



## INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE AND MANAGEMENT

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## PRODUCTIVITY CHANGE IN THE INDIAN HEALTH INSURANCE BUSINESS: A MALMQUIST TOTAL FACTOR PRODUCTIVITY ANALYSIS

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### ABSTRACT

*In order to increase the standard of living of an economy continuous increase in its productivity is required, which in turn depends upon the continuous increase in the productivity of the system that provides the goods and services. For the measurement of productivity, number of methods have been developed and applied. Out of these the principal methods used are: Data Envelopment Analysis (DEA) and Stochastic Frontier. DEA is a non parametric mathematical programming approach which uses Malmquist Index for the measurement of productivity. This paper seeks to use DEA to evaluate the productivity of health insurance business of general insurance companies in India. The present study is focused upon 10 general insurance companies of India including 4 public sector companies and cover a period of 8 years from 2002-03 to 2009-10. The study uses the equity capital and labour (including commission, agents' fees, referral and other expenditure) as input and net premium as output. It was observed that all the insurance companies have improved its productivity, except two public sector companies namely, Oriental Insurance Company Limited and New India Assurance Company Limited which show the reduction in its productivity. As initially their total factor productivity change from 2002-03 to 2003-04 was 1.474 and 1.309, which decreased to 1.115 and 1.136 from 2008-09 to 2009-10. This can attributable to the fact that all the insurance companies are taking the advantages of technological Change/technical progress or technical efficiency except these two companies.*

### KEYWORDS

Data Envelopment Analysis, Technological Change, Efficiencies, Malmquist Index and Productivity.

### INTRODUCTION

In order to increase the standard of living of an economy continuous increase in its productivity is required, which in turn depends upon the continuous increase in the productivity of the system that provides the goods and services. Productivity growth is acting as a key factor behind the increasingly competitive global market for maintaining and advancing the economic opportunities for individuals and societies. Interest in productivity has increased enormously in recent year because of wide spread concerned about the prospects of productivity improvement among local authorities, hospitals, schools, shops, business houses, banks, insurance companies etc. The growth in the productivity is one of the most important factors that have contributed to the advancement of nations. In the last few years we have contemplated into a revolution in terms of productivity (Singhania, 1995). Productivity is the heart of every economy, because standard of the living of an economy depends upon its productivity growth. Higher the productivity growth better will be the standard of living of an economy. Similarly, lower the productivity growth dreadful will be the standard of living of an economy. The productivity was defined in five different ways by Frensky (1968): Productivity in the form of efficiency; productivity is the utility of resources; it is the ratio rather than phenomenon; it is a measure of some kind; and it is a rate of return.

As far as the productivity of an Indian insurance market is concerned, it is increasing over a period of time on the same line of global Insurance markets. Dozens of countries have deregulated or liberalized their insurance markets on the expectations that competitive markets are in a better position to enhance consumers' choice and welfare than are rigidly regulated insurance markets. One of such liberalized insurance market is an Indian insurance market, where twenty six percents Foreign Direct Investments (FDIs) is allowed in insurance sector. Forwarding attention deep towards Indian Insurance market will reflect that since its inception it has faced numerous milestones in the phases of development. But inspite of those milestones the Indian insurance industry found the new track of success and growth in the year 1999, when reforms in the insurance sector was initiated with lying and passing of IRDA Bill in Parliament. The Insurance Regulatory and Development Authority (IRDA), since its incorporation in April, 2000 have fastidiously stuck to its schedule of framing regulations and opening up of an insurance sector to private players as well as permitting FDIs in insurance sector. The FDI was allowed on the same line of as other countries are considering that privatization and liberalization will ensure the efficient, effective services to the insured ones and will also enhance productivity of the insurers. To what extent Indian liberalized and privatized market has achieved its objectives of increasing and enhancing productivity of insurers as well as enhancement of consumers' choice and welfare is a matter of controversy and discussion.

In order to measure the productivity, number of methods have been developed and applied. Out of these the principal methods used are: Data Envelopment Analysis and Stochastic Frontier. Data Envelopment Analysis (DEA) is a non parametric mathematical programming approach to frontier estimation, which uses data to determine a sphere which represent the best practice for measuring efficiencies, inefficiencies and productivity. The Data Envelopment Analysis has number of favorable economic implications because it is fit to evaluate the productive efficiency of different lines of business and the identification of production function. Besides this, its scope is far broader than imagination because of its wide range of applicability in various fields such as hospitals, banks, insurance companies, air force wings, universities, cities, courts, business firms, and others, including the performance of countries, regions, states etc. As far DEA applicability in the insurance area is concerned, it is helpful in the measurement of productivity of insurance companies with the use of Malmquist Index.

### REVIEW OF LITERATURE

Various studies related directly or indirectly to the objectives of the present study have been reviewed. **Charnes, Cooper and Rhodes (1978)** provided with a nonlinear programming model which have given a new definition of efficiency and productivity. This model can objectively determine the weights with reference to observational data for multi-input and multi-output. **Weiss (1986)** concluded that applicability of the output and productivity measurement methodologies developed is not limited to the specific insurers studied, but rather can be used as a guide in measuring the productivity of any life insurer or insurance industry. **Grace and Timme (1992)** analyzed the U.S. life insurance industry and provided with the estimation of both overall and product specific scale economies, as well

as, pair-wise cost complementarities for a wide variety of products. In contrast, previous studies only provide a single point estimate of industry cost characteristics using the sample mean output vector. This study, therefore, provides a more complete representation of the industry's cost characteristic. **Cummins, Turchetti and Weiss (1996)** examined the efficiency and productivity under the new European regulatory regime and indicated that technical efficiency in the Italian insurance industry ranged from 70 to 78 percent during the sample period. However, productivity declined significantly over the sample period, with a cumulative decline of about 25 percent. **Fukuyama (1997)** investigated the productive efficiency and productive changes of Japanese life insurance companies and reveals mutual and stock companies possess identical technologies, but the productive efficiency and productive performance changes from time to time in the case of stock and mutual under different economic conditions. **Cummins and Zi (1998)** provided that alternative methodologies give significantly different estimates of efficiency and productivity for the insurers. Moreover the efficiency rankings are quite well-preserved among the econometric methodologies; but the rank correlations are lower between the econometric and mathematical programming categories and between alternative mathematical programming methodologies. **Cummins and Misas (2001)** analyzed the causes and effects of consolidation in Spanish insurance industry and showed that many small, inefficient, and financially under-performing firms were eliminated from the market due to insolvency or liquidation and those acquirers in the mergers and acquisitions market prefer relatively efficient target firms. **Boonyasai, Grace and Skipper (2002)** examined the impact of liberalization and deregulation of four life insurance markets and found that liberalization and deregulation of the Korean and Philippine life insurance industries seem to have stimulated increases and improvements in productivity whereas liberalization of the Taiwanese and Thai life insurance industries seems to have had little effect on increases and improvements in productivity. **Cummins, Weiss and Zi (2003)** provided the evidence for the existence of weak economies of scope in the U.S. insurance industry and also that strategic focus appears to be a better strategy. **Eling and Luhn (2008)** analyzed and provided new empirical evidence on frontier efficiency measurement in the insurance industry and found that a steady technical and cost efficiency growth in international insurance markets from 2002 to 2006, with large differences across countries. **Yuan and Phillips (2008)** examined the efficiency and productivity effect from the possible economies of scope across two formally separate sectors by estimating multi-product costs, revenue, and profit function and suggested that a significant number of cost scope diseconomies, revenue scope economies, and weak profit scope economies exist in the post-GLB U.S. integrated banking and insurance sectors. **Owusu, Dontwi, Seidu, Abudulai, and Sebil (2010)** evaluated the performance, efficiency and productivity of Ghanaian general insurance companies from the year 2002 to 2007 and provided with the result that Ghanaian general insurers operated at an average overall efficiency of 68%, technical efficiency of 87% and scale efficiency of 78%.

Having the in-depth review of related studies has provided that there is a huge importance of DEA in evaluating the performance and productivity of the insurance industry. Keeping in mind such an importance of DEA model in evaluation of an entity, we have used the same in the present study in order to achieve the following objectives:

- To examine the productivity as well as change in productivity of health insurance business of general insurance companies.
- To identify and explore the various derives behind such productivity change.

## DATA BASE AND RESEARCH METHODOLOGY

The present study is covering a period of 8 years from 2002-03 to 2009-2010. The base year is taken as 2002 i.e. the companies which are providing health insurance since 2002 are forming a part of the study. The basic reason behind the selection of base year as 2002 lies in the fact that, this is the exclusive year in which maximum numbers of general insurance companies are operating in insurance industry and started extension of health insurance under their existing network of service. The companies under the scope of study include, Tata AIG General Insurance Company Limited, IFFCO Tokio General Insurance Company Limited, Reliance General Insurance Company Limited, Royal Sundram Alliance Insurance Company Limited, Bajaj Allianz General Insurance Company Limited, ICICI Lombard General Insurance Company Limited, United India Insurance company limited, Oriental Insurance Company Limited, New India Assurance Company Limited and National Insurance Company Limited. The study is entirely based upon secondary data, which is mainly drawn from the annual reports of the insurance companies under consideration. Beside this the use of statistical year book of IRDA and other publication related with the insurance was made for the collection of certain facts and figures necessary for the present study.

In order to accomplish the objectives of study, we used the Data Envelopment Analysis (DEA), a mathematical programming approach to investigate the productivity as well as change in the productivity of health insurance business of general insurance companies in India. DEA helps in measuring productivity by using Malmquist index summary. This summary provided with Efficiency Change (EC), Technological Change (TC), Pure Technical Efficiency Change (PTEC), Scale Efficiency Change (SEC) and Total Factor Productivity Change (TFPCH). Overall it provided with TFPCH which comprises of EC, TC, PTEC and SECE. Thereby an effort has been maintained to calculate the Total Factor Productivity Change (TFPCH) by using the Malmquist index provided by DEA. The TFP growth in this case measure the change in the production frontier and how the current frontier relates to the firm frontier over time. The growth of TFP has two major components: technological change/technical progress and efficiency change. Technological change/technical progress is represented by a shift in the production frontier while efficiency change is based upon an index of a firm's efficiency relative to past and future frontiers.

If we let  $D_t(x_t, y_t)$  be the distance from the origin for a firm with an input vector of  $x_t$  and an output vector of  $y_t$  where  $t$  represents time and the subscript  $s$  for the firm is omitted for clarity, then,

$$M_t = \frac{D^t(x^t, y^t)}{D^t(x^{t+1}, y^{t+1})} \quad (1)$$

The ratio of the two distances,  $M_t$ , is the Malmquist productivity index. This index suffers from a problem that it depends upon the starting values. For example, if we examined the Malmquist index with respect to the period  $t + 1$  frontier, we have

$$M^{t+1}_t = \frac{D^{t+1}(x^t, y^t)}{D^{t+1}(x^{t+1}, y^{t+1})} \quad (2)$$

So, to avoid an arbitrary choice of which frontier to choose, we take the geometric mean, which yields the Malmquist index of total factor productivity,

$$M(x^{t+1}, y^{t+1}, x^t, y^t) = \left[ \frac{D^t(x^t, y^t)}{D^t(x^{t+1}, y^{t+1})} \times \frac{D^{t+1}(x^t, y^t)}{D^{t+1}(x^{t+1}, y^{t+1})} \right]^{1/2} \quad (3)$$

The change in efficiency is thus the ratio of the distance from the frontier in period  $t$  to the distance in period  $t + 1$ . If technical efficiency increases, the ratio will be greater than one and, if it decreases, the ratio will be less than one.

To calculate technical change, we examine how the firm uses its inputs to produce outputs in periods  $t$  and  $t + 1$  and how the input/output bundles change over time. Technical change is computed as follows:

$$TC(x^{t+1}, y^{t+1}, x^t, y^t) = \left[ \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^t(x^{t+1}, y^{t+1})} \times \frac{D^t(x^t, y^t)}{D^{t+1}(x^t, y^t)} \right]^{1/2} \quad (4)$$

If favorable technological change exists, the frontier will have moved to the left, and both output bundles will be farther from the period  $t + 1$  frontier than they are from the period  $t$  frontier. Once again, a ratio greater than one indicates progressive technical change.

(Source: Coelli T.J. 1996)

## MEASUREMENT OF INPUTS AND OUTPUTS

For the application of DEA, accurate identification and selection of variable of inputs and outputs is necessary. By the study of literature it came into notice that researchers have general agreement on the selection of inputs indicators. Generally labor, capital and materials are selected as shown in Grace and Timme (1992), Gardner and Grace (1993), Cummins and Zi (1998). **THE VARIABLES OF INPUTS WHICH ARE CONSIDERED UNDER THE PRESENT STUDY ARE AS:**

**EQUITY CAPITAL (X1):** According to the theory of corporate finance, financial capital can be authorized capital or capital actually invested i.e. invested capital. The invested capital includes long term debt and equity capital. However, reserve constitutes almost all the long term debt of insurers. But at the same time the debt is not stable in the financial reports. Therefore, we cannot say that insurers use this long term debt to support their business. In this study we have taken equity share capital as the first indicator of input.

**AMOUNT OF LABOUR (X2):** As the insurance companies do not constitute the part of the manufacturing industries, rather form a part of the financial service industry so it does not require raw material. In financial service industry the cost of labor is the most important input. The main difficulty regarding this input was to get salary data of insurers, which is not feasible. So alternatively we have taken amount of commission, agent, and referral fees as the second indicator of input.

**THE VARIABLES OF OUTPUTS WHICH ARE CONSIDERED UNDER THE PRESENT STUDY ARE AS:**

As far as the variable of output is concerned wide diversity found in literature, because of the fact that defining and measuring outputs in the insurance industry has been a challenging task. In various studies three commonly used outputs are: premium income, weighted sum of activities, and incurred benefits plus additions -to-reserves. In most of the previous studies net written premiums or net earned premiums have been used as proxies for outputs. Doherty (1981); Yuengert (1993); Cummins and Zi (1998) thinks premium cannot reflect the quantity of output. However, Houston and Simon (1970) thinks premium to insurers is what income to manufacturers, and therefore can be regarded as the indicator of output. Similar arguments appeared in: Praetz (1980); Fields and Murphy (1989); Grace and Timme (1992); Gardner and Grace (1993); and Rai (1996). They consider premium as an appropriate indicator of output, assuming the product is homogeneous and competitive pressures compel all insurers to charge the same price.

Finally we have selected two indicator of input as capital and cost to the insurers; one indicator of output as premium, which is also in accordance with the assumption of DEA, that number of DMUs should be three time of number of inputs and outputs.

## EMPRICAL RESULTS, ITS ANALYSIS AND INTERPRETATION

**I. DIRECTION OF PRODUCTIVITY CHANGE AND MALMQUIST INDEX SUMMARY:** Productivity change and malmquist index has been investigated in order to know where companies are standing in relation to previous year, so as to arrive at conclusion whether productivity change exists or not. Further if change exist, whether it is positive change or negative change. This change in the productivity has been analyzed and interpreted in two ways: A. company wise productivity change and Malmquist index summary and B. Year wise productivity change and Malmquist index summary.

### A. COMPANY WISE PRODUCTIVITY CHANGE AND MALMQUIST INDEX SUMMARY

This has been done to arrive at conclusive findings in relation to Total Factor Productivity Change (TFPC), which comprises of Efficiency Change (EC), Technological Change (TC), Pure Technical Efficiency Change (PTEC) and Scale Efficiency Change (SEC). In other words the effort has been made to find out individually which of the company has improved its productivity or vice versa.



TABLE I: SHOWS THE COMPANY WISE PRODUCTIVITY CHANGE AND MALMQUIST INDEX SUMMARY

Tata AIG General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	1.317	2.907	0.477	5.645	0.928	2.056	0.858
TC	0.778	0.309	3.491	0.456	1.266	0.607	1.199
PTEC	1.328	3.961	0.356	7.567	1.606	1.000	1.000
SEC	0.922	0.734	1.341	0.746	0.578	2.056	0.858
TFPC	1.026	0.898	1.665	2.572	1.174	1.247	1.028
IFFCO Tokio General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	0.629	3.756	0.260	5.061	0.365	2.079	1.948
TC	1.596	0.274	3.070	0.456	1.329	0.607	1.170
PTEC	0.692	7.311	0.140	1.000	0.278	1.893	1.901
SEC	1.000	0.514	1.855	2.353	1.314	1.099	1.025
TFPC	1.105	1.028	0.798	1.072	0.485	1.261	2.278
Reliance General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	1.286	0.944	0.850	2.353	1.090	1.620	1.000
TC	0.759	0.717	1.079	0.456	1.409	0.722	1.007
PTEC	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SEC	1.286	0.944	0.850	2.353	1.090	1.620	1.000
TFPC	0.976	0.677	0.917	1.072	1.535	1.170	1.007
Royal Sundram Alliance General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	1.559	1.939	0.632	1.719	0.782	1.633	0.937
TC	0.653	0.533	2.856	0.485	1.455	0.615	1.121
PTEC	1.931	2.492	0.435	1.619	0.807	1.546	0.981
SEC	0.807	0.778	1.451	1.602	0.968	1.056	0.956
TFPC	1.019	1.033	1.804	0.834	1.138	1.004	1.051
Bajaj General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	1.066	2.384	0.398	4.094	1.000	0.775	1.118
TC	0.698	0.449	3.735	0.441	1.340	0.643	0.934
PTEC	1.392	2.957	0.788	1.273	1.000	1.000	1.000
SEC	0.766	0.806	0.505	3.215	1.000	0.775	1.118
TFPC	0.744	1.070	1.485	1.805	1.340	0.498	1.044
ICICI Lombard General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	1.000	0.793	0.310	1.998	0.517	2.478	1.384
TC	0.000	0.038	3.110	0.601	1.582	0.702	0.988
PTEC	1.000	1.000	0.304	1.869	0.628	2.528	1.108
SEC	1.000	0.793	1.021	1.069	0.824	0.980	1.249
TFPC	0.000	0.030	0.966	1.200	0.818	1.740	1.368
United India Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	0.635	1.525	0.837	0.834	0.091	2.311	1.130
TC	0.974	0.685	1.297	1.082	1.434	1.115	1.110
PTEC	0.635	1.575	0.927	0.752	0.089	2.334	1.111
SEC	1.000	0.968	0.904	1.110	1.016	0.900	1.017
TFPC	0.618	1.045	1.086	0.903	0.130	13.730	1.255
Oriental Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	0.924	1.744	0.909	1.133	0.845	1.198	1.000
TC	1.596	0.619	1.298	1.088	1.390	1.102	1.115
PTEC	0.924	1.802	1.009	1.000	1.000	1.000	1.000
SEC	1.000	0.968	0.901	1.133	0.845	1.198	1.000
TFPC	1.474	1.080	1.181	1.233	1.175	1.319	1.115
New India Assurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	1.000	1.000	1.000	1.000	1.000	0.843	1.045
TC	1.309	0.452	2.100	0.671	1.576	0.873	1.088
PTEC	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SEC	1.000	1.000	1.000	1.000	1.000	0.843	1.045
TFPC	1.309	0.452	2.100	0.671	1.576	0.737	1.136
National Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
EC	1.019	1.000	1.000	1.000	1.000	1.000	1.000
TC	1.285	0.503	1.099	1.130	1.384	1.178	1.318
PTEC	1.019	1.000	1.000	1.000	1.000	1.000	1.000
SEC	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TFPC	1.310	0.503	1.099	1.130	1.384	1.178	1.318

The above table I reveals Total Factor Productivity Change (TFPC), which comprises of EC, TC, PTEC and SEC has followed diverse path during the period under consideration. The TFPC which is the results of EC, TC, PTEC and SE has improved in all the companies except two Public sector companies namely, Oriental Insurance and New India Assurance Company limited. Numerically stated as that initially the productivity change in case of Tata Aig, IFFCO Tokio, Reliance, Royal Sundram, Bajaj, ICICI, United India and National Insurance Company Limited was 1.026, 1.105, 0.976, 1.019, 0.744, 0.000, 0.618, 1.310 respectively, which increased to 1.028, 2.278, 1.007, 1.051, 1.044, 1.368, 1.255 and 1.318 respectively, in the year 2009-10. Although the driver behind productivity change can be change in technical efficiency and technical progress/technology change, yet all the companies was least derived by technology change and mostly derived by the change in technical efficiency. Moreover, the results provided with the fact that there are only two public sector companies which show the reduction in the productivity over a period of time. Overall they are also good as their productivity change is greater than one. But if we look at two extremes then found that

improvement in productivity has reduced as the initial productivity change in case of Oriental and New India Assurance Company Limited was 1.474 and 1.309, which decreased to 1.115 and 1.136. This can be attributable to the fact that all the insurance companies are taking the advantages of Technological Change (TC), Efficiency Change (EC), Pure Technical Efficiency Change (PTEC) and Scale Efficiency Change (SEC) except the two namely Oriental and New India Insurance which shows the reverse trends for the change in productivity.

#### B. YEAR WISE PRODUCTIVITY CHANGE AND MALMQUIST INDEX SUMMARY

This has been done in order to find out the year wise Total Factor Productivity Change (TFPC), which is the result of Efficiency Change (EC), Technological Change (TC), Pure Technical Efficiency Change (PTEC) and Scale Efficiency Change (SEC) of various companies under consideration i.e. an effort has been made to find out the year in which maximum TFPC occurred in the companies under consideration.

TABLE II SHOWS THE YEAR WISE PRODUCTIVITY CHANGE AND MALMQUIST INDEX SUMMARY

Year		EC	TC	PTEC	SEC	TFPC
2002-03 to 2003-04	Tata	1.317	0.778	1.328	0.992	1.026
	Iffco	0.692	1.596	0.692	1.000	1.105
	Reliance	1.286	0.759	1.000	1.286	0.976
	Royal	1.559	0.653	1.931	0.807	1.019
	Bajaj	1.066	0.698	1.392	0.766	0.744
	ICICI	1.000	0.000	1.000	1.000	0.000
	United	0.635	0.974	0.635	1.000	0.618
	Oriental	0.924	1.596	0.924	1.000	1.474
	New India	1.000	1.309	1.000	1.000	1.309
2003-04 to 2004-05	Tata	2.907	0.309	3.961	0.734	0.898
	Iffco	3.756	0.274	7.311	0.514	1.028
	Reliance	0.944	0.717	1.000	0.944	0.677
	Royal	1.939	0.533	2.492	0.778	1.033
	Bajaj	2.384	0.449	2.957	0.806	1.070
	ICICI	0.793	0.038	1.000	0.793	0.030
	United	1.525	0.685	1.575	0.968	1.045
	Oriental	1.744	0.619	1.802	0.968	1.080
	New India	1.000	0.452	1.000	1.000	0.452
2004-05 to 2005-06	Tata	0.477	3.491	0.356	1.341	1.665
	Iffco	0.260	3.070	0.140	1.855	0.798
	Reliance	0.850	1.079	1.000	0.850	0.917
	Royal	0.632	2.856	0.435	1.451	1.804
	Bajaj	0.398	3.735	0.788	0.505	1.485
	ICICI	0.310	3.110	0.304	1.021	0.966
	United	0.837	1.297	0.927	0.904	1.086
	Oriental	0.909	1.298	1.009	0.901	1.181
	New India	1.000	2.100	1.000	1.000	2.100
2005-06 to 2006-07	Tata	1.000	1.099	1.000	1.000	1.099
	Tata	5.645	0.456	7.567	0.756	2.572
	Iffco	5.061	0.456	7.138	0.709	2.306
	Reliance	2.353	0.456	1.000	2.353	1.072
	Royal	1.719	0.485	1.619	1.062	0.834
	Bajaj	4.094	0.441	1.273	3.215	1.805
	ICICI	1.988	0.601	1.869	1.0619	1.200
	United	0.834	1.082	0.752	1.110	0.903
	Oriental	1.133	1.088	1.000	1.133	1.233
2006-07 to 2007-08	New India	1.000	0.671	1.000	1.000	0.671
	National	1.000	1.130	1.000	1.000	1.130
	Tata	0.928	1.266	1.606	0.578	1.174
	Iffco	0.365	1.329	0.278	1.314	0.485
	Reliance	1.090	1.409	1.000	1.090	1.535
	Royal	0.782	1.455	0.807	0.968	1.138
	Bajaj	1.000	1.340	1.000	1.000	1.340
	ICICI	0.517	1.582	0.628	0.824	0.818
	United	0.091	1.434	0.089	1.016	0.130
2007-08 to 2008-09	Oriental	0.845	1.390	1.000	0.845	1.175
	New India	1.000	1.576	1.000	1.000	1.576
	National	1.000	1.384	1.000	1.000	1.384
	Tata	2.506	0.607	1.000	2.056	1.247
	Iffco	2.079	0.607	1.893	1.099	1.261
	Reliance	1.620	0.722	1.000	1.620	1.170
	Royal	1.633	0.615	1.546	1.056	1.004
	Bajaj	0.775	0.643	1.000	0.775	0.498
	ICICI	2.478	0.702	2.528	0.980	1.740
2008-09 to 2009-10	United	2.311	1.115	2.334	0.990	1.730
	Oriental	1.198	1.102	1.000	1.198	1.319
	New India	0.843	0.873	1.000	0.843	0.737
	National	1.000	1.178	1.000	1.000	1.178
	Tata	0.858	1.199	1.000	0.858	1.028
	Iffco	1.948	1.170	1.901	1.025	2.278
	Reliance	1.000	1.007	1.000	1.000	1.007
	Royal	0.937	1.121	0.981	0.956	1.051
	Bajaj	1.118	0.934	1.000	1.118	1.044
	ICICI	1.384	0.988	1.108	1.249	1.368
	United	1.130	1.110	1.111	1.017	1.225
	Oriental	1.000	1.115	1.000	1.000	1.115
	New India	1.045	1.088	1.045	1.045	1.136
	National	1.000	1.318	1.000	1.000	1.318

For the purpose of year wise analysis of TFPC, three categories of change has been made i.e. less than 1 TFPC, 1-2 TFPC and more than 2 TFPC. Thereafter from the table II it was observed that in almost all the year the TFPC was lies between first two categories i.e. either less than 1 or 1-2, except for the year 2004-05 to 2005-06, 2005-06 to 2006-07 and 2008-09 to 2009-10. Because during these years the TFPC lies in third category i.e. the TFPC was more than 2.

## II ANALYSIS OF DRIVERS BEHIND PRODUCTIVITY CHANGE AND MALMQUIST INDEX

After the investigation of productivity change and Malmquist index Summary, an effort has been made to know the drivers behind this change, which may due to change in technical efficiency or technical progress/technology change. These drivers behind the productivity change and Malmquist index has been analyzed and interpreted in two ways: A. company wise analysis of drivers behind productivity change and Malmquist index and B. Year wise analysis of productivity change and Malmquist index.

### A. COMPANY WISE ANALYSIS OF DRIVERS BEHIND PRODUCTIVITY CHANGE AND MALMQUIST INDEX

This has been done in order to drive the results for each of the company for the period under consideration i.e. an effort has been made to identify and explore the various drivers behind the productivity change of each company individually for all the years.

**TABLE III SHOWS THE COMPANY WISE ANALYSIS OF DRIVERS BEHIND PRODUCTIVITY CHANGE AND MALMQUIST INDEX**

Tata AIG General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency	X	X		X		X	
Technical Progress			X		X		X
IFFCO Tokio General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency		X		X		X	X
Technical Progress	X		X		X		X
Reliance General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency	X	X		X	X	X	
Technical Progress		X	X		X		X
Royal Sundram Alliance General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency	X	X		X		X	
Technical Progress			X		X		X
Bajaj General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency	X	X		X		X	X
Technical Progress			X		X	X	
ICICI Lombard General Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency	X	X		X		X	X
Technical Progress	X	X	X		X		
United India Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency	X	X				X	X
Technical Progress	X		X	X	X	X	X
Oriental Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency		X		X		X	
Technical Progress	X		X	X	X	X	X
New India Assurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency						X	X
Technical Progress	X	X	X	X	X	X	X
National Insurance Company Limited							
Indicators	2002-03 to 2003-04	2003-04 to 2004-05	2004-05 to 2005-06	2005-06 to 2006-07	2006-07 to 2007-08	2007-08 to 2008-09	2008-09 to 2009-10
Technical Efficiency	X						
Technical Progress	X	X	X	X	X	X	X

The table III shows the drivers behind the productivity change which can be change in technical efficiency or technical progress/technology change. The presence of sign (X) shows the applicability of particular driver behind such change. Moreover the results has provided with the fact that the productivity change in the companies under consideration is basically derived by either technical efficiency or technical progress/technology change. Whereas in very few cases the change in productivity is attributable of both technical efficiency and technical progress/technology change.

### B. YEAR WISE ANALYSIS OF DRIVERS BEHIND PRODUCTIVITY CHANGE AND MALMQUIST INDEX

This has been done to in order to find out the year analysis of drivers behind productivity change and Malmquist index, which is the result of technical efficiency, technical progress/technology change i.e. an effort has been made to find out the year in which change was due to technical efficiency or technical progress or both.

TABLE IV SHOWS THE YEAR WISE ANALYSIS OF DRIVERS BEHIND PRODUCTIVITY CHANGE AND MALMQUIST INDEX

Year	Drives	Insurers
2002-03 to 2003-04	Driven by Technical Efficiency	Tata Aig, Reliance, Royal Sundram, Bajaj
	Driven by Technical Progress/Technology Change	IFFCO, Oriental, New India
	Driven by both	ICICI, National, United
2003-04 to 2004-05	Driven by Technical Efficiency	Tata Aig, IFFCO, Royal Sundram, Bajaj, United, Oriental
	Driven by Technical Progress/Technology Change	New India, National
	Driven by both	Reliance, ICICI
2004-05 to 2005-06	Driven by Technical Efficiency	
	Driven by Technical Progress/Technology Change	Tata Aig, IFFCO, Reliance, Royal Sundram, Bajaj, ICICI, United, Oriental, New India, National
	Driven by both	
2005-06 to 2006-07	Driven by Technical Efficiency	Tata Aig, IFFCO, Reliance, Royal Sundram, Bajaj, ICICI,
	Driven by Technical Progress/Technology Change	United, New India, National
	Driven by both	Oriental
2006-07 to 2007-08	Driven by Technical Efficiency	
	Driven by Technical Progress/Technology Change	Tata Aig, IFFCO, Royal Sundram, Bajaj, ICICI, United, Oriental, New India, National
	Driven by both	Reliance
2007-08 to 2008-09	Driven by Technical Efficiency	Tata Aig, IFFCO, Reliance, Royal Sundram, ICICI
	Driven by Technical Progress/Technology Change	National
	Driven by both	Bajaj, United, Oriental, New India
2008-09 to 2009-10	Driven by Technical Efficiency	Bajaj, ICICI
	Driven by Technical Progress/Technology Change	Tata Aig, Reliance, Royal Sundram, Oriental, National
	Driven by both	IFFCO, United, New India

The above table shows that in almost all the year the drives behind the Malmquist index and productivity change is change in technical efficiency of the insurers, except the change in 2004-05 to 2005-06, 2006-07 to 2007-08 and 2008-09 to 2009-10 which was mainly driven due to change in technology or attributable to technical progress.

## CONCLUSION

The results of productivity derived with the application of DEA provided with the fact that all insurance companies have improved its productivity during the period under consideration, except only two public sector companies namely, Oriental Insurance Company Limited and New India Assurance Company Limited which show the reduction in the productivity over a period of time. As initially their total factor productivity growth/change from 2002-03 to 2003-04 was 1.474 and 1.309, which decreased to 1.115 and 1.136 from 2008-09 to 2009-10. This can attributable to the fact that all the insurance companies are taking the advantages of Technological Change (TC), Efficiency Change (EC), Pure Technical Efficiency Change (PTEC) and Scale Efficiency Change (SEC) except these two. Moreover only in the following years (2004-05 to 2005-06, 2005-06 to 2006-07 and 2008-09 to 2009-10) Total Factor Productivity Change (TFPC) lies in third category i.e. it was more than 2. Beside this in almost all the year the drives behind the Malmquist index and productivity change is change in technical efficiency of the insurers, except the change in 2004-05 to 2005-06, 2006-07 to 2007-08 and 2008-09 to 2009-10 which was mainly driven due to change in technology or attributable to technical progress.

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