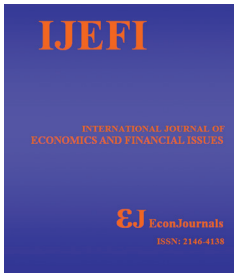

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Challenges of Islamic Insurance

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ABSTRACT

The aim of this paper is to study the stability of insurance companies. The majority of works on this topic has focused on the determinants of financial stability. Therefore, they interested in the Z-score, focused on the ROA, as well as the panel method. Unlike previous work, we have formed a score made up of indicators of efficiency, effectiveness, profitability, solvency, productivity, investment and risk, as well as macroeconomic indicators. Our sample consists of 30 insurance companies, 15 of which are shariaa compatible. The choice of these companies is justified by their contribution to the total assets of the both types of finance. This selection method allowed us to have a global idea on the effectiveness, efficiency, risk and stability of the two insurance sectors. The analysis of the stability scores, determined using the scoring and logit transformation method, revealed that Islamic insurance companies are more stable than conventional insurance companies. From a risk perspective, Islamic insurance companies are less risky than conventional insurance companies. They lose, on average, 1.598% of their assets against 3.704% for conventional insurance companies. This observation related to three types of risk, namely; liquidity risk, market risk and credit risk. Furthermore, this empirical investigation revealed that takaful companies are not immune to the toxic funds of the crisis. Likewise, we note that Islamic insurance companies are sensitive to political shocks such as that of the Arab revolutions that took place in 2011.

Keywords: Effectiveness, Efficiency, Stability, Islamic Insurance and Conventional Insurance
JEL Classifications: C62, G01, G22

1. INTRODUCTION

A takaful contract is a collective donation contract under which a natural or legal person pays a sum not previously defined to the partners' account, which differs from that of the shareholders. These two accounts are managed and invested separately by the takaful company in return for a share of the profits. Similarly, a takaful contract is a contract through which the transfer of a person's losses is made to a committee account. Thus, if the result is positive, the takaful company is expected to distribute the profit among the members. On the other hand, if the members' account is in deficit it must cover these losses. To do this, it uses technical reserves, a request for donation by members or even by means of a "qarth hasan" from a re-takaful company or the shareholders' account. This loan, "qarth hasan," will be reimbursed later by future earnings.

Although the financial literature is rich in works on the stability of banks, it does not contain any paper studying the stability of insurance companies. The majority of works on this topic has focused on studying the determinants of financial stability. Therefore, they became interested in the Z-score, focused on the ROA, as well as the panel method. Unlike previous work, we have formed a score made up of indicators of efficiency, effectiveness, profitability, solvency, productivity, investment and risk, as well as macroeconomic indicators. Our sample consists of 30 insurance companies, 15 of which are shariaa compatible. The choice of these companies is justified by their contribution to the total assets of both types of finance. This selection method allowed us to have a global idea on the effectiveness, efficiency, risk and stability of the two insurance sectors.

The rest of the paper is organized as follows: The first section is reserved for the presentation of the main works on this topic.

The second section is devoted to the description of the data, the variables and the methodology used. Finally, in the third section, we will present and discuss the main results obtained.

2. REVIEW OF THE LITERATURE

Nowadays, the topic of stability is of major interest. Although it is quite important for the insurance sector than the banking sector, studies are rare. Das et al. (2003) indicated that the failure of insurance companies could lead to major and costly disruptions. Furthermore, Cummins et al. (2017) suggested that the insurer's solvency not only protects the insured by ensuring that the insurer will be able to meet its financial obligations in the future, but also contributes to the stability of the financial system.

Indeed, financial stability can be defined as a specificity of the financial system, intended to cope with systemic shocks in a sustainable manner and without generating major disruption. It is used to efficiently allocate the financial resources within the economic department and to identify and manage risks effectively (Mirela, 2008). However, insurance companies are faced with two types of risks, namely specific risks and non-specific risks. Non-specific risks mainly consist of liquidity risk, market risk, insolvency risk and operational risk. On the other hand, the specific risk is an intrinsic risk, linked to the activity of insurance companies, for example the underwriting risk (Krenn and Oschischnig, 2003). In this regard, Mirela (2008) attempted to develop a mathematical model allowing insurance companies to control their level of stability and avoid the risk of insolvency and therefore bankruptcy. This model is based on optimizing the subscription portfolio and supports the creation of an adequate insurance fund to cover compensation and the risk of insolvency. However, this model is only applicable if the conditions of competition are ensured. Mathematically speaking, the level of financial stability is an increasing function of the variation in the net premium rate and the number of areas insured. As a result, the insurance company can improve its level of stability by increasing the net premiums or the number of areas insured. However, to reduce the risk, it must cede part of its contracts to the reinsurance company.

Moreover, Tomislava *et al*. (2019) were interested in determining internal and external financial stability of insurance companies in Central and Eastern Europe. The results of this study revealed that the stability of Croatian insurers is positively influenced by the size of the insurer. In Hungary and Poland, on the other hand, reinsurance is an important factor positively affecting soundness. In fact, these results are consistent with those of Cummins et al. (2008) and Berger et al. (1992). Cummins et al. (2008) indicated that the reinsurance reduces the risk of insolvency by stabilizing losses, limiting specific risks and increasing protection against disasters. Similarly, Berger et al. (1992) stated that the reinsurance is an important risk diversification mechanism in insurance markets, as it protects the insurer against catastrophic loss and possible insolvency.

Zarina et al. (2018) focused on Solvency II and the internal factors of business stability. The results of this paper shows that non-life insurance companies in the Baltic were highly capitalized in 2016, with a total capital surplus of 237 EURO million. In addition, the analysis of the solvency ratios, the risk profile and the excess capital suggests that the Baltic non-life insurance market is more stable than that of Europe and that there is strong growth potential. However, Baltic insurance companies need to lower their associated risk level.

In the same wake, Ziemele and Voronova (2013) studied the solvency as a tool for achieving financial stability in the insurance industry. This paper examines the role of Solvency II in improving the financial stability of insurance companies. The analysis of the new solvency system shows that the Solvency II system will reveal the true financial situation of insurers and improve transparency and confidence throughout the sector. The introduction of risk-based regulatory requirements will ensure that a fair balance is struck between strong protection for policyholders and reasonable costs for insurers.

Cummins et al. (2017) explored the relationship between the stability of life insurance companies and competition. To do this, Cummins et al. (2017) used the z-score, based on the ROA, and Boone's indicator as a proxy reflecting the level of competition. This analysis covers the period 1999-2011 and covers a sample of 10 EU countries, namely, Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Spain, Sweden and the United Kingdom. The main conclusion of this paper is that competition has a positive impact on the financial stability of insurance companies.

Pasiouras et al. (2013) studied the relationship between insurer stability and insurance regulatory policies. They used an international dataset of more than 1700 insurers from 46 countries. The regulatory variables used consist of the capital requirement index, the supervisory power index, the technical provisions index and the investment index. Likewise, they used governance indices such as the internal control index, the corporate governance index and the supervisory power index. The results of this investigation suggest that the supervisory powers of the competent authorities, as well as the regulations relating to technical provisions and investments, appear to have a positive impact on stability.

Schich (2009) examined the role of non-life insurance and investment portfolios in the instability of the insurance industry. It states that the main sources of destabilization of the insurance system are mortgage insurance and financial guarantee companies. A number of exposures to credit and market risks have been revealed, notably in mortgage insurance and financial guarantee activities.

Chen et al. (2004) studied the determinants of financial stability in Asian countries. They were mainly interested in Japan, Malaysia, Taiwan and Singapore. The results of this study suggest that firm size, investment performance, liquidity ratio, excess growth and operating margin are the determinants of stability for non-life insurance companies. On the other hand, the stability of life insurance companies is sensitive to the size of the company, the composition of the assets and the performance of investments.

From a critical point of view, the works exposed previously in the literature review focused on the study of the determinants of financial stability. To do this, the authors interested in the Z-score, focused on the ROA, as well as the panel method. In addition, comparative studies between conventional and Islamic insurance companies have not addressed this subject. Thus, this work could be a starting point for further research.

3. METHODOLOGY

The aim of this paper is to study the stability of Islamic and conventional insurance companies. Unlike previous work, we calculated the efficiency and effectiveness scores, using the SFA and DEA method, instead of using ratios reflecting these two indicators. Then, the efficiency and effectiveness scores were used together with the profitability, solvency, productivity, investment and risk indicators, as well as macroeconomic indicators in order to calculate the stability scores of the two types of insurance company (Islamic and conventional).

Efficiency[1] is the rational use of available resources to achieve pre-set objectives, it is the ability to achieve the objectives and goals envisaged while minimizing the resources committed.

On the other hand, effectiveness measures the achievement of objectives without any measure or precision of the resources employed.

In order to study these two indicators, we will use the DEA method and the SFA method.

Our sample consists of 30 insurance companies, 15 of which are Islamic.

These companies were selected based on their respective contributions in the total assets of the Islamic and conventional insurance sector and the availability of their financial losses. The insurance companies are distributed as follows in Table 1.

3.1. Data Envelopment Analysis

The nonparametric method was developed by Farrell (1957) in his paper "The measurement of productive efficiency." Farrell (1957) was interested in the phenomenon of decision-making and was based on the choice of different baskets (Input; Output) available, and which maximize profits. This method was modified by Charnes, Cooper and Rhodes (1978) who relied on the data enveloping of decision units (Drake, L., Maximilian, H.J.B., Simper, R. 2006), hence the name Data Envelopment Analysis (DEA).

If we have several inputs and outputs, the score will be presented as follows (Srinivas Talluri, 2000):

$$\text{Effectiveness} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}}$$

To judge the efficiency of a basket (input; output) and determine its efficiency score, knowing that there are n decisions, m inputs and outputs, we can use the following form of the DEA model (Srinivas Talluri, 2000):

$$Max \frac{\sum_{k=1}^{s} Vk\ Ykp}{\sum_{j=1}^{m} Uj\ Xjp}$$

$$U.C: \quad \frac{\sum_{k=1}^{s} Vk\ \ Yki}{\sum_{j=1}^{m} Uj\ \ \ Xji} \leq 1 \quad \forall i$$

With: $V_k, U_j \geq 0\ \forall\ k, j$

Where: k=1….s, J=1….m, I=1….n
X_{ji} = Input price used by i DMU.
Y_{ki} = Price of k output produced by i DMU.
V_k = Weighting attributed to the outputs.
U_j = Weighting attributed to inputs.

However, as presented by Charles et al. (1978), equation (2) can be written as follows:

$$Max \sum_{k=1}^{s} Vk\ \ Ykp$$

$$UC: \quad \sum_{j=1}^{m} Uj\ \ Xjp = 1$$

$$\sum_{k=1}^{s} Vk\ \ Yki - \sum_{j=1}^{m} Uj\ \ \ Xji\ \leq 0 \qquad i$$

Such as $V_k, U_j \geq 0\ \forall\ k, j$

The DEA allows determining the maximum of inputs to be injected into a production mechanism above which the benefit drops.

To estimate the efficiency scores of the DMUs we used the following variables in Table 2.

3.2. Stochastic Frontier Analysis

The cost function is presented by Aigner, Lovell and Schmidt (1977) and Meeusen and Van Den Broeck (1977) in the following form:

$$\text{Ln TC} = f(y_i, p_k) + \varepsilon$$

Where: TC = Operating cost.
y_i = Outputs vector.

1 Lesdefinitions.fr : online dictionary.

Table 1: Insurance companies

Continent	Insurance companies
America	1
Europe	7
Asia	22

pk= inputs vector.
ε = Error component.

The translog function will be (Ihsan, I. 2002):

$$\text{Ln TC} = \alpha_0 + \frac{1}{2}\sum_{i=1}^{2}\beta_i \text{Lny}_i + \frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2}\beta_{ij}\text{Lny}_i\text{Lny}_j + \sum_{k=1}^{3} y_k \text{Lnp}_k + \frac{1}{2}\sum_{l=1}^{3}\sum_{m=1}^{3} y_{lm} \ln p_l \text{Lnp}_m + \sum_{i=1}^{2}\sum_{k=1}^{3}\zeta_{ik}\text{Lny}_i\text{Lnp}_k + \varepsilon$$

However, any inefficient DMU, from income point of view, must reduce its marginal cost per unit produced. This relation can be written in the following form (Laurent, 2010):

$$\text{MC} = \frac{TC}{Yi}(\beta_i + \beta_{ij}\text{Lny}_j + \sum_{k=1}^{3}\zeta_{ik}\text{Lnp}_k)$$

The translog profit function is more important than the translog cost function because it explains the input-output relationship. The profit-efficiency function was presented by Isik and Hassan (2002) in the following form (Ihsan, I. 2002):

$$\text{Ln}(\pi + a) = \alpha_0 + \frac{1}{2}\sum_{i=1}^{2}\beta_i \text{Lny}_i + \frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2}\beta_{ij}\text{Lny}_i\text{Lny}_j + \sum_{k=1}^{3}\gamma_k \text{Lnp}_k + \frac{1}{2}\sum_{l=1}^{3}\sum_{m=1}^{3} y_{lm} \text{Ln}\, p_l \ln p_m + \sum_{i=1}^{2}\sum_{k=1}^{3}\zeta_{ik}\text{Lny}_i\text{Lnp}_k + \varepsilon_{\pi b}$$

Since the profit can be negative, we must add a constant "a" so that (π + a) is positive. This constant is usually greater than the maximum loss.

To estimate the efficiency scores of the DMUs, we used the following variables in Table 3.

Table 2: Definitions of DEA method variables

Variables	Definitions
Net premium	Price that the policyholder must pay to benefit from the insurance cover in the event of a claim.
Net income	Total income - total cost - tax
other assets	invested values + interbank funds (gain) + loans to special sectors (directed loan)
Total Cost	Total interest and non-interest
Number of employees	Number of employees
Net claims paid	Paid net claims
Technical provision	Total provisions for risks and claims
Price of labor	Total staff costs/Number of employees

3.3. Scoring Method

The third empirical investigation in our paper focuses on the stability of the two types of insurance companies, and their respective z-scores can be written as follows:

$$L_{Ass} = \alpha + \beta_1 \text{CE}_{it} + \beta_2 \text{PE}_{it} + \beta_3 \text{TE}_{it} + \beta_4 \text{ROE}_{it} + \beta_5 \text{SR}_{it} + \beta_6 \text{CTI}_{it} + \beta_7 \text{INT}_{it} + \beta_8 \text{MR}_{it} + \beta_9 \text{CR}_{it} + \beta_{10} \text{LR}_{it} + \beta_{11} \text{Ln(TA)}_{it} + \beta_{12} \text{INF}_{it} + \varepsilon_{it}$$

Then, we will use the exponential transformation of the logit model to derive the respective stability levels of insurance companies (Table 4). This probabilistic relation can be expressed as follows:

$$W_i = \frac{1}{1 + Exp} - L$$

4. RESULTS AND INTERPRETATIONS

4.1. Estimation of the Variables

The descriptive statistics of the different variables showed that conventional insurance companies were 7 times more productive than takaful companies Table 5 and 6). This productivity gap is due to the size of their customer portfolio and product portfolio. In

Table 3: Definitions of the variables of the SFA method

Variables	Definitions
Cost	Total interest and non-interest
Net income	Total income - total cost - tax
Net premium	Price that the policyholder must pay to benefit from the insurance cover in the event of a claim.
Technical Provision	Total provisions for risks and claims
Price of labor	Total staff costs/Number of employees
Net claims paid	Paid net claims
Other assets	invested values + interbank funds (gain) + loans to special sectors (directed loan)

Table 4: Definitions of Z-Score variables of insurance companies

Variables	Definitions	Variables	Definitions
CE	Cost efficiency: cost X-efficiency score	INT	Total investment
PE	Profit efficiency: profit x-efficiency score	MR	Market risk: Loss of the insurance company i, in the year t, on the financial market.
TE	Technical efficiency	CR	Credit risk = loss due to a default in the bonds
ROE	Return on equity= Net income/total equity	LR	Liquidity risk: liquidity losses
SR	Solvability ratio = Total debt / Total equity	TA	Total assets
CTI	Cost to income ratio = Total cost / Net income	INF	Inflation

addition, conventional insurance companies are characterized by their large size. In fact, these two tables illustrate that conventional insurance companies admit an average cost of $ 278.3190 million against $ 153.6636 million for Islamic insurance companies and they are 13 times more profitable than takaful companies. These results confirm the role of the liberalization of the insurance sector that has mobilized resources to this sector, improve and diversify its products and services.

The results of estimates, made using the OLS method, show that the R squares of the translog cost function is 0.863626 for conventional insurance companies and 0.956536 for takaful

Table 5: Descriptive statistics of conventional insurance companies

	Net premium	Net income	Other assets	Total Cost	Number of employees	Technical provision	Net claims paid	Price of labor
Mean	48.95058	573.2716	4.273518	278.3190	37290.38	29.15565	1.985314	0.001125
Median	20.00682	51.36635	1.787000	14.83611	33152.00	19.45130	0.033523	8.62E-05
Maximum	435.7428	9533.480	23.00766	5323.297	222029.0	178.1192	24.44900	0.019832
Minimum	0.163885	0.858416	0.000815	0.940981	1000.000	0.602368	0.000530	5.30E-06
Std. Dev.	75.20897	1596.814	5.650044	858.7324	33503.04	31.00921	5.116235	0.003848
Skewness	2.826630	3.859756	1.425110	4.312814	2.801056	2.161669	3.240649	3.784343
Kurtosis	12.23684	18.28939	4.259318	21.61011	14.30833	8.442279	12.32774	15.92563
Jarque-Bera	806.2900	2016.824	66.75374	2892.572	1094.926	332.1289	886.9714	1542.454
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	8076.846	94589.81	705.1305	45922.64	6152913.	4810.682	327.5767	0.185686
Sum Sq. Dev.	927647.7	4.18E+08	5235.372	1.21E+08	1.84E+11	157697.6	4292.841	0.002429
Observations	165	165	165	165	165	165	165	165

Table 6: Descriptive statistics of Islamic insurance companies

	Net premium	Net income	Other assets	Total Cost	Number of employees	Technical provision	Net claims paid	Price of labor
Mean	196.1425	42.66144	0.838841	153.6636	892.3879	263.1638	0.063315	0.041612
Median	0.627400	10.60000	0.023034	26.40629	582.0000	31.36134	0.012323	0.013768
Maximum	4041.438	456.6412	7.839000	1421.889	5708.000	4418.738	1.300831	0.326539
Minimum	1.43E-05	−10.41067	2.42E-06	0.003613	33.00000	0.008296	2.64E-05	4.18E-06
Std. Dev.	588.9500	76.68280	1.794240	283.8751	1106.318	758.1169	0.152348	0.057964
Skewness	4.682110	3.035643	2.513836	2.761366	2.312935	3.972104	4.870471	2.162453
Kurtosis	26.93804	12.71814	8.249243	10.73064	8.682076	18.47240	33.12109	8.354505
Jarque-Bera	4542.438	902.7060	363.2203	620.5606	369.0820	2079.727	6889.891	325.7068
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	32363.51	7039.137	138.4088	25354.49	147244.0	43422.02	10.44700	6.865950
Sum Sq. Dev.	56885389	964361.2	527.9650	13215953	2.01E+08	94257567	3.806408	0.551003
Observations	165	165	165	165	165	165	165	165

Table 7: Estimation of the translog function

	Conventional insurance		Islamic insurance	
	LnCost	Lnprofit	LnCost	Lnprofit
LNP1	0.827159 (0.362861)	0.485147*** (2.820018)	0.389678 (0.119245)	0.313050 (−0.003198)
LNX1	0.741233* (2.752384)	0.434750** (0.873439)	0.163417*** (0.665882)	0.131282*** (0.387136)
LNX2	1.424288 (−0.954869)	0.835377* (−1.387908)	0.265617 (0.415803)	0.213385 (0.263376)
LNX3	0.684980 (0.931926)	0.401756 (−0.438878)	0.363212 (0.426908)	0.291788 (−0.444197)
LNX4	0.445035*** (−1.232635)	0.261023* (0.500968)	0.181017*** (−0.596188)	0.145421 (0.065331)
LNP1_P1	0.037479 (0.007724)	0.021982*** (0.135720)	0.027173* (0.053060)	0.021830 (−0.008204)
LNX1_X1	0.064557 (0.011999)	0.037864 (−0.012664)	0.009201** (0.021285)	0.007392 (0.003127)
LNX2_X2	0.144646** (0.329942)	0.084838** (0.172429)	0.016972 (0.009434)	0.013635 (0.004912)
LNX3_X3	0.040692** (−0.099560)	0.023866 (0.014112)	0.031465** (0.063858)	0.025277** (−0.062924)
LNX4_X4	0.020096 (−0.006362)	0.011787 (−2.81E−05)	0.012137 (0.005100)	0.009750 (8.91E−05)
LNX1_P1	0.077266*** (0.242776)	0.045318* (0.083791)	0.022499 (0.029351)	0.018074 (0.016403)
LNX1_X2	0.129481** (−0.261089)	0.075944 (0.005872)	0.018463 (−0.029817)	0.014832 (0.009012)
LNX1_X3	0.081504*** (−0.244188)	0.047804 (−0.074706)	0.018072*** (0.055323)	0.014518*** (0.058113)
LNX1_X4	0.060207 (0.043705)	0.035313 (0.039189)	0.010788 (−0.006930)	0.008666 (−0.008676)
LNX2_P1	0.121519 (−0.058583)	0.071274 (−0.104193)	0.028705 (0.034808)	0.023060 (0.021448)
LNX2_X3	0.104216*** (0.289614)	0.061125* (0.114832)	0.034165*** (−0.096052)	0.027447 (−0.010923)
LNX2_X4	0.063532 (0.045755)	0.037263** (−0.093266)	0.027717* (0.047923)	0.022267 (−0.006818)
LNX3_P1	0.069197** (0.143902)	0.040586 (−0.025475)	0.033836** (−0.081210)	0.027183 (0.008309)
LNX3_X4	0.045544*** (0.148950)	0.026713* (0.049438)	0.030771 (−0.046600)	0.024720 (0.005290)
LNX4_P1	0.051417*** (−0.149005)	0.030157 (0.016329)	0.025327*** (−0.071680)	0.020347 (0.017421)
C	4.669144 (4.715578)	2.738557*** (17.44953)	1.732528 (2.030043)	1.391835 (1.598493)

Table 8: Cost X-efficiency of Islamic and conventional insurance companies

Conventional insurance	Scores	Islamic insurance	Scores
Aegon	81,63%	Iran insurance company (bimeh iran)	78,87%
Allianz	84,12%	The company for cooperative insurance (tawuniya) (NCCI)	74,58%
American International Group (AIG)	82,76%	Syrikat takaful malaysia berhad	74,61%
Aviva	79,38%	Islamic Arab insurance company-salama	78,30%
ERGO Insurance Group	81,90%	parsian insurance Company	74,32%
Meiji Yasuda Life Insurance Company	83,90%	Alborz insurance company	78,53%
MS&AD Insurance	81,89%	Arabia insurance cooperative company	75,82%
Munich Re	81,71%	Dubai islamic insurance and reinsurance company (aman)	77,26%
Nippon Life Insurance Company	81,03%	Abu dhabi national takaful Co	78,93%
Ping An Insurance	80,34%	Takaful international	78,48%
Sumitomo Life Insurance	78,98%	PT Ansuransi Adira Dinamika	80,87%
Swiss RE	80,71%	PT Reasuransi Nasional Indonesia	76,48%
T & D Holdings	82,14%	PT Asuransi Jiwa Asih GreatEastern	79,81%
Tokio Marine Holdings	81,23%	BEST Retakaful	76,27%
Zurich Insurance Group	79,99%	Gulf Takaful Insurance Co	76,78%
Average	81,45%	Average	77,33%
Wilcoxon Test	Ho: score AC = score AI	z = 3.237	Prob > |z| = 0.0012
Student's Test	Ho: mean(diff) = 0	Ha: mean(diff) < 0 Pr(T < t) = 0.9999	Ha: mean(diff) != 0 Pr(|T| > |t|) = 0.0001	Ha: mean(diff) > 0 Pr(T > t) = 0.0001

companies which means that 86.36% and 95.65% of LC variations are explained respectively in the two regressions (Table 7). With regard to translog profit-function, 92.99% and 74.77% of the data variability of conventional insurance companies and takaful companies are respectively around the average. In order to verify these results, we performed the Fisher test. The results of this test suggest the rejection of the null hypothesis which states that the explanatory variables "σ1" are equal to those non-explanatory "σ2" such that:

- $H0 : \sigma_1^2 = \sigma_2^2$
- $H1 : \sigma_1^2 \neq \sigma_2^2$

The homogeneity test revealed that the explanatory variables are 46 and 96 times more than the non-explanatory variables in the LC and LR function of conventional insurance companies and 158 and 21 times, respectively, for takaful companies.

Thus, we can conclude that the model is globally significant.

4.2. X-Efficiency of Islamic and Conventional Insurance Companies

In this section, we will present the empirical results of the study of the cost and profit x-efficiency of both types of insurance companies.

Based on Tables 8 and 9 we note that conventional insurance companies are more cost-effective than takaful companies. The most effective insurance companies are Allianz and PT Ansuransi Adira Dinamika, which have respective cost effectiveness scores of 84.12% and 80.87%. These scores were calculated over an 11-year period from 2004 to 2014. Over this period, the scores vary between 78.98% and 84.12% for conventional insurance companies and between 74.32% and 80.87% for takaful companies. Before the crisis, both scores were growing at a faster pace because of the competition that gave rise to new cost-saving potentials (Paul et al., 2008). In view of the work of Paul et al. (2008), Germany and France are the two countries most affected by mergers and

Table 9: Cost X-efficiency of Islamic and conventional insurance companies

	Conventional insurance	Islamic insurance
2004	81,83%	77,19%
2005	82,05%	77,46%
2006	81,86%	77,46%
2007	81,28%	77,41%
2008	81,42%	77,23%
2009	81,28%	77,11%
2010	81,45%	77,54%
2011	81,36%	77,25%
2012	81,26%	77,30%
2013	81,21%	77,28%
2014	80,93%	77,34%
Average	81,45%	77,33%
Wilcoxon Test	Ho: score AC = score AI	z = 2.934 Prob > |z| = 0.0033
Student's Test	Ho: mean(diff) = 0	Ha: mean(diff) < 0 Pr(T < t) = 1.0000 Ha: mean(diff) != 0 Pr(|T| > |t|) = 0.0000 Ha: mean(diff) > 0 Pr(T > t) = 0.0000

acquisitions and they have average scores of 0.985 and 0.988 respectively. In the same vein (cross-country study), Anoop (1996) concluded that:

- The average score of x-inefficiency is 0.27.
- Insurance companies in the United Kingdom and Switzerland have a high degree of inefficiency compared to those in France and Finland.
- Large companies admit a score of 0.297 against 0.252 for small companies.
- The average score of large companies is 0.523 in the USA and Japan and 0.475 in Europe.
- The average score of small companies is 0.484 in the USA and Japan and 0.529 in Europe.

However, Awang and Aleng (2012) concluded that the insurance sector in Malaysia improved between 2007 and 2009 and that a 1%

Table 10: Profit X-efficiency of Islamic and conventional insurance companies

Conventional insurance	Scores	Islamic insurance	Scores
Aegon	84,69%	Iran insurance company (bimeh iran)	86,84%
Allianz	86,33%	The company for cooperative insurance (tawuniya) (NCCI)	86,77%
American International Group (AIG)	84,58%	Syrikat takaful malaysia berhad	85,76%
Aviva	82,10%	Islamic Arab insurance company-salama	88,37%
ERGO Insurance Group	83,65%	Parsian insurance Company	86,77%
Meiji Yasuda Life Insurance Company	83,64%	Alborz insurance company	88,64%
MS&AD Insurance	83,39%	Arabia insurance cooperative company	88,24%
Munich Re	84,05%	Dubai islamic insurance and reinsurance company (aman)	88,63%
Nippon Life Insurance Company	83,38%	Abu dhabi national takaful Co	88,98%
Ping An Insurance	85,12%	Takaful international	89,00%
Sumitomo Life Insurance	83,26%	PT Ansuransi Adira Dinamika	87,66%
Swiss RE	81,59%	PT Reasuransi Nasional Indonesia	87,63%
T & D Holdings	81,07%	PT Asuransi Jiwa Asih GreatEastern	88,49%
Tokio Marine Holdings	84,03%	BEST Retakaful	88,45%
Zurich Insurance Group	82,07%	Gulf Takaful Insurance Co	87,53%
Average	83,53%	Average	87,85%
Wilcoxon test	Ho: score AC = score AI	z = -3.408	Prob > |z| = 0.0007
Student's Test	Ho: mean(diff) = 0	Ha: mean(diff) < 0 Pr(T < t) = 0.0000	Ha: mean(diff) != 0 Pr(|T| > |t|) = 0.0000	Ha: mean(diff) > 0 Pr(T > t) = 1.0000

cost reduction will improve the efficiency of Malaysian insurance companies by 92%.

In summary, cost efficiency scores range from 0.7 to 0.99 with a dominance of traditional insurance companies and mutual societies. In contrast, takaful firms are more efficient in terms of profit (Awang and Aleng, 2012) and their scores vary in the literature between 0.806 and 0.957. On our part, the review of the "profit efficiency" of Islamic and conventional insurance companies resulted in an average score of 83.53% and 87.85% in favor of takaful companies as shown in the Table 10 and 11.

Despite their protectionist structure, Islamic insurance companies, as conventional insurance companies, were affected by the credit-subprime. After the tornado and precisely in 2010 the level of profit-efficiency of takaful companies has improved except the Arab revolution period. The Arab spring has negatively affected the production of insurance resulting in lower scores of "profit-efficiency".

Table 11: Profit X-efficiency of Islamic and conventional insurance companies

	Conventional insurance	Islamic insurance
2004	83,75%	88,18%
2005	83,79%	87,89%
2006	83,52%	87,66%
2007	83,41%	88,09%
2008	83,63%	87,93%
2009	83,47%	87,70%
2010	83,49%	87,80%
2011	83,63%	87,74%
2012	83,49%	88,11%
2013	83,39%	87,58%
2014	83,25%	87,70%
Average	83,53%	87,85%
Wilcoxon test	Ho: score AC = score AI	z = -2.934 Prob > |z| = 0.0033
Student's Test	Ho: mean(diff) = 0 Ha: mean(diff) != 0	Ha: mean(diff) < 0 Pr(T < t) = 0.0000 Pr(|T| > |t|) = 0.0000 Ha: mean(diff) > 0 Pr(T > t) = 1.0000

4.3. Efficiency of Islamic and Conventional Insurance Companies

The DEA method allows studying several types of efficiency namely CRS, VRS, SCALE Efficiency ...ect. In the present work, we have limited ourselves to the study of the VRS because it takes into account the variability of inputs and outputs over time. This study resulted in the following scores (Table 12).

From Tables 12 and 13, we note that despite the drop in their efficiency levels, insurance companies were able to be efficient between 2008 and 2010. Their scores have steadily increased until 2011 and 2012 during which time they were impacted by the Arab revolutions. In fact, Takaful International, PT Ansuransi Adira Dinamika and PT Reasuransi Nasional Indonesia are the only takaful companies that have not been affected by the reduction of production and cost growth in the time of the uprisings. The other takaful company that has been able to withstand this outbreak is Best Retakaful which has had a score drop of 0.002 during the crisis. With regard to conventional insurance companies, the Arab revolutions have no impact, but more than 73% of our sample experienced lower levels of efficiency in the crisis period. Rahman (2013) concluded that Bangladeshis takaful companies are less profitable (by 9%) and perform better than conventional insurance companies. The takaful companies' score in this study is 0.974. Similarly, in Pakistan and Malaysia, takaful companies are more efficient than traditional insurance companies (Abdul, K.H., Adams, M.B., Hardwick, P. 2010), Norashi Kim et al., 2011; Khan and Noreen, 2014).

On the other hand, Mansor and Radam (2000), Norma and Nur (2011) and Norma (2012) concluded that traditional insurance companies dominated takaful firms, with a score of 0.773 (Norma, 2012) between 2007 and 2009, a score of 0.794 (Norma and Nur, 2011) between 2000 and 2005 and 0.7265 (Mansor and Radam, 2000) between 1988 and 1998.

Table 12: Efficiency of Islamic and conventional insurance companies

Conventional insurance	Scores	Islamic insurance	Scores
Aegon	76,65%	Iran insurance company (bimeh iran)	84,81%
Allianz	63,96%	The company for cooperative insurance (tawuniya) (NCCI)	40,66%
American International Group (AIG)	95,40%	Syrikat takaful malaysia berhad	79,31%
Aviva	98,80%	Islamic Arab insurance company-salama	51,59%
ERGO Insurance Group	99,48%	Parsian insurance Company	86,37%
Meiji Yasuda Life Insurance Company	88,01%	Alborz insurance company	33,29%
MS&AD Insurance	42,17%	Arabia insurance cooperative company	98,81%
Munich Re	38,53%	Dubai islamic insurance and reinsurance company (aman)	60,66%
Nippon Life Insurance Company	43,33%	Abu dhabi national takaful Co	82,62%
Ping An Insurance	34,81%	Takaful international	65,71%
Sumitomo Life Insurance	65,39%	PT Ansuransi Adira Dinamika	77,17%
Swiss RE	97,82%	PT Reasuransi Nasional Indonesia	4,10%
T & D Holdings	98,85%	PT Asuransi Jiwa Asih GreatEastern	45,23%
Tokio Marine Holdings	51,81%	BEST Retakaful	99,06%
Zurich Insurance Group	81,96%	Gulf Takaful Insurance Co	85,21%
Average	71,80%	Average	66,31%
Wilcoxon test-Mann-Whitney	Ho: score AC= score AI	Z = -0,477	Prob > |z| = 0,015
Student's Test Ho: mean(diff) = 0	Ha: mean(diff) <0 Pr(T < t) = 0.3148	Ha: mean(diff) != 0 Pr(|T| > |t|) = 0.6296	Ha: mean(diff) > 0 Pr(T > t) = 0.6852

Table 13: Efficiency of Islamic and conventional insurance companies

	Conventional insurance	Islamic insurance
2004	86,09%	67,33%
2005	72,25%	69,69%
2006	74,01%	63,27%
2007	76,39%	55,41%
2008	66,04%	63,19%
2009	64,23%	66,91%
2010	67,83%	69,57%
2011	68,77%	68,13%
2012	70,74%	64,98%
2013	69,50%	69,44%
2014	73,94%	71,45%
Average	71,80%	66,31%
Wilcoxon test-Mann-Whitney	Ho: score AC = score AI	Z = -2,134 Prob > |z| = 0 ,003
Student's Test Ho: mean (diff) = 0		Ha: mean(diff) < 0 Pr(T < t) = 0.9770 Ha: mean(diff) != 0 Pr(|T| > |t|) = 0.0460 Ha: mean(diff) > 0 Pr(T > t) = 0.0230

Table 14: Descriptive statistics of conventional insurance companies

Variable	Obs	Mean	Std. Dev.	Min.	Max.
mr	165	82.89482	138.1772	0.026199	711.2484
lr	165	14.69568	34.85129	0.0005205	251.9294
cr	165	3.46215	6.914436	0.0000131	35.42073
te	165	0.7179818	0.3171931	0.085	1
ce	165	0.8144818	0.0176165	0.7705249	0.8510135
pe	165	0.8352944	0.0157838	0.7908782	0.8755729
roe	165	0.3625654	0.3458175	0.0214901	1.4573
sr	165	11.69349	20.89278	0.0094097	113.4083
cti	165	0.8636777	1.00144	0.0265823	4.506321
ta	165	9014.646	23539.19	72.07005	153244.4
ti	165	1098.041	3909.055	0.028399	20220.59
inf	165	1.112121	1.386775	−1.3	5.9

Table 15: Descriptive statistics of Islamic insurance companie

Variable	Obs	Mean	Std. Dev.	Min.	Max.
mr	165	0.6262999	0.8146019	0.0000786	4.210162
lr	165	0.8384705	1.597336	0.000047	10.9783
cr	165	0.8721507	1.641857	0.0000458	9.117588
te	165	0.6630727	0.3159146	0.007	1
ce	165	0.7732584	0.0209473	0.7209721	0.8190235
pe	165	0.8785147	0.0118862	0.8395308	0.9240927
roe	165	0.1807165	0.1556893	−0.0302717	0.8936648
sr	165	2.976213	2.241026	0.078733	9.61795
cti	165	5.117662	7.039223	−4.89131	44.0158
ta	165	1016.602	1469.199	0.0343807	7181.895
ti	165	158.6129	344.0107	0.0287868	1742.84
inf	165	7.467879	7.808438	−0.4	39.3

The study conducted by Norashi Kim et al. (2011), using VRS, resulted in an average efficiency score of 0.703. In addition, Norashi Kim et al. (2011) suggest that takaful companies in GCC countries admit a score that varies between 53% and unity against a score that does not exceed 65% in Malaysia (Miniaoui and Chaibi, 2014).

The Yang (2006) study resulted in a score of 74.04% for Canadian insurance companies. This score is the average of the productivity level (76%) and the inverse of the investment efficiency score (52%). According to the work Yang (2006), Liang et al. (2007) found that Canadian life and health insurance companies had scores of 0.79 and 0.83, with an average score of 0.81.

4.4. Stability of Islamic and Conventional Insurance Companies

As illustrated above, conventional insurance companies are more efficient than takaful companies. In contrast, takaful companies are more effective. However, we note in Tables 14 and 15 that takaful companies admit minimal losses compared to traditional insurance companies. Although conventional insurance companies are more profitable, they invest less than Shria-compatible ones. In fact, takaful companies invest on average 26.33% of their assets against an investment rate of 8.14% for their conventional counterparts. On the other hand, conventional insurance companies have an average cost to income ratio of 86.4% compared to 5.118% for takaful companies and a solvency ratio of 11.69 against 2.98%

for Islamic insurance companies. This shows that conventional insurance companies are more productive and solvent than Islamic insurance companies.

In view of the stability scores shown in Table 16 and 17, we note that Islamic insurance companies are more stable than conventional insurance companies. The takaful companies admit an average stability score of 93.3030% against 79.6763% for conventional insurance companies. The most stable takaful company is B.E.S.T Retakaful with a score of 99.622% while the least stable is PT Asuransi Jiwa Asih GreatEastern with a score of 54.3123%. On the other hand, the most stable conventional insurance company is Munich Re, while the least stable is Allianz and they admit stability scores of 95.473% and 57.641% respectively.

From a risk perspective, Islamic insurance companies are less risky than conventional insurance companies. They lose on average 1.598% of their assets against 3.704% for conventional insurance companies. This observation relates to three types of risk namely, liquidity risk, market risk and credit risk. From the point of view of liquidity risk and credit risk, takaful companies lose, respectively and on average, 0.697% and 0.5784% of their assets against 0.205% and 0.233% for conventional insurance companies. On the other hand, Islamic insurance companies lose 9.88% less than conventional insurance companies in terms of market risk. This seems logical because traditional insurance companies are more active in financial markets than Islamic insurance companies that tend to invest in real estate. They invest mainly 26.327% in real estate, energy, industrial and new technologies. Their losses in terms of stability did not exceed 0.3% (0.2465% for conventional insurance and 0.1155% for Islamic insurances), which once again testifies to the robustness of Islamic financial institutions during the crisis. Similarly, we note that Islamic insurance companies are sensitive to political shocks such as that of the Arab revolutions that took place in 2011. These revolutions have lost to Islamic insurance companies 0.22% of their stability scores. This observation seems entirely logical because of the nature of takaful products marketed on the insurance market. As a result, takaful companies are expected to commercialize new products in order to diversify their product portfolio, reduce the associated risk and thus improve their profitability and productivity.

Similarly, Waheed and Saad (2017) and Waheed and Saad (2017) revealed that takaful insurance is more resilient in times of crisis.

Indeed, Waheed and Saad (2017) compared the demand for Islamic insurance with that of conventional insurance in 14 countries during the period 2005-2014. Empirical results suggest that demand for Islamic and conventional insurance is negatively affected by GDP per capita. Similarly, the savings rate has a negative impact on the demand for conventional insurance since conventional savings products are replacing conventional insurance. However, the increase in average income is positively (negatively) related to demand for Islamic insurance in the Middle East (ASIA), which is likely related to different Islamic finance practices in both regions.

In the same spinning, Waheed and Saad (2017) focused on the analysis and differentiation of the determinants of conventional and Islamic insurance in the regions of Asia and the Middle East. They applied fixed and random effects regression models to assess the impact of macroeconomic and demographic factors on conventional and Islamic insurance. The estimation results suggest that takaful companies are more stable than conventional insurance companies. In addition, the net income and financial sector variables have a positive and significant impact on insurance demand in all regions. Thus, the development of the financial sector is a significant determinant of demand for insurance and Takaful in the Asian region. For the Middle East region, the development of the financial sector affects only the demand for conventional insurance.

Table 16: Stability of Islamic and conventional insurance companies

Conventional insurance	Score	Islamic insurance	Score
Aegon	93,8008%	Iran insurance company (bimeh iran)	99,2748%
Allianz	57,6408%	The company for cooperative insurance (tawuniya) (NCCI)	99,9639%
American International Group (AIG)	87,3914%	Syrikat takaful malaysia berhad	99,4985%
Aviva	84,0592%	Islamic Arab insurance company-salama	99,0010%
ERGO Insurance Group	91,7448%	Parsian insurance Company	99,9454%
Meiji Yasuda Life Insurance Company	86,7555%	Alborz insurance company	60,4519%
MS&AD Insurance	60,0689%	Arabia insurance cooperative company	89,7631%
Munich Re	95,4726%	Dubai islamic insurance and reinsurance company (aman)	99,6347%
Nippon Life Insurance Company	93,2876%	Abu dhabi national takaful Co	99,4322%
Ping An Insurance	63,1314%	Takaful international	99,6853%
Sumitomo Life Insurance	82,2520%	PT Ansuransi Adira Dinamika	99,7513%
Swiss RE	86,4709%	PT Reasuransi Nasional Indonesia	99,2718%
T & D Holdings	68,1079%	PT Asuransi Jiwa Asih GreatEastern	54,3123%
Tokio Marine Holdings	63,5047%	B.E.S.T Retakaful	99,9371%
Zurich Insurance Group	81,4554%	Gulf Takaful Insurance Co	99,6216%
Average	79,6763%	Average	93,3030%
Wilcoxon test	Ho: score AC = score AI	z = −2.385	Prob > |z| = 0.0171
Student's Test	Ho: mean (diff) = 0 Ha: mean(diff)<0 Pr(T < t) = 0.0063	Ha: mean(diff) != 0 Pr(|T| > |t|) = 0.0125	Ha: mean(diff) > 0 Pr(T > t) = 0.9937

Table 17: Stability of Islamic and conventional insurance companies (per year)

	Islamic insurance	Conventional insurance
2004	93,2000%	76,1688%
2005	93,1596%	77,7002%
2006	93,1232%	77,8940%
2007	93,0077%	77,6475%
2008	93,9023%	77,9199%
2009	94,2850%	82,9742%
2010	93,1774%	82,1474%
2011	93,3113%	80,3428%
2012	93,0916%	81,1301%
2013	92,7190%	81,7453%
2014	93,3559%	80,7687%
Average	93,3030%	79,6763%
Wilcoxon test	Ho: score AI = score AC	z = 2.934
		Prob > |z| = 0.0033
Student's Test	Ho: mean(diff) = 0	Ha: mean(diff) < 0
		Pr(T < t) = 1.0000
		Ha: mean(diff) != 0
		Pr(|T| > |t|) = 0.0000
		Ha: mean(diff) > 0
		Pr(T > t) = 0.0000

5. CONCLUSION

Takaful insurance is a sector with high potential, it has access to abundant liquidity and its ethical, commercial and sharing aspect presents it as an alternative to conventional insurance which creates value only for shareholders.

A research in the empirical literature revealed that works on this topic has focused on studying the determinants of financial stability. To do this, the authors interested in the Z-score, focused on the ROA, as well as the panel method.

Unlike previous work, we have established a stability score composed of micro and macroeconomic indicators. This study covers the period 2004-2014 and our sample consists of 30 insurance companies, 15 of which are shariaa compatible. The choice of these companies is justified by their contribution to the total assets of the both types of finance. This selection method allowed us to have a global idea of the effectiveness, efficiency, risk and stability of the both insurance sectors.

The analysis of the stability scores, determined using the scoring and logit transformation method, revealed that Islamic insurance companies are more stable than conventional insurance companies. From a risk perspective, Islamic insurance companies are less risky than conventional insurance companies. They lose, on average, 1,598% of their assets against 3,704% for conventional insurance companies. This observation related to three types of risk, namely; liquidity risk, market risk and credit risk. In terms of liquidity risk and credit risk, takaful companies lose, respectively and on average, 0.697% and 0.5784% of their assets against 0.205% and 0.233% for conventional insurance companies. In contrast, Islamic insurance companies lose 9.88% less than conventional insurance companies in terms of market risk.

Furthermore, this empirical investigation revealed that takaful companies are not immune to the toxic funds for the crisis. Likewise, we note that Islamic insurance companies are sensitive to political shocks such as that of the Arab revolutions that took place in 2011. These revolutions have caused Islamic insurance companies to lose 0.22% of their stability scores.

Overall, takaful companies are called upon to market new products in order to diversify their product portfolio, reduce the associated risk and therefore improve their profitability and productivity.

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