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Stability of Conventional and Islamic banks, externalities and resilience to crises: evidences from comprehensive Saudi banks' time-series data

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Abstract

There is a number of theoretical reasons that suggest that Islamic banks (hereafter, IBs) are more stable and financially more resilient than Conventional banks (hereafter, CBs) during times of crises. Hence, their presence in a mixed banking system should improve the stability of the banking system as a whole. This paper aimed at testing this conjecture by focusing on the Saudi banking context. It employed a comprehensive sample covering all IBs and CBs belonging to the Saudi banking system, and a long quarterly time-series financial data covering the 2007-2018 period. By employing the z-score index as a measure of bank's stability, the statistic and econometric exercises showed that: i) IBs, whether Large or Small, are significantly more stable than CBs. ii) IBs exert positive externalities on CBs' stability. iii) Some banks specifics, sectorial and macroeconomic factors are found to be significantly related to banks' stability. iv) IBs are found to significantly better resist than CBs to the GFC of 2008/09. v) The 2014/16 crisis did not affect stability of both IBs and CBs, which suggests that soundness of the entire Saudi banking system improved after the GFC crisis. vi) Finally, the econometric exercise supports the distinction between Large and Small banks when analyzing their stability factors.

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1. Introduction

The Global Financial Crisis (hereafter, GFC) of 2008/09 amplified the interest for Islamic finance within the community of academics as well as national and international financial operators. As it is argued by Khan, (1986), Chapra (1990) and Zaman and Movassaghi (2002), Islamic Banking is one medium that has the potential to reduce the endemic risk exposure associated with financial transactions and can, therefore, successfully fill the failure of Conventional banks (hereafter, CBs) in maintaining financial stability. In fact, Islamic Banking, with its Islamic-derived principles, abolishes payment and receipt of interest "*Riba*", as well as complex derivatives and speculative activities "*Gharar*" (i.e., hazardous transactions), which are considered prime factors of instability within the Conventional financial system. The Islamic banking system can be regarded as an equity-based, rather than an interest-based intermediation system, in which investment funds are separated from current deposits. In this Islamic system, banking products are assets-backed, current deposits are fully guaranteed while the investment deposits yield returns upon the PLS (Profit-Loss-Sharing), and markup principles. Accordingly, there is a mainstream opinion along which, Islamic Banks (hereafter, IBs) should be more stable than CBs and more resilient during times of market distress, and are likely to maintain financial stability of the whole banking system.

Nonetheless, another opinion identifies some vulnerabilities in Islamic banking and therefore, argues that IBs are not necessary more sound and more stable than their Conventional peers. The most important vulnerabilities stem from the fact that: i) the PLS rule can generate a higher credit-risk to IBs comparing to CBs (Sechafia and Abduh, 2014; Effendi and Yuniarti, 2018); ii) the principle of assets-backed financing instruments can expose IBs to a potential liquidity-management-risk (Akhtar, Ali and Sadaqat, 2011; Djelassi and Boukhatem, 2019); and iii) IBs are also found to have higher management-risk related to monitoring, reporting, and mitigation (Eid and Asutay, 2019). As it is argued in Hachicha and Ben Amar (2015) and Ben Mimoun (2019), it seems that in practice and all over the world, IBs are relying much more on mark-up-based financing (*Mudayana* contracts) rather than on PLS-based financing (*Musharaka* contracts), and this can be interpreted as a choice seeking to minimize the whole risks mentioned above.

This paper aims to contribute to the existing literature on the stability and resilience of IBs and CBs by focusing on the Saudi banking system, one of the largest holders of IBs' assets worldwide[1]. Special attention is paid to the following questions: i) whether Saudi IBs are more stable than their Conventional counterparts; ii) whether the two institutions have different risk-profiles; iii) whether Islamic banking development exerts positive externalities effects on the CBs' financial stability; and iv) whether IBs were financially more resilient during the past two crises (the GFC of 2008/09 and the real crisis[2] of 2014/16), which hit the Saudi economy.

Contrarily to most existing studies in this field, the present study relies on a quarterly-frequency data-series and not annual, covering a quite long period from 2007:q1 to 2018:q4 (48 observations). It also relies on a comprehensive sample of banks including all banks operating in the Saudi banking system (4 IBs and 8 CBs). In addition, this study sheds light on the comparative reactions of banks not only during GFC, but also during the crisis of 2014/16 that recently hit the Saudi economy. It also takes into account the

[1] According to the Islamic Financial services Industry Stability Report 2019, the highest share of Global Islamic Banking Assets in 2018:q2, was in Iran (32.1%), followed by Saudi Arabia (20.2%), Malaysia (10.8%), the UAE (9.8%), Kuwait (6.3%), Qatar (6.2%), and Turkey (2.6%).

[2] This second crisis is of a real nature in the sense that it started with a significant oil price fall at the start of 2014 (from $105 in 2014:q2 to only $37 in 2015:q4 and $53 in 2016:q4), which had a direct impact on the country's economic growth as it can be seen in Figure 2A, in the Appendices.

potential effects of some additional macroeconomic factors which have been previously neglected.

The rest of this paper is organized as follows. Section 2 provides a critical literature review on some relevant studies shedding light on IBs and CBs' comparative financial stability, the IBs' externalities effect, and the relative resilience of the two institutions to shocks. Section 3 presents the banks' financial stability model. Section 4, describes the data and its evolution in the Saudi context. Section 5 conducts the econometric analysis. Finally, Section 6 concludes the study.

2. A critical literature review on IBs and CBs' financial stability

As it is stressed above, there is a significant body of theoretical literature establishing the supremacy of the IBs over the CBs in terms of financial stability. Furthermore, as explained by Khalid Rahman (2009), Islamic banking is viewed as a stabilizing factor not only for IBs but for the banking system as a whole, because Islamic finance curbs speculative activities and prohibits all short-term dealings that cause chaos and panic in financial markets, exchange markets and commodities. It is also assumed that, by better controlling the expansion of loans through linking financing to real assets, Islamic banking actively contributes to resorbing inflation, which is harmful for the banks' stability. The study by Nabi (2012) showed the positive impact of the presence of IBs in a specific region on the stability of CBs, and that the strategy of diversifying the assets of IBs across the regions in which they operate, reduces the instability across CBs. By investing in assets in some sectors (and not by providing them with credit), IBs reduce the possibility of the assets' prices deterioration and the Return-on-Assets fluctuation when the sectors are exposed to unexpected shocks. This, in turn, supports the financial stability of CBs that finance the same assets in these sectors.

Nonetheless, some recent studies relativize the conjecture of the supremacy of IBs in terms of stability and their ability to contribute to the stability of the entire banking system. They put attention on some inherent vulnerabilities associated to the Islamic banking activities, namely their higher potential exposure to credit-risk, liquidity- management-risk, and management-risk related to monitoring, reporting, and mitigation. Such risks tend to weaken IBs' soundness and make them vulnerable in periods of crises quite like CBs.

The existing empirical literature shows that whether IBs are inherently more stable than CBs, whether their presence is associated with positive externalities in terms of financial stability, and whether they adjust better than CBs in periods of crises, are purely empirical issues for which, the answers depend upon the considered country (or the sample of countries) and chosen time-range. A recent study by Hassan and Aliyu (2018) reviews most relevant empirical studies on Islamic banking and concentrates on their main findings with regard to their comparable performances to their conventional counterparts. The study of Čihák and Hesse (2010) was the first one to compare financial stability of these two types of banks, while the one of Hasan and Dridi (2011) was the first to empirically compare their resilience to GFC shocks. Čihák and Hesse (2010)'s findings are (i) small IBs tend to be financially stronger than small CBs; (ii) large CBs tend to be financially stronger than large IBs; and (iii) small IBs tend to be financially stronger than large IBs. Abedifar et *al.* (2011) showed that small IBs have lower credit risk and insolvency risk than CBs. Hasan and Dridi (2011) found that on average, IBs better resist during the 2008-2009 GFC than their Conventional counterparts in 8 countries including the Gulf Cooperation Council (GCC) region. By contrast, the study by Bourkhis and Nabi (2013) found no significant difference in terms of the effect of the GFC on the soundness of these two banks groups. Beck et *al.* (2013) used data on 22 countries from 1995-2009 that included 510 banks, 88 of which are IBs, and showed that IBs are less cost-effective but have a higher intermediation ratio and higher asset quality.

They are also both better capitalized and less likely to disintermediate during crisis periods. Such result is also in accordance with the study of Farooq and Zaheer (2015) which showed, that IBs branches in Pakistan are not prone to withdrawals and also tend to attract deposits, as well as granting more loans during the crisis. Therefore, IBs are found to contribute in enhancing banking stability.

Mat Rahim and Zakaria (2013) compared the z-scores for a range of IBs and CBs in Malaysia and found that, IBs are relatively more stable than their conventional peers. Pappas et *al*. (2017) showed, on the basis of a sample of 421 banks in 20 Middle and Far Eastern countries from 1995 to 2010, that IBs have a significantly lower risk of failure than that of their conventional peers. A comparable survival analysis is conducted by Aliyu and Yusof (2017) on 170 IBs of 24 countries over the 1987–2014 period. The results confirm that IBs can survive longer during risk time exposure. On the contrary, Alandejani et *al.* (2017) found opposite results in the context of 56 Islamic and conventional banks in the GCC countries and the 1995–2011 period. The results indicate that IBs have a higher incidence rate of failure and therefore a shorter survival time than CBs. The recent study by Alqahtani and Mayes (2018) covers also banks in the GCC region and over the 2000–2013 period, and finds that the difference between the two banking types was initially not significant during the GFC. However, when the financial shock spread to the real economy during the later phases of the crisis, IBs suffered a significantly higher level of financial instability than CBs. However, this result holds true for large IBs only. Small IBs demonstrated a relatively better handling of the economic downturn than large IBs, supporting the finding shown first by Cihak and Hesse (2010). Another interesting study on the GCC region is the one of Mseddi and Benlagha (2017) who used the daily return data for IBs and CBs for the period 2005-2015 to assess the impact of the GFC on spillovers between the bank sectors in terms of both returns and volatility time series. The study relied on a dynamic conditional multivariate GARCH model, and found a strong bidirectional returns spillover between CBs but a very weak spillover from IBs to CBs. Hence IBs contribute to overall banking stability through reducing the transmission of shocks from IBs to CBs. Ghassan and Guendouz (2019) focused on the Saudi banking system. They used quarterly data of 2 IBs and 4 CBs over the 2005-2011 period. They found that IBs are less stable than CBs and that the modest presence of IBs in the Saudi banking sector does not qualify them to significantly improve banking stability. Although this paper provides some interesting, but discussable results, its main insufficiency stems from its reliance on a very limited number of observations, which should lead taking its results with some caution. Our paper reconsiders the Saudi banks' experience and finds new results with regard to the issues addressed above on the basis of a larger dataset.

3. Bank's stability model

We use the z-score measure to evaluate banks' financial stability as it is the case in a vast body of empirical literature of this field[3]. Mathematical construction of the z- score is presented in the Appendices. It is inversely related to the probability of banks insolvency. As it is underlined in the literature of this field, the z-score index is influenced

[3] In this literature, the z-score index is used to measure the number of standard deviations a bank's return realization has to fall in order to deplete equity and the bank becomes insolvent. An increase of the z-score is equivalent to a decrease of the insolvency risk. The *z*-score offers several advantages over other measures of financial stability, such as Value-at-Risk and stress tests. First, it is not affected by the nature of the bank's activities as stressed in Čihák and Hesse (2010) showing that it can be applied to banks that use accounting methods specific to the Islamic banking sector. Second, it measures insolvency risk, whereas other methods signal liquidity problems.

by some internal factors specific to the banks, sectorial, and Macroeconomic factors. We consider the following model, which is in accordance with this conjecture.

$$z_{it} = \alpha + \beta A_{it} + \gamma IB_i + \delta S_t + \rho M_t + [\mu_1(IB_i * SIB_t) + \omega_1(CB_i * SIB_t)] + [\mu_2(IB_i * crisis1) + \omega_2(CB_i * crisis1)] + [\mu_3(IB_i * crisis2) + \omega_3(CB_i * crisis2)] + v_i + \epsilon_{it} \quad (1)$$

where z represents the z-score index (in logarithm); the subscript i stands for banks consisting of IBs and CBs; and t represents time. In the z-equation, $A_{i,t}$ is a vector of banks' specific explanatory factors reflecting the well-known CAMEL rating system, which covers some main areas of financial soundness including Capital adequacy, Asset quality, Management efficiency, Earning and Liquidity, and which have been partly or fully used in the past empirical studies. These banks' internal factors are represented in this study by these variables: the total assets (*TA*), the loans (or financing for IBs) -to- assets ratio (*LA*), the operating costs-to-income ratio (*CI*).

IB_i is a dummy-variable taking the value of one if the bank is an IB, and zero otherwise. It is included to assess whether the stability of IBs is higher relatively to that of the CBs. S_t is a vector containing time-varying sectorial-specific variables. Two variables are considered in this vector: the share of Islamic banking (*SIB*) -i.e., the ratio of IBs' financing to total financing of the banking sector, which captures the externalities effect related to Islamic Banking; and the Herfindahl-Hirschman Index (*HHI*)[4], which is a measure of market concentration degree. It is expected that higher banking sector concentration be associated with lower banks' financial stability. M_t is a vector of macroeconomic variables. Four variables are considered: the real GDP growth rate (*Ggdpr*), the oil-price growth rate (*GOil*p), the inflation rate (*INF*), and the real exchange rate depreciation (*EXCH_DEP*).

The model also includes some interactive dummy-variables. The first set includes two interaction-variables between the *SIB* variable and the banks' types dummy variables (i.e., CBs and IBs). These interactions are useful to test if the financial stability of CBs and IBs are differently affected by the externalities effect associated with the *SIB*. The second set of interactions is between the *crisis1* dummy variable (which takes the value of 1 if the quarter *t* belongs to the 2008:q1-2009:q4 period), and the banks' types dummy variables (i.e., CBs and IBs). The last set of interactions is between the *crisis2* period dummy- variable (which takes the value of 1 if the quarter *t* belongs to the 2014:q1-2016:q4 period), and the banks' types dummy variables. The last two interaction variables are introduced in the model to analyze how IBs and CBs have been affected during the two considered crises in terms of their financial stability. Finally, in the model, the parameters v_i and ϵ_{it} represent the bank's specific-effect and the error term, respectively.

4. Data: description and evolution

The Saudi banking system is an interesting example of a mixed-banking system in the sense that some 8 CBs operate side by side with 4 full-fledged IBs[5]. We use banks' financial data from their financial quarterly reports[6] over the period[7] ranging from 2007:q1 to 2018:q4, in order to construct their z-score indexes and some needed specific variables.

[4] The HHI is calculated as the sum of squared market shares in terms of total assets of all the banks in a given time t. Values range between 0 for the least concentrated market and 10000 for the highest concentrated one.

[5] Parallel to these full-fledged IBs, some CBs as well, claim to offer Islamic-compliant financing through their "Islamic Windows". In our study, we do not consider these IWs for data (non)-availability reason.

[6] Source: https://www.argaam.com/ar/company/financial-pdf

[7] The starting period (2007:q1) reflects difficulties to obtain published data before this time particularly, for IBs.

These banks are listed in Table 2A, in the Appendix. Table I, below, provides a pairwise comparison of banks' z-scores and the values of some internal factors, as described in Model (1). The "*t-test*", indicates a significant difference in the mean of the z-scores between CBs and IBs over the entire study period. More precisely, mean z-score is lower in CBs than in IBs at a 1% significance level (5,32 vs 5,60 in Natural logarithm). Thus, IBs are –in the whole- more stable than CBs. Distinguishing banks by their size (*Large* and *Small* banks)[8] reveals that *Small* IBs are significantly more stable than *Small* CBs. Although *Large* IBs are also more stable than *Large* CBs, this difference is non-significant as shown by the *t-test*. In terms of their size, IBs are, on average, significantly smaller than CBs as it is ascertained by the Assets value (102 billion SR against 165 Billion). Meanwhile, IBs are better capitalized than CBs as it is illustrated by Equity to Assets ratio (19,7% against 13,7%). But, IBs have higher operating Costs- to-Income ratios than CBs (62,4% against 47,4%), which may reflect challenges of management efficiency in IBs. They also have lower Loans to Assets ratios than their Conventional counterparts (67,8% against 70,1%).

Table I: z-score and specific banks' data: pairwise comparisons

	CBs					IBs					Diff = (Mean CBs-Mean IBs)	
	N	**Mean**	**Std**	**Min**	**Max**	**N**	**Mean**	**Std**	**Min**	**Max**	**Sign**	**Prob**
z-score (Natural. log)												
All banks	376	5,323	0,911	2,751	7,732	184	5,603	1,048	3,153	7,555	< 0	p (T < t) = 0,001
Large banks	233	5,422	0,843	3,724	7,732	48	5,570	0,910	3,538	7,388	< 0	p (T < t) = 0,138
Small banks	143	5,142	1,003	2,751	7,468	136	5,614	1,096	3,153	7,555	< 0	p (T < t) = 0,001
Assets (Billion SR)	376	165	93,2	39,9	477	184	102	100	11,3	365	> 0	p (T > t) = 0,000
Equity/Assets Ratio (%)	376	13,76	2,44	7,98	19,63	184	19,70	14,98	9,08	95,75	< 0	p (T < t) = 0,000
Loans/Assets Ratio (%)	376	70,08	12,6	42,59	100	184	67,82	14,9	1,85	89,36	> 0	p (T > t) = 0,039
Cost/Income Ratio (%)	376	47,38	16,4	23,69	185,1	184	62,40	21,64	19,34	191,1	< 0	p (T < t) = 0,000
Return On Assets (%)	376	0,483	0,17	-0,743	1,050	184	0,479	0,348	-0,398	1,863	> 0	p (T > t) = 0,454

Note: The sample of CBs is composed of N=376 observations and not 384 (=48*8) because data for NCB is unavailable for 2007 and 2008 years (8 obs). The sample of IBs contains N=184 and not 192 (=48*4) because ALINMA bank began to publish its data quarterly only since 2009:q1 (8 missing obs).

All these banks' specifics come out significantly different across the two types of banks. Nonetheless, there is no significant difference in the profitability ratio (Returns on Assets) between the two types of banks, as shown by the *t-test*. Of interest is to examine how banks financial stability has evolved during the studied period, and particularly during and outside the 2008-2009 and 2014-2016 crises that hit the Saudi economy. Figures 1A and 1B in the Appendices, show the individual evolution of the z-scores for CBs and IBs, respectively. Figure1, below, shows the evolution of the mean-z-score values for CBs and IBs, separately, during different sub-phases, while Table2, below, presents the results of the mean comparison *t-tests*.

Figure1 reveals that, in all sub-periods, IBs were, on average, more stable than their Conventional counterparts. Both versions of the *t-test* carried out in Table II, provide qualitatively the same results. There is evidence that CBs' mean z-score is significantly lower in the GFC of 2008-2009 (crisis1) relatively to the pre-crisis1 period. There is, however, no evidence that IBs have experienced the same fate, which is a result

[8] The classification criterion is the bank's Total asset. A bank *i* at a given period *t* is classified as being a "Large bank" if its Total assets exceed the median Total asset in that period; otherwise, it is considered as a "Small bank".

supporting their resilience in the GFC. In the post-crisis1 sub-period, both banks groups have been significantly better off in terms of financial stability, which is an indication of better soundness of the overall Saudi banking system. As indicated by the *t-tests*, the crisis2 of 2014-2016 did not seem to exert significant impact on mean z-scores of both banks groups, relatively to the previous sub-period. As the crisis2 has passed, the stability index has significantly improved for both IBs and CBs, as ascertained by the *t-tests* probability-values. The econometric exercise conducted hereafter is useful to assess whether the crisis1 and crisis2 have had significant effects on banks' stability after controlling for the rest of the sub-periods and determinants of banks' stability; and whether these effects are of similar nature across the two banks groups.

Figure 1: Evolution of banks' mean z-scores (in log) during and outside crises

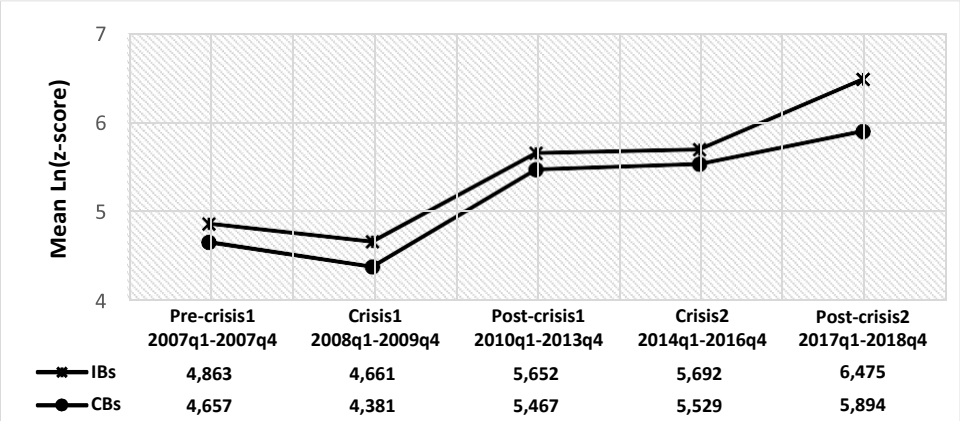

Table II: Mean comparison *t-tests* for Ln(z-score)

Mean Ln(z-score)		Mean comparison t-test (1) p (T < t)		Mean comparison t-test (2) p (T < t)	
	Sign	CBs	IBs	CBs	IBs
Diff = (Crisis1 - Pre-crisis1)	< 0	0.0476**	0.2540	0.0740*	0.2447
Diff = (Crisis1 - Post-crisis1)	< 0	0.0000***	0.0000***	0.0000***	0.0000***
Diff = (Crisis2 - Post-crisis1)	< 0	0.7696	0.5825	0.7625	0.5777
Diff = (Crisis2 - Post-crisis2)	< 0	0.0046***	0.0004***	0.0042***	0.0001***

Notes: (1) and (2) stand, respectively, for equal and unequal variances between the two periods considered as options in the t-test. *, ** and *** stand for p<0.1, p<0.05 and p<0.01, respectively.

As for the evolution of the sectorial and macroeconomic context in Saudi Arabia during the period of study, one can refer to the Figure 2A in the Appendices, which depicts the trends of the variables which are considered in the banks' z-scores model. The summary statistics of these variables are provided in Table 3A, in the appendices.

5. Econometric regressions and results

As a preliminary step in the regression of model (1), we check the stationarity of the variables to be used in the regression (Table 4A in the Appendices). The Im-Pesaran-Shin (IPS) (2003) panel unit-root test and the Fisher-type unit root test[9] indicate that all the

[9] Some other well-known panel unit-root tests are available such that the Levin, Lin and Chu (LLC) (2002) test, the Harris-Tzavalis (1999) test, the Hadri (1999) test and The Breitung (2000) test. However, there are two major limitations of these tests relatively to the IPS and Fisher-type tests: their reliance on the

variables are stationary except for the *LTA* (=Ln *TA*) variable, which is I(1). Therefore, the *LTA* variable will be used in its first difference form while all the other explanatory variables are employed in-level in the regressions. In these regressions, standard tests are performed: significance tests of specific-effects (Fisher test or Breusch and Pagan (1980)'s LM test, for respectively fixed and random specific effects) and their fixed or random nature (Hausman, 1978), tests of potential serial correlation and heteroskedasticity (Wooldridge, 2002 and Modified Wald tests, respectively). Taking these tests into consideration, we provide the estimation results of the z-score model in Table 1A in the Appendices, based on Feasible Generalized Least Squares (FGLS). The FGLS estimations allow fitting random-effects models while controlling for serial correlation and heteroskedasticity issues. From Table 1A, in the Appendices, simple correlations coefficients across explanatory variables are low, suggesting the absence of potential multicollinearity issue when putting these variables together in a single equation.

The results are presented for the three samples: "*All banks*", "*Large banks*" and "*Small banks*", to test whether the considered determinants of financial stability affect differently *Large* and *Small* banks[10]. In addition, by fitting the model on the three samples, the robustness of the explanatory variables to sample changes, is verified. We regress five specifications for each sample, which allows us to assess the robustness of the explanatory variables to specification changes. Overall, the results are satisfactory and in accordance with the study's expectations. As for the banks' specifics, the assets (*LTA*) growth rate, the costs to operating income ratio (*LCI*) and the *IB*-type dummy variable, all are strongly significant and robust in all the specifications and for all the samples. The faster the bank grows in size, the more vulnerable this bank is, whether large or small. This result is in line with some previous studies, such as Čihák and Hesse (2010), suggesting that a rapid trend of assets extension may weaken banks' financial soundness, a result in support of the existence of an optimal banks' size. Banks get also less stable financially as their operation costs to income ratio raise[11]. Meanwhile, IBs are more stable than their peers as indicated by the positive and significant coefficient of the IB dummy variable. In *Large banks*-group, the IB dummy is positive but significant at 10% only, while it is significantly positive at 1% and 5% in the *Small banks*-group specifications. Thus, *Small* IBs are more financially stable than *Small* CBs, while *Large* IBs group (RAJHI bank) is slightly more stable than *Large* CBs group[12]. Looking at the individual cross effects presented in Table 6A of the Appendices, ALINMA bank has the highest positive impact on z-score compared to the SAUDI-FRANSI bank (a large CB), followed consecutively by ALBILED, RAJHI and JAZIRA banks. The effect of Loans to Assets ratio (*LLA*) comes out insignificant in all specifications and in all samples.

As for the sectorial variables, the estimation results show that the coefficient on the interaction between *SIB* and the CB-dummy variable comes out positive and strongly significant, particularly for the *Small banks*-group. This is evidence in support of the positive externalities-effect hypothesis associated with IBs' financing model. Overall, market concentration index (*HHI*) is not robust to changes to specifications and samples.

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assumption that all panels have the same value of rho, and their requirement that the data be strongly balanced, which is not the case for our data.

[10] A test of Chow (1960) is carried out to check the stability of the estimations across the different samples. The test supports the distinction between *Large* and *Small* banks when analyzing their stability factors, rather than considering them as belonging to a unique and homogenous group.

[11] This result contrasts with the one of Ghassan and Guendouz (2019) showing insignificant effect of the operation costs to income ratio on Saudi banks' stability.

[12] This result contrasts, once again, with the finding of Ghassan and Guendouz (2019) showing that CBs are more stable than IBs.

Among the macroeconomic determinants, Inflation (*INF*) and Exchange depreciation rate (*EXCH_DEP*) come out as the most robust and significant determinants of banks' stability. The *crisis0809* period has affected differently IBs and CBs' financial stability. More precisely, all CBs whether *Large* or *Small*, have experienced a significant decline in their z-score levels as it is indicated by the highly negative and significant coefficient on the interaction variable (crisis0809*CB) in all the specifications. *Large* IBs have also experienced a significant reduction of their stability. By contrast, *Small* IBs have been relatively safe from the effects of that crisis. This result is evidence of a stronger resilience to the GFC of IBs group compared to CBs, on one side, and a stronger resilience of *Small* IBs relatively to *Large* IBs, on the other side.

As for the *crisis1416*, neither IBs nor CBs have been affected during this crisis period in terms of financial stability, which tends to confirm the resilience of the banking system in the whole during this second crisis period. Such result is coherent with the highly positive assessment outcomes issued by the Basel Committee on Banking Supervision for Saudi Arabia, both in 2015 and 2018, with regard to its implementation of the Basle rules[13].

6. Conclusions and policy implications

This paper aimed at testing the conjecture that IBs are more stable and financially more resilient than their conventional peers during times of financial distress by focusing on the Saudi banking context. It employed a relatively long quarterly time-series financial data over the 2007-2018 period of all IBs and CBs belonging to the Saudi banking system. The "mean-comparison t-tests" of the z-score indexes showed that IBs are significantly more stable than CBs over the entire study period as well as during and outside the two crises periods of 2008/09 and 2014/16. Moreover, *Small* IBs are significantly more stable than Small CBs, while *Large* IBs-group is slightly more stable than *Large* CBs. By regressing a z-score model that uses banks' specifics, sectorial and macroeconomic factors as explanatory variables, the findings confirm the supremacy of IBs over CBs in terms of financial stability. Banks's size growth and the costs to income ratio are robust factors, negatively and significantly related to banks' stability. Furthermore, the higher is the Share of Islamic Banking (*SIB*), the more stable will be the banking system. This result with the one of differences in stability of IBs and CBs (and also small and big size banks) should be attributed to the special Islamic-derived principles namely abolition of "*Riba*", avoidance of "*Gharar*", equity-based features, asset-back products, and PLS system, that may affect the risk-return perspectives of the respective banking systems. This suggests that banking system stability may improve as a result of additional national monetary- authorities' efforts, to enhance the presence of IBs and their activities.

On the macroeconomic side, inflation (*INF*) and exchange depreciation rate (*EXCH_DEP*) are the most significant factors that explain the banks' risk profiles. The results also provide evidence of a stronger resilience to the GFC of IBs compared to CBs on one side, and a stronger resilience of *Small* IBs relatively to *Large* IBs, on the other side. As for the *crisis1416*, the estimation results tend to confirm that, overall, neither IBs nor CBs have been affected in this crisis period, which tends to prove the resilience of the banking system during this second crisis period and its better soundness after the GFC period. Finally, our econometric exercise supports the distinction between *Large* and *Small* banks when analyzing their stability factors, rather than considering them as belonging to a unique and homogenous group.

[13] https://www.bis.org/press/p150930.htm for the 2015 report, and https://www.bis.org/press/p180927.htm for the 2018 report.

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Appendices

Table 1A: FGLS regression results of the z-score model (dependent variable: Ln(z-score))

VARIABLES	All banks					Large banks					Small banks				
	[1]	[2]	[3]	[4]	[5]	[1]	[2]	[3]	[4]	[5]	[1]	[2]	[3]	[4]	[5]
D.LTA	-0.846***	-0.877***	-0.878***	-0.887***	-0.886***	-2.171***	-1.999**	-2.213***	-2.033***	-1.991**	-0.763**	-0.777**	-0.760**	-0.728**	-0.772**
	(0.296)	(0.292)	(0.299)	(0.292)	(0.295)	(0.842)	(0.806)	(0.816)	(0.771)	(0.789)	(0.347)	(0.339)	(0.352)	(0.343)	(0.343)
LLA	0.0197	-0.0367	0.0283	-0.000799	-0.0261	-0.157	0.0142	0.150	0.341	0.300	-0.0375	-0.0760	-0.0434	-0.0372	-0.0971
	(0.165)	(0.173)	(0.163)	(0.171)	(0.172)	(0.468)	(0.490)	(0.467)	(0.490)	(0.490)	(0.179)	(0.192)	(0.178)	(0.189)	(0.191)
LCI	-0.286***	-0.251***	-0.287***	-0.248***	-0.253***	-0.326**	-0.249*	-0.296**	-0.244*	-0.232*	-0.342***	-0.313***	-0.345***	-0.289***	-0.310***
	(0.0804)	(0.0783)	(0.0803)	(0.0776)	(0.0785)	(0.143)	(0.135)	(0.138)	(0.130)	(0.132)	(0.104)	(0.101)	(0.105)	(0.102)	(0.101)
IB	5.058***	5.339***	5.259***	5.751***	5.518***	6.578*	6.602*	6.370*	6.624*	6.422*	5.314**	5.638**	5.358**	5.964***	5.505**
	(1.795)	(1.849)	(1.819)	(1.866)	(1.870)	(3.751)	(3.704)	(3.470)	(3.439)	(3.446)	(2.163)	(2.212)	(2.189)	(2.227)	(2.226)
SIB_IB	-0.855*	-0.507	-0.854*	-0.446	-0.544	-1.914*	-1.235	-1.851*	-1.345	-1.288	-0.503	-0.282	-0.513	-0.0845	-0.266
	(0.508)	(0.536)	(0.515)	(0.530)	(0.541)	(1.129)	(1.129)	(1.035)	(1.022)	(1.041)	(0.577)	(0.609)	(0.580)	(0.587)	(0.609)
SIB_CB	0.592*	1.051***	0.648**	1.230***	1.067***	0.125	0.808*	0.181	0.765*	0.759	1.016**	1.371***	1.016**	1.668***	1.358***
	(0.305)	(0.323)	(0.307)	(0.303)	(0.324)	(0.476)	(0.486)	(0.471)	(0.451)	(0.483)	(0.433)	(0.453)	(0.440)	(0.438)	(0.457)
LHHI	-1.605	0.586	-1.252	1.388	0.673	0.139	3.844*	1.349	3.986**	4.219*	-2.351	-0.570	-2.378	0.836	-0.603
	(1.303)	(1.351)	(1.314)	(1.182)	(1.356)	(2.254)	(2.272)	(2.218)	(1.969)	(2.232)	(1.733)	(1.794)	(1.768)	(1.583)	(1.807)
INF	-0.133***	-0.130***	-0.144***	-0.131***	-0.136***	-0.0832**	-0.0693**	-0.115***	-0.0911***	-0.0939***	-0.193***	-0.194***	-0.196***	-0.177***	-0.192***
	(0.0201)	(0.0199)	(0.0211)	(0.0208)	(0.0211)	(0.0343)	(0.0339)	(0.0347)	(0.0343)	(0.0347)	(0.0271)	(0.0266)	(0.0286)	(0.0279)	(0.0282)
Ggdpr	0.00302	-0.000296	0.00225		-0.000577	0.00234	-0.00327	-3.81e-05		-0.00449	0.00488	0.00214	0.00514		0.00267
	(0.00375)	(0.00372)	(0.00379)		(0.00375)	(0.00672)	(0.00648)	(0.00653)		(0.00634)	(0.00499)	(0.00493)	(0.00509)		(0.00499)
GOilp	-0.00156*	-0.000863	-0.00151*		-0.000864	-0.00102	0.000163	-0.000691		0.000262	-0.00223**	-0.00167	-0.00231**		-0.00173
	(0.000815)	(0.000810)	(0.000817)		(0.000813)	(0.00144)	(0.00140)	(0.00139)		(0.00136)	(0.00111)	(0.00110)	(0.00113)		(0.00111)
EXCH_DEP	-0.0188***	-0.00889	-0.0202***		-0.00978	-0.0169*	0.00155	-0.0222**		-0.00481	-0.0258***	-0.0194**	-0.0255***		-0.0173**
	(0.00556)	(0.00585)	(0.00569)		(0.00607)	(0.00922)	(0.00958)	(0.00922)		(0.00977)	(0.00755)	(0.00782)	(0.00781)		(0.00816)
crisis0809_IB		-0.336		-0.332	-0.301		-0.924**		-0.818**	-0.802*		-0.201		-0.284	-0.227
		(0.219)		(0.218)	(0.223)		(0.461)		(0.416)	(0.426)		(0.252)		(0.244)	(0.254)
crisis0809_CB		-0.600***		-0.670***	-0.589***		-0.848***		-0.767***	-0.750***		-0.554***		-0.751***	-0.623***
		(0.132)		(0.124)	(0.134)		(0.196)		(0.183)	(0.199)		(0.184)		(0.179)	(0.188)
crisis1416_IB			0.131	0.0547	0.0808			1.107***	0.986***	1.008***			-0.0525	-0.108	-0.0790
			(0.157)	(0.153)	(0.156)			(0.316)	(0.311)	(0.314)			(0.175)	(0.168)	(0.174)
crisis1416_CB			0.161*	0.0479	0.0732			0.361**	0.253*	0.271*			-0.0193	-0.197	-0.151
			(0.0952)	(0.0944)	(0.0976)			(0.145)	(0.140)	(0.145)			(0.137)	(0.138)	(0.139)
Constant	16.17*	-0.546	13.46	-6.961	-1.255	6.157	-23.10	-3.983	-25.40*	-26.89	20.77*	7.249	21.03*	-3.880	7.655
	(9.436)	(9.802)	(9.526)	(8.419)	(9.845)	(16.56)	(16.82)	(16.33)	(14.46)	(16.54)	(12.52)	(12.99)	(12.78)	(11.22)	(13.09)
Observations	519	519	519	519	519	258	258	258	258	258	259	259	259	259	259
Number of banks	12	12	12	12	12	6	6	6	6	6	6	6	6	6	6

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2A: Saudi banks by type and assets amount

IB		CB	
Bank's name	**Assets in 2018:q4 (in Billion SAR)**	**Bank's name**	**Assets in 2018:q4 (in Billion SAR)**
1. RAJHI	365,003	5. NCB	453,389
2. ALINMA	121,333	6. SAMBA	229,938
3. ALBILAD	73,636	7. RIYAD	229,899
4. JAZIRA	73,003	8. SAUDI FRANSI	190,200
		9. ANB	178,290
		10. SABB	174,564
		11. SAUDI INVEST	96,069
		12. AWWAL	82,028
***Source**: Saudi banks' financial reports.*			

Appendix 1: z-score construction

Let *E/A* stands for the Equity-to-Assets ratio, and *ROA* for the Return-on-Assets Ratio where the Return is the shareholders' profits denoted by π. Let also the bank's return distribution be denoted by $f(ROA)$ with $\mu(ROA)$ and $(\sigma_{ROA})^2$ are its first and second moments, respectively. By defining insolvency as a state where losses, i.e., negative profits $(-\pi)$, exceed Equity capital E, then the probability of default is:

$$P(\pi \leq -E) = P\left(ROA \leq -\frac{E}{A}\right) = \int_{-\infty}^{-E/A} f(ROA)d(ROA)$$

As it is shown in De Nicoló (2000), this probability satisfies the following inequality:

$$P\left(ROA \leq -\frac{E}{A}\right) \leq \frac{(\sigma_{ROA})^2}{\left(\frac{E}{A} + \mu_{ROA}\right)^2} = \frac{1}{z^2}$$

where:

$$z = \frac{\frac{E}{A} + \mu_{ROA}}{\sigma_{ROA}}$$

Therefore, an increase of the z-score is equivalent to a decrease of the upper bound of the insolvency risk. Said differently, a higher z-score corresponds to a lower insolvency risk. Under the assumption of a normally distributed banks' returns, one can write:

$$P\left(ROA \leq -\frac{E}{A}\right) \leq \int_{-\infty}^{-E/A} N(0,1)\, d(ROA)$$

In this case, the z-score measures the number of standard deviations a bank's return realization has to fall in order to deplete equity and the bank becomes insolvent.

Figure 1A: Evolution of *z*-scores (in natural log) of IBs.

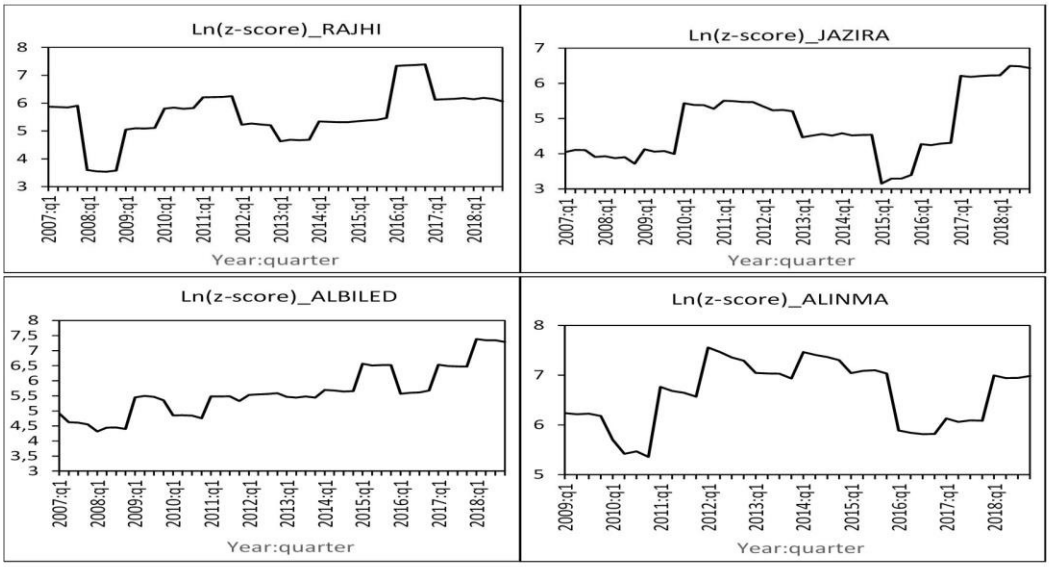

Figure 1B: Evolution of *z*-scores (in natural log) of CBs.

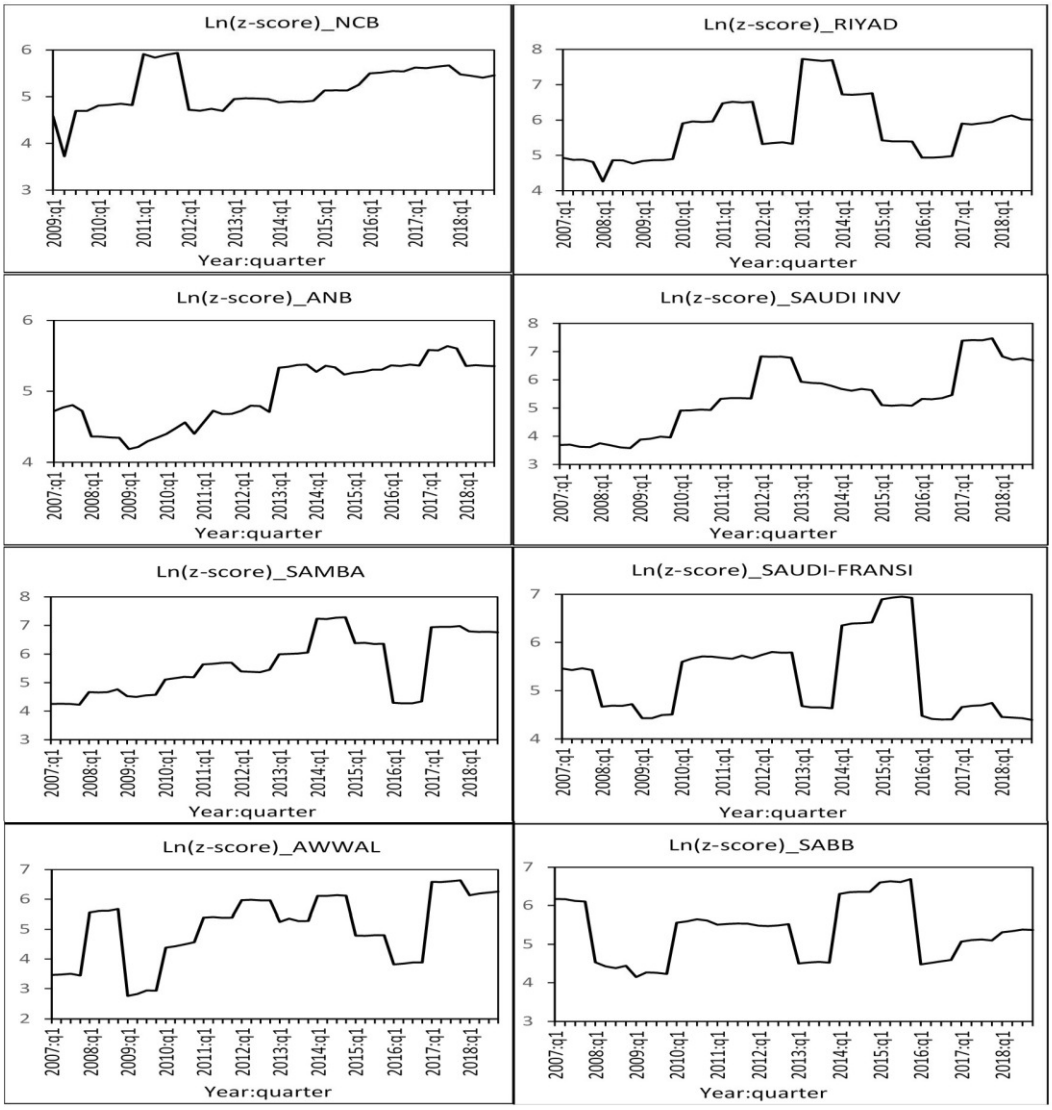

Figure 2A: Evolution of sectorial and macroeconomic variables.

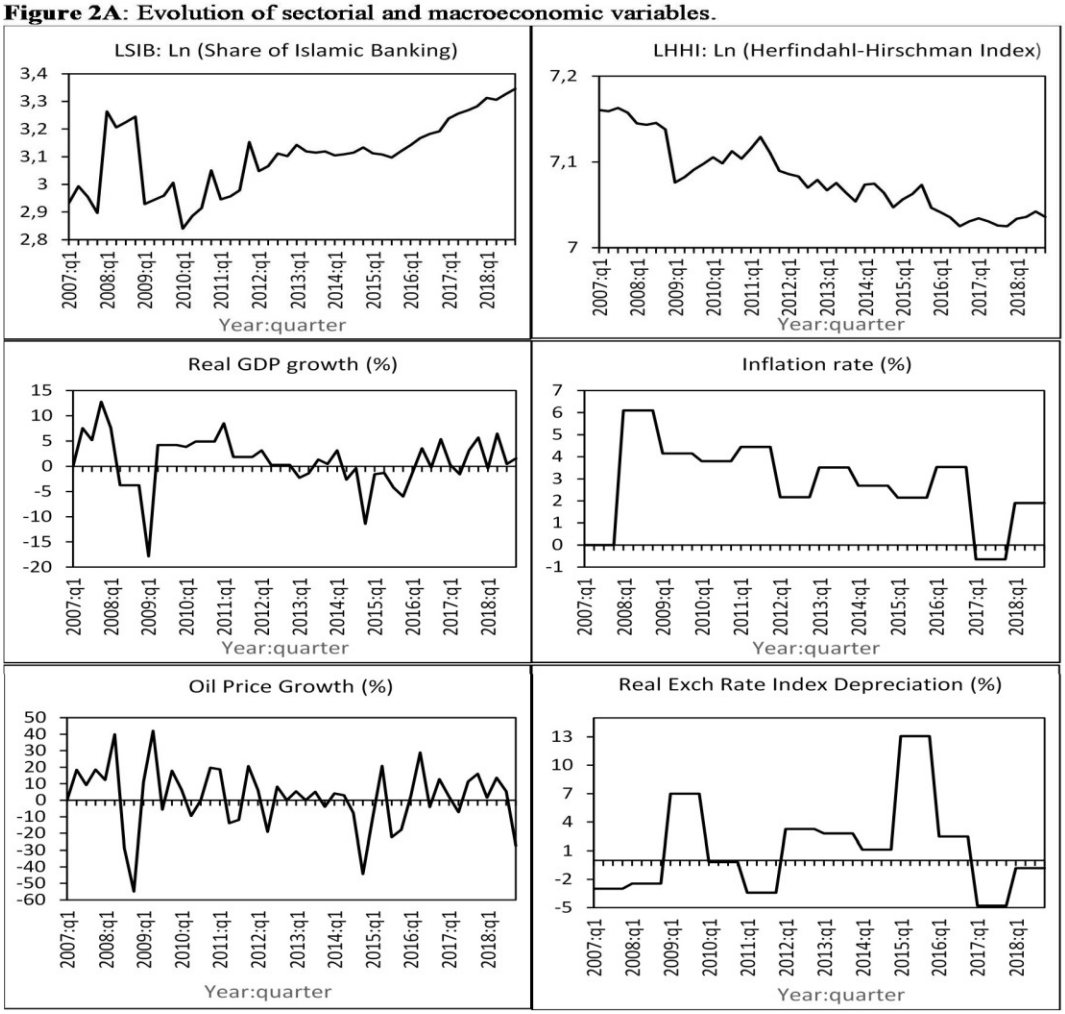

Table 3A: Summary statistics of sectorial and macroeconomic variables

Variable	Obs	Mean	Std. Dev.	Min	Max
LSIB	576	3.104851	.129483	2.840511	3.345893
LHHI	572	7.080747	.040836	7.02518	7.162883
Ggdpr	564	1.058932	5.042813	-17.85768	12.76986
GOilp	564	1.9812	18.71707	-55	42
INF	528	3.072524	1.658996	-.6540698	6.1
EXCH_DEP	576	1.25409	4.806261	-4.786363	13.0672

Source of data: Data on sectorial variables (SIB and HHI) are constructed from individual financial banks' data available on the Saudi financial market website. Data on macroeconomic variables are collected from the Saudi Arabia Monetary Authority (SAMA) database, the Saudi General Authority of Statistics (real GDP growth, INF, and Depreciation rate), and the OPEC database (Oil price).

Table 4A: Panel Unit-Root Tests

		Level				First difference			
Variable	**P.U.R.T**	**Trend**	**statistic**	**p-value**	**I(.)**	**Trend**	**statistic**	**p-value**	**I(.)**
Ln_z-score	I-P-S	Yes	-3.731	0.000***	I(0)				
	FISHER-TYPE	Yes	1.549	0.060*	I(0)				
LTA	I-P-S	Yes	-0.966	0.166	I(1)	No	-6.68	0.000***	**I(0)**
	FISHER-TYPE	Yes	0.454	0.324	I(1)	No	53.07	0.000***	**I(0)**
LLA	I-P-S	Yes	-4.212	0.000***	I(0)				
	FISHER-TYPE	Yes	1.877	0.030**	I(0)				
LCI	I-P-S	No	-10.57	0.000***	I(0)				
	FISHER-TYPE	No	34.15	0.000***	I(0)				
LSIB	I-P-S	Yes	-6.737	0.000***	I(0)				
	FISHER-TYPE	Yes	5.849	0.000***	I(0)				
LHHI	I-P-S	Yes	-5.807	0.000***	I(0)				
	FISHER-TYPE	Yes	4.718	0.000***	I(0)				
GDPg	I-P-S	No	-10.46	0.000***	I(0)				
	FISHER-TYPE	No	29.28	0.000***	I(0)				
OILg	I-P-S	No	-13.05	0.000***	I(0)				
	FISHER-TYPE	No	51.41	0.000***	I(0)				
INF	I-P-S	No	-3.193	0.000***	I(0)				
	FISHER-TYPE	No	2.960	0.001***	I(0)				
EXCH_DEP	I-P-S	No	-3.950	0.000***	I(0)				
	FISHER-TYPE	No	4.954	0.000***	I(0)				

Notes:
I-P-S indicates Im, Pesaran and Shin (2003) test and the null hypothesis assumes all panels have root process.
FSHER-TYPE stands for Fisher-type test with the Phillips-Perron approach. The null hypothesis assumes all panels contain unit roots based on unit root tests conducted individually on each panel.
Trend stands for the trend which is introduced in the unit-root test when it is significant.
***p<0.01,** p<0.05, * p<0.1

Table 5A: Simple correlations (obs=520)

	Ln_zscore	**D.LTA**	**LLA**	**LCI**	**LSIB**	**LHHI**	**Ggdpr**	**GOilp**	**INF**	**EXCH_D**
Ln_zscore	1.0000									
D.LTA	0.0387	1.0000								
LLA	0.0533	-0.1254	1.0000							
LCI	-0.1244	0.0505	-0.0685	1.0000						
LSIB	0.1948	0.0004	0.3635	-0.1001	1.0000					
LHHI	-0.3255	0.2086	-0.2766	0.0225	-0.3998	1.0000				
Ggdpr	0.0287	0.0354	0.0682	0.1232	-0.0569	0.1017	1.0000			
GOilp	-0.0907	0.0192	-0.0644	-0.0198	-0.1000	-0.0427	0.4074	1.0000		
INF	-0.4282	0.1657	-0.3138	0.0169	-0.3947	0.4666	-0.0037	0.0149	1.0000	
EXCH_D	-0.1090	-0.0718	-0.1922	-0.0247	-0.2809	-0.1257	-0.3236	-0.0181	0.0356	1.0000

Table 6A: Banks' specific effects on z-scores unsing FGLS regressions

Banks' name	**Effect**	**Banks' name**	**Effect**	**Banks' name**	**Effect**
RAJHI	5.001***	**NCB**	-0.150	**SAMBA**	0.545
	(1.785)		(0.331)		(0.359)
ALBILED	5.405***	**RIYAD**	0.616*	**AWWAL**	0.168
	(1.784)		(0.380)		(0.388)
ALINMA	6.247***	**ANB**	-0.163	**SABB**	0.026
	(1.793)		(0.280)		(0.339)
JAZIRA	4.566**	**SAUDI_INV**	0.391	**SAUDI_FRANSI**	-----
	(1.787)		(0.320)		-----

Notes: These values are obtained from specification [5] of the "All banks" sample. Standard errors are in parentheses; ***, ** and * denote significance at 1%, 5% and 10%, respectively.