Time Series Analysis of Financial stability of banks: Evidence from Saudi Arabia

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Abstract

Islamic banks are characterized by their compliance to Islamic laws and practices, primarily the prohibition of interest and the trading of loans. During the 2008–2009 financial crisis, when a large number of conventional banks announced bankruptcy, no Islamic bank failures were reported. However, there is no clear consensus in the literature on the question of whether Islamic banks are more or less stable than conventional banks. To shed some light on this issue, we studied a sample of Saudi banks using quarterly data over a period centered on the 2008 financial crisis. Careful analysis of the data suggested first of all that many of the variables typically used in financial stability studies may be non-stationary, a methodological point largely ignored in the literature. Using time-series methods suitable for this type of data, we concluded that individual heterogeneity may matter more than either the conventional or Islamic nature of the banks. Concentrating on the largest banks, we find the Islamic banks contribute positively to the stability of the system.

JEL Classification: G21, G28, C12
Keywords: Financial crisis, financial stability, z-score model, Islamic banks, Saudi Arabia.

1. Introduction

The recent financial crisis is the most immediate motivation for studying the interaction between banks and real economy variables and the likelihood default of banks via z-score variable in Saudi Arabia, which is characterized by a bi-banking system with Islamic and conventional banks. According to Reinhart and Rogoff (2008), the resulting insolvency of the financial system leads progressively to a deep downturn in real activity. The international interconnection between banking systems through equities and loans propagates some financial contagion on Saudi banking system. The main question is to determine in what extent this system was impacted by the volatilities in Western banking and generally financial system. Focusing on bank default, we build a z-score model to determine which banks lead to crisis while others do not.

Our purpose is to identify the disparities between banks in Saudi banking system and to determine which one contribute to reduce the financial instability. The global economic crisis – via a bursting housing bubble in USA through high impact of household default – hits many banks across the world since the third of 2008, but the impact on Saudi banks was relatively avoided due to the liquidity support of the government. To improve liquidity of banks and plug the decline in deposits and loans, the Saudi Arabian Monetary Agency (SAMA) reduced repo and reverse repo rates five times in 2008 and twice in 2009. That is why the loan to deposit ratio for Saudi banks peaked at 80.5% during 2008. These outcomes are also due to the profit-and-loss sharing system (PLS) of Islamic banks (IB) and the diversification of Saudi economy in the non-oil sectors. The overall non-performing-loans (NPL) ratio[1] varies during 2009 and 2010 from 3.8% to 3.6%, which indicate a significant decrease around 5.2%, due to the reduction number of credit defaults leading to an overall recovery in the bank profitability. The IBs contribute more to reinforce the ability of the Saudi banking system to increase the credit income, but the banks still have risk-averse lending behavior. Following the sample of our paper, NPL ratio of IBs (Al-Rajhi bank and Al-Bilad bank) decreased with 7.32%, whereas NPL ratio of conventional banks (CB) (including Riyad bank, Saudi American bank, Saudi British bank and Saudi Investment bank), decreased only with 4.05%.

Islamic banks are characterized by their compliance to Islamic laws and practices, and chiefly the prohibitions against the collecting of interest (replaced by PLS arrangements and goods and services trading; e.g., Chapra, 2000; Khan, 2010; Siddiqi, 2000) and against the trading of loans and derivatives. Although the first Islamic banks were established only about four decades ago, according to Standard & Poor's, Islamic financial institutions currently satisfy 15% of Muslims' needs for financial services. In 2009, the size of assets deemed compatible with Islamic-Shariah law had reached USD 400 billion, while the total assets under the control of Islamic financial institutions surpassed USD 1 trillion (CIBAFI,[2] 2010).

Remarkably, during the 2008–2009 financial crisis, when a large number of conventional banks around the world announced their bankruptcy — about 140 in the USA alone, according to the Federal Deposit Insurance Corporation (FDIC 2010) — not a single Islamic bank reported failure. Pappas, Izzeldin and Fuertes (2012) find that Islamic banks have lower failure risk and are less interconnected which reduces the probability of domestic co-failure. In fact, there are reasons to expect Islamic banks to be probably more stable than conventional banks. According to Khan and Ahmed (2002), IBs have two models of financing, in the first one, IBs as financial corporations have only investment deposits on the

[1] The Non-Performing-Loans (NPL) refers to defaulted loans or those that are close to default. The NPL ratio represents NPL over total loans disbursed by banks; it refers to the bank asset quality.
[2] General Council for Islamic Banks And Financial Institutions (CIBAFI), http://www.cibafi.org/.

liabilities side invested through PLS system. The losses on assets are absorbed through sharing-risks between depositors-partners. Hence, IBs are more stable than conventional bans. In the second model, IBs use both funds of current accounts and investment deposits through PLS system (*Mudarabah* and *Musharakah*), fixed-income modes (*Murabahah*), installment sale (long term *Murabahah*), *Istisnaa* or *Salam* (deferred sale or prepaid sale) and *Ijarah* (leasing). This model is less stable, owing that the current depositors do not share the risk, and then IBs must bear all risks.[3]

The absence of Islamic bank failure does not mean that there is no illiquidity difficulty. The monetary authorities in Gulf Cooperation Council (GCC) banking system support many banks during the last international financial crisis to avoid potential failure. The adoption of the PLS system by a number of banks around the world may thus be claimed to have contributed positively to international financial stability and to a reduction in the volatility of global financial markets (Beck, Demirgüç-Kunt and Merrouche, 2013). One possible explanation of the relatively better performance in terms of stability during the recent international financial crisis is the higher capitalization and liquidity reserves of Islamic banks. Another potential explanation is the only partial integration of Islamic banks into the global financial system, as Islamic banks are prohibited from dealing with the sale of derivatives and loans (Hassan, 2006). However, the expansion of Islamic finance, and its further integration with the global banking system, could clearly reduce the immunity of Islamic banks to future financial contagions.

Nevertheless, the huge capital investments in strategic sectors and infrastructure are expected to boost the Saudi banking sector. In addition, the rising banking popularity of Islamic banking as an ethical alternative to CBs represents a major factor driving growth in Saudi banks. The Islamic loans are around 40% of the total loans in Saudi Arabia during 2010 (SAMA, annual report). By obeying to Shariah-compliance principles, IBs have low leverage and are less risky than CBs, then they contribute more to financial stability.

As responsible for maintaining financial stability, SAMA also lowered the cash reserve requirement on demand deposits to 70% to guarantee more liquidity in banks. During 2009, the capital to risk-weighted assets of Saudi banks raised at 16.5% i.e. much more than the internationally prescribed Basel Standard of 8.0%. This signifies that the banks are well-capitalized i.e. with a strong capital position. Furthermore, the Saudi banking sector has lower leverage ratios ranging in average during our sample 2005-2009 from 10.84% to 18.12% for banks listed in Saudi stock market. This feature justifies the resilience of Saudi banking sector against the financial turmoil indicating generally an adequate risk management.

To avoid or reduce any likelihood of defaults or bankruptcy[4], the banks manage such risks through many tools and measures as internal rating and mostly external ratings. SAMA recognizes external credit assessment agencies namely the following credit-rating agencies: Moody's Investors Service, Standard & Poor's Ratings Group and the Fitch Group. Also, the Islamic International Rating Agency (IIRA) – approved by the Islamic Development Bank (IDB) – is the sole rating agency providing rating spectrum for capital markets and banking sector in predominately Islamic countries.

Despite the prima facie evidence discussed above, there is no clear consensus in the literature on the question of whether Islamic banks are more or less stable than conventional banks. This may be due in part to the heterogeneity within the Islamic banking sector. Čihak

[3] For more details see Hassan, Kayed and Oseni (2013), Islamic Financial Services Board (2005), Uthmani (2002) and Khan and Ahmed (2001).

[4] The most important types of risks identified by all banks are credit risk, market risk (including risks of profit-rate, foreign-exchange rate, and equity-price), liquidity risk and operational risk.

and Hesse (2010, henceforth CH), for instance, concluded on the basis of a large-scale panel study that small Islamic banks tend to be more stable than both their conventional counterparts and large Islamic banks, which in turn seem to be less stable than large conventional banks. This suggests that careful case studies of individual banks may provide insights that it would not be possible to achieve with panel modeling, which requires some assumption of homogeneity.

The purpose of this paper is to study the individual time series of a sample of Saudi Islamic and conventional banks. The period chosen is 2005:q1–2011:q4, which allows us to evaluate the reaction of these two types of financial institution to the recent financial crisis. Saudi Arabia provides interesting material for a case study, as the Saudi banking sector at large also apparently was not much affected by the financial crisis: net profits declined only by approximately 2.6% in 2009 as a consequence of a series of prudential measures taken by the banking system as a whole.

Our article contributes to the literature of banking stability in several ways. First of all we analyze a dataset at quarterly frequency, while many previous papers use annual data (from Bankscope provided by Bureau Van Dijk), which may hide high-frequency variations of the z-score. Second, the sample we examine is taken from one of the largest (both in terms of size and external financing[5]) banking systems in the GCC area, where the PLS system is growingly most rapidly. Last, but not least, we take into account the statistical properties of the data much more carefully than usually done in the literature on PLS, thus obtaining more robust and reliable results. These three ways are the main motivation of our article.

The paper plan is that Section 2 reviews briefly the empirical literature on banking stability. In Section 3, we discuss in some details the z-score measure to model banking stability. Model estimates and the main discussion of the results are presented in Section 4, while Section 5 concludes and exhibits directions for further research.

2. Literature review

According to many theoretical and empirical papers (e.g., Kainer, 2013; Di Giorgio and Rotondi, 2011; Allen and Wood, 2006; Borio, 2006; Goodhart, 2006; Poloz, 2006; Schinasi, 2004; Mishkin, 1999), the financial instability affects not only the financial system (banks, stock markets, debt markets and financial infrastructure of payments and settlements) through sudden change in different financial prices or costs, but generates many significant perturbations and disruptions on the real economy. They explain that the unanticipated shocks emerging in financial system should impede the normal evolution of real economy and reduce the confidence of the population as individuals and firms. The financial system fails in channeling efficiently savings into productive investment and couldn't distribute or redistribute risks appropriately between contractual parties in financial system.

The current economic and financial theories based on risk-shifting paradigm have many deficiencies and require new concepts and principles to face new economic and financial challenges (Institute for the new economic thinking – INET,[6] 2012). The stability of the financial system requires a greater role for equity and risk-sharing and tying the credits to real economy. Such conditions implemented in a new paradigm of financial framework (Chapra, 2005) and a new paradigm of social-economic system would preserve the market discipline

[5] The banking sector of Saudi Arabia is in second position after Qatar in terms of total assets. Source: Bank's Annual and Quarterly Reports from Zawya (http://www.zawya.com/), plus author's calculation.
[6] https://ineteconomics.org/

leading to stabilize the financial system and to promote socio-economic will-being of the society (Hassan and Kayed, 2009).

According to Hassan and Lewis (2007), the Islamic financing has two family of contracts, the first one (e.g., *Musharaka*, *Mudaraba*, *Sukuk*) is related to the PLS system, where the return is stochastic and depends on the ultimate outcome of the investment. This system is closely correlated to the real economy and then could help to reduce the likelihood of financial crisis. The second family (e.g., *Murabaha*, *Ijarah*, and *Salam*) is associated to the sale of goods and services on credit and leads to the indebtedness of the party purchasing those goods and services at a fixed price of sale including commercial profit. This model was faced by a lot of operational risks.[7] Thus, Islamic banks switched to the use of multi-layers Mudarabah Islamic model, i.e., Mudarabah of assets (sources) and liabilities (uses), where all assets are financed through PLS system. But, it remains that the multiplicity of financial products methods could lead to the misinterpretation i.e. legal ambiguity of the terms of contracts, which increase in fine the operational risks.

Nevertheless, the implementation of a mix-financial system in the majority of Islamic countries makes not easy and feasible to prove empirically the stability of Islamic banks in comparison with conventional banks. Islamic banks are still in stage of shaping themselves to operate in thorough Shariah-complaint models.

Few papers have applied quantitative models to analyses of the financial stability of Islamic and conventional banks, respectively. Beyond the paper by CH cited in the introduction, we may mention the report of Hasan and Dridi (2010), which examined the effects of recent international financial crises on conventional and Islamic banks in eight countries, including all of the countries of the Gulf Cooperation Council. Analyzing a range of banking indicators, they found that the performance of Islamic banks was better than that of conventional banks. So that the presence of Islamic banks contributed to increased financial stability; there were some weaknesses, however, related to their risk management. Imam and Kpodar (2010) found that the per capita income and the competitiveness in the banking system have significant positive impacts on the spread of Islamic banks. Also, the decrease in real interest rates was found to lead to more deposits being made with Islamic banks. Ariss (2010) focused on the competitiveness conditions of Islamic and conventional banks by analyzing several indicators. But using yearly data that spanned 2000–2006, the findings indicated that traditional banks tended to be more competitive than Islamic banks.

Pappas, Izzeldin and Fuertes (2012) provide an analysis of bank failure risk about IBs and CBs using survival-time model i.e. Cox Proportional Hazards model, where the failure risk is represented by the inverse of the z-score variable. They suggest that higher leverage i.e. the inverse of equity to assets ratio increases (decreases) failure risk for CBs (IBs); and that higher liquidity is generally associated to lower failure risk. Beck, Demirgüç-Kunt and Merrouche (2013) formalized the conception of bank stability via several indicators, including z-score, return on assets, equity to assets ratio and maturity matching. Using annual data from BankScope, their empirical estimations identified few significant differences between Islamic and conventional banks. They find that the higher capitalization of Islamic banks, in addition to their higher liquidity reserves, could explain the relatively better performance in terms of performance and stability mainly during the recent international financial crisis. Islamic Banks have shown relative stability to the first wave of the last

[7] The importance of operational risk in Islamic finance, as Shariah compliance risk, reveals the complexities related to the implementation and the monitoring of PLS modes to avoid the negligence and misconduct of the entrepreneurs.

international crisis of 2007-2008, and then contribute to reduce the volatility of global financial markets. By using banks level and macroeconomic determinants, Abedifar, Molyneux and Tazari (2013) find no significant differences concerning insolvency risk between Islamic banks and conventional banks.

AlKholy (2009) showed that the Saudi banking sector successfully absorbed the shocks of the international financial crisis thanks to both interventions made by SAMA and to measures of self-protection undertaken in the form of credit rationing. The shock absorption contributed to the sector's ability to avoid a domestic financial crisis and the consequent damaging effects such a local crisis could have had on the real economy. Finally, in spite of its good performance, Ghassan, Taher and Adhailan (2011) identified some key weaknesses of the Saudi banking system as a part of the broader financial system in the aftermath of the most recent financial crisis. Their key findings included the high concentration of bank loans among a limited number of firms and individuals and the large proportion of bank investments that had been made in foreign assets with relatively high rates of returns compared to the interest yields able to be realized on domestic assets.

3. Modeling banking stability

3.1. Stylized facts

According to The Banker (Financial Times publication, London, 2010), Saudi Arabia ranked second in the world, trailing only Iran, in terms of Sharia-compliant assets as of 2010, at which point it controlled USD 138.24 billion in such assets. The Saudi banking sector exhibited what were taken to be signs of health during the financial crisis because record levels of profitability were maintained.

Following the conservative measures taken by banks and recommended by SAMA, however, the total reserves were voluntarily increased over the period spanning January–September 2009, from SAR 1.6 billion to over SAR 6 billion. This step was undertaken as a precautionary action to meet any possible losses due to investor defaults on bank loans. It was also noted that the equity capital of Saudi banks was increased, and that the banks' assets did not suffer from the drastic negative impacts that hit the banking sectors of other industrialized nations, where some large and famous banks were forced to announce their bankruptcy. The Saudi banks' huge reserves most likely shielded domestic banks against the tremendous negative impacts of the international financial crisis. Moreover, some international credit rating agencies, such as Moody's and Standard & Poor's, have reported that the basic financial forecasts of the Saudi banking sector are relatively stable, flexible and able to absorb negative shocks that might arise as a result of a future international financial crisis.

3.2. Underlying variables for stability z-score model

In this paper, we have followed the widespread practice of measuring financial stability using z-score as an individual measure of bank soundness (or a distance from insolvency) which uses only accounting information without any direct market information (Roy, 1952; Altman, 1968; Boyd and Graham, 1986; Hannan and Hanweck, 1988; Boyd and Runkle, 1993; Altman, 2002; Stiroh, 2004; Yeyati and Micco, 2007; Vasquez and Federico, 2012; Schaeck, Cihak, Maechler and Stolz, 2012; Lepetit and Strobel, 2013). Following the discussion of Altman (2002), this measure should not be confused with the Altman z-score measure used in the corporate finance literature. The z-scores authorize to compare the risk of default in different groups of financial institutions, which may have a specific capital structure, but face many risks of insolvency. The basic definition of the z-score, allowing to measure individual-level stability, is as follows:

$$z_t = \frac{k_t + \mu_t}{\sigma_t} \quad (1)$$

where k_t is the ratio of equity capital plus total reserves to assets, i.e., $\frac{\mathrm{E}}{\mathrm{A}}$; μ_t is the average returns/assets ratio, i.e. $\frac{R}{A}$ (or alternatively, the ratio of the averages of returns and assets); and σ_t the standard deviation of the returns/assets ratio. The alternative random variables, to z-score leading to measure the insolvency-risk of banks i.e. its instability, are the adjusted return on assets (ROA) defined by the return on assets to the standard deviation of ROA, and the adjusted return on equity (ROE) defined by the return on equity to the standard deviation of ROE. As advocated by Laeven and Levine (2009) and Houston et al. (2010), in empirical implementation we use the logged z-score to reduce the skewness of the simple z-score and to improve its meaningful probabilistic interpretation (for more details see Strobel, 2014).

Also, it is possible to reduce the effects of the potential volatility of the value of total assets by using the return on equity ratio named ROE-based z-score instead of the return on assets ratio named ROA-based z-score. The z-score offers several advantages over other measures of financial stability, such as Value-at-Risk (VaR) and stress tests. First, it is not affected by the nature of the bank's activities (Maechler, Mitra and Worrell, 2005; CH, 2010), so 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. The insolvency problem is more serious than the liquidity problem, as it means that the bank's liabilities exceed the value of its assets. A bank may become illiquid even when it is solvent, if its assets held are illiquid assets (either long-term financial assets or real assets) that can only be liquidated at high cost. The bank may be forced to sell such assets at lower than normal values. But in fact, the liquidity problems, which are as important capital requirements to bank stability, could easily morph into solvency troubles.

The z-score index reflects the probability of insolvency, defined as a state in which losses exceed equity. The bank becomes insolvent when the negative returns or losses $(-R)$ exceed equity (E): $-R > E$. Expressing the insolvency in term of probability, we have: $p(-R \geq E) \Leftrightarrow p(R \leq -E) \Longrightarrow p\left(\frac{R}{A} \leq -\frac{E}{A}\right)$. By assuming that bank returns are normally distributed and using equation (1), the probability of default is:

$$p(\mu \leq -k) = \int_{-\infty}^{-z} f_Z(u)du \Leftrightarrow p\left(\frac{\frac{R}{A} - \mu_{\frac{R}{A}}}{\sigma_{\frac{R}{A}}} \leq \frac{-\left[\frac{E}{A} + \mu_{\frac{R}{A}}\right]}{\sigma_{\frac{R}{A}}}\right) = p(Z \leq -z) = \Phi(-z) \quad (2)$$

so the z-score is thus understood as measuring the number of standard deviations that returns realization have to fall in order to deplete equity (Čihak, 2007). A significantly lower z-score variable for a bank indicates that the bank is closer to insolvency than are other banks — therefore, the greater the z-score, the less the likelihood of bank insolvency (or the less likely it is that the bank's liabilities will exceed the value of its assets).

Empirically, we can determine a probabilistic version of the z-score by using one-sided Chebyshev. By using the Markov inequality, we can show that for any random variable as $\frac{R}{A}$ with mean μ and standard deviation σ for any shape of distribution, and any positive number a (which is satisfied because $a = \mathrm{k} + \mu > 0$), the following one-side Chebyshev inequality holds. It is easy to prove this proposition: Considering $\mathrm{b} > 0$, we obtain that $p\left(\mu - \frac{R}{A} \geq a\right) = p\left(\mu - \frac{R}{A} + b \geq a + b\right) \leq p\left(\left(\mu - \frac{R}{A} + b\right)^2 \geq (a+b)^2\right)$. Upon applying Markov inequality on the preceding, we get that: $p\left(\frac{R}{A} \leq \mu - a\right) \leq \frac{\mathrm{E}\left[\left(\left(\mu - \frac{R}{A}\right) + b\right)^2\right]}{(a+b)^2} = \frac{\sigma^2 + \mathrm{b}^2}{(a+b)^2}$

By letting $b = \frac{\sigma^2}{a}$ and knowing that $z\sigma = \mathrm{k} + \mu = a$, we obtain the following result:

$$p\left(\frac{R}{A} \leq \mu - a\right) = p\left(\mu - \frac{R}{A} \geq a\right) \leq \frac{\sigma^2}{\sigma^2 + \mathrm{a}^2} = \frac{1}{1+\mathrm{z}^2} < 1 \qquad (3)$$

this gives the upper bound of the probability of insolvency in bank. It can be used across time as the probabilistic interpretation of z-score.[8]

Standard models relate the *z*-score to bank-specific, sector-level and macro variables. Individual variables typically include total assets (A), credit-assets ratio (CA), operating cost-income ratio (CI) and income diversity (ID). For conventional banks, CA is measured via the loans to assets ratio while, for Islamic banks, it is measured by the ratio of finance activity to assets.

The standard definition of ID is ID = 1-|(net interest income-other operating income)/total operating income|. For Islamic banks, we replace interest income (commissions) and interest charges with finance income from the PLS system (including positive or negative flows) and finance charges. A higher value for the income diversity variable corresponds to greater diversification of income. Sector-level variables usually include the share of Islamic banks, i.e., the ratio of Islamic banks' assets (deposits) to total assets (deposits) of the banking sector (IS) and a competitiveness index. Following Ariss (2010), Evrensel (2008) and Beck, Demirgüç-Kunt and Levine (2006), we will use the standard Hirschman-Herfindhal index (HH), which measures banks' competitiveness across a range from zero (maximum competitiveness)–10,000 (minimum competitiveness).[9]

According to the National Competitiveness Center (NCC) report (2011), many rooms should be improved to establish in Saudi economy a competitive banking system. The main serious problems are related to the imperfect legal and regulatory framework and the shortage of quality of human capital. The Saudi banking system competitiveness is biased because the CBs can use the Islamic financial products whereas the IBs can manage only the permissible financial products with Shariah compliance. As in Qatar, the specificity of banks should be legally determined meaning that the CBs could not open Islamic windows. Additionally, the IBs have to develop their formal Islamic interbank money market serving to restore liquidity and encouraging more lending. Such financial developments would modify the degree of competitiveness and will affect the efficiency and the stability of all banks. The competitive conditions could influence the profitability and the stability of all banks. We have use HH index based on assets which reveals that the market share of CBs is around 75% and 25% for the IBs. The average of HHI is around 6121 indicating a relatively weak level of competitiveness between IBs and CBs. The small number of IBs shows that there is more competitiveness among CBs.

Finally, standard macroeconomic variables are the gross domestic product (GDP) growth and inflation rate (Männasoo and Mayes 2009, Demirguc-Kunt and Detragiache 1998) to detect if the low level of real economic growth and the increased inflation rate have adverse effects on banks financial stability.

[8] The formula (3) is to show how the z-score variable reflects the probability of insolvency or default. The empirical literature on the banks stability focuses mostly on the z-score, and the probability of insolvency could help for additional interpretation as it corresponds to the z-score variability.

[9] In our empirical work, the competitiveness is considered at a global level in the banking sector. We expect to explore in a future paper the competition at banks level by using a modified Lerner index (Bing et al. 2013, Boone 2008, Corts 1999) avoiding some empirical biases due to the specificity of the IBs, and detecting the market or pricing power in the banking sector.

4. Model estimates and analysis

4.1. Dataset

Our dataset includes six banks from their quarterly accounting information, all listed on the Saudi stock market and encompassing 64% of the Saudi banking sector (Table 1, and Table A1 in Appendices). Four are conventional banks: Riyad Bank (RYD), Saudi Investment Bank (SIB), Saudi British Bank (SBB), and Saudi American Bank (SAB); the latter two banks are located offshore and are closely linked to international banks, which allows us to investigate the impacts of the international financial crisis on the Saudi financial system. The remaining two banks — Al-Rajhi (RJH) and Al-Bilad (BLD) — follow Islamic finance rules and laws. According to the National Competitiveness Center (2011), Islamic financial institutions in Saudi Arabia can specify their Sharia-related activities and develop new products under the control of their own Sharia-compliant supervisory boards.[10] Unfortunately, no other Islamic banks could be included in the sample, as these include Alinma Bank (IMA), founded only in 2008, and Al-Jazirah Bank (JZR), which was fully converted from a conventional into a Sharia-compliant bank only in 2007. Collecting data from the Saudi Stock Market (Tadawul), we were able to present quarterly data for the period spanning 2005–2011, a total of 168 observations.[11] The sample is centered on the 2008 international financial crisis. Some details on the individual banks are reported below (Appendices, Table A1).

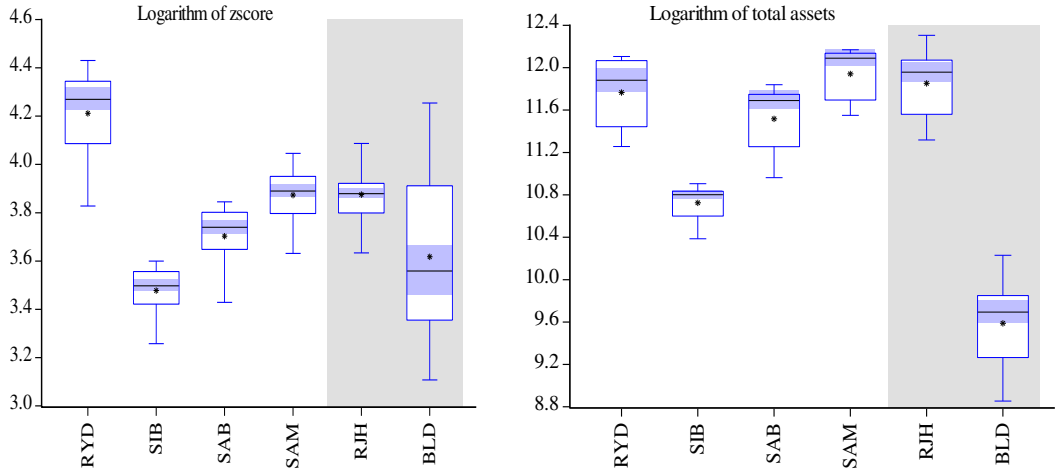

Fig. 3: Box-plots of z-score and bank size or total assets in logarithm between 2005:q1 and 2011:q4
Notes: The shaded zone is for Islamic banks. The star point inside the box is the mean and the horizontal line inside the box is the median value of the distribution of z-score and total assets.

The box-plots[12] reported in Fig. 3 provide a useful summary of the data on z-scores and total assets. The box-plot clearly highlights important points about the data. First of all, the inner fences in the box of z-score reveal a range of the median between 3.5 and 4.3; with a range smaller than 1, while the medians of total assets have a much larger range (2.4, from 9.7 to 12.1). Obviously, the banks manage different levels of financial assets, but generally face

[10] According to non-interest financing practices, "Halal2 center" specifies Islamic and non-Islamic features of firms and banks listed on the Saudi stock market. http://www.halal2.com/main.asp?id=71.
[11] Note that most of the data available from the international database BankScope, the standard source for financial stability studies, are available at annual frequencies, with some series at biannual frequency and no quarterly series.
[12] The box-plot, with the mean (known as whisker diagram) summarizes the distribution of our data set by displaying the centering and spread of the data. The points outside the inner fence (shaded part of Fig. 3) are known as outliers.

no different risks. The Saudi investment bank and Al-Bilad bank have the lower mean of z-score and total assets among the other banks, whereas Riyad bank shows the greatest median of z-score and has the third high median of total assets. Saudi investment bank, Al-Bilad bank and Riyad bank work mostly in domestic financial markets, but the banks operating in international financial markets indicate more risks in terms of z-score as Saudi American bank and Al-Rajhi bank.

Further, the distribution of z-scores is negatively skewed for all conventional banks, but positively skewed for Islamic banks. The conventional banks appear to hold riskier activities as the Saudi American bank and the Saudi British bank, which operate actively in international financial markets. On the other hand, Al-Bilad bank as IBs, working essentially into the Saudi banking system, appears with both risky assets and liabilities, while Al-Rajhi bank shows a quasi-symmetric distribution of risks implying a balanced position towards risks on instability. Al-Rajhi bank assets are probably more diversified and are not mostly composed of loans.

The z-score indices indicate more variability across banks; despite the good z-score of Riyad bank, we expect that there are fewer disparities between Saudi American bank and Al-Rajhi bank conducting international investment in comparison to other banks. The next step is to model z-scores, to find which are the factors explaining their variability across banks.

Table 1: Banks listed in the Saudi Stock Exchange (2012)

Bank name	Code	Bank type	Capital in Billions SAR
1. Riyad Bank	RYD	Conventional + IW	15.0
2. Saudi Investment Bank	SIB	Conventional + IW	04.5
3. Saudi American Bank	SAB	Conventional + IW	09.0
4. Saudi British Bank	SBB	Conventional + IW	07.5
5. Al-Rajhi Bank	RJH	Islamic	15.0
6. Al-Bilad Bank	BLD	Islamic	03.0
1. Saudi Hollandi Bank	SHD	Conventional	03.3
2. Banque Saudi Fransi	SAF	Conventional + IW	07.2
3. Arab National	ARN	Conventional + IW	06.5
4. Al-Jazirah	JZR	Islamic	03.0
5. Alinma Bank	IMA	Islamic	15.0

Source: http://www.tadawul.com.sa (2012). 1 USD=3.75 SAR.
Notes: IW stands for Islamic Windows opened in Conventional banks. Two Islamic banks are not included in our sample: Al-Jazira bank (which moved to PLS banking in 2007) and Alinma bank (founded in 2008).

The visual exam of the plots of the series (Fig. 1a–1e and Fig. 2 in Appendices), an exercise not usually carried out in large panel studies, reveals that many variables show trends or very large swings around their mean levels — in other words, they show the typical behavior of a non-stationary series. The importance of this point cannot be emphasized too much: if the data are not stationary, the estimators typically used in the literature (OLS, GMM) are not valid, and an entirely different approach must be followed. This finding casts a doubt on all existing results, which may be flawed.

4.2. Tests and model estimates

We tested for unit root tests by applying the ADF-GLS test (Elliot, Rothenberg and Stock, 1996) to all variables except RYD's *z*-score, which has a large break in mean at 2008:q1, suggesting the use of the test developed by Perron (1989). Since the break is very large and falls precisely at the peak of the financial crisis, we could safely assume the break point to be known, avoiding the use of tests with endogenous break points. The results (details are given

in Table A3) largely support the visual impression: with the exception of income diversity (at all banks) and cost-income ratios (at all banks but one), the variables of our dataset seem to be largely non-stationary. Most important, this is the case for the z-scores, as well. These results show that all banks face different risks in the long run.[13]

As anticipated above, the implications of these results are rather serious. First, if z-scores are non-ergodic, the standard practice of evaluating stability on the basis of sample means of z-scores is obviously not valid. Second, the stationary panel methods widely employed in the extant literature (inter alia, by CH) are similarly not valid (see e.g., Ioannides, Peel and Peel, 2003). Under conditions of non-stationarity, models may be estimated only after having tested for the existence of a long-run equilibrium relationship and only when employing an appropriate procedure. In our case the existence of a long-run equilibrium has an interesting meaning — i.e., that the bank of interest managed to keep under control the deviations of z from its long-run target value. In other terms, the bank behavior helps to reach the financial stability in the long run.

A delicate point is that, in our set-up, not all deviations are alike: negative deviations (those in which z falls below its long-run target value so that the bank is getting closer than desired to default as a result of taking excess risks in order to increase the potential return of its assets) are different from positive deviations (in which z rises above its long-run target value so that the bank is farther than desired from default, as a result of excess caution that could reduce the potential return of bank activities). Hence, we may expect the adjustment coefficients to be different in the two circumstances and the error correction mechanisms to be asymmetric. Of course, standard cointegration tests, such as those developed by Engle-Granger (1987) and Johansen-Juselius (1990), assume symmetric adjustment. The hypothesis of asymmetric cointegration may instead be tested using the generalization of the Engle-Granger test developed by Enders and Siklos (2001), which entails replacing the usual autoregressive equation in the second step of the Engle-Granger procedure with a threshold autoregressive (TAR) step. In our case, the threshold is zero, so that the equation of the second step is defined as follows:

$$\Delta e_t = \begin{cases} \rho_1 e_{t-1} + \sum_{j=1}^{p} \Delta\lambda_j e_{t-j} + \varepsilon_t & \text{if } e_{t-1} \geq 0 \\ \rho_2 e_{t-1} + \sum_{j=1}^{p} \Delta\lambda_j e_{t-j} + \varepsilon_t & \text{if } e_{t-1} < 0 \end{cases} \tag{2}$$

where $e_t = z_t - \beta' X_t$, with X_t a set of explanatory variables and β the vector of cointegrating coefficients; ρ_1 and ρ_2 are the speed–adjustment coefficients. Using the Heaviside indicator I_t, defined as:

$$\begin{cases} 1 & \text{if } e_{t-1} \geq 0 \\ 0 & \text{if } e_{t-1} < 0 \end{cases}$$

equation (2) may be more compactly written as:

$$\Delta e_t = I_t \rho_1 e_{t-1} + (1 - I_t)\rho_2 e_{t-1} + \varepsilon_t$$

The null hypothesis of no cointegration may be tested using the statistics $\mathrm{t}_{\max} = \max(\mathrm{t}_1, \mathrm{t}_2)$, where t_1 and t_2 are the usual t-tests for the hypotheses $\rho_1 = 0$ and $\rho_2 = 0$, and Φ is the F statistic for the joint hypothesis $\rho_1 = \rho_2 = 0$. The distributions of these tests are non-standard but are tabulated by Enders and Siklos (2001). Unfortunately both tests tend to have poor power even when the true data generating process involves a TAR adjustment, as the burden of estimating the extra parameter tends to balance the higher generality of the

[13] The model is implemented at bank-level to extract more specificities of each bank of the panel. The implicit general equation of z-score $z_{it} = f_i(B_{it-1}, S_{t-1}, M_{t-1}, D_i) + \varepsilon_{it}$ where $B_{it-1}, S_{t-1}, M_{t-1}$ and D_i are banks, banking sector, macroeconomic and dummy variables to distinguish between IBs and CBs, respectively (Ghassan and Taher, 2013).

specification. Enders and Siklos (2001) therefore suggested performing a standard no cointegration test as a first step and then checking the data for non-linearity with the TAR version of the test.

We will follow this route, running first the standard Engle-Granger tests (which are more parsimonious and, hence, more suitable for our dataset than Johansen's system tests) for all banks. In the case of RYD, the presence of a clear break in the constant suggested the use of a test that allows for varying parameters — namely, the Carrion-i-Silvestre and Sansó (2006) generalisation of the KPSS test of cointegration with breaks[14]. For all banks, we included only non-stationary variables, so that income diversity (ID) was never included in the model and operating cost-income ratio (CI) was included only for RJH. For the same reason, real GDP growth and inflation, both obviously stationary, have been dropped from the beginning of the study. The results of the cointegration tests are easily summarised (for the details, Appendices, Table A4): cointegration with symmetric adjustment held only for all banks except SBB.

The next step was to run the test allowing for TAR error dynamics. The results (for the details, Table A5 in Appendices) are not available for RYD, since the tests developed by Enders and Siklos assume constant parameters. Bearing in mind that, with only 28 observations, power was likely to be low and that the need for caution is also suggested by the use of critical values simulated for T = 50, we can conclude that the TAR no cointegration tests broadly support the conclusions of the Engle-Granger tests. The hypothesis of symmetric adjustment is never rejected by the F-tests, but this is hardly surprising in view of the small sample size. These results could be explained by the measured risk taking by banks operating together in stock exchange market (Tadawul Stock Index, TASI). We expect that the banks have accumulated experience leading to shifting from more risky situations and to limit the investment of less risky projects.

Summing up, although the sample size is indeed rather small the power of the cointegration tests turned out to be remarkably adequate, as both the Engle-Granger and TAR tests rejected the null hypothesis of no cointegration in all cases but one.[15] Comforted by these conclusions we proceeded to estimate a model of the z-score for each of the five banks for which a long-run equilibrium seemed to hold, namely SAB, SBB, SIB, RJH and BLD. Since our data are not stationary we use an efficient estimator suitable for I(1) data, namely Phillips and Hansen (1990) fully-modified ordinary least squares (FM-OLS). We followed a parsimonious approach searching for the best specification, dropping variables which had either with the wrong signs or with very small coefficients.[16]

As discussed above, following the literature we included in the right-hand side variables a competitiveness index, given by the log of HH index, the market share of Islamic banks, the log of total assets, and the credit-assets ratio. The aim of such variables is essentially that of capturing both global market conditions (i.e. market concentration and prevailing institutional profile) and individual reserve status (total assets, credit-assets ratio) so to measure their

[14] During the second quarter of 2008, the Bank increased its share capital from SAR 6,250 million to SAR 15,000 million (Table 1) through a rights issue of 875 million shares offered to the Bank's existing shareholders which increased the Bank's shares to 1,500 million.

[15] Seasonality here is not an issue, as it will cause weak dependence i.e. asymptotic non-correlation at seasonal frequencies. It is irrelevant for the long-term analysis.

[16] Given the small sample size, irrelevant variables may have non-zero coefficients that lead to spurious non-rejection of the no cointegration hypothesis (Fachin, 2007). Suppose two $I(1)$ variables, y and x, so that $\epsilon_t = y_t - bx_t$ is stationary. Then, consider an $I(1)$ variable ω, independent from y; the residual $\epsilon_t' = y_t - b_1 x_t - b_2 \omega_t$ will be stationary if and only if $b_2 = 0$. This will hold asymptotically but not necessarily in small samples.

impact on financial stability (Laeven and Levine 2009), while allowing for full individual heterogeneity. The final specification used for each bank is provided in Table 2.

The FM-OLS estimates reveal that Saudi American Bank (SAB), which has the largest size and lowest loan-to-asset ratio among Saud's banks, appears to be more risky, this outcome could be a result of its excess-implication in financial derivatives. In contrast, Al-Rajhi Bank (RJH) exhibits much less risk, this outcome could be explained firstly by the positive effect of credit-to-asset ratio and secondly by the tiny marginal negative effect on its z-score. Nevertheless, the conventional small Saudi Investment Bank (SIB) is more stable than the Islamic small Al-Bilad Bank (BLD). The findings show that the largest conventional bank (SAB) seems to be less stable comparing to largest Islamic bank (RJH). Also, the smallest IBs (BLD) stands out less stability in comparison to the smallest CBs (SIB). We can deduce that the presence of IBs could have a favourable influence on the stability of the overall banking system. The FM-OLS estimators show that the financial stability of three of the banks included in our sample, SAB, SIB and RJH, is sensitive to both global market conditions and individual reserve status, while for the remaining two (one conventional, SBB and the other Islamic, BLD) only the latter seems to matter. In the first group, the most noticeable finding is arguably the highly significant negative effect of concentration on financial stability. This result goes against the current conventional wisdom which assumes that higher average bank size implies higher stability. Such outcome can be explained by the non-optimal number of banks in Saudi banking system. It remains that each bank could be exposed to the negative impacts of financial shocks or crises. But, the low financial leverage i.e. $\frac{ROE}{ROA}$, in average around 5.92 for IBs and 8.22 for CBs, supported Islamic banks to confine the impact of the last international financial crisis.

Table 2: FM-OLS estimates (dependent variable logarithm of z-score)

	Conventional Banks			Islamic Banks	
	SAB	SBB	SIB	RJH	BLD
Log of Competitiveness Index	-16.68 (5.60)		-18.13 (6.48)	-54.41 (7.52)	
Share of Islamic Banks	14.46 (6.13)		-17.31 (7.08)	57.35 (8.31)	
Log of Total Assets	-0.33 (0.05)	-0.48 (0.06)	-0.45 (0.08)	-0.03 (0.05)	-0.87 (0.03)
Credits/Assets	-0.62 (0.12)	0.34 (0.22)	0.30 (0.10)	0.50 (0.11)	
Constant	157.23 (50.79)	9.77 (0.78)	171.79 (58.83)	496.30 (68.17)	11.99 (0.30)
ΔConstant after 2008:q2		0.51 (0.04)			

Notes: Standard errors are in parentheses. Using parsimonious approach, the non-significant parameters are dropped from the model (empty box). The FM-OLS proposed firstly by Phillips and Hansen (1990) is an optional estimation to deal with endogeneity bias and any serial correlation of error terms.

Having estimated the equations, we can compute a useful descriptive tool, namely the average number of consecutive deviations from the long-run equilibrium with the same sign (*runs*). From Table 3, we can appreciate that Islamic banks, as a group, have on average longer disequilibrium runs (both positive and negative) than do their conventional counterparts. These outcomes are consistent with the remarks suggested by the analysis of the box-plots in section 3.1. However, we should not overlook the point that this is the consequence of one case, BLD, having disequilibrium runs that were much longer than all other banks included in this sample, while another, RJH, had runs that were the shortest or

nearly so. This is confirmed by the FM-OLS estimates, which were computed for all the banks in which cointegration held: an estimate of the long-run average z-score, the constant of RJH was the largest of all banks, indicating the stability performance of this bank, while BLD's was clearly the smallest, along with SBB's. We noted that, from 2008 to 2009, BLD and SBB recorded decrease in net profits with rates of 66% and 11%, respectively. Since RJH is much larger than BLD (Table 1), these findings were in contrast with those reported by CH, who found that small Islamic banks tended to be more stable than large Islamic banks.

Table 3: Average length of disequilibrium runs

	Conventional Banks					Islamic Banks		
	SAB	RYD	SBB	SIB	Mean	RJH	BLD	Mean
$\bar{R}^+$	2.0	2.1	2.0	2.5	2.1	1.6	4.0	2.8
$\bar{R}^-$	1.6	1.9	2.3	2.2	2.0	1.7	3.5	2.7

$\bar{R}^+$: number of consecutive observations such that $e_t \geq 0$.
$\bar{R}^-$: Number of consecutive observations such that $e_t < 0$.

The signs of the coefficients are broadly in line with both our expectations and with those reported in the extant literature: when included in the final specification, competitiveness has a negative impact on stability, which is consistent with the findings of, for instance, Schaeck, Čihák and Wolfe (2006) and Beck, Demirgüç-Kunt and Levine (2006). It means that lower concentration in the banking sector decreases more the likelihood of failure for IBs than CBs. Size also seems to have a negative effect on stability, more clearly so for conventional banks, which all have very similar coefficients, than for the two Islamic banks in our sample, which had very different measures of elasticity. Finally, when included in the final specification, the market share of Islamic banks has, with one exception, a positive effect on stability.

5. Conclusion

This article analyzes the features of a panel of Saudi Arabia Islamic and conventional banks. Our study reached several interesting conclusions. First, for our sample of Saudi banks, the variables typically used in financial stability studies appear to be largely non-stationary, a feature heretofore ignored in the literature. This suggests that the available results based on stationary panel regressions, as in CH (2010) and Abedifar et al. (2013), should be treated with caution. Our examination of the cointegration properties of the variables led us to find that all of the banks included in our sample but one managed to keep their z-scores stationary around some long-run desired level determined by total assets, credit-assets ratio, the competitiveness of the banking sector and the share of Islamic banking in the banking sector. The only exception proved to be a single conventional bank, Saudi British Bank, which somehow supports the view of this type of bank as comparatively less stable than an Islamic bank. However, a comparison of the long-run average z-scores, as estimated by the constants of FM-OLS regressions of the cointegrating banks, suggests that individual heterogeneity may matter more than the conventional or Islamic nature of the banks. Also, since that each group of banks has specific attitude towards risk and stability, the monetary authority SAMA should apply different regulation and legislation systems. The running of such policies would generate more competitiveness and efficiency in the banking system. Clearly, further work is needed, for instance applying GARCH models to the analysis of volatility in z-scores.

Acknowledgements

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6. Appendices

Table A1 Brief banks identity

Name	Start year	Main features	Average assets in SAR billion 2005-2011
Riyad Bank (RYD)	1957	237 branches, providing a full range of banking and investment services	135
Saudi Investment Bank (SIB)	1976	45 branches, full range of traditional wholesale, retail and commercial banking products and services, in particular for the industrial sector	46
Saudi British Bank (SBB)	1978	One of the first banks to issue credit cards in the Saudi market	104
Samba Financial Group, Saudi American Bank (SAB)	1980	First Bank in Saudi Arabia to offer Foreign Exchange Derivatives, Interest Rate Derivatives and Credit Shield Insurance	157
Al-Rajhi Bank[17] (RJH)	1976	Practicing banking and investment activities in a manner that respects traditional Islamic law	147
Al-Bilad Bank[18] (BLD)	2005	Providing a full range of Shariah-compliant banking services	16

Table A2 Main Differences between Islamic and Conventional Banks

	Conventional Banks	Islamic Banks
Model	Based on conventional law, seek to maximize profits subject to differential interest rates.	Based on Islamic law (Sharia), seek to maximize profits subject to Profit-Loss Sharing (PLS) System.
Risk [a]	• Shifting risk when involved or expected. • Guarantee all its deposits. • Focus on the credit-worthiness of clients.	• Bearing risks when involved in any transaction. • Guarantee only current account deposits, with other deposits invested via multilayer Mudarabah system as part of the PLS system. • Focus on the viability of projects.
Money and liquidity	• Interest on borrowings made from any market. • Sale of debts.	• Based on Sharia-compliant rules and regulations for any transaction. • Large restrictions on the sale of debts.

Source: Ahmad and Hassan (2007). [a] For more details, Van Greuning & Iqbal (2008).

[17] RJH is listed as the second leading International Islamic financial institution in terms of Shariah-compliant assets, with USD 45.53 billion as of 2010 (The Banker 2010).

[18] The bank has a Shariah Department that is responsible for follow-up and monitoring of the implementation of the Shariah-based decisions issued by the Shariah Committee.

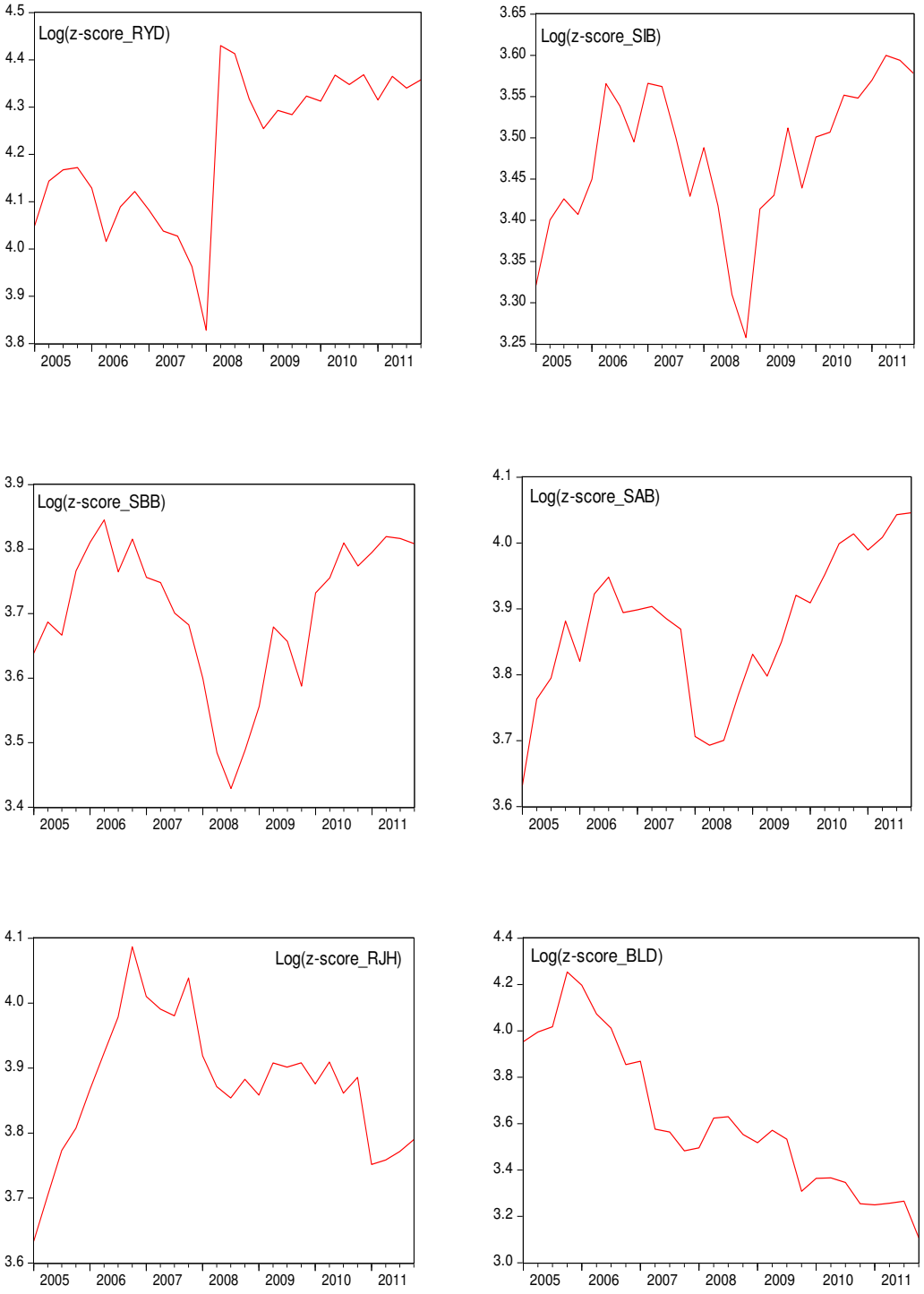


Fig. 1a: *z*-scores, 2005:q1–2011:q4 (Natural Logarithm of z-score, LZ)

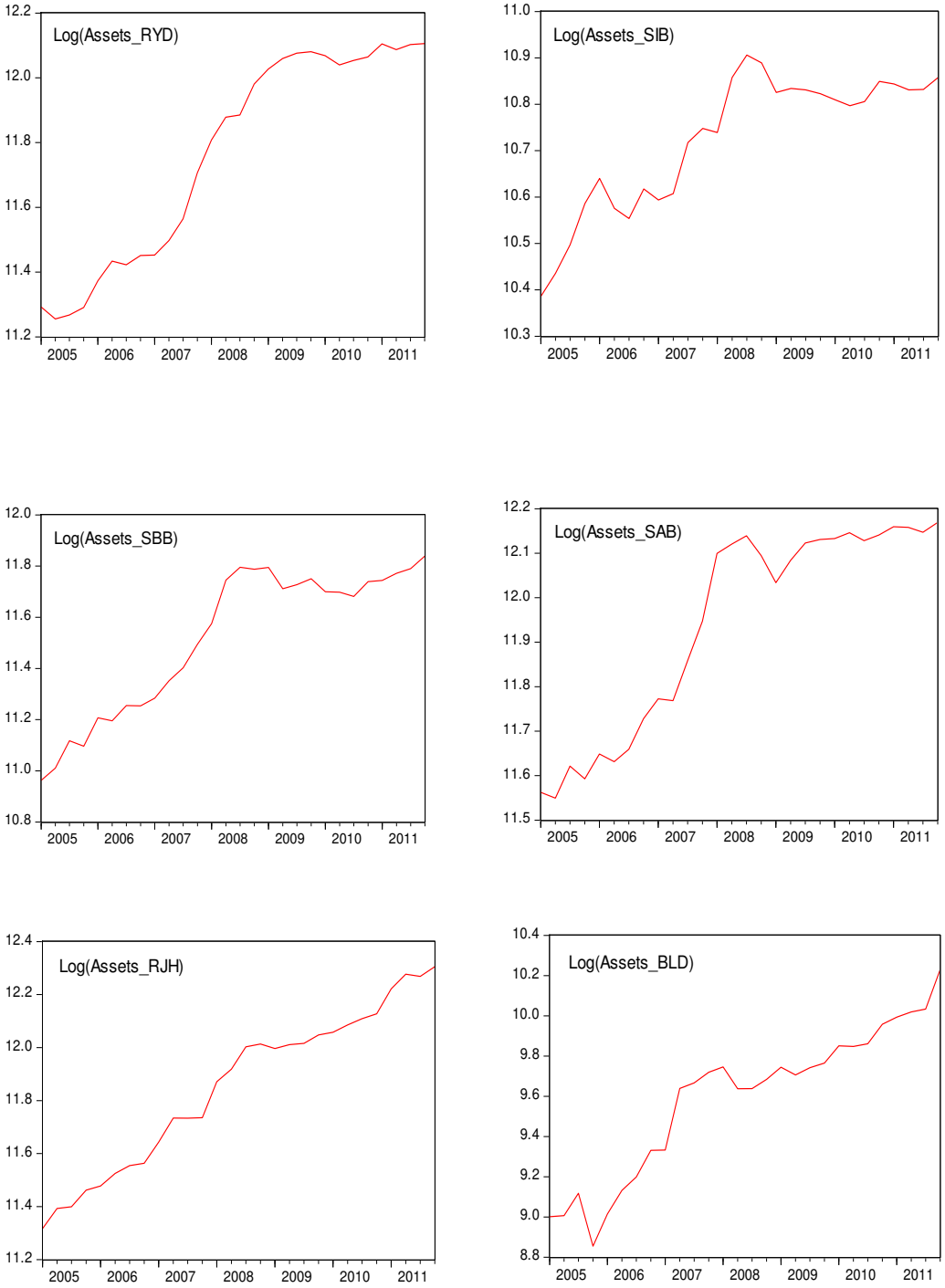
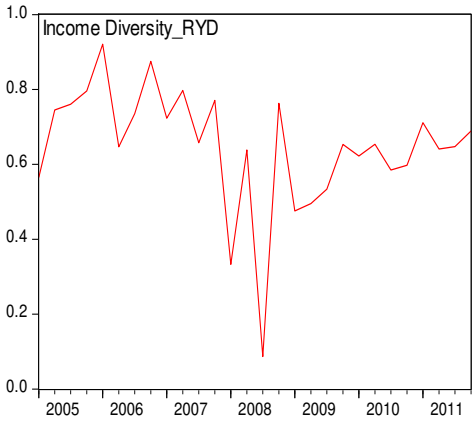
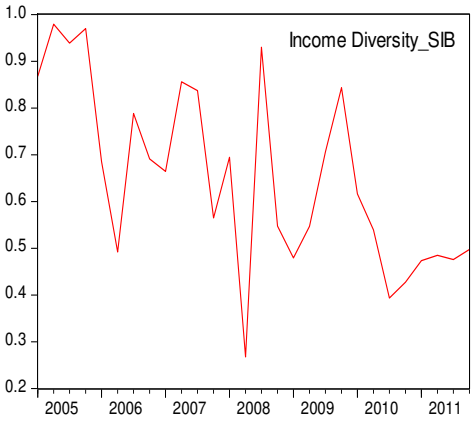


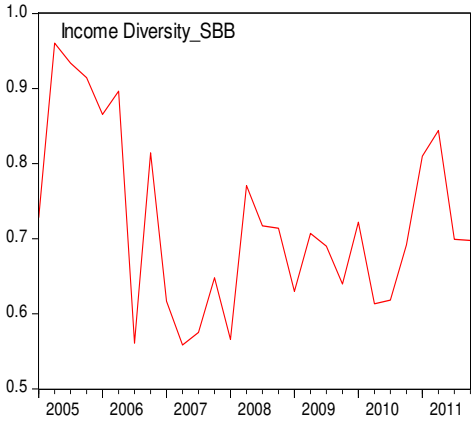
Fig. 1b: Total assets (Bank size), 2005:q1–2011:q4 (Natural logarithm of Assets, LA)

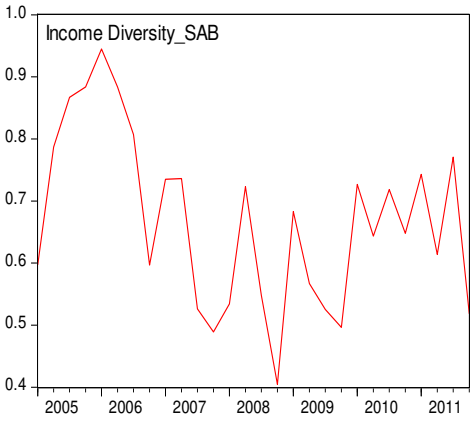
Fig. 1c: Credit-assets ratio 2005:q1–2011:q4

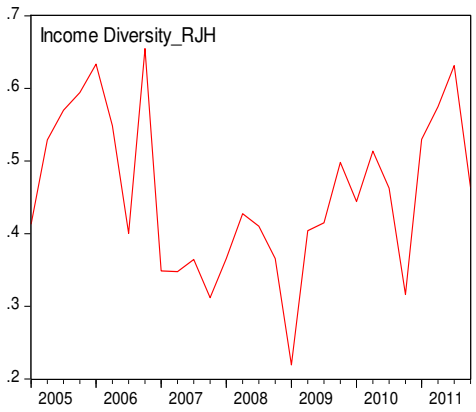
Fig. 1d: Cost-income ratio, 2005:q1–2011:q4











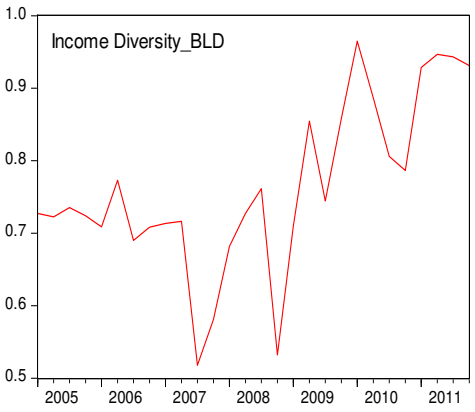


Fig. 1e: Income diversity, 2005:q1–2011:q4

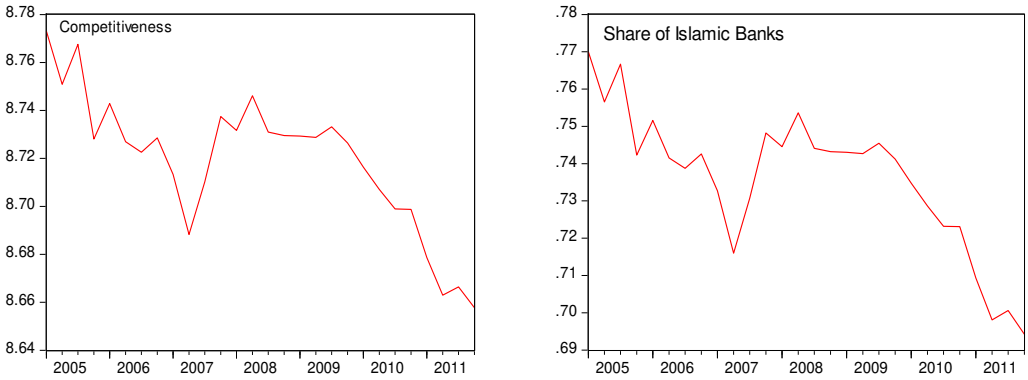


Fig. 2: Competitiveness (left, natural logarithm of HH Index) and share of Islamic banks in the Saudi banking sector (right, IS ratio), 2005:q1–2011:q4

Table A3 Unit root tests

	Conventional Banks				Islamic Banks	
	SAB	RYD	SBB	SIB	RJH	BLD
LZ^a	-1.08 (0.25)	-2.71[b]	-1.36 (0.16)	-1.73 (0.08)	-1.58 (0.11)	-0.19 (0.61)
LA^c	-1.08	-1.50	-1.92	-1.78	-1.99	-2.27
CA^a	-0.99 (0.29)	-1.64 (0.09)	-2.09 (0.04)	-1.49 (0.13)	-0.40 (0.54)	-0.15 (0.63)
CI^a	-5.16 (0.00)	-2.91 (0.00)	-2.58 (0.01)	-2.52 (0.01)	-1.33 (0.17)	-3.85 (0.00)
ID^a	-3.07 (0.00)	-2.28 (0.02)	-3.25 (0.00)	-3.64 (0.00)	-3.38 (0.00)	-2.30 (0.02)
HH^a	-0.70 (0.41)					
IS^a	-0.53 (0.49)					

[a] : ADF-GLS with constant, except bank 2 (RYD), p-values in parenthesis.
[b] : $t_{\tilde{\alpha}}$ (Perron, 1989, model A, break in 2008:q1), critical values (5%, 10%): -3.76, -3.46.
[c] : ADF-GLS with trend, critical values (5%, 10%): -3.19, -2.89; lag length selection: Ng-Perron (t-test on last lag).

Table A4 Engle-Granger No-Cointegration tests

Conventional Banks				Islamic Banks	
SAB	RYD	SBB	SIB	RJH	BLD
-5.04 (0.04)	0.03	-3.31 (0.32)	-4.67 (0.08)	-5.04 (0.04)	-3.82 (0.03)

Banks SAB, SBB, SIB, RJH, BLD: Engle-Granger tests, p-values in parentheses.
Bank RYD: cointegration KPSS test with break, H_0: cointegration; (Carrion-i-Silvestre and Sanso, 2006, Model An); critical values (5%, 10%): 0.087, 0.071.

Table A5 TAR No-Cointegration tests

	Conventional Banks			Islamic Banks	
Test	SAB	SBB	SIB	RJH	BLD
t_{max}	-3.48**	-2.06*	-2.61**	-2.37**	-1.79
Φ	9.56**	3.72	7.71**	4.43	6.66**
F	0.03 (0.86)	0.05 (0.82)	0.69 (0.41)	0.06 (0.81)	0.77 (0.39)

t_{max}: Critical values (5%, 10%): -2.16, -1.92; Φ: critical values (5%, 10%): 5.08, 6.18; F: F-test for H_0: $\rho_1 = \rho_2$, p-value in parentheses; Lag length selected by AIC always equals to 1. *, **: significant at 10% and 5%, respectively.

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