The Estimation of Risk Management Efficiency and its Determinants

(Anggaran Kecekapan Pengurusan Risiko dan Penentunya)

Uzma Noreen
International Islamic University Islamabad

ABSTRACT

This research aims at finding risk management efficiency and its determinants of non-life insurers operating in Pakistan. This study applies Data Envelopment Analysis (DEA) to determine the efficiency scores for risk management practices of firms over the period 2009-2018. Tobit model is applied to identify factors influencing risk management efficiency of firms. DEA results obtained indicate that the overall average efficiency score increases from 68% in 2009 to 76% in 2018. Tobit estimates show that the age and firm size has a significantly positive relationship with risk management efficiency of firms. The study suggests that firms at lower efficiency frontier could improve their efficiency level by performing better in terms of underwriting and investment activities as well as enhancing the value-added of the firms. The study also recommends that non-life insurers should adopt a multifaceted approach in managing the risks to derive greater benefits from their businesses.

Keywords: Risk management; efficiency; Data Envelopment Analysis

ABSTRAK

Penyelidikan ini bertujuan untuk mengkaji kecekapan pengurusan risiko dan penentunya bagi syarikat selain insurans nyawa yang beroperasi di Pakistan. Kajian ini menggunakan Analisis Pengumpulan Data (DEA) untuk menentukan skor kecekapan bagi amalan pengurusan risiko firma dalam tempoh 2009-2018. Anggaran Tobit menunjukkan faktor-faktor yang mempengaruhi kecekapan pengurusan risiko firma. Keputusan DEA menunjukkan bahawa skor purata keseluruhan kecekapan meningkat dari 68% pada tahun 2009 kepada 76% pada tahun 2018. Anggaran Tobit menunjukkan bahawa umur dan saiz firma mempunyai hubungan positif yang signifikan dengan kecekapan pengurusan risiko firma. Kajian ini mencadangkan bahawa firma yang mempunyai tahap kecekapan yang rendah dapat meningkatkan tahap kecekapan mereka dengan menunjukkan prestasi yang lebih baik dari segi aktiviti penaja jaminan dan pelaburan serta meningkatkan nilai tambah firma. Kajian ini juga mengesyorkan agar syarikat insurans selain insuran nyawa seharusnya menggunakan pendekatan pelbagai aspek dalam menguruskan risiko bagi memperoleh manfaat yang lebih besar dari perniagaan mereka.

Kata Kunci: Pengurusan risiko; kecekapan; Analisis Pengumpulan Data

INTRODUCTION

The important objective for the establishment of the insurance business is to cover various types of risks faced by individuals, businesses and institutions. Since policyholders pass on their risk to insurance firms, therefore, insurers not only have to manage the risk of policyholders (insured) but also their own risk. Along with underwriting risk, insurance firms also play a vital role in the mobilization of resources for long term investments through its intermediation function; thus, making it an key pillar in the financial sector of an economy (Kokobe & Gemechu 2016). The risk predicting and managing function of insurers promotes the stability in the financial market under chaotic conditions. Without the insurance industry, it would not be sustainable for businesses to retain various types of risks. Insurance business offers the opportunity to larger

industries having more risks, to expand its business by insuring their physical assets including machinery and plant. According to Magezi (2003), mismanagement of risk by insurance firms will increase the losses in the settling of claims by policyholders which will result in the poor financial performance of the firm.

To play its due role in the economy, it is very much important for insurers to optimally manage risks. Optimal risk management practices contribute to the soundness and robustness of insurance business which is essential to ensure the stability of the country's financial sector and sustainable growth in the economy (Financial Stability Review 2011). Iqbal and Mirakhor (2007) state that effective risk management practices play significant role in determining the financial performance of institutions. Yusop (2011) highlights that "financial institutions that can handle their risk efficiently are most likely to succeed and remain in the business".

Considering the importance of risk management activity in the firm's financial performance, it is motivating to investigate the efficiency of that activity. Over the past 30 years, numerous studies have been carried out globally to evaluate the overall performance of firms in terms of efficiency. Despite several studies around the globe, there is a very limited number of studies related to the efficiency analysis of the insurance sector in Pakistan, (For example, Afzal & Asghar 2010; Afzal & Asghar 2012; Khan & Noreen 2014; Janjua & Akmal 2015; Noreen & Ahmed 2016). All of the above-mentioned studies in Pakistan were based on the overall efficiency of insurance firms instead of efficiency analysis of single activity/operation. While the traditional efficiency measures are usually considered good indicators of overall performance and have important implications for the firms; however, it is challenging for inefficient firms to identify which of its activity is causing inefficiency (Yusop et al., 2014).

The major goal of this research is to assess risk management efficiency of general insurers in Pakistan for the period 2009-2018. The outcome of this study will be helpful for the insurance service providers to identify their weak areas in risk management operations and adopt efficient strategies to boost their risk management performance. Moreover, the suggestions based on the findings of the study will contribute to enhancing the risk management performance of general insurers in Pakistan. The remainder of the paper is outlined as follows. Section 2; briefly review the literature related to risk management efficiency studies. Section 3 provides the methodological framework. Section 4 defines input, output, and explanatory variables. Section 5 and Section 6 detail out the results, discuss the findings and suggest policy implications.

LITERATURE REVIEW

Over past three decades, extensive research has been conducted related to insurance industry based on the traditional measures of efficiency such as cost, allocative and profit efficiency by using various frontier models of efficiency measurement (Eling & Luhnen 2010b). For instance, Noreen and Ahmed (2016) examine the cost efficiency and total factor productivity of life and non-life firms in Pakistan for the period 2000-2009. They find that insurance firms in Pakistan are inefficient in terms of choosing a cost-minimizing combination of inputs. However, there was an improvement in productivity. Nourani et al. (2018) use network DEA to estimate the performance of Malaysian general and life insurers in terms of premium accumulation and investment capability. They identify that lack of investment and high input usage were the main factors causing low efficiency. They also highlight that foreign insurers outperform the local insurers in investment capability. Similarly, Sen (2019) use DEA to compute efficiencies of Life Insurance Industry of India over the period 2006-2015. He reported the prevalence of cost inefficiencies and suggested that life insurers need to reallocate resources for improving efficiency.

Viverita (2019) uses output-oriented DEA to investigate the efficiency of Indonesian private health insurance after the implementation of BPJS regulations in 2014. The study documented no substantial differences in the efficiency of companies before and after the application of BPJS. However, results highlighted that local insurance firms gain more benefit as compared to joint venture due to enhanced competition in the market. Almulhim (2019) performed two-stage DEA to examine the efficiency of Saudi Takaful and conventional firms. The study reveals declining average efficiency scores for both conventional and takaful firms. The study suggests new consolidation and regulation related to foreign participation to help the firms to become more dynamic and robust.

Recently, insurance firms have increased their focus on enhancing risk management practices because of change in the risk profile, deregulation, privatization and enhanced competition. According to Banks (2004) focusing on risk management enables the firm to save the cost by controlling the risk, hence making risk management important particularly for businesses dealing with risk. Although rich and diverse literature focuses on overall efficiency over the past decades, however, few studies exist in the literature to measure the performance of various activities (operations) of insurers such as underwriting process, risk and investment management. For instance, Yang (2006), Hsiao and Su (2006), Wu et al. (2007), Yusop et al. (2011), Yakob et al. (2014) and Ertugrul et al. (2016) measure the firm's performance in terms of underwriting, risk or investment management.

Cummins et al. (2009) explore the impact of financial intermediation and risk management activities in enhancing the performance of the insurance firm. The authors highlight that both of these activities play an instrumental role in the overall reduction of cost. This benefit of cost reduction may then be transferred to improvements inefficiency. Similarly, Acharyya (2013) investigate whether or not enterprise risk management (ERM) added value to insurers. Based on U.S. Property/Casualty insurance companies' data, they find that effective adoption of ERM plays a critical role in reducing risk and increasing value addition for all stakeholders. Lin and Wen (2008) also analyze the influence of risk management on the average cost efficiency by using the data of USA's property-liability insurers. They point out the enhancement in cost efficiency due to managing investment risk; however, they do not find any significant influence of managing underwriting risks on the efficiency of firms.

Although, these studies incorporated that managing risk is an important factor in a determining the overall firm's financial management performance, however, neither of these studies investigates the efficiency of firms in their risk management activities. Some studies (such as Ren 2007; Yusop et al. 2011; Yakob et al. 2014) directly measure the performance of the risk management process instead of the overall performance of the firm. Ren (2007) gave the idea to look at the efficiency of risk management operation of firms. Later, Yusop et al. (2011) and Yakob et al. (2014) measure the performance of insurance firms in Malaysia in terms of risk management activity. These studies focus on the efficiency of the insurance sector with dual system of insurance service (conventional and takaful insurance) providers in terms of risk and investment management and correlate these with the overall performance of firms. For example, Yakob et al. (2015) evaluate the risk and investment performance of conventional and takaful firms in Malaysia. They find that the Takaful operator's efficiency level in risk management remained higher than that of the conventional firms. They propose mergers and acquisitions of inefficient firms to get the benefits of large-scale operations, hence improving efficiency. Yusop et al. (2011) conclude that risk and investment management efficiencies are important drivers to ensure the overall efficiency and profitability of insurance firms.

Several studies focus on the determinants of insurance sector efficiency. For instance, Hsu and Petchsakulwong (2010) look into the impact of corporate governance and efficiency of the non-life insurer in Thailand. They find out that board independence and firm size are positively correlated with a firm's efficiency while audit committee size, diligence, board tenure and age, as well as board ownership, harm the efficiency performance. The connection between firm size and efficiency is explored by Afza and Kausar (2010) for Pakistani non-life insurers. High-efficiency scores of large insurers imply that the size of the firm is one important determinant of efficiency. Similarly study of Adu et al. (2012) on insurance firms in Ghana also identifies that size and market share are important determinants of efficiency.

Sharew and Fentie (2018) analyze the factors influencing the 'performance/efficiency' of the insurance companies' in Ethiopia over the period 2006-2015. They documented that number of branches and firm size significantly affects the efficiency of firms. Sen (2019) also investigates the impact of non-discretionary factors on the cost efficiency of life insurers in India. The study reveals that the growth rate in premium, age, and market share significantly affects the cost-efficiency. Moreover, this study notes that the solvency ratio has also a significant relationship with cost efficiency implying that adequate solvency margin could be important for determining a firm's efficiency. Jaloudi (2019) perform

a study to identify the external and internal determinants of technical efficiency of insurance firms operating in Jordan for years 2006-2016. Their study evidences a significant correlation between type, size, and ROA and efficiency of the firm. Based on the findings study suggests mergers to gain the benefits of operating at large scale, thus, improve efficiency.

As mentioned above, several researchers from developed and developing countries focus on overall efficiency with different perspectives and by using different methodologies. We also highlight some studies explore the link between the efficiency of firms in risk management practices and performance. We note that efficiency in risk management activities is positively influencing the firm's performance. Despite the importance of risk management in determining firm profitability and soundness, we find few studies on the subject around the globe but none about Pakistan. After financial sector reforms in Pakistan, the regulatory environment has been changed and the openness of insurance markets also enhanced competition that leads to significant growth in the insurance business in Pakistan. Thus, it is motivating to explore the efficiency of this important component (i.e. risk management) of insurance business in Pakistan which will determine the overall long-term performance of the insurance sector.

METHODOLOGICAL FRAMEWORK

Contemporary research applied frontier models for the measurement of efficiency. Frontier approaches can further be classified into mathematical and econometric approaches with further subtypes. The mathematical and econometric approaches, both are used to construct the best frontier. The parametric method requires the specification of functional form about the production frontier and distributional assumptions about the error term while mathematical approach does not assume any specific functional form nor it takes into account the error term. There is no consensus in the literature about the choice of methodology as both approaches have their own set of merits and limitations (Noreen & Ahmed 2016; Eling & Luhnen 2010b).

We apply Variable Returns to Scale model (VRS) DEA method to compute the risk management technical efficiency scores. The DEA method is preferred over the stochastic frontier technique due to certain advantages. The first advantage of this approach is it does not impose any functional form like Cobb-Douglas or Translog functional form. Another important advantage is DEA easily accommodates multiple inputs-output especially in case of insurance firms. DEA model also works well even if the sample size is small. However, its principle limitation lies in assuming no measurement error, therefore, entire deviation from the frontier is considered as inefficiency hence yields unreliable

results if the integrity of data is not guaranteed (Avkiran 1999). Based on actual data, DEA constructs efficiency frontier, firms on the frontier are considered efficient otherwise inefficient. This efficiency measure is relative, means the efficient firm is the best practice firm in the given sample.

Farrell (1957) gave the idea of technical and price efficiency. Charnes et al. (1978) introduce the Data Envelopment Analysis method to measure the efficiencies. Later on, Banker et al. (1984) extended the initial model.

The DEA method aims to calculate the relative efficiency of each DMU (Decision Making Unit) to make a comparison. In this study, we calculate the technical efficiency of risk managing activity of DMUs in the insurance industry. Efficiency scores can be calculated using the Input or output-oriented DEA model. A firm is considered technically efficient if it minimizes inputs (input-oriented) for given output or maximizes output (output-oriented) for given input resources, while technically inefficiency occurs when a firm fails to produce either given output by using minimum inputs or produce maximum output from the given level of inputs. In other words, output-oriented version of DEA means that firm is not on the efficient frontier if it is possible to increase output for a given level of inputs vice versa.

Following Coelli (1996) output-oriented linear programming problem (LP) is solved to calculate efficiency score:

$$\max_{\theta,\lambda} \ \theta$$
$$subject\ to$$
$$-\theta o_i + O\lambda \geq 0,$$
$$i_i - I\lambda \geq 0,$$
$$\lambda \geq 0 \tag{1}$$

where θ is a scalar, λ is an $n \times 1$ vector of constants. Assuming data on k inputs and m outputs for N firms, O is the $(m \times n)$ matrix of outputs produced by firms and I is the $(k \times n)$ matrix of inputs utilized by firms (DMUs) in the production. For the ith DMU, inputs and outputs are represented by the vectors i_i and o_i respectively, θ represent the efficiency score (must lie between 0 and 1) for the ith DMU after solving LP given in (1). The above-mentioned linear programming problem is solved for N times, once for each firm in each year of analysis. We have 13 firms; hence for each year, this problem is solved thirteen times.

In LP (2), assumption of CRS is relaxed by introducing the convexity constraint $NI'\lambda = 1$ in to (1) to write where NI is an $n \times 1$ vector while all other symbols are defined as previously. We obtain the VRS DEA model by substituting $NI'\lambda = 1$ restriction with $NI'\lambda \leq 1$ in (1).

$$\max_{\theta,\lambda} \ \theta$$
$$subject\ to$$
$$-\theta o_i + O\lambda \geq 0,$$
$$i_i - I\lambda \geq 0,$$
$$NI'\lambda = 1$$
$$\lambda \geq 0 \tag{2}$$

The approach forms a convex hull of intersecting plans which envelope the data point more closely than CRS hull, thereby providing efficiency score greater than or equal to those obtained using the CRS model. We choose DEAP software by Coelli (1996) to compute efficiency scores.

This study also uses the Tobit model to examine the impact of those specific characteristics of the firm which characterize the same on the risk management efficiency scores (generated through DEA using the first set of variables). We apply the Tobit model as OLS regression give inconsistent estimates of parameters because efficiency scores obtained through DEA are censored between 0 and 1. Following Tobit model equation is formulated and proposed to capture the effects of the firm's specific features on the efficiency of risk management activity:

$$y_{it} = \alpha_0 + \sum_{i=1}^{k} \alpha_{iZ_{it}} + \varepsilon_{it} \tag{3}$$

In the above relation, we use risk management efficiency score as dependent variable (y_i) computed through DEA, Zi is a vector of explanatory variables including firm size, market share, the tangibility of assets, and age of firm to describe the differences in efficiency across firms (Noreen & Ahmed 2016).

VARIABLE DESCRIPTION AND DATABASE

Specifying an input-output variable in the insurance industry is the most challenging and complicated task. Results can be misleading in case variables are poorly defined (Cummins & Weiss 1998). For efficiency analysis and performance differences among firms, we use two sets of variables. In the first set input-output variables are collected for the measurement of efficiency scores; while the second set consists of firm-specific variables to explain inter firm's efficiency differences.

INPUT-OUTPUT VARIABLES

International Actuarial Association (IAA 2004) identifies five main types of risk facing insurance firms. IAA risk types include underwriting, credit, market, operational and liquidity risk. Doff (2007) divides risk into three main categories i.e. underwriting risk (non-life & life risk), investment risk (credit and market risk) and non-financial risk (operational and business risk). The inputs

for risk management should be the risks born by an insurer as risk absorption is the core activity of insurance firms. According to Ren (2007), the main determinant of risk for insurers is underwriting and investment risk because of its risk pooling and intermediation activities. Ren (2007) also highlighted the importance of leverage as a financial risk for insurance. It is crucial to note that the selection of firm's input-output variables should be based on the activity/service for which we intend to assess efficiency. Thus, leverage, underwriting risk, and investment risk are the important inputs for this analysis as this study is based on the valuation of risk management operation of firm.

The underwriting process is important in evaluating the risk to be insured and determining the premiums rate for that policy. Underwriting risk may result due to an incorrect estimation of the risks associated with writing an insurance policy or factors beyond the control of underwriter. This is one of the major risks factors in the insurance business since an inaccurate assessment of risk results in an inaccurate calculation of the premium rates. As a result, the policy may cost businesses a lot more than it earned in premiums. Following Ren (2007), we use the variance of loss ratio to calculate underwriting risk (I_1). Loss ratio is calculated by taking the ratio of claims to premiums paid.

Following (Ren 2007; Yasop et al. 2014) investment risk (I_2) computed by taking the variance of return on investment. According to Doff (2007) investment risk consist of market and credit risk. Akotey (2013) explains that Credit risk arises due to the uncertainty in counterparty's inability to meet its obligations (decrease in counterparty's credit quality), while market risk related to the investment's activities of firms. It is the risk that value of an investment will decrease (the possibility that actual return may be very different from the expected return) resulting from a change in the prices of market parameters like interest rates, equities and currencies. Further, riskier investments can potentially affect the claim repayment ability of an insurance company. Leverage (I_3) is set as the third input of risk management

analysis. Leverage is computed by taking the liability to equity ratio which reflects the firm's ability to fulfil an obligation to their policyholders (See Figure 1).

Choosing an output variable is another crucial task for efficiency analysis in the services sector. Outputs are "final goods or goals" that firm wants to increase. The key objective of the risk management process is to eliminate or reduce possible future losses and enhance the firm's solvency. Another core objective is to increase the value addition of risk-bearing through higher profitability (Ren 2007). Based on the above-mentioned objectives, two measures solvency and value addition of risk-bearing are selected as output keeping in mind the inputs used in this analysis. Return on assets (ROA) is used as a proxy output for value addition of risk-bearing. As the return on assets illustrates how efficient management is utilizing available resources and generating profit. Solvency measures the firm's ability to meet its obligations. Ren (2007) explains that firms good at-risk management have a lower possibility of bankruptcy. Solvency ratio for the insurance firm is calculated by taking the ratio of net assets to net premium written.

EXPLANATORY VARIABLES

The second set of variables consists of some exogenous variable that determines the efficiency differences among firms. These explanatory variables for this study include market share, asset's tangibility, total assets and age. The efficiency score obtains in the first stage is regressed again these variables in Tobit analysis. To evaluate the impact of size on efficiency we use the log of total assets Yakob et al. 2007; Hao and Chou 2005; Ashraf and Kumari 2016; Afzal and Kausar 2010, use log of total assets to study the impact of the firm's size on efficiency. Their results documented that larger firms take advantage of the economies of scale, which improve the efficiency of the firm. According to Caporale (2017) growth in the gross premium reveals the good financial
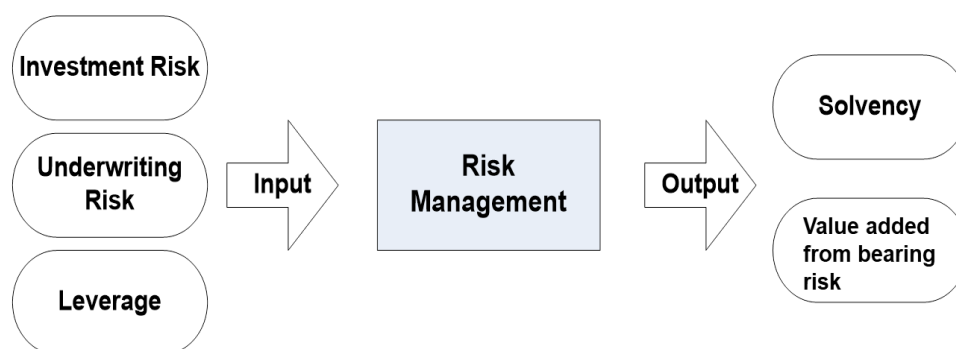

FIGURE 1. Input-Output Variables for calculating risk management efficiency
Source: Ren (2007)

position of the firm. Following Kripa and Ajasllari (2016) and Carpole (2017), we add the growth rate of gross premium written.

To explore the linkage of assets tangibility with firm's efficiency in risk management we use fixed assets to total assets ratio. Various studies have been performed to explore the link between a firm's performance and tangibility of assets but found contradicting results. (see Pouraghajan et al. 2012; Derbali 2014; Ajayi & Zahiruddin 2016; Kamran 2017). For instance, the study of Pouraghajan et al. (2012) evidences a positive relationship between firms' performance and assets tangibility. Derbali (2014) performs a study to identify the determinants of insurance firms in Tunisia. He finds that tangibility was not a significant factor of the firms' performance. While the study conducted by Kamran (2017) on Pakistani financial firms reported a significantly inverse impact of assets tangibility on firms 'performance.

Hao and Chou (2005) point out that firm with larger market share can raise more revenue and profit; hence improve the overall efficiency of the firm. Similarly, Adu et al. (2012) also documented a positive link between market share and firm efficiency. We also include market share (firm premium to industry premium) variable to validate whether firms having more market share likely to perform better than those of having less share.

Karim (2005) included Age of the firm based on the argument that experienced firms are more efficient in utilizing their resources as compared to fewer experience firms. Therefore, "Age" of the firm is included in the analysis to capture the effect of "learning by experience". The age variable is measured by finding the difference between the establishment year and the observation year of the firm.

DATABASE

The sample consists of 13 non-life insurers operating in insurance industry of Pakistan, ranges over the period from 2009 to 2018. The sample constitutes more than 75% of non-life insurance industry both in terms of premium and assets. For each firm-annual observation, data has been collected from the yearly reports of firms and the Year Book of Insurance Association of Pakistan. The selected sample is in line with DMUs requirement of DEA. With 2 outputs and 3 inputs model, Golany and Roll (1989) and Dyson et al. (2001) recommend using 12 firms. The summary statistics for the variables is presented in Table 1.

ESTIMATION RESULTS

In this part, we discuss the result of the firm's VRS technical efficiency scores obtained using DEA and results in efficiency determinants retrieved through Tobit analysis. In this study, 13 general insurance firms operating in Pakistan were taken as DMUs to assess their efficiency in terms of risk management activity. We compute the efficiency scores separately for each year. The year-wise average efficiency scores obtained through VRS-DEA model are presented in Table 2, while Table 3 comprises of the efficiency scores of individual firms included in the sample.

The average efficiency score increases from 68% in 2009 to 76% in 2018. However, there was a decrease in 2014 and 2017. This decline in efficiency might be due to deterioration in the profitability of non-life insurers because of passive investment income due to low-interest rate. Moreover, net claims also rose during that time (Financial Stability Review 2017). However, year 2018 again witnessed improvement in efficiency gain.

TABLE 1. Summary statistics of selected variables

Variables	Description	Mean	Median	Standard Deviation
	Output Variables			
O_1	Return on Assets	0.057	0.054	0.038
O_2	Solvency	4.812	1.697	9.808
	Input Variables			
I_1	Variance of Loss Ratio	0.122	0.108	0.057
I_2	Variance of ROI	0.013	0.010	0.019
I_3	Leverage	1.878	1.221	3.457
	Explanatory Variables			
Z_1	Log of Total Assets	22.29	22.04	1.195
Z_2	Gross Premium Growth (%)	11.46	12.20	0.192
Z_3	Tangibility of Assets	0.045	0.029	0.051
Z_4	Age	47.35	56.00	24.83
Z_5	Market Share (%)	6.11	3.00	0.772

TABLE 2. Risk Management Efficiency Scores of Non-Life Insurance (2009-2018)

Year	Average Efficiency	Standard Deviation	Min	Max	Firms on Efficient Frontier
2009	0.682	0.425	0.008	1	53%
2010	0.690	0.420	0.018	1	54%
2011	0.701	0.314	0.181	1	54%
2012	0.749	0.363	0.027	1	62%
2013	0.718	0.322	0.144	1	54%
2014	0.541	0.318	0.111	1	23%
2015	0.684	0.308	0.246	1	38%
2016	0.778	0.303	0.085	1	54%
2017	0.705	0.323	0.074	1	46%
2018	0.769	0.247	0.398	1	38%

TABLE 3. Risk Management Efficiency Scores across Firms (2009-2018)

Firms	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Adamjee	1.00	0.34	0.31	1.00	0.75	0.47	1.00	1.00	1.00	1.00
EFU Gen	0.20	0.09	0.34	0.63	0.35	0.39	1.00	1.00	1.00	1.00
Askari Gen	0.01	0.54	0.50	0.33	0.38	0.42	0.54	0.77	0.77	1.00
IGI	1.00	1.00	1.00	1.00	1.00	0.11	1.00	1.00	0.37	0.77
Jubilee Gen	1.00	1.00	1.00	1.00	1.00	0.59	0.65	0.63	0.62	0.78
Premier	1.00	1.00	1.00	1.00	0.30	0.28	0.26	0.08	0.07	0.40
Habib	1.00	1.00	0.62	1.00	1.00	0.71	0.52	0.75	0.44	0.49
Shaheen	0.19	0.02	0.18	0.03	1.00	0.16	0.25	1.00	1.00	1.00
Atlas	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Security	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
United Gen	0.53	0.94	0.50	0.59	0.57	0.67	0.85	0.52	0.48	0.57
UBL Ins.	0.02	0.04	0.67	0.17	0.14	0.23	0.26	0.36	0.41	0.54
East West	1.00	1.00	1.00	1.00	1.00	1.00	0.58	1.00	1.00	0.45

According to Financial Stability Review (2018) even though the return on investment slightly decreased but overall profitability increased due to better underwriting performance of non-life insurers. Overall average efficiency score remained 70% for the period of analysis implies potential improvement in the firm's performance by 30% if it were to perform according to best risk management practices. The efficiency level could be improved both from the output and input perspective. The input dimensional improvement requires firms to perform better in terms of underwriting and investment activities, while output dimensional improvement could be achieved by increasing a firm's value addition and solvency. Also, results reveal that on average 48% of firms included in the sample remained relatively efficient (efficiency score equal to 1) in managing risk.

Table 3 reports the efficiency score of all firms included in the analysis for the period 2009-2018. Our results of the firm-level analysis show that among thirteen firms, only Security Gen insurer remained on efficient frontier throughout the analysis period while Atlas insurer also obtained the efficiency score of 1 except for the year 2009. Besides, the performance of Adamjee, EFU, IGI, Jubilee, Premier, and East West was also promising as they achieved maximum efficiency score four to five times. Apart from UBL and United Gen. rest of the firms enjoyed risk management efficiency for at least one year.

It is to mention that insurance companies with efficient risk management have better performance in terms of solvency, return on assets, and cost minimization. Figure 2 illustrates the average efficiency level of all the firms included in the sample. The efficient insurer in Pakistan's non-life insurance sector was the Security general and serves as a reference point for all other firms. The remaining 12 firms have technical efficiency score of less than 1. The results, thus, indicate a presence of marked deviations of the insurers from the best practice frontier, hence need to improve their efficiency by increasing output for given inputs.
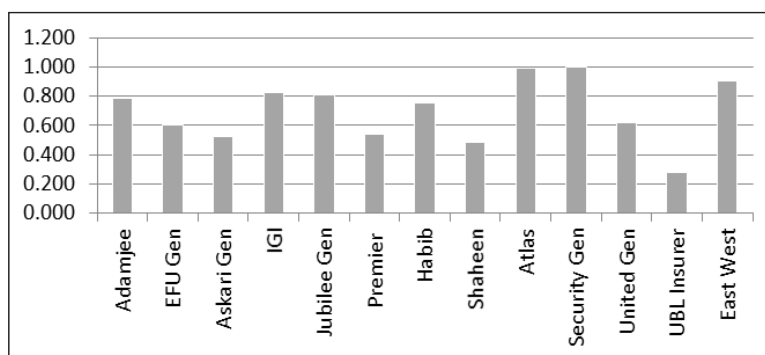
FIGURE 2. Average Efficiency across Firms (2009-2018)

TABLE 4. Determinants of Risk Management Efficiency

Variables	Coefficients	Standard Error	p-value
Log of Total Assets	0.104	0.037	0.006
Tangibility	-0.297	0.580	0.609
Growth Rate of Gross Premium	0.002	0.001	0.211
Age	0.003	0.001	0.025
Market Share	-0.015	0.005	0.005
Constant	-1.681	0.797	0.000

Observation	130	
LR chi2(5)	22.81	
Prob>chi2	0.0004	
Pseudo R^2	0.2769	
Log Likelihood -29.78		

We use Tobit model to determine if firm's related specific variables such as total assets, assets tangibility, growth rate of gross premium written, firm's age and market share affect the risk management efficiency of general insurance sector in Pakistan. Table 4 present the estimated coefficients, standard errors and respective probabilities.

We observe a positive and significant impact of assets size on firm's performance in managing risk. The large companies are expected to enhance value addition through economies of scale and able to deal with the risk in an efficient way. This result supports the theoretical behavior and is in line with other empirical findings (See Hao & Chou 2005; Ashraf & Kumari 2016; Afzal & Kausar 2010).

We also find a positive influence of age on the risk management performance because older firms can benefit from experienced staff, accumulated knowledge, improved skills and a better understanding of the industry. However, our results of market share indicate the inverse relationship between risk management efficiency and share of the firm in the market. According to Simon (2010), there are good and bad market shares. He explained that good market share is achieved by superior services, better quality and innovation while bad market share is earned through price reductions.

Carpole (2017) also notes that firms with good premium rate may be due to mispricing that increases the sales by charging less premium rate.

In sum, we find an overall improvement in the efficiency of non-life insurance firms over the study period. It is also noticed that risk management efficiency varies significantly with the firm's size. The study also confirms that firm with more years of experience is very good at managing the risk efficiently as compare to new entrants.

CONCLUSION

Although, an extensive literature is concerned with the overall performance of insurance industry, however, very few studies exist in literature to focus on the efficiency of insurance firms in its different operations like risk and investment.

This study contributes to the insurance industry efficiency literature by providing information on the risk management efficiency and factor influencing the firm's performance in terms of risk management. This study applies Data Envelopment Analysis (DEA) to compute the efficiency scores for the risk management practices of the firms over the period 2009-2018. Tobit

model is also applied to identify factors affecting the risk performance of firms. The results of the firm-level analysis indicate that among 13 firms, Security general was the best peer in terms of managing risk and maximizing benefits. Further, we also find enhancement in efficiency performance over time particularly from 2009-2013, after a decrease in mid-years, it again increased. We observe that Security General and Atlas are most efficient in managing their risks among others. These firms have small market share in terms of premium, business volume and outreach as compare to other firms with large market share. It is suggested that firms lower on efficiency frontier need to employ the best strategies to cope with risk to catch up with the efficient firms. The inefficient firms can enhance their efficiency level by improving underwriting and investment activities, which will increase the risk management efficiency of firms by increasing firm's value addition and solvency Finally, we employ Tobit model to explore the relationship between efficiency in risk management and firm-specific characteristics. We find a significant explanatory power of some of the firm's specific factors over risk efficiency such as size and age.

The study recommends that to enhance financial management performance and profitability, inefficient firms should adopt a multifaceted approach for managing the risks to derive greater benefits from their businesses. A comprehensive risk management framework plays a major role in determining the financial soundness of insurers. The study further recommends that firms should continuously update their risk management strategies considering the changes in the operating environment. Focusing on effective corporate governance, training of employees to increase risk management capacity, installation and upgrading of information technology for risk assessment and mitigation is essential for effective risk management. Efficiency in risk identification and mitigation will derive significant benefits to firms. The insurance firms in the non-life sector should improve the risk assessment and risk diversification to enhance the returns from this activity.

The future projects a constructive and affirming picture for the non-life insurance business in Pakistan, as per the findings of this study. Although there are many challenges ahead, however insurers should revise not only their risk strategies but also focus on other operations such as investment management to improve the company's overall financial performance. This research can be extended in several directions. For example, parametric and non-parametric frontier models could be applied to investigate and compare the efficiency scores under various models and assumptions. Other firm-specific factors such as nature of ownership etc. and macroeconomic variables could also be added for explaining the efficiency differences among firms.

REFERENCES

Acharyya, M., & Mutenga, S. 2013. The benefits of implementing enterprise risk management: evidence from the non-life insurance industry. *Enterprise Risk Management* 6(1): 22-24.

Adu, K.A., Andoh, C. & Abor, J. 2012. Evaluating the cost efficiency of insurance companies in Ghana. *The Journal of Risk Finance* 13(1): 61-76.

Afza, T., & Asghar, M. J. K. A. 2012. Financial reforms and efficiency in the insurance companies of Pakistan. *African Journal of Business Management 6*(30): 8957-8963.

Ajayi, O. D., & Zahiruddin, B. G. 2016. The impact of capital structure on firm performance: Empirical evidence from Nigeria. *IOSR Journal of Economics and Finance* 7(4): 23-30.

Almulhim, T. 2019. Analysis of Takaful vs. Conventional insurance firms' efficiency: Two-stage DEA of Saudi Arabia's insurance market. *Cogent Business & Management* 6(1) https://doi.org/10.1080/23311975.2019.1633807

Asghar, M. J. K. A., & Afza, T. 2010. Firm size and efficiency in the non-life insurers of Pakistan. *Journal of Quality and Technology Management* 6: 165-183.

Ashraf, S., & Kumari, N. 2016. An Evaluation of Investment Performance of Private Life Insurance Industry in India. *International Journal of Accounting Research* 4:121 https://doi:10.4172/ijar.1000121.

Avkiran, N. K. 1999. An application reference for data envelopment analysis in branch banking: helping the novice researcher. *International Journal of Bank Marketing* 17(5): 206-220.

Banker, R. D., Charnes, A., & Cooper, W. W. 1984. Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management science* 30(9): 1078-1092.

Banks, E. 2004. *Alternative risk transfer: integrated risk management through insurance, reinsurance, and the capital markets*. John Wiley & Sons.

Caporale G.M., Cerrato, M. & Zhang, X. 2017. Analyzing the determinants of insolvency risk for general insurance firms in the UK). *Journal of Banking and Finance* 84: 107–122

Charnes, A., Cooper, W. W., & Rhodes, E. 1978. Measuring the efficiency of decision-making units. *European Journal of Operational Research* 2(6): 429-444.

Coelli, T.J. 1996. A guide to DEAP Version 2.1: A data envelopment analysis (computer) program. CEPA Working Papers – No. 8/96. Department of Econometrics, University of New England, Armidale, Australia.

Coelli, T.J. 1996. A guide to DEAP Version 2.1: A data envelopment analysis (computer) program. CEPA Working Papers – No. 8/96. Department of Econometrics, University of New England, Armidale, Australia.

Coelli, T.J. 1996. *A guide to DEAP Version 2.1: A data envelopment analysis (computer) program*. CEPA Working Papers Series No. 8/96. Department of Econometrics, University of New England, Armidale, Australia.

Cummins, J. D., & Zi, H. 1998. Comparison of frontier efficiency methods: An application to the US life insurance industry. *Journal of Productivity Analysis* 10(2):131-152.

Cummins, J. D., & Xie, X. 2008. Mergers and acquisitions in the US property-liability insurance industry: Productivity and efficiency effects. *Journal of Banking and Finance* 32(1):30-55.

Cummins, J. D., Dionne, G., Gagné, R., & Nouira, A. H. 2009. Efficiency of insurance firms with endogenous risk management and financial intermediation activities. *Journal of Productivity Analysis* 32(2): 145-159.

Derbali, A. 2014. Determinants of performance of insurance companies in Tunisia: The case of life insurance. *International Journal of Innovation and Applied Studies* 6 (1): 90-96.

Doff, R., 2015. *Risk Management for Insurers: Risk Control, Economic Capital and Solvency II (3rd edn)*. London Risk Books.

Dyson, R.G., Allen, R., Camanho, A.S., Podinovski, V.V., Sarrico, C.S., & Shale, E.A. 2001. Pitfalls and Protocols in DEA, *European Journal of Operational Research* 132(2): 245-259.

Eling, M., & Luhnen, M. 2010a. Efficiency in the international insurance industry: A cross-country comparison. *Journal of Banking & Finance* 34(7): 1497-1509.

Eling, M., & Luhnen, M. 2010b. Frontier efficiency methodologies to measure performance in the insurance industry: Overview, systematization, and recent developments. *The Geneva Papers on Risk and Insurance Issues and Practice* 35(2): 217-265.

Ertugrul, I., Oztas, G.Z., Ozcil, A., and Oztas, T. 2016. Efficiency Analysis of Non-Life Insurance Companies in Terms of Underwriting Process with Data Envelopment Analysis. *European Scientific Journal, Special edition*: 71-83.

Golany, B. and Roll, Y. 1989. An Application Procedure for DEA. *Omega* 17 (3): 237-250.

Hao, J. C., & Chou, L. Y. 2005. The estimation of efficiency for life insurance industry: The case in Taiwan. *Journal of Asian Economics* 16(5): 847-860.

Hsu, W.Y. & Petchsakulwong, P. 2010. The impact of corporate governance on the efficiency performance of the Thai non-life insurance industry. *The Geneva Papers on Risk and Insurance-Issues and Practice* 35(1): S28-S49.

Iqbal Z. & Mirakhor A. 2007. *An Introduction to Islamic Finance: Theory and Practice.* Second Edition. John Wiley & Sons.

Jaloudi, M.M. 2019. The efficiency of Jordan insurance companies and its determinants using DEA, slacks, and logit models. *Journal of Asian Business and Economic Studies* https://doi.org/10.1108/JABES-10-2018-0072.

Janjua, P. Z., & Akmal, M. 2015. A comparative analysis of economic efficiency of conventional and Islamic insurance industry in Pakistan. *Pakistan Business Review* 17(1): 21-44.

Kamran, M. K., Mohammad, N., Zhou, J., & Muhammad, I. K. 2017. Determinants of financial performance of financial sectors (An assessment through economic value added). *European Academic Research* 5(7): 3291-3328.

Karim, M. Z. 2005. Cost efficiency and profitability in Thailand's life insurance industry: A stochastic cost frontier approach. *International Journal of Applied Econometrics and Quantitative Studies 2*: 19-36

Kokobe, S. A., & Gemechu, D. 2016. Risk Management Techniques and Financial Performance of Insurance Companies. *International Journal of Accounting Research* 4(1): 126-127.

Khan, A., & Noreen, U. 2014. Efficiency measure of insurance v/s Takaful Firms using DEA approach: a case of Pakistan. *Islamic Economic Studies* 22(1): 139-158.

Kripa, D., and Ajasllari, D. 2016. Factors affecting the profitability of Insurance Companies in Albania. *European Journal of Multidisciplinary Studies* 1(1): 352-360.

Lin, H. J. & Wen, M.M. 2008. Effects of integrated risk management on mean and variance of cost efficiency of property/liability insurance industry. Project Paper, Society of Actuaries.

Magezi, J.K. 2003. A New Framework for Measuring the Credit Risk of a Portfolio. *Institute for Monetary and Economic Studies (IMES):* 1-45.

Noreen, U., & Ahmad, S. 2016. Cost Efficiency and Total Factor Productivity: An Empirical Analysis of Pakistan's Insurance Sector. *Lahore Journal of Economics* 21(1): 123-150.

Nourani, M., Devadason, E.S. and Chandran, V. 2018. Measuring Technical Efficiency Of Insurance Companies Using Dynamic Network DEA: An Intermediation Approach. *Technological and Economic Development of Economy* 24(5):1909–1940.

Akotey, J. O., & Abor, J. 2013. Risk management in the Ghanaian insurance industry. *Qualitative Research in Financial Markets* 5(1): 26-42

Pouraghajan, A., Malekian, E., Emamgholipour, M., Lotfollahpour, V. & Bagheri, M.M. 2012. The relationship between capital structure and Firm performance evaluation measures: Evidence from the Tehran Stock Exchange. *International Journal of Business and Commerce* 1(9): 166-181.

Ren, Y. 2007. Measuring risk management performance of insurers: A DEA approach. In Seminal Paper at ARIA Annual Meeting, Loews Le Concorde, Quebec City.

Sen, S. 2019. Analysis of Cost Efficiency of Indian Life Insurers: A comparison of Quantity vs Value based DEA Approach. *Asia-Pacific Journal of Risk and Insurance* 14 (1).

Simon, H. 2010. Hidden Champions of the 21st Century: Role Models of Leadership Beyond the Crisis. *Master of Business Administration* 18(4): 3-17

Sharew, A., & Fentie, G. 2018. Data Envelopment Analysis on Efficiency of Insurance Companies in Ethiopia. *American Scientific Research Journal for Engineering, Technology, and Sciences* 48(1):138-170

State Bank of Pakistan. 2017. Performance and Risk Analysis of Insurance Sector, *Financial Stability Review*, Karachi.

State Bank of Pakistan. 2018. Performance and Risk Analysis of Insurance Sector, *Financial Stability Review*, Karachi.

Viverita, V. 2019. Efficiency Analysis of Private Insurance Firms Before and After the Application of BPJS Regulations. *Advances in Economics, Business and Management Research* (89): 368-373.

Wu, D., Yang, Z., Vela, S., & Liang, L. 2007. Simultaneous analysis of production and investment performance of

Canadian life and health insurance companies using data envelopment analysis. *Computers & Operations Research* 34(1): 180-198.

Yang, Z. 2006. A two-stage DEA model to evaluate the overall performance of Canadian life and health insurance companies. *Mathematical and computer modelling* 43(7): 910-919.

Yakob, R., Yusop, Z., Radam, A., & Ismail, N. 2015. The relative efficiency of investment management of life insurers and takaful operators. *Investment Management and Financial Innovations* 12(1):78-89.

Yusop, Z., Radam, A., Ismail, N. 2011. Risk management efficiency of conventional life insurers and Takaful operators. *Insurance Markets and Companies: Analyses and Actuarial Computations* 2: 58-68

Uzma Noreen
Department of Economics
Female Campus
Intl. Islamic University
Islamabad
PAKISTAN
E-mail: uzma.noreen@iiu.edu.pk