PRODUCTIVITY PERFORMANCE OF INDIAN NON-LIFE INSURANCE INDUSTRY: POST-LIBERALIZATION FOCUS

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The reforms in the Indian insurance sector have opened new vistas in the insurance industry and has generated intensely competitive environment. The insurance companies have to ensure quality products at competitive price. It is not surprising, therefore, that there is a growing interest and concern about the productivity analysis of Non-Life Insurance companies operating in India. So, in this paper, an attempt has been made to assess the productivity performance of the government owned and private sector owned Non-Life insurance companies in India in the post-liberalization period. The results highlight that the private insurers produced more outputs with the same level of inputs at the end of the study period than at the beginning as compared to the government insurers, whereas few private insurers made a wrong choice while adopting the new technology and scale of operation which perhaps led to produce lesser outputs. However, after gaining experience by operating in the new environment and overcoming the initial shortcomings in the adoption of new technology and correcting the scale of operation, the productivity of these two insurers can also be improved. Productivity of the private insurers due to their high-tech environment is higher than the government insurers. The study suggests that in order to increase productivity, both the Government insurers as well as the private insurers should go for full computerization including latest technology and suggests training and development of manpower to cope with the increasing customer demands of more speed, accuracy and quality service / product.

INTRODUCTION

Productivity is the key indicator of economic progress and is closely associated with standard of living. To enhance the standard of living depends on continuous increase in productivity of the system that provides goods and services. The growth in productivity is one of the most important factors that have contributed to the advancement of nations. It is the heart of an economy and the higher is the productivity growth, the better will be

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the share of productivity gains which, in turn, increases the standard of living. Productivity growth means all round prosperity. It leads to efficient utilization of human, material and technological resources. The poor performance of a firm or an industry may result from low and falling productivity. Relatively low and falling productivity means relatively high and rising production cost. So, an organization which cares for productivity is far better than an organization which does not care for it.

CONCEPT OF PRODUCTIVITY

Productivity is the measure of how well resources are brought together in the organization for accomplishing a set of results (Mali, 2003). The broader concept of total factor productivity includes productivity of labor, capital and also the efficiency with which producers combine those and other factors of production in producing an output. Technical progress, technology usage, managerial efficiency, distribution network etc. are some of the other factors which have a bearing in the case of service sector (Ravishankar, 1996). Productivity is a concept that concerns how well concerns use the resources (Miller and Schmidt, 1984). Essentially, it is the ratio between level of output of the system and the level of the input resources required to achieve that output. Frenskey (1968) explained productivity in five different ways: (i) It is the forum of efficiency; (ii) It is the utility of resources; (iii) It is the ratio rather than phenomenon; (iv) It is the measure of some kind; and (v) It is the rate of return.

REVIEW OF LITERATURE

Productivity has become a buzz word for last couple of decades and the researchers have explored and probed this aspect worldwide. **Neil (1981),** in his paper, discussed conceptual and econometric problems arising from the use of premium income as a proxy for outputs. The study suggested that this measure is appropriate if the product is homogeneous and competitive pressures compel all insurers to charge the same price. **Goran (1982)** used cross-section regressions to evaluate the extent of economies of scale in the Swedish property-liability insurance industry. For the sake of comparison, all regressions conducted with claim volume have also been duplicated using premium income. The results showed that the premium income is less prone to reveal returns to scale when such returns exist. **Cummins et al. (1996),** in their paper examined technical efficiency and productivity growth in the Italian Insurance market. The research concluded that technical efficiency in the Italian insurance industry ranged from 70 to 78

per cent during the study period. However, productivity declined significantly over the sample period, with a cumulative decline of about 25 per cent. **Donni and Fecher (1997),** in their research paper, measured the technical efficiency levels in 15 OECD insurance industries over the period 1983. The paper showed that the growth in productivity observed in all countries is essentially imputable to improvements in technical progress. Reinsurance rates and market share in OECD both seem to favour efficiency levels. **Cummins and Weiss (1998),** in their paper explained modern frontier efficiency methodologies which were rapidly becoming the dominant approach for measuring a firm's performance. The authors concluded that frontier efficiency methods dominate traditional techniques in terms of developing meaningful and reliable measures of insurance firm performance. **McIntosh (1998),** in his article, investigated the scale efficiency in the Canadian insurance industry. Significant short run scale economies were found with respect to both the output of new policies and the stock of policies issued in previous periods. **Ray et al. (1999),** in their paper, surveyed pre-1994 regulation in Germany and the UK, and the European Commission's policy. The results supported the hypothesis that tighter solvency regulation allowed the survival of a larger proportion of higher-cost firms. **Cummins et al. (1999),** in their paper, analysed the relative efficiency of alternative organisation forms in an industry. The results indicated that stocks and mutual insurers are operating on separate production and cost frontiers, and thus, represent distinct technologies. **Brown (2000),** in his paper, outlined the rationale for applying methodologies developed to estimate different kinds of efficiencies of insurer. The results suggested that there were increasing return to scale for the smaller companies and decreasing return to scale for the larger companies, for their risk bearing/ risk pooling services taken as a whole. **Mansor and Radam (2000),** in their study, measured the productivity of life insurance industry in Malaysia by employing the non-parametric malmquist index approach. The results indicated that despite the productivity growth in the insurance industry, it was relatively low compared to the real economic growth experienced by Malaysia. **Diacon (2001),** in his paper, explored the efficiency of UK specialist and composite insurer transacting Non-life Insurance business. The results indicate that UK general and composite insurance companies have the potential to be among the most efficient in Europe. **Diacon et al. (2002),** in their research paper, explored the efficiency of European specialist and composite insurers transacting long-term insurance business. It is clear from the analysis that there were wide variations in all types of efficiency. The more efficient insurance companies in technical terms are likely to be either very large or very small (specialist) companies. It was also observed that average technical efficiency declined over the four years of the

study. **Ennsfellner et al. (2004),** examined the development in the production efficiency of the Austrian insurance market for the period 1994 using firm- specific data on life/ health and non-life insurers obtained from the Austrian insurance regulatory authority. The study provides strong evidence that the process of deregulation had positive effects on the production efficiency of Austrian insurers. **Choi and Weiss (2005),** in their study, analyzed the relationships among market structure and performance in property liability insurers over the period 1992-98 using data at the company and group levels. The overall results suggested that cost efficient firms charge lower prices and earn higher profits, in conformance with the ES hypothesis. **Jeng and Lai (2005),** in their article, used the non-parametric frontier method to examine differences in efficiency for three unique organizational firms in the Japanese non-life insurance industry, Keiretsu firms, non-specialized independent firms (NSIFs), and specialized Independent firms (SIFs). The paper revealed that the value added approach and the financial intermediary approach provide different but complementary results. **Leverty and Grace (2008),** examined two methods for measuring Property-Liability Insurer efficiency; the value added approach and the flow (or financial intermediation) approach. The results showed that approaches are not mutually consistent. The value added approach is closely related to traditional measures of firm performance but the flow approach is generally not. **Jenlin and Wen (2008),** in their paper, applied stochastic frontier approach to investigate the relationship between cost efficiency and the risk management mechanism adopted by a group of property/ liability insurance companies that include both organization forms of stock and mutual insurers for the year 2003. The results indicated that the use of financial derivatives in managing investment risks can enhance the cost efficiency while the use of reinsurance in managing underwriting risks cannot. **Bikker and Gorter (2008),** analyzed competition in the Dutch non-life insurance industry indirectly by measuring scale economies and X inefficiency, assuming that strong competition would force insurance firms to exploit unused scale economies and to push down inefficiencies.

The above review indicates that the measuring productivity of Non-life insurance companies in developed countries like Europe, United States, and Canada etc. has attracted much attention from researchers, at the international level. But no worthwhile research has been conducted to find out the impact of liberalization on the productivity of the Indian Non-life Insurance industry. This gap in the research is particularly notable, because in this liberalized world, productivity performance is a key for survival and growth. So, this paper tries to fill this research gap and evaluate the impact of liberalization on the productivity of Non-life insurance companies

Objectives and Research Methodology of the study

The study aims to achieve following objectives:

1. To appraise the comparative productivity of the Government Sector and the Private Sector Non-life Insurance Companies in India.
2. To identify the gaps in the productivity and to make suggestions to improve the productivity of the Non-life Insurance Industry in India.

The study is mainly based on the secondary data which has been collected from Insurance Regulatory and Development Authority of India (IRDA) annual reports, annual reports of Non-life Insurance companies, various journals related to insurance, websites etc. The reforms in the insurance industry were initiated in the year 1999 and the private sector Non-life Insurance companies started their business in 2000. A total of eight private sector Non-life Insurance companies started their business from the year 2002-03. So, to analyze the comparative productivity of the Government and private sector Non-life Insurance companies in the post-reform period, all the four Government Sector companies and eight private sector companies were taken up for the study. The period of the study was 2002-03 to 2007-08.

MEASUREMENT OF PRODUCTIVITY GROWTH

Numerous methodologies for measuring productivity have been developed over the last three decades. The commonly accepted indices of productivity change are Tornqvist Index, Fisher Ideal Index and Malmquist Index. The popularity of Tornqvist and Fisher Ideal indices results from two desirable features they share. Firstly, both can be calculated directly from price and quantity data, and it is not necessary to recover the structure of the underlying best practice production frontier, and how it shifts over time whether by using econometric techniques to estimate the parameters of functions characterizing the frontier or by using mathematical programming techniques to construct the frontier. Secondly, both are consistent with flexible representations of the frontier, i.e., both are superlative indices.

The popularity of Malmquist Index stems from three quite different sources. Firstly, it is calculated from quantity data only, a distinct advantage if price information is unavailable or if prices are distorted. Secondly, it rests on much weaker behavioral assumptions than the other two indices, since it does not assume cost minimizing or revenue maximizing behavior. Thirdly, provided panel data is available, it provides a

decomposition of productivity change into two components. One is labeled technical change, and it reflects improvement or deterioration in the performance of best practice manufacturing industries. The other is labeled technical efficiency change, and it reflects the convergence toward or the divergence from best practice on the part of the remaining firms. The value of the decomposition is that it provides information on the source of overall productivity change in the firms. The study implements the Malmquist Index by solving a series of linear programming problems to construct the distance functions that make up the Malmquist Index. These distance functions characterize the best practice frontier at any point in time, and they also characterize shifts in the frontier over time as well as movements towards or away from the frontier.

The productivity change of one activity may be due to two components: an efficiency change or a technological change. Consequently, the Malmquist Index of productivity change, TFPC, is obtained as the product of two factors, that is, efficiency change (EC), and technological change (TC).

TFPC = EC x TC

Efficiency Change: Efficiency change is obtained as the ratio between efficiency scores achieved in periods t + 1 and t.

Technological Change: The modern economists emphasize the catalytic role that technological changes play in the growth of an economy. Technological change is a prime mover of economic growth. It refers to the changes in the input-output relations of production activities (Mathur, 1963). As the economy moves from lower to higher stages of development, there occurs a shift from simpler to more modern and complicated techniques of production. Technological changes bring about an increase in income, either by reducing the amount of inputs per unit of output or by yielding more output for a given amount of input (Leontief, 1963). This shift requires different, as well as skill sets much higher level of skill, sets targeted to achieve efficiency in production or service delivery systems. Technological change is a measure of the shift in the frontier over the two periods (Donni and Fecher, 1997). The value of Index>1 shows that insurers are more dynamic in the adoption of new technology (Singh and Kumar, 2005). A value of less than 1 in the index indicates a regress in productivity, equal to 1 indicates stagnation and greater than 1 indicates a productivity growth between period t and t+1 from the perspective of period t.

Malmquist Productivity Index

The Malmquist index is a summary measure of the change in TFP of a given unit over time. Each unit is identified by its inputs-outputs bundle x, y with the superscript indicating whether it is observed at time t and t+1. Following the Malmquist (output-oriented) TFP change index between period t (the base technology period) and period t+1 (the reference technology period) is given by

$$M^{t}_{0}(X_{t+1}, Y_{t+1}, X_t, Y_t) = \frac{D^{t}_{0}(X_{t+1}, Y_{t+1})}{D^{t}_{0}(X_t, Y_t)}$$

Alternatively, the output based Malmquist productivity index with reference to period t+1 technology as

$$M^{t+1}_{0}(X_{t+1}, Y_{t+1}, X_t, Y_t) = \frac{D_{0}^{t+1}(X_{t+1}, Y_{t+1})}{D^{t}_{0}(X_t, Y_t)}$$

The output based Malmquist productivity change index can also be explained as follows:

$$M_0(X_{t+1}, Y_{t+1}, X_t, Y_t) = \left[\left(\frac{D^{t}_{0}(X_{t+1}, Y_{t+1})}{D^{t}_{0}(X_t, Y_t)}\right)\left(\frac{D_{0}^{t+1}(X_{t+1}, Y_{t+1})}{D_{0}^{t+1}(X_t, Y_t)}\right)\right]^{\frac{1}{2}}$$

This is the geometric mean of output base Malmquist productivity indices with reference to period t and period t+1 technology. A value of less than 1 in the index indicates a regress (decline) in productivity, equal to 1 indicates stagnation and greater than 1 indicates a productivity growth between period t and t+1 from the perspective of period t.

$$= \left(\frac{D_{0}^{t+1}(X_{t+1}, Y_{t+1})}{D_{0}^{t+1}(X_t, Y_t)}\right)\left[\left(\frac{D^{t}_{0}(X_{t+1}, Y_{t+1})}{D_{0}^{t+1}(X_{t+1}, Y_{t+1})}\right)\left(\frac{D^{t}_{0}(X_t, Y_t)}{D_{0}^{t+1}(X_t, Y_t)}\right)\right]^{\frac{1}{2}}$$

Where, $\frac{D_{0}^{t+1}(X_{t+1}, Y_{t+1})}{D^{t}_{0}(X_t, Y_t)}$ is the change in relative technical efficiency between periods t and t+1

and $\left[\left(\frac{D_{0}^{t}(X_{t+1}, Y_{t+1})}{D_{0}^{t+1}(X_{t+1}, Y_{t+1})}\right)\left(\frac{D^{t}_{0}(X_t, Y_t)}{D_{0}^{t+1}(X_t, Y_t)}\right)\right]^{\frac{1}{2}}$ ɔtures the shift in technology

(technological change) between the two time periods evaluated at (X_t, Y_t) and (X_{t+1}, Y_{t+1}).

Hence, we have Total Factor Productivity Change = Technical Efficiency Change x Technological Change.

Technical efficiency change measures the change in efficiency between current (t) and next (t+1) periods, while the technological change (innovation) captures the shift in frontier technology.

Measurement of Inputs and Outputs

An important step in productivity analysis is the definition of inputs and outputs. Indeed, the results can be misleading or meaningless if those quantities are poorly defined. This problem is especially acute in the service sector, where many outputs are intangible and many prices are implicit. Defining inputs also must be done with care, where basic data of some inputs, such as the number of hours worked and number of employees is not available in Government sources. In spite of the challenges, researchers have come up with ways to measure inputs and outputs that produce economically meaningful efficiency scores (Communis and Weiss, 1998). Although the choice of inputs and outputs is fundamental to the success of any efficiency analysis it has proved to be problematic in the case of financial services firms.

Particular difficulties can arise in classifying intermediate goods and services, which can have both input and output characteristics. In general, inputs such as land, labour and capital represent the resources that are utilized to produce the firm's output, and the acquisition of these inputs represents a cost to the firm. Output, on the other hand, represents those goods or services which the customers of the firm are prepared to purchase, and the sale of these outputs generates revenue. For financial services companies such as insurers, the output is often intangible, and therefore, difficult to measure. The pragmatic approach is, therefore, to identify the services provided by such firms and find measurable proxies that are highly correlated with those services. There has been considerable disagreement over the appropriate proxies to use the output for insurance services. When it comes to considering insurance company output, the majority of efficiency studies have used premium income as a proxy for the output (of non- investment related) insurance services even though premiums are really a form of revenue, that is price times quantity rather than a count of output units. Investment income is often used to proxy for the investment related services provided by insurers (since again there is no available count of investment units). The problems with using premium income to proxy output have led some authors to use the value of claim payments.

The rational for the use of claim to proxy for insurance output is that the primary function of insurance is risk pooling, i.e., the collection of funds from the policyholder pool and the redistribution of funds to those pool members who incur losses. Claims are also a good proxy for "real services" provided by insurers, such as coverage design and providing legal defense in liability suits (Cummins et al., 1999). However, it is difficult to understand why the management of insurance companies would seek to maximize the value of insurance claims, and this therefore, violates the principal characteristic that more output should be preferred to less (Diacon et al., 2002).

When different outputs provide different conclusions, researchers need to be careful about interpreting results. It may not be appropriate to use only one approach and to draw conclusions from the results of that approach (Jeng and Lai, 2005). Therefore, in this study, three models of output have been used to examine the efficiency and productivity of Non-life Insurance companies in India. In the first model, net written premium has been taken as proxy for the output; in the second, net claim incurred has been taken as output; and in the third, net premium written and investment income have been taken as output. The premiums are usually paid in advance of loss payment. It is necessary to appropriately account for investment income when measuring insurance output (Cummins and Weiss, 1998).

When it comes to the choice of inputs, there is general agreement that labor (administrative, managerial and sales) and capitals are the main input resources utilized in the production of insurance. Although it may be possible to undertake a head count of staff, most studies use total operating and selling costs as a proxy. In the insurance industry, this approximation is a necessity because of the widespread industry practice of outsourcing administrative and sales functions (so that a simple head count would seriously underestimate staff inputs). This study uses staff and capital resources as the main inputs. The inputs of sales, administrative and managerial staff are proxied by the insurers total operating expenses including commission. Capital inputs included shareholders capital plus reserves & surplus.

In the present study, value measures as proxies for inputs and outputs have been used to assess the efficiency and productivity. The widespread practice of using value measures (such as revenue, costs, and capital) as proxies for the inputs and outputs of financial services firms raises questions about exactly what type of efficiency is being measured. Technical efficiency strictly requires inputs and outputs to be measured in units. However, the intangible nature of financial services output often means that no

homogeneous unit of output can be identified (sometimes even conceptually) and output prices cannot be quality adjusted. Similarly, inputs like capital can only exist in value terms, and the unit cost of capital is difficult to measure in firms that are not publically quoted. Thus, the technical efficiencies reported here are value-based rather than the more traditional units-based measures found in many non-financial efficiency studies. The term 'value-based' is used to recognize that the technical efficiency measures are based on monetary values for inputs and outputs (using both cost/revenue flows, and capital stocks), but do not capture optimal choices in response to market prices (Diacon, 2001).

Choice of Model

The question that has to be dealt with is whether to use output or input orientation model. Input-oriented model deals with input minimization approach, which holds outputs constant and determines the minimum level of inputs necessary to achieve that level of outputs. While output orientation model deals with output maximization which holds inputs constant and determines the maximum outputs that can be produced for that given level of inputs.

The current study attempts to measure the productivity using the output maximization model. The Indian insurance industry, still in its nascent stage, has a huge potential to be tapped. So, it makes sense to use output maximization model. To curve the impact of inflation, the whole analysis of productivity has been done at constant prices. The index has been taken from National Income Statistics, July 2008 published by Centre for Monitoring Indian Economy.

Model-I

Output : Premium

Input : Capital and Operating Expenses (Including Commission)

Table 1: Malmquist Growth in Technical Efficiency Index of Non-Life Insurance Companies in the Post-reform Period (Output: Premium)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.000	0.868	1.065	0.852	1.004	0.954
New India	0.659	0.908	1.107	1.096	1.278	0.985
Oriental	0.805	0.742	0.972	1.215	1.066	0.945
United India	0.685	0.770	0.925	1.129	1.236	0.926
Mean	0.776	0.819	1.015	1.064	1.140	0.952
Royal Sundaram	1.056	0.896	1.243	1.234	0.991	1.075
Reliance	0.354	2.164	1.179	1.106	0.776	0.951
Iffco-Tokio	0.960	0.998	0.974	0.906	1.182	1.000
Tata AIG	0.992	1.064	0.852	0.985	1.029	0.982
Bajaj Allianz	1.000	1.000	1.000	1.000	1.000	1.000
ICICI Lombard	2.292	1.000	0.934	1.016	1.054	1.180
Cholamandalam	4.256	1.622	1.150	0.923	1.440	1.602
HDFC Chubb	3.732	1.048	0.947	0.955	1.303	1.357
Mean	1.377	1.170	1.027	1.011	1.080	1.126

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08

Table 1 indicates decline in average technical efficiency change in the years 2003-04 and 2004-05 in the case of Government sector, whereas improvement from 2005-06 to 2007-08. Overall, the average technical efficiency of the Government sector has declined by average 5 per cent per annum. The efficiency change results imply that the Government insurers became less efficient (average efficiency change: $0.95<1$). On the other hand, the private sector has shown a positive growth in efficiency change over the period of study. The average efficiency of the private sector has improved by 12.6 per cent. Overall, the private sector has registered a gain in the efficiency level in the post-reform period, whereas the efficiency level of the Government sector has deteriorated. The analysis also reveals that there is a large disparity of efficiency change among the private insurers.

Table 2: Malmquist Growth in Technology Index of Non-Life Insurance Companies in the Post-reform Period (Output: Premium)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.061	1.193	0.975	1.003	0.973	1.038
New India	1.158	1.159	0.923	1.089	0.845	1.027
Oriental	0.993	1.210	1.002	0.978	0.874	1.006
United India	1.116	1.191	0.968	1.056	0.845	1.028
Mean	1.080	1.188	0.967	1.031	0.883	1.025
Royal Sundaram	1.155	1.190	0.985	1.019	1.110	1.089
Reliance	2.664	0.555	0.825	1.089	0.951	1.048
Iffco-Tokio	1.323	1.136	0.957	0.997	0.935	1.061
Tata AIG	1.122	1.209	0.975	0.987	1.074	1.070
Bajaj Allianz	1.103	1.231	0.993	0.945	1.039	1.058
ICICI Lombard	2.791	0.009	0.897	1.044	0.847	0.461
Cholamandalam	1.437	0.976	0.834	1.076	0.940	1.034
HDFC Chubb	1.377	1.173	0.989	0.934	0.901	1.061
Mean	1.515	0.572	0.929	1.010	0.971	0.955

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08.

The mean technological progress of the Government sector insurers is 2.5 per cent. All the Government sector insurers preferred to go for the technological change. On the other hand, the private sector insurers made technological progress during the years 2003-04 and 2006-2007, while a regress was witnessed during the years 2004-2005, 2005-06 and 2007-2008. ICICI Lombard lagged behind all the private insurers showing a decline of 54 per cent in the technological change. All other private insurers recorded a gain in technical change. Among the private insurers, Royal Sundaram progressed at the highest rate of 8.9 per cent followed by TATA AIG showing a progress of 7.0 per cent. Overall, both the public and private sector insurers progressed technologically except ICICI Lombard which recorded the highest decline of 99 per cent in technological change during the year 2004-05.

Table 3: Malmquist Total Factor Productivity Index of Non-Life Insurance Companies in the Post-reform Period (Output: Premium)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.061	1.035	1.038	0.854	0.976	0.990
New India	0.763	1.053	1.022	1.193	1.080	1.011
Oriental	0.799	0.898	0.974	1.189	0.932	0.950
United India	0.764	0.916	0.895	1.192	1.044	0.952
Mean	0.838	0.973	0.981	1.096	1.006	0.975
Royal Sundaram	1.219	1.066	1.225	1.258	1.100	1.171
Reliance	0.943	1.200	0.973	1.205	0.738	0.996
Iffco-Tokio	1.270	1.135	0.932	0.904	1.106	1.061
Tata AIG	1.113	1.286	0.831	0.972	1.105	1.050
Bajaj Allianz	1.103	1.231	0.993	0.945	1.039	1.058
ICICI Lombard	6.396	0.009	0.838	1.061	0.892	0.544
Cholamandalam	6.117	1.583	0.959	0.993	1.353	1.657
HDFC Chubb	5.139	1.229	0.936	0.891	1.173	1.440
Mean	2.087	0.669	0.955	1.021	1.048	1.075

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08.

Table 3 presents the Malmquist productivity indices of the public and private sector Non-Life Insurance companies. As is evident from the table, Government sector Non-Life Insurance companies showed improvement in their productivity during the period 2006-07 and 2007-08. On the other hand, the private insurers showed improvements in productivity in 2003-04, 2006-07 and 2007-08. The geometric mean in the case of private insurers in the year 2003-04 was 2.087, registering the highest productivity growth rate of 109 per cent, while in the year 2004-05 it was 0.669, recording maximum decline of about 33 per cent in productivity. The geometric mean of 1.07 in the case of all the private insurers during the study period indicated 7.5 per cent progress in productivity. Among the private insurers, Reliance and ICICI Lombard showed a decline in productivity, whereas all other private insurers recorded progress in productivity. The study provides that in the case of Government insurers, a 5 per cent decline in technical efficiency is partially offset by a 2.4 per cent improvement in technology change which resulted in a overall reduction of 2 per cent in total factor productivity. On the other hand, the decline of 2 per cent in technological change of the private insurers was being compensated by the 12.5 per cent improvement in efficiency change which resulted into overall 7.5 per cent growth in total factor productivity of the

private sector. The fall in productivity of the Government insurers over the period is attributable to technical efficiency change.

Model II

Output: Premium and Investment Income

Input: Capital and Operating Expenses (Including Commission)

Table 4: Malmquist Growth in Technical Efficiency Index of Non-Life Insurance Companies in the Post-reform Period (Output: Premium and Investment Income)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.000	1.000	1.000	1.000	1.000	1.000
New India	0.804	1.116	1.275	1.000	1.000	1.027
Oriental	1.000	1.000	1.000	1.000	1.000	1.000
United India	0.940	0.954	1.115	0.981	1.019	1.000
Mean	0.932	1.016	1.092	0.995	1.005	1.007
Royal Sundaram	1.047	0.896	1.243	1.234	0.991	1.074
Reliance	0.717	1.294	1.077	1.000	0.776	0.951
Iffco-Tokio	0.960	0.998	0.974	0.924	1.159	1.000
Tata AIG	0.995	1.079	0.842	0.987	1.022	0.982
Bajaj Allianz	1.000	1.000	1.000	1.000	1.000	1.000
ICICI Lombard	2.163	1.000	1.000	0.989	1.011	1.167
Cholamandalam	1.415	1.349	1.205	0.913	1.390	1.239
HDFC Chubb	3.535	1.033	0.975	0.955	1.264	1.339
Mean	1.292	1.072	1.032	0.996	1.062	1.086

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08.

The results indicate that there is a decline of 7.7 percent per annum in technical efficiency change of the Government insurers in the year 2003-04. However, in all other years, Government insurers showed improvement in technical efficiency over the previous years. The geometric mean of technical efficiency change of the Government insurers is 1.007 which indicates about marginal gain of 1 per cent in their efficiency change. The geometric mean of efficiency change of National, Oriental and United India companies is 1, which indicates that efficiency change of these three Government sector insurers remained the same during the sample period. The results show that the geometric mean of efficiency change of the private insurers is 1.086, indicating 8.6 per cent improvement in efficiency level. It has been found that the efficiency progress of the private sector is higher than that of the Government sector Non-Life Insurance

companies. However, Reliance and Tata AIG showed no change in their efficiency level.

Table 5: Malmquist Growth in Technology Index of Non-Life Insurance Companies in the Post-reform Period (Output: Premium and Investment Income)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.035	1.006	1.187	0.945	0.987	1.029
New India	1.060	1.008	0.927	1.143	1.055	1.036
Oriental	1.203	1.005	0.917	1.105	0.915	1.023
United India	1.066	1.069	0.983	1.039	1.052	1.041
Mean	1.089	1.022	0.998	1.055	1.001	1.032
Royal Sundaram	1.139	1.186	0.985	1.021	1.114	1.086
Reliance	0.761	0.520	0.967	1.010	0.951	0.818
Iffco-Tokio	1.309	1.136	0.956	1.004	0.951	1.063
Tata AIG	1.119	1.174	0.982	0.986	1.083	1.066
Bajaj Allianz	1.102	1.205	0.992	0.947	1.050	1.056
ICICI Lombard	2.597	0.009	0.846	1.041	0.900	0.450
Cholamandalam	0.989	0.868	0.805	1.047	0.957	0.929
HDFC Chubb	1.071	1.162	0.973	0.956	0.920	1.013
Mean	1.183	0.555	0.936	1.001	0.988	0.905

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08.

The table reveals that all the Government insurers made technological progress during the study period. In their case, the geometric mean of technological change is 1.03, which means that these companies technologically made a progress of average 3 per cent per annum over the period. The results of the private sector companies showed technological regress in 2004-05, 2005-06 and 2007-08. The geometric mean of technological change in the case of private sector is 0.91, indicating 9 per cent regress in technological change. All private insurers did not exhibit regress in technological change. ICICI Lombard showed the highest decline followed by Reliance and Cholamandalam. All other private insurers showed technological progress over the study period. Overall, the results indicate that in the post-reform period, the Government sector companies showed technological progress, while their counterparts showed regress in technological change. This decline in technological change implies that private insurers need more inputs to produce their outputs at the end of the study period than at the beginning. The analysis reveals that in a dynamically changing environment many private insurers adopted new approaches to increase their outputs. In

this effort, some of the companies made wrong choice in the selection of technology, which resulted into excessive consumption of inputs. So, the private insurers must improve their technology carefully in this competitive environment.

Table 6: Malmquist Total Factor Productivity Index of Non-Life Insurance Companies in the Post-reform Period (Output: Premium and Investment Income)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.035	1.006	1.187	0.945	0.987	1.029
New India	0.852	1.125	1.182	1.143	1.055	1.064
Oriental	1.203	1.005	0.917	1.105	0.915	1.023
United India	1.002	1.020	1.096	1.019	1.072	1.041
Mean	1.015	1.038	1.090	1.050	1.005	1.039
Royal Sundaram	1.193	1.062	1.225	1.259	1.104	1.166
Reliance	0.546	0.672	1.041	1.010	0.738	0.778
Iffco-Tokio	1.256	1.135	0.931	0.927	1.103	1.063
Tata AIG	1.113	1.266	0.826	0.973	1.107	1.046
Bajaj Allianz	1.102	1.205	0.992	0.947	1.050	1.056
ICICI Lombard	5.619	0.009	0.846	1.030	0.910	0.526
Cholamandalam	1.400	1.171	0.970	0.956	1.330	1.151
HDFC Chubb	3.786	1.201	0.948	0.913	1.163	1.356
Mean	1.529	0.595	0.966	0.997	1.049	0.983

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08.

It is evident from the table that Government sector insurance companies showed improvement in their productivity during the period 2003-04 to 2007-08. The geometric mean of productivity change of the Government sector insurers is 1.04 which reflects average 4 per cent improvement in their productivity during the study period. The geometric mean of the total factor productivity change of the private insurers is 0.98 which shows just 2 per cent regress in productivity. There is a large disparity in the productivity change among the private insurers. ICICI Lombard and Reliance exhibited productivity change means of 0.526 and 0.778 which explains a decline in productivity of 47 per cent and 22 per cent respectively. However, all other private sector insurers recorded progress in productivity. It has been found that the decline of 9.5 per cent in the technological change of the private insurers is being compensated by 9 per cent progress in efficiency change which resulted into 2 per cent regress in overall total factor productivity of the private sector during the study period.

Table 8: Malmquist Growth in Technology Index of Non-Life Insurance Companies during the Post-reform Period (Output: Claim)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.082	0.953	1.253	0.785	1.047	1.012
New India	0.951	0.838	1.089	0.999	1.047	0.981
Oriental	1.080	0.931	1.130	0.976	1.027	1.026
United India	0.947	0.867	1.110	0.995	1.047	0.990
Mean	1.013	0.896	1.144	0.934	1.042	1.002
Royal Sundaram	0.949	0.866	1.131	0.749	1.090	0.947
Reliance	1.654	0.434	1.039	0.999	1.069	0.955
Iffco-Tokio	1.072	0.815	1.105	0.979	1.014	0.992
Tata AIG	0.985	0.939	1.162	0.871	1.090	1.004
Bajaj Allianz	1.008	0.902	1.130	0.933	1.060	1.003
ICICI Lombard	1.851	0.007	1.076	0.991	1.047	0.434
Cholamandalam	1.140	0.700	1.044	0.999	1.063	0.976
HDFC Chubb	1.088	0.850	1.119	0.963	1.019	1.003
Mean	1.183	0.426	1.100	0.932	1.056	0.887

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08.

The mean technological change of all the Government insurers is 1.0, which signifies that there was no technological change. The private sector insurers exhibited technological progress during the period in their case 2003-04, 2005-06 and 2007-08, while a regress during 2004-05 and 2006-07. The geometric mean of all the private insurers during the study period is 0.89, indicating 11 per cent decline in technological change. The private insurers experienced highest decline in technological change in the year 2004-05.

Table 9: Malmquist Total Factor Productivity index of Non-Life Insurance Companies during the Post-reform Period (Output: Claim)

Name of the Company	2003-04	2004-05	2005-06	2006-07	2007-08	Mean
National	1.112	0.953	1.253	0.785	1.047	1.018
New India	0.679	1.064	1.147	1.094	1.197	1.016
Oriental	0.808	1.175	0.937	1.247	1.008	1.022
United India	0.732	0.988	0.894	1.130	1.073	0.952
Mean	0.817	1.042	1.047	1.049	1.079	1.002
Royal Sundaram	1.280	1.023	0.983	1.083	1.177	1.104
Reliance	0.670	1.054	0.975	0.667	1.177	0.884
Iffco-Tokio	1.601	0.990	0.942	1.151	1.078	1.131
Tata AIG	1.087	1.153	0.990	0.964	1.118	1.060
Bajaj Allianz	1.007	1.106	1.264	0.797	1.157	1.053
ICICI Lombard	8.959	0.007	0.877	1.162	1.096	0.595
Cholamandalam	18.525	2.215	1.090	0.623	1.418	2.086
HDFC Chubb	12.185	2.009	0.877	0.959	1.376	1.952
Mean	2.725	0.674	0.993	0.903	1.194	1.146

Source: Compiled from Annual Reports of IRDA from 2002-03 to 2007-08.

The results exhibit an improvement in the productivity of Government insurers from 2004-2005 to 2007-08 and a decline only in the year 2003-04. The private insurers exhibited progress in productivity during the period 2003-04 and 2007-08 and a decline during the years 2004-05 to 2006-07. The geometric mean of all the Government insurers is 1.002, which means that a slight improvement in productivity was visible at the beginning of the period to the end of the study period. On the other hand, mean of total factor productivity change of the private insurers is 1.15, which reveals 15 per cent growth in productivity. It is evident from the study that the private insurers have shown better productivity results than the Government sector. The study also concludes that the decline in technological change of the private insurers is being compensated by the improvement in efficiency change which resulted into overall improvement in productivity of the private insurers.

CONCLUSION

It has been found that different output models have produced different productivity results during the post-reform period. The Premium Output Model exhibited that the Government insurers showed 4.8 per cent regress in efficiency change and 2.5 per cent

progress in technology which resulted into overall 2.5 per cent decline in total factor productivity change. On the other hand, the private insurers exhibited 12.6 per cent progress in efficiency change and 4.5 per cent regress in technological change which resulted into 7.5 per cent improvement in total factor productivity. As per the Premium and Investment Income Output Model, the Government insurers exhibited 0.7 per cent progress in efficiency change and 3.2 per cent progress in technological change, which resulted into 3.9 per cent growth in total factor productivity. Among the private insurers, there is 8.6 per cent improvement in efficiency and 9.5 per cent regress in technological change leading to 1.7 per cent decline in total factor productivity. As per the Claim as Output Model, the Government insurers exhibited almost the same level of efficiency change, technological change and total factor productivity, whereas the private insurers showed an improvement of 29.2 per cent in efficiency change and a decline of 11.3 per cent in technological change which resulted into 14.6 per cent progress in total factor productivity. Among the private insurers, ICICI Lombard and Reliance exhibited the highest decline in total factor productivity. On the whole, it is observed that but for ICICI Lombard and Reliance, other private insurers exhibited higher improvement in productivity change than the Government insurers during the post-reform period as per Premium Output and Claim Output Models. The results highlight that the private insurers produced more outputs with the same level of inputs at the end of the study period than at the beginning as compared to the Government insurers, whereas in the case of two private insurers, namely, ICICI Lombard and Reliance, it looks that these two insurers made a wrong choice while adopting the new technology and scale of operation which perhaps led to produce lesser outputs. However, after gaining experience by operating in the new environment and overcoming the initial shortcomings in the adoption of new technology and correcting the scale of operation, the productivity of these two insurers can also be improved. Productivity of the private insurers due to their high-tech environment was higher than the Government insurers. These were basically technology driven companies. These insurers invested more in latest technology rather than employing more and more manpower. It can be suggested that in order to increase productivity, both the Government insurers as well as the private insurers should go for full computerization including latest technology and also appoint trained computer experts to handle the insurance service. Existing staff must also be trained according to the latest technical requirements. From time to time, training of manpower is suggested in order to cope with the increasing customer demands of more speed, accuracy and quality service / product.

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