Cost Efficiency and Total Factor Productivity: An Empirical Analysis of Insurance Sector in Pakistan

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Total factor productivity

DEDICATION

This work is dedicated to my beloved parents whose love, inspiration and guidance have always been working as a source of motivation for me.

Certificate

It is to certify that this thesis submitted by **Ms. Uzma Noreen**, is accepted in its present form by the Department of Economics (Women Campus), International Islamic University, Islamabad as satisfying the requirement for partial fulfilment for the degree of Master in Philosophy in Economics

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Abstract

This study examines the impact of financial sector reforms on the efficiency and productivity of Pakistan's insurance sector using Data Envelopment Analysis (DEA) and Malmquist Index approach over the period 2000-2007. Tobit model is used to explain the impact of financial sector reforms on the efficiency of insurance companies. Firm's characteristics are included in the model to control the heterogeneity among the firms. Results indicate that insurance sector is 36 percent cost inefficient, mainly due to allocative inefficiency. However firms remain technically more efficient with pure technical efficiency (82 percent) and scale efficiency (85 percent). Malmquist index results are also indicative of productivity growth i.e. total factor productivity shows 4.8 percent growth over the sample period. Tobit results illustrate that large firms are relatively inefficient in allocating resources by equating marginal products to factor prices. Furthermore, results demonstrate that private firms are more efficient than public firms. Nevertheless, life insurance firms perform better than their counter parts. The findings suggest that a more competitive environment, diversified products and innovative technology can improve the efficiency and productivity of insurance firms.

Table of Contents

CHAPTER

1

Introduction

Insurance industry plays an important role for the development of social and economic sectors of an economy by minimizing risk of all economic activities, on the one hand and producing long term financial resources, on the other hand. An efficient and productive insurance sector also indirectly contributes to economic growth of a country by converting savings into investment projects through the financial institutions (Financial Sector Assessment: 2005). Insurance companies offer different services to households and businesses for their well being. The primary service of insurance company is to provide risk coverage against any loss of property, business and life, etc. Thus, an insurance firm encourages the risk-averse individuals and entrepreneurs to undertake high return activities, of course with higher risk than they would be in the absence of insurance. This risk-taking behavior of insurance companies contributes to higher productivity and economic growth. However, in case of a life insurance where contract comprises of a longer time period, it also pools the individual risk together with savings which is common in developing countries. Having multiple functions that aid to both socio-economic development of an economy, the productivity of this sector becomes even more important, which calls for particular attention of policy makers and researchers.

Growth in insurance sector has attracted researchers to investigate the performance of this sector in the wake of recent financial sector reforms (See for instance, Meador et al.,

1996; Berger and Humphrey, 1997; Cummins and Zi, 1998; Worthington and Hurley, 2002). While a rich and diverse literature focused on banking research in recent years, limited studies are available which measures the performance of insurance sector, particularly, in developing countries (For example, Mansoor and Radam, 2000; Kao et al. 2008).

In the past, insurance sector in Pakistan did not get a considerable attention of policy makers. Insurance sector in Pakistan remain undeveloped and relative size is considerably smaller as compare to other regional developing countries. Further, this sector has been dominated by the state-owned insurance companies controlling most of the industry.

Like many other developing countries, Pakistan has started the process of financial sector reforms in 1990s. As a result of this financial deregulation, private domestic and foreign firms were allowed to participate in the insurance business. In spite of the 1990s deregulation process, state owned corporations continued to dominate the insurance industry till 2000. However from year 2000 to onwards, the insurance sector business in Pakistan witnessed a significant growth. Overall stable macroeconomic environment and economics growth; have improved per capita income, growth in private sector credit and expansion in trade sector have contributed most of the growth in the insurance sector (Financial Stability Review: 2006).

Given the importance of insurance sector in the country's socio-economic development and its distinct functions from other financial institutions, it seems attractive to look at its

performance. The insurance sector in Pakistan has fairly developed in the recent years by transforming its landscape from monopolistic to competitive market structure. Therefore, it would be interesting to examine the performance of this sector and look at the factors which affect its performance.

1.1 Objectives of the Study

Most of the empirical studies on the efficiency of insurance sector have primarily concentrated on the developed countries.[1] However, there are few studies available to measure the efficiency and productivity of insurance sector in developing countries, but these studies have limited scope (see for example, Mansoor and Radam, 2000; Karim and Jhantasans, 2005; Hao and Chou, 2005). We do not find even a single study focusing on the performance analysis of insurance sector in Pakistan.

Like other financial institutions, insurance industry has also undergone the financial liberalization and deregulation in Pakistan. Therefore, present study attempts to examine the performance of insurance industry and try to explore if these reforms have altered the efficiency and productivity of individual insurance companies. Thus, this study endeavors to bridge the gap in the literature on efficiency and productivity of insurance sector of developing countries in general, and Pakistan in particular. More specifically, the study will concentrate on:

i. How did financial sector reforms affect the economic efficiency and productivity of insurance sector in Pakistan?

[1] See for example, Cummins and Weiss (1991), Yuengert (1993), Cummins and Weiss (1997), Rees and Kessner (1999), and Mahlberg and Url (2000).

ii. Decomposition of cost efficiency into pure technical, allocative and scale efficiency.

iii. To investigate the total factor productivity of insurance firms and its decomposition into Efficiency change and technical change.

iv. Examine the efficiency and productivity differentials among different insurance service providers.

v. To identify the exogenous factors (such as ownership structure, various insurance services and profitability indicator etc.) influencing the efficiency of these firms.

Thus, the present study contributes the existing literature on insurance sector efficiency in developing countries on the one hand and sets lines for the future research on insurance sector in Pakistan, on the other hand.

1.2 Organization of the Study

This thesis is organized in the following sections. Chapter 1 presents the introduction of the topic and highlighted the objectives of the study. Chapter 2 provides an overview of the insurance sector of Pakistan. Chapter 3 reviews the related literature on the efficiency and productivity of insurance sector. Chapter 4 outlines efficiency and productivity concepts and empirical methodology. Chapter 5 presents data and the description of the selected variables. Chapter 6 analyzes efficiency and productivity results and explains the key determinants affecting performance of insurance industry of Pakistan. Finally, chapter 7 concludes the study by underlining its limitation, pointing out some policy implications and suggesting the future lines for further research in insurance industry of Pakistan.

Chapter 2

AN OVERVIEW OF INSURANCE SECTOR IN PAKISTAN

2.1 Introduction

Insurance sector plays a diverse role by supporting individuals, entrepreneurs and companies confronted with a multiplicity of risks, in addition to its limited role of financial intermediation. The well organized insurance sector is essential for the promotion of sustainable economic growth and stabilization of the economy by fostering capital mobilization as well as efficient investment through financial Markets (Financial Sector Assessment, 2005). An insurance firm has a multiple functions which can be broadly categorized into two types. It has some primary functions that are associated with provision of protection against economic losses of future risk, accidents and uncertainty. The secondary functions of an insurance company are to guide individuals and businessmen to adopt suitable mechanism to prevent inopportune consequences of risk adopting in their businesses. The insurance industry also supports the business community by paying off some premium against risks and uncertainty resulting from security investments. Further, it offers opportunity to larger industries having more risks, to expand its business by insuring their physical assets including machinery and plant. The other issues may be included as means of savings and investment, foreign exchange earnings and risk free trade by offering a diversity of insurance policies.

2.2. Types of Insurance Sector Business

Broadly speaking, the insurance industry of Pakistan is categorized into two different types regarding its business activities such as life insurance and non-life insurance sector (Financial Sector Assessment, 2003). The life insurance company insures the risk of individuals against death offering different kind of policies such as time life, cash value life and variable life insurance. On the other hand, non-life insurance companies deal with a diversified insurance policies that include health insurance, disability insurance, property insurance, liability insurance and other guaranteed insurance related to investment (Financial Sector Assessment, 2005). However, each insurance policy differs in term of its terms and conditions and other regulations, which also vary from country to country.

2.3 An Overview of Insurance Sector in Pakistan

The insurance sector of Pakistan has a long history that goes back to the independence of Pakistan. At the time of independence, insurance sector was heavily dominated by the foreign insurance companies. There were 77 foreign companies working in Pakistan as compared to 7 domestic companies mostly working under state-ownership. In 1953, however, government of Pakistan set up Pakistan Insurance Corporation (PIC) to encourage the participation of local insurers and subsequently National Co-Insurance Scheme (NCIS) was launched with the support of local insurers to compete the foreign insurer. The ultimate goal of the establishment of NCIS was increase the participation of

local firms in insurance business and to help the small insurance firms to compete with their rivalry foreign companies, which resulted in expansion of local firms to 60 by decreasing the foreign insurance considerably to 7 only. Until 1972, the insurance sector of Pakistan was run by the private sector companies. However, in 1972 again the life insurance sector was nationalized and State Life Insurance Corporation (SLIC) was established by taking over all assets and liabilities of the private sector and later on, in 1976 National Insurance Corporation (NIC) was established to nationalize the General insurance Business.

Since the process of financial liberalization began in early 1990s, the insurance market was opened for the domestic and foreign insurers. Although, government stepped up by providing a level playing field for the insurance sector, still state owned corporation continued to dominate the market perhaps due to a large network. On the other hand, private sector confined to its limited growth that resulted from lack of professional expertise as well high premium rates compared to state-owned firms (Financial Sector Assessment, 2003). However, in the early 2000s private insurance sector got a growth momentum in its business and domestic firms developed fairly in this period. The insurance industry in Pakistan showed a healthy growth in the last few years.[1]

However, after the implementation of insurance ordinance 2000, both the public and private insurance sector saw a persistent improvement in its capital base, assets structure

[1] In recent years, there has been a significant increase in gross premiums, which has been recorded about 17% in non-life sector, while life premiums rose by 36% (IAP annual report, 2007-08).

and profitability. [2] The macroeconomic factors such as high economic growth, expansion in trade sector, higher per capita income and growing private sector credit also contributed to the better performance of the insurance sector (Financial Stability Review, 2007-08).

Compared to the insurance markets in other developing countries, the Pakistan's insurance sector is relatively underdeveloped. The insurance industry of Pakistan has a very low insurance density (i.e., Gross Premium Per Capita) and insurance penetration (i.e., Gross Premium as a Percent of GDP) as compared to other developing countries. The low density and dissemination of insurance business in Pakistan may be the resulting from low per capita, unaffordable premium rates, inflation, religious and other cultural factors that have not created much insurance demand in Pakistan.

2.4 Performance Indicators of Insurance Industry in Pakistan

The insurance industry in Pakistan experienced significant changes in its structure after Securities Exchange Commission of Pakistan introduced a series of reforms to make non-banking financial sector sound and competitive. Table 2.1 shows the assets composition of insurance sector in state-owned, private and foreign companies both under life and non-life business. Asset structure of the overall insurance industry shows that life insurance sector dominates the overall insurance industry. We note that by the end of 2005, life insurance sector made about 70 percent of the total insurance in Pakistan, reduced to 59 percent in the later years. We also note that life insurance business is still

[2] Under the insurance ordinance, SECP required from the general and Takaful insurers to improve their paid up capital from Rs. 120 million in year 2007 to Rs. 300 million by 2011, while life insurers are required to enhance their paid up capital from Rs. 300 million to Rs. 500 million at the end of 2011.

dominated by the publically owned companies, which make about 52 percent of the total insurance business in Pakistan. On the other hand, non-life insurance makes only 37 percent of the insurance industry of Pakistan. However, there has been a significant growth in non-life business as it increased from 23.4 percent in 2001 to 37.3 percent in the year 2007. It is noticeable that major part of non-life business is owned by private sector opposite to life insurance sector. It can be observed from the last row of the table that there has been a momentous growth in assets of insurance industry during the period 2001-2007. The total assets grew with an annual average rate of 20 percent amounting to Rs. 325 billion by the end of 2007.

Table 2.1
Asset Structure of the insurance industry: 2001-2007
(Shares in percent)

shares	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Life	73.7	73.7	71.4	71.0	70.6	67.1	59.0
State owned	71.6	71.2	67.7	66.8	65.5	61.5	52.2
Private	1.1	1.5	2.4	2.6	3.1	3.3	4.3
Foreign	0.9	1.0	1.3	1.6	2.0	2.3	0.8
Non-Life	23.4	23.1	24.5	25.5	26.6	30.2	37.3
State owned	9.9	9.4	9.3	8.6	8.4	7.4	6.6
Private	12.7	12.8	14.2	15.9	17.4	22.0	30.0
Foreign	0.8	0.9	1.0	0.6	0.8	0.8	0.8
Reinsurance	2.9	3.2	4.1	3.8	2.8	2.6	3.2
State owned	2.9	3.2	4.1	3.8	2.8	2.6	3.2
Takaful	...	...	...	...	...	0.3	0.5
Total Assets[a]	113.4	129.8	151.4	174.6	201.7	246.1	325.1

Source: Financial Stability Review, 2007-08, a: Assets are given in Billion Rupees.

2.4.1. Financial Soundness Indicators of Non-Life Insurance

Non-life insurance business is further classified into four different categories such as fire, marine, motor and miscellaneous.[3] Although, currently, there are 52 general insurance companies registered under the insurance ordinance 2000, but, general insurance business is heavily concentrated by the few large insurers as discussed above.[4] Table 2.2 presents the capital adequacy measures of the non-life insurance sector. We find that non-life insurance sector on average shows healthy performance in terms of its assets and equity growth over the period 2002-2007. It is noticed that equity of insurance companies in non-life business sector grew with an average rate of 36.2 percent, while growth in assets of these firms remained about 31.3 percent annually.

Table 2.2
Capital adequacy ratios of non-life insurance sector

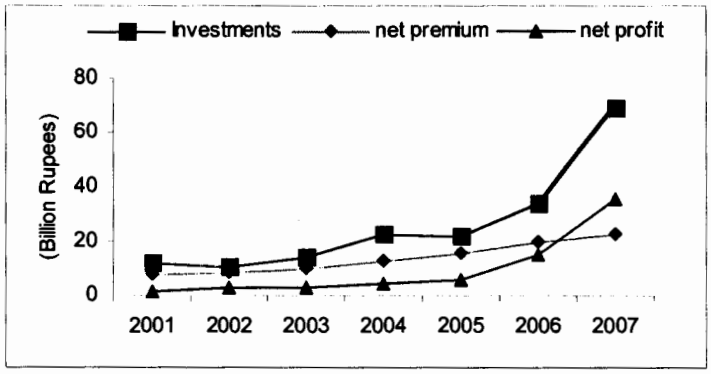
Year	Capital/Total Assets	Paid-up Capital/ Total Equity	Growth rate of Equity	Growth rate of Assets
2002	17.0	40.6	18.1	18.7
2003	15.0	37.6	15.3	13.8
2004	15.0	36.1	19.1	45.8
2005	12.0	32.5	27.4	22.1
2006	11.0	32.0	59.3	34.8
2007	17.5	14.1	72.2	53.5
Average	14.6	32.2	36.2	31.3

Source: Financial Stability Review, 2007-08.

[3] The miscellaneous insurance includes many different insurance classes like aviation, cash related insurance and travel insurance etc.
[4] Top ten insurance firms hold about 84 percent of insurance business (see Appendix, Table A.1.1 and A.1.2).

Investments, net premiums and net profit are considered important indicators to determine the financial performance of the industry. Figure 2.1 shows increasing trends of investments, net premium and net profit in non-life insurance sector, which indicates that general insurers improved its productivity during 2001-2007. Figure shows that there has been a sharp increase in investment in non-life business sector in recent years, which rose about four times from 2005 to 2007. Similarly, there have been upward trends in net premium as well as net profit of the industry during this period.

Figure 2.1
Growth in productivity and profitability 2001-2007



2.4.2 Financial Soundness Indicators of Life Insurance

We note from our previous discussion that life insurance sector is dominated by public sector making 68 percent of the market share in terms of premium and 89 percent in terms of assets share in year 2007 (see Appendix, Table A.1.3 and A.1.4). Table 2.3 presents financial indicators of life insurance sector of Pakistan for the year 2002-2007. It is evident from the table that life sector show a considerable improvement in its performance indicators. Equity and assets show a remarkable growth in recent years, which increased to 40.4 percent and 16.8, respectively.

Table 2.3
Capital Adequacy Measures of life insurance sector

Year	Capital/Total Assets	Growth Rate of Equity	Growth Rate of Assets
2002	1.4	18.6	14.4
2003	1.7	20.2	12.6
2004	1.5	37.6	15.1
2005	1.5	31.5	14.9
2006	1.7	28.9	15.4
2007	2.1	40.4	16.8
Average	1.7	29.5	14.9

Summing up, the insurance sector of the Pakistan showed healthy trends in recent years. We note that liberalization of insurance industry in recent years reduced the public share, particularly in non-life sector, which encouraged private sector by providing a competitive environment.

Chapter 3

THE REVIEW OF LITERATURE

The growth of the financial sector in recent years and its importance to the economy got the attention of the researchers and policy makers to measure the efficiency of financial institutions. Financial sector comprises of banks as well as non-bank financial institutions. Nonetheless, financial sector is dominated by banking industry in all countries in the world, non-banks financial institutions make a considerable share of these economies. These institutions are well established in many countries and saw a momentous growth in recent years. Non-banking financial sector includes development financial institutions, investment banks, mutual funds, insurance companies, venture capital and leasing companies.[1]

The process of deregulation and financial liberalization also motivates the researchers to measure the impact of this process on the efficiency and performance of financial institutions. Several studies have been carried out to measure the banking efficiency both in developed and developing countries by using parametric and non-parametric approaches[2]. However most of the studies on insurance efficiency heavily concentrated

[1] In recent years, there has been a significant growth in Islamic mode of finances such as Mudaraba, Musharka, Islamic leasing and Takaful (reinsurance) in Pakistan as well as in other Islamic countries.

[2] These studies include Ferrier and Lovell (1990) and Wheelock and Wilson (1999) for USA Banks, Fukuyama (1993) for Japanese commercial banks, Lang and Welzel (1998) for German cooperative banks, Noulas (2001) for Greek Banks, Isik and Hassan (2002) for Turkish Commercial banks, Yudistira (2004) for Islamic banks, Adongo et al. (2005) for Namibia's banking sector, Ataullah and Le (2006) for Indian banks and Burki and Niazi (2006) for Pakistan.

on the developed countries and particularly, on the USA insurance industry [Amel et al (2004)]. The efficiency studies that evaluated the performance of USA insurance sector are [Weiss (1991), Gardner and Grace (1993), Yuengert (1993), Cummins and Weiss (1998), Cummins, Tennyson, and Weiss (1999), Cummins, Weiss, and Zi (1999), Meador et al (2000), Greene and Segal (2004), Jeng et al (2007), Cummins and Xie (2008)]. The insurance industries of European countries have been analyzed by Cummins et al. (1996), Hardwick (1997), Rees and Kessner (1999), Mahlberg and Url (2000), Ennsfellner et al. (2004), Cummins and Rubio-Misas (2006), Fenn et al (2007), Bikker and Leuvensteign (2008). These studies focus on insurance sectors of Italy, UK, Germany and UK, Germany, Austria, Spain, EU and Denmark, respectively. The following section presents a review of efficiency literature on insurance industry.

3.1 A Review of U.S. Insurance Sector Efficiency and Productivity

U.S. insurance sector is considered one of the leading and well developed sectors in the world, therefore, has attracted a lot of researchers to investigate the performance of this sector since last few decades. We try to highlight some of the significant studies on US insurance sector. These studies focus on efficiency, productivity and scale economies of US insurance industry and try to correlate with the pre- and post deregulation period. For instance, Cummins and Weiss (1993), Gardner and Grace (1993), and Yuengert (1993) measure the X-efficiency of either the life or the property industry in the United States. Cummins, Weiss, and Zi (1999) also use a frontier analysis (data envelopment analysis, DEA) to examine the efficiency difference between different organizational forms in the U.S. Further, Cummins, Tennyson, and Weiss (1999) also apply DEA method to study

the efficiency performances of the mergers and acquisitions. A brief chronology of some studies on U.S. insurance sector is outlined in this section.

Yuengert (1993) investigates the x-inefficiency and scale economies of U.S. life insurance industry. This study distinguishes itself in term of methodology from the earlier studies as it applies mixed-error model (normal-gamma model). By relaxing that assumption he allows the distribution terms to vary with firm size.

Meador et al (1996) investigate the relationship between x-efficiency and product choice of the firms using Distribution Free Approach (DFA) for the period 1990-1994. Testing two hypotheses (i.e., diversification hypothesis and concentration hypothesis)[3] the study reveals that average x-efficiency score remain 54.92 percent, with a wide dispersion in efficiency. [4] Further, the regression correlates find a positive relationship of market share with x-efficiency and a negative relationship with equity to total assets ratio showing that firms with more equity are less cost efficient.

Cummins et al. (1999) examine the relationship between M & A, efficiency and scale economies for U.S. life insurance industry for the period 1988-1995. They note that M&A lead to improve the efficiency gains of acquired (target). Results of Malmquist index also indicate a substantial improvement in efficiency and productivity of acquired firms than those of non-M&A firms. Similarly, Cummins and Xie (2008) analyze the

[3] Diversification hypothesis states that x-efficiency increases when a DMU produce a wide range of different but related outputs and concentration hypothesis states that a DMU can achieved greater efficiency when they focused or specialize in a small number of products.

[4] High Herfindhal index value is used as a proxy for focused product while low Herfindhal index is used as a proxy for diversified product.

effects of Mergers and Acquisitions (M & A) on the efficiency and productivity of US property-liability insurance industry for the period 1994-2003 by using DEA and Malmquist index. Analysis shows that large firms with high returns are more likely to an acquirer compared to unaffiliated which are less likely to acquirer.

Greene and Segal (2004) study impact of competition on US life insurance industry's cost inefficiency and profitability. Using stochastic frontier analysis for the period 1995-1998 they show that insurance industry achieved about 80 percent efficiency. However, they do not find any significant difference among different groups. Similarly, Jeng et al. (2007) measure the change in efficiency after demutualization of the U.S. life insurance industry for the period 1980s and 1990s. However, they also conclude that there is no significant improvement in efficiency after demutualization.

There are also a few studies that focus on performance of Canadian insurance sector as well. For illustration, Bernstein (1999) analyzes the total factor productivity (TFP) growth for the Canadian life insurance over the period 1979-1989, while, McIntosh (1998) uses data for the period 1988-1991 to analyze the scale efficiency of the Canadian insurance industry. These studies document that Canadian insurance sector shows a significant improvement both in terms of its efficiency and productivity.

3.2 Evidence of European Insurance Sector Performance

There are many studies that explore the efficiency and productivity of insurance sector of European countries. For instance, Rees and Kessner (1999) evaluate the direct effects of

pre-1994 European Union's policy of deregulation on the efficiency of British and German life insurance companies. They find that level of efficiency for German market remains (i.e., 48 percent) lower than British market (i.e., 57 percent). They further indicate that the regulatory reforms of EU commission have improved the welfare of the buyers than highly regulated German market.

Hardwick (1997) performs a study to measure the cost efficiency of the life insurance companies of UK over the period 1989-1993 and find high level of economic inefficiency (i.e., 30 percent) in the insurance sector. However, study evidences positive economies of scale in UK insurance industry. The study further points out that large companies are main beneficiaries of the single European market, while the survival of small companies will be at risk in a competitive environment.

Noulas et al. (2001) also analyze the impact of legal framework on the efficiency of non-life insurance industry in Greece and report an average 64.69 percent efficiency. Further, they point out that high operating cost and low productivity are the main problems of insurance sector in Greece. They suggest, therefore, merger and acquisitions in the insurance sector to gain benefits from large scale operations, thus, improve the efficiency.

Ennsfellner et al. (2004) investigate the production efficiency of Austrian insurance industry, while Cummins et al. (2004) examine the impact of organizational structure on the technical, cost and revenue efficiency of Spanish insurance firms. The former shows a positive impact of deregulation on the production efficiency for both life and health and

Fukuyama (1997) investigates the production efficiency and productivity changes for the life insurance sector of Japan focusing on ownership structure under different economic circumstances. The findings of this study reveal that major source of cost efficiency is due to technical inefficiency for scale inefficiency. However, these firms experience TFP throughout the period of analysis, majorly contributed by technological progress.

Mansoor and Radam (2000) look into the productivity of Malaysian life insurance industry by applying the Malmquist index approach. Results indicate the large variations in efficiency scores among the insurance firms varying from 45 percent to 98 percent with an average efficiency of Malaysian insurance sector about 72 percent. Karim and Jhantasans (2005) on the other hand, apply SFA to evaluate the cost efficiency and its relationship with profitability for Thailand's life insurance industry for the period 1997-2002. They conclude that efficiency ranges from 40 percent to 82 percent. Further, they point out that the firm size is positively correlated with mean efficiency implying that firms with larger size are using best practices.

Kao and Hwang (2008) explore the efficiency of non-life insurance companies of Taiwan. They decompose the whole production process into two sub-processes to the efficiency of each process through a relational model[6]. The results show that companies perform more efficiently in the first stage (i.e., the premium acquisition stage) than the second stage (i.e. that profit generating stage). Hao and Chou (2005) also measure the

[6] The efficiency of the first stage measures the performance of insurance firms in marketing etc and the second sub-process measures the performance of insurance firms that how they generate the profit from the premium income. The efficiency of the whole process is the product of the efficiency score of these two sub-processes [Kao and Hwang (2008)].

efficiency of life insurance industry in Taiwan. Using distribution free approach (DFA) and Battese and Coelli model for analysis over the period 1977-1999 they find that average inefficiency is 33.98 percent by DFA, while 81percent from Battese and Coelli (1995) model.

Huang (2007) estimate the cost and profit efficiency of Chinese insurance industry over the period 1999-2004 by using the stochastic frontier approach. They note that efficiency largely varies across firms showing that low efficiency score might be due to endogenous factors. The study further explore that state owned companies are profit efficient that non state owned and foreign.

As we discuss several studies focus on insurance sector efficiency and productivity in both developed as well as developing countries. We note that the deregulatory process have improved the efficiency and productivity of insurance sector around the globe, however, there are significant variations in these efficiency scores across the countries. Further, results from these studies conclude that U.S. insurance sector efficiency is majorly resulting from scale operations and mergers and acquisition activities that occurred after the liberalization and deregulation process in recent years. Similarly, European insurance sector also experience a significant improvement in efficiency and productivity resulting partly from consolidation of the sector as well as form diversification and competitive environment which was consequence of recent financial liberalization. Studies on Asian economies also share the same premises in terms of

efficiency and productivity measurement; however, results vary significantly across the countries.

Despite a growing literature is available on insurance sector around the globe we do not find even a single study on Pakistan's insurance sector except few on baking efficiency (see, Patti and Hardy, 2005; Burki and Niazi, 2006; Burki and Ahmad, 2009). In recent years there has been a significant growth in insurance sector of Pakistan, which calls for the need of analysis of this sector that motivate us to investigate the efficiency and productivity of insurance industry of Pakistan.

Chapter 4

THEORETICAL BACKGROUND OF EFFICIENCY AND ITS EMPIRICAL MODEL

In this chapter we will briefly cover the basic efficiency concepts and discuss the empirical methodology that is used to measure the efficiency and productivity of the insurance sector of Pakistan. We discuss the theoretical underpinnings of efficiency measurement first, and then describe our model of cost efficiency and productivity measurement.

4.1. The Concept of Efficiency and productivity

The idea of cost efficiency and its decomposition into technical efficiency and allocative efficiency was first presented by Farell (1957). He pointed out that for a producer it is always a matter of concern how to expand the level of output of the firm expanded without using more resources. A firm is technically inefficient if it fails to produce maximum output from the given level of input, while allocative inefficiency means that firm is not using optimal input mix to produce a certain level of output at given prices. The former arises due to bad management, inferior input quality uses etc. while the latter happens due to firm's failure to equate its marginal products to the respective input prices.[1]

[1]Scale efficiencies are important to discuss when productivity of a firm is decomposed. If firm is producing multiple outputs, then scope efficiencies are also considered.

4.1.1: Theoretical Background and Measurement of Cost Efficiency

The efficiency concept is basically used to measure the performance of a firm. Conventionally, financial ratios such as return on assets, return on equity, expense to premium ratios etc. are used to measure the insurance firms' performance. However the development of the frontier methodologies and their meaningful and reliable measures dominate the conventional approaches and now most studies used the frontier methods.[2] There are two main frontier approaches used to measure the efficiency- the econometric approach (Parametric approach) and the mathematical programming approach (Non-Parametric approach). Parametric approach can be further classified into Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA) and Distribution Free Approach (DFA), while non-parametric approaches consist of Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH). The parametric approach requires the specification of functional form about the production, cost and profit frontier and some distributional assumptions about the error term. On the other hand, non-parametric approach does not assume any specific functional form for evaluating efficiency, therefore, does not take into account the error term. Both approaches have advantages and disadvantages (Cummins and Zi, 1998). The main advantage of parametric approach is that it separates inefficiency from the overall error term, while non-parametric approach consider any deviation from frontier as inefficiency without taking into account the error term that may be caused due to some external factors like bad luck and

[2]Financial ratios are not considered a good measure of performance due to following reasons: First, the choices of accounting policies may distort intercompany comparisons. Second, comparison of performance over time price changes as inflation renders comparisons of results over time misleading because financial figures will not be within the same levels of purchasing power. As two or more companies under comparison are not same, therefore, using ratios to compare one company with another could provide misleading information. Thus, ratios are not definitive measures, therefore, need to be interpreted carefully. Although, ratios can provide clues to the company's performance or financial situation, but, they cannot show whether performance is good or bad.

measurement error etc. The main disadvantages associated with parametric approach are its distributional assumptions and requirement of specific functional form for production, cost and profit frontier that leads to specification errors and thus, may affects the efficiency estimates (Cummins and Xie; 2008).

This study uses non-parametric approach by applying Data Envelopment Analysis (DEA). We choose this approach on the basis of following advantages. First, the main advantage of this approach is that it is less data demanding and does not impose any functional form. According to Worthington and Hurley (2002), it is relatively easy to alter the specification of inputs and outputs for the formulation of the production correspondence relating inputs to outputs in parametric models. However, in insurance sector where the product of individual insurers varies considerably, the linear programming approach offers useful insights. Further, DEA analyzes the efficiency of each firm separately, thus we can easily identify the efficiency and productivity changes firm by firm (Cummins and Xie; 2008). Moreover, by using DEA analysis we can easily decompose the cost efficiency into pure technical, scale and allocative efficiency.

Nevertheless, the main disadvantage associated with DEA is that it does not separate inefficiency from error term and consider the whole deviation from the frontier as inefficiency. However, this drawback can be partially covered by using the post efficiency regression analysis where we take the obtained efficiency score as a dependent variable over a set of explanatory variables to find the efficiency differentials.

4.1.2: Estimation of Firm Level Efficiency

DEA was first introduces by Charnes et al. (1978) and extended by Banker, et al. (1984). The purpose of this approach is to measure the relative efficiency of each DMU (Decision Making Units) with best practices firm. DEA decomposes the cost efficiency (CE) into two components. One is technical efficiency (either maximizing output from a given level of input or minimizing inputs for a given level of output) and the other is allocative efficiency (using input in optimal proportions given the input prices and output quantities). Technical Efficiency (TE) can be further decomposed into pure technical efficiency (PTE) and scale efficiency (SE). SE occurs when firm operate at constant returns to scale (CRS) and PTE occurs when firm maximizes its output from with variable returns to scale. The efficiency score ranges from zero to one showing the most efficient firm with score one and most inefficient firm with score zero (Jeng et al., 2007).

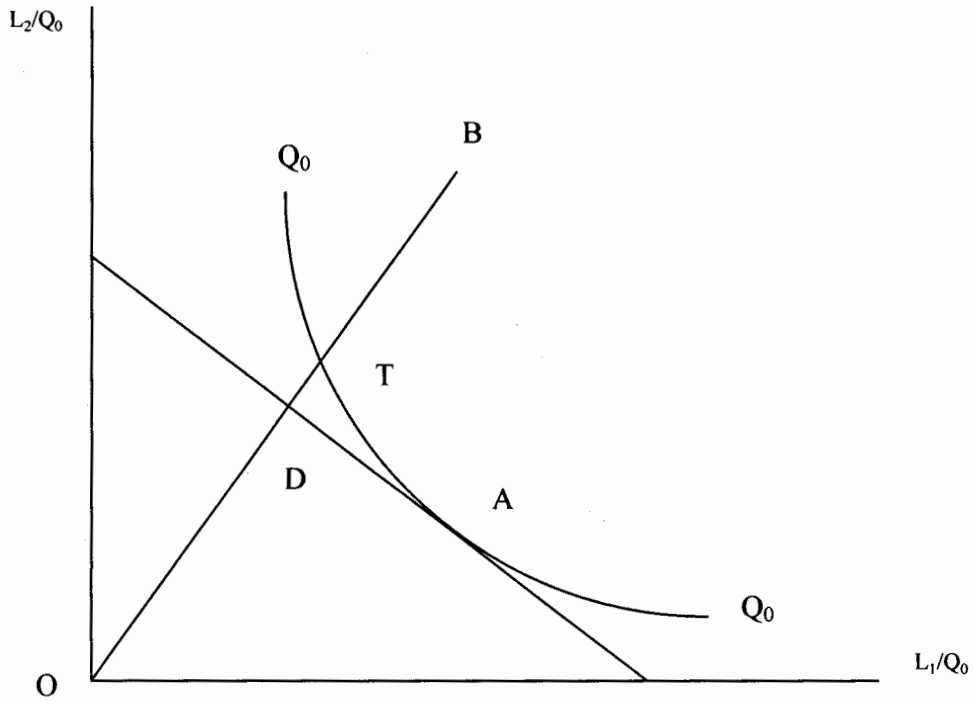
We investigate insurance efficiency within the framework of data envelopment analysis (DEA), which is a non-parametric mathematical programming approach to frontier estimation and is based upon the work of Farrell (1957) and its extensions.[3] The DEA method to frontier estimation involves construction of a non-parametric best-practice frontier or a piecewise linear surface obtained from the observed data set, which serves as the reference point or benchmark for comparison. The resultant efficiency measure,

[3] DEA approach has been widely used in measuring banking efficiency. For a survey of DEA literature, see Lovell (1993), Ali and Seiford (1993) and Seiford (1996). For a survey of DEA in banking, see Berger and Humphrey (1997).

ranging between zero (least efficient) and one (most efficient), depicts the distance from each unit to frontier.

The cost (or economic) efficiency of a firm consists of allocative efficiency and technical efficiency. The non-parametric cost minimizing approach used in this study allows us to decompose cost efficiency into its different components. First, we illustrate the efficiency measures used in this study in the perspective of insurance firms with the help of Figure 4.1 below.

Figure 4.1: Cost, Technical and Allocative Efficiency



Suppose a firm that uses two inputs L_1 and L_2 to produce one output Q. Assume the production function $Q = f(L_1, L_2)$ be homogeneous of degree one (i.e., unit isoquant)

then, $1 = f(L_1/Q, L_2/Q)$. In figure 4.1, unit isoquant is portrayed by Q_oQ_o. Points in the northeast region of Q_oQ_o are inefficient while points in the southwest region are not feasible. Suppose firm uses an input combination at point *B*. The technical efficiency (*TE*) at point *B* is defined by *OT/OB,* which describes that the ratio of inputs technically required to the inputs actually employed. If the price of L_1 and L_2 are given by line *cc*, then points *A* and *D* represent the least cost combinations of producing a given quantity of *Q*. The allocative efficiency (*AE*) of the firm is defined by *OD/OT*, which is independent of technical inefficiency of the firm. The ratio *OD/OB* is called cost efficiency (*CE*), explaining a composite measure of productive efficiency that comprises of allocative and technical efficiencies.

4.2 Empirical Model of Cost Efficiency Measurement

We specify an input price vector to specify and calculate a measure of cost efficiency (*CE*) for each firm by solving this envelopment form of linear programming (LP) problem as (See, Fare at al. 1994)

$$
\begin{aligned}
&Min\ w_i l_i^* \\
&subject\ to \\
&-q_i + Q\lambda \geq 0, \\
&l_i^* - L\lambda \geq 0, \\
&NI'\lambda = 1, \\
&\lambda \geq 0
\end{aligned}
\qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4.1
$$

Where l_i^* is the cost minimizing vector of input quantities, w_i and q_i represent input prices and output levels, respectively for the *i*th decision making units (DMU), *Q* is the $(m \times n)$ matrix of outputs, *L* is the $(k \times n)$ matrix of inputs, NI is an $n \times 1$ vector, and λ is a $n \times 1$

vector of constants and where n is the number of DMUs. The cost efficiency of each observation indicates the amount by which cost of production is increased due to technical and allocative inefficiency. In other words, the cost efficiency is the ratio of minimum cost to the observed cost.

The allocative efficiency is calculated residually by dividing cost efficiency (*CE*) with technical efficiency (*TE*), or $AE = CE/TE$. By its nature, the above procedure of cost efficiency includes any slacks into allocative efficiency, which is justified by Ferrier and Lovell (1990) on the grounds that slacks reflect sub-optimal input mix.

To measure technical efficiency (*TE*), we specify input oriented linear programming problem of the form

$$\begin{aligned} &\min_{\gamma,\lambda} \gamma \\ &subject\ to \\ &-q + Q\lambda \geq 0, \\ &\gamma l_i - L\lambda \geq 0, \\ &\lambda \geq 0 \end{aligned} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4.2$$

Where, γ is a scalar λ is an $n \times 1$ vector of constants, Q is the $(m \times n)$ matrix of outputs and L is the $(k \times n)$ matrix of inputs. For the ith DMU, the vectors l_i and q_i represent the inputs and outputs, respectively. After solving the linear programming problem given above, the value of γ will represent the efficiency score for the ith DMU, where the condition $\gamma \leq 1$ will hold. To obtain the value of γ for each DMU, the linear programming problem will be solved n times. Due to constant returns to scale the LP problem in (4.2) does not fully envelop the data set and thus enlarges the feasible region.

Therefore, in the second step, we relax the assumption of CRS by introducing the convexity constraint $NI'\lambda = 1$ in to (4.2) to write where NI is an $n \times 1$ vector while all other symbols are defined as previously. A measure of scale efficiency is obtained by substituting the $NI'\lambda = 1$ restriction with $NI'\lambda \leq 1$in (4.3).

$$\begin{aligned} &\min_{\gamma,\lambda} \gamma \\ &\textit{subject to} \\ &-q + Q\lambda \geq 0, \\ &\gamma x_i - L\lambda \geq 0, \\ &NI'\lambda = 1 \\ &\lambda \geq 0 \end{aligned} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4.3$$

A common difficulty encountered in the measuring technical efficiency with the DEA approach is known as input-slacks and output-slacks, which are sections of the piecewise linear frontier that run parallel to the x-axis or y-axis and may lead to inaccurate measurement of technical, pure technical and scale efficiency in the LP problems specified above. We use a multi-stage methodology suggested by Coelli (1996) that takes care of the problem of slacks successfully.

4.3: Decomposition of Total Factor Productivity: Malmquist Index Approach

In order to measure the total factor productivity (TFP) change over time, we use Malmquist Index approach [see for example, caves et al. (1982)]. The most commonly used indices to measure the productivity are Tornqvist index, Fisher ideal index and Malmquist index. We choose Malmquist index for estimating productivity as it has several advantages over the Fisher and Tornqvist index. First, we can calculate Malmquist index only on the bases of quantity data even if the price information is not

available as other indices requires. Secondly, like other two indices it does not impose any behavioral assumption like cost minimization or profit maximization, thus, making it useful in the case where the objectives of the producers vary or unidentified (Mansoor and Radam; 2000). Further, it can be decomposed into components and make it easy to analyze the change in productivity due to technological change and technical efficiency change, separately (Cummins and Xi, 2008). One can measure productivity change relative to period $t(M_0^t))$ or relative to period $t+1(M_0^{t+1})$, where $M_0^t = \left[\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)}\right]$ and $M_0^{t+1} = \left[\frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)}\right]$ following Caves et al. (1982).[4]

The first term Following Fare et al. (1994), the Malmquist productivity index is can be described as geometric mean of these two indexes.

$$M_0^t(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left\{\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)}\right\} \times \left\{\frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)}\right\}\right]^{1/2} \quad \text{..... 4.4}$$

When this index exceeds unity implies that there has been increase in productivity between period *t* and *t+1,* while a value of index less than unity indicates a decline in productivity and equal to unity means no change. Fare et al. (1992) further decompose this change in productivity into two components (i.e., technical efficiency change and technological change), which is described as follows:

[4] These two measures are same for single input single output; however, these may not be same in case of multiple inputs and outputs.

Chapter 5

DATA COLLECTION AND VARIABLE DESCRIPTIONS

This chapter describes data and the sample period used in the analysis for insurance companies' performance. Further, variable description and the various measures of the output, input variables and their respective price construction mechanism are discussed. We also include some exogenous variables and its justification to determine whether these factors affect the efficiency and productivity of insurance industry significantly. We also present summary statistics of the variables used in the analysis.

5.1 Sources of Data

Micro level data collection is not an easy task particularly, in developing economies like Pakistan. We use the data for insurance industry of Pakistan to measure the performance of this sector. We collect data of insurance industry and include 12 largest insurance companies operating in Pakistan, which makes 84% of the insurance industry.[1] These firms are registered under the insurance ordinance 2000, and listed in Karachi Stock Exchange (KSE) of Pakistan. We obtain the data from balance sheets and income statements reported in the Annual Reports of insurance companies during 2000-2007. For this, we put extended efforts to approach to different sources. We got insurance companies annual reports from (i) the Securities & Exchange Commission of Pakistan,

[1] The total numbers of companies in Pakistan are 53 in year 2007. We choose only top 12 firms out of these because the remaining firms are too small and the inclusion of these may affect the results.

Islamabad; (ii) the State Bank of Pakistan, Karachi; (iii) head offices and finance offices of insurance companies; (vi) libraries of different institutions, and (vii) the regional offices of insurance companies in Rawalpindi and Islamabad.

The assets, net premium and net profit of insurance companies included in the analysis presented in Table 4.1. The selected sample includes two life and ten general insurance companies representing more than 80% (in terms of premium) of the market share, which is quite representative sample of Pakistan Insurance sector[2]. To estimate the cost efficiency, we use un-balanced panel data for the period 2000 to 2007, obtained from the

Table 5.1
List of Selected Insurance companies

Companies	Net Premium (Rs. Billion)	Total Assets	Net Profit
1. State Life Insurance Corporation of Pakistan	18.71	169.82	0.1
2. Adamjee insurance Company Limited	5.53	18.76	4.2
3. EFU General Insurance Company Limited	6.11	27.38	14.37
4. EFU Life Assurance Limited	4.43	13.31	1.2
5. National Insurance Company Limited	2.43	21.55	2.31
6. New Jubilee Insurance Company Limited	1.81	5.93	0.56
7. IGI Insurance Limited	0.58	14.01	2.93
8. Askari General Insurance Corporation Limited	0.58	1.11	0.05
9. Shaheen Insurance Company Limited	0.57	0.87	0.06
10. Atlas Insurance Limited	0.44	1.73	0.4
11. Premier Insurance Company Limited	0.34	2.4	0.47
12. Habib Insurance Company Limited	0.33	2.1	0.4

[2] The two firms included in our sample are from the life insurance business holding 85% market share of the life insurance sector, while the remaining ten firms are chosen from the general insurance business that makes 84% market share of the non-life insurance sector.

annual reports of these insurance companies. The sample includes 10 companies in 2000, 11 companies in year 2001, 12 firms in 2002, 12 in 2003, 11 in 2004, 10 in 2005, 11 in 2006 and 11 in 2007. The total numbers of observations available for the analysis are 88[3].

5.2 Variable Description

The most critical task of the efficiency analysis for financial sector is to define output, inputs and their prices (See, Sealey and Lindley, 1977, for a detailed discussion on variable selection). An appropriate selection of the output-input variables in the insurance industry is even makes it more difficult and challenging job. The precision of the efficiency results depends upon the definition of outputs, inputs quantities and their respective prices. There has been much debate on the selection criteria of input-output variables in financial sector, particularly, for insurance industry (see for example, Yuengert, 1993; Cummins and Weiss, 1998; Worthington and Hurley, 2002).

5.2.1. Output and Input Variables

Different output variables have been used in various studies to measure the efficiency and productivity of insurance industry. However, most commonly used outputs for an insurance firm are net premium income and invested assets (see for example, Hardwick 1997; Noulas et al., 2001; Greene and Segal, 2004; Hao and Chow, 2005). Many studies use premium income a common measure of risk pooling as policy holders buy risk

[3] To estimate the Malmquist Productivity Index we need a balanced panel data. For this purpose, we include only 10 firms for 8 years (i.e., 80 observations).

protection through insurance contracts. Most of these studies include invested assets and premium income as an output (Cummins et al., 1999; Worthington and Hurley, 2002; Ennsfellner et al. 2004; Jeng and Lai, 2005).[4] Worthington and Hurley (2002) also take invested assets as an output and argue that most of the general insurer's net profit is generated from investing in marketable securities and borrowing from policyholders rather than premium. The choice of input variables is not as controversial as outputs in insurance industry. Three input variables including labor, capital and business services (materials) are used most commonly to measure efficiency of insurance sector (See for example, Meador et al. 1996; Cummins et al. 1996; Greene and Segal, 2004; Karim and Jhantasana, 2005; Jeng et al. 2007; Cummins and Xie, 2008). There are some other studies on insurance efficiency which include equity capital as an input [Cummins, Turchetti, and Weiss (1996), Cummins and Zi (1998), Greene and Segal (2004), and Jeng and Lai (2005)]. It is important because insurers need to maintain equity capital for the payment of claims to their policyholders if losses exceed the expected limits.

We use two outputs net premium income (q_1) and invested assets (q_2) in our efficiency and productivity analysis. The data on the net premium (excluding re-insurance expenses from earned premium) income is taken from the "statement of Premiums" section of annual reports of insurance firms. The data on invested assets is taken from the "balance sheet" of each insurance company. We include four inputs labor (l_1), total fixed assets (l_2), business Services (l_3) that comprises of operating expenses excluding salaries & depreciation and financial capital (l_4). Insurance industry is the labor intensive industry

[4] Cummins and Zi (1998) argue that risk pooling or risk bearing and intermediation services are considered two main services that insurance industry provides to customers.

return on assets (ROA), market share, equity to total assets ratio, time trend and two dummy variables to capture ownership structure (i.e. whether the firm is publically or privately owned) and business type (life versus non-life insurance company). Return on assets is used to investigate the relationship between firm's profitability and efficiency (See for instance, Greene and Segal (2004).

Table 5.2
Descriptive statistics of the outputs, inputs and explanatory variables

Variables	Description	Mean	Median	Standard Deviation
	Output Variables			
Q_1	*invested assets*	$9.98x10^9$	$8.26x10^8$	$2.69x10^9$
Q_2	*Net Premium*	$2.10x10^9$	$5.46x10^8$	$3.51x10^9$
	Input Variables			
L_1	*Labor*	783	265	1178
L_2	*Total Fixed Assets*	$1.38x10^8$	$5.42x10^7$	$1.69x10^8$
L_3	*Equity capital*	$1.45x10^9$	$5.30x10^8$	$2.72x10^9$
L_4	*Business Services*	$4.52x10^8$	$6.73x10^7$	$9.80x10^8$
	Input Prices			
W_1	*Labor price*	298368	292453	158951
W_2	*Total Fixed Assets price*	0.208	0.178	0.149
W_3	*Equity capital price*	0.322	0.304	0.206
W_4	*Business Services Price*	0.056	0.043	0.042
	Control Variables			
Z_1	*Total Assets*	$1.44x10^9$	$1.75x10^9$	$3.38x10^{10}$
Z_2	*Return on equity*	37.264	30.425	19.507
Z_3	*Return on assets*	12.325	9.635	11.309
Z_4	*Equity to total Asset ratio*	0.321	0.304	0.206
Z_5	*Market share*	7.606	1.865	11.835
Z_6	*Ownership structure*	0.862	1.000	0.346
Z_7	*Business type*	0.818	1.000	0.389
Z_8	*Time*	4.540	1.000	2.274

To capture the effect of firm size on efficiency we use log of total assets. Further, to know the behavior of efficiency change with firm size we include square term of total assets. Hao and Chou (2005) highlight that firm with larger market share collects more

revenue and profit, hence improve the efficiency of firm. We include market share of insurance firms as an explanatory variable in our analysis. Equity to total assets ratio is included to find out the impact of different capital ratios on the firm's efficiency. We also include two dummy variables along with other explanatory variables that may also have some effect on efficiency.

CHAPTER
6

RESULTS OF EFFICIENCY AND PRODUCTIVITY ANALYSIS

In this chapter we discuss the results of cost efficiency obtained using Data Envelopment Analysis (DEA) and it decomposition such as the technical, scale and allocative efficiency. We also measure total factor productivity by decomposing it into technical efficiency change and technical change. Further, to find determinants of cost efficiency and productivity we conduct regression analysis choosing several exogenous factors that may affect the performance of insurance industry. Using panel data for the sample of twelve insurance firms from Pakistan insurance sector for the year 2000-2007, to obtain the efficiency estimates, we apply Data Envelopment Analysis (DEA) approach, while for measuring the total factor productivity change we use Malmquist Productivity Index.[1]

6.1. Estimates of Insurance Industry Cost Efficiency

First, we measure the cost efficiency of individual insurance firms and its components of pure technical, scale and allocative efficiency for each year from 2000 to 2007. The results of mean efficiency of insurance industry for each year are presented in table 6.1. Results depict that the insurance industry on average remains technically efficient. However, insurance sector shows on average lower allocative efficiency consequently, dominating the cost efficiency. We find that pure technical efficiency increased over the period from 73 percent in the year 2000 to 89 percent in the year 2007. Results also

[1] We use Data Envelopment Analysis Programme (DEAP) developed by Coelli (1996).

indicate that on average, insurance sector shows 82 percent efficiency during the period of analysis. Similarly, scale efficiency of insurance industry remains about 85 percent indicating a significant expansion in insurance sector of Pakistan during 2000-2007.[2] Results show that pure technical and scale efficiency continues to increase after the year 2002. On the other hand, average cost efficiency of this sector is recorded only 64 percent for the period 2000-2007 showing that insurance firms could have reduced about 36 percent expenditures from the existing level to produce same output. It is notable that insurance sector of Pakistan remains about 33 percent allocatively inefficient during the period of analysis, which might have contributed cost inefficiency of this sector significantly. We also note that both allocative and cost efficiency decrease continuously after the year 2005.

Table 6.1
Mean Efficiency Score for year 2000-2007

Year	Pure Technical Efficiency	Scale Efficiency	Allocative Efficiency	Cost Efficiency
2000	0.733	0.758	0.711	0.682
2001	0.801	0.818	0.698	0.676
2002	0.761	0.777	0.705	0.685
2003	0.821	0.862	0.667	0.611
2004	0.858	0.891	0.681	0.655
2005	0.874	0.912	0.747	0.728
2006	0.831	0.886	0.593	0.568
2007	0.893	0.902	0.528	0.523
Mean	0.821	0.850	0.666	0.641

The year wise results of Table 6.1 show that the mean cost efficiency score for the entire study period is 64 percent, which illustrates that insurance companies could have

[2] Which implies that on average firms are 15 percent far away from their optimal production scale.

produced the same amount of output by utilizing 36 percent less than the current observed cost.

Figure 6.1

Mean cost efficiency of insurance industry in Pakistan (2000-2007)

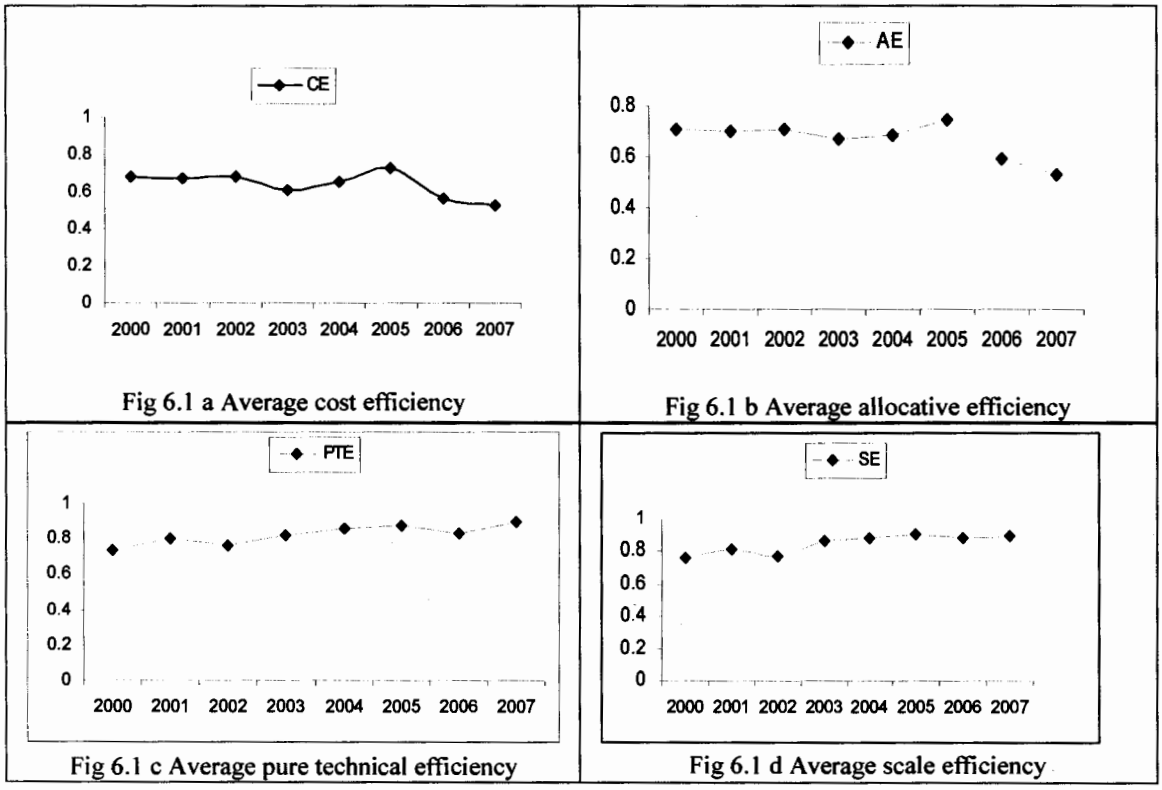


Fig 6.1 a Average cost efficiency

Fig 6.1 b Average allocative efficiency

Fig 6.1 c Average pure technical efficiency

Fig 6.1 d Average scale efficiency

Figure 6.1 represent the yearly trend of efficiency. The highest score is observed in year 2005 and than decrease in year 2006 and 2007.The low level of allocative efficiency reveals the fact that firms are not performing very well in choosing the cost minimizing combination of inputs and failed to equalize its marginal rate of technical substitution to the factor price ratio. This implies that factor inputs are not close substitutes to each other.

Pure technical efficiency shows that how much resource allocation and internal management are efficient in their performance. Figure 6.1c illustrates the year wise mean

pure technical efficiency (PTE). The mean score for pure technical efficiency is found about 82 percent during the study period. To achieve the most efficient level, firms, on average need a reduction of 18 percent in the inputs level that they are currently using to produce the same level of output.

6.1.2: Firm Level Efficiency of Insurance Sector

Table 6.2 reports the average pure technical, scale, allocative and cost efficiency for each firm included in the analysis for the year 2000-2007. As discussed in table 6.1, insurance sector shows lower cost efficiency compared to its technical and scale efficiency. We find that state life insurance company remains 100 percent cost efficient among others whereas NICL remains least efficient in terms of cost efficiency with only 10 percent efficiency. State life insurance has several advantages of being the largest market share holder in terms of branch network and making more than 60% of the total assets of insurance sector in Pakistan. Similarly, life insurance sector has improved its business, which ultimately enhanced its operational efficiency and profitability over the time. Insurance sector has been successful to overcome its operational expenditures which might have increased overall efficiency of the industry. A closer examination of the figure 6.2 shows that among twelve firms, only two companies are found fully cost efficient (i.e., Shaheen insurance and State Life Insurance Corporation). The former is a private general insurer while latter is a public insurance from life insurance sector. The lowest score was observed for National Insurance Corporation

Table 6.2
Firm level cost efficiency and its components (2000-2007)

Firm	Pure Technical Efficiency	Scale Efficiency	Allocative Efficiency	Cost Efficiency
Shaheen	0.775	0.775	1.000	1.000
State Life	1.000	1.000	1.000	1.000
EFU Life	0.976	0.982	0.903	0.896
Askari	0.783	0.784	0.820	0.820
EFU Gen	1.000	1.000	0.664	0.664
Atlas	0.545	0.545	0.653	0.653
Adamjee	0.963	0.980	0.571	0.560
Habib	0.485	0.587	0.598	0.470
IGI	0.914	0.914	0.393	0.393
New Jubilee	0.921	0.992	0.409	0.385
Premier	0.416	0.587	0.557	0.382
NICL	1.000	1.000	0.100	0.100

Limited (i.e., 10 percent only) followed by New Jubilee, Premier, IGI and Habib Insurance. It is noticed that about 60% of insurance companies show more cost efficiency (i.e., more than 50% efficiency score), while other remain less efficient (i.e., with efficiency 50 % or below). We further, decompose the cost efficiency into its different components and results are presented in table 6.2 and figure 6.2, respectively.

Technical efficiency of individual firms

Decomposition of cost efficiency into its different components further enables us to further investigate what have contributed to overall efficiency of insurance sector. We find that state life insurance; EFU insurance and NICL are most technically efficient among others. All these three firms are larger in terms of business volume and outreach which might have put them advantageous to optimize the input resources. On the other

hand, Premier insurance company remains on the lowest frontier with least efficiency score (i.e., 0.416). Similarly, Habib and Askari insurance also record a low efficiency level relative to its peer group. One of the reasons of low efficiency of these firms may be associated with their limited business diversification that might have hindered these firms to use optimal input level compared to larger firms. To catch up with the efficient firms these companies need to employ efficient input combination. Firm wise PTE results shows that only State Life, EFU-General and NICL are 100 pure technically efficient, while among remaining forms only Habib and Premier insurers PTE score lies below 50 percent. Firm wise scale efficiency analysis shows that State life, EFU General and NICL are the most scale efficient with 100 percent score, while the most inefficient insurers are Atlas, Habib and Premium with the score of 54, 58 and 58 percent, respectively (See figure 6.2c).

Scale efficiency

Under variable returns to scale (VRS) technical efficiency can further be decomposed into pure technical efficiency and scale efficiency. Scale efficiency indicates whether the firm is operating on optimal scale or not. Scale efficiency equal to one (i.e. constant returns to scale) is the indication that firm is operating at optimal scale, while deviation from one (either increasing returns to scale or decreasing returns to scale) depicts that firm is away from its optimal level. Figure 6.2d shows the mean scale efficiency of firms in the sample. We note that that all insurance companies were expanding its operations during 2000-2007 as scale efficiency score remains high for all firms. We again find that all larger firms stand with higher scale efficiency (i.e., 100%), while a few remain below

60%. For instance, Atlas insurance and Premier insurance show their scale efficiency scores 0.55 and 0.58, respectively. We observe that both of these insurance companies are very small in size in terms of their assets and make a tiny part of insurance industry. Therefore, their small operations perhaps put them disadvantageous to expand their operations as of the larger firms. Further analysis of scale efficiency shows that only three firms are operating at optimal scale i.e. showing constant returns to scale, while the remaining shows increasing returns to scale except for Adamjee that shows decreasing returns to scale for year 2005, 2006 and 2007 (For details, see appendix Table A.2.1 to A.2.12).

Allocative efficiency

Another important source of cost efficiency is firm's allocative efficiency. If a firm is successful to equate its marginal products to input price ratios then it is optimizing its resources to produce a certain level of output. The mean allocative efficiency for all the insurance companies over the study period remains about 66.6 percent. A firm level comparison shows that that only State Life insurance and Shaheen insurance are found the leading firms that achieved the maximum efficiency level (i.e. 100 percent). However, NICL remains least allocatively efficient with a score of 0.1 only, unlike its technical and scale efficiency. While, other insurance companies show mixed results for allocative efficiency. Results conclude that overall insurance industry failed to allocate its resources with least combination. However, it is noteworthy that allocative efficiency dominates the cost efficiency as firm even with highest technical efficiency shows lower cost efficiency, as they remain less efficient allocatively. These results are not unexpected

because insurance sector has been highly concentrated as few firms are dominating the whole sector. This high concentration and product differentiation of insurance industry might have resulted insurance firms not to use their resource efficiently. However, a

Figure 6.2
Firm level average efficiency of insurance industry (2000-2007)

Fig 6.2 a Average cost efficiency

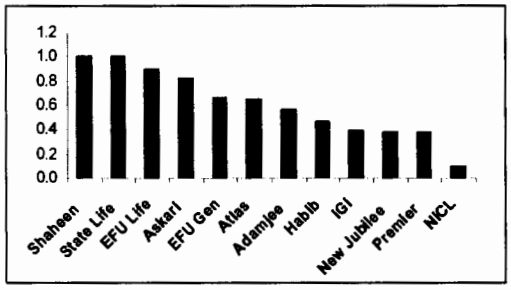


Fig 6.2 b Average allocative efficiency

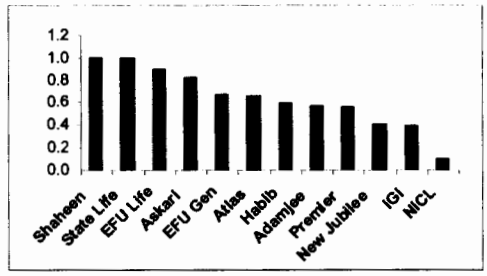


Fig 6.2 c Average pure technical efficiency

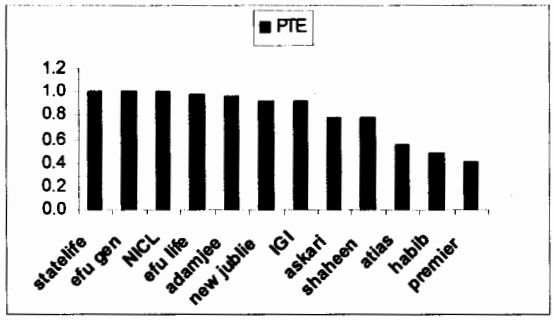
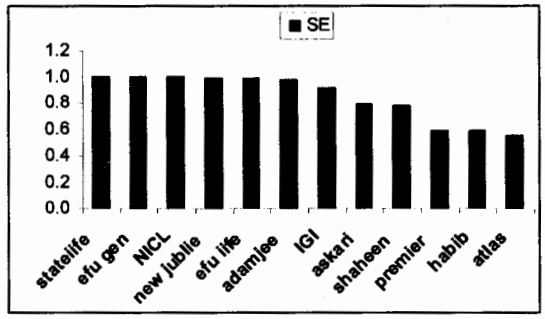


Fig 6.2 d Average scale efficiency



recent wave of competition and deregulatory process may improve the resource allocation mechanism of these firms by providing a level a level playing field to insurance sector in coming years.

6.2: Malmquist Index Results

In this section, the results for total factor productivity and its components are presented. There are several methods to compute the Malmquist productivity index (See for

example, Fare et al. 1992). We estimate output oriented Malmquist index in this study, which is based on DEA. We use output oriented technical efficiency measure which reduces the proportional inputs for a given level of output. [3] Unlike cost efficiency analysis, we use a balanced panel consisting of 10 insurance companies to estimate productivity index and its components for the insurance sector of Pakistan. Table 6.3 presents year wise average results for Malmquist index and its components of technical efficiency change, technological change and total factor productivity change.[4] If the value of Malmquist index and any of its components exceeds the unity, it indicate the improvement in performance, while the value equal to unity shows no change and less than unity shows the deterioration in its performance. The results show that on average insurance sector experienced growth in total factor productivity and its components.

Table 6.3
Average Malmquist Index Results for year 2001-2007

Year	Efficiency Change(Effch)	Technical change (Techch)	Total Factor Productivity Change (TFPch)
2001	1.089	1.017	1.107
2002	1.007	0.674	0.679
2003	1.120	0.999	1.118
2004	1.020	1.089	1.111
2005	1.035	1.128	1.167
2006	0.975	1.199	1.169
2007	1.064	0.928	0.987
Mean	1.044	1.005	1.048

[3] Practically speaking, the input and output specification produce equal results, however, theoretically it is desired to take into account the suitable approach.
[4] Although, one can use unbalanced panel to estimate productivity index, since, we use DEA software to compute Malmquist index,, it has limitation of computing Productivity with unbalanced data.

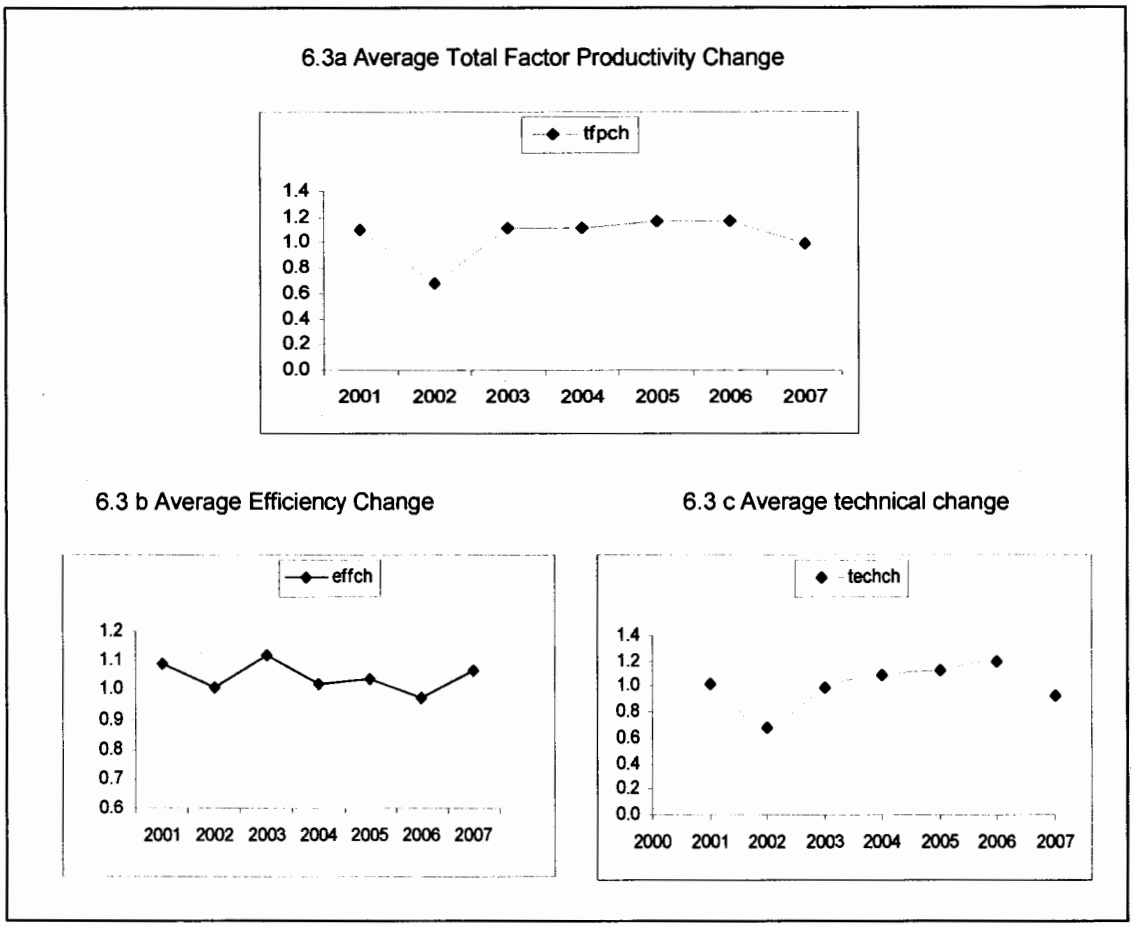
Average growth in total factor productivity is found to be 4.8 percent annually. Similarly, there has been significant technical efficiency improvement as efficiency change registers a 4.4 percent growth on average also consistent with our previous results of cost efficiency obtained on the basis of DEA. However, we do not find any significant improvement in technological change in the insurance sector as it shows on average 0.5 percent annual growth only. As can be seen from figure 6.3, there has been a decline in productivity in the year 2002, which may be the consequence of introduction of prudent regulations by Security Exchange Commission of Pakistan implemented by the end of 2001. Consequently, insurance sector has to make compliance with the regulations and adjusted its operations according to rules of business that might have caused a slip in productivity of these firms. However, soon after insurance industry were able to catch up its productivity in a more competitive environment, which continues to improve in the following years. Malmquist productivity results also show that insurance industry has experienced overall productivity growth which is contributed majorly by technological innovation in the industry. Further, the size of the business has a significant impact on different efficiency measures though in different.

Figure 6.3b and 6.3c depict the patterns of TFP components such as technical efficiency change and technological change. It is noticed that efficiency change produces mixed trends in different years. However, technical change shows a consistent trend except two years (i.e., 2002 and 2006), otherwise increasing gradually. We also note that TFP moves along with the technological change showing that technology is contributing more

towards the productivity of insurance industry in Pakistan, which is appealing as industry has diversified its products in recent years.

Figure 6.3

Average Malmquist Index Results for year 2001-2007



Firm level analysis of total factor productivity change is presented in table 6.4. Results describe that EFU-Life is found with highest total factor productivity change in insurance sector. The average annual growth of total factor productivity remains 16.9 percent

during 2001-2007 majorly contributed by technological change. It implies that EFU Life Insurance Company has adopted new technologies during its expansion in recent years, which might have contributed to its productivity significantly. The firm exhibits about 13.4 percent change in its technology, while the technical efficiency change remains 3.1 percent only. On the other hand, two insurance firms record technological regress (i.e., Adamjee and New Jubilee) implying that these firms have been constrained to innovate its technology, which ultimately reduced the productivity of these firms. In our previous analysis, although, Adamjee is found closer to frontier in terms of technical efficiency, however, it could not maintain it efficiency level in the later years.

Table 6.4
Malmquist Index Summary of Firm Means for year 2001-2007

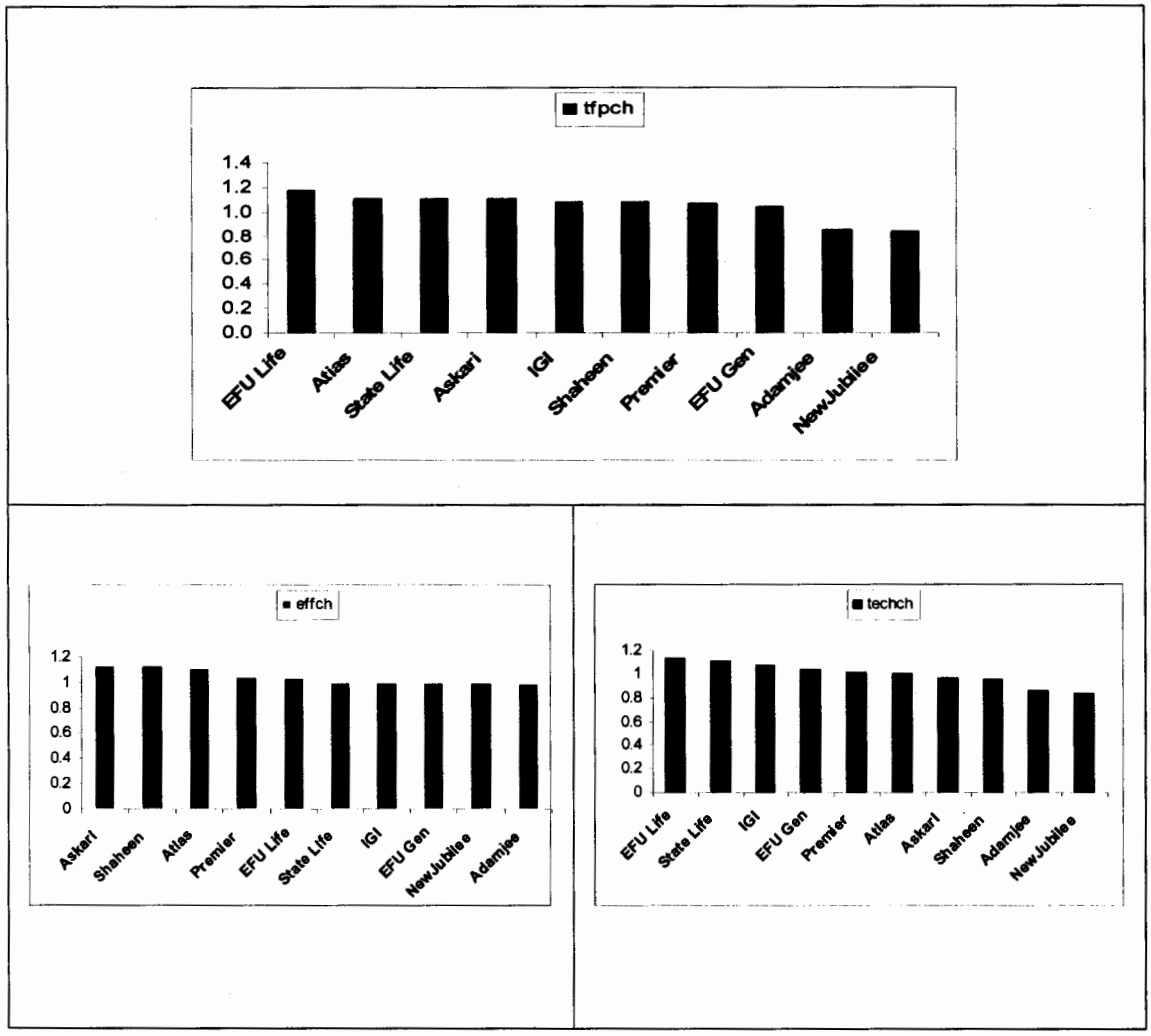
Firm	Efficiency Change (Effch)	Technical change (Techch)	Total Factor Productivity Change (TFPch)
EFU Life	1.031	1.134	1.169
Atlas	1.112	0.997	1.108
State Life	1.000	1.106	1.106
Askari	1.137	0.968	1.101
IGI	1.000	1.073	1.073
Shaheen	1.132	0.946	1.071
Premier	1.047	1.012	1.060
EFU Gen	1.000	1.030	1.030
Adamjee	0.989	0.852	0.843
New Jubilee	1.000	0.833	0.833

Figure 6.4 portrays the total factor productivity and its components at firm level in a descending order moving from left to right. As it is clear from the figure 6.4a that EFU stands on highest productivity level discussed earlier whereas Adamjee and New Jubilee at the lower end, on the other hand. Askari insurance shows highest change in its

technical efficiency followed by Shaheen insurance. However, New Jubilee and Adamjee still stay on the lower end in terms of efficiency change as well as technological change.

Figure 6.4

Firm Level Total factor Productivity and its Components



6.3: Determinants of Efficiency and Productivity

In this section, we try to correlate the different factors that may affect the efficiency and productivity of insurance industry. We perform a regression analysis to determine if different firm's characteristics affect the performance of insurance sector of Pakistan. We conduct a multiple regression analysis using all performance indicators as dependant variables whereas firm characteristics and other environmental variables as exogenous factors. We include pure technical efficiency, allocative efficiency and scale efficiency as dependant variables and conduct separate regression analysis for each measure on exogenous variables such as size, profitability, market share, type of ownership, and business nature. We use the natural logarithm of total assets (LOGTASSET) to measure the size of firm; equity to total assets ratio (ETA) as a proxy for capital structure; return on assets (ROA) for profitability indicator and the fraction of firm's premium to the total premium to capture the market share (MKTSH) of industry for each year. We also use a time trend (TIME) to know the patterns of performance measures over the time. We use two dummy variables for ownership structure (OWN), and business type (BSNESS).

To estimate this impact of firm's characteristics and other factors we use Tobit regression model because our efficiency estimates are continuous and censored between 1 and 0.[5] Results for allocative efficiency regression model based on the censored Tobit model, its estimated coefficients, standard errors and respective probabilities are presented in the table 6.5. It is noticed that assets size shows an inverse relationship with the performance indicator implying that larger firms have been failed to produce its output cheaper vis-à-

[5] Since the efficiency estimates are truncated at zero, therefore, we use Tobit regression instead of ordinary least square method.

vis smaller firms. In other words, the larger firms could not equate its marginal productivities to the corresponding input factor prices. This is also corroborated from our previous discussion on allocative efficiency. These results are not unusual if we look the market structure of insurance industry in Pakistan, which is highly skewed. This trend seems to be continued with decline in allocative efficiency as square of size variable turns out positive emphasizes the provision level playing field in insurance industry to promote a more competitive environment.

Table 6.5

Determinants of allocative efficiency

Explanatory Variables	***Coefficient***	***Standard Error***	***Z-Statistic***	***Probability.***
Intercept	18.017	2.474	7.280	0.000
LOGTASSET	-1.476	0.237	-6.207	0.000
LOG(TASSET)^2	0.031	0.006	5.486	0.000
ETA	-0.950	0.129	-7.325	0.000
OWN	0.198	0.097	2.038	0.041
TIME	0.035	0.008	4.620	0.000
BSNESS	-0.097	0.047	-2.098	0.035
ROA	-0.003	0.002	-1.624	0.104
MKTSH	0.007	0.003	2.063	0.039
Adjusted R-squared	0.838			
Sample size	88			

We also include leverage (equity to total assets) variable to verify whether firms with more liquidity perform better than those of having less liquidity. However, our results do not support the theoretical behavior that firms with high leverage are more efficient unlike other studies (Cummins and Nini, 2002; Cummins et al. 2007). One of the reasons for this contradiction may be the limited data availability. However, it is noticeable that small insurance companies possess high capital to asset ratio compared to larger firms,

but are less efficient perhaps due to limited scale operations as discussed earlier. We also introduce ownership dummy variable setting equal to 1 for private insurance firm and 0 for state-owned insurance company. Results indicate that privately owned firms are allocating their resource more efficiently than those of publicly owned. However, dummy variable for nature of business shows that life insurance firms are found more efficient than non-life firms.

Further, we estimate regression models of pure technical efficiency and scale efficiency on same set of exogenous variables and find that size enters into the model with positive sign representing that large firms are technically more efficient than smaller firms again support our previously discussed results. These results are presented in the table 6.6 and 6.7, respectively. We note that size enters significantly positive into scale efficiency model (i.e., table 6.7) indicating that more efficient firms are expanding its business taking advantage of its scale operations, which put these firms advantageous on other

Table 6.6
Determinants of pure technical efficiency

Explanatory Variables	***Coefficient***	***Standard Error***	***Z-Statistic***	***Probability.***
Intercept	-11.577	3.779	-3.064	0.002
LOGTASSET	1.076	0.362	2.973	0.003
LOG(TASSET)^2	-0.023	0.009	-2.638	0.008
ETA	-0.241	0.196	-1.232	0.218
OWN	-0.045	0.114	-0.392	0.695
TIME	-0.002	0.012	-0.178	0.859
BSNESS	0.012	0.074	0.156	0.876
ROA	-0.001	0.003	-0.465	0.642
MKTSH	0.000	0.005	0.092	0.927
Adjusted R-squared	0.453			

firms to use inputs more skillfully. Other variables including time, ownership, business nature and market share are found statistically insignificant in both pure technical efficiency and scale efficiency model.

Table 6.7
Determinants of scale efficiency

Explanatory Variables	*Coefficient*	*Standard Error*	*Z-Statistic*	*Probability*
Intercept	-12.630	2.961	-4.265	0.000
LOGTASSET	1.175	0.284	4.139	0.000
LOG (TASSET)^2	-0.025	0.007	-3.695	0.000
ETA	-0.240	0.154	-1.557	0.120
OWN	-0.047	0.090	-0.521	0.602
TIME	-0.002	0.009	-0.176	0.861
BSNESS	0.022	0.058	0.372	0.710
ROA	-0.001	0.002	-0.490	0.625
MKTSH	0.000	0.004	-0.005	0.996
Adjusted R-squared	0.560			

In sum, the cost efficiency of insurance industry produces a mixed trend over the period of analysis, while technical and scale efficiency components have been on the increasing trend, which shows that insurance sector has been successful to produce the given output level with minimal inputs and expanded its operations significantly on the whole. However, allocative efficiency dominates the overall cost efficiency perhaps due to highly concentrated and regulated insurance sector in the past. Malmquist productivity results also show that insurance industry has experienced overall productivity. Further, we observe that efficiency varies significantly with the size of firm suggesting that competitive environment is imperative for a healthy insurance sector.

Chapter 7

SUMMARY AND CONCLUSION

Insurance sector plays a varied role by supporting individuals, entrepreneurs and companies confronted with a multiplicity of risks, in addition to its limited role of financial intermediation. The insurance sector of the Pakistan fairly developed after liberalization and deregulation process introduced in recent years, which encouraged the private sector, particularly, in non-life business by providing a level playing field for the insurance industry Pakistan like other segments of financial sector of Pakistan. Needles to say that insurance sector plays an important role by providing support to different segments of the society.

Although, a growing literature is concerned with insurance sector efficiency and productivity keeping into view its importance in economic development around the globe, but, we hardly find any study on Pakistan's insurance sector. This study attempts to break new grounds for measuring performance of insurance sector in Pakistan. As study aims at investigating the efficiency and productivity of the insurance sector of Pakistan, we employ non-parametric approach by using Data Envelopment Analysis (DEA) to measure the efficiency and productivity of insurance industry. For this purpose, we use a firm level data for the period 2000-2007. Our sample is quite representative as it covers about 84 percent of the insurance sector of Pakistan.

First, we compute the cost efficiency index and its composition using DEA approach. Our results indicate that the insurance remains technically efficient. We find that technical efficiency increased over the period from 73 percent in the year 2000 to 89 percent in the year 2007. Insurance sector shows on average 82 percent efficiency during the period of analysis. Similarly, results are also indicative of scale efficiency (i.e., 85 percent) illustrating a significant expansion in insurance sector of Pakistan during 2000-2007. However, insurance sector, on the other hand, experiences allocative inefficiency, which dominates the cost efficiency.

Our results of firm level analysis show that among twelve firms, only two remained fully cost efficient. Further, we also find that State Life insurance; EFU insurance and NICL are most technically efficient among others. All these three firms are larger in terms of business volume and outreach, which might have put them on advantageous to optimize the input resources. On the other hand, small firms stay on the lower frontier perhaps due to their limited business diversification these firms failed to optimize their resources. However, these firms need to employ their input resources optimally to catch up with the efficient firms. We also note that that all insurance companies were expanding its operations during 2000-2007 as scale efficiency score remains high for all firms. However, the mean allocative efficiency for all the insurance companies remains about 66.6 percent during the study period, which points out that insurance industry has been failed utilize input mix optimally. Although, we find mixed trends of cost efficiency of insurance industry in our analysis, however, technical and scale efficiency components

show increasing trends, which signify the continuation of the initiated reforms to make the sector more sound and competitive. As we note that allocative efficiency dominates the overall cost efficiency perhaps due to highly concentrated and regulated insurance sector in the past, therefore, necessitates removing the distortions prevalent in the insurance industry of Pakistan. Our results of Malmquist productivity index also show a good sign as there has been a significant improvement in efficiency change, which registers about 4.4 percent growth on annually. However, we do not find any considerable contribution of technology to improve overall productivity, which suggest the introduction of innovative and diversified products in insurance industry of Pakistan.

To explain the differences in efficiency, some explanatory variables are included in regression model to investigate the impact of firm characteristics on performance of these insurance companies. The empirical finding, thus, suggest that a more competitive environment is desired to achieve winning results in the long run.

To conclude, findings of this study suggest a significant improvement in the performance of insurance sector of Pakistan contributed majorly from technical efficiency and technological innovations. However, firms could not succeed to allocate its resources optimally, perhaps due to market imperfections prevalent in the insurance industry.

This study explores issues of efficiency and productivity in the insurance sector of Pakistan and tries to highlight these problems which are needed to be addressed to make the industry viable and sound. Thus, this study sets lines for the further research in the

insurance sector Pakistan. However, limitation of this study is that we have just estimated the efficiencies of insurance firms in the post-reforms period after insurance ordinance 2000 have been implemented. This study, however, does not provide any idea about the efficiencies of firms in the pre-reform period, which could be a good benchmark to analyze the impact of insurance industry. Further, we have investigated the impact of firm characteristics on its performance, ignoring macroeconomic environment perhaps due to our data constraints.

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Appendix-A

A.1. Overview of insurance sector

Table A.1.1

Premiums share in general insurance sector: 2002-2007 (percent)

Year	State	Private	Foreign	Top Five	Top Ten	Overall
2002	23.3	72.3	4.4	79.4	88.6	100
2003	16.6	77.7	5.7	75.9	87.1	100
2004	13.5	86.5	3.3	75.1	86.4	100
2005	14.1	81.5	4.4	73.2	85.3	100
2006	10.5	85.1	4.3	73.4	82.6	100
2007	10.5	85.6	4.2	72.4	84.0	100

Source: Financial Stability Review, 2007-08.

Table A.1.2

Asset Share in General Insurance Sector: 2001-2007

Year	State	Private	Foreign	Top Five	Top Ten	Overall
2002	40.7	55.2	4.1	76.0	85.8	100
2003	37.8	58.0	4.2	73.9	84.6	100
2004	34.3	65.7	2.6	72.5	83.4	100
2005	31.6	65.5	2.9	71.1	82.8	100
2006	24.6	72.8	2.6	74.0	85.4	100
2007	17.8	80.5	2.1	73.5	87.8	100

Source: Financial Stability Review, 2007-08.

Table A.1.3
Premiums share in Life insurance sector 2001-2007 (percent)

Year	State	Private	Foreign	Overall
2001	86.5	7.1	6.4	100
2002	83.7	9.6	6.7	100
2003	78.1	14.1	7.8	100
2004	76.0	20.0	4.0	100
2005	75.0	14.0	11.0	100
2006	71.2	15.4	13.4	100
2007	68.0	28.0	4.0	100

Source: Insurance Association of Pakistan 2007-08, 2006.

Table A.1.4

Assets share in Life Insurance Sector: 2001-2007

Year	State	Private	Foreign	Overall
2001	98.04	1.41	0.54	100
2002	97.55	1.85	0.60	100
2003	94.83	3.30	1.87	100
2004	94.08	3.62	2.30	100
2005	92.89	4.22	2.89	100
2006	91.61	4.89	3.50	100
2007	88.57	7.21	4.23	100

Source: Insurance Association of Pakistan 2007-08, 2006.

A.2. Firm-Wise Efficiency Score

Table A.2.1

STATE LIFE

YEAR	CE*	AE	TE	PTE	SE	RTS
2000	1	1	1	1	1	CRS
2001	1	1	1	1	1	CRS
2002	1	1	1	1	1	CRS
2003	1	1	1	1	1	CRS
2004	1	1	1	1	1	CRS
2005	1	1	1	1	1	CRS
2006	1	1	1	1	1	CRS
2007	1	1	1	1	1	CRS
Mean	**1**	**1**	**1**	**1**	**1**	

* Cost Efficiency (CE), Allocative Efficiency (AE), Technical Efficiency (TE)
Pure Technical Efficiency (PTE), Scale Efficiency (SE), Returns to Scale (RTS)

Table A.2.2

SHAHEEN

YEAR	CE	AE	TE	PTE	SE	RTS
2000	1	1	1	0.42	0.42	IRS
2001	1	1	1	0.53	0.53	IRS
2002	1	1	1	0.26	0.26	IRS
2003	1	1	1	0.99	0.99	IRS
2004	1	1	1	1	1	CRS
2005	1	1	1	1	1	CRS
2006	1	1	1	1	1	CRS
2007	1	1	1	1	1	CRS
Mean	**1**	**1**	**1**	**0.78**	**0.78**	

Table A.2.3

EFU-LIFE

YEAR	CE	AE	TE	PTE	SE	RTS
2000	0.78	0.84	0.94	0.81	0.86	IRS
2001	0.74	0.74	1	0.99	0.99	IRS
2002	1	1	1	1	1	CRS
2003	1	1	1	1	1	CRS
2004	0.99	0.99	1	1	1	CRS
2005	0.86	0.86	1	1	1	CRS
2006	0.89	0.89	1	1	1	CRS
2007	0.91	0.91	1	1	1	CRS
Mean	**0.896125**	**0.90**	**0.99**	**0.98**	**0.98**	

Table A.2.4

ASKARI

YEAR	CE	AE	TE	PTE	SE	RTS
2000	0.71	0.71	1	0.407	0.407	IRS
2001	0.94	0.94	1	0.582	0.582	IRS
2002	0.89	0.89	1	0.773	0.773	IRS
2003	0.76	0.76	1	0.936	0.936	IRS
2004	0.71	0.71	1	0.986	0.986	IRS
2005	0.78	0.78	1	0.826	0.826	IRS
2006	0.76	0.77	0.995	0.757	0.761	IRS
2007	1	1	1	1	1	CRS
Mean	**0.82**	**0.82**	**0.999375**	**0.783375**	**0.783875**	

Table A.2.5

EFU-GENERAL

Year	CE	AE	TE	PTE	SE	RTS
2000	0.674	0.67	1	1	1	CRS
2001	0.825	0.825	1	1	1	CRS
2002	0.721	0.721	1	1	1	CRS
2003	0.481	0.481	1	1	1	CRS
2004	0.835	0.835	1	1	1	CRS
2005	0.853	0.853	1	1	1	CRS
2006	0.816	0.816	1	1	1	CRS
2007	0.108	0.108	1	1	1	CRS
Mean	**0.664125**	**0.664125**	**1**	**1**	**1**	

Table A.2.6

ATLAS

Year	CE	AE	TE	PTE	SE	RTS
2000	0.564	0.564	1	0.361	0.361	IRS
2001	0.681	0.681	1	0.365	0.365	IRS
2002	0.785	0.785	1	0.435	0.435	IRS
2003	0.778	0.778	1	0.494	0.494	IRS
2004	0.83	0.83	1	0.543	0.543	IRS
2005	0.667	0.667	1	0.605	0.605	IRS
2006	0.442	0.442	1	0.795	0.795	IRS
2007	0.475	0.475	1	0.758	0.758	IRS
Mean	**0.65275**	**0.65275**	**1**	**0.5445**	**0.5445**	

Table A.2.7

ADAMJEE

YEAR	CE	AE	TE	PTE	SE	RTS
2000	0.56	0.56	1.00	1.00	1.00	CRS
2001	0.50	0.50	1.00	1.00	1.00	CRS
2002	0.79	0.79	1.00	1.00	1.00	CRS
2003	0.59	0.59	1.00	1.00	1.00	CRS
2004	0.76	0.76	1.00	1.00	1.00	CRS
2005	0.54	0.59	0.90	0.84	0.93	DRS
2006	0.50	0.53	0.95	0.94	0.99	DRS
2007	0.25	0.25	1.00	0.93	0.93	DRS
Mean	0.56	0.57	0.98	0.96	0.98	

Table A.2.8

IGI

Year	CE	AE	TE	PTE	SE	RTS
2000	0.549	0.549	1	1	1	CRS
2001	0.535	0.535	1	1	1	CRS
2002	0.364	0.364	1	0.802	0.802	IRS
2003	0.292	0.292	1	0.819	0.819	IRS
2004	0.237	0.237	1	0.693	0.693	IRS
2005	1	1	1	1	1	CRS
2006	0.085	0.085	1	1	1	CRS
2007	0.078	0.078	1	1	1	CRS
Mean	**0.3925**	**0.3925**	**1**	**0.91425**	**0.91425**	

Table A.2.9

NEW JUBILEE

Year	CE	AE	TE	PTE	SE	RTS
2000	0.586	0.586	1	1	1	CRS
2001	0.616	0.616	1	1	1	CRS
2002	0.354	0.354	1	1	1	CRS
2003	0.342	0.36	0.948	0.936	0.987	IRS
2004	0.323	0.388	0.831	0.82	0.987	IRS
2005	0.235	0.266	0.883	0.869	0.984	IRS
2006	0.244	0.321	0.761	0.742	0.975	IRS
2007	0.381	0.381	1	1	1	CRS
Mean	**0.385125**	**0.409**	**0.927875**	**0.920875**	**0.991625**	

Table A.2.10

PREMIER

Year	CE	AE	TE	PTE	SE	RTS
2000	0.398	0.637	0.626	0.329	0.526	IRS
2001	0.472	0.712	0.663	0.349	0.526	IRS
2002	0.509	0.643	0.792	0.463	0.585	IRS
2003	0.438	0.763	0.574	0.326	0.568	IRS
2004	0.449	0.671	0.669	0.391	0.585	IRS
2005	0.349	0.448	0.78	0.607	0.778	IRS
2006	0.215	0.304	0.706	0.408	0.577	IRS
2007	0.229	0.279	0.822	0.453	0.552	IRS
Mean	**0.382375**	**0.557125**	**0.704**	**0.41575**	**0.587125**	

Table A.2.11

HABIB

Year	CE	AE	TE	PTE	SE	RTS
2002	0.688	0.799	0.861	0.398	0.462	IRS
2003	0.572	0.892	0.641	0.355	0.554	IRS
2006	0.29	0.373	0.776	0.504	0.649	IRS
2007	0.328	0.328	1	0.683	0.683	IRS
Mean	**0.4695**	**0.598**	**0.8195**	**0.485**	**0.587**	

Table A.2.12

NICL

Year	CE	AE	TE	PTE	SE	RTS
2001	0.123	0.123	1	1	1	CRS
2002	0.12	0.12	1	1	1	CRS
2003	0.084	0.084	1	1	1	CRS
2004	0.071	0.071	1	1	1	CRS
Mean	**0.0995**	**0.0995**	**1**	**1**	**1**	

A.3. Firm-Wise Malmquist Index Results

Table A.3.1

EFU-LIFE

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.23	0.94	1.07	1.15	1.16
2002	1.01	1.44	1.00	1.01	1.45
2003	1.00	1.52	1.00	1.00	1.52
2004	1.00	0.83	1.00	1.00	0.83
2005	1.00	1.01	1.00	1.00	1.01
2006	1.00	1.20	1.00	1.00	1.20
2007	1.00	1.16	1.00	1.00	1.16
Mean	**1.03**	**1.16**	**1.01**	**1.02**	**1.19**

Table A.3.2

ATLAS

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.01	1.05	1.00	1.01	1.06
2002	1.19	0.77	1.00	1.19	0.92
2003	1.14	0.95	1.00	1.14	1.08
2004	1.12	1.09	1.00	1.12	1.22
2005	1.10	1.19	1.00	1.10	1.30
2006	1.31	1.04	1.00	1.31	1.37
2007	0.95	0.94	1.00	0.95	0.90
Mean	**1.12**	**1.00**	**1.00**	**1.12**	**1.12**

Table A.3.3

STATE LIFE

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.00	1.30	1.00	1.00	1.30
2002	1.00	1.05	1.00	1.00	1.05
2003	1.00	1.01	1.00	1.00	1.01
2004	1.00	1.09	1.00	1.00	1.09
2005	1.00	1.10	1.00	1.00	1.10
2006	1.00	1.09	1.00	1.00	1.09
2007	1.00	1.11	1.00	1.00	1.11
Mean	**1.00**	**1.11**	**1.00**	**1.00**	**1.11**

Table A.3.4

4. ASKARI

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.43	0.98	1.00	1.43	1.40
2002	1.33	0.76	1.00	1.33	1.01
2003	1.21	1.00	1.00	1.21	1.21
2004	1.06	1.18	1.00	1.06	1.25
2005	0.84	1.12	1.00	0.84	0.94
2006	0.92	1.12	1.00	0.92	1.02
2007	1.32	0.72	1.01	1.32	0.96
Mean	**1.16**	**0.98**	**1.00**	**1.16**	**1.11**

Table A.3.5

IGI

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.00	1.01	1.00	1.00	1.01
2002	1.00	0.56	1.00	1.00	0.56
2003	0.91	1.08	1.00	0.91	0.98
2004	0.91	0.98	1.00	0.91	0.89
2005	1.21	1.27	1.00	1.21	1.54
2006	1.00	2.39	1.00	1.00	2.39
2007	1.00	0.91	1.00	1.00	0.91
Mean	**1.00**	**1.17**	**1.00**	**1.00**	**1.18**

Table A.3.6

SHAHEEN

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.25	0.95	1.00	1.25	1.18
2002	0.50	0.69	1.00	0.50	0.35
2003	3.74	0.95	1.00	3.74	3.57
2004	1.01	1.20	1.00	1.01	1.21
2005	1.00	1.24	1.00	1.00	1.24
2006	1.00	0.98	1.00	1.00	0.98
2007	1.00	0.75	1.00	1.00	0.75
Mean	**1.36**	**0.97**	**1.00**	**1.36**	**1.33**

Table A.3.7

PREMIER

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.06	0.95	1.06	1.00	1.00
2002	1.33	0.68	1.19	1.12	0.91
2003	0.71	0.94	0.73	0.98	0.67
2004	1.23	1.14	1.17	1.05	1.39
2005	1.50	1.22	1.17	1.29	1.84
2006	0.67	1.25	0.91	0.74	0.84
2007	1.11	1.04	1.16	0.96	1.15
Mean	**1.09**	**1.03**	**1.05**	**1.02**	**1.11**

Table A.3.8

EFU-GENERAL

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.00	1.14	1.00	1.00	1.14
2002	1.00	1.02	1.00	1.00	1.02
2003	1.00	1.09	1.00	1.00	1.09
2004	1.00	1.15	1.00	1.00	1.15
2005	1.00	0.90	1.00	1.00	0.90
2006	1.00	1.01	1.00	1.00	1.01
2007	1.00	0.93	1.00	1.00	0.93
Mean	**1.00**	**1.03**	**1.00**	**1.00**	**1.03**

Table A.3.9

ADAMJEE

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.00	1.07	1.00	1.00	1.07
2002	1.00	0.25	1.00	1.00	0.25
2003	1.00	1.04	1.00	1.00	1.04
2004	1.00	1.11	1.00	1.00	1.11
2005	0.84	0.90	0.90	0.93	0.75
2006	1.12	1.04	1.06	1.06	1.16
2007	0.99	0.85	1.05	0.94	0.84
Mean	**0.99**	**0.89**	**1.00**	**0.99**	**0.89**

Table A.3.10

NEW JUBILEE

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	1.00	0.98	1.00	1.00	0.98
2002	1.00	0.33	1.00	1.00	0.33
2003	0.94	0.61	0.95	0.99	0.57
2004	0.92	1.12	0.91	1.00	1.02
2005	1.01	1.11	1.02	1.00	1.12
2006	0.85	1.20	0.86	0.99	1.03
2007	1.35	0.96	1.32	1.03	1.29
Mean	**1.01**	**0.90**	**1.01**	**1.00**	**0.91**