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PROFIT BENCHMARKING OF INDIAN GENERAL INSURANCE COMPANIES[2]

While there are several studies regarding the efficiency of Indian general insurance companies, the field of profit efficiency remains unexplored till date. In the present paper, a quantity-based ratio form model has been adopted for the estimation of profit efficiency. The profit efficiency scores so derived are then decomposed into revenue and cost efficiency components. Bootstrap-based and bias-corrected lower and upper bounds of profit, revenue and cost efficiency scores have also been estimated. The data set includes information pertaining to fifteen general insurance companies for the period 2011-12 to 2016-17. The outcome shows that the public sector insurers have done well in terms of revenue efficiency but needs to be concerned about cost-efficiency. Further, we have explored the linkage of profit, revenue and cost efficiency with solvency ratio and return on equity using Tobit regression. The results show that profit, revenue and cost efficiency have a strong linkage with both solvency ratio and return on equity.
Keywords: General insurance; Profit Efficiency; Revenue Efficiency; Cost Efficiency; Return on Equity; Solvency Ratio; Censored Regression
JEL: C61; D21; G22

Introduction

General insurance encompasses all other forms of insurance except life insurance. In the Indian context, the size of the general insurance relative to the total insurance market is quite small (approximately 23%). However, the origin of the industry is quite old. The modern form of the insurance business was first established in pre-independent India when Triton Insurance Co. Ltd was formed in 1850. This was followed by the establishment of the Bombay Mutual Life Insurance Society in 1870 and the Oriental Assurance Company in 1880. Subsequently, many general insurance companies were formed in India. Thus, there were more than a hundred general insurance companies in India at the time of its nationalisation in 1973, when the industry was nationalised. The process of nationalisation involved the establishment of General Insurance Corporation as the state-sponsored

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reinsurance company and the formation of four state-sponsored general insurance companies (by amalgamating 107 private general insurers).

In the 1990s, India embraced an open market economy with a greater role for the private sector. Financial sector reform was an integral part of the reform process, which was initiated with banking sector reform involving deregulation of private sector entry and introduction of prudential regulations of banking operations. At the same time, the Govt. of India set up a high powered committee on the Indian insurance sector (headed by Shri R. N. Malhotra) for examining the existing scenario and recommend appropriate measures for boosting competitive efficiency and strengthening the regulatory framework.

In the post-liberalisation phase, the sector underwent important regulatory and structural changes during the last two decades leading to a rapid growth of the industry. Table 1 provides an overview of the industry growth during the period 2011-12 to 2016-17.

Table 1

The General Insurance Industry in India

Particulars	2012	2013	2014	2015	2016	2017
Number of general insurance companies (including reinsurers)	28	28	29	29	30	31
Insurance Penetration	0.78	0.8	0.7	0.7	0.70	0.77
Insurance Density	10.5	11	11	11	11.5	13.2
Gross Direct Premium (Rs Crores)	54578	65023	79934	87151	99333	130971

Source: IRDA: Handbook of Insurance Statistics, various years.

The changing role of the general insurance sector in the Indian economy has attracted the attention of researchers and during the last few years, several research studies attempted to estimate the efficiency and productivity performance of the industry by adopting non-parametric methods. However, there is no study of the profit efficiency performance of the general insurance companies in India as yet. The present study seeks to fill this gap as it tries to measure the profit efficiency performance of 15 major general insurance companies in India for the period 2011-2012 to 2016-2017. The present study has a taken a two-stage approach. Thus in the first stage, the profit efficiency of the in-sample general insurance companies has been computed using the Farrell framework as well as the Directional Distance Function approach. In the second stage, the impact of several contextual variables (including solvency, return on equity and return of asset) on the efficiency scores is assessed using censored regression.

The paper has five sections and proceeds as follows. Section 1 provides a brief survey of the cross-country efficiency literature related to the non-life insurance industry. Section 2 reviews the research methodology and describes the two-stage approach adopted in the present study. Section 3 describes the analysis. Section 4 discusses the results. Section 5 provides the conclusion and policy implications.

1. Survey of Literature and Motivation for the Study

Among the literature devoted to the analysis of efficiency performance of financial services industries, there are relatively few efficiency studies on the non-life insurance sector. The extant literature made efficiency and productivity evaluation of general insurance companies under the assumptions of both global and local returns to scale. While the majority of the studies considered one stage production model, a few studies considered a two-stage model. Both parametric and non-parametric approaches have been used for estimating efficiency.

Toivanen (1997) examined the economies of scale and scope for non-life insurance companies of the Finland industry for the period 1989-1991. The study suggested that the creation of a branch network is important for acquiring market power or acquiring informational advantages. Fukuyama and Weber (2001) evaluated the efficiency and productivity growth of Japanese non-life insurance companies for the period 1983-1994. The study confirmed the presence of productivity improvement during 1983-1990, which was mainly driven by technological improvement. Choi and Weiss (2005) examined the performance of the U.S. property-liability industry using a stochastic frontier approach. Yang (2006) made use of a two-stage DEA (data envelopment analysis) model for estimating the efficiency of the Canadian life and health (L&H) insurance industry. Kao and Hwang (2006) applied a two-stage DEA model to evaluate the performance of 24 non-life insurance companies of Taiwan using data for the years 2001 and 2002. Barros, Nektarios and Assaf (2010) applied a two-stage robust estimation framework for estimating the efficiency performance of 71 Greek life and non-life insurance companies. Mahlberg and Url (2010) examined the impact of the single market project of the European Commission on the efficiency and productivity change of the German insurance companies for the period 1991-2006. Cummins and Xie (2013) examined efficiency, productivity and scale economies in the U.S. property-liability insurance industry. Jarraya and Bouri(2014) investigated profit efficiency and optimal production targets for the European non-life insurance industry for the period 2002-2008. Alhassan and Biekpe (2015) estimated efficiency, productivity and returns to scale for the non-life insurance market in South Africa for the time span 2007-2012. Ferro and Leon (2017) estimated the technical efficiency of Argentine non-life insurance companies for the period 2009-2014 using a stochastic frontier approach. The results indicated a low level of mean technical efficiency for the observed insurers, a stagnated level of efficiency during the later phase of the observed time period and a technical regress. Ilyas and Rajasekharan (2019a, 2019b) estimated the efficiency, total factor productivity and returns to scale economies of the Indian non-life insurance industry over the period 2005-2016. The first study (2019a) finds the Indian non-life insurance industry to be moderately technical, scale, cost and allocative efficient. The second study (2019b) found (using the Fare-Primont index) that the non-life insurance sector exhibits a very low level of total factor productivity. The total factor productivity growth observed during the observed period (2005-2016) is mainly attributable to scale-mix efficiency.

The extant literature on the efficiency of non-life/general insurance industries focused on primarily the technical efficiency and changes in total factor productivity of the observed insurers (with the exception of one study which covered cost efficiency). None considered profit efficiency. The motivation for the present study stems from the research gap.

2. Research Methodology

2.1. Evolution of profit efficiency methodology

In a market-driven economy, business enterprises produce goods and services with the end objective of earning profit. However, most of the efficiency studies concentrate on input or output oriented technical efficiency performance of the business firms. In the context of the business sector, this method certainly provides a partial picture of firm efficiency as profit efficiency implies both technical and allocative efficiency.

Nerlove (1965) perhaps made the earliest contribution to the profit efficiency literature. He had chosen gross profit (total revenue minus total variable cost) for measuring profit efficiency. However, a finite and benchmark (maximum) level of profit is needed for the measurement of profit efficiency. This necessitates that the profit function reaches a maximum at a particular point and declines thereafter. This necessity led to the emergence of the concept of restricted profit function [introduced by Mcfadden (1978)]. Subsequent contributions by Lee and Chambers (1986), Chambers, Chung Y and Färe (1998), Portela and Thanassoulis (2005), Cherchye, Kuosmanen and Leleu (2010) and Fare, He, Li and Zelenyuk (2019) provided new directions to the methodology of measuring profit efficiency.

For describing the methodology of profit efficiency measurement, we consider technology T_S given by T_S={$(x, y)|x$ can produce y} where $x \epsilon R_n^+$ represent a vector of inputs (x_1,x_2,....,x_n) and yϵR_m^+ represents a vector of m outputs (y_1,y_2,....,y_m). Let p_{y1} ,p_{y2},....,p_{ym} represent the output prices and w_{x1} ,w_{x2},....,w_{xn} represent the input prices.

Let π be the profit arising out of the activity: $\pi = \sum_{i=1}^{m} p_{yi}\, y_i - \sum_{j=1}^{n} w_{xj}\, x_j$. We may define the maximum profit as: π^{max}(p,w)=Max {py-wx: (x,y) ϵT_S}, $p \epsilon R_m^+$ and wϵR_n^+.The profit function is assumed to satisfy the following conditions (Fare and Primont,1995):

(i) It is non-negative,non-increasing in w and non-decreasing in p,

(ii) The profit function is homogeneous of degree one in input and output prices,

(iii) The function is convex and continuous in positive prices.

Maximum profit is obtained by a firm when the profit function is tangential to the technology set (T_S). Let x^* and y^* be optimal levels of x and y for which profit is maximised. Thus $\pi^{max} = py^* - wx^*$.Beyond the maximum profit level, the profit function exhibits decreasing returns to scale. The implicit assumption is that the production possibilities are constrained by the physical or economic environment or by the existence of prior contracts relating to input procurement/output delivery (Mcfadden,1972). Fare, He, Li and Zelenyuk (2019) mentioned some additional constraints like requirement of minimum employment, input availability limits, budget constraints etc.

Nerlove (1965) formally introduced two concepts of profit efficiency. The first measure introduced by him was a ratio measure: $\pi_{effR} = \frac{\pi(w^0, P^0)}{(P^0Y^0 - w^0x^0)}$ where w^0 and p^0 represent observed input and output prices respectively and x^0 and y^0 stand for observed levels of x and y. The second measure is an additive measure : $\pi_{eff} = \pi(w^0,\ P^0) - (P^0Y^0 - w^0x^0)$.

Varian (1990) provided another measure of profit efficiency:

$\pi_v = \frac{\pi(w^0, P^0) - (P^0 Y^0 - w^0 x^0)}{(P^0 Y^0 - w^0 x^0)} = \frac{\pi(w^0, P^0)}{(P^0 Y^0 - w^0 x^0)}$ -1. This measure indicates the per cent extra profit that the firm could earn by choosing the optimal instead of the observed input-output vector.

Chambers, Chung Y and Färe (1998) have presented a new measure of profit efficiency using the directional distance function approach:

$D_\pi(x^0, y^0, w^0, p^0, g_x, g_y)$ =max [β,$p^0(y^0 + \beta g_x)$-$w^0(x^0 - \beta g_y) \leq \pi^{max}$]. Thus profit efficiency $\pi_{eddf} = \frac{\pi(w^0, P^0) - (P^0 Y^0 - w^0 x^0)}{p^0 g_y + w^0 g_x}$. It is evident from the ratio that the direction vectors g_y and g_x are used to normalise the distance function.

Portela and Thanassoulis (2005,2007) adopted the Geometric Distance Function (GDF) for estimating profit efficiency. The GDF is defined as the ratio of input and output related indices. The input index is computed as the ratio of target and observed levels of inputs. The output index is computed as the ratio of observed and target levels of output. Geometric averages are used to find out the average levels of targets and actual (of inputs and outputs). Portela and Thanassoulis (2005) applied this method for computing the profit efficiency of a set of Portuguese bank branches and decomposed them into technical and allocative components.

Cherchye, Kuosmanen and Leleu (2010) reviewed the alternative profit efficiency measures and they identified Varian's measure of profit efficiency as their preferred alternative for the estimation of short-run profit efficiency. Further, they showed that the gauge function [Mcfadden (1978)]can be represented as Varian's measure of profit efficiency at the shadow prices and provides an upper bound for the measure of profit efficiency, which applies to any system of market prices.

Fare et al. (2019) introduced a Farrell type distance function π_{DF}=max[f(μ,θ):θ($p^0 y^0$) − μ($w^0 x^0$)≤π^{max}] where θ($p^0 y^0$) and μ($w^0 x^0$) represent revenue and cost functions respectively. The relative profit efficiency measure is:

$\pi_F = \frac{\pi^{max} - \pi^0}{R^0} + 1 = \frac{\Delta\pi}{R^0} + 1$. Since the numerator of the ratio on the right-hand side is both finite and positive, the profit efficiency measure is ≥1. This measure indicates that subject to the given level of input and output prices (w^0, p^0), the observed firm can augment its profit by$\left(\frac{\Delta\pi}{R^0}\right)$per cent of its revenue.

2.2 Estimation approach of the present paper

Since our data set includes some negative data, the present study considers a ratio based measure of profit, i.e. total revenue divided by total cost. Thus profit efficiency of an insurer is defined as the ratio of observed to optimal revenue-cost ratio.

For measuring profit efficiency with this ratio of ratio approach, we have used a Farrell type distance function which is a quantity-based approach. Following Farrell's (1957) approach regarding distance function, the profit distance function can be written as D_π=

max[β:$\pi_o(y,x)$β, (y,x)ϵT_S]. For an observed firm (firm "o"), the DEA program for profit maximisation (in the radial framework) for the firm can be written as :

$$\text{Max } \pi_o = \sum_{i=1}^{m} p_{yio}\, y_{io} - \sum_{j=1}^{n} w_{xjo}\, x_{jo}$$

$$\text{Subject to: } x_o \geq \lambda X,\ y_o \leq \lambda Y, \lambda \geq 0, \sum \lambda = 1$$

The profit efficiency of the firm can be computed as $\frac{\pi^o}{\pi^{max}}$. π_{max} stands for the benchmark profit.

As indicated earlier, when profit is negative, efficiency estimation creates obvious difficulties in the radial DEA model. However, we have taken the ratio of revenue and cost instead of taking the difference. Thus the DEA program for the observed firm becomes:

$$\text{Max } \pi_{ratio} = \frac{\sum_{i=1}^{m} P_{yio} Y_{io}}{\sum_{j=1}^{n} W_{xjo} X_{jo}}$$

$$\text{Subject to: } x_o \geq \lambda X,\ y_o \leq \lambda Y, \lambda \geq 0, \sum \lambda = 1$$

Ratio based profit efficiency of the firm can be computed as $\frac{\pi_O}{\pi_*}$where π_* is the optimal revenue-cost ratio. Thus it can be decomposed into revenue efficiency and cost efficiency components:

$\frac{\pi_O}{\pi_*} = (\frac{R_O}{R*}) \times (\frac{C_*}{C_O})$ where $(\frac{R_O}{R*})$ represents revenue efficiency and $(\frac{C_*}{C_O})$ represents cost efficiency.

2.3. Bootstrap estimation of lower and upper bounds of profit efficiency

DEA uses mathematical programming for constructing the frontier and provides point estimates of the efficiency scores. Simar and Wilson (1998) elaborated the procedure of bootstrap DEA, which can be used to construct lower and upper bounds of efficiency scores. Bootstrap is essentially a procedure of mimicking the population by resorting to resampling. In the case of frontier estimation, however, smoothed bootstrap method (which uses a Gaussian kernel density estimate) is essential to get consistent estimates of the frontier and efficiency.

2.4. Second stage regression

In the second stage analysis, we need to regress the profit efficiency scores obtained from the application of both the approaches on a few contextual variables. However, the profit efficiency scores are bounded from below and above, with the lower and upper bounds being 0 and 1, respectively. Consequently, the application of ordinary least squares for the purpose of regression would lead to biased estimates of the regression parameters. The problem can be countered either by resorting to data transformation (such as logarithmic or box-cox transformation) or by imposing restrictions (setting lower and upper bounds) on the dependent variable. In the present context, we have applied censored regression which is a generalisation of the standard Tobit model. In the censored regression framework, the dependent variable can be either left or right-censored, or both left and right-censored. The lower or upper limit of the dependent variable can be any number. The censored regression model can be represented as:

$$Y^L = X'\beta + U$$

Y=m if Y*≤0,Y=Y* if m<Y*<n and Y=n if Y*≥n

Where Y^L is a latent (unobserved) variable and Y is the observed variable. X is a vector of explanatory variables. a and b are the lower and upper limits of the dependent variable. β is a vector of unknown parameters and U represents the disturbance term.

Censored regression models are usually estimated by the Maximum Likelihood method. Under the assumption that the disturbance term u is normally distributed with mean 0 and variance σ^2, the log-likelihood function can be written as:

$$LogL= \sum[Imlog\varphi(\frac{a-X'\beta}{\sigma}) + In\log\varphi(\frac{X'\beta-b}{\sigma}) + (1\text{-Im-In})\{log\theta(\frac{Y-X'\beta}{\sigma})\text{-}log\sigma\}]$$

where $\varphi(.)$ and $\theta(.)$ denote the probability density function and the cumulative distribution function of the standard normal distribution and Im & In are the indicator functions with

Im=1 if Y=m and Im=0 if y>m and In=1 if Y=n and In=0 if y>n.

3. Data, Results and Discussion

Measurement of profit efficiency requires the identification of inputs, outputs and prices. However, the specification of variables (and price parameters) in the context of the insurance industry is a challenging proposition because of the existence of multiple approaches towards the description of the productive activities of insurers.

Eling and Luhnen (2010) identified three major types of inputs used in the insurance industry: labour (including agents and office staff), business services (including items such as travel, communications and advertisement) and capital (including debt and equity capital). On the output side, Leverty and Grace (2010) found three alternative approaches for choosing outputs: the financial intermediation approach, the user cost approach and the value-added approach. In the context of banking and other financial intermediaries (who are engaged in fund-based activities), this approach treats financial service firms as intermediaries who bridge the gap between demanders and suppliers of funds. The value-added approach considers those activities as outputs, that contribute significant value-added as assessed using operating cost allocations (Berger, Hanweck and Humphrey, 1987). Broadly speaking, the value-added approach assumes that the insurers provide three major services: risk-pooling and risk-bearing, real financial services and intermediation. Some studies have used net premiums as value-added, while some others have used incurred benefits and the changes in reserves as output proxies (Jarrya and Bouri, 2013).

The present study seeks to estimate profit efficiency and consequently we need to identify the major activities which contribute to insurer revenue as well as the principal contributors of cost. Since we do not have very detailed information on various inputs which contribute towards operating expenses, the number of offices maintained by the in-sample insurers is considered as the proxy input for capturing branch level activities. The relative input price is operating expenses incurred by the relative insurer per office. The expenses on account of claims, submitted by the insured, are considered as the second cost element. Since we do not have information about the number of outstanding policies at the insurer level, the price of this input is taken as unity. On the output side, we have considered net premium income and investments as the two outputs. Since we do not have insurer specific information about the number of policies sold by the general insurance companies, the price of net premium income is also taken as unity. Finally, the rate of return on investment is considered as the price of investment. Table 2 provides an overview of the inputs, outputs and prices.

Table 2

Inputs, outputs and prices

Description	Input	Output	Price
Offices	√	-	Operating expenses per office
Claims incurred	√	-	Unity
Net Premium Income	-	√	Unity
Investment	-	√	Rate of return on investment

The current study is based on the observations for fifteen general insurance companies for six consecutive financial years: 2011-12 to 2016-17. The in-sample general insurance companies include eleven private sector and four public sector general insurance companies. The relative data have been collected from two main sources: Annual Reports of IRDA for the respective years and the Handbook on Indian Insurance Statistics published by IRDA for the years 2012-13,2014-15 and 2016-17. The audited accounts of the in-sample insurers have also been consulted, where found necessary.

The present study has a two-stage process. The first stage includes three segments. The first segment provides point estimates of profit efficiency estimated under variable returns to scale. The second segment includes lower and upper bounds of profit efficiency scores. The third segment provides estimates of scale efficiency. In the second stage, we have explored the relationship of profit efficiency with contextual variables.

4. Results and Economic Explanations

4.1. Efficiency estimates

The present sub-section has three segments. The first segment (4.1.1) provides descriptive statistics of profit efficiency scores for the in-sample insurance companies and then provides the decomposition of mean profit efficiency into revenue and cost components. Further, it includes the decomposition of efficiency across ownership categories. The second segment (4.1.2) includes the interval estimates of profit, revenue and cost-efficiency. The third segment (4.1.3) provides information about returns to scale and scale efficiency.

4.1.1. Point estimates of profit efficiency performance

Table 3 presents the descriptive statistics of efficiency scores of the in-sample general insurance companies for the observed period. The efficiency scores are computed relative to the year wise profit frontiers constructed on the basis of sample data and consequently, efficiency scores are not comparable across time periods. However, the mean efficiency scores and the related standard deviation do provide us with an idea about the performance variability relative to the economic (profit) frontier. Thus, from the observed results, we find that divergence in performance (as indicated by movements in the mean and standard deviation of efficiency) has increased across the first five years. However, the mean efficiency score has improved (and standard deviation has declined) in the last year under observation. The number of efficient decision-making units (insurers) was 9 and 10 for the first two years under observation (2011-12 and 2012-13) and declined to 8 for the subsequent two years (2013-14 and 2014-15).In the last two years, the total number of efficient units was 6 and 9 respectively. The insurer wise mean and standard deviation of profit, revenue and cost efficiency scores for the entire time span under observation are included in appendix table A1-A3. On the other hand, insurer wise profit, revenue and cost efficiency scores for each year under observation are included in appendix tables A4-A6.

Table 3

Descriptive statistics of efficiency scores (2011-12 to 2016-17)

Particulars	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Mean efficiency score	0.9435	0.9325	0.9169	0.8859	0.8198	0.9330
Standard deviation	0.0904	0.1036	0.1039	0.1475	0.2286	0.1058
Maximum	1	1	1	1	1	1
Minimum	0.6743	0.7230	0.7385	0.5466	0.4087	0.6529
No of efficient DMUs	9	10	8	8	6	9

Source: Calculated.

The profit efficiency performance so estimated can be decomposed into revenue and cost efficiency components. Table 4 provides the mean revenue efficiency estimates for the period under observation. It shows that between 2011-12 and 2015-16, mean revenue efficiency has declined in a secular fashion. Similarly, mean cost efficiency has also declined during the period (with the exception of 2012-2013).

Table 4

Decomposition of profit efficiency

Particulars	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Mean Revenue efficiency	0.9801	0.9566	0.9476	0.9274	0.9378	0.9859
Mean Cost efficiency	0.9611	0.9720	0.9658	0.9524	0.8662	0.9460
Overall	**0.9435**	**0.9325**	**0.9169**	**0.8859**	**0.8198**	**0.9330**

Source: Calculated.

We are also interested to know how efficiency performance varies across ownership categories (private and public sector general insurers). Table 5 provides the relative summary information.

The table indicates that during the first four years under observation (2011-12 to 2014-15), public sector general insurance companies exhibited superior mean efficiency scores compared to the private sector insurers. The trend is reversed in the next two years (2015-16 and 2016-17). Decomposition of the profit efficiency into revenue and cost efficiency shows that during the entire observed period, public sector insurers performed better than the private sector counterparts in respect of mean revenue efficiency. However, this is not the case with mean cost efficiency.

Table 5

Efficiency variations across private and public sector general insurers

Category & Efficiency type	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Private Sector Revenue efficiency	0.9731	0.9409	0.9307	0.9011	0.9205	0.9834
Private Sector Cost efficiency	0.9608	0.9619	0.9698	0.9583	0.8984	0.9916
Private Sector Profit efficiency	0.9371	0.9080	0.9049	0.8677	0.8388	0.9758
Public Sector Revenue efficiency	0.9993	1	0.9941	0.9997	0.9854	0.9930
Public Sector Cost efficiency	0.9620	1	0.9548	0.9363	0.7776	0.8206
Public Sector Profit efficiency	0.9614	1	0.9501	0.9361	0.7673	0.8156

Source: Calculated.

4.1.2. Interval estimation of profit efficiency

As mentioned earlier, DEA provides us with point estimates of efficiency and interval estimates can not be obtained. In order to overcome this problem, we have applied the bootstrap technique for getting interval estimation of efficiency. However, in the present context, the conditional density has bounded support over the interval (0,1) and is right discontinuous at 1. Consequently, the naive bootstrap method would have provided inconsistent estimates of efficiency. Accordingly, we have used smoothed bootstrap technique outlined in Simar and Wilson (1998) to generate lower and upper bounds of profit, revenue and cost efficiency scores for the period under observation. The bootstrap-based mean estimates of profit, revenue and cost are, however, not significantly different from the point estimates and consequently not reported. Table 6 provides the lower and upper bounds of profit efficiency, Table 7 provides the lower and upper bounds of revenue efficiency and table 8 provides the lower and upper bounds of cost-efficiency. The insurer wise details about profit, revenue and cost efficiency lower and upper bounds are presented in Tables A7-A12.

Table 6

Mean lower and upper bounds of profit efficiency scores

Particulars	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Profit efficiency (lower bound)	0.9326	0.9237	0.9038	0.8728	0.8016	0.9238
Profit efficiency (upper bound)	0.9547	0.9420	0.9278	0.8987	0.8346	0.9420

Source: Calculated.

Table 7

Mean lower and upper bounds of revenue efficiency scores

Particulars	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Revenue efficiency (lower bound)	0.9692	0.9478	0.9366	0.9147	0.9233	0.9767
Revenue efficiency (upper bound)	0.9856	0.9662	0.9580	0.9381	0.9490	0.9912

Source: Calculated.

Table 8

Mean lower and upper bounds of cost efficiency scores

Particulars	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Cost efficiency (lower bound)	0.9499	0.9629	0.9533	0.9395	0.8536	0.9237
Cost efficiency (upper bound)	0.9719	0.9813	0.9770	0.9649	0.8792	0.9421

Source: Calculated.

4.1.3. Scale efficiency and returns to scale

We have estimated profit efficiency in the present study based on the assumption that the profit function can not be globally CRS. Table 9 provides the local estimates of mean scale efficiency across ownership categories, while table A 13 (included in the appendix) presents the insurer wise scale efficiency scores. Table 10, on the other hand, provides summary information regarding returns to scale. Appendix table A14 provides detailed information regarding insurer wise returns to scale.

Table 9

Mean scale efficiency of public and private sector general insurers

Particulars	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Private sector insurance companies	0.9538	0.9662	0.9534	0.9388	0.7217	0.9425
Public sector insurance companies	0.7832	0.6869	0.7344	0.6242	0.3240	0.7336
Overall	0.9083	0.8917	0.8950	0.8549	0.6156	0.8868

Source: Calculated.

Table 10

Returns to scale composition of the in-sample insurers

Particulars	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Number of insurers exhibiting CRS	4	4	3	4	2	5
Number of insurers exhibiting IRS	3	7	3	4	8	4
Number of insurers exhibiting DRS	8	4	9	7	5	6

Source: Calculated.

4.2. Linkage with contextual variables

In assessing the financial health of general insurers, there are two important and widely accepted indicators of performance: return on equity and solvency ratio. In the present part of the study, we explore the relationship of profit/revenue/cost efficiency scores (point estimates as well as lower and upper bounds of efficiency estimates) with the aforementioned contextual variables in terms of censored regression. Table 11 presents the regression results relating to profit efficiency estimates (mean, lower bound and upper bound of profit efficiency). Table 12 considers mean, lower bound and upper bound of revenue efficiency as the dependent variables. Finally, table 13 represents the regression of cost efficiency estimates (mean, lower bound and upper bound) on the contextual variables.

The results indicate that the coefficients of both solvency ratio and return on equity are statistically significant at 95% level of confidence for the profit efficiency and cost efficiency regressions. This is along the expected lines. However, when we take point estimate or lower bound of revenue efficiency as the dependent variables, the coefficient of return on equity becomes statistically significant only at 91% level of confidence. Further, return on equity is not significant at all if we take the upper bound of revenue efficiency as the dependent variable.

Table 11

Profit efficiency regression

Dependent variable	Explanatory variable	Coefficient	Std. Error	Co-efficient/Standard error	p-value
Profit efficiency	Intercept	0.2381	0.1623	1.467	0.1425
	Solvency Ratio	0.3974	0.0925	4.297	<0.0001
	Return on Equity	0.2485	0.1199	2.071	0.0384
Profit efficiency lower bound	Intercept	0.2887	0.1659	1.741	0.0818
	Solvency Ratio	0.3724	0.0978	3.807	0.0001
	Return on Equity	0.2188	0.1126	1.942	0.0521
Profit efficiency upper bound	Intercept	0.4099	0.1429	2.869	0.0041
	Solvency Ratio	0.3151	0.0850	3.709	0.0002
	Return on Equity	0.1909	0.0947	2.017	0.0437

Source: Calculated.

Table 12

Revenue efficiency regression

Dependent variable	Explanatory variable	Coefficient	Std. Error	Co-efficient/Standard error	p-value
Revenue efficiency	Intercept	0.5722	0.1292	4.4291	<0.00001
	Solvency Ratio	0.2419	0.0674	3.5908	0.0003
	Return on Equity	0.1509	0.0871	1.7336	0.0830
Revenue efficiency lower bound	Intercept	0.5048	0.134451	3.754	0.0002
	Solvency Ratio	0.2747	0.0698	3.933	<0.0001
	Return on Equity	0.1691	0.0939	1.800	0.0719
Revenue efficiency upper bound	Intercept	0.6235	0.169256	3.684	0.0002
	Solvency Ratio	0.2683	0.0841	3.192	0.0014
	Return on Equity	0.1459	0.1274	1.146	0.2518

Source: Calculated.

Table 13

Cost efficiency regression

Dependent variable	Explanatory variable	Coefficient	Std. Error	Co-efficient/Standard error	p-value
Cost efficiency	Intercept	0.4301	0.1174	3.6639	0.00025
	Solvency Ratio	0.3170	0.0747	4.2464	0.00002
	Return on Equity	0.1715	0.07931	2.1618	0.03063
Cost efficiency lower bound	Intercept	0.3595	0.1239	2.902	0.0037
	Solvency Ratio	0.3528	0.0781	4.520	<0.0001
	Return on Equity	0.1875	0.0880	2.131	0.0330
Cost efficiency upper bound	Intercept	0.4951	0.1103	4.488	<0.0001
	Solvency Ratio	0.2872	0.0701	4.097	<0.0001
	Return on Equity	0.1568	0.0729	2.149	0.0316

Source: Calculated.

4. Conclusion and Policy Implications

The present study provides us with some important results about profit efficiency, which are important for SWOT analysis and future policy formulation. First, except for the last year under observation, mean profit efficiency has declined over the years. Decomposition of profit efficiency into revenue and cost efficiency components shows that this is primarily due to a decline in mean revenue efficiency. Second, the decomposition of results across ownership categories shows that the private sector general insurers have a higher mean profit efficiency than their public sector counterparts. However, the public sector general insurers have done better than the private sector insurance companies in terms of revenue efficiency but done badly in respect of cost-efficiency. Third, estimation of local returns to scale reveals, that all the public sector general insurance companies have exhibited decreasing returns to scale and the mean scale efficiency of the public sector insurers is much lower than the private insurers. Fourth, there is a strong linkage of profit efficiency with solvency and return on equity. These outcomes facilitate the process of identification of the industry leaders and laggards and the restructuring initiatives for the general insurers with weak financial health.

In the present study, we have considered a quantity-based model of profit efficiency where input and output prices are considered as given during the period of analysis. As a consequence, the possibility of improvement by considering the price factor can not be captured in the present framework. Future research studies may take into cognisance of this issue and proceed accordingly.

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Table A1

Descriptive statistics of profit efficiency for the in-sample period

Insurer	Profit Efficiency	Standard Deviation
Bajaj Allianz	0.9858	0.0348
Cholamandalam	0.9027	0.0947
Future Generali	0.7653	0.2419
HDFC Ergo	0.8921	0.1104
ICICI Lombard	1.0000	0.0000
IFFCO Tokio	1.0000	0.0000
Reliance	0.6901	0.1115
Royal Sundaram	0.7769	0.1612
SBI General	0.9999	0.0002
Shri Ram General	0.9600	0.0980
Tata AIG	0.9862	0.0337
National	0.9342	0.1023
New India	1.0000	0.0000
Oriental	0.7495	0.1851
United	0.9366	0.0988

Source: Calculated.

Table A2

Descriptive statistics of revenue efficiency for the in-sample period

Insurer	Revenue Efficiency	Standard Deviation
Bajaj Allianz	0.9947	0.0130
Cholamandalam	0.9492	0.0595
Future Generali	0.8272	0.2239
HDFC Ergo	0.9260	0.0847
ICICI Lombard	1.0000	0.0000
IFFCO Tokio	1.0000	0.0000
Reliance	0.8099	0.0654
Royal Sundaram	0.8893	0.0732
SBI General	0.9999	0.0002
Shri Ram General	0.9647	0.0865
Tata AIG	0.9968	0.0080
National	0.9972	0.0052
New India	1.0000	0.0000
Oriental	0.9895	0.0104
United	0.9944	0.0103

Source: Calculated.

Table A 3

Descriptive statistics of cost efficiency for the in-sample period

Insurer	Cost Efficiency	Standard Deviation
Bajaj Allianz	0.9908	0.0225
Cholamandalam	0.9492	0.0475
Future Generali	0.9151	0.0704
HDFC Ergo	0.9610	0.0352
ICICI Lombard	1.0000	0.0000
IFFCO Tokio	1.0000	0.0000
Reliance	0.8392	0.1456
Royal Sundaram	0.8571	0.1251
SBI General	1.0000	0.0000
Shri Ram General	0.9940	0.0147
Tata AIG	0.9893	0.0263
National	0.9360	0.0994
New India	1.0000	0.0000
Oriental	0.7548	0.1836
United	0.9402	0.0943

Source: Calculated.

Table A4

Insurer wise Profit efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	1	1	0.9147	1	1
Cholamandalam	0.9614	0.8141	0.7977	1	0.8427	1
Future Generali	0.8489	0.7877	0.9997	0.5466	0.4087	1
HDFC Ergo	0.8954	0.9212	0.8227	0.7133	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	1	1
Reliance	0.6743	0.7230	0.7385	0.6797	0.4940	0.8313
Royal Sundaram	0.9277	0.7418	0.8353	0.7724	0.4823	0.9021
SBI General	1	1	1	1	0.9995	1
Shri Ram General	1	1	0.7599	1	1	1

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Tata AIG	1	1	1	0.9174	1	1
National	1	1	1	1	0.7887	0.8165
New India	1	1	1	1	1	1
Oriental	0.8456	1	0.8003	0.7442	0.4538	0.6529
United	1	1	1	1	0.8267	0.7929

Source: Calculated.

Table A5

Insurer wise Revenue efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	1	1	0.9681	1	1
Cholamandalam	0.9918	0.9018	0.8573	1	0.9442	1
Future Generali	0.9871	0.8807	1	0.6047	0.4909	1
HDFC Ergo	0.9505	0.9534	0.8683	0.7837	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	1	1
Reliance	0.7771	0.7760	0.8103	0.7236	0.8916	0.8810
Royal Sundaram	0.9980	0.8377	0.9133	0.8514	0.7993	0.9361
SBI General	1	1	1	1	0.9995	1
Shri Ram General	1	1	0.7882	1	1	1
Tata AIG	1	1	1	0.9805	1	1
National	1	1	1	1	0.9870	0.9964
New India	1	1	1	1	1	1
Oriental	0.9971	1	0.9766	0.9987	0.9800	0.9843
United	1	1	1	1	0.9746	0.9915

Source: Calculated.

Table A6

Insurer wise Cost efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	1	1	0.9449	1	1
Cholamandalam	0.9694	0.9027	0.9305	1	0.8926	1
Future Generali	0.8599	0.8944	0.9997	0.9039	0.8326	1
HDFC Ergo	0.9420	0.9662	0.9474	0.9102	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	1	1
Reliance	0.8676	0.9317	0.9114	0.9394	0.5540	0.8313
Royal Sundaram	0.9295	0.8856	0.9146	0.9072	0.6035	0.9021
SBI General	1	1	1	1	1	1
Shri Ram General	1	1	0.9641	1	1	1
Tata AIG	1	1	1	0.9357	1	1
National	1	1	1	1	0.7992	0.8165
New India	1	1	1	1	1	1
Oriental	0.8481	1	0.8195	0.7452	0.4631	0.6529
United	1	1	1	1	0.8483	0.7929

Source: Calculated.

Table A7

Insurer wise lower bound of Profit efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	1	1	0.8850	0.8194	1
Cholamandalam	0.9340	0.7868	0.7707	1	1	1
Future Generali	0.8229	0.7616	0.9707	0.5198	0.7522	1
HDFC Ergo	0.8654	0.8938	0.7943	0.6860	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	0.3395	1
Reliance	0.6465	0.6953	0.7115	0.6507	0.6118	0.8026
Royal Sundaram	0.9030	0.7174	0.8075	0.7439	0.4576	0.8716
SBI General	1	1	1	1	1	1
Shri Ram General	1	1	0.7289	1	1	1
Tata AIG	1	1	1	0.8905	0.7275	1
National	1	1	1	1	0.7436	0.7900
New India	1	1	1	1	1	1
Oriental	0.8171	1	0.7740	0.7159	0.7224	0.6276
United	1	1	1	1	0.8499	0.7657

Source: Calculated.

Table A8

Insurer wise lower bound of Revenue efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	1	1	0.9383	1	1
Cholamandalam	0.9648	0.8760	0.8288	1	0.9168	1
Future Generali	0.9586	0.8515	1	0.5795	0.4603	1
HDFC Ergo	0.9254	0.9282	0.8406	0.7562	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	1	1
Reliance	0.7486	0.7490	0.7842	0.6969	0.8645	0.8540
Royal Sundaram	0.9713	0.8122	0.8864	0.8255	0.7738	0.9072
SBI General	1	1	1	1	0.9724	1
Shri Ram General	1	1	0.7594	1	1	1
Tata AIG	1	1	1	0.9540	1	1
National	1	1	1	1	0.9600	0.9692
New India	1	1	1	1	1	1
Oriental	0.9693	1	0.9504	0.9699	0.9546	0.9568
United	1	1	1	1	0.9466	0.9635

Source: Calculated.

Table A9

Insurer wise lower bound of Cost efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	1	1	0.9179	1	1
Cholamandalam	0.9440	0.8771	0.9057	1	0.8671	1
Future Generali	0.8311	0.8661	0.9718	0.8783	0.8059	1
HDFC Ergo	0.9134	0.9384	0.9212	0.8832	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	1	1
Reliance	0.8410	0.9036	0.8843	0.9125	0.5246	0.8039
Royal Sundaram	0.9011	0.8588	0.8862	0.8738	0.5773	0.8730
SBI General	1	1	1	1	1	1
Shri Ram General	1	1	0.9389	1	1	1
Tata AIG	1	1	1	0.9092	1	1
National	1	1	1	1	0.7722	0.7888
New India	1	1	1	1	1	1
Oriental	0.8182	1	0.7912	0.7180	0.4361	0.6249
United	1	1	1	1	0.8210	0.7648

Source: Calculated.

Table A10

Insurer wise upper bound of Profit efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1.0000	1	1	0.9425	0.8746	1
Cholamandalam	0.9885	0.8424	0.8250	1	1	1
Future Generali	0.8772	0.8148	1	0.5747	0.8065	1
HDFC Ergo	0.9229	0.9511	0.8493	0.7419	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	0.3943	1
Reliance	0.7026	0.7502	0.7639	0.7056	0.6669	0.8563
Royal Sundaram	0.9583	0.7721	0.8640	0.8012	0.5125	0.9279
SBI General	1	1	1	1	1	1
Shri Ram General	1	1	0.7871	1	1	1
Tata AIG	1	1	1	0.9430	0.7845	1
National	1	1	1	1	0.7997	0.8440
New India	1	1	1	1	1	1
Oriental	0.8716	1	0.8274	0.7715	0.7748	0.6822
United	1	1	1	1	0.9048	0.8199

Source: Calculated.

Table A11

Insurer wise upper bound of Revenue efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	1	1	0.9954	1	1
Cholamandalam	1	0.9318	0.8834	1	0.9719	1
Future Generali	1	0.9052	1	0.6347	0.5181	1
HDFC Ergo	0.9793	0.9811	0.8957	0.8120	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	1	1
Reliance	0.8047	0.8065	0.8371	0.7516	0.9187	0.9064
Royal Sundaram	1	0.8680	0.9407	0.8781	0.8269	0.9619
SBI General	1	1	1	1	1	1
Shri Ram General	1	1	0.8136	1	1	1
Tata AIG	1	1	1	1	1	1
National	1	1	1	1	1	1
New India	1	1	1	1	1	1
Oriental	1	1	1	1	1	1
United	1	1	1	1	1	1

Source: Calculated.

Table A12

Insurer wise upper bound of Cost efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1.0000	1	1	0.9708	1	1
Cholamandalam	0.9976	0.9324	0.9569	1	0.9206	1
Future Generali	0.8853	0.9217	1	0.9314	0.8623	1
HDFC Ergo	0.9686	0.9920	0.9749	0.9387	1	1
ICICI Lombard	1	1	1	1	1	1
IFFCO Tokio	1	1	1	1	1	1
Reliance	0.8935	0.9602	0.9393	0.9677	0.5794	0.8594
Royal Sundaram	0.9566	0.9125	0.9422	0.9329	0.6336	0.9305
SBI General	1	1	1	1	1	1
Shri Ram General	1	1	0.9934	1	1	1
Tata AIG	1	1	1	0.9612	1	1
National	1	1	1	1	0.8272	0.8439
New India	1	1	1	1	1	1
Oriental	0.8761	1	0.8481	0.7702	0.4906	0.6785
United	1	1	1	1	0.8746	0.8185

Source: Calculated.

Table A13

Insurer wise scale efficiency scores

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	1	0.9280	0.9991	0.8503	0.7604	1
Cholamandalam	0.9952	0.9920	0.9993	1	0.6698	0.9533
Future Generali	0.9091	0.9399	0.7355	0.9253	0.7190	0.7266
HDFC Ergo	0.9839	1	0.9906	0.9922	0.6717	1
ICICI Lombard	0.7415	0.8011	0.8410	0.8064	1	0.9452
IFFCO Tokio	0.8892	1	1	1	1.0000	1
Reliance	0.9761	0.9729	0.9653	0.9405	0.7463	0.9644
Royal Sundaram	0.9969	0.9947	0.9675	0.8854	0.6566	0.9025
SBI General	1	1	1	1	0.4262	1
Shri Ram General	1	1	0.9894	1	0.5921	1
Tata AIG	1	1	1	0.9271	0.6969	0.8752
National	0.7536	0.9280	0.6858	0.5922	0.3021	0.7360
New India	0.7693	0.9920	0.6963	0.6058	0.2552	0.6710
Oriental	0.8508	0.9399	0.7908	0.7314	0.4316	0.7974
United	0.7591	1	0.7648	0.5672	0.3072	0.7298

Source: Calculated.

Table A14

Insurer wise returns to scale

Insurer	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bajaj Allianz	Constant	Decreasing	Decreasing	Decreasing	Decreasing	Constant
Cholamandalam	Increasing	Increasing	Increasing	Constant	Increasing	Increasing
Future Generali	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
HDFC Ergo	Decreasing	Increasing	Decreasing	Increasing	Increasing	Constant
ICICI Lombard	Decreasing	Decreasing	Decreasing	Decreasing	Constant	Decreasing
IFFCO Tokio	Decreasing	Constant	Constant	Constant	Constant	Constant
Reliance	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing
Royal Sundaram	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
SBI General	Constant	Constant	Constant	Constant	Increasing	Constant
Shri Ram General	Constant	Constant	Decreasing	Constant	Increasing	Constant
Tata AIG	Constant	Constant	Constant	Increasing	Increasing	Increasing
National	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
New India	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Oriental	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
United	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing

Source: Calculated.