



Classification of Lending Risks and Interpretation of Operational Efficiency in Islamic Banks Registered on the Bahrain Stock Exchange

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ABSTRACT

This paper aims to classify the credit risk and interpret the operational efficiency for Islamic banks listed on the Bahrain stock exchange (BSE). The paper is divided into two parts. Part I relates to classifying the risk of lending via a range of variables: Lending ratios, loan profitability, and bank risk variables such as capital bank adequacy and financial leverage. Discriminant analysis has been used to prove the hypothesis in this section. Part II relates to the interpretation of operational efficiency via a set of variables reflecting the bank's ownership, number of branches, financial leverage, and the size of the bank. The hypothesis here was proven by using a random regression effects analysis. The regression results reflected the impact of the mentioned variables on the operating efficiency for Islamic banks listed on the BSE. The study is structured as follows: Introduction; models of forecasting financial failure; review of literature on the efficiency of banks; hypothesis of part I, which classifies Islamic banks into three categories—low, medium, or high—based on the banks' efficiency including hypotheses tests, description of variables, and the mathematical model; Results of hypotheses of part I; hypotheses of part II, which is devoted to testing the efficiency of Islamic banks using the explained variables and the same methodology as in part I; results of part II; conclusion; and references.

Keywords: Loans Profit Efficiency, Islamic Banks, Z-scores, Operating Efficiency, Classification

JEL Classifications: C33, C38, G21

1. INTRODUCTION

Banking risks have gained increasing importance in recent times due to their impact on the banks' performance and the difficulty of forecasting and hedging against the same. In light of the many developments in banks, especially commercial ones, the systems of control were standardized after unequal competition in world banking markets, owing to the low capital of some industrialized countries' assets. This added to the mounting risks from credit operations, which in turn necessitated increased regulatory action from central banks to control those risks.

Several academic studies concerning multiple bank risk classification have addressed such risks. These are categorized as systematic and

non-systematic risks, as environmental risks and distribution risks: Irregular scalable risks that include financial risks (Rose pp.165). Saunders and Cornett (2006. p. 180-88) classified such risks as follows:

1.1. Environmental Risks

1. Legal risks: Changes in laws that affect the activity of commercial banks
2. Economic risks: Accompanied by the risks of economic factors that significantly affect the performance of the bank, such as inflation and exchange rate risks
3. Competition risks: Risks that lead to non-bank financial institutions providing banking products and services
4. Organizational risks: Includes a set of rules and procedures that affect the way the bank provides its services.

1.2. Distribution Risks

Most of these risks are associated with the distribution of financial services and include the following:

1. The original may cease on maturity and hence the value of the asset portfolio.
2. Liquidity risk: Also called funding risks, these are an indicator of the bank's ability or potential to provide its financing needs. They may result in the bank's inability to meet a customer's needs to withdraw and ask borrowers for loans, which forces the bank to borrow emergency funds at a higher price. This effectively lowers the profitability of the bank.
3. Interest rate risk: A change in the market interest rate has an impact on the revenue margin and the bank's costs if the interest expense on the funds borrowed increases the interest income on loans and investment bonds, which in turn reduces the profit margin.
4. Profit risk: They are the risks of net income volatility, and the unexpected decline in profits affects many factors. These factors include banking facilities and other external factors such as the change in economic indicators or restrictions imposed by regulation.
5. Risk of leverage: This is called the risk of capital inadequacy as the bank's capital works to protect the depositors and lenders from a decline in the value of the asset portfolio.

2. MODELS FOR FORECASTING FINANCIAL FAILURE

Beaver (1966) built a forecasting model to predict a financial failure, followed by Altman (1968). This is now commonly known as the Z-score model. Altman designed his model on a set of complex and interconnected financial ratios in a time-series spanning a time horizon over several accounting periods and having a dynamic attribute. This makes it a good tool to predict the financial failure of companies. Ever since, many researchers have put forth new models to predict and develop their predictive capacities. The Z-score model was further developed and later defined as the zeta model in 1977.

Alternately, the financial ratios used to construct the model were traditional ratios drawn from financial statements prepared on an accrual basis. These were later combined with other ratios drawn from the cash flow list. The model's development did not use these financial ratios but extended to the nature of the variables forming these models and the methods used to create them. Regarding the quality of the variables, this is no longer limited to variables of a financial nature but rather to the construction of few variables of financial services (quality) such as company management qualifications, employee turnover rate, organizational effectiveness, company size, and company age.

Argenti (1983) was the first to adopt this kind of model. This trend was also followed by Lennox (1999), wherein his model included non-financial variables derived from the company's external environment such as general economic conditions, market conditions, inflation rates, and prevailing laws and legislation. The methods used to construct those models were most common after the multiple regression analysis method.

Following is a list of models used to predict financial failures: Beaver (1966), Altman (1968), Altman and McGough (1974), Argenti (1976), Ohlson (1980), Kida (1981), Casey (1986), and Lennox (1999).

Altman's model (1968) is based on five variables weighted by numbers based on five major financial ratios:

$Z\text{-score} = 1.2A + 1.4B + 3.3C + 0.6D + 1.0E$, where,

A = Working capital ÷ total assets,

B = Retained earnings ÷ total assets,

C = Earnings before interest & taxes ÷ total assets,

D = Market value of equity ÷ total liabilities, and

E = Sales ÷ total assets.

When analyzing the Z-score of a company, the lower the value, the higher the odds that the company is headed toward bankruptcy. Altman came up with the following rules for interpreting a firm's Z-score. These are listed as follows: Z-score < 1.8 indicates that a firm is headed for bankruptcy; Z-score > 3.0 indicates that a firm is unlikely to enter bankruptcy; and $1.8 < Z\text{-score} < 3.0$ is interpreted as the statistical "gray area."

The Kida model (1981) builds on five weighted variables with figures based on the five main financial ratios. The mathematical model is as follows:

$$Z = 1.042 \times 1 + 0.42 \times 2 - 0.461 \times 3 - 0.463 \times 4 + 0.271 \times 5$$

According to this model, if the (Z) value is positive, the unit is at a safe distance from financial failure, but if the (Z) value is negative, the probability of failure is high. This model is one of the better models that demonstrates a high level of predictability of the financial failure of the establishments in question.

The Angelini study (2000), which deals with banking risks, aims at identifying the tendency of banks toward risk. This applies to an Italian interbank market from 1993 to 1996, and it analyzes the times of borrowing and lending, the sizes of these operations, and the daily interest rates. This study found that banks are not inclined toward risk.

Khalil (2004) tested the impact of distressed debt on the financial results of commercial banks when applied to national banks. The study found that the profitability of the banks is fundamentally affected by both the volume of distressed debt and the proportion of debt distressed and the rate of loan losses. This is true for The Egyptian Ali, Bank of Egypt and Banque du Cairo from 1985 to 1996.

3. REVIEW OF LITERATURE ON BANK EFFICIENCY

For the adequacy of bank capital and its relationship to bank risks, Altunbas et al. (2004) tested the relationship between capital, risk, and the efficiency of a large sample in European banks between 1992 and 2000. The inefficiency of European banks appeared to result from a higher increase in capital and lesser risk. The practical guide showed that a positive relationship between risk and the level of capital, and liquidity might indicate the use of

capital as a means of restricting the activities risk. Furthermore, there was evidence that the financial strength of the corporate sector had a positive impact on reducing bank risks and capital levels. There were no significant differences in the relationship between capital and efficiency to the risks of commercial banks and savings banks.

To assess the importance of factors affecting financial failure and inefficiency, Souza and Tabak's (2003) study used a data development analysis to assess the technical competence of the Brazilian banking system. The study used different approaches to assess several factors influencing efficiency; these included the analysis of variability and the maximum probability of the natural distribution of income. This study thus focuses on the correlation between the output measured and the data analyzed since 2001. The factors affecting the bank's efficiency are as follows: The nature of the bank (commercial or comprehensive), the type of bank (credit, business, or segmentation), the size of the bank (large and medium-sized), the bank control (private or public), the destination of the bank (local or foreign), and the outstanding loans. The last variable is a measure of bank risks where all quantities change, including outstanding loans, and is measured on a per employee basis. The importance of the effect of variables varies and there is a moral effect in all models with the outstanding loan variable. There is a moral effect on the levels of inefficiency and the risks of bank failure.

The Alzoubi study (2017), which was titled "determinants of liquidity risk in Islamic banks," submitted a comprehensive model including several variables that affected the liquidity of the 42 Islamic banks' sample between 2007 and 2014. The results showed a negative correlation between the cash flow ratios and liquidity risk, from the perspective of efficiency, and their relationship to the performance of the bank. The Kwan study (2004) used the random border approach to verify the cost-efficiency of commercial banks in Hong Kong. The study found that the average internal efficiency was about 16-30%, which is similar to the results of the United States banking industry efficiency. The banks in Hong Kong are now operating closer to the cost limits than before. This is a result of technological innovations in the Hong Kong banking industry. Moreover, the average internal efficiency of large banks in Hong Kong is lesser than the average efficiency of small banks, especially in earlier periods of time.

As a result of the increasing interest in recent years in the profitability of Mexican banks, there has been a growing concern to verify the best model, which can explain the recent increases in profitability of Mexican banks due to market power or changes in efficiency. Mora et al. (2005) recognized indicators for efficiency by using the competency curve approach and incorporated traditional indicators into the profitability structure model. The study found similar findings to the previous research and supported the premise of market power. However, it did not find confirmation of the impact of any economic and political indicators.

Ali (2014) studied the three stages of analysis. The first phase measured the efficiency of Islamic banks using non-parametric

methods and the data envelopment analysis (DEA) method. Phase II included risk analysis through credit measurement of operational and liquidity risks using all financial ratios. In Phase III, the researcher used the correlation coefficients to examine the relationship between the credit, operating, and liquidity risks from 2006 to 2009. The results showed that the credit risk was adverse, while operational risks were found to be highly correlated with efficiency. Liquidity risk has shown a non-correlation with efficiency in Islamic banks in the Middle East and North Africa region.

Colesnic et al. (2018) in the paper "Estimating risk efficiency in Middle East banks before and after the crisis: A Metafrontier framework" aimed to test the relationship between the risk efficiency and efficiency level at Middle East banks before and after the crisis from 1998 to 2014 and measure the impact of risk efficiency to reduce the banks' cost. They deduced that this impacted the small banks more.

Novickyt and Drożdż (2018) aimed to build a cost alternative model based on inputs and outputs and test the Lithuanian banks' efficiency on bank profitability between 2012 and 2016. The study proved that the larger Lithuanian banks (subsidiaries) applied a more appropriate business model than smaller (local) banks.

Hong Lu, Li Yang (2018) employed the CCR model of DEA to evaluate the operating efficiency (OE) of domestic banks in Taiwan from 1998 to 2004. The study found that the non-performing loans/gross loans ratio in the high-efficiency group is significantly lower than that of the low-efficiency group. Additionally, it found capability for improvement in the non-interest income and investments in each year and made suggestions for banks to adjust all the variables to enhance their overall OE.

This paper divided into two parts. The first part deals with the observations for classifying the banks according to the discriminant function of the observations to low, medium, or high efficiency, according to the loans efficiency (risk and return of loans profits index). Researchers have used multiple linear regression to test the hypotheses in this part. The second part deals with the study of factors influencing the operational efficiency of banks. The researcher used the multiple linear regression analysis models to test the hypotheses of this segment.

4. HYPOTHESES OF PART I

1. There is no statistically significant effect of the explanatory variables on a discrimination function.
2. Independent variables are separate and independent from each other.
3. Observations cannot be categorized as being low, medium, and highly efficient.
4. The differences between the observations' average is large.

4.1. The Mathematical Model

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p + \varepsilon \quad (1)$$

Where,

Z is the variable formed by the linear combination of the dependent variable,
 X_1, X_2, X_p are the P independent variables,
 $\beta_0, \beta_1, \beta_p$ are the coefficient of independent variables, and
 ε is the random error.

4.2. Study Methodology

1. Uses the method of panel (data) discriminant analysis (Stata.V.14)
2. Uses the method of panel (data) multiple linear regression (Stata.V.14)
3. The study period is 10 years, started from 2006 and ending in 2015.
4. All test were carried out on six Islamic banks registered at the Bahrain Stock Exchange (BSE)—Bahrain Islamic Bank, Ithmar Bank, Gulf Bank, Al Baraka Group, Kuwait Finance Bank, and Al-salaam Bank.

4.3. Description the Variables of the Part I

4.3.1. Interpreted variables

1. Bank adequacy (CA): This variable reflects the sufficiency of the bank’s capital, weighted by the asset risk weights reflecting the degrees and levels of risk in accordance with the Basel II classification of banks.
2. Financial leverage (TL/TA): This reflects bank risks related to total bank obligations attributable to total assets.
3. Profitability of lending (ROL): A reflects the loans profits granted by Islamic banks.
4. Lending ratio: This reflects the ratio of an Islamic Bank to total investment in the bank.

4.3.2. Dependent variable

ZDS: This reflects the efficiency of the lending profitability index (the efficiency of the differential coefficient for the profitability and risk of lending).

5. RESULTS OF HYPOTHESIS TESTS (PART I)

The test results of the first hypothesis relate to the existence of a significant effect of the interpreted variables (CA bank adequacy, LR ratio of lending, ROL profitability of the lending, and TLTA financial leveraged) on the efficiency index of Islamic banks and the ability of these variables to categorize observations as low, medium, or high efficiency. The results summarized in Table 1 for the discriminant canonical regression test is for a model with significance at zero ($P > F = 0.000$); the coefficient of canonical correlation (0.734) was high. Table 2 shows the summary of the univariate analysis, where the coefficients for all variables were of a high significance (0.000) except when bank adequacy was significantly < 0.05 ; the eigenvalue was 1.17, which indicated the

ability of these variables to interpret the efficiency index of the Islamic banks, as shown in Figure 1.

The discriminant function $Z = -0.94 CA - 82 LR - 86 TLTA - 0.21 ROL$ (2)

The test results of the second hypothesis proved the validity of the second imposition that the interpreted variables are separate from each other. This is showed in a Table 3 of the correlation matrix of the classification of the observations within the three groups.

The test results of the third hypothesis regarding the inability of the discriminant analysis function to categorize the observations (as low, medium, or high efficiency) is incorrect. Table 4 summarized results where the alternate hypothesis is valid. Figure 2 shows the ability of the discriminatory function to classify these observations to three levels in terms of efficiency of the lending profitability index (1 is low efficiency, at a classification rate up to 41.67%; 2 is medium efficiency, at a classification rate up to 40%; and 3 is high efficiency, at a classification rate up to 18.33%). As is showed in Table 4.

The fourth hypothesis test validates the hypothesis that the averages between the categorized groups are separate. This is reflected in Table 5 through the squared Mahalanobis distance between the groups, which shows that there are significant differences between the averages of the categorized in the groups, which was 2.3 between Groups 1 and 2, 6.2 between Groups 1 and 3, and 9.9 between Groups 2 and 3.

The discriminant function $Z = -0.94 CA - 82 LR - 86 TLTA - 0.21 ROL$ (2)

6. HYPOTHESES PART II

There is no statistically significant effect on the independent variables—number of branches, bank’s ownership, leverage, and the impact of volume on the operational efficiency of Islamic banks.

The independent variables are unrelated to each other. There is no auto-correlation between the residuals.

6.1. The Mathematical Model

$$Y_{OE} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p + \varepsilon \quad (3)$$

Where,

Y_{OE} is the dependent variable,
 X_1, X_2, X_p are the P independent variables,
 $\beta_0, \beta_1, \beta_p$ are the coefficients of independent variables, and
 ε is the random error.

Table 1: Canonical linear discriminant analysis

Function	Canonical correlation	Eigen-value	F	df1	df2	P>F
1	0.735	1.172	9.756	88	108	0.0000e
2	0.518	0.3662	6.714	3	55	0.0006e

6.2. Methodology

1. Use of the panel (data) multiple linear regression method (Stata.V.14).
2. The study period is 10 years, starting from 2006 and ending in 2015.
3. All test were carried out on six Islamic banks registered at the BSE — the Bahrain Islamic Bank, Ithmar Bank, Gulf Bank, Al Baraka Group, Kuwait Finance Bank, and Al-salaam Bank.

6.3. The Descriptions of the Variables (Part II)

6.3.1. The independent variables

- Bank size (Log TA): This reflects the total investment available to a bank as measured by the natural logarithm of its asset size.
- Financial leverage (TL/TA): This reflects bank risks related to total bank obligations attributed to total assets.

Figure 1: The independent variables

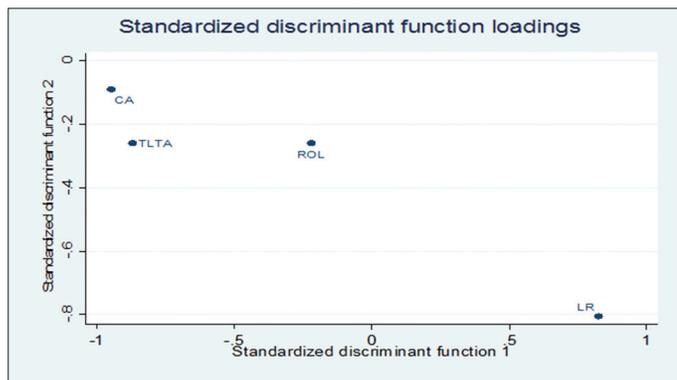


Table 2: Univariate ANOVA summaries

Variable	Model MS	Residual MS	Total MS	R-S. q	Adj R-S. q	P>F
CA	0.0491	0.3980	3862	0.1098	0.0786	0.0363**
LR	0.5986	1.437	1.409	0.2940	0.2692	0.0000***
TLTA	0.953	1.949	1.9155	0.328	0.3048	0.0000***
ROL	0.0288	0.1382	0.1345	0.1727	0.1437	0.0045***

Number of observations = 60, model df = 2, residual df = 57 **P>0.05, ***P>0.01

Table 3: Between-groups correlation matrix

	CA	LR	TLTA	ROL
CA	1			
LR	0.5	1		
LTA	0.6	-0.3	1	
ROL	0.80	0.47	0.64	1

Table 4: Classification summary

True DIS	Classified			Total
	1	2	3	
1	22 (73.33)	6 (20.00)	2 (6.67)	30 (100.00)
2	3 (15.00)	17 (85.00)	0 (0.00)	20 (100.00)
3	0 (0.00)	1 (10.00)	9 (90.00)	10 (100.00)
Total	25 (41.67)	24 (40.00)	11 (18.33)	100.00

Table 5: Mahalanobis squared distances between groups

DIS	DIS		
	1	2	3
1	0		
2	2.305586	0	
3	6.266235	9.988723	0

- Number of bank branches (N): This reflects the total number of branches for a bank.
- Type of bank (BT): This reflects whether the bank is Bahraini or foreign.

6.3.2. The dependent variable

OE: This is measured by expenses to revenue.

7. RESULTS OF THE PART II

7.1. First Hypothesis Test Results

The hypothesis test through the results of variance test (Table 6) reflected a high significance of the regression coefficient at a zero level, while the adjusted determination coefficient reached 0.978. The researcher rejected the null hypothesis and accepted

Figure 2: Discriminant function scores

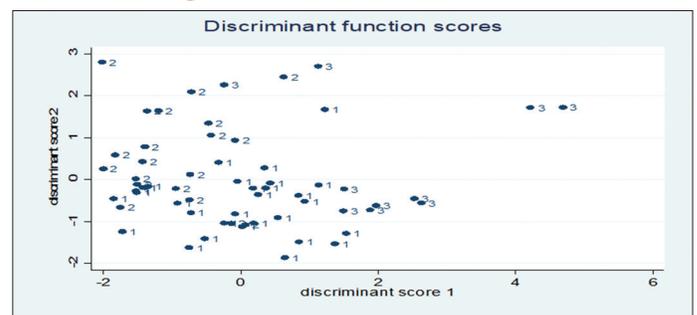


Table 6: Standardized canonical discriminant function coefficients

	Function 1	Function 2
CA	-0.9467437	0.0894014
LR	0.8251154	0.8043652
TLTA	-0.8697138	2587304
ROL	-0.2199044	0.2588564

Table 7: ANOVA results

Source	SS	df	MS	P>F	R ²	Adj R ²	Root MSE
Model	2.143	5	0.4286	0.000	0.981	0.979	0.0280
Residual	0.0423	54	0.00078				
Total	2.185	59	0.03704				

Table 8: Regress results

E	Coef.	SE	P> t
N Branches	-0.01	0.00	0.00
TB	-0.01	0.01	0.16
LR	-0.00	0.02	0.89
TLTA	-0.03	0.02	0.09
Size effect	0.07	0.00	0.00
cons	0.18	0.03	0.00

Table 9: FIV

Variables	VIF	1/VIF
Size effect	1.57	0.635
N Branches	1.5	0.665
LR	1.28	0.783
TLTA	1.18	0.849
TB	1.14	0.878
Mean VIF	1.33	

Table 10: Panel random-effects GLS regression

Number of observations	60	OE	Coef.	SE	P> z	P > χ^2
Number of groups	6	N Branches	-0.0101	0.0014	0.000***	
R-S. q		Size effect	0.0712	0.0015	0.000***	
		LR	-0.0031	0.0221	0.886	
Within	0.9933	TLTA	-0.030	0.0178	0.083	0.0000
Between	0.9381	TB	-0.014	0.0103	0.083	
Overall	0.9806	Cons	0.1804	0.0288	0.000	
Sigma_ e			0.0137			
rho			0			Fraction of variance due to U. I

P>0.05, *P>0.01

the alternative hypothesis, which was highly significant for interpreting the variables (number of branches, type of bank, the ratio of lending, leverage, and the effect of a variable of size) on the operational efficiency of the Islamic banks.

Additionally, the variables had a high significance level ranging between 0.00 and 0.02 (Table 7) with an adverse relationship between the independent variables and the dependent variable. An increase in the number of a bank's branches led to lower operational efficiency in these banks by increasing their fixed costs of administrative expenses. This increase also led to an increase in the bank's efficiency that was confirmed by the overall adjusted R² at 98% and high significance of the variables coefficients, which denotes the high capacity of the model to determine operational efficiency in the Islamic banks listed on the BSE.

7.2. Second Hypothesis Test Results

The interpreted variables are independent of each other, which is validated by the variance inflation factor test as shown in Table 8.

7.3. Third Hypothesis Test Results

The residuals are not auto-correlated and independent of each other. The validity of this is imposed by the Cook-Weisberg test, where the Chi2 value was not significant at $P > \chi^2$, where $\chi^2 = 0.85$ (Tables 9 and 10).

$$\chi^2(1) = 0.03$$

$$P > \chi^2 = 0.8592$$

8. CONCLUSION

The variables—lending ratio, bank adequacy, financial leverage, and profitability of lending—classified the observation of the efficiency of loans to low, medium, and high efficiency, according to the discriminatory analysis function in the first part of the study. The number of branches and the impact of assets size explained the operational efficiency at a very high rate. through the panel overall adjusted 98% determination rate and a significance of <1% for the coefficients of all variables.

Thus, the researcher recommends that these banks can improve their operational efficiency by reducing the number of branches and increasing the size of assets representing a positive impact on the operational efficiency. This is true of all Islamic banks listed on the BSE.

REFERENCES

- Ali, S. (2012), Islamic banking in the Middle-East and North-Africa (MENA) region. *Islamic Economic Studies*, 20(1), 1-44.
- Altman, E. (1968), Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589-609.
- Altman, E., McGough, T. (1974). Evaluation of a Company as a Going Concern. *Journal of Accountancy*. p50-57.
- Altunbas, Y., Carbo, S., Gardener, E.P.M., Molyneux, P. (2004), Examining the Relationship Between Capital, Risk and Efficiency in European Banking. Center for Banking and Financial Studies. Bangor, UK: SBARD, University of Wales. p1-35.
- Alzoubi, T. (2017), Determinants of liquidity risk in Islamic banks. *Journal of Banks and Bank Systems*, 2(3), 142-148.
- Angelini, P. (2000), Are banks risk averse? Intraday timing of operations in the inter-bank market. *Journal of Money Credit and Banking*, 32, 54-73.
- Argenti, J. (1983), Predicting corporate failure. In: *Accountants Digest*. Vol. 138. London: Institute of Chartered Accountants in England and Wales. p1-25.
- Beaver, W. (1966), Financial ratios as predictors of failure. *Journal of Accounting Research Supplement*, 4, 71-102.
- Casey, C. (1986). The Variation in Accounting Information Load: The Effect on Loan Officers' Predictions of Bankruptcy, *Accounting Review*. p.36-49.
- Colesnic, O., Kounetas, K., Michael, P. (2018), Estimating Risk Efficiency in Middle East Banks Before and After the Crisis. A Metafrontier Framework. Available from: <https://www.mpra.ub.uni-muenchen.de/84795>, 1-32.
- Khalil, A. (2000). Analysis of the Impact of Bad Debts on Financial Results of Commercial Banks with Application to National Banks, Unpublished Master Thesis, Assiut, Faculty of Commerce, Assiut University.
- Kida, S. (1981), Motion of an elliptic vortex in a uniform shear flow. *Journal of the Physical Society of Japan*, 50, 3157-3520.
- Kwan, S. (2004), The X-Efficiency of Commercial Banks in Hong Kong, Federal Reserve Bank of San Francisco, Hong Kong Institute for Monetary Research, Working paper /24, December,. p1-31.
- Lennox, C. (1999), Identifying failing companies: A re-evaluation of the Logit Probit and MDA approaches. *Journal of Economics and Business*, 51(4), 347-364.
- Mora, R., Villarreal, E., Benitez, M. (2005), Profitability, Concentration and Efficiency in the Mexican Banking Industry. México: Banco de México. p1-24.
- Novickyt, L., Drozd, J. (2018), Measuring the efficiency in the Lithuanian banking sector: The DEA application. *International Journal of Financial Studies*, 6(37), 1-15.
- Saunders, A., Cornett, M. (2006), *Financial Institution Management: A Risk Approach*. 5th ed. New York: McGraw-Hill Companies, Inc.
- Souza, G., Tabak, B. (2003), Factors Affecting the Technical Efficiency of Production of the Brazilian Banking System: A Comparison of Four Statistical Models in the Context of Data Envelopment Analysis. Central Bank of Brazil, Research Department, March 26.