

Cite this Article: Ahmed, M. F., & Jatoi, M. M. (2026). Scale, Market Position, Profitability and Leverage as Drivers of Efficiency in a Dual Insurance System: Evidence from Conventional and Takaful Insurers in Pakistan, 2013–2022. *Journal of Regional Studies Review*, 5(2), 51–63. <https://doi.org/10.62843/jrsr/2026.v.ii.215>

RESEARCH ARTICLE

JOURNAL OF REGIONAL STUDIES REVIEW (JRSR)

Scale, Market Position, Profitability and Leverage as Drivers of Efficiency in a Dual Insurance System: Evidence from Conventional and Takaful Insurers in Pakistan, 2013–2022

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Abstract: Several emerging markets have developed conventional risk-transfer insurers and Takaful risk-sharing operators operating in parallel, yet it remains unclear whether the efficiency-enabling factors are similar in both types of entities. This study analyses 15 conventional insurers and four Takaful operators in Pakistan from 2013–2022 to examine which structural dimensions—size, market share, profitability, and leverage—drive differences in efficiency. A two-stage design is adopted, in which Data Envelopment Analysis (DEA) generates technical efficiency, super efficiency, and overall efficiency scores, which are then regressed against firm characteristics separately for each model using Tobit regressions. The mean technical efficiency of conventional insurers decreased from 0.98 in 2013 to 0.58 in 2022, while the mean technical efficiency of Takaful operators remained close to the Takaful benchmark of 0.60 and exceeded conventional insurers from 2017 onwards. The pooled mean efficiency was 0.69 for Takaful operators compared with 0.64 for conventional insurers. Market share showed both positive and negative correlations with efficiency among conventional insurers. For Takaful operators, size was positively correlated with technical and overall efficiency but negatively correlated with profitability, while market share influenced super efficiency. Five out of six models showed a negative relationship between leverage and efficiency. Overall, the findings suggest that in a dual system, contract design is not the most important determinant of efficiency; rather, efficiency depends more on how the scale of the system, capital, and competitive position are managed.

Keywords: Takaful, Conventional Insurance, Data Envelopment Analysis, Tobit Regression, Firm Size, Leverage, Pakistan

Introduction

Efficiency in the use of capital to generate premiums and investment income is important to the industry and to the economy because insurance brings long-term savings, pools risk and helps promote financial inclusion. This is now being done in a growing number of emerging markets by two institutional models in parallel. Traditional insurers shift risk to another company where the shareholders are and charge for the risk. Takaful operators set up a pool of participants to share the risk, under Shariah principles. Taking Pakistan as an example: Takaful was formally launched in 2005 under the guidance of the Securities and Exchange Commission of Pakistan (SECP) and has expanded along with a significantly larger conventional insurance industry, in a small insurance system by international standards (Khan & Kouser, 2021).

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There is extensive literature that has compared the efficiency of Takaful and conventional insurers (Almulhim, 2019; Ashraf, 2019; Benyoussef & Hemrit, 2019). Less attention has been given to a second question: whether the same firm-level factors that affect the efficiency of the firm under the two models have positive or negative effects. The question is policy relevant. Where efficiency is determined in the same way in both models, due to size, market position, profitability and leverage, a single framework for supervision and competition is defensible. If they don't, the rules of the game may be biased in favour of one model, by default. Pakistan has limited evidence on this second question, and it is based on only a few studies (Ashraf, 2019; Khan & Kouser, 2021).

This paper aims to tackle the question based on 10 years of data (2013–2022) for 15 conventional insurers and four takaful operators. It has three contributions. First of all, it has three complementary measures of efficiency – technical, super and overall efficiency – thereby capturing both the typical and the exceptional performer. Secondly, it specifies the determinants of each measure independently for each insurance model, rather than common coefficients. Third and most importantly, the time frame covered by the study coincides with the volatility of currencies and the COVID-19 pandemic, providing the ability to compare the efficiency difference across a longer time horizon than in one stable phase.

The analysis focuses on two questions. Has there been an improvement in the technical efficiency, super efficiency and overall efficiency of conventional insurers and Takaful operators from 2013 to 2022? Do the two groups have the same relationships between size, market share, profitability, efficiency and leverage? The findings reveal a steep downward trend and then a level-out of traditional efficiency, a slightly lower but more consistent trend for Takaful operators, and quite different drivers. There is evidence that suggests bigger size is associated with higher efficiency for Takaful operators and that efficiency is negatively associated with profitability for conventional insurers, while market share is positively associated with efficiency for conventional insurers. However, the efficiency of nearly all the models is negatively related to leverage. The review of the literature and the formulation of hypotheses are in Section 2, the description of data and method in Section 3, the report of the results in Section 4, the discussion of the results in Section 5, and the conclusion in Section 6.

Literature Review and Hypotheses

Measuring Insurer Efficiency

One of the most popular frontier analysis techniques employed by insurers is Data Envelopment Analysis (DEA), which does not require an explicit production function and encompasses multiple inputs and outputs. Some recent applications include the Takaful and cooperative insurers in Saudi Arabia (Benyoussef & Hemrit, 2019), property insurers in China (Li et al., 2021), and non-life insurers in Croatia (Pavić Kramarić et al., 2022). Using DEA efficiency as a summary performance measure is also supported by Niu et al. (2022), who examine property and casualty insurance companies and find that the efficiency measure is consistent with the conventional regulatory financial ratios and can be applied in situations when the conventional financial ratios provide conflicting signals.

Many of these studies apply a two-stage approach, where the DEA scores are regressed on firm characteristics (Lee et al., 2019; Li et al., 2021; Pavić Kramarić et al., 2022). In the insurance literature, there are a number of different types of truncated and panel regressions, and the statistical analysis of the second stage is still under debate. For instance, Banker et al. (2019) compare the ordinary least squares regression of the second stage with the bootstrap approaches in a stochastic frontier context. Such methodological diversity should be taken into account when interpreting the findings of two-stage studies.

Takaful and Conventional Insurers

Comparative evidence is context-dependent and uncertain. Benyoussef and Hemrit (2019) discover that, on average, Takaful companies have greater efficiency than conventional companies, but Almulhim (2019), who uses a two-stage DEA for 26 conventional and seven Takaful companies between 2014 and 2017, observes less average efficiency for both types of companies. Lee et al. (2019) study family Takaful operators for the

Malaysian context and determine that the general Takaful operators are less cost efficient than family Takaful operators, with the implication that family Takaful operators are more cost efficient, and that the reason for this cost efficiency is found in the corporate governance of the Takaful operators and not the factors specific to the firm. The direction of inquiry in two-stage efficiency and productivity analysis of conventional and Takaful insurers in Egypt is essentially the same (Abdellatif & Xie, 2024; Abdellatif et al., 2024).

For Pakistan, Ashraf (2019) explores 14 insurance companies and four Takaful companies from 2008 to 2016. There was no significant difference in technical efficiency and pure technical efficiency among the different types of firms, while conventional insurers had higher scale efficiency and there was a negative relationship between size and conventional technical efficiency but a positive relationship between size and Takaful technical efficiency. For the 51 firms investigated in the study, Khan and Kouser (2021) link DEA efficiency with the characteristics of the firm, and emphasize the need for premium growth in Takaful insurance. In the outside world, Ikhwan and Rusydiana (2022) discover that COVID-19 almost had no impact on efficiency on average in the 70 Indonesian insurance companies for the 2016-2020 period, and hurt conventional (non-Sharia-compliant) insurance companies, but not Sharia-compliant ones. Takaful research is still growing, but not uniform (Alam et al., 2023), and the industry is still suffering from specific structural problems (Abidi et al., 2020) and the need for innovation (Nugraheni & Muhammad, 2019).

Determinants of Efficiency and Hypotheses

Size can increase efficiency by virtue of scale economies and/or diversification, or it can reduce efficiency through coordination costs and bureaucracy. There is conflicting evidence. While size is an essential determinant of Chinese property insurers' technical efficiency (Li et al., 2021) and the financial performance of Saudi Takaful and cooperative insurance (Hemrit, 2020), it is not a significant determinant for Croatian non-life insurers (Pavić Kramarić et al., 2022) and opposite signs are obtained for both models by Ashraf (2019) for Pakistani non-life insurance companies. If the number of participants in a Takaful increases, the risk will be spread out better, while the number of conventional insurers increases, administration would increase. This leads to the third hypothesis below.

Market share indicates the competitive performance, whether in terms of negotiating with reinsurers and distributors or brand recognition. Ashraf (2019) reports that conventional insurers' efficiency in Pakistan is positively associated with it. However, while the growth of Takaful operators is based on the trust of their members and Shariah credibility, the conversion of share to efficiency is less certain. The ideas of profitability and efficiency are also different; according to Alsofiani (2022), Ben Dhiab (2021) et al., reviews of insurers' performance approach profitability and its determinants as a separate research stream. The high return on equity could be due to outcomes of shareholder funding, not necessarily productivity; in Takaful, where there is a surplus sharing mechanism, investments are screened for Shariah compliance. Ashraf (2019) noted that ROE has negative coefficients with Takaful technical and scale efficiency.

Despite the inconsistent results, in most of the insurer performance reviews, leverage is a standard firm-level variable (Alsofiani, 2022), and in the Croatian non-life efficiency review, it is not significant (Pavić Kramarić et al., 2022). For the operator of Takaful, however, limitations on interest-based financing can limit the available options for capital structure, which can mean that the use of borrowed funds can indicate stress rather than flexibility. Based on these arguments, six hypotheses are tested.

- H1.** Takaful operators show higher technical efficiency than conventional insurers, reflecting their risk-sharing model.
- H2.** Market share raises the efficiency of conventional insurers more than that of Takaful operators.
- H3.** Larger size raises the efficiency of Takaful operators but lowers that of conventional insurers.
- H4.** Higher profitability (return on equity) lowers the efficiency of Takaful operators but has no effect on conventional insurers.
- H5.** Leverage reduces efficiency more strongly for Takaful operators than for conventional insurers.
- H6.** Takaful operators reach super efficiency through market dominance rather than through large size.

Methodology

Research Design

The study adopts a longitudinal panel data design of a quantitative and comparative study, and the data are taken from 2013 to 2022. All insurers are assumed to be decision-making entities that transform resources into underwriting and investment products, which is a typical approach in insurance efficiency studies (Benyoussef & Hemrit, 2019; Pavić Kramarić et al., 2022). The functional form is not imposed on a multi-product technology, and a frontier approach is appropriate as it compares each insurer with best observed practice. Efficiency is estimated with DEA in a first stage using DEA-Solver, and Stata is used for data preparation, diagnostics and the second-stage regressions. The results are reported separately for conventional insurers and takaful operators, and the second-stage models are estimated separately to ensure that the differences in Shariah compliance are not embodied in a single pooled estimate, taking into account the differences in fund structure and governance.

Sample and Data

There are about 50 conventional insurers, life and non-life insurers, and five full-fledged Takaful operators. All conventional insurers and Takaful operators with complete audited statements for the 10 years analysed were included in the analysed panel, which amounts to 15 conventional insurers and four Takaful operators. The second stage includes size as an explanatory variable since there is a significant scale heterogeneity between the groups even after the design of the sampling; for example, State Life is much larger than any Takaful operator.

Data are sourced from annual reports and financial statements audited by the auditors and reports submitted to the SECP. Observations were supplemented by interpolation from neighbouring years, or when there was no statement in the firm-year, the firm was deleted, and insurers with incomplete statements for most years were removed to maintain the panel structure. Reporting format for Takaful insurers is different from that of conventional insurers, so variables were harmonised to similar definitions and monetary values were adjusted for inflation and currency changes to ensure that years were comparable. Outliers were detected through descriptive screening and influence checks prior to estimation since the DEA frontiers are sensitive to outliers. The ten-year period covered the time of exchange rate volatility and the COVID-19 pandemic, impacting many insurance markets around the world (Babuna et al., 2020; Wang et al., 2020).

Variables

In Table 1, the variables are categorized. Fixed assets and the number of employees are the DEA inputs. Net premium revenue (contributions for Takaful operators), investment income and other income are the outputs. Four firm characteristics are used as second-stage regressors: size, market share (MS), return on equity (ROE) and leverage (LEV).

Table 1

Variables Used in the Study

Variable	Symbol	Role	Description
Fixed assets	FA	DEA input	Fixed assets reported in audited financial statements
Number of employees	NE	DEA input	Headcount reported by the insurer
Net premium revenue	NPR	DEA output	Net premium income (contributions for Takaful operators)
Investment income	II	DEA output	Income earned on investments
Other income	OI	DEA output	Other operating income
Firm size	Size	Regressor	Scale of the insurer
Market share	MS	Regressor	Insurer's share of the market
Return on equity	ROE	Regressor	Profit relative to shareholders' equity
Leverage	LEV	Regressor	Debt relative to equity

Note: DEA = Data Envelopment Analysis. Efficiency scores (TE, SE, OE) are the dependent variables in the second stage.

First stage: Data Envelopment Analysis

DEA performs a linear programme for each insurer-year to identify the input-output mix that is closest to the best practice frontier. There are 3 scores. The most commonly used relative measure is technical efficiency (TE), which is limited by the value of one. Super efficiency (SE) removes the evaluated unit from its own reference set, allowing frontier units to attain efficiencies greater than 1.0 and to be compared to each other. The summary score reported with TE and SE is Overall Efficiency (OE). In DEA-Solver models, models were solved with constant- and variable-returns-to-scale assumptions. There are two caveats. DEA is based on the assumption that the production environment in which the units operate is broadly similar, which is not necessarily a valid assumption when Shariah constraints limit investment opportunities for Takaful operators, and it fails to distinguish between noise and inefficiency, meaning macroeconomic shocks can be interpreted as inefficiency.

Second Stage: Tobit Regression

Efficiencies are bounded ($0 \leq TE, OE \leq 1$ and TE, OE are unbounded above for SE), and this suggests a censored-regression specification, although second-stage ordinary least squares may be justified under certain conditions (Banker et al., 2019). The Tobit model for insurer i in year t is:

$$\text{Efficiency}(i,t) = \beta_0 + \beta_1 \text{Size}(i,t) + \beta_2 \text{MS}(i,t) + \beta_3 \text{ROE}(i,t) + \beta_4 \text{LEV}(i,t) + \varepsilon(i,t)$$

where Efficiency is TE, SE or OE. The six models correspond to the two groups of efficiency measures, one model for each efficiency measure. Pairwise correlations and variance inflation factors were inspected prior to estimation, and Wald tests were used for the joint significance of the regressors. The interpretation of the coefficients is conditional rather than causal as it is based on distributional assumptions in the Tobit model.

Results

Efficiency Trends

The annual means and cross-firm standard deviations of TE, SE and OE are reported for the 15 conventional insurers and four Takaful operators in Tables 2 to 4. As the group of Takaful consists of only four members, the means and dispersion are descriptive.

Table 2

Annual Technical Efficiency (TE), 2013–2022

Year	Conventional mean	Conventional SD	Takaful mean	Takaful SD	Difference (Takaful – conventional)
2013	0.98	0.03	0.61	0.30	–0.37
2014	0.96	0.06	0.84	0.31	–0.12
2015	0.88	0.11	0.69	0.36	–0.19
2016	0.68	0.22	0.65	0.39	–0.03
2017	0.54	0.23	0.60	0.44	+0.06
2018	0.55	0.23	0.60	0.45	+0.05
2019	0.55	0.26	0.60	0.46	+0.04
2020	0.56	0.25	0.59	0.47	+0.03
2021	0.57	0.24	0.60	0.45	+0.03
2022	0.58	0.23	0.61	0.44	+0.03

Note: Means and standard deviations (SD) are computed across 15 conventional insurers and four Takaful operators in each year. Values are computed from the firm-level efficiency scores.

Technical efficiency of conventional insurers was close to the frontier at the start of the period (0.98 in 2013 and 0.88 in 2015), fell to 0.68 in 2016 and 0.54 in 2017, and recovered only to 0.58 by 2022 (Table 2). The cross-firm standard deviation increased from 0.03 to a range of 0.22 to 0.26, creating a spread of leaders to laggards with the decline. The situation is different with Takaful technical efficiency. It reached its

highest point of 0.84 in 2014 and then remained in the range of 0.59-0.69 throughout the decade. The Takaful mean was thus lower than the conventional mean until 2016 and higher by 0.03 to 0.06 points in the remaining years since 2017. Means mask substantial differences. The TE for the three life insurers (State Life, Jubilee Life and EFU Life) was an average of 0.86, compared to 0.64 for the other twelve traditional insurers. State Life (0.99) and IGI (0.91) were close to the frontier all year round, while Shaheen (0.49), Alfalah (0.51) and Premier (0.52) averaged around one-half. The Takaful group is more polarized. Pak-Qatar Family and Dawood Islamic performed well with scores of 1.00 and 0.94 respectively in each of the years, while Pak-Qatar General (and Islamic Pak) consistently had poor scores of 0.26 and 0.35 respectively. Forty per cent of Takaful firm-years recorded a score of 0.99 or higher, while 45 per cent earned a score of less than 0.50 – compared with 25 and 32 per cent for conventional insurers, respectively.

Table 3

Annual Super Efficiency (SE), 2013–2022

Year	Conventional mean	Conventional SD	Takaful mean	Takaful SD	Difference (Takaful – conventional)
2013	1.00	0.02	1.64	0.82	+0.64
2014	1.46	0.62	1.43	0.51	–0.03
2015	1.37	0.70	1.43	0.54	+0.06
2016	1.23	0.58	1.60	0.77	+0.37
2017	1.14	0.71	1.26	0.33	+0.12
2018	1.17	0.69	1.87	1.18	+0.70
2019	1.05	0.51	1.32	0.44	+0.27
2020	1.16	0.55	1.31	0.39	+0.15
2021	1.07	0.59	1.35	0.44	+0.28
2022	1.10	0.58	1.53	0.73	+0.43

Note: SE scores above one indicate frontier units that remain efficient when excluded from their own reference set. SE and TE are not mechanically comparable at the firm level.

The table shows a different ordering for super-efficiency scores (Table 3). In 2013, the conventional mean was 1.00 and ranged from 1.05 to 1.46 over the following ten years, while the Takaful mean was higher than the conventional mean in nine of the 10 years, ranging from 1.26 to 1.87. While half of the Takaful firm-years performed above one, 28 per cent of conventional insurers did the same, but it was due to the performance of two operators, Dawood Islamic and Pak-Qatar General, with both operators scoring at least 1.4 in each year. The results for SE scores should be interpreted with caution. Not always at the firm level is TE consistent with OE, for Pak-Qatar General have one of the lowest TE amongst the Takaful operators with one of the highest SE score. SE findings are thus considered as supplementary to the TE and OE findings.

Table 4

Annual Overall Efficiency (OE), 2013–2022

Year	Conventional mean	Conventional SD	Takaful mean	Takaful SD	Difference (Takaful – conventional)
2013	0.99	0.04	0.66	0.25	–0.32
2014	0.97	0.06	0.88	0.23	–0.09
2015	0.93	0.08	0.73	0.31	–0.20
2016	0.80	0.21	0.69	0.36	–0.11
2017	0.69	0.22	0.65	0.41	–0.04
2018	0.70	0.22	0.66	0.41	–0.04
2019	0.69	0.24	0.67	0.40	–0.02
2020	0.68	0.23	0.63	0.43	–0.05
2021	0.74	0.21	0.65	0.42	–0.08
2022	0.75	0.21	0.66	0.40	–0.08

Note: Computed across 15 conventional insurers and four Takaful operators in each year.

Table 4 indicates that the overall efficiency of the conventional insurers has been higher compared to that of the takaful operators for all years. The conventional mean dropped to 0.99 from 0.75, and the Takaful mean has been oscillating around 0.66 since reaching 0.88 in 2014. The gap narrowed from 0.32 in 2013 to between 0.02 and 0.05 in 2017–2020 and widened again to 0.08 in 2021–2022. There is no pandemic year offset for either group's mean TE. The decrease in 2020 was slight for both groups (conventional: 0.69 to 0.68; and Takaful: 0.67 to 0.63) and is consistent with the small aggregate effect reported in Indonesia by Ikhwan and Rusydiana (2022); albeit with four Takaful firms, it is not sufficient to test for the small aggregate effect.

Descriptive Statistics

The 150 conventional firm-year scores and 40 Takaful firm-year scores have been summarised in Table 5. The mean TE (0.69) and mean OE (0.79) for conventional insurers are slightly higher than those for the others (0.64 and 0.69 respectively), while there is less dispersion (TE standard deviation 0.26 against 0.37). The Takaful minimum is lower in comparison (0.16 vs. 0.19 for TE), while both groups have 1.00 on TE and OE. The mean SE is higher with the operators of Takaful (1.47 compared to 1.18). So, both groups achieve similar maximum efficiency, but the efficiency of the individual actors in the Takaful group is negatively skewed by worse-than-average actors, thus lowering the overall average.

Table 5

Descriptive statistics of efficiency scores, 2013–2022 (firm-year observations)

Measure	Group	N	Mean	SD	Min	Max
TE	Conventional	150	0.69	0.26	0.19	1.00
TE	Takaful	40	0.64	0.37	0.16	1.00
SE	Conventional	150	1.18	0.59	0.34	3.19
SE	Takaful	40	1.47	0.61	0.95	3.50
OE	Conventional	150	0.79	0.22	0.19	1.00
OE	Takaful	40	0.69	0.33	0.17	1.00

Note: Statistics are computed from the firm-year scores underlying Tables 2 to 4 (15 conventional insurers and four Takaful operators, ten years each).

Diagnostics

The variance inflation factors and pairwise correlation among the explanatory variables are presented in Table 6. There are no negative and nonsignificant correlations. The strongest links are between size and market share (0.78) and between market share and leverage (0.52). Variance inflation factors (VIF) were used to identify multicollinearity, and the highest value was 3.49 (size) with a mean of 2.22 which is below the threshold of 5, therefore, multicollinearity was not severe. The size–market share correlation does make the separate coefficients of these two variables problematic, however. The Wald test indicates that all six models (Tables 7 and 8) are not insignificant.

Table 6

Correlations and Multicollinearity Diagnostics for the Explanatory Variables

	Size	MS	ROE	LEV
Panel A: Pairwise correlations				
Size	1	0.7756***	0.3756***	0.4341***
MS		1	0.2310***	0.5156***
ROE			1	0.1342**
LEV				1
Panel B: Variance inflation factor				
VIF	3.49	2.78	1.23	1.39

*Note: *** $p < 0.01$, ** $p < 0.05$. MS = market share; ROE = return on equity; LEV = leverage. Mean VIF = 2.22.*

Determinants of Efficiency

For conventional insurers (Table 7), size has a negative and significant coefficient in the TE model (-0.194 , $p < 0.001$) and the OE model (-0.104 , $p < 0.001$) and is insignificant for SE ($p = 0.208$). Market share is positive and significant in all three models: 2.538 for TE ($p = 0.013$), 1.619 for SE ($p < 0.001$) and 2.415 for OE ($p = 0.001$). For TE and OE, ROE is null and for SE it is slightly negative (-0.074 , $p = 0.042$). Leverage is negative for TE (-0.595 , $p = 0.030$) and SE (-0.343 , $p = 0.013$) but not significant for OE ($p = 0.285$).

Table 7

Tobit Regression Results for Conventional Insurers

Variable	Technical efficiency	Super efficiency	Overall efficiency
Size	-0.1937^{***} ($p < 0.001$)	-0.0261 ($p = 0.208$)	-0.1042^{***} ($p < 0.001$)
MS	2.5380^{**} ($p = 0.013$)	1.6185^{***} ($p < 0.001$)	2.4150^{***} ($p = 0.001$)
ROE	-0.0741 ($p = 0.172$)	-0.0738^{**} ($p = 0.042$)	-0.0365 ($p = 0.317$)
LEV	-0.5950^{**} ($p = 0.030$)	-0.3425^{**} ($p = 0.013$)	-0.1642 ($p = 0.285$)
Wald χ^2 (p-value)	53.74 (< 0.001)	7.87 (0.023)	25.19 (< 0.001)
R ² (adjusted R ²), as reported	0.548 (0.478)	0.572 (0.505)	0.601 (0.538)
Observations	125	125	125

Note: Coefficients with p-values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors are not shown.

The findings of the Takafuls are very significant (Table 8). Size is positive and significant for TE (0.353) and OE (0.326), both $p < 0.001$, but negative for SE (-0.129 , $p < 0.001$). Only for SE, a large coefficient (7.152 , $p = 0.008$) indicates the significance of the market share. ROE is strongly negative for TE (-1.871) and OE (-1.605), both $p < 0.001$, and insignificant for SE. Leverage is negative and significant in all three models: -0.451 for TE ($p = 0.015$), -0.248 for SE ($p < 0.001$) and -0.480 for OE ($p = 0.002$). The R² values reported in the Takaful models range between 0.682 and 0.756 , while the conventional models have R² values between 0.548 and 0.601 , but these are based on only 35 observations cross-sectional data across four firms, and should not be interpreted as evidence of better explanatory power.

Table 8

Tobit Regression Results for Takaful Operators

Variable	Technical efficiency	Super efficiency	Overall efficiency
Size	0.3528^{***} ($p < 0.001$)	-0.1285^{***} ($p < 0.001$)	0.3255^{***} ($p < 0.001$)
MS	0.4905 ($p = 0.944$)	7.1520^{***} ($p = 0.008$)	2.8050 ($p = 0.725$)
ROE	-1.8705^{***} ($p < 0.001$)	0.0528 ($p = 0.512$)	-1.6050^{***} ($p < 0.001$)
LEV	-0.4510^{**} ($p = 0.015$)	-0.2476^{***} ($p < 0.001$)	-0.4800^{***} ($p = 0.002$)
Wald χ^2 (p-value)	77.24 (< 0.001)	19.31 (0.008)	34.85 (< 0.001)
R ² (adjusted R ²), as reported	0.701 (0.677)	0.756 (0.746)	0.682 (0.653)
Observations	35	35	35

Note: Coefficients with p-values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Estimates rest on four Takaful operators and should be treated as indicative.

Hypothesis Assessment

Table 9 makes a comparison between the evidence and the six hypotheses. There is no doubt about the support of H6. Main measures (TE and OE) are supported by H3 and H4 with exceptions in SE models. The TE/ OE is supported for H2, whereas SE is not supported. H5 is only partially supported, H1 is not supported when using pooled means.

Table 9

Assessment of Hypotheses

Hypothesis	Evidence	Assessment
H1: Takaful TE exceeds conventional TE	Pooled mean TE is 0.64 (Takaful) against 0.69 (conventional), but the Takaful annual mean is higher in every year from 2017 (Table 2). Conventional OE is higher in every year (Table 4).	Partly supported
H2: Market share helps conventional insurers more	MS is positive and significant in all three conventional models but only for SE among Takaful operators, where its coefficient is larger (7.152 against 1.619).	Supported for TE and OE; not for SE
H3: Size helps Takaful, hurts conventional	Size is negative for conventional TE and OE and positive for Takaful TE and OE. For SE, size is negative for Takaful and insignificant for conventional insurers.	Supported for TE and OE
H4: ROE hurts Takaful, no effect on conventional	ROE is negative and significant for Takaful TE and OE and insignificant for SE. For conventional insurers it is insignificant for TE and OE but negative for SE ($p = 0.042$).	Largely supported
H5: Leverage hurts Takaful more	Leverage is negative in five of six models. Conventional coefficients are larger for TE and SE; the Takaful coefficient is larger only for OE (-0.480 against an insignificant -0.164).	Partly supported (OE only)
H6: Takaful super efficiency via market share, not size	For Takaful SE, MS is positive (7.152, $p = 0.008$) and size is negative (-0.129 , $p < 0.001$).	Supported

Note: Coefficient magnitudes are compared across separately estimated models with different dependent-variable distributions and are indicative only.

Discussion

The findings suggest two models that may perform more efficiently than the other one, but do not suggest that the first model is superior to the other one. There is some evidence for H1 on levels. In the case of conventional insurers, TE and OE were higher in the pooled data but, from 2017, the mean TE was higher for Takaful operators, due to the conventional insurers' efficiency dropping significantly with a mean of 0.57. This is similar to Ashraf (2019) and Benyoussef and Hemrit (2019), in which Takaful operators are performing better on technical efficiency, and to Almulhim (2019) in his report of Saudi Arabia where the average efficiency of both types decreases. However, this Takaful average is actually a compound of two near-frontier operators and two consistently poor ones, and therefore should be interpreted as a dispersion around operators, rather than a sector-wide strength. The difference in size is the most obvious one. While larger conventional insurers are less efficient on TE and OE, larger Takaful operators are more efficient. The signs are similar to Ashraf (2019) in the case of technical efficiency. They are different from the results of Pavić Kramarić et al. (2022) which indicate that size is not a significant factor in the case of non-life insurers in Croatia. There are two possible explanations for traditional insurance companies. This may be counterbalanced by coordination and administrative costs that are higher for larger firms.

On the other hand, since a firm's size is associated with both the number of its employees and the amount of its fixed assets, which are DEA inputs, part of the negative relationship might be mechanical. Takaful operators may see a positive size effect from larger participation numbers due to increased risk sharing, but the four operators selected in this study may drive this. The performance of the typical operator seems to be enhanced by scale, which is reflected by the negative impact of the size on the efficiency of the Takaful super. Market share is more significant within the conventional group, with a positive correlation with all three efficiency measures. This supports Ashraf (2019), and is in line with the benefits of having a better competitive position such as bargaining power, distribution and brand. For Takaful operators the association only shows up for SE, indicating that market leadership can make a difference for exceptional operators but not for the typical operator.

The opposite signs of the two variables (size and market share) suggest that relative, not absolute, size is more important, given market share. The profitability results take the productive efficiency out of the accounting results. Similarly, ROE is negatively correlated with Takaful TE and OE, and is not significantly correlated with conventional efficiency, which corroborates the results of Ashraf (2019) with negative Takaful coefficients. A possible explanation is that equity returns in Takaful rely on the results of shareholders' lending, and on sharing the surplus, a feature that is not directly related to the operating productivity measured by DEA. This is an interpretation and has not been tested, and the data does not support verification. Five of the six models have negative relationships between leverage and efficiency. The conventional leverage coefficients in TE and SE are bigger in magnitude compared with H5 while the Takaful coefficient is bigger in OE (with insignificant conventional effect).

Magnitudes are only indicative since the distribution of the dependent variables are different for the models. The results are added to the literature in three ways when taken together. First, they demonstrate that a judgement on the efficiency of one model over another is dependent on the measure and the period. A single headline comparison is misleading because operators of conventional insurers top in terms of mean efficiency over the years while operators of takafuls top in terms of mean technical efficiency in the later years, and mean super efficiency (with the caveat above). Second, the sign differences in the second stage estimated separately by the model, such as size and profit, that would be averaged by using a pooled regression with a takaful indicator. Thirdly, although the debt-financing options vary between the two models, in almost all of them, the higher the leverage the lower the efficiency. This implies that the discipline of capital is a common concern while the role of other determinants differs between the two models. These findings are for the sample and time period examined and could be validated in larger panels. Last, the largest drop in traditional performance (2016-2017) comes before the pandemic, with no apparent split in 2020-2021 mean scores. The study doesn't account for the previous drop. Other possibilities are regulatory change, macroeconomic volatility and changes in the composition of the efficient frontier, but these are not examined here. Though, COVID-19 has been noted to have impacted insurance markets (Babuna et al., 2020; Wang et al., 2020) and a lack of visible break may be due to offsetting influences rather than no influence.

Conclusion

The efficiency of 15 conventional insurers and four Takaful operators was compared in Pakistan during 2013-2022 and analyzed whether the definition of efficiency is the same for both models and is explained by size, market share, profitability and leverage. The efficiency of conventional business fell significantly after 2015 and levelled off, whereas Takaful efficiency was not significantly lower than conventional efficiency, and were even superior to conventional efficiency from 2017 onwards, with the pooled average given more weight. The determinants differ. In the traditional insurance industry, relationship between market share and efficiency is positive and negative respectively. Market share is positively linked to efficiency for conventional insurers while efficiency is negatively linked to market share. There is a positive relationship between size and the technical efficiency and overall efficiency of Takaful operators, while market share is only relevant to super efficiency. In all models the efficiency is negatively related to leverage. Both models were not found

to be structurally better. Variations seem to be related to different ways of dealing with scale and to the acquisition of capital and competitive position within the institutional boundaries of firms.

Implications

Findings suggest supervisor treatment be proportionate and not uniform. Both groups can benefit from the monitoring of capital adequacy that discourages excessive borrowing, and Shariah-compliant capital instruments could boost the growth of Takaful operators without them taking on debt. Competition policy should take into account the positive relationship between market position and efficiency in traditional insurance, and scalability, including potential for consolidation and shared infrastructure as evidenced by the Takaful, should be considered. In the case of traditional insurance companies, growth of size should be directed more towards competitiveness and discipline of operation rather than just size. Growth will be treated by the manager of a Takaful as being potentially efficiency enhancing, but high equity returns should not be interpreted as an indication of efficiency. When assessing the efficiency of insurers, investors and policyholders should not look solely at profitability: the two parameters can contradict each other, especially for Takaful operators.

Limitations and Future Research

These conclusions are subject to a number of qualifications. The four Takaful operators covered in the group are sensitive in terms of means, dispersion and regression results. DEA does not distinguish between noise and inefficiency and makes underlying production assumptions. Super-efficiency scores are not necessarily congruent with technical-efficiency scores at the firm level; therefore, the results of the super-efficiency should be viewed with caution. The second stage coefficients are correlated with size and with the coefficients of the first-stage variables, which might affect the results. The Tobit specification is based on distributional assumptions and the selection of the second-stage estimator is a matter of debate (Banker et al., 2019). Lastly, results are correlational and not causal estimates within one emerging market. Alternative second-stage estimators could be used, productivity-change measures were not included, and the sample could be expanded to other markets that have a dual system of measurements, and the characteristics of the governance and Shariah-boards could be analyzed along with the financial variables in this study.

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