

## **Efficiency Measure of Insurance v/s *Takāful* Firms Using DEA Approach: A Case of Pakistan**

ATIQUZZAFAR KHAN\*

UZMA NOREEN\*

### **Abstract**

*This study aims at comparing the Pakistan's Takāful and conventional insurance companies in terms of efficiency and productivity for the period 2006-2010. We apply Data Envelopment approach to estimate technical, allocative and cost efficiencies. The results indicate that the insurance industry as a whole is cost inefficient due to high allocative inefficiency. However, technical efficiency components show improving trends. Results further indicate that Takāful firms are more efficient as compared to conventional insurance firms. Malmquist productivity index shows a significant improvement in scale efficiency. However, we do not find any considerable contribution of technology to improve overall productivity. The study suggests introduction of innovative and diversified products in insurance industry of Pakistan, particularly for Takāful companies.*

Keywords: *Takāful*, insurance, Comparative Analysis, Non-Parametric Methods.

JEL Classification: G22, P51 D22, C14.

KAU-IEI Classification: I44.

### **1. Introduction**

The insurance industry plays an important role in the development of social and economic sectors of an economy by minimizing risk of all economic activities on the one hand and by channelizing long term financial resources on the other. An efficient

---

\* Assistant Professor, International Institute of Islamic Economics, International Islamic University, Islamabad, Sector H-10, Pakistan. Email: atiquzzafar@iiu.edu.pk.

\* Lecturer, International Institute of Islamic Economics, International Islamic University, Islamabad, Pakistan. Email: uzma.noreen@iiu.edu.pk.

and productive insurance sector also contributes to economic growth of a country by transforming savings into investment projects through the financial intermediation (Financial Sector Assessment: 2005). Insurance companies offer different services to households and businesses for their well-being. The primary service of insurance company is to provide risk coverage against any loss to property, business and life, etc. Thus, an insurance company encourages the otherwise risk-averse individuals and entrepreneurs to undertake high return activities, of course with higher risk, than they would normally hesitate to do so.

Given the importance of insurance in the country's socio-economic development and its distinct functions from other financial institutions, it seems attractive to look at its performance, particularly in the presence of dual insurance system where *Takāful*<sup>1</sup> and conventional insurance firms are working side by side. Before the introduction of *Takāful* rules in 2005, insurance sector in Pakistan comprised of only conventional insurance firms. Since 2005, *Takāful* industry started operation and now 5 *Takāful* firms (two family and three general *Takāful* firms) are offering different Shari'ah<sup>2</sup> compliant products in the market. First *Takāful* firm in Pakistan started its operation in 2006, and now five *Takāful* firms are operational in the country by 2011. Since 2006, *Takāful* industry demonstrated healthy growth in its net & gross premium and assets structure [See Appendix A Table 1].

Efficiency is an important issue for *Takāful* firms as they are facing intense competition from the well-established conventional insurers. Moreover *Takāful* operators have the vast opportunity to attract those customers who were not previously having the conventional insurance because of its incompliance with Shari'ah; hence it is possible to increase customer base and the insurance penetration rate in Pakistan.

In recent years there has been a significant growth in insurance sector of Pakistan along with the entry of *Takāful* firms in industry. This very fact motivates us to undertake the efficiency and productivity analysis of insurance and *Takāful* firms. The present study attempts to measure the performance of insurance and *Takāful* industry and tries to explore the relationship between the efficiency and productivity

---

<sup>1</sup> *Takāful* is the concept of Islamic insurance (as alternative to conventional insurance) based on principles of shared responsibility and risk sharing through mutual cooperation, rather than risk exchange.

<sup>2</sup> Sacred orders of Allah in the Qur'an, religious, social and commercial practices of the Prophet (SAW), *Qiyās* (Analogy), and *Ijmā'* (the agreement of whole Islamic world on an issue) form the basis of Shari'ah.

with different operational measures of risk protection. More specifically, the study will concentrate on the comparison of cost efficiency and total factor productivity of different *Takāful* and conventional firms under reference. It is expected that the findings of this study will help the insurers, regulators, government and Shari‘ah Boards of *Takāful* companies to design new and innovative Shari‘ah compliant products in Pakistan, which in return will stimulate *Takāful* demand and increase the insurance penetration in the country

The rest of the paper is planned as follows. Section 2 reviews the relevant literature on efficiency and productivity of insurance and *Takāful* companies. Section 3 outlines the related concepts and empirical methodology. Section 4 presents data and the description of the selected variables and Section 5 analyzes the results. The last section concludes the study.

## 2. Literature Review

There are many studies that explore the efficiency and productivity of insurance sector, both in developed and developing economies, by using parametric and non-parametric approaches. However very few studies are available that measures the efficiency of *Takāful* industry. Most of the studies on insurance efficiency have focused heavily on the developed countries and particularly, on the insurance industry in USA and the west [see, Gardner and Grace (1993), Yuengert (1993), Cummins et al. (1999), Amel et al. (2004), Greene and Segal (2004) and Jeng et al. (2007)].

Studies that evaluated the performance of European insurance sector include Diacon et al. (2002), Ennsfellner et al. (2004), Cummins and Misas (2006), Fenn et al (2007). For instance, Ennsfellner et al. (2004) investigate the production efficiency of Austrian insurance industry, while Cummins and Misas (2006) examine the impact of organizational structure on the efficiency of Spanish insurance firms. Other studies in European countries focus on productivity measurement using Malmquist index and stochastic frontier analysis [see for example, Cummins et al. (1996) for Italy, Fenn et al. (2007) for European countries]. These studies document that both efficiency and productivity of insurance companies altered significantly due to deregulatory process in these countries. Further, it is concluded that growth in new products and adoption of technology has improved the performance of insurance sector in these economies significantly.

Although, most of the literature is centered upon the performance of insurance sector either in U.S. or other developed countries, however, in recent years, we find

other studies that investigate efficiency and productivity of this sector in Asian economies. While majority of these studies cover East Asian economies (see for example, Mansoor and Radam, 2000; Karim and Jhantasana, 2005; Hao and Chou, 2005; and Jeng and Lai, 2005), there are a few studies on South Asian countries as well.

Most of the studies have attempted to measure the efficiency of conventional insurance, but a few studies have also focused on the efficiency of *Takāful* firms, for instance Kader et al. 2010; Yusop et al. 2011; Ismail et al, 2011; examines the efficiency of *Takāful* firms operating in different countries. Kader et al (2011) investigated the cost efficiency of *Takāful* firms operating in seventeen Islamic countries. Their study concludes that average cost efficiency scores of *Takāful* firms are comparable with developed conventional insurers. They further suggest that a skilled and experienced Board of Directors can contribute positively to optimal resource allocation and hence the efficiency.

Ismail et al. (2011) perform a study to measure the efficiency of *Takāful* and conventional insurers in Malaysia over the period 2004-2009. They find that efficiency score for *Takāful* firms' remains lower (i.e. 64 percent) than their conventional counterparts (i.e. 87 percent). The study further suggests that *Takāful* firms should reduce their agency cost and management expenses and improve their investment gains by investing in healthy projects. Saad et al. (2006) also analyze the efficiency of life insurance industry in Malaysia, using the data on *Takāful* and conventional insurance firms. The findings of the study indicate that conventional firms are performing better as compared to *Takāful* firms. They further suggest that *Takāful* firms should increase their size to optimal level in order to improve the efficiency score.

Despite the fact that a growing literature is available on efficiency of insurance sector as well as on *Takāful* firms around the globe, we do not find even a single study that measures the comparative performance of Pakistan's insurance and *Takāful* sector. Of course, a few studies are available on comparison of Islamic and conventional banking efficiency (see, Khyzer et al, 2011; Akhtar et al, 2011; Shah et al, 2012). Thus it will be interesting to investigate the relationship between the efficiency and productivity of two different organizational forms i.e. *Takāful* and conventional firms having different operational framework towards risk protection.

### **3. Methodology**

The efficiency concept is basically used to evaluate the performance of a firm. Conventionally, financial ratios such as return on assets, return on equity, expense to premium ratios etc. are used to measure their performance. However the emergence of frontier methodologies with their meaningful and reliable measures now dominates the conventional approaches to evaluate efficiency and most studies follow the new approach.

There are two main frontier based approaches used to measure the efficiency: namely parametric and non-parametric approach. The parametric approach requires the specification of functional form of the production, cost and profit frontier and some distributional assumptions about the error term. On the other hand, non-parametric approach does not assume any specific functional form for evaluating efficiency, and therefore, does not take into account the error term. (Cummins and Xie; 2008).

Data Envelopment Analysis (DEA) was first introduced by Charnes et al. (1978) and extended by Banker, et al. (1984). The purpose of this approach was to measure the relative efficiency of each DMU (Decision Making Unit) with the best practices firm. DEA decomposes the cost efficiency (CE) into two components. One is technical efficiency (either maximizing output for a given level of inputs or minimizing inputs for a given level of output). The other is allocative efficiency (using input in optimal proportions given the input prices and output quantities). Technical Efficiency (TE) can be further decomposed into Pure Technical Efficiency (PTE) and Scale Efficiency (SE). SE occurs when firm operates at Constant Returns to Scale (CRS) and PTE occurs when firm maximizes its output with Variable Returns to Scale (VRS). The resultant efficiency measure, ranging between zero (least efficient) and one (most efficient), depicts the distance from each unit to frontier.

The present study uses non-parametric approach by applying DEA. We choose this approach on the basis of certain advantages. The main advantage of this approach lies in lesser demand for data and therefore it is appropriate for small sample size. Further, DEA<sup>3</sup> analyzes the efficiency of each firm separately, and can easily identify the efficiency and productivity changes across the firms (Cummins

---

<sup>3</sup> For further details on DEA see [Coelli (1996) and Coelli et al. (1997)].

and Xie; 2008). We use the software package DEAP<sup>4</sup> developed by Coelli (1996) to measure the cost efficiency and its components.

Finally, to measure the change in efficiency and technology, we adopt the DEA based Malmquist Index Approach. The idea was first presented by Malmquist (1953) and later extended by Caves et al. (1982). There are several methods to compute the Malmquist productivity index. We estimated output oriented Malmquist index in this study, which is based on DEA. Malmquist indices can also be calculated by using DEAP software package. To estimate the Malmquist Productivity Index we need a balanced panel data. For this purpose, we include only 16 firms for the period 2007-2010.

#### **4. Data and Variable Description**

##### *4.1. Data*

The data sample for this analysis consists of 12 conventional insurance and 5 *Takāful* companies operating in Pakistan (List of insurance and *Takāful* companies is given as Appendix B). The sample size represents more than 80% of the market share (in terms of premium) reflecting the fact that the selected sample is the representative of Pakistan Insurance and *Takāful* sector. To estimate the cost efficiency, we use un-balanced panel data for the period 2006 to 2010, obtained from the annual reports of insurance and *Takāful* companies.

##### *4.2. Variable Description*

The most critical task of the efficiency analysis for financial sector is to define output, inputs and their prices.<sup>5</sup> An appropriate selection of the output-input variables in the insurance industry makes it a more difficult and challenging job.

The precision of the efficiency results depends upon the definition of outputs, inputs quantities and their respective prices. There has been much debate on the selection criteria of input-output variables in financial sector, particularly, for insurance industry (see for example, Yuengert, 1993; Cummins and Weiss, 1998; Worthington and Hurley, 2002).

---

<sup>4</sup> Data Envelopment Analysis Program (DEAP), software used to calculate efficiency score.

<sup>5</sup> See, Sealey and Lindley (1977), for a detailed discussion on variable selection.

**Table-1**  
**Descriptive Statistics**

<b>Description</b>	<b>Mean</b>	<b>Median</b>	<b>Standard Deviation</b>
<b>Output Variables</b>			
invested assets	13.28 x 10 <sup>9</sup>	10.10 x 10 <sup>8</sup>	37.9 x 10 <sup>9</sup>
Net Premium	3.12 x 10 <sup>9</sup>	5.42 x 10 <sup>8</sup>	6.22 x 10 <sup>9</sup>
<b>Input Variables</b>			
Labor	635	223	975
Total Fixed Assets	1.97 x 10 <sup>8</sup>	1.03 x 10 <sup>8</sup>	2.27 x 10 <sup>8</sup>
Business Services	9.82 x 10 <sup>8</sup>	8.81 x 10 <sup>7</sup>	2.40 x 10 <sup>9</sup>
Equity capital	3.16 x 10 <sup>9</sup>	9.70 x 10 <sup>8</sup>	4.50 x 10 <sup>9</sup>
<b>Input Prices</b>			
Labor	473498	455424	259383
Total Fixed Assets	0.1664	0.1435	0.1154
Business Services	0.0808	0.0419	0.1201
Equity capital	0.4826	0.4760	0.2620

Different output variables have been identified by various studies to measure the efficiency and productivity of insurance sector. Risk pooling (or risk bearing) and intermediation services are considered two main services that insurance industry provides to customers [Cummins and Zi (1998)]. Much of the existing literature prefer to use premium income as a common measure of risk pooling as policy holders in fact buy protection against risk by purchasing insurance policies.

For intermediation function we used the proxy of invested assets [See Cummins et al. (1999), Worthington and Hurley (2002), Jeng and Lai (2005)]. Worthington and Hurley (2002) consider invested assets as an output with the argument that net profit of most general insurers comes from the intermediation function of borrowing from policyholders and investing in marketable securities rather than premium

The choice of input variables is somehow undisputed as compared to the selection of output variables in insurance analysis. In general, three types of input variables namely Labor, Capital and business services are used to measure the efficiency [see Meador et al (1996), Cummins et al (1996), Greene and Segal (2004), Cummins and Xie (2008)]. Some studies also used the equity capital as an input [Cummins, Turchetti, and Weiss (1996), Greene and Segal (2004), and Jeng and Lai (2005)]. It is important in the sense that insurers need to maintain equity capital for the payment of claims to their policyholders if losses exceed the expected limits. We include four

inputs Labor ( $X_1$ ), total fixed assets ( $X_2$ ), business Services ( $X_3$ ) and equity capital ( $X_4$ ), in the present study.

## 5. Results and Discussion

In this section we discuss the results of cost efficiency and its decomposition into technical and allocative efficiency arrived at by DEA analysis. We also measure total factor productivity by decomposing it into technical efficiency change and technical change

### 5.1. Efficiency Results

First, we measure the cost efficiency of individual insurance and *Takāful* firms and its components of pure technical, scale and allocative efficiency for each year from 2006 to 2010. Year wise average efficiency results of *Takāful* and conventional insurers for the period 2006-2010 are presented in Table 2.

**Table-2**  
**Year wise Efficiency Results of *Takāful* and Insurance Firms**

Year	Pure Technical Efficiency	Scale Efficiency	Allocative Efficiency	Cost Efficiency
2006	<u>0.92</u>	<u>0.84</u>	<u>0.58</u>	<u>0.54</u>
2007	<u>0.96</u>	<u>0.77</u>	<u>0.53</u>	<u>0.51</u>
2008	<u>0.93</u>	<u>0.76</u>	<u>0.54</u>	<u>0.50</u>
2009	<u>0.72</u>	<u>0.50</u>	<u>0.41</u>	<u>0.29</u>
2010	<u>0.91</u>	<u>0.82</u>	<u>0.48</u>	<u>0.43</u>
<b>Mean</b>	<b><u>0.89</u></b>	<b><u>0.74</u></b>	<b><u>0.51</u></b>	<b><u>0.45</u></b>

Results depict that both the insurance and *Takāful* industry in Pakistan on the average remain technically efficient. However, insurance sector shows lower allocative efficiency on the average and consequently the cost efficiency dominates.

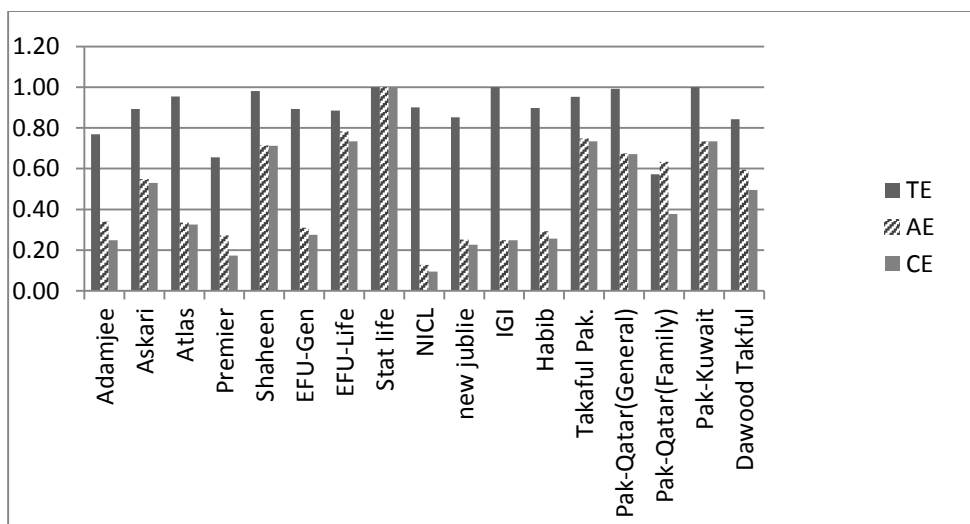
We find mix trend for pure technical efficiency over the period. Results indicate that on the average, insurance and *Takāful* sector shows 89 percent pure technical efficiency. This measure shows as to how much resource allocation and internal management are efficient in their performance. To achieve the most efficient level, firms, on the average need a reduction of 11 percent in the inputs level which they are currently using to produce the same level of output.



Similarly, scale efficiency of insurance industry remains about 74 percent indicating a significant expansion in insurance sector of Pakistan during 2006-2010. This measure indicates whether the firm is operating on optimal scale or otherwise. Scale efficiency equal to one (i.e. constant returns to scale) is the indication that firm is operating at optimal scale, while deviation from unity (either increasing returns to scale or decreasing returns to scale) depicts that firm is away from its optimal level.

Another important source of cost efficiency is firm’s allocative efficiency. If a firm is successful to equate its marginal products to input price ratios then it is optimizing its resources to produce a certain level of output. It is notable that insurance sector of Pakistan remains about 49 percent allocatively inefficient during the period of study, which might have contributed to cost inefficiency of this sector significantly. Average cost efficiency of this sector is recorded only 45 percent over the period concerned showing that insurance and *Takāful* firms could have reduced about 55 percent expenditures as compared to the existing level to produce same output level.

**Figure-1**  
**Firm Wise cost efficiency and its components (2006-2010)**



Firm wise efficiency score depicts that only one firm that is also the largest firm in sample is 100 percent cost efficient. It is noteworthy that allocative efficiency dominates the cost efficiency as firm even with highest technical efficiency shows lower cost efficiency, as they remain less efficient allocatively. These results are not

unexpected because insurance sector of Pakistan has been highly concentrated as few firms are dominating the whole sector. This high concentration plus product differentiation of insurance industry might have resulted into care free attitude on the insurance firms who do not use their resources efficiently. However, recent wave of competition and deregulatory process may improve the resource allocation mechanism in these firms by providing them a level playing field to insurance sector in coming years.

Comparative analysis of *Takāful* and conventional insurers shows that overall *Takāful* firms are more cost efficient as compared to their conventional counterparts. It is noteworthy that allocative efficiency dominates the cost efficiency as *Takāful* firms are cost efficient due to high allocative (68%) efficiency, while conventional firms observed low allocative efficiency (43%) even though they are technically more efficient.

**Table-3**  
**Efficiency Comparison of *Takāful* and Conventional Firms**

Firms*	PTE	SE <sup>6</sup>	AE	CE
Conventional Firms	<u>0.89</u>	<u>0.86</u>	<u>0.43</u>	<u>0.40</u>
<i>Takāful</i> Firms	<u>0.87</u>	<u>0.38</u>	<u>0.68</u>	<u>0.60</u>

\* PTE = Pure Technical Efficiency, SE = Scale Efficiency, AE = Allocative Efficiency & CE = Cost Efficiency

High allocative efficiency of *Takāful* firms indicates that this industry is choosing the optimal combination of inputs. However lower scale efficiency of *Takāful* firms indicates that the operators should expand their size to enjoy the benefits of economies of scale.

---

<sup>6</sup> All Takaful firms are operating at Increasing Returns to Scale (IRS), while among conventional firms 51% are operating at Constant Returns to Scale, 44% at Increasing Returns to Scale and only 5% at Decreasing Returns to Scale.

## 5.2. Productivity Results

In this section, the results for total factor productivity and its components are also presented. We estimate output oriented Malmquist index in this study, which is based on DEA. Table 4 presents year wise average results for Malmquist index and its components of technical efficiency change, technological change and total factor productivity change.

**Table-4**  
**Malmquist Index Results**

<b>YEAR</b>	<b>EFFCH*</b>	<b>TECHCH</b>	<b>PECH</b>	<b>SECH</b>	<b>TFPCH</b>
2008	<u>0.997</u>	<u>1.021</u>	<u>0.955</u>	<u>1.044</u>	<u>1.017</u>
2009	<u>1.022</u>	<u>0.94</u>	<u>0.985</u>	<u>1.038</u>	<u>0.961</u>
2010	<u>1.083</u>	<u>1.001</u>	<u>0.974</u>	<u>1.112</u>	<u>1.083</u>
<b>Mean</b>	<b>1.033</b>	<b>0.987</b>	<b>0.971</b>	<b>1.064</b>	<b>1.019</b>

\*EFFCH = Efficiency Change, TECHCH = Technological Change, PECH = Pure Efficiency Change, SECH = Scale Efficiency Change and TFPCH = Total Factor Productivity Change.

If the value of Malmquist index and any of its components exceeds unity, it indicates the improvement in performance, while a value equal to unity shows no change and less than unity shows the deterioration in its performance. The results show that on the average insurance sector experienced growth in total factor productivity, mainly due to scale efficiency change, while deterioration is observed in technical change.

The average growth in total factor productivity is found to be 1.9 percent annually. Similarly, there has been significant technical efficiency improvement as this measure registers a 3.3 percent growth on the average, which is also consistent with our previous results of cost efficiency obtained on the basis of DEA. However, we find deterioration in technological change.

As can be seen from Table 4, there has been a decline in productivity in the year 2009, which may be the consequence of decline in overall economic growth, high inflation rate, floods, global financial crisis and internal security situation of the country. These factors might have caused a reduction in productivity. Malmquist productivity results also show that insurance industry has experienced an overall productivity growth, which is contributed mainly by scale efficiency change.

Further, the size of the business has a significant impact on different efficiency measures, although not identical for all firms.

**Table-5**  
**Productivity Comparison of *Takāful* and Conventional Firms**

Firms	EFFCH	TECHCH	PECH	SECH	TFPCH
<b>Conventional Firms</b>	<u>1.008</u>	<u>1.012</u>	<u>1.009</u>	<u>0.999</u>	<u>1.019</u>
<b><i>Takāful</i> Firms</b>	<u>1.189</u>	<u>0.943</u>	<u>0.902</u>	<u>1.286</u>	<u>1.120</u>

The comparative results as shown in Table 5 reflect that *Takāful* firms observed a significant improvement in productivity with score 12%, that arises mainly from scale efficiency change. On the other hand conventional insurers observed only 1.9 % growth in total factor productivity. Conventional firms mainly depicts growth due to improvement in technology, while *Takāful* firms show deterioration in technology, which suggests that more innovative and diversified products should be introduced by *Takāful* firms to improve their productivity.

## 6. Conclusion

Although, a growing literature is concerned with insurance sector efficiency and productivity keeping into view its importance in economic development around the globe, only limited information is available on the efficiency comparison of conventional and Islamic insurance. This study attempts to break new grounds for measuring performance of insurance and *Takāful* firms in Pakistan. We compared efficiency of *Takāful* and conventional Insurance from 2006-2010, using DEA model

Results of the analysis indicate that the insurance firms remain technically efficient showing about 89 percent efficiency during the period under reference. Similarly, results are also indicative of scale efficiency (i.e., 74 percent) illustrating a significant expansion in insurance sector of Pakistan during 2006-2010. On the other hand, however, insurance sector experiences allocative inefficiency, which dominates the cost efficiency.

The empirical results of cost efficiency indicate that *Takāful* firms are more efficient than conventional counterparts due to high allocative efficiency, leads to

the conclusion that their choice of inputs is optimal. Further we compared *Takāful* and conventional insurers in terms of economies of scales. The results suggest that all of the *Takāful* firms are operating at IRS as compared to 44% in case of conventional firms using this model. This means that large number of *Takāful* firms enjoying a chance to increase their operations to reduce scale inefficiency and improve their performance. Most of the conventional firms (51%) are operating at CRS with the exception of only 5% with DRS, which show that they are operating at optimal scale.

Malmquist index also shows high productivity results for *Takāful* firms, mainly due to scale efficiency change. However we do not find any contribution from technology change for both types of firms. It is recommended that *Takāful* and conventional firms should introduce new and innovative products to improve the productivity. Finally, the comparative analysis highlights that *Takāful* firms are efficiently competing with their conventional counter parts despite the fact that they are new in the field. It is recommended that *Takāful* firms should increase their efficiency and win the competition by improving their services, product quality and marketability of their products. To conclude, the study observes a significant improvement in the performance of insurance sector of Pakistan that is mainly contributed by technical and scale efficiency. However, firms could not succeed to allocate their resources optimally, perhaps due to market imperfections in the insurance industry.

It can be claimed that our study lays the foundations for further research to be carried out on the *Takāful* industry in different parts of the Islamic World with different perspectives, like macroeconomic environment, consumer preferences and corporate governance.

### References

- Akhtar, W., Raza, A., Zaib, O., and Akram, M., 2011. Efficiency and Performance of Islamic Banking: The Case of Pakistan. *Far East Journal of Psychology and Business* 2, 54-70.
- Amel, D., Barnes, C., Panetta, F., and Salleo, C., 2004. Consolidation and efficiency in the financial sector: A review of the international evidence. *Journal of Banking and Finance* 28, 2493-2519.
- Banker, R., Charnes, A., and Cooper, W., 1984. Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science* 30, 1078-1092.
- Caves, D., Christensen, L., and Diewert, E., 1982. Economic theory of index numbers and the measurement of input, output, and productivity. *Econometrica* 50, 1393-1414.
- Charnes, A., Cooper, W., and Rhodes, E., 1978. Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research*, 2, 429-444.
- Coelli, T., 1996. A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program. *CEPA Working paper*, 96/08.
- Coelli, T., Rao, P., and Battese, G., 1997. An Introduction to Efficiency and Productivity Analysis. Kluwer, Boston.
- Cummins, D., Turchetti, G., and Weiss, M., 1996. Productivity and Technical Efficiency in the Italian Insurance Industry. Working Paper, *Wharton Financial Institution Centre*, University of Pennsylvania, Philadelphia.
- Cummins, D., and Zi, H., 1998. Measuring cost efficiency in the U.S. life insurance industry: Econometric and mathematical Programming approaches. *Journal of Productivity Analysis*, 10, 131-152.
- Cummins, D., and Weiss, M., 1998. Analyzing firm performance in the insurance industry using frontier efficiency methods. Working Paper, *Wharton Financial Institution Centre*, University of Pennsylvania, Philadelphia.

- Cummins, D., Tennyson, S., and Weiss M., 1999. Consolidation and efficiency in the US life insurance industry. *Journal of Banking & Finance* 23, 325-357.
- Cummins, D., and Misas, R., 2006. Deregulation, consolidation and efficiency: evidence from the Spanish insurance industry. *Journal of Money, Credit and Banking* 38, 323-355.
- Cummins, D., and Xie, X., 2008. Mergers and acquisitions in the US property-liability Insurance industry: productivity and efficiency effects. *Journal of Banking and Finance* 32, 30-55.
- Diacon, S., Starkey, K., O'Brien, C., 2002. Size and efficiency in European long-term insurance companies: An international comparison. *The Geneva Papers on Risk and Insurance* 27, 444-466.
- Ennsfellner, K., Lewis, D., and Anderson, R., 2004. Production Efficiency in the Austrian Insurance industry: A Bayesian Examination. *The Journal of Risk and Insurance* 71, 135-159.
- Fenn, P., Vencappa, D., Diacon, S., Klumpes and O'Brien, C., 2008. Market structure and the efficiency of European insurance companies: a stochastic frontier analysis. *Journal of Banking and Finance* 32, 86-100.
- Fukuyama, H., 1997. Investigating productive efficiency and productivity Changes of Japanese life insurance companies. *Pacific-Basin Finance Journal* 5, 481-509.
- Gardner, L., and Grace, M., 1993. X-efficiency in the US life insurance industry. *Journal of Banking and Finance* 17, 497-410.
- Greene, W., and Segal, D., 2004. Profitability and efficiency in the U.S. life insurance industry. *Journal of Productivity Analysis* 21, 229-247.
- Hardwick, P., 1997. Measuring cost inefficiency in the UK life insurance industry. *Applied Financial Economics* 7, 37- 44.
- Hao, J., and Chou, L., 2005. The Estimation of efficiency for life insurance industry: The case in Taiwan. *Journal of Asian Economics* 16, 847-860.

- Ismail, N., Alhabshi, D., and Bacha, O., 2011. Organizational Form and Efficiency: The Coexistence of Family *Takaful* and Life Insurance in Malaysia. *Journal of Global Business and Economics* 3, 122-137.
- Jeng, V., Lai, G., and McNamara, M., 2007. Efficiency and Demutualization: Evidence from the U.S. Life Insurance Industry in the 1980s and 1990s. *The Journal of Risk and Insurance* 74, 683-711.
- Jeng, V., and Lai, G.C., 2005. Ownership structure, agency costs, specialization, and efficiency: analysis of Keiretsu and independent insurers in the Japanese non-life insurance industry. *The Journal of Risk and Insurance* 72, 105-158.
- Kader, H., Adams, M., and Hardwick, P., 2010. The Cost Efficiency of *Takaful* Insurance Companies. *The Geneva Papers on Risk and Insurance—Issues and Practice* 35, 161–181.
- Karim, A., and Jhantasana, C., 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.
- Khyzer, B., Ahmed, Z., and Warriach, K., 2011. Scale Efficiency of Islamic Banks of Pakistan. *Arabian Journal of Business and Management Review* 5, 5-25.
- Malmquist, S., 1953. Index Numbers and Indifference Curves. *Trabajos de Estadística* 4, 209-42.
- Mansoor, S., and Radam, A., 2000. Productivity and efficiency performance of the Malaysian life insurance industry. *Journal Ekonomi Malaysia* 34, 93-105.
- Pakistan Financial sector Assessment, 2005. State Bank of Pakistan: Karachi.
- Rees, R., and Kessner, E., 1999. Regulation and efficiency in European insurance Markets. *Economic Policy* 14, 363-397.
- Saad, N et al, 2006. Measuring Efficiency of Insurance and *Takaful* Companies in Malaysia Using Data Envelopment Analysis (DEA). *Review of Islamic Economics* 10, 5-26.
- Sealey, C., and Lindley, J., 1977. Inputs, outputs and a theory of production and cost at depository financial institutions. *The Journal of Finance* 32, 1251-1266.



- Shah, A., Shah, A., and Habib, A., 2012. Comparing the efficiency of Islamic versus conventional banking: through data envelopment analysis (DEA) model. *African Journal of Business Management* 6, 787-798.
- Worthington, A., and Hurley, E., 2002. Cost efficiency in Australian general insurers: A non-parametric approach. *British Accounting Review* 34, 89-108.
- Weiss, M., 1999. Efficiency in the Property-Liability Insurance Industry. *Journal of Risk and Insurance* 58, 452-479.
- Yusop, Z., Radam, A., and Ismail, N., 2011. Risk management efficiency of conventional life insurers and *Takaful* operators. *Insurance Markets and Companies: Analyses and Actuarial Computations* 2, 58-68.
- Yuengert, M.A., 1993. The measurement of efficiency in life insurance: Estimates of mixed normal-gamma error model. *Journal of Banking and Finance* 17, 483-496.

**Appendix-A****Premium, Assets and Investment Income of *Takāful* Industry**

<b>Year</b>	<b>Net Premium</b>	<b>Gross Premium</b>	<b>Total Assets</b>	<b>Investment Income</b>
2006	32587061	128968834	314028583	18699897
2007	122158639	265261596	2049709638	72611699
2008	430305193	799922277	2561899601	68721395
2009	1157135909	1463608137	3015843070	189346770
2010	1580238472	2243204264	3341469369	181640658

**Efficiency score of *Takāful* firms**

<b><i>Takāful</i> Firms</b>	<b>PTE</b>	<b>SE</b>	<b>AE</b>	<b>CE</b>
<i>Takāful</i> Pak.	0.95	0.25	0.75	0.71
Pak-Qatar(Gen)	0.99	0.22	0.67	0.67
Pak-Qatar(FMY)	0.57	0.53	0.63	0.36
Pak-Kuwait	1.00	0.31	0.73	0.73
Dawood Takful	0.84	0.59	0.59	0.50
Mean	0.87	0.38	0.68	0.60

**Malmquist Results for *Takāful* Firms**

<b>FIRM</b>	<b>EFFCH</b>	<b>TECHCH</b>	<b>PECH</b>	<b>SECH</b>	<b>TFPCH</b>
<i>Takāful</i> Pak.	2.198	0.919	1.003	2.192	2.020
Pak-Qatar(Gen)	1.045	0.915	0.989	1.056	0.956
Pak-Qatar(Fmy)	0.857	0.922	0.797	1.075	0.790
Pak-Kuwait	1.171	1.029	1.000	1.171	1.205
Dawood Takful	0.674	0.931	0.719	0.937	0.628
Mean	1.189	0.943	0.902	1.286	1.120

## **Appendix-B**

### **List of Insurance and *Takāful* Companies used in this Study**

#### **List of Insurance Companies**

1. State Life Insurance Corporation Ltd.
2. Adamjee Insurance Company Ltd.
3. Askari General Insurance Company Ltd.
4. Atlas General Insurance Company Ltd.
5. Premier Insurance Company Ltd.
6. Shaheen Insurance Company Ltd.
7. E.F.U. General Insurance Company Ltd.
8. E.F.U. Life Insurance Company Ltd.
9. National Insurance Corporation Ltd.
10. New Jubilee Insurance Company Ltd.
11. International General Insurance Co. of Pak.
12. Habib Insurance Company Ltd.

#### **List of *Takāful* Companies**

1. *Takāful* Pakistan Ltd.
2. Pak-Qatar General *Takāful* Ltd.
3. Pak-Qatar Family *Takāful* Ltd.
4. Pak-Kuwait *Takāful* Ltd.
5. Dawood Family *Takāful* Ltd

