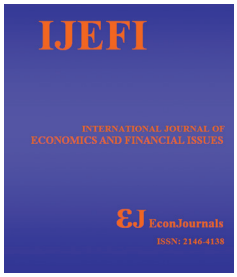

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Financial Performance of Islamic Versus Conventional Banks a Comparative Analysis for Jordan

Malika Neifar[1]*, Sameh Charfeddine[1], Aida Kammoun Abdelmoula[2]

[1]IHEC, University of Sfax, Sfax, Tunisia, [2]ISAAS, University of Sfax, Bestmod Laboratory, University of Tunis, Tunis, Tunisia. *Email: malika.neifar@ihecs.usf.tn

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ABSTRACT

This paper contributes to the empirical literature on interest-free finance by investigating the financial performance of interest-free and conventional banks in Jordan over the period 2005–2014 covering GFC period. Three models, two sub-periods, and 11 ratios are considered to compare bank performance evolutions. We give first a univariate based t-test analysis, and then a discriminant analysis is presented in order to determine which variables differentiate between conventional and Islamic banks. Finally, a multivariate nonlinear analysis from Binary outcome panel data models such as Probit and Logit model is conducted. Based on t-test univariate analysis, there is significant evidence that Islamic Banks (IBs) are in average less stable and more risky than conventional banks (CBs) for the three considered periods: Full period, pre Global Financial Crisis (GFC) and post GFC. Pre GFC, IBs are more capitalized, more liquid, and more profitable in average. However, post GFC, IBs are in average only more liquid in addition to excess of instability and credit risk. From the results of Pooled Probit model, interest free banks seem again to be less stable, but less liquid, and riskier for the total period. The failure to find more stability for IBs is due to assumption of a stable relationships. Once we introduce interaction effect variables to take into account of behavior instability (due to Subprime crisis [GFC]), we show that IBs are rather more stable, more liquid but less profitable post GFC.

Keywords: Jordan, Islamic Banks versus Conventional Banks, Univariate and Multivariate Analysis, GFC of 2008
JEL Classifications: E32 E44 G01 G21 G32 Z12

1. INTRODUCTION

A vast empirical literature compares Islamic banks (IBs) and conventional banks (CBs) in terms of their financial indicators (e.g.; (Beck et al., 2013; Chowdhury et al., 2016; Daoud and Kammoun, 2017; Neifar and Gharbi, 2020; Daoud and Kammoun, 2020; Neifar, 2020; and Majeed and Zainab, 2021). The outcome results do not make clear cut about whether IBs are more Profitable, more liquid, more risky in credit or in insolvency, or more stable than CBs.

This paper contributes to this empirical literature by investigating the performance of interest-free and CBs in Jordan. The study of the Jordanian banking system is very important since this Jordanian banking system has undergone a profound competitive and regulatory changes in the 1990s period preceding the 2008 global financial crisis (GFC).

On the regulatory front, the Jordanian Central Bank (JCB) has launched a series of reforms to ensure the stability of its banking system. Several stylized facts are worth highlighting:

i. Applying the recommendations of the Basel I Accord as early as 1993, the JCB imposed at that time a solvency ratio (Equity/Risk Weighted Assets) of 10%, which was raised to 12% in 1997, instead of the 8% recommended in the Basel accords. This threshold is still applied today
ii. Following the destabilizing effects of the bank over-leverage observed during the subprime crisis, the Basel Committee

defined a leverage ratio (Tier 1 capital/total assets), and set the minimum threshold at 3%. This ratio is supposed to act as a safety net. In fact, CBJ decided in 2007 to impose a liquidity ratio (liquid assets/short-term liabilities-the definition recommended by the IMF) of 100% for foreign currency assets and 70% for those denominated in domestic currency

iii. In response to the crisis that began in 2007–2008, the Jordanian banking authorities introduced a guarantee on local and foreign currency deposits and interbank loans in 2009 (until the end of 2010) in order to strengthen confidence in the banking system. The CBJ's prudential ratio requirements have been largely met by Jordanian banks (Zrelli et al., 2017).

As mentioned, these reforms seek to ensure the stability of Jordanian banking system and so to protect the banking system from crises. It will be interesting to see whether these reforms have been successful in protecting against the subprime crisis in 2008. On the competitive side, Jordan adopted a policy of privatization and liberalization in order to improve the efficiency of the banking system and to attract capital to finance its development (Maghyereh, 2004). According to (Kouzez and Bruno, 2019), in the last 10 years, six foreign banks have received approval to operate in Jordan, bringing the number of foreign bank subsidiaries to ten out of a total of 26 institutions. Of these, fifteen (15) are now listed on the Amman Stock Exchange, two (2) of which are IBs (Jordan Islamic Bank and Jordan Dubai Islamic Bank).

It seems that the number of IBs in the Jordanian banking system is relatively low, which leads us to ask the question of their performance: In fact, this low number may imply a low demand for their products which will explain low performance of IBs. In this sense, the study by Zrelli et al. (2017) argues that IBs represent less than 5% of the market in Egypt, Jordan, Palestine and Yemen. In addition, this study argues that the IBs in Jordan (as well as in Tunisia, Syria and Yemen) are non-performing, explaining this by the fact that Jordan is constitutionally independent of Shariah.

It is clear that a comparative study of the annual financial performance of the Islamic and conventional banking industry is interesting and necessary for Jordan. Moreover, such a study, pre and post the subprime crisis, is missing in the literature.

Three technics are considered for performance analysis and comparisons. In a first stage, we give a univariate analysis based on t-test statistic. In a second stage, a discriminant function analysis is investigated. And, in the third stage, a multivariate nonlinear analysis for panel data from Probit and logit model is conducted. Unlike previous research (Khediri et al., 2015 and Parashar and Venkatesh, 2010) who focus on 2008 GFC crisis only by modeling estimation results for sub periods (pre, during, and post GFC), our study seek to explain changes of results via interaction variables. This approach appreciates better differences in IBs and CBs of our Jordanian sample while controlling for behavior changes occurring after GFC period.

This study proceeds as follows: After a brief introduction, section 2 gives a literature review related to banks performance. Section 3 describes the data, variables and methodology. Section 4 gives a univariate descriptive comparative study between IBs and CBs based on t-test statistic, presents discriminant function analysis results and discusses results of nonlinear Panel Logit and Probit models. Section 5 concludes the paper.

2. BANKS PERFORMANCE: LITERATURE REVIEW

The literature comparing business models and financial characteristics of Islamic and CB is conflicting. The first category supports the similarity hypothesis suggesting that the two categories were not fundamentally different in view of their financial indicators. In this literature, we cite (Chong and Liu, 2009; Ariff and Rosly, 2011; Aggarwal and Yousef, 2000; and Khan, 2010). (Olson and Zoubi, 2008) confirmed that this result seems logical since both types of banks operate in the same industry in the same region of the world and are all submitted to the same regulations imposed by central banks such as financial reporting rules and the Basel capital requirements.

On the other hand, the alternative hypothesis suggests that despite some similarities, there are some considerable differences between the two categories of competitive banks and that some financial indicators can be significant discriminators between them. In this context, Beck et al. (2013) proved empirically on a sample of 510 banks including 88 IBs examined over the period 1995-2009, the existence of certain differences in activity, efficiency, asset quality, and stability between Islamic and CBs. Specifically, according to the results, IBs appeared less efficient but had higher intermediation ratios, better asset quality, and were more capitalized than their conventional corollaries.

For (Olson and Zoubi, 2008), results on a sample of 237 banks over the period 2000-2005 show that variables retained to measure profitability, efficiency, asset quality, liquidity, and risk could be good to distinguish between the two categories of banks. Specifically, their results show that IBs are more profitable but less efficient and more risky than CBs. On a sample of 76 banks of GCC (Golf Cooperation Council) over the period 2005-2014, Miah and Uddin (2017) provided evidence that IBs are functionally different from their conventional counterparts and the difference remains valid even after controlling for bank-specific variables as well as country dummy. They also proved that IBs are more stable in the short-term than CBs and no significant difference is found between them as far as the long-term stability is concerned.

For (Khediri et al., 2015), results found on 61 Islamic and CBs in GCC over the period 2003-2010 indicate that IBs are more profitable, more liquid, better capitalized, and have lower credit risk than CBs. In the same line, (Parashar and Venkatesh, 2010) have tested for 12 banks from GCC countries over 2006-2009 period and found results proving that IBs are higher capitalized and more profitable over 4 year period.

For (Neifar and Gharbi, 2020), in the Tunisian context for a sample of 16 banks observed over 2005-2014 period, the results found

suggest that IBs tend to have higher levels of profitability, liquidity, capitalization and stability but are riskier and less solvent than CBs.

The argument about higher capitalization of IBs is also supported by (Metwally, 1997; Samad, 2004; Olson and Zoubi, 2008; and Toumi et al., 2010). (Daoud and Kammoun, 2020) supported that well-capitalized IBs have lower risk of insolvency which indicates better capacity to absorb financial shocks for IBs. However, in a dynamic context, it was recently proved by (Hoque and Liu, 2021) that the adjustment speed to adapt capital structure to asset risk exposure is lower for IBs than conventional ones.

Using data for 25 banks of the UAE, the results of (Miniaoui and Gohou, 2013) study show that the conventional banking system in the UAE is performing better than the Islamic one. After the GFC crisis, IBs seem to close the gap for most of performance indicators.

Differences in financial indicators between the two categories of banks during and after crisis periods had been proved by many other empirical studies such as (Parashar and Venkatesh, 2010) who provide empirical evidence that during crisis, Islamic banking suffered more in terms of capital adequacy and leverage while their conventional competitors suffered more in terms of return on average assets and liquidity. Results of (Hasan and Dridi, 2010) support the greatest performance of IB during the crisis. (Beck et al., 2013) results show that the better capitalization and better quality of the assets of IBs allowed them to outperform CBs during the GFC. They also show that IBs are globally more resilient to financial shock than their conventional counterparts. This finding is supported by (Abedifar et al., 2013) and also by (Rahim and Zakaria, 2013) but is in contradiction with the results of (Kabir and Worthington, 2017) suggesting that IBs are less stable than CBs and (Bourkhis and Nabi, 2013) showing no significant difference in terms of the effect of the financial crisis on the soundness of the two categories of banking.

In the study of (Hoque and Liu, 2021) concerning a sample from 23 countries between 1995 and 2015, results reflect that IBs seem to be in a disadvantaged position compared to others in the capabilities of managing capital structure to support asset expansion implying that IBs need a regulatory framework to help address the major risks inherent in their operations and to establish a level playing field with CBs.

3. DATA, VARIABLES AND METHODOLOGY

3.1. Data and Variables

In this paper, we use panel data of Jordanian individual banks' balance sheets from DataStream. Data is based on annual frequency from 2005 to 2014, and covers 13 Jordanian banks: 3 Islamic and 10 CBs (Table 1).

We have 130 observations, or bank-years of data, for banks operating in Jordan. There are 100 observations for CBs and 30 observations for IBs. Eleven financial ratios are considered. We classify these ratios into four groups: profitability ratios (ROA, and ROE), liquidity ratios (CTA, and CTD), credit risk (LLR, NPL, LTA, LTD), and insolvency risk (DTA, Z-score, CAP). These variables are defined in Table 2.

In addition, we use the Z-score as a measure of bank stability. It indicates the distance from insolvency, combining accounting measures of profitability, leverage and volatility, which has been widely used in the literature [see for example (Laeven and Levine, 2009) and (Houston et al., 2010)]. The Z-score variable can be calculated as follows:

$$Zscore_{it} = \frac{ROA_{it} + (\frac{EQ}{TA})_{it}}{\sigma ROA} \text{ for bank i in year t,}$$

Where,

- ROA is the standard measure of return on asset
- Equity to assets ratio (ETA= EQ/TA)
- And σ_{ROA} is the fluctuation of ROA measured by the standard deviation.

The higher the Z-score the lower is the bank's default risk.

Table 3 presents descriptive statistics (average value, max value and min value for all banks for each variable, number of observations, as well as standard deviations). According to Table 3, based on means and medians, it appears that banks have comparable characteristics for Z-score, CAP, LLR, LTA, ROA and ROE. On the other hand, a disparity is noticed for other ratios.

Table 1: Bank list

Conventional banks	Islamic banks
• Arab bank Plc	• Islamic international Arab bank
• Arab banking corporation	• Jordan dubai Islamic bank
• Bank of Jordan Plc	• Jordan Islamic bank
• Cairo Amman bank	
• Capital bank of Jordan	
• Housing bank for trade and finance	
• Jordan Ahli bank Plc	
• Jordan commercial bank	
• Jordan Kuwait bank	
• Société générale de banque	

Table 2: Definition of variables

Ratios	Definitions
Profitability	
ROA	Return on assets=Net income/total assets
ROE	Return on equity=Net income/stockholders' equity
Liquidity	
CTA	Cash to assets=cash/total assets
CTD	Cash to deposits=cash/total customer deposits
Credit risk	
LLR	Loans loss reserves to gross loans
NPL	Non-performing loans to gross loans
LTA	Loans to assets=loans/total assets
LTD	Loans to deposits=loans/total customer deposits
Insolvency risk	
DTA	Deposits to assets=Deposits/Total assets
Z-score	A measure of bank default risk $Zscore_{it} = \frac{ROA_{it} + (\frac{EQ}{TA})_{it}}{\sigma ROA}$ For bank i in year t
CAP	CAP=total capital/total assets

Table 3: Descriptive statistics

	NPL	Z_SCORE	CAP	CTA	CTD	DTA	LLR	LTA	LTD	ROA	ROE
Mean	0.092089	33.42519	0.155093	0.135233	0.689683	0.072360	0.049188	0.472257	1.018167	0.015448	0.108121
Median	0.064400	32.99399	0.133056	0.099885	0.175650	0.052968	0.044010	0.482320	0.740500	0.014765	0.109400
Maximum	0.513400	109.4492	0.826118	0.578606	34.20000	0.369436	0.218910	0.809650	9.737300	0.078947	0.257354
Minimum	0.000000	1.906303	0.051698	0.000348	0.009781	0.000000	0.000000	0.000000	0.000000	-0.013055	–0.031674
SD	0.090192	17.12110	0.097584	0.118521	3.469265	0.070997	0.039990	0.143775	1.237967	0.011270	0.056223
Skewness	2.313775	1.512776	3.848881	1.881492	8.596608	1.188537	2.172692	-1.282831	4.624692	2.569833	–0.100375
Kurtosis	10.43340	7.940708	22.54938	6.667515	80.92991	4.526630	9.310390	6.824360	28.52567	15.00034	2.787028
Obs	93	116	117	119	111	115	99	102	98	118	116
Prob	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.813014

So, Jordanian banks are comparable in terms of profitability and insolvency risk but different in terms of liquidity and credit risk.

3.2. Methodology

To investigate business models and financial characteristics differences between conventional and IBs of our sample, we use a three-step progressive analysis. First, we compare between the two categories of banks using a univariate based t-test analysis. Second, we apply discriminant analysis in order to determine whether the retained variables differ between Islamic and CBs of our sample and which of them discriminate better between the two groups. Third, we use the multivariate nonlinear analysis for panel data from Probit and logit model. We take account of behavior instability (due to Subprime crisis [GFC]) using interaction variables.

3.2.1. Discriminant analysis

The aim is to determine whether the variables of financial characteristics and performance indicators of our analysis differ between Islamic ad CBs of our sample and which of them discriminate between the two groups.

Discriminant function analysis can so be used to determine which variables are the best predictors to discriminate between IB and CB. The dependent variable to be predicted is the categorical variable:

Y_{it}= 1, If Bank i is IB and zero if not.

The discriminant variables are the 11 variables defined in Table 2. Standardized regression coefficients are given for the overall period. The larger the coefficient is, the greater the contribution of the respective variable to discriminate between IB and CB.

3.2.2. Multivariate nonlinear models

We consider a binary outcome in which Y_{it} the dependent variable to be predicted is a categorical variable taking on the value of one for an Islamic bank and zero for a conventional bank;

Y_{it}= 1, If Bank i is IB and zero if not.

Then parametric model to be considered is the Panel Probit or Logit (nonlinear) regression. These models suppose that the probability of dichotomous outcome $Yi, P_i = P(Y_{it} = 1/X)$ is related to a set of potential predictor variables X in the forms:

$$P_i = \begin{cases} \phi(\beta_{i0} + \sum \beta_k X_{kit}) \\ \Lambda(\beta_{i0} + \sum \beta_k X_{kit}) \end{cases} \quad (1)$$

Where,

- Φ is the standard normal cumulative distribution function (CDF) for the probit model
- $\Lambda(z)= \frac{\exp(z)}{1+\exp(z)}$ is the logistic CDF for logit model,
- $\beta i0$ is the intercept term (individual time invariant specific effect),
- βk for k ∈ (1..., K) represents the coefficient associated with the corresponding explanatory variable $Xkit$.

If individual-specific effects are not present, then the alternative to the random effects model is the following pooled binary model:

$$P(Y_{it} = 1/X) = F(X_{it}\beta) \quad (2)$$

where,

- F ≡ Φ for Probit model and Λ for logit one
- $X_{it} = (X_{1it},\ldots, X_{Kit})$ and $\beta = (\beta_1,\ldots, \beta_K)'$.

Ignoring the random effects in a pooled model produces an inconsistent-downward biased estimate of β. The fixed effects model encounters an incidental parameters problem that renders the maximum likelihood estimator inconsistent (Greene, 2012). So, in this paper only Pooled and random effect models will be estimated.

4. RESULTS AND DISCUSSION

4.1. Univariate Analysis

The univariate analysis is carried out to investigate the evolving behavior of all banks over the period of study, for pre-crisis period (2005-2008) and the post-crisis period (2009-2015). Table 4 presents mean for each variable for all banks, average value for conventional and IBs as well as the P-value of a two-sided t-test.

The t-student analysis shows that IBs are significantly different from CB at 5% level with respect to some variables used in this study (Panel A for the full period of the study, Panel B for Pre Global financial crisis (GFC) 2008, and Panel C for post GFC).

The results show that for all periods considered, there are significant differences in business orientations and financial characteristics between Islamic and CBs.

For the full period of the study (Panel A), difference is significant (at 1%) for Z-score, Capital adequacy ratio (CAP), Loan to asset (LTA), Loan to deposit (LTD), and Non-performing loans (NPL). On average, compared to CBs, Islamic entities show higher

Table 4: Comparison of means between CB versus IB: *P* value for student t statistic for different periods

	All	Panel A: ALL			Panel B: PRE 2008			Panel C: POST 2007		
		IB	CB	P-value	IB	CB	P-value	IB	CB	P-value
NPL	0.0715949	0.1937923	0.0755625	0.0000	0.10654	0.0647367	0.1347	0.248325	0.082058	0.0000
Z-score	32.88629	21.21227	36.28353	0.0001	23.94103	34.4505	0.0104	19.32313	37.14276	0.0022
CAP	0.1452053	0.2070808	0.1430541	0.0051	0.2116527	0.13659	0.0259	0.2039157	0.1460376	0.0608
CTA	0.1101014	0.1663257	0.1281805	0.1740	0.1225481	0.1311097	0.8845	0.1966333	0.1268689	0.0193
CTD	0.1911196	1.882223	0.3948984	0.0716	0.221215	0.1255482	0.0320	3.032151	0.5121961	0.0487
DTA	0.088069	0.0916428	0.0687815	0.2110	0.1396836	0.0701746	0.0611	0.0676224	0.0681578	0.9792
LLR	0.0426173	0.0463145	0.0499161	0.7210	0.02166	0.0422317	0.0668	0.05959	0.0546208	0.7269
LTA	0.4907702	0.5595823	0.4482426	0.0010	0.53695	0.4313433	0.0837	0.5752508	0.4583822	0.0038
LTD	0.9467915	2.289222	0.73218	0.0000	2.822057	0.7243833	0.0014	1.950145	0.736858	0.0000
ROA	0.0153761	0.018847	0.014669	0.1172	0.0320543	0.0193052	0.0218	0.0097035	0.0125616	0.1781
ROE	0.1133375	0.1170018	0.1060422	0.4129	0.1494404	0.1450643	0.8041	0.0945443	0.0877507	0.6664

probability of default as measured by Z-score despite their higher levels of capitalization. This can be explained by their lower assets quality as reflected by their greater engagement in credit activity (LTA and LTD indicators) and non-performing loans ratio with significantly higher averages for IBs. Interest-free banks are also more liquid and more profitable but differences with CBs are not significant.

After considering the two sub-periods separated by GFC, differences in average values characterizing the two groups of our sample do not change in orientation but present lower statistic and economic significance.

For Pre GFC period (Panel B), difference is significant for Z-score, Cash to deposit (CTD), Capital adequacy ratio (CAP), Loan to deposit (LTD), and return to Asset (ROA) at 1% level. For capitalization and Z-score indicators, results for the entire period are also confirmed for pre-GFC. The profitability, as measured by the ROA, is higher for interest-free banks than for conventional peers. The ROA of 3.21% for interest-free banks versus 1.93% for CB is significantly larger at the 5% level. However, when we use the ROE as proxy of profitability, we do not find any significant difference between IBs and CBs. Evidence shows that interest-free banks show higher levels of Credit to Deposit ratio (282.21%) than CBs case (72.44%) for Pre GFC periods at 1% level of significance. However, IBs show for pre GFC period, Liquidity ratio that is significantly higher than CBs. The cash to deposit ratio in average for the Interest free banks is 22.12% which is higher than 12.55% ratio for CBs. For this ratio, the difference is significant at the 5% level and supports the better liquidity for the Interest free banks.

Globally, for Pre GFC, IBs are found to be less stable, more capitalized, more liquid, more risky, and more profitable than CB in average.

For Post-GFC period (Panel C), difference is significant for Z-score, Cash to deposit (CTD), Cash to asset (CTA), Loan to deposit (LTD), and Loan to Asset (LTA) at 1% level. Evidence shows that the liquidity of IBs, measured by cash to deposits ratio (CTD) and cash to Asset (CTA), is statistically higher during the Post GFC. Regarding the credit risk exposure, the average loans to assets ratio (LTA) and the average loans to deposits ratio (LTD) for IBs are higher than CBs and the difference is statistically significant indicating higher levels of intermediation activities.

For Post GFC, IBs are found to be less stable, more liquid, and more risky than CBs in average.

The t-student analysis results of our study on Jordanian banks so far provide suggestive evidence of statistically significant differences between Islamic and CB' activities and financial performance. This is in line particularly with (Beck et al., 2013; Miniaoui and Gohou, 2013; Miah and Uddin, 2017; Olson and Zoubi, 2011) empirical studies.

So far, we provided empirical evidence that IBs are less stable both before and after GFC since interest-free banks of our sample show lower Z-score average values for all considered periods though they show higher capitalization levels than the CBs. These results are in contradiction with those of (Parashar and Venkatesh, 2010; Beck et al., 2013; and Kabir and Worthington, 2017) who found that gaps in capitalization and stability levels of Islamic and Non-Islamic banks changed after financial crisis.

However, univariate analysis show that pre GFC, compared to CBs, IBs are in addition, more liquid, and more profitable in average. Post GFC, IBs show more developed levels of intermediation activities which expose them to higher credit risk.

4.2. Discriminant Analysis

Table 5 provides the standardized regression coefficients in multiple regression for the overall period. The larger the standardized coefficient, the greater is the contribution of the respective variable to discriminate between IBs and CBs.

The measure of credit risk, loan to deposit (LTD), was the strongest predictor in discriminating the two types of banks, while return to Asset (ROA) was the next in importance as a predictor. These two ratios are followed respectively by Z-score measure for stability, liquidity ratio measured by cash to deposit (CTD), the insolvency measure debt to asset (DTA), the cash to asset (CTA), loan to asset (LTA), LLR, ROE, NPL, and CAP.

4.3. Regression Estimation Results

Unit root test results for each ratio are presented in Table 5. From this table, we see that only ROA, CTA, and CTD are stationary. Then, before looking for significant linear association between considered ratios, we get in first difference all non-stationary series.

The classification results of logistic regression are sensitive to high correlation between the explanatory variables. Hence, because of the problem of multi-collinearity, we excluded some of the explanatory variables. In fact, after an examination of the correlation matrix (Table 6), we conclude that only 4 out of the 11 ratios can be used in a regression model, which are Z-score, NPL, LTA, and CTA.

Estimation results of Pooled ($\beta_{\square 0} = \beta 0 \; \forall \; i$) Probit model and of Pooled Logit model for overall period (2005-2014), are given respectively at column (1) and column (3) in Table 8. Robust estimation of both models are given at column (1)' and column (3)'.

Estimation results of random effect Probit model and random effect Logit model are given at column (2) and column (4) in the same Table ($\beta i0$ is a random bank specific effect) [1] The fitted values from regression are the estimated probabilities for Yit=1 for each observation i [2].

The choice of one specification Pooled Probit (Logit) rather than the Random Probit (Logit) cannot be based on the likelihood ratio test because of the two likelihoods are not comparable [3]. The choice between Pooled Probit (Logit) model and Random Probit (Logit) models will be based on Hausman test. (Hausman, 1978)'s specification test compares an estimator βc that is known to be consistent (under Ho and Ha) with an estimator βe that is efficient under the assumption being tested Ho (but inconsistent under Ha). Under the null hypothesis of homogeneity, Ho: $Q_{i0} = Q0 \; \forall \; i$, usual maximum likelihood estimator for pooled model is efficient (but inconsistent under alternative). Maximum likelihood estimator for random model is consistent under null hypothesis of homogeneity and under the alternative but non-efficient under the null hypothesis of homogeneity.

Table 5: Standardized canonical discriminant function coefficients

LTD	ROA	Z-score	CTD	DTA	CTA
0,813	–0.282	–0.269	0.243	0.215	–0.2
LTA	LLR	ROE	NPL	CAP	
0.179	–0.155	–0.124	0.082	0.081	
Canonical correlation		**Wilks' lambda**		**Chi²**	**P-value**
0.79		0.376		50.388	0

This table reports the results from linear discriminant analysis model for full period

If the null hypothesis of homogeneity is true, there should be no systematic difference between the two estimators. If it exists a systematic difference in the estimates, we have reason to doubt the assumptions on homogeneity. The Hausman statistic is distributed as χ^2 (K) under null hypothesis and is computed as

$H = (\beta c - \beta e)' \; (Vc - Ve)^{-1} (\beta c - \beta e)$,

Where βc is the coefficient vector from the consistent estimator, βe is the coefficient vector from the efficient estimator, V_c is the covariance matrix of the consistent estimator, V_e is the covariance matrix of the efficient estimator. We reject homogeneity hypothesis for large value of statistic H (P-value is inferior to level α = 5%). Hence, by Hausman test, we test

Ho: Pooled Logit model vs. Ha: Random Logit model.

Ho is not rejected since $H = \chi^2 (4) = 4.26$ with p-value = 0.3721. So, Pooled Logit model is significant at 5% levels. We test also

Ho: Pooled Probit model vs. Ha: Random Probit model.

Also Ho is not rejected since $H = \chi^2 (4) = 3.46$ with p-value = 0.4837. So, Pooled Probit Model is significant at 5% levels. Then only Pooled Logit model and Pooled Probit model results (Table 8) will be discussed.

Like the discriminant analysis, the results of the binary logistic regression confirm that financial ratios can be used to discriminate between IBs and CBs.

Looking at Table 8 (column 1), from the Pooled Probit model results for the whole period (2005-2014), only 2 predictor out of the 4 variables are statistically significant and so can be used to discriminate between IBs and CBs. These variables are the measure of bank stability (Z-score) and the Non-performing loan ratio (NPL) for credit risk. Interpretation of the coefficients needs slight care. The overall rate of correct classification for this model is estimated to be 92.86%, with only 50% of the normal weight group correctly classified (specificity) and 100% of the low weight group correctly classified (sensitivity) [4]. Area under ROC curve = 0.9217 indicates good predictive power and acceptable discrimination for the model [5].

Table 6: Correlation matrix

	ΔNPL	ΔZscore	ΔCAP	CTA	CTD	ΔDTA	ΔLLR	ΔLTA	ΔLTD	ROA	ΔROE
ΔNPL	1.0000										
ΔZscore	–0.1485	1.0000									
ΔCAP	0.1699	0.6114*	1.0000								
CTA	–0.0560	0.0086	0.0343	1.0000							
CTD	0.2938*	0.1904	0.5611*	0.2379*	1.0000						
ΔDTA	–0.0340	0.1304	–0.0831	–0.0303	–0.0789	1.0000					
ΔLLR	0.6048*	–0.2403	0.0904	–0.1334	0.1296	0.0691	1.0000				
ΔLTA	–0.2727*	–0.0333	–0.2799*	–0.1814	–0.5027*	0.2538*	–0.2409	1.0000			
ΔLTD	0.0027	0.1843	0.5833*	–0.1833	-0.0649	0.2811*	–0.1197	0.4196*	1.0000		
ROA	–0.2659*	0.2000*	0.2171*	–10.1045	–0.1005	0.0398	–0.1495	0.0788	0.1699	1.0000	
ΔROE	–0.2558*	–0.0936	–0.2069*	0.1332	–0.1581	–0.1475	–0.1856	–0.1039	–0.3953*	0.0629	1.0000
	0.0448	0.3520	0.0379	0.1841	0.1261	0.1515	0.1357	0.3354	0.0002	0.5321	

Table 7: Panel unit root tests (LLC, IPS, and fisher)

Method	LLC-t	IPS-W	ADF –Fisher χ^2	PP – Fisher χ^2	Conclusion
Null: Unit root assume	Common unit root	Individual unit root			
NPL	0.81570	0.76194	0.32619	0.08518	
ROA	−17.145*	−3.3428*	49.453*	58.644*	SL2
LTA	−2.5589*	0.48547	29.2133	23.7586	
Z-score	−4.2063*	0.61078	27.1877	34.3122	
²LTD	0.48968	1.46764	16.9996	2.32544	
CTA	−62.093*	−9.5562*	−3.128*	−1.45511***	SL2
CTD	−6.09860	−1.299***	−1.8466**	−1.829**	SL2
CAP	−8.71872	0.41346	1.37609	−0.57814	

LLC: Levin, Lin and Chu, IPS: Im, Pesaran and Shin, ADF: Augmented dickey- fuller, SL2: Stationary process, *** P<0.1, ** P<0.05, * P<0.01

Table 8: Panel data binary choice models results from pooled and random probit models and pooled and random logit models

Variables	(1)	(1)'	(2)	(3)	(3)'	(4)
	Pooled probit	Robust PP	Random probit	Pooled logit	Robust PL	Random logit
Z-score	–0.0697**	–0.0697***	–0.229	–0.118**	–0.118***	—0.413
	(0.0342)	(0.0187)	(0.194)	(0.0599)	(0.0302)	(0.396)
NPL	15.32**	15.32***	47.24	27.52**	27.52***	95.19
	(6.320)	(3.543)	(36.96)	(12.09)	(8.886)	(73.11)
LTA	–1.966	–1.966	–10.23	–1.490	–1.490	–18.30
	(3.630)	(3.813)	(23.77)	(6.781)	(8.111)	(48.23)
CTA	–9.931*	–9.931**	–18.35	–15.18	–15.18*	–35.69
	(5.532)	(4.373)	(29.25)	(10.27)	(9.176)	(59.08)
Constant	1.345	1.345	1.093	0.903	0.903	0.460
	(2.496)	(2.606)	(14.82)	(4.695)	(5.822)	(30.21)
$\chi^2_{(4)}$	29.25	68.50	5.45	29.17	54.20	6.48
	(0.0000)	(0.0000)	(0.2440)	(0.0000)	(0.0000)	(0.1661)
R^2	50.95%	50.95%		50.8%	50.8%	
LL			–4.97127			–4.94273
Hausman: χ^2 (4)	3.46			4.26		
	(0.4837)			(0.3721)		
LR test for ρ=0			18.22			18.36
			(0.000)			(0.000)
Classification accuracies	92.86%			92.86%		
Observations	70	70	70	70	70	70

Standard errors in parentheses, (P-value for $\chi^2_{(4)}$, Hausman, and LR tests), ***P<0.01, **P<0.05, *P<0.1. PP: Pooled probit, PL: Pooled logit. LL: Log likelihood

The coefficient on Non-performing loan (NPL) is positive and significant at 5% level, which indicates that IBs are more likely to be more risky than CBs. The negative and significant (at 5% level) coefficient on Z-score variable confirms that interest-free banks are more likely to be less stable than their conventional peers.

Thus, from the Pooled Probit model (stable by hypothesis) results, banks which are less stable, less liquid, and riskier are more likely to be interest-free banks.

Looking at Table 8 (column [3]), from Pooled Logit model, again only 2 predictors out of the 4 variables are statistically significant and so can be used to discriminate between IBs and CBs. These variables are again the measures of bank stability (Z-score) and NPL. Again, the negative and significant (at 5% level) coefficient on Z-score indicate that IBs are more likely to be less stable. And also, CBs are likely to be less risky than IBs.

Finally, results from column (1) and from robust results given at column (1)' or (3)', cash to asset (CTA) has negative significant effect indicating that IBs are likely to be less liquid than CBs. The reminder of variables the loan to asset (LTA) is not statistically significant according to Pooled Probit or Pooled Logit model. This result reveals that no difference exists between the two types of banks with respect to financial characteristics represented by loan to asset (LTA).

4.4. Global Financial Crisis and Interaction Effects Models

While the previous sub-section main findings remain somewhat robust for alternative used technics for full period (Table 8), they should be treated with caution as they are subject to caveats, including those that rise with model instability specification hypothesis.

Indeed, till now, both considered models ([1] and [2]) suppose stable specifications. However, since 2008 global financial crisis (GFC), banks face additional risks. Some behavior changes or structural instability can occur and then any based stable hypothesis results can be inaccurate. To depict and measure the effect of 2008 GFC on Jordanian banks, we add some interaction terms:

$X_{kit}2008 = X_{kit} \times D_{2008}$, k = 1, 2,…

to equation (1) and (2), where

D_{2008} = 1 for post GFC period (t >2007) and 0 for pre GFC period.

Looking at Table 6 of ratio mean comparisons pre and post GFC crisis, it is clear that out of the 4 considered ratios (Table 8), it is the CTA ratio which reveal only one significant difference between CBs and IBs at post GFC. In addition to CTA, we note that ROA and CAP give also significant difference between CBs and IBs that is only pre GFC.

To measure this asymmetry towards 2008 GFC, three interaction effects are considered; cash to asset for Post 2008 (CTA_{2008}), return to Asset for post GFC period (ROA_{2008}), and capital adequacy ratio post GFC (CAP_{2008});

$$CTA_{2008} = CTA \times D_{2008}$$

$$ROA_{2008} = ROA \times D_{2008}$$

$$CAP_{2008} = CAP \times D_{2008}$$

Any significant positive (negative) coefficient for $X_{kit}2008$ say that Post (Pre) GFC, X_{kit} get higher effect Post (Pre) GFC for IBs comparing to CBs. Results of these investigations are reported at Table 9.

Again, we begin by Hausman test to test H_{01}: Pooled Logit model vs H_{a1}: Random Logit model and H_{o2}: Pooled Probit model versus H_{a2}: Random Probit model. Pooled Logit model is significant at 5 % levels since H_{o1} is not rejected ($H = \chi^2(7) = 2.94$ with $P = 0.8909$). And also Pooled Probit Model is significant at 5% levels since H_{o2} is not rejected since $H = \chi^2(7) = 4.69$ with $P = 0.6983$). Then only Pooled Probit model and Pooled Logit model results (column [I] and column [III] from Table 9) will be discussed. Looking at these columns, results from pooled logit resemble to those from pooled probit by difference only in magnitudes. So, only results from column (I) will be presented.

From the Pooled Probit model results for the whole period (2005-2014), 3 predictor out of the 4 variables are statistically significant and so can be used to discriminate between IBs and CBs. These variables are Z-score the measure of bank stability and the cash to asset (CTA) for liquidity and Loan to asset (LTA) for credit risk. In addition, all considered interaction effects have significant effect in line with predicted signs. The overall rate of correct classification for this model is estimated to be 97.14%, with 98.33% of the normal weight group correctly classified (specificity) and 90.00% of the low weight group correctly classified (sensitivity). Area under ROC curve = 0.9917 indicates good predictive power and acceptable discrimination for the model.

The coefficient on Z-score and on LTA (on CTA) are positive (is negative) and significant at 5% and 10% (1%) level, which indicate(s) that IBs are more likely to be more stable and riskier (less liquid) than CBs. The negative and significant (at 1% level) coefficient on ROA_{2008} variable confirms that interest-free banks are more likely to be less profitable post GFC than their conventional peers. The coefficient on CTA_{2008} and CAP_{2008} are positive and significant at 1% level indicating that IBs post GFC are more likely to be more liquid and more capitalized than CBs.

Table 9: Robust PP and RP, Robust PL and RL models results with interaction effects

Variables	(I)	(II)	(III)	(IV)
	Robust PP	RP	Robust PL	RL
Zscore	0.0669**	0.0724	0.131**	0.132
	(0.0291)	(0.275)	(0.0581)	(0.563)
NPL	0.738	16.69	-0.396	37.05
	(4.029)	(47.56)	(6.541)	(84.45)
CTA	–97.36***	–223.2	–186.6***	–436.6
	(29.27)	(151.7)	(72.02)	(294.0)
LTA	6.630*	9.252	13.18*	16.41
	(3.872)	(30.03)	(7.101)	(70.66)
CTA2008	57.47***	95.06	111.3**	187.1
	(19.00)	(181.2)	(46.24)	(369.5)
ROA2008	–273.2***	–518.8	–515.0**	–1.012
	(98.10)	(781.3)	(217.3)	–1.792
CAP2008	21.54***	63.73	41.15***	123.5
	(7.066)	(52.15)	(15.83)	(85.27)
Constant	–3.149	–5.031	–6.154*	–7.775
	(2.035)	(18.08)	(3.345)	(42.47)
/lnsig2u		2.967***		4.224***
		(1.128)		(1.073)
Observations	70	70	70	70
Number of ID		12		12
$\chi2$ (7)	21.36	5.94	11.38	8.09
	(0.0033)	(0.5469)	(0.1228)	(0.3250)
R^2	0.8165		0.8149	
LL	–5.266713	–3.14476	–5.314908	–3.05876
Hausman: $\chi2$ (7)		2.94		4.69
		(0.8909)		(0.6983)
LR test for ρ=0		4.24		4.51
		(0.020)		(0.017)
Classification accuracies	97.14%		97.14%	

Standard errors in parentheses (P-value for $\chi^2_{(7)}$, Hausman, and LR tests), ***P<0.01, **P<0.05, *P<0.1, PP: Pooled probit, RP: Random probit, PL: Pooled logit, RL: Random logit, LL: Log likelihood

From the well specified Pooled Probit (or pooled logit) model results, banks which are more stable, more engaged in credit activity and so riskier and less liquid are more likely to be Islamic. However, post GFC, this category of banks seems to be more capitalized and more liquid but less profitable than conventional banks.

5. CONCLUSION

The Jordanian Central Bank (JCB) has launched a series of reforms to ensure the stability of its banking system and so to protect the banking system from crises. A large number of previous research papers argue that the effect of crises on the performance of Islamic and CBs is not the same. This paper contributes to the empirical literature on interest-free finance by investigating the financial characteristics of interest-free and CBs in Jordan over the period 2005–2014. To check any behavior instability, generally this period was divided into two sub-periods: a period before the subprime crisis (Pre GFC) from 2005 to 2007 and a period after this crisis (Post GFC) from 2008 to 2014. In this paper, in addition to this classic used technic, we consider interaction effects in the considered model to rigorously taking into account of instability effects due to 2008 GFC.

Three technics are considered to the comparison analysis. In a first stage, we give a univariate analysis based on t-test statistic. Secondly, discriminant analysis is conducted to determine the most influential variables in distinguishing between the two bank categories. And in the third stage, a multivariate nonlinear analysis for panel data from binary outcome data by probit and logit models is conducted with and without interaction effects.

Based on univariate analysis, Pre GFC, IBs are found to be less stable, more capitalized, more liquid, more risky, and more profitable than CBs in average while Post GFC, IBs are found to be less stable, more liquid, and more risky than CBs in average.

From Discriminant function analysis and for the overall period sample (for the Pre/Post 2008 GFC period) LTD (CTA/CTD) was the strongest predictor in discriminating the two types of banks while ROA (CTD/CAP) was the next in importance as a predictor.

From the Pooled Probit (or pooled logit) model and after considering behavior instability due to GFC of 2008 by using interaction variables, result changes indicating that banks which are more stable, riskier and less liquid are more likely to be Islamic. However, post GFC, this category of banks seem to be more capitalized, more liquid and less profitable than conventional banks.

Although Jordanian authorities adopted reforms since 1990 to protect conventional banks against crises, we find that IBs were more performant Post subprime crisis. These results suggest that Jordanian authorities should encourage Islamic banking development which can participate to reduce risks due to financial crises especially because they seem to adopt higher levels of capitalization and of liquid assets despite the fact that this can imply less extended credit activity and less profitability.

In this paper, comparison between pre and post 2008 GFC gives a significant permanent effect behavior changes. However, the effect of unpredictable event can be temporary, especially if we consider the period pre and post Covid-19. For future research, we may use "event study" methodology to identify and estimate the eventual abnormal return and instability effects.

Notes

1. Statistical inference should then be based on panel-robust standard errors. Standard errors and t-ratios can be calculated and hypothesis tests can be conducted in the usual fashion
2. The slope estimates for the linear probability model can be interpreted as the change in the probability that the dependent variable will equal 1 for a one unit change in a given explanatory variable, holding the effect of all other explanatory variables fixed
3. Standard errors and t-ratios can be calculated and hypothesis tests can be conducted in the usual fashion
4. Sensitivity is the fraction of $Yit = 1$ observations that are correctly classified. Specificity is the percentage of $Yit = 0$ observations that are correctly classified
5. A model with no predictive power would be a 45° line. The greater the predictive power, the more bowed the curve, and hence the area beneath the curve is often used as a measure of the predictive power. A model with no predictive power has area 0.5; a perfect model has area 1.

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