Long run comparison analysis and Short run Stability sensitivity: Empirical Evidence from Tunisian Banks

NEIFAR, MALIKA

IHEC SFAX UNIVERSITY TUNISIA

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NEIFAR Malika[1]

Abstract

This paper consider Tunisian banks case study over the period 2005–2014. The **long run** comparison analysis based on t-test between interest-free banks (IFB) and conventional banks (CB) of bank specific factors indicates that there are difference between Islamic and conventional banks behavior. CB are found to be more stable, while IFB have better liquidity and are riskier than CB. In **long run**, It is found alo that **2011 Yesameen revolution** has negative effect on CB stability and 2008 GFC has positive effect on IFB stability. This paper investigates also the **short run** stability question based on dynamic model for Z-score ratio of tunisian banks during the same period. The paper finds that the level of Z-score can be attributed to both macroeconomic conditions and banks' specific factors. Z-score is found to respond in **short term** to macroeconomic conditions. Z-scores tends to **increase** when Interest rate (INTER) and Foreign Direct Investment (FDI) rise. While instability **increase** when Unemployment rises, Exchange rate depreciates, and Inflation is high. It is found alo that in **short run,** 2011 Yesameen revolution and 2008 GFC have a significant **positive** effect on tunisian bank stability.

JEL classification: E32 E44 G01 G21 G32 Z12.

Keywords: Financial stability, Z-score, 2008 Global financial crisis (GFC), **2011 Yesameen tunisian revolution,** Tunisia, Islamic bank (IB), conventional bank (CB), macroeconomic factors, and banks' specific factors.

[1] Professor in Quantitative Methods at IHEC (Sfax) New Economics Department. Postal address : Sfax University Institut des Hautes Etudes Commerciales (IHEC). Mailing address : Route Sidi Mansour Km 10, B.P. 43, 3061. Sfax, Tunisia. Email : mneifar68@gmail.com.

I. Introduction

The emergence of interest-free finance can be traced back to 1963 in Egypt, while its importance comes to the global financial system only after the Global Financial Crisis (GFC) occurred in 2008.[2] Islamic banking and finance is one of the fastest growing segments of the global banking industry and has risen to prominence recently through its distinctive characteristics. This rapid growth of interest-free banking system has attracted the attention of many international policy makers and academic researchers. While most previous studies on interest-free finance have investigated and explained the general Islamic principles and the instruments used in Islamic banking, recent researches have investigated whether profitability, stability, efficiency, and risks differ significantly across interest-free and conventional banks (CB).

Islamic banking is different from the conventional banking as it is **interest free**. Islamic banking operates under different principles and they have different risk profiles.[3] The interest-free banks have regulations of two types; first is the government and the central bank that govern the conventional banks and second is the Shariah Supervisory Board that approves the products of the Islamic banks and keeps a check over the implementation of the rules defined by the board.[4] The central bank defines some rules which are specific to the Islamic banks (IB).[5]

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[2] The tunisian Islamic banking is working with the simple profit and loss sharing accounts, Islamic savings and investment products but it does not yet introduce the Islamic bonds (Sukuk) and hedge funds in the market as done in other countries.

[3] Islamic financial system is based upon a commerce law known as fiqh al-mu'amalat. This law considers issues of social justice, equity, and fairness in all business transactions, and promotes the entrepreneurship, protects the property rights and emphasizes the transparency of contractual obligations according to divine law of Allah and his last messenger Muhammad (PBUH≡ﷺ). It is based on Shariah approved products which do not involve Riba (interest/usury), gharar (uncertainty), maisir (gambling), and non-halal (prohibited) activities.

[4] The Committee is responsible for supporting the bank in the implementation, supervision and approval of all products according to the principles of Islamic finance (Taktak & Zouari, 2014).

[5] Although Islam has allowed the profits, but the pre-determined fix amount of returns is not allowed. Risk of loss and variability of profits must be faced to get the returns (Ariss, 2010). The main products of Islamic banks are now based on profit and loss sharing principle

There is no doubt that interest-free financial sector development plays an important role in the overall development and stability of an economy. In regard to financial stability, the theory and practice of Islamic banking do not give a clear answer concerning whether interest-free banks should be more or less financially stable than traditional banks. Although, there are many empirical studies that examined the relationship between banking sector and financial stability, but specific empirical studies on the relationship between Islamic banking and economic stability factor post the **global financial crisis** and the **2011 Yasameen revolution** are not too many. To help in filling this **gap** in empirical literature, this study attempts to examine empirically the relationship between Islamic banking, conventional banking, and economic stability in Tunisia pre and post the 2008 global financial crisis and the 2011 Yasameen revolution.

However, empirical studies investigating the **financial stability** of IB are still limited (see (Abedifar, Molyneux, & Tarazi, 2013); (Beck, Demirguc -Kunt, & Merrouche, 2013); (Bourkhis & Nabi, 2013); (Čihák & Hesse, 2010); (Rajhi & Hassairi, 2013), (Alqahtani & Mayes, 2018)).

The literature identifies two sets of factors to explain the evolution of bank stability over time. One group focuses on external events such as the overall macroeconomic conditions, while the second group, which looks more at the variability of Z-scores across banks, attributes the level instability to bank-level factors. Empirical evidence, however, finds support for both sets of factors. GDPG and INFlation rate are considered in some papers [see (Abedifar, Molyneux, & Tarazi, 2013), (Johnes & al., 2013), (Louhichi & Boujelbene, 2016), (Ibrahim, Aun, & Rizvi, 2017), and (Doumpos, Iftekhar, & Fotios, 2017)]. The impact of INFlation, however, may be ambiguous. Indeed, higher inflation can

(Mudarabah), partnerships or joint ventures (Musharakah), Sales contract (Salam), leasing contract (Ijarah) and interest-free loans (Qard-e-Hasna), trade with markup (Murabaha).

make debt servicing easier by reducing the real value of outstanding loan, but on the other hand, it can also reduce the borrowers' real income when wages are sticky.[6] Other macroeconomic variables, which were found to affect banks' asset quality, include the exchange rate and interest rate. In this regard, exchange rate depreciation might have a **negative** impact on asset quality[7] and **interest** rate hikes affect the ability to service the debt, particularly in case of floating rate loans (Louzis, Vouldis, & Metaxas, 2010).

The objective of this study is twofold. First, our study investigates the differences between Islamic and conventional banks in terms of financial characteristics [profitability ratios (ROA, and ROE), liquidity ratios (CTA, and CTD), credit risk (LLR, NPL, LTA, LTD), insolvency risk (DTA), Reglementary risk (CAP), and asset structure ratios (FAA, OBSIA)]. Univariate descriptive analysis based on t-test is then considered for the **long run** comparison. Second, the study aims to evaluate the determinants of stability in Tunisia banking system by looking at both bank-level data and macroeconomic indicators [GDPG, Inflation, Interest rate, Exchange rate, Foreign direct investment (FDI), and unemployment rate] over 2005-2014. Dynamic regression specification is then considered for **short term** stability evolution.

This study proceeds as follows: After a brief introduction (section I), section II describes the data, defines different ratios used in the study, and gives a descriptive comparative study between **interest-free** banks and **conventional** banks in the **long run**. Section III presents methodology of **dynamic** regression model to evaluate the determinants of stability, while Section IV discusses results

[6] In countries where loan rates are variable, higher inflation can also lead to higher rates resulting from the monetary policy actions to combat inflation ((Nkusu, 2011).

[7] Particularly in countries with a large amount of lending in foreign currency to un-hedged borrowers.

for stability analysis in the **short run**. Section V concludes with a discussion of implications, limitations, and suggestions for future research.

II. Data and variables : Long run Descriptive univariate comparison analysis

Our sample contains 16 banks (14 conventional and 2 Islamic). List of tunisian banks is given at Appendice, see **Table A 1** . We have 160 observations, or bank-years of data, for banks operating in Tunisia for the calendar years 2005–2014. There are 140 observations for conventional banks (CB) and 20 observations for Islamic banks (IB). 12 financial ratios are used in this study. All are defined in **Table 1**. we classify these ratios into six general categories: **profitability** ratios (ROA, and ROE), **liquidity** ratios (CTA, and CTD),[8] **credit** risk (LLR, NPL, LTA, LTD), **insolvency risk** (DTA), **Reglementary risk** (CAP), and asset **structure** ratios (FAA, OBSIA).[9] To ensure that our results were not driven by the presence of some outliers, we do correct all variables (we did not eliminate extreme values).[10]

Six macro economic variables are considered in this study : Gross Domestic Product Growth (GDPG), inflation rate (INF), Foreign direct investment (FDI), Exchange rate (Exrate), Interest rate (INTER), and Unemployment rate (Unemp).

[8] Liquidity means how quickly a bank can convert its assets into cash at face value to meet the cash demands of the depositors and borrowers.

[9] Regarding the later ratios, we use fixed assets to assets ratio, and off-balance sheet items to assets ratio to account for the operating leverage, and off-balance sheet activities, respectively. These ratios are used in the previous empirical banking literature (see, (Srairi, 2010) and (Ben Khediri, Charfeddined, & Ben Youssef, 2015)).

[10] To control for the remaining outliers, we'll use a robust estimation technique (an alternative method) as a superior estimation method, less sensitive to outliers, proposed by (Rousseeuw, Hampel, Ronchetti, & Stahel, 1986).

Figure 1 illustrates evolution of GDP, INF, △FDI, △EXRATE, △UNEMP, and INTER. Each of All these vriables has stationary pattern.

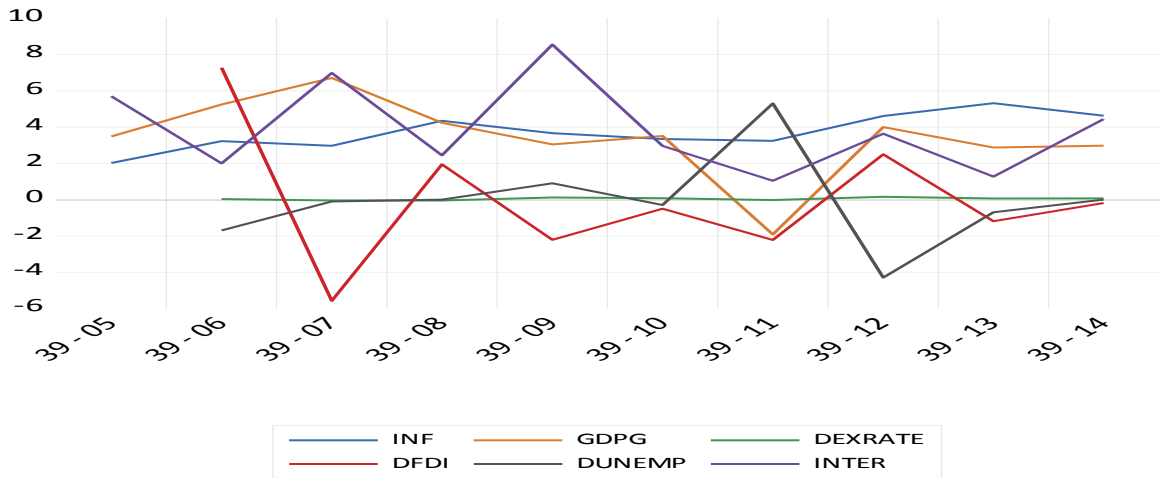

Figure 1: Tunisian Macroeconomic variables evolution from 2005 to 2014.[11]

The present study is confined to the **stability comparison** between two types of banking, that is, interest-free and conventional banking. For this purpose, two interest free banks, i.e. Zitouna Bank and Elbaraka bank are considered in the study for the comparison of their performance with conventional banks of Tunisia during the year 2005–2014. The importance of this period is higher because it shows the performance of the banks post the recession (global financial crisis, GFC 2008) period and the 2011 Yesameen revolution. So, the results will depict the impact of these crisis on both types of banking.

The research employs the Z-score variable for comparison of stability between the both types of banking. The dependent variable : Z-score is calculated as:[12]

$$Z_{it} = \frac{ROA_{it} + (EQ/TA)_{it}}{\sigma_{ROA}}$$

[11] DEXRATE ≡ ΔEXRATE, DFDI ≡ ΔFDI, and DUNEMP ≡ ΔUNEMP.

[12] This measure has been used in a vast body of literature ((Boyd & Runkle, 1993); (Čihák & Hesse, 2007); (Iwamoto & Mori, 2011); (Laeven & Levine, 2009); (Lown, Osler, Sufi, & Strahan, 2000); (Maechler, Worrell, & Mitra, 2007) ; and (Alqahtani & Mayes, 2018)).

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 indicated by the standard deviation. zscore indicates the number of standard deviation that a bank's return on asset has to drop before it evaporates bank's equity capital. Or in other words, Z-score indicates the multiple of a **bank's equity buffer** before it falls into the state of default. In this sense, the higher the Z-score is the lower is the bank's default risk.

Table 1: Definition of variables[13] and expected signs[14] for Z-score.

Ratios	Definitions	Expected sign for Zscore
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	-
Reglementary risk		
CAP	Capital adequaty ratio	+
Insolvency risk		
DTA	Deposits to assets = Deposits/Total assets	-
Asset structure		
FAA	Fixed assets to assets = Fixed assets/Total assets	
OBSIA	Off-balance sheet items to assets = Off-balance sheet items/Total assets	
Dummies and Interactions		
IB≡M	Dummy variable equal to 1 if the bank is (interest free), 0 otherwise (i.e. Conventional banks (CB))	-

[13] We have not yet explained how certain ratios are calculated for Islamic banks. (Turen, 1995) provides an excellent explanation of the differences between Islamic banks and conventional banks.
[14] (Ben Khediri, Charfeddined, & Ben Youssef, 2015).

M*2008	Interaction terms between the Islamic bank (IB) and post 2008 GFC period
D2008	Dummy variable equal to 1 if year ≥ 2008 (post GFC period)
D2011	Dummy variable equal to 1 if year ≥ 2011 (post Yesameen revolution period)
Bank caracteristics	
Size[15]	Log(Total asset)
DBS	Dummy variable equal to 1 if bank is large (size > median), 0 otherwise
Large_IB	Inetraction term between large bank and islamic bank.[16]
Macro-economic variables	
GDPG	Gross Domestic Product Growth (annual % change)
INF	Annual country inflation rate in percentage measured by annual % change in consumer prices
FDI	Foreign direct investment
EXRate	Exchange rate
INTER	Interest rate
Unemp	Unemployment rate

Table 2 shows the descriptive statistics of dependent and independent variables in the study. Descriptive statistics present the general statistics of the variables. The statistics gives the mean value, standard deviation value for each group of banks, and Difference t-test p-value between two means of each variable (mean for IB and for CB). Difference is significant for LTA, LTD, and Z-score. Conventional banks have higher Z-score (are more stable).[17]

The risk ratios indicate some important differences in operational characteristics. Interest free banks (IFB) extend more loans or equivalents relative to deposits (LTD) than conventional banks. The difference is significant at the 5% level and may suggest **greater risk** for Interest free banks.

[15] It is found in the literature that the size is measured either by the amount of loans or assets (Miah & Uddin, 2017).

[16] Give a dummy variable equal to 1 if islamic bank is big, 0 otherwise (small bank).

[17] The probability that a banking system defaults is measured by the z-score. A higher z-score implies a lower probability of insolvency, indicating that the banking sector is more stable. The z-score (or distance to default) is a ratio, defined as((ROA + (equity)/assets))/sd(ROA), where ROA is average annual return on end-year assets and sd(ROA) is the standard deviationof ROA.

In contrast, the **liquidity** ratios are not significantly different between types of banks, but Interest free banks keep less cash relative to **deposits** and more relative to assets than conventional banks. The deposit to asset ratio (DTA) in everage for the Interest free banks was 4.2% which is lower than 12.17% ratio of Conventional banks. This supports the **better liquidity** performance for the Interest free banks.

The asset-quality indicators reveal littel additional differences between Interest free and conventional banks. The LLR (Loans loss reserves To gross loans) ratio is higher (not significantly at the 10% level) for Interest free banks. Conventional banks maintain smaller reserves for loan losses, but the interpretation is not clear. For example, Ijara and various Islamic leaseback schemes may involve more risk than conventional loans, so more reserve is needed. Alternatively, Interest free banks may be operating with **lesser risk** because they maintain higher contingency reserves for bad loan-like products.

From a brief look at **Figure 2** , we conclude that : **Z-score average** evolution from 2005 to 2014 for islamic banks (IB) is different from one's of conventional banks (CB). The pattern of latter path is **decreasing** from **2012** (post 2011 Yesameen revolution) while the former has an **increasing** path from **2009** (post GFC). CB have higher Z-score in mean than IB **during** period of study.

From **Figure 3** , mean of **Zscore** comparisions in different dimensions say that: IB are **less stable** than CB, Large IB are more stable than Small IB,[18] Large CB are more stable than Small CB, all Banks are **less** stable Post GFC 2008 and Post TUNisian Revolution 2011, and Islamic Banks are **less stable** Post GFC 2008. Between year comparison show that Zscore in mean has its **lowest** value at 2013,

[18] A bank is said to be large if its size > median,

and between tunisian banks (ID) ,[19] 41≡ **Banque Nationale Agricole** is the **more** stable bank while 54 ≡ **Banque Franco-Tunisienne** is the **less** stable bank.[20]

Regarding the **insolvency** risk, evidence shows that leverage, as measured by **Deposits (or Dept) to assets ratio** (DTA), there is some difference in some spaces. **Figure 4** gives a sum up of **insolvency** risk (DTA) in average comparisions in different dimensions. It say that: IB (and Small_IB) have **better liquidity** performance than CB and Post GFC 2008 (than Large_IB), while Large_CB have better liquidity performance than Small_CB. All Banks have better liquidity performance Post TUN Revolution 2011 but not Post GFC 2008. Between year comparison show that DTA in mean has its **lowest** value at 2013, and between tunisian banks (ID) 54 Banque Franco-Tunisienne is the worst bank in term of liquidity performance.

From **Figure 5** and **Figure 9** (see Appendice), Z-score exhibit negative correlation with DTA and DTA_{-1}.[21] Z-score is then strongly linearly related to DTA_{-1}. Z-score and DTA average evolution for All banks is illustrated at **Figure 7** (see Appendice). Both variables have decreasing trend (from 2010 for DTA and from 2012 for Z-score). Z-score and DTA average evolution for each type of banks is illustrated at **Figure 8** (see Appendice). In averge there is no difference

[19] 39 ≡Albaraka Bank Tunisia, 40 ≡Banque Internt Arabe Tunisi, 41≡ Banque Nationale Agricole, 42 ≡Société Tunisienne de Bank, 43 ≡Amen Bank, 44 ≡Banque de l'Habitat, 45≡ Attijari Bank, 46 ≡Arab Tunisian Bank, 47≡ Banque de Tunisie, 48≡ Union Internl de Banque, 49≡ Union Bancaire Comrce et l'Industrie, 50≡ North Africa International Bank – NAIB, 51≡ Arab Banking Corporation – Tunisie, 52 Banque Zitouna, **53 ≡Alubaf International Bank,** 54 ≡Banque Franco-Tunisienne.

[20] Code for each bank is as follow : 39 Albaraka Bank Tunisia, 40 Banque Internt Arabe Tunisi, 41 Banque Nationale Agricole, 42 Société Tunisienne de Bank, 43 Amen Bank, 44 Banque de l'Habitat, 45 Attijari Bank, 46 Arab Tunisian Bank, 47 Banque de Tunisie, 48 Union Internl de Banque, 49 Union Bancaire Comrce et l'Industrie, 50 North Africa International Bank – NAIB, 51 Arab Banking Corporation –Tunisie, **52 Banque Zitouna**, 53 Alubaf International Bank**,** 54 Banque Franco-Tunisienne.

[21] Figure 6 in Appendice gives time evolution of each of these variables for each tunisian bank.

in evolution of these variables between two type of banks. However, difference is depected in magnitude of these means. Conventional banks have higher means.

To summarise, it can be seen from this comparison that there are some differences between Interest free and conventional banks (as well as different size groups) in terms of their stability and operations. However, it is premature to draw any conclusion based on these results alone. Therefore, we will extend our investigation by implementing the regression analysis methodology and to investigate the effect of economic turmoil on Tunisian banks.

All the variables under the study must be stationary otherwise spurious regression may be found. Henceforth, Levin, Lin & Chu, ADF - Fisher Chi-square, and PP - Fisher Chi-square Unit Root Tests for PANEL data have been implemented to ensure that all the bank specific variables in the regression equation are stationary. The result is shown in Table A 6 (see Appendice). All considered bank specific variable are stationary. Unit root tests results for Macroeconomic series (given also at Table A 6) are not fiable since PP and ADF tests for time series are asymptotic tests and we need at least 30 observations for each variable (we have only 10 observations for each series). However, from **Figure 1**, we conclude that INF, GDPG, and INTER are stationary series in level, while Exrate, FDI, and Unemp are stationary series in first difference.

Table 2: Descriptive statistics for the entire dataset, for IB and CB.

	Nber. of obs.	Mean	Standard deviation	IB	CB	Difference t-test p-value
ROA	123	.0031492	.0561079	.0254133	.000518	0.1309
ROE	122	.1236556	.4625882	.0565899	.1309718	0.5989
CTA	122	.0392261	.0564197	.0605664	.0368981	0.1686
CTD	118	.0529417	.088573	.0357429	.0545342	0.5233
LTA	124	.5671394	.2393439	.4652975	.582227	**0.0680**
LTD	124	.9191758	.4953456	1.168744	.8822028	**0.0302**

LLR	78	.1326936	.1000929	.1539838	.1271994	0.3432
NPL	43	.1711651	.2612057	.1357429	.1780528	0.6999
CAP	122	.106693	.1333503	.1436303	.1026635	0.3142
DTA	122	.1139159	.1759551	**.0420362**	**.1217573**	0.1368
Zscore	122	26.4649	24.53635	1.825296	29.15286	**0.0002**

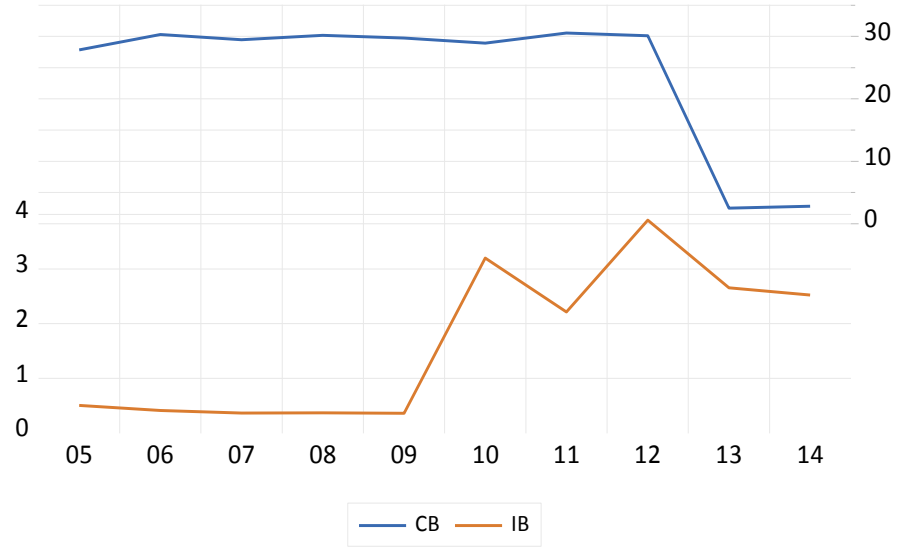

Figure 2 : Z-score **average evolution** for CB and IB from 2005 to 2014.

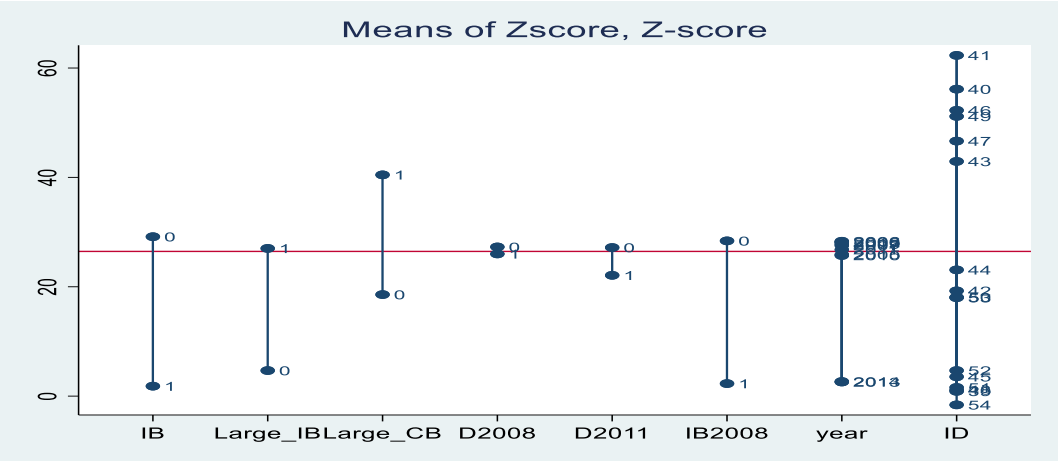

Figure 3: **Mean of Zscore comparisons** : IB vs CB, Large_IB vs Small_IB , Large_CB vs Small_CB, Pre vs Post GFC 2008 for all Banks, Pre vs Post GFC 2008 for IB banks, Pre vs post TUNisian Revolution of 2011 for all Banks, between year, and between tunisian banks (ID).[22]

[22] Note : IB=1 if the bank is an islamic one, Large_IB=1 if IB is large and zero if not. Large_CB=1 if CB is large and zero if not. D2008=1 for post GFC, D2011=1 for post 2011 revolution, IB2008=1 for IB post GFC, year=mean of Z-score for each year, ID= mean of Z-score for each bank. For all, if not indicator variable take value zero. A bank is said to be large if its size > median,

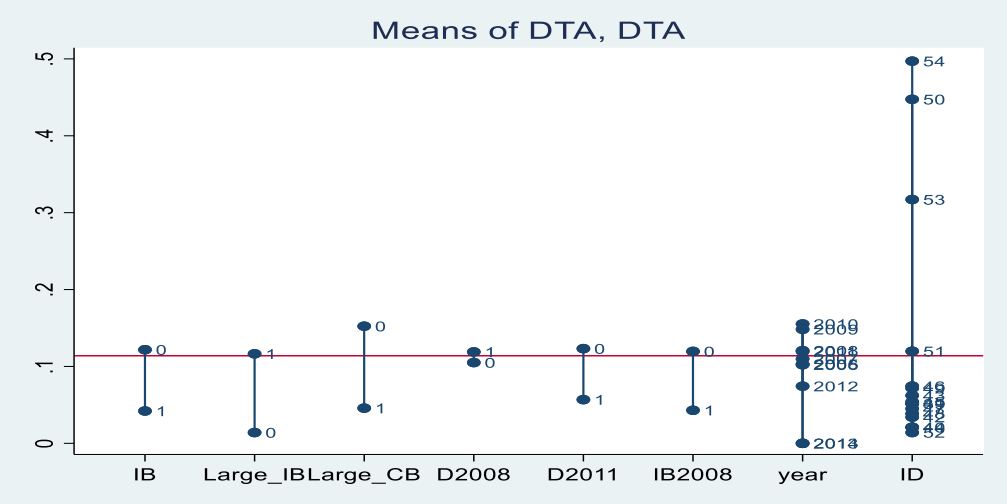

Figure 4: **Mean of DTA comparisons** : IB vs CB, Large_IB vs Small_IB , Large_CB vs Small_CB, Pre vs Post GFC 2008 for all Banks, Pre vs Post GFC 2008 for IB banks, Pre vs post TUNisian Revolution 2011 for all Banks, between year, and between tunisian banks (ID). [23]

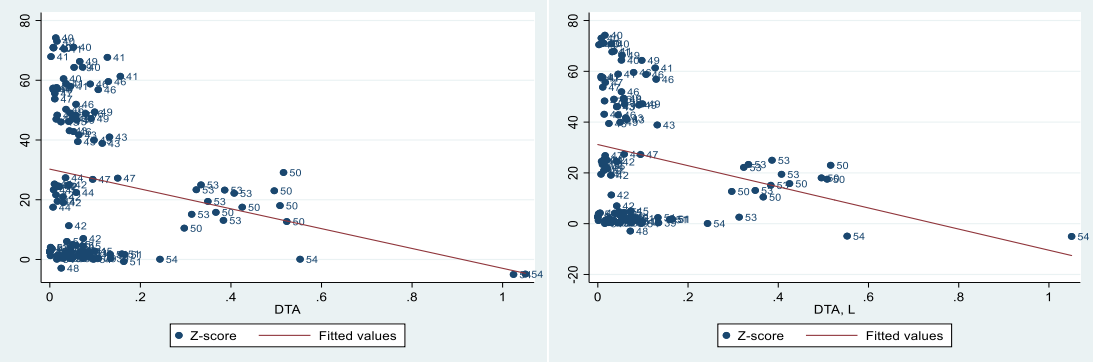

Figure 5: Z-score and the DTA (DTA$_{-1}$) **linear static relation** in Tunisia conomies, 2005-2014[24]

III. Methodology : Short run dynamic stabilty sensitivity.

Our dependent variable to evaluate financial **stability** is the well-known Z-score ratio. It has also been used in the literature relating to Interest free banking (see

[23] Note : IB=1 if the bank is an islamic one, Large_IB=1 if IB is large and zero if not. Large_CB=1 if CB is large and zero if not. D2008=1 for post GFC, D2011=1 for post 2011 revolution, IB2008=1 for IB post GFC, year=mean of DTA for each year, ID= mean of DTA for each bank. For all, if not indicator variable take value zero.

[24] DTA L ≡ DTA$_{-1}$.

Table A 2), and (Čihák & Hesse, 2010) suggest that it is appropriate to use with respect to Interest free banking.

The Pearson correlation test reveals the correlation among the variables.[25] The test result shows positive relation relationship of **Z-score** with Return on equity (ROE), Capital adequaty ratio (CAP), Size, and Fixed assets to assets (FAA). It implies that Z-score will be increased with increase of the Return on assets (ROA), CAP, Size, and FAA. The opposite relationship is found between Z-score, **Debt** to assets (DTA) and Off-balance sheet items to assets (OBSIA). Results of the Correlation analysis between **CAP** and ROA, Loans to assets (LTA), Loans to deposits (LTD), and Loans loss reserves to gross loans (LLR) depict positive significant coefficients. The opposite is true for the relation between CAP and ROE, Cash to assets (CTA), and Cash to deposits (CTD). Significant strong relationship is found among the exogenous variables in the correlation matrix. So it can not be assumed that the data set is free from Multicollinearity problem (see Table A 4 in Appendice). From Table A 4,[26] and to avoid problem of multiolinearity, we propose

$$\text{Z-score} = F(\text{MACRO variables, BANK specific variables}),$$

where MACRO variables ≡ (INF, GDP, EXRate, FDI, Unempl, INTER) and BANK specific variables ≡ (DTA, CAP, LTD, FAA, Size).

[25] It indicates how the variables are related with each other and also to what extent.

[26] From Table A 4, we can have three principal lineaire relations Z-score=f (ROA, CAP, Size, FAA, DTA, and OBSIA), Debt to assets, DTA=f(ROA, CTD, LTA, LTD, and CAP), and Capital adequaty ratio CAP=f(ROA, ROE, CTA, CTD, LTA, LTD, and LLR). The simple correlation does not imply anything regarding the causality amongst the variables. To find out the causal relationship between two variables Engle-Granger (1969) causality test is implemented between variables. From Table Table A 7 (see in Appendice), we deduce that Z-score = g(EXRate, NPL), DTA = g(ROA, CTA), and CAP= g(LTA, LTD, Zise).

First order Correlation between Z-score and its previous value is significant and equal to 0.9515 < 1. So, we propose the three dynamic panel model which take account also of 2008 GFC and 2011Yesameen Tunisian revolution effects :

$$\text{Zscore}_{i,t} = \gamma_{i0} + \rho Zscore_{i,t-1} + \gamma_1 INF_t + \gamma_2 GDPG_t + \gamma_3 \Delta \text{EXRate}_t + \gamma_4 \Delta \text{FDI}_t + \gamma_5 \Delta \text{Unempl}_t + \gamma_6 INTER_t + \alpha_1 M2008_{i,t} + \alpha_2 D2008_t + \alpha_3 D2011_t + \varepsilon_{i,t}, \quad (1)$$

for **macroeconomic factors** case,

$$\text{Zscore}_{i,t} = \gamma_{i0} + \rho Zscore_{i,t-1} + \beta_1 \boldsymbol{DTA_{i,t-1}} + \beta_2 CAP_{i,t} + \beta_3 \text{LTD}_{i,t} + \beta_4 \text{FAA}_{i,t} + \beta_5 \text{Size}_{i,t} + \alpha_1 M2008_{i,t} + \alpha_2 D2008_t + \alpha_3 D2011_t + \varepsilon_{i,t} \quad (2)$$

when utilizing **bank specific factors** as predictors , and

$$\text{Zscore}_{i,t} = \gamma_{i0} + \rho Zscore_{i,t-1} + \gamma_1 INF_t + \gamma_2 GDPG_t + \gamma_3 \Delta \text{EXRate}_t + \gamma_4 \Delta \text{FDI}_t + \gamma_5 \Delta \text{Unempl}_t + \gamma_6 INTER_t + \beta_1 DTA_{i,t-1} + \beta_2 CAP_{i,t} + \beta_3 \text{LTD}_{i,t} + \beta_4 \text{FAA}_{i,t} + \beta_5 \text{Sizel}_{i,t} + \alpha_1 M2008_{i,t} + \alpha_2 D2008_t + \alpha_3 D2011_t + \varepsilon_{i,t} \quad (3)$$

if **both factors** are considered, where dummy variables are

D2008_t = 1 if t = year > 2008 and zero if not

D2011_t = 1 if t = year > 2011 and zero if not.

In addition to D2008, these models include an interaction between D2008 and M_i $(noted\ by\ M2008_{i,t})$

$$M2008_{i,t} = M_i * D2008_t,$$

where

$M_i = 1$ if Bank i is Interest free and zero if not.

The idea is that GFC might have a different effects for Islamic and Conventional banks. Effect of Yesameen 2011 tunisian revolution is also to be analysed via $D2011_t$.

IV. Empirical Results

We consider three alternative estimation techniques. The **first** one is the **fixed effects method ≡ FE** (the **second** : GLS for random effect ≡ **RE** model)[27] for fixed effect model which controll for unobserved heterogeneity across banks. While these approaches are rather simple and intuitive, they may give rise to "dynamic panel bias" which results from the possible endogeneity of the lagged variable and the fixed effects in the error term. This can be avoided by applying a **third** method : the "**system GMM**" developed by (Arellano & Bover, 1995) and (Blundell & Bond, 1998) which give more precise results than : "**difference GMM**" method of (Arellano & Bond, 1991) which transforms the data to **first differences** to remove the fixed effect element and uses the lagged levels of the right hand-side variables as instruments.[28]

The results presented in **Table 3, Table 4,** and **Table 5** broadly confirm that both bank-level and macroeconomic factors play a role in affecting the banks' stability quality in the **short term**. All time (years) dummies were excluded since they were jointly statistically equal to zero, implying that controlling for unobserved factors varying across time is not necessary in these models.

From **Table 3**, our analyses do generally provide significant support for the impact of macroeconomic factors. For **Inflation** (and **exchange rate**), we find strong statistical and economic evidence of its **negative** (depreciation) impact on financial stability. While for **FDI** (and **interest rate**), we find strong statistical and economic evidence of its **positive** impact on financial stability. However, for income (**GDPG**), we do not find strong statistical and economic evidence of its **negative** impact on financial stability.[29]

[27] Selection is made by Hausmn test. FE and RE results are presented only for reference.
[28] We used a robust regression estimation method to handle the presence of outliers.

[29] This is not in line with previous research (e.g. (Bourkhis & Nabi, 2013); (Čihák & Hesse, 2010); Maghyereh & Awartani, 2014) suggesting that this might be owing to the lack of experience in non-traditional activity.

From **Table 4, size** is found to have a highly statistical and economic significance in Tunisian Banks, which is consistent with a large and growing literature on economies of scale. **Previous period's DTA** as a measure of better **liquidity** performance of the bank's management leads to **higher** Z-scores, while higher risk ratios loans to deposits (LTD) leads to **lower** Z-scores (destabilising tunisian banks).

From **Table 5, Capital ratios** (CAP) as a proxy for asset quality is found to be statistically significant and play a greater role in stabilising tunisian banks.

If we look at **GFC** effect, we conclude that GFC has a significant **positive** effect for Conventional banks equal to **57.472263** from **Table 5** (and for both type of banks equal to **64.58454** from **Table 3**), while for Interest free banks, GFC has a significant **negative** effect equal to **-8.641213** from **Table 4** (**positive** effect equal to **51.638295 = 57.472263** - **5.8339681** from **Table 5**).

If we look at $\mathbf{D2011_t}$ effect, we conclude that **2011 Yesameen tunisian revolution** has a significant positive effect on tunisian bank stability, see **Table 3** and **Table 5.**

In all cases, the Hansen/Sargan-test suggests that the instruments used are uncorrelated with the residuals, and the Arellano-Bond tests rejects the hypothesis that the errors are not autocorrelated in the first order (AR(1)), but cannot reject this hypothesis for the second order (AR(2)).

Table 3 : Macroeconomic effects on Z-score dynamic [Model (1)]

Variable	FE[30]	RE	1step sys GMM
Zscore-1	.84691556***	**1.0017942*****	**1.0324742*****
INF	-50.14932***	-53.211239***	-53.59863***
GDPG	-3.3608955*	-1.2795811	-1.4092755
△EXRate	-363.04223***	-359.13553***	-363.0903***

[30] F test that all u_i=0: F(15, 79) = 1.30, Prob > F = 0.2250.

△FDI	5.3880651***	5.9807867***	6.014778***
△unempl	-6.5402851***	-4.2927565***	-4.4939179***
INTER	8.1767817***	8.1914136***	8.2807255***
M2008	1.3636137	.36757083	3.377796
D2011	42.761998***	52.900162***	**52.682976*****
D2008	59.44231***	64.376101***	**64.58454*****
_cons	129.38052***	123.54132***	124.04162***
N	105	105	105
R^2	.81454372		
F/Wald	34.697641	2468.71	2716.264
Hausman		**3.68(0.9607)**	
AR(1)			0.058
AR(2)			0.745
Hansen/Sargan			1.000

Legend: * p<.1; ** p<.05; *** p<.01. Note : p-values are reported for Sargan/Hansen test, Hausman test, and AR(1) and AR(2) tests. F/Wald is Fisher or Wald global significant test statistic. AR(1) statistic is the Arellano-Bond tests for first ordrer autocorrelation and AR(2) statistic for second order autocorrelation.

Table 4: Bank specific effects on Z-score dynamic [Model(2)]

Variable	FE	RE	1step sys GMM
Zscore-1	**.08217912**	.89212804***	**.88416272*****
DTA-1	-4.7781874	-29.592022***	-33.919968*
CAP	156.90206***	41.120976***	49.949983
LTD	-9.498089***	7.043302***	8.794938***
FAA	-60.091166	-272.5567***	-373.01549***
size	-17.5051***	-3.4597908**	-4.01235**
M2008	-.28272989	-6.7350631*	**-8.641213***
D2008	2.5945615**	1.9826747	2.5824434
D2011	.9407625	-3.6115424	-3.282941
_cons	69.294019***	9.1131958	10.347462
N	91	91	91
R^2	.88620059		
F/Wald	57.972806	759.77	535.06078
Hausman	**68.15(0.000)**		
AR(1)			0.062
AR(2)			0.281
Hansen/Sargan			1.00

Legend: * p<.1; ** p<.05; *** p<.01. Note : p-values are reported for Sargan/Hansen test, Hausman test, and AR(1) and AR(2) tests. F/Wald is Fisher or Wald global significant test statistic. AR(1) statistic is the Arellano-Bond tests for first ordrer autocorrelation and AR(2) statistic for second order autocorrelation.

Table 5: All factors effects on Z-score dynamic [Model(3)]

Variable	FE[31]	RE	1step sys GMM
Zscore-1	**.23711144****	.96663084***	**.93675876*****
DTA-1	-1.7699883	-13.334444**	-23.413986**

[31] F test that all u_i=0: F(14, 61) = 7.91, Prob > F = 0.0000.

CAP	126.52989***	14.756346	40.640876*
LTD	-2.3295778	3.8254102**	5.7151984**
INF	-17.814852***	-50.61256***	-46.70228***
GDPG	-5.0984119***	-1.4185829	-1.0855176
△EXRate	-170.52393***	-341.95911***	-310.39275***
△FDI	1.1803155	5.6670494***	5.1615539***
△unemploy	-6.6580644***	-4.1780588**	-3.5275304***
INTER	3.3926306***	7.7963717***	6.9811443***
FAA	-96.002197	-198.18201***	-340.26867**
size	-12.758881***	-.22298877	-1.223107
M2008	2.0616331	-3.4714485	**-5.8339681****
D2011	7.3502955	50.740322***	**48.352293*****
D2008	20.317987**	61.599965***	**57.472263*****
_cons	109.6477***	119.6465***	112.56826***
N	91	91	91
R^2	.93149857		
F/Wald	55.299495	1940.00	49466.416
Hausman	**169.91(0.00)**		
AR(1)			0.051
AR(2)			0.301
Hansen/Sargan			1.000

Legend: * p<.1; ** p<.05; *** p<.01. Note : p-values are reported for Sargan/Hansen test, Hausman test, and AR(1) and AR(2) tests. F/Wald is Fisher or Wald global significant test statistic. AR(1) statistic is the Arellano-Bond tests for first ordrer autocorrelation and AR(2) statistic for second order autocorrelation.

V. Conclusion

The first aim of the current paper was to compare between the features of Interest free banks (IB) and conventional banks (CB) in Tunisia using selected financial ratios. We show that Interest free and conventional banks behave somewhat differently. Based on Z-scores, mean tests results show that in the **long term**, CB are more stable than IB, supporting the second line of argument suggesting that IB are riskier than CB.[32] Also, we find that IB have better liquidity and have more credit risk than their conventional peers.

Based on **dynamic** regression models, in the **short run**, we finds that Z-scores are sensitive to bank-level factors. Better liquidity performance of the bank's

[32] The difference remains significant for the large banks group as well as for small banks compared to small conventional banks. Large Islamic banks are slightly more stable than small Islamic banks and large conventional banks are more stable than small conventional banks.

management, as measured by the previous period's DTA, and Capital ratios, as a proxy for asset quality, are found to be statistically significant and play a greater role in stabilising tunisian banks (lead to **higher** Z-scores), while The risk ratios suggesting greater risk [more loans or equivalents relative to deposits (LTD)] for Tunisian banks leads to **lower** Z-scores (destabilise tunisian banks).

While the paper's main findings remain robust for alternative specifications and time periods, they should be treated with caution as they are subject to caveats, including those that arise from the Z-score' data quality. With this in mind, the paper finds also that, the level of Z-scores can be attributed to both macroeconomic conditions and banks' specific factors.[33] Beyond the Bank-specific effects, the results confirm that the level of Z-scores tends to increase when Interest rate (INTER) and Foreign direct investment (FDI) rise. While instability increase when unemployment rises, exchange rate depreciates, and inflation is high.

In regard to economic turmoil, the difference between the two banking types was significant post the 2008 GFC and post 2011 Yesameen Revolution.

The current research may be extended by investigating other features of banks such as business model and efficiency. Further, the question of whether Interest free and conventional banks have or not the same behavior when operating on a small or large scale should be explored in future research.

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Appendice

Tables

Table A 1 : List of Tunisian banks (with code)

Conventional Banks	**Islamic Banks**
• 40 Banque Internt Arabe Tunisi, • 41 Banque Nationale Agricole, • 42 Société Tunisienne de Bank, • 43 Amen Bank, • 44 Banque de l'Habitat, • 45 Attijari Bank, • 46 Arab Tunisian Bank, • 47 Banque de Tunisie, • 48 Union Internl de Banque, • 49 Union Bancaire Comrce et l'Industrie, • 50 North Africa International Bank – NAIB, • 51 Arab Banking Corporation – Tunisie, • **53 Alubaf International Bank,** • 54 Banque Franco-Tunisienne,	• 39 Albaraka Bank Tunisia, [34] • 52 Banque Zitouna[35]

[34] "Al Baraka Bank Tunisia" is launched in June 1983. At the end of 2012, "Al Baraka Bank Tunisia" became a resident bank (Taktak & Zouari, 2014).

[35] "Zitouna Bank" is a universal commercial bank and is initiated in May 2010 (Taktak & Zouari, 2014).

Table A 2: Existing empirical literature

Authors	Sample	Methodology	Variables	Main results
(Metwally, 1997)	15 Isl. banks 15 conv. banks 1992– 1994	Logit model Probit model Descriminant analysis	Liquidity: cash to deposits Leverage: deposits to assets; equity to assets Credit risk: funds channeled to direct investments to loanable funds; loans used to finance durable to total loans; personal loans to total loans **Profitability: gross income to assets;** average return on deposits Efficiency ratios: operating expenses to assets	The two groups of banks may be differentiated in terms **of liquidity, leverage and credit risk**, but not in terms of profitability and efficiency
(Iqbal, 2001)	12 conv. banks 12 Isl. banks 1990– 1998	T-test for equality of means	Profitability: return on asset (ROA); return on equity (ROE) Bank capital: capital to assets. Liquidity: cash and accounts with banks to total deposits. Deployment ratio: total investment to total equity and total deposits. **Efficiency**: cost to income ratio	Islamic banks are **better capitalized and more profitable** than conventional banks
(Olson & Zoubi, 2008)	28 conv. banks 16 Isl. banks GCC region 2000– 2005	. T-test for equality of means . Logistic regression . Neural networks . k-means nearest neighbors	**Profitability**: ROA; ROE; profit margin; return on deposits; return on shareholders' capital; net operating margin Efficiency: interest income to expenses; operating expense to asset; operating income to assets; operating expenses to revenue; asset turnover; net interest margin; net-non interest margin **Asset quality**: provision to earning assets; adequacy of provisions for loans; write off ratio; loan to assets; loans to deposits **Liquidity**: cash to assets; cash to deposits Risk: deposits to assets; equity multiplier; equity to deposits; total liabilities to equity; total liabilities to shareholder capital; retained earnings to assets	Accounting ratios are good discriminators between Islamic and conventional banks. Islamic banks are **more profitable but less efficient** than conventional banks
(Srairi, 2010)	48 conv. banks 23 Isl. banks GCC region 1999– 2007	stochastic frontier analysis (SFA) T-test for equality of means	Profitability: net profit to average total assets Capital adequacy: equity to total assets Credit risk: loans to total assets Operation cost: cost to income Size: natural logarithm of total assets	Conventional banks are more efficient than Islamic banks
(Belanes & Hassiki, 2012)	19 conv. banks 13 Isl. banks MENA region 2006– 2009	Data envelopment analysis (DEA)Wilcoxon ranksum test	Profitability: ROA; ROE; net Interest margin Liquidity: short-term assets to short-term loans Risk: total debts to assets; reserves for losses on credits to total credits	There is no significant difference in the efficiency scores between these two types of banks
(Beck, Demirguc - Kunt, & Merrouche, 2013)	Sample of 510 banks across 22 countries 1995– 2009	T-test for equality of means, regression	Business model: Fee income to operational income; nondeposit funding to total funding; loans to deposit Efficiency: cost to income ratio; overheads to assets Asset quality: loss reserves to gross loans; loan loss provisions to gross loans; nonperforming loans to	There are few significant differences in business models. Islamic banks are less efficient, but have higher intermediation ratios, have higher asset quality, and are better capitalized than conventional banks.

			gross loans; Stability: z-score; ROA; equity to assets; liquid assets to deposit	
(Abedifar, Molyneux, & Tarazi, 2013)	553 banks from 24 countries 1999–2009	T-test for equality of means, random effect regression	Credit risk: loan loss reserves to gross loans; impaired loans to gross loans; loan loss provision to average gross loans Insolvency risk: z-score Bank **interest rate:** net interest margin; **interest income rate**; interest expense rate; loan rate; deposit rate Financial ratio: equity capital to asset ratio; ROA; ROE; net loans to total earning assets; cost to income ratio; total assets	Islamic banks are more capitalized and profitable than conventional banks. Islamic banks have lower credit risk than conventional banks, specifically small, leveraged, or those operating in countries with more than 90% Muslim populations. In terms of insolvency risk small Islamic banks are more stable than small conventional banks
(Johnes & al., 2013)	207 conventional and 45 Islamic Banks across 18 countries (Bahrain; Bangladesh; Brunei; Egypt; Indonesia; Jordan; Kuwait; Malaysia; Mauritania; Pakistan; Palestine; Qatar; Saudi Arabia;Sudan; Tunisia; Turkey; United Arab Emirates; Yemen.) 2004–2009	DEA and meta-frontier analysis (MFA). Bootstrapping methods. Random effects estimation approach with heteroscedasticity-corrected standard errors. Tobit model	A binary variable to reflect whether or not the bank is classified by Bankscope as fully-fledged Islamic (ISLAMIC). A dummy variable to reflect whether the bank is listed on the stock market (LIST) and an interaction term between ISLAMIC and LIST (ISLIST). The value of a bank's total assets (ASSETS). The ratio of loan loss reserves to loans (LOANLOSS/LOAN). The ratio of total loans to total assets (LOANS/ASSETS). Ratio of net loans to total assets (NETLOANS/ASSETS). The normalized Herfindahl index (HHI). The degree of market capitalization (MCAP). **Per capita GDP (GDPPC**). Year dummies for changes in banking efficiency over time. Region dummies for differences in efficiency between three broad regions.	Islamic banks are typically on a par with conventional ones in terms of gross efficiency, significantly higher on net efficiency and significantly lower on type efficiency. The low type efficiency of Islamic banks could be attributed to lack of product standardization whereas high net efficiency reflects high managerial capability in Islamic banks.
(Ben Khediri, Charfeddined, & Ben Youssef, 2015)	43 conv. banks 18 Isl. banks 4 Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Qatar, Saudi Arabia,and the United Arab Emirates) 2003-2010	T-test for equality of means, linear discriminant analysis Logistic regression Neural networks classification techniques	Five groups of ratio: profitability ratios (ROA, and ROE), liquidity ratios (CTA, and CTD), credit risk (LLR, NPL,LTA, LTD), insolvency risk (ETA, DA, DTA, and DTE), and asset structure ratios (FAA, OBSIA).	Islamic banks are, on average, more profitable, more liquid, better capitalized, and havelower credit risk than conventional banks. Islamicbanks are, on average, less involved in off-balance sheet activities and have more operating leverage than their conventional peers the two types of banks may be differentiated in terms of credit and insolvency risk, oper-ating leverage and off-balance sheet activities, but not in terms of profitability and liquidity. Global financial crisis has a time shifted negative impact on the profitability for both Islamic and conventional. banks

(Louhichi & Boujelbene, 2016)	30 islamic bank and 87 conventional bank 10 OIC countries (Organization of Islamic Cooperation) 2005 -2012	one-step generalized method of moments (GMM) system estimator. panel vector autoregressive (PVAR) model	NPL, bank size, loan loss provisions, cost efficiency, equity to assets,real **gross domestic product, annual inflation rate**	Results support the"bad management" hypothesis for conventional banks. Results support the moral hazard and skimping hypotheses for both banks" type. Islamic banks behave differently to credit risk dilemma.
(Ibrahim, Aun, & Rizvi, 2017)	45 Islamic banks from 13 countries (Bangladesh, Bahrain, Egypt, Indonesia, Jordan, Kuwait, Malaysia, Pakistan, Qatar, Saudi Arabia, Tunisia, Turkey and the United Arab Emirates). 2000-2014	non-linear relation first-difference GMM ,system GMM estimator, LSDVC estimator	Z = Z-score computed as the sum of bank's return on assets and equity-to-asset ratio divided by the standard deviation of asset return; NZ = normalized Z-score; Size = natural logarithm of total assets; Rsize = the size of total assets relative to GDP; Lend = ratio of gross loans to total assets; Prof = return on average assets; Liquid = ratio of liquid assets to total assets; **△Y = real GDP growth; INF = inflation**; AR = activity restrictions; PM = private monitoring; SUP = supervisory power; CR = capital stringency	Larger Islamic banks are more stable, at least when they surpass a certain threshold size.
(Miah & Uddin, 2017)	48 conventional banks and 28 Islamic banks of the Gulf Cooperative Council (GCC) 2005-2014	DEA approach, Stochastic Frontier Analysis (SFA), and ordinary least square (OLS) regression technique	FEEINC, LDR, SFA, CIR, Z_SCORE, LADR, EQAR, PLL, ROAA, TA	Conventional banks are more efficient in managing cost. Islamic banks are more solid in terms of short-term solvency but no such difference exists as far as the long-term stability is concerned. Operations of Islamic banks are different from their conventional counterparts. Highly capitalized banks are more stable.
(Doumpos, Iftekhar, & Fotios, 2017)	101 Islamic banks, 347 conventional banks, and 52 banks with an Islamic banking window operating in 21 countries (members of the Organisation of	Multicriteria methodology random effects model	Strength index (BOFSI)[36] EQAS Equity / Total Assets LLP Loan loss provision / Gross loans ratio COST Cost / Income ROA Profits / Total Assets LIQ Liquid assets / Deposits and short term funding ratio LNTA Natural logarithm of bank total assets **GDPGR GDP Growth** (annual % change)	Conventional banks outperform both the Islamic banks and the banks with Islamic window in the case of Asia and the Gulf Cooperation Council; however, Islamic banks perform better in the MENA and Senegal region bank overall financial strength index is influenced by various country-specific attributes.

[36] This index is developed with a multicriteria methodology that allows to aggregate various criteria capturing bank capital strength, asset quality, earnings, liquidity, and management quality in controlling expenses.

	Islamic Cooperation) 2000–2011		**INFL Inflation**, measured by annual % change in consumer prices INSTIT Overall indicator of institutional development CONC Concentration in the banking sector CRGDP Private credit by deposit money banks & other financial institutions / GDP CORR Indicator of the control of corruption RQUAL Indicator of regulatory quality RQUAL Indicator of regulatory quality RLAW Indicator of rule of law GOVEFF Indicator of Government effectiveness PSTAB Indicator of Political Stability and Absence of Violence/Terrorism VACC Indicator of Voice and Accountability	

Table A 3 : Z-score Evolution

Year	CB	IB
2005	27.84269	.5025719
2006	30.31671	.4088434
2007	29.47542	.363595
2008	30.1782	.3670602
2009	29.74458	.3599491
2010	28.93348	3.199474
2011	30.55912	2.215715
2012	30.09865	3.89422
2013	2.513966	2.653184
2014	2.815631	2.523751

Table A 4: Correlation matrix

	ROA	ROE	CTA	CTD	LTA	LTD	LLR	NPL	CAP	DTA	Zscore
ROA	1.0000										
ROE	-0.1034	1.0000									
CTA	-0.3542*	0.0175	1.0000								
CTD	-0.7129*	0.3347*	**0.9470***	1.0000							
LTA	0.2378*	-0.0858	-0.0343	-0.1414	1.0000						
LTD	0.2055*	-0.1167	-0.0677	-0.1368	0.7098*	1.0000					
LLR	0.1811	-0.1018	-0.2356	-0.2210	-0.0503	0.2440*	1.0000				
NPL	0.1404	-0.1021	-0.1414	-0.1377	-0.1490	0.0726	0.6136*	1.0000			
CAP	0.6060*	-0.1803*	-0.2724*	-0.3521*	0.2057*	0.2128*	0.4237*	0.2538	1.0000		
DTA	-0.5360*	0.0087	0.0877	0.2841*	-0.2980*	-0.2302*	0.0659	0.0436	-0.4570*	1.0000	
Zscore	0.1936*	-0.0874	-0.0863	-0.0404	0.0466	0.0860	0.1523	0.1277	0.3546*	-0.2382*	1.0000

(suite)

	Zscore	ROA	DTA	GDPG	INF	EXRate	unemploy	INTER	FDI	size	OBSIA	FAA	Share	AGE
Zscore	1.0000													
ROA	0.1936*	1.0000												
	0.0326													
DTA	-0.2382*	-0.5360*	1.0000											
	0.0083	0.0000												
GDPG	0.0217	0.0011	-0.0222	1.0000										
	0.8125	0.9900	0.8086											
INF	-0.0411	0.1008	-0.0538	-0.0610	1.0000									
	0.6528	0.2675	0.5564	0.4434										

EXRate	-0.0941	0.0850	-0.0819	-0.2686*	0.6860*	1.0000							
	0.3025	0.3498	0.3697	0.0006	0.0000								
unemploy	-0.0047	0.0053	-0.0045	-0.9030*	-0.1784*	0.1154	1.0000						
	0.9593	0.9540	0.9606	0.0000	0.0240	0.1463							
INTER	0.0174	-0.1659	0.0356	0.4011*	-0.3547*	-0.2632*	-0.3193*	1.0000					
	0.8490	0.0667	0.6972	0.0000	0.0000	0.0008	0.0000						
FDI	0.0507	0.0158	-0.0070	0.5984*	-0.0787	-0.4462*	-0.5757*	-0.0896	1.0000				
	0.5791	0.8620	0.9390	0.0000	0.3227	0.0000	0.0000	0.2598					
size	0.3026*	0.0069	-0.4549*	-0.1301	0.1487	0.1912*	0.1271	-0.0978	-0.1151	1.0000			
	0.0007	0.9397	0.0000	0.1531	0.1022	0.0349	0.1631	0.2837	0.2067				
OBSIA	-0.2999*	-0.2527*	0.1013	-0.0655	0.0359	-0.0230	0.0519	0.0337	-0.0810	0.0224	1.0000		
	0.0069	0.0228	0.3713	0.5396	0.7369	0.8294	0.6274	0.7529	0.4477	0.8439			
FAA	-0.2028*	0.0245	-0.1448	-0.0123	0.0769	0.0767	-0.0058	-0.0132	-0.0587	-0.0072	0.3016*	1.0000	
	0.0313	0.7956	0.1261	0.8918	0.3958	0.3974	0.9491	0.8840	0.5174	0.9394	0.0039		
Share	-0.0606	-0.0019	-0.2207*	-0.0256	0.2133*	0.3022*	-0.0217	-0.0515	-0.0874	0.6775*	0.0796	-0.0584	1.0000
	0.5072	0.9832	0.0146	0.7793	0.0183	0.0007	0.8125	0.5729	0.3384	0.0000	0.4829	0.5392	
AGE	0.0788	-0.2320*	0.1901*	-0.0353	0.0650	0.0734	0.0196	-0.0258	-0.0430	-0.0336	-0.0646	0.4336*	-0.1021	1.0000
	0.3884	0.0098	0.0359	0.6574	0.4145	0.3565	0.8058	0.7457	0.5893	0.7132	0.5452	0.0000	0.2634	

legend: * p<.1; ** p<.05; *** p<.01.

Table A 5 : Z-score and DTA autocorrelations.

	DTA	L.DTA	Zscore	L.Zscore
DTA	1.0000			
L.DTA	0.9068*	1.0000		
	0.0000			
Zscore	-0.2382*	-0.2691*	1.0000	
	0.0083	0.0055		
L.Zscore	-0.2512*	-0.2516*	0.9515*	1.0000
	0.0097	0.0056	0.0000	

legend: * p<.1; ** p<.05; *** p<.01

Table A 6: Unit root tests Results (variables in level).[37]

	Z-score		CAP		CTA	
	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**
Levin, Lin & Chu t*	-1.51600	0.0648	-3.89345	0.0000	-2.25411	0.0121
ADF - Fisher Chi-square	45.1644	0.0614	58.1656	0.0031	47.2569	0.0235
PP - Fisher Chi-square	70.3316	0.0001	75.6457	0.0000	68.5359	0.0001

	Size		DTA	
	Statistic	Prob.**	Statistic	Prob.**
Levin, Lin & Chu t*	-3.57745	0.0002	-6.54861	0.0000
ADF - Fisher Chi-square	25.7068	0.6900	44.7733	0.0663
PP - Fisher Chi-square	38.7699	0.1310	47.0672	0.0418

	CTD		ROA		ROE		NPL	
	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**
Levin, Lin & Chu t*	-5.51957	0.0000	-7.95951	0.0000	-12.8326	0.0000	-4.5227	0.0000
ADF - Fisher Chi-square	35.8160	0.1473	50.3903	0.0058	47.3888	0.0125	37.2040	0.0002
PP - Fisher Chi-square	65.4927	0.0001	58.2293	0.0007	60.0155	0.0004	52.5490	0.0000

[37] Null: Unit root (assumes common unit root process) for Levin, Lin & Chu t* and Breitung t-stat. While Null: Unit root (assumes individual unit root process) for ADF - Fisher Chi-square test and PP - Fisher Chi-square.

		UNIT ROOT TEST TABLE (PP)				
	At Level					
		GDPG	**UNEMPLOY**	**INTER**	**FDI**	**INF**
With Constant	t-Statistic	-2.3590	-2.4960	-0.0010	-2.8446	-2.0824
	Prob.	0.1761	0.1465	0.9336	0.0900	0.2536
		n0	n0	n0	*	n0
Without Constant & Trend	t-Statistic	-0.9789	-0.3336	14.8858	-0.9399	1.1341
	Prob.	0.2679	0.5361	0.9999	0.2834	0.9182
		n0	n0	n0	n0	n0
	At First Difference					
		△(GDPG)	△ (UNEMPL)	△ (INTER)	△ (FDI)	△ (INF)
Without Constant & Trend	t-Statistic	-5.2652	-6.0823	-0.0011	-9.1443	-3.6664
	Prob.	0.0002	0.0001	0.6526	0.0000	0.0026
		***	***	n0	***	***
			UNIT ROOT TEST TABLE (ADF)			
	At Level					
		GDPG	UNEMPL	INTER	FDI	INF
With Constant	t-Statistic	-2.3638	-2.4960	-0.0015	-1.5405	-2.0774
	Prob.	0.1749	0.1465	0.9335	0.4644	0.2553
		n0	n0	n0	n0	n0
Without Constant & Trend	t-Statistic	-1.1435	-0.3646	-0.2189	-2.8735	0.5101
	Prob.	0.2110	0.5241	0.5758	**0.0102**	0.8047
		n0	n0	n0	**	n0
	At First Difference					
		△ (GDPG)	△ (UNEMPL)	△ (INTER)	△ (FDI)	△ (INF)
Without Constant & Trend	t-Statistic	-4.7642	-4.3015	-0.0033	-10.6131	-3.3802
	Prob.	0.0005	0.0010	0.6477	0.0001	0.0043
		***	***	n0	***	***

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant
*MacKinnon (1996) one-sided p-values. [38]

Table A 7: Granger non Causality test results.

[38] This Result is The Out-Put of Program Has Developed By:
Dr. Imadeddin AlMosabbeh
College of Business and Economics
Qassim University-KSA

Null Hypothesis:	F-Statistic	Prob.	Null Hypothesis:	F-Statistic	Prob.
* GDPG does not Granger Cause CTA	2.79800	0.0667	* LTA does not Granger Cause LTD	5.46642	0.0059
* EXRATE does not Granger Cause Z_SCORE	3.62646	0.0309	* LTD does not Granger Cause NPL	5.89142	0.0129
* UNEMPLOY does not Granger Cause CTA	2.78056	0.0678	* LTD does not Granger Cause OBSIA	3.04962	0.0575
* CAP does not Granger Cause ROE	2.80929	0.0660	* LTD does not Granger Cause ROA	3.63549	0.0313
* SIZE does not Granger Cause CAP	2.59993	0.0803	* LTD does not Granger Cause SIZE	7.11832	0.0015
* DTA does not Granger Cause CTA	3.92784	0.0234	* LTD does not Granger Cause CAP	7.09437	0.0015
* ROA does not Granger Cause DTA	5.52982	0.0056	* CTA does not Granger Cause DTA	3.99466	0.0221
* NPL does not Granger Cause Z_SCORE	9.82628	0.0030	* CTA does not Granger Cause INTER	3.60796	0.0314
* LTA does not Granger Cause CAP	7.98165	0.0007	* CTA does not Granger Cause ROE	3.92582	0.0235
* LTD does not Granger Cause LLR	3.03018	0.0587	* OBSIA does not Granger Cause CTA	4.84176	0.0127

Figures

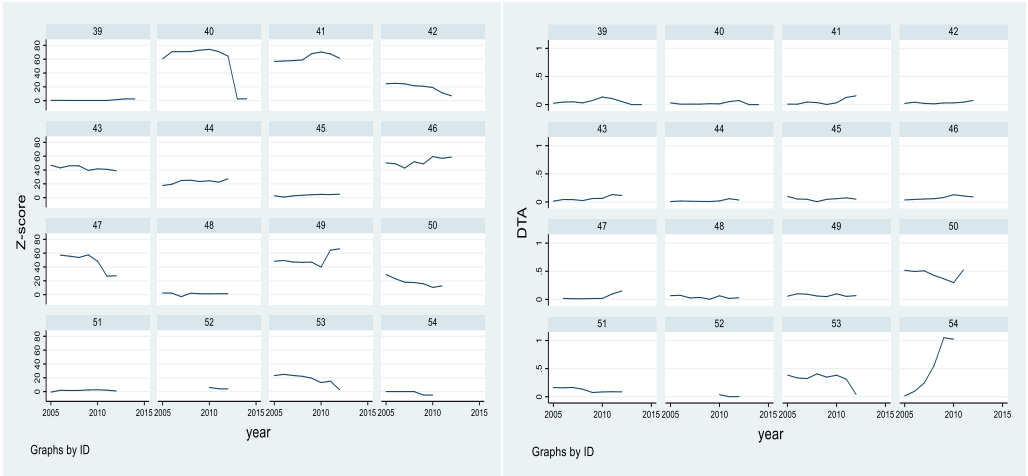

Figure 6: Z-score and DTA evolutions **by bank** from 2005 to 2014.

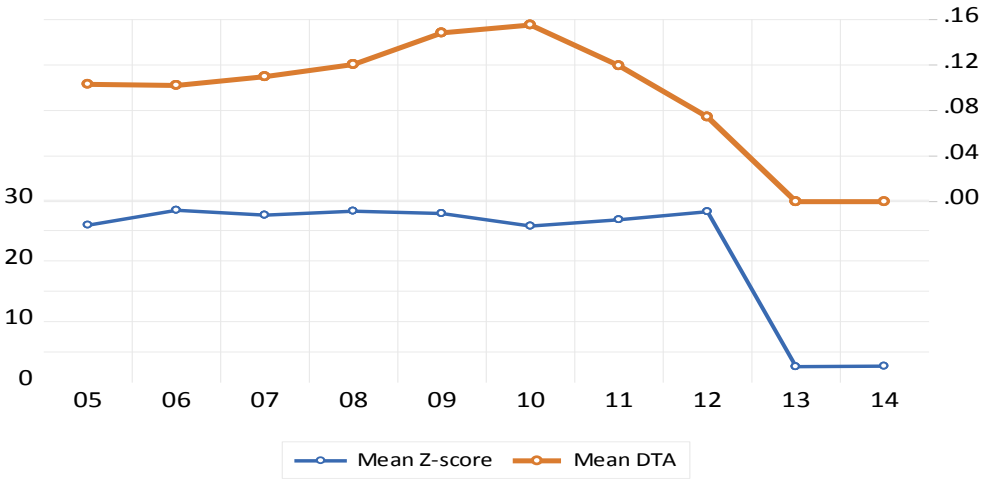

Figure 7 : Z-score and DTA **average evolution** for **All banks**.

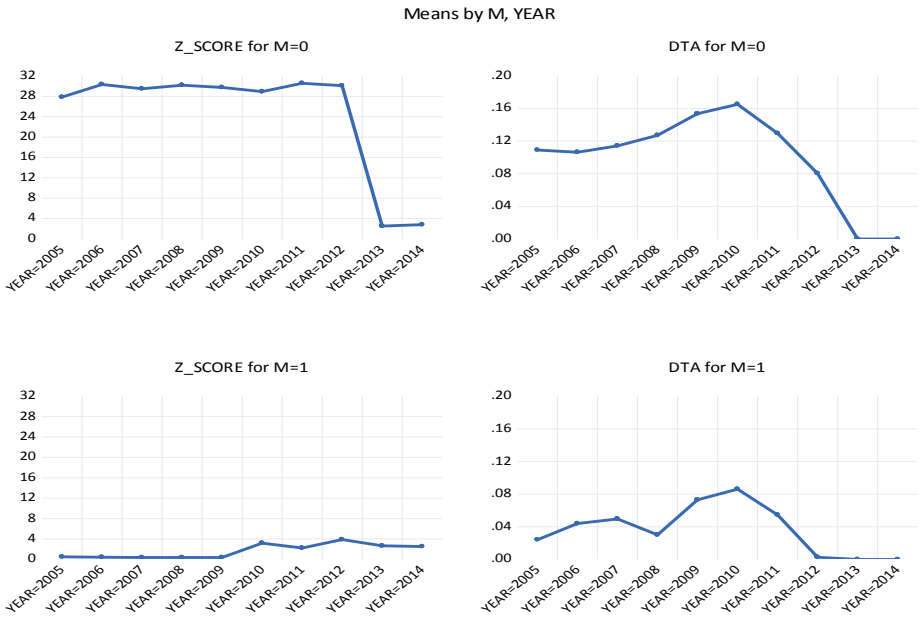

Figure 8 : Z-score and DTA **average evolution** for IB (M=1) and CB (M=0).

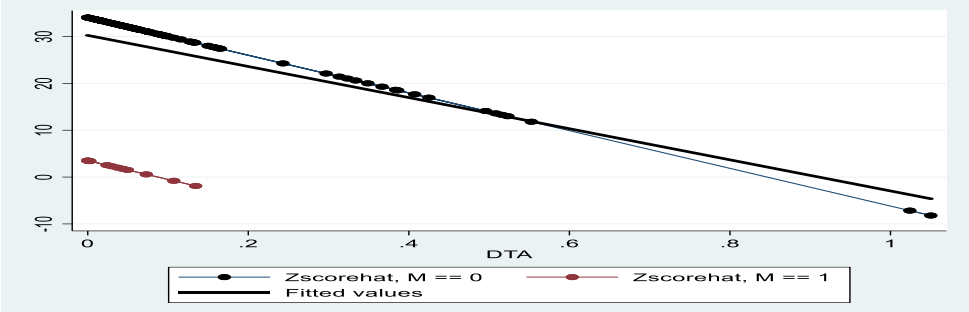

Figure 9 : Z-score and the DTA **linear static relation** for IB, CB, and all tunisian banks.