, which is represented by the dummy, has an instable effect on the UAE banking system.

TABLE 4 - *Competition and Financial Stability (Generalized Method of Moments)*

Explanatory variables	Model (1) *Natural logarithm of the Z-Score*	Model (2) *Natural logarithm of the NPL*
Dependent variable lagged	0.1229**	0.2637***
	(0.038)	(0.000)
Herfindahl-Hirschman index	0.3762***	-0.1544***
	(0.000)	(0.008)
Bank Size	4.9052***	-5.6746***
	(0.000)	(0.000)
Cost Efficiency	0.4816***	-0.3169**
	(0.002)	(0.016)
Liquidity	0.1300***	-0.1462**
	(0.003)	(0.017)
Capitalization	0.0387*	-0.2969
	(0.092)	(0.203)
Annual growth real GDP *per capita*	0.0271**	-0.0078**
	(0.045)	(0.021)
Global Financial Crisis	-0.1973***	0.4320***
	(0.000)	(0.000)
Constant	-8.6807***	4.6678***
	(0.000)	(0.000)
Wald test	1391.27***	2615.19***
	(0.000)	(0.000)
AR(1)	-0.7397	-2.5379**
	(0.4595)	(0.011)
AR(2)	-1.3677	0.8589
	(0.1714)	(0.390)
Sargan test	16.2767	17.2561
	(0.4338)	(0.369)

Note: Wald is a test statistics indicating goodness of fit of the regression, Sargan is a test statistics for overidentifying restrictions, AR(1) and AR(2) are tests statistics for first and second order autocorrelations, respectively. P-values are in parentheses. The *, **, and *** denote statistical significance at the 10, 5, and 1% level, respectively.

results are not reported in the paper but they are available from the author upon request. We thank the anonymous referee for raising this point.

In Tables 5 and 6, we analyze whether our results reported in Table 4 continue to hold when we use alternative regression techniques. In Table 5, we re-run our regressions using the ordinary least squares technique without lagged the Z-Score/or NPLs. The both specifications include time dummies, which control for time-invariant, and for a common time effects across banks.

TABLE 5 - *Competition and Financial Stability (OLS)*

Explanatory variables	Model (1) *Natural logarithm of the Z-Score*	Model (2) *Natural logarithm of the NPL*
Herfindahl-Hirschman index	0.2308***	-0.3107**
	(0.009)	(0.013)
Bank Size	0.999**	-4.1551*
	(0.035)	(0.071)
Cost Efficiency	0.7412***	-0.7748***
	(0.000)	(0.000)
Liquidity	0.1288	-0.0324
	(0.159)	(0.792)
Capitalization	0.6574***	-0.1161*
	(0.001)	(0.066)
Annual growth real GDP *per capita*	0.0072**	-0.0113*
	(0.014)	(0.054)
Global Financial Crisis	-0.1650**	0.2414**
	(0.024)	(0.013)
Constant	2.2660	-6.7534**
	(0.213)	(0.010)
Adjusted R^2	0.329	0.232
F-test statistics	14.52***	9.27***
	(0.000)	(0.000)

Note: P-values are in parentheses. The *, **, and *** denote statistical significance at the 10, 5, and 1% level, respectively.

Consistent with what is reported in Table 4, we continue to find that the *HHI* index is positively and significantly associated with Z-Score, and negatively ~~positively~~ and significantly associated with NPLs. Additionally, in Table 6 we present results based on the fixed effects method. This estimation technique ~~of~~ controls for unobserved firm heterogeneity (individual differences). Our findings support our earlier statement that found that competition is bad for the health of banks. Overall, the use of ordinary least squares and fixed effects method has reinforced our previous findings.

TABLE 6 - *Competition and Financial Stability (Fixed Effects)*

Explanatory variables	Model (1) *Natural logarithm of the Z-Score*	Model (2) *Natural logarithm of the NPL*
Herfindahl-Hirschman index	0.2745**	-0.5718***
	(0.046)	(0.000)
Bank Size	1.7137**	-6.6738***
	(0.049)	(0.000)
Cost Efficiency	1.2917***	-1.0534***
	(0.000)	(0.000)
Liquidity	0.0253	-0.0590
	(0.786)	(0.601)
Capitalization	0.3987*	-0.3070
	(0.075)	(0.389)
Annual growth real GDP *per capita*	0.0111***	-0.0093**
	(0.001)	(0.016)
Global Financial Crisis	-0.1833***	0.2527***
	(0.000)	(0.000)
Constant	2.5071*	-9.7120***
	(0.065)	(0.000)
Adjusted R^2	0.375	0.220
F-test statistics	7.470***	20.860***
	(0.000)	(0.000)

Note: P-values are in parentheses. The *, **, and *** denote statistical significance at the 10, 5, and 1% level, respectively.

5. CONCLUSIONS

This paper contributes to the existing literature by investigating the impact of competition and concentration on bank stability or risk-taking behavior in the UAE banking industry over the period 2006- 2015. The Herfindahl–Hirschmann Index (HHI) is used as a proxy for competition, while the nonperforming loans (NPL) ratio and Z-scores are used as proxies for bank risk-taking. The paper also considers whether the 2008-2009 financial crisis has changed the direction of the relation between competition and risk-taking behavior of the UAE banking industry.

Our empirical results suggest that the increase in competition erodes banks' charter value and increases their tendency to assume additional risks with associated negative repercussions on financial stability. Moreover, while the primary focus of the paper is the competition-stability nexus, we also derive some other interesting results. For instance, we found that larger, more capitalized and more liquid banks are relatively more stable.

This study provides important policy implications for regulators and supervisors. The evidence of the negative association between bank competition and bank stability indicates that fueling competition may have adverse unintended consequences on bank stability, especially if it is not accompanied by appropriate level of regulations. Thus, to reap the benefits of bank competition, appropriate attention needs to be paid to banking regulations. Specifically, any attempt to improve the competitive environment should be associated with strengthening regulations and supervision to ensure an eventual correction of the negative consequences of competition on stability.

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APPENDIX A

List of sample banks

Emirates NBD PJSC	National Bank of Fujairah
National Bank of Abu Dhabi	Commercial Bank International P.S.C.
Abu Dhabi Commercial Bank	United Arab Bank PJSC
First Gulf Bank	Ajman Bank
Mashreq Bank	Al Khaliji France
Union National Bank	National Bank of Oman
Commercial Bank of Dubai P.S.C.	National Bank of Bahrain
Bank of Sharjah	Al Ahli Bank of Kuwait
Dubai Bank PJSC	United Bank Limited
National Bank of Ras Al-Khaimah	Barclays Bank
National Bank of Umm Al-Qaiwain	BNP Paribas Bank
Al Masraf	Lloyds Bank TSB