Efficiency of Life Insurance Companies in Malaysia and Brunei: A Comparative Analysis

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Abstract

This study focuses on the efficiency of the life insurance industry in Brunei and Malaysia. Data Envelopment Analysis (DEA) is used to explore the contributions of technical and efficiency change to the growth of productivity in the Malaysian and Brunei life insurance industries by applying the generalized output-oriented Malmquist index for the year 2000-2005. The output-input data consists of a panel of 9 life insurance firms in Malaysia and 2 life insurance companies in Brunei that were chosen as the sample of the study. This study utilizes two inputs and two outputs, namely, commission and management as well as premium and net investment income, respectively. In the DEA technique, efficiency is measured by the Malmquist index. The Malmquist efficiency measures are decomposed into two components: the efficiency change and technical change index. Efficiency change is again decomposed into pure efficiency and scale efficiency. It is found that, on average, the TFP of the life insurance industry is mainly due to both efficiency and technical changes where the main source of the efficiency change is scale efficiency rather than pure efficiency.

Keywords: Data Envelopment Analysis (DEA); Malmquist index; Insurance efficiency; Malaysia, Brunei.

1. Introduction

The primary function of insurance is to act as a risk transfer mechanism to provide peace of mind and protect against losses (Sabbir, 2002). Insurance schemes utilize the combination method by persuading a large number of individuals to pool their risks into a large group to minimize overall risk (Ali, 2000). In the developed world, insurance is part of society such that some forms of cover are required by law. In developing countries, the need for such a safety net is much greater, particularly at the poorest levels where vulnerability to risks is much greater and there are fewer opportunities available to recover from a large loss. Therefore, in the developing countries which are characterized as having low-income levels, and lacking access to social security systems, healthcare, and education, sanitation, and employment opportunities, the need for insurance as a risk transfer mechanism is even more imperative. This study focuses on the performance of the insurance industries in Malaysia and Brunei by making comparison on the efficiency of life insurance companies in Malaysia and Brunei. To the researchers' knowledge, this is the first study that makes a comparison of the performance between insurance industries in Malaysia and Brunei. In this study, Malaysia becomes the benchmark in the performance comparison since it is a member of ASEAN (Association of Southeast Asian Nations) that has a significant development in the financial sector. Brunei, on the other hand, is an ASEAN member with a relatively young financial sector which merits an evaluation in terms of its performance.

In the attempt to analyze the performance of the insurance companies in Malaysia and Brunei, this study measures the efficiency of life insurance companies in Brunei and Malaysia for the year 2000 – 2005 by using the Data Envelopment Analysis (DEA). In the DEA technique, efficiency is measured by the Malmquist index. The Malmquist efficiency measures are decomposed into two components: efficiency change and technical change index. Efficiency change is again decomposed into pure efficiency and scale efficiency. In measuring the efficiency of insurance companies in Malaysia, this utilizes the output-input data which consists of a panel of 9 life insurance firms. As for measuring the efficiency of life insurance companies in Brunei, a panel of 2 companies are utilized. This study utilizes two inputs, namely, commission and management expenses and two outputs, i.e. premium and net investment income. The paper is organized as follows. Section 2 presents the literature review and in Section 3, we discuss the methodology of DEA and Malmquist Index. Section 4 presents the results and analysis and finally, Section 5 concludes.

2. Literature Review

While there have been numerous international studies on the performance of other financial services industries, especially deposit-taking institutions, only a handful have been concerned with the insurance industry. A study on the performance of the insurance industry is crucial since the said industry is currently facing many challenges, including increased competition, consolidation, solvency risks, and a changing regulatory environment. The question of the efficiency of the firms in this industry is clearly important in order to determine how the industry will respond to these challenges and which firms are likely to survive (Berger et. al, 1993). Due to the increased competition, consolidation and a changing regulatory environment that have characterized the insurance industry in recent years, it is imperative for the insurance operators to always seek for ways and methods to improve their operating performance. The findings from the expanding body of literature on efficiency in insurance for both developed and emerging economies, have important implications for both insurance operators in improving their competitive edge and the policymakers as well as the regulators of insurance companies in order to improve the stability of the financial institutions and to enhance further the effectiveness of the monetary system as a whole.

The measurement of insurance efficiency is mostly focused on the efficient frontier approach. This has been used widely to assess the efficiency levels as both approaches allow the use of multiple inputs and outputs from a sample of institutions to develop an efficiency frontier and evaluate the efficiency of a decision-making unit (DMU) relative to other DMUs in the sample. According to a survey conducted by Berger and Humphrey (1997) on 130 past studies that apply frontier efficiency analysis to financial institutions in 21 countries, there are various methods used to measure efficiency. These methods are divided into two approaches namely parametric and non-parametric. The most commonly used parametric approaches are the Stochastic Frontier Approach (composed error), Distribution Free Approach (different composed error) and the Thick Frontier Approach. For non-parametric approaches, the most commonly used are the Data Envelopment Analysis and the Free Disposable Hull [Cummins et al. (1999); Cummins and Zi (1998)].

Among the methods, the two main ones that have been widely used in the literature to measure the efficiency of the insurance industry are Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA). The SFA which is also known as the Econometric Frontier Approach was developed by Aigner et al., (1977). This approach specifies a functional form for cost, profit or production relationship among inputs, outputs, and environmental factors and allows for random error (Berger and Humphrey, 1997). The functions are used to estimate the distance that a firm is from the optimizing envelope (Seale, 2000). Data Envelopment Analysis (DEA) or the mathematical programming approach was introduced by Charnes et al. (1978) and draws upon the efficiency concept in Farrell (1957). According to Charnes et al. (1978), DEA estimates efficiency under the assumption of constant returns to scale, while Banker et al. (1984) assumed variable returns to scale. This approach constructs the frontier of the observed input-output ratios by linear programming. It assumes that linear substitution is possible between observed input combinations on an isoquant.

In other words, DEA is a model that combines all the input and output information on the firm into a single measure of productive efficiency that lies between zero (i.e. a completely inefficient firm) and unity (i.e. a completely efficient firm). In addition, the DEA effectively estimates the frontier by finding a set of linear estimates that bound (envelop) the observed data (Leong et al., 2003). Thus, this technique is a benchmarking technique in the sense that the 'best practice' firms lie on the frontier and 'envelop' other inefficient firms (Neal, 2004). Previous studies on the insurance industry's efficiency using DEA provided evidence to understand the performance of the insurance sector in certain countries, e.g. those studies which analyze insurance in national markets such as the case in the United States done by Berger et al. (1997), Cummins et al. (1999), Meador et al. (2000), Gardner and Grace (2002), Cummins and Weiss (2002) and Cummins et al. (2010), and the insurance industries in other countries like in Japan, Italy, United Kingdom, Australia, Spain, and Germany have been studied by Fukuyama (1997), Cummins et al. (1996), Diacon (2001), Worthington and Hurley (2002), Cummins and Rubio-Misas (2001), and Mahlberg and Url (2010), respectively.

Besides that, there are also studies that conduct analyses of the insurance industry in multi-markets such as Rees and Kessner (2000) and Diacon et al. (2002) where they have conducted studies by internationally comparing the efficiency of insurance companies in Europe. A study undertaken by Cummins et al. (1996) measured technical efficiency and productivity growth in the Italian insurance market by estimating production frontiers based on a sample of 94 Italian insurers for the period 1985-1993. In this study, they found that technical efficiency in the Italian insurance industry ranged from 70 to 78 percent and measured total factor productivity gains of about 3.4 percent during the sample period. There was almost no efficiency change over the sample period, i.e. on average, Italian insurers operated at about the same distance from the production frontier throughout the sample period.

However, productivity declined significantly over the sample period, with a cumulative decline of about 25 percent. The decline was attributable almost exclusively to technological regress, implying that the Italian insurers needed more inputs to produce their outputs at the end of the sample period than at the beginning. Another study on the effect of deregulation and consolidation on financial services markets by analyzing the Spanish insurance industry was done by Cummins and Rubio-Misas (2001). They analyzed a sample consisting of nearly all insurers reporting to the Spanish regulatory authority over the period 1989-1998 by estimating the "best practice" production and cost frontiers using the data envelopment analysis (DEA), while total factor productivity growth was analyzed using the Malmquist index methodology to draw inferences about the relationship between consolidation and productivity gains or losses in the industry. They found that cost efficiency was relatively low in the Spanish insurance market, averaging only 22.7 percent in 1998 which was primarily caused by allocative inefficiency, i.e. the failure to choose the optimal mix of inputs. Average allocative efficiency in 1998 was only 41.2 percent, whereas pure technical efficiency averaged 60 percent. Thus, Spanish firms on average are more successful in employing technology than in choosing optimal inputs.

In addition, the Malmquist analysis showed that Spanish insurers experienced average total factor productivity growth over the sample period ranging from 0.6 to 2.6 percent per year, while the change in total factor productivity was attributable primarily to the technical efficiency growth rather than favorable technical change. Thus, the authors conclude that consolidation had improved efficiency in the Spanish insurance market, but on average, firms have not succeeded in achieving technical improvements. Fukuyama (1997) investigated productive efficiency and productivity changes of Japanese life insurance companies by focusing primarily on the ownership structures (mutual and stock) and economic conditions (expansion and recession) where he found that productive efficiency and productivity performances differ from time to time across the two ownership types under different economic conditions. Fukuyama (1997) found that stock and mutual life insurers in Japan have approximately equal technical efficiency scores. For the sample period 1989-1992, Fukuyama (1997) found the average technical efficiency in the Japanese life insurance industry to be about 0.91 (Cummins et al., 1996) and a total factor productivity gains of about 19 percent.

Comparing the results of the three countries' insurance industries with their United States counterparts, in terms of total factor productivity growth which is measured by the Malmquist index, the Japanese life insurers (Fukuyama, 1997) and the Italian life and property-liability insurers (Cummins et al., 1996) indicate efficiency gains that are considerably higher than in the U.S. In the case of the Spanish insurance industry, Cummins and Rubio-Misas (2001) found that cost efficiencies for Spanish insurers are low compared to the U.S insurers. Besides studies on a country-level basis, there are studies on the international comparison on the efficiency of insurance companies such as in Europe. Rees and Kessner (2000) found that the average efficiency level of the German firms was about 48 percent and the average efficiency level of the British firms was markedly higher, with a mean of around 57 percent and median of 52 percent. On the other hand, Diacon et al. (2002) found that, when a comparison was made between insurance companies in the U.K., Spain, Sweden and Denmark, U.K. insurers appear to have particularly low levels of scale and mix efficiencies.

While studies of efficiency of the insurance industries in the United States and European countries are quite numerous, only few studies could be found in the case of Asian countries. Dutta and Sengupta (2010) conducted a study to investigate the impact of technological innovation on the efficiency of Indian insurance industry. Dutta and Sengupta (2010) examined whether increasing investment on IT-infrastructure which is resulting a technological innovation in business operation of the private companies has positive impact on efficiency changes or not. They used a panel data set of 12 life insurance companies over the period 2006-2009 to evaluate their efficiency scores by applying Data Envelopment Analysis and calculating the scale efficiency. The study concluded that increasing investment on IT-infrastructure has a positive impact on scale and technical efficiency change under constant and variable returns to scale assumptions.

A prior study on the efficiency of the Malaysian insurance industry by Abu Mansor and Radam (2000) was conducted by using the non-parametric Malmquist Index approach to measure the productivity of the life insurance industry in Malaysia. In measuring the efficiency performance, they evaluated the Malmquist Index of a sample of 12 Malaysian insurance companies over the 1987 to 1997 period. Abu Mansor and Radam found that the overall productivity growth of the insurance industry in Malaysia was contributed by both technical efficiency and technical progress. A more recent empirical study on the efficiency of Malaysian insurance companies as well as other insurance companies around the world was conducted by Eling and Luhnen (2010). In this study Eling and Luhnen (2010) examined the efficiency of 3,831 companies from 91 countries using DEA and SFA techniques. Their sample includes 28 firm-years of life insurance companies and 113 firm-years of non-life insurance companies from Malaysia.

In addition, considering the Malaysian dual financial system environment where the Takaful operators are operating in parallel with their conventional counterparts, another recent study was undertaken by Md. Saad et al. (2007) to analyze the sources of efficiency and technical changes of all the life insurance companies and compare the performance results with that of the Takaful operators in Malaysia. Using a sample of 13 Malaysian insurance companies over a period of 2002 to 2005, they used a non-parametric approach of DEA together with the Malmquist Index to isolate the contributions of technical change, efficiency change, the pure and scale changes to the total factor productivity growth of different life insurance companies and the Takaful operators. On the basis of the findings, the authors found that on average, the total factor productivity growth of the insurance industry in Malaysia is mainly due to technical change while efficiency change contributed a negative change. While Takaful presents a below average in total factor productivity but slightly above average for technical change as well as an equal to industry average in scale efficiency. However, this result is still inconclusive on the Takaful industry as a whole. Thus, the overall productivity growth of the insurance industry in Malaysia over the sample period was more or less contributed by both technical efficiency and technical progress.

3. Data Sources and Methodology

Two inputs and outputs are utilized to investigate efficiency of life insurance firms in Brunei and Malaysia in this study. The inputs are commission and management expenses and the outputs are premium and net investment income. These inputs and outputs are used to investigate efficiency of 9 life insurance firms in Malaysia and 2 life insurance companies in Brunei. The 9 Malaysian firms involved in the study are Takaful Nasional Sdn Bhd, Asia Life (M) Bhd, Great Eastern Life Assurance (M) Bhd, Hong Leong Assurance Bhd, Malaysian Assurance Alliance Bhd, Mayban Life Assurance Bhd, MCIS ZURICH Insurance Bhd, Malaysia Nasional Insurance Bhd, and Prudential Assurance Malaysia Bhd, whereas the representative companies from Brunei are American International Assurance Co. Ltd. And TM Asia Life Assurance Society Ltd. Data on inputs and outputs are collected from period of 2000 to 2005. The data for the Malaysian life insurance companies are gathered from the insurance annual reports and *takaful* annual reports, whereas the data for Brunei insurance firms are obtained the Financial Institutions Division (FID) of the Ministry of Finance, Brunei.

In exploring the contributions of technical and efficiency change to the growth of productivity in the Malaysian life insurance industries the generalized output-oriented Malmquist index, developed by Fare et al. (1989) is adopted in this study. The Malmquist indexes are constructed using the Data Envelopment Approach (DEA) and estimated using Coelli's (1996) DEAP version 2.1. Malmquist index was chosen as there are a number of desirable features for this particular study. The DEA does not only require input prices or output prices in their construction, which make the method particularly useful in situations in which prices are not available publicly or non-existent, but it also does not require a behavioral assumption such as cost minimization or profit maximization in the case where the producers' objectives differ, unknown or unachieved. This is first demonstrated by Fare et al. (1989) using the geometric mean formulation of the Malmquist index. Following this, Forsund (1991) derived the decomposition of the simple version of the Malmquist productivity index into technical change and efficiency change. Following Fare et al. (1989), the Malmquist index of total factor productivity growth is written as follows:

$$M_o\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = \frac{D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_o^t\left(x^t, y^t\right)} \times \left[\left(\frac{D_o^t\left(x^{t+1}, y^{t+1}\right)}{D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)}\right)\left(\frac{D_o^t\left(x^t, y^t\right)}{D_o^{t+1}\left(x^t, y^t\right)}\right)\right]^{\frac{1}{2}} \qquad (1)$$

where the notations $D_o^t\left(x^{t+1}, y^{t+1}\right)$, represents the distance from the period *t+1* observation to the period *t* technology. The first ratio on the right hand side of equation (1) measures the change in relative efficiency (i.e., the change in how far observed production is from maximum potential production) between years *t* and *t+1*. The second term inside the brackets (geometric mean of the two ratios) captures the shift in technology (i.e., movements of the frontier function itself) between the two periods evaluated at x^t and x^{t+1}. Essentially, the change in relative efficiency measures how well the production process converts inputs into outputs (catching up to the frontier) and the later reflects improvement in technology. According to Fare et al. (1994a), improvements in productivity yield Malmquist index values greater than unity. Deterioration in performance over time is associated with a Malmquist index less than unity. The same interpretation applies to the values taken by the components of the overall TFP index. Improvement in the efficiency component yielded index values greater than one and is considered to be evidence of catching up (to the frontier). Values of the technical change component greater than one are considered to be evidence of technological progress.

Following Fare et al. (1994), this study uses an enhanced decomposition of the Malmquist index by decomposing the efficiency change component calculated relative to the constant returns to scale technology into a pure efficiency component (calculated relative to the VRS technology) and a scale efficiency change component which captures changes in the deviation between the VRS and CRS technology. The subset of pure efficiency change measures the relative ability of operators to converts inputs into outputs while scale efficiency measures to what extent the operators can take advantage of returns to scale by altering its size toward optimal scale.

4. Findings of the Study

4.1Descriptive Statistics

Table 1 above reports the descriptive statistics of the outputs and inputs of 11 life insurance firms which include 9 firms in Malaysia and 2 firms in Brunei during the period of study. Within the period of analysis, Great Eastern Life Assurance (M) Bhd. and American International Assurance Co. Ltd. had the highest amount of output, premium and net investment income; respectively while Prudential Assurance Malaysia Bhd. and Malaysia National Insurance Bhd. had the lowest amount of outputs, premium and net investment income, respectively. As for inputs, American International Assurance Co. Ltd. seemed to have the highest amount of inputs, while Takaful Nasional Sdn. Bhd. seemed to have the lowest. On average, the amount of premium and net investment income within the period of study are US$1, 365, 208 and US$118, 041 millions, respectively. Meanwhile, the average commission and management expenses are US$162, 741 and US$44, 949 millions, respectively.

Insert Table (1) about here

4.2. Production Frontier and Efficiency

As shown in Tables 2 and 3, the study initially reports efficiency change for the 11 life insurance firms from 2000-2005 under constant returns to scale (CRS) and variable returns to scale (VRS) respectively, since the basic component of the Malmquist productivity index is related to measures of efficiency. For the values of unity, the firm is implied to be on the industry frontier in the associated year, while the values that are less than unity imply that the firm is below the frontier or technically inefficient. Thus, the lower the values from unity, the firm is said to be more inefficient compared to the values closer to one. For the years reported in tables 2 and 3, Great Eastern Life Assurance (M) Bhd., Malaysia Nasional Insurance Bhd. and TM Asia Life Assurance Society are consistently efficient, both under constant returns to scale (CRS) and variable returns to scale (VRS). Asia Life (M) Bhd. and American International Assurance Co. Ltd. are consistently efficient under VRS but not under CRS. Prudential Assurance Malaysia Bhd. is the least efficient firm for CRS and VRS versions respectively. In addition, the estimates indicate that Mayban Life Assurance Bhd. and MCIS Zurich Insurance Bhd. have successfully kept pace with technically feasible production possibilities and improving their distance to the industrial production frontier for both versions of technologies.

Insert table (2) about here

The values in Tables 2 and 3 show the percentage of the realized output level compared to the maximum potential output level at the given input mix. As an example, in 2000, Takaful Nasional Sdn. Bhd. produced 29.8 percent of its potential output level and Asia Life (M) Bhd. produced 93.2 percent of its potential output under CRS. Under VRS in the same year, both produced at their maximum potential output, which was at 100 percent. As for the representatives from Brunei's life insurance industry, in 2003, American International Assurance Co. Ltd. produced 29.4 percent of its potential output level and TM Asia Life Assurance Society Ltd. produced 96.6 percent of its potential output under CRS. Under VRS in the year 2003, both the companies in Brunei produced at their maximum potential output at 100 percent, which is similar to the Malaysian firms. As indicated by the weighted geometric mean in Tables 2 and 3, the average efficiency for the whole industry increases for the period 2000 to 2002 under CRS, but experienced a decrease for the period 2003 to 2004 and later increases slightly in 2005. Meanwhile, under VRS, the average efficiency for the whole industry fluctuates between 2000 and 2003 but shows a slight increase in later years. On average, efficiency performance of the life insurance industry is relatively higher based on VRS than CRS.

Insert table (3) about here

4.3. Productivity Performance of the Individual Company

Tables 4 to 5 report the performance of the firms from 2000 to 2005 in terms of TFP change and its two subcomponents which are technical change and efficiency change respectively. Note that a value of the Malmquist TFP productivity index and its components of greater than one imply improvements of productivity in the relevant aspects, while values less than one indicate a decrease or deterioration in productivity.

Subtracting 1 from the number reported in the table gives an average increase or decrease per annum for the relevant time period and relevant performance measure. These measures also capture the performance relative to the best practice in the relevant performance or relative to the best practice in the sample.

Insert table (4) about here

Table 4 shows calculated changes in the Malmquist-based Total Factor Productivity index. As shown in the results, Takaful Nasional Sdn. Bhd., Hong Leong Assurance Bhd., MCIS Zurich Insurance Bhd. and TM Asia Life Assurance Society Ltd. have positive productivity changes for the adjacent years of 2001-2002, 2002-2003 and 2004-2005, but they faced a reduction in productivity in 2003-2004 and subsequently improved in 2004-2005. In contrast, Malaysian Assurance Alliance Bhd. and Malaysia National Insurance Bhd. recorded a deterioration in TFP for the year 2004-2005 where in previous years both recorded marked improvement in TFP. There are also some improvements of TFP change for Prudential Assurance Malaysia Bhd. In addition, American International Assurance Co. Ltd. in Brunei has the highest average TFP growth at an annual average rate of 16.3 percent, followed closely by Malaysian Assurance Alliance Bhd. with an annual rate of 15 percent, and then Takaful Nasional Sdn. Bhd. ranked third with an annual rate of 14.3 percent. The TFP change, on average, only showed significant growths in the periods of 2001-2002, 2002-2003 and 2004-2005 with 9 percent, 29.7 percent, 13.8 percent and 15.4 percent, respectively. However, it deteriorated in 2000-2001 and 2003-2004 with 9 and 17.9 percents, respectively.

The Malmquist TFP index is further decomposed into its two components, technical change and efficiency change. The results of technical change and efficiency change are displayed in Tables 5 and 6. Table 5 presents the index values of technical progress or regress as measured by average shifts in the best-practice frontier from period *t* to *t+1*. According to the results, all the firms experienced both technical progress and regress. Hong Leong Assurance Bhd. and Prudential Assurance Malaysia Bhd. are the firms that experienced technical progress for the periods of 2000 to 2005 but experienced technical regress during the period 2003-2004. Over the period of the analysis, Great Eastern Life Assurance (M) Bhd. recorded the highest change in technical progress (4.2 percent) in the period 2000-2001, while American International Assurance Co. Ltd. recorded the highest technical growth between the period 2001 and 2002 with 41.2 percent and 57.5 percent in 2002-2003.

In the period 2003-2004, only Great Eastern Life Assurance (M) Bhd. recorded technical progress (2.9 percent) while all other firms have experienced technical regress. For the period 2004-2005, Prudential Assurance Malaysia Bhd. recorded the highest technical growth with 11.4 percent. Table 5 also displays that technical progress was experienced by 3 firms (2000-2001), 10 firms (2001-2002 and 2002-2003), 1 firm (2003-2004) and 6 firms (2004-2005). On the average, the years 2001-2002, 2002-2003 and 2004-2005 are found as the years of technical progress (19.1 percent, 29.8 percent and 2.1 percent, respectively), while for the years 2000-2001 and 2003-2004, the life insurance firms recorded technical regress of -12.5 percent and -24.1 percent respectively. Over the period of analysis, Prudential Assurance Malaysia Bhd. was found to be the most technical progressive firm (3.2 percent), while Takaful Nasional Sdn. Bhd. was found as the most technical regressive firm (-1.5 percent).

Insert table (5) about here

Table 6 reports the changes in relative efficiency for each individual company. The results indicate considerable variation across companies and time. Only Great Eastern Life Assurance (M) Bhd. was found to be consistently efficient in all periods from 2000 to 2005. For the other firms, there are periods with positive, negative or no changes in efficiency. Furthermore, the results show that many firms improved their efficiency during the period 2004-2005. During the entire period of study, the results indicate that, on average, the only Islamic insurance firm under study, i.e. Takaful Nasional Sdn. Bhd. recorded the highest efficiency change with 16 percent, followed by American International Assurance Co. Ltd. with 14.2 percent, Mayban Life Assurance Bhd. with 13.7 percent and Malaysian Assurance Alliance Bhd. with 11.7 percent. Asia Life (M) Bhd. and Prudential Assurance Malaysia Bhd. are the two firms that experienced efficiency deterioration where Prudential Assurance Malaysia Bhd. deteriorated at the rate of -15.5 percent. Overall, there was an improvement in relative efficiency throughout these years with a slight deterioration during the period 2002-2003 at -12.3 percent.

Insert table (6) about here

In order to identify a change in scale efficiency, the efficiency change is further decomposed into two subcomponents, namely pure efficiency change and scale efficiency change in which the results are reported in Table 7. The results indicate that the pure efficiency and scale efficiency appear to be an equally important source of growth to efficiency change. Great Eastern Life Assurance (M) Bhd. recorded no changes in annual growth for both the scale and pure efficiencies during the period 2000 to 2005.

Relative to other insurance firms, American International Assurance Co. Ltd. recorded the highest deterioration of scale efficiency at -55.4 percent in 2002-2003. On the other hand, Takaful Nasional Sdn. Bhd. recorded the highest growth in scale efficiency of 85.6 percent in 2000-2001.

Insert table (7) about here

In terms of pure efficiency, Takaful Nasional Sdn. Bhd. recorded the highest deterioration by -45.0 percent in 2002-2003. It is interesting to note that although Takaful Nasional Sdn. Bhd recorded the highest deterioration in pure efficiency; it also experienced the highest growth in scale efficiency with 48.0 percent in the same period. On the other hand, Malaysian Assurance Alliance Bhd. recorded the highest growth in pure efficiency with 62.9 percent in the same period. Malaysian Assurance Alliance Bhd. seemed to not being able to maintain its pure efficiency performance when it registered a deterioration at -19.6 percent in 2004-2005, which is the lowest deterioration among the other firms. However, it managed to improve its scale efficiency performance from a low -24.0 percent in 2002-2003 to 7.8 percent in 2004-2005. Takaful Nasional Sdn. Bhd. having the highest deterioration in 2002-2003 has significantly improved its pure efficiency performance by having the highest growth of 26.6 percent in the period 2004-2005. During the entire period of study, only the years between 2001-2002, 2003-2004 and 2004-2005 are identified as the years of pure efficiency improvement, while the years between 2000-2001, 2001-2002, 2003-2004 and 2004-2005 are recorded to be the years of scale efficiency improvement.

4.4. Productivity Performance of the Industry

Table 8 summarizes the performance of the Malmquist productivity index of the insurance industry in Malaysia and Brunei between 2000 and 2005. On average, American International Assurance Co. Ltd. recorded the highest growth in TFP with 16.3 percent, efficiency and technical changes with 14.2 and 1.9 percent, respectively. Prudential Assurance Malaysia Bhd., on the other hand, recorded the lowest growth in TFP with -12.8 percent, which is mainly due to efficiency regress (-15.5 percent). Takaful Nasional Sdn. Bhd. took the third rank by having TFP of 14.3 percent, which is mainly contributed by efficiency progress (16.0 percent). On average, the TFP of the life insurance industry is mainly due to both efficiency and technical changes with 2.8 and 1.2 percents, respectively. Furthermore, the efficiency change is largely contributed by scale efficiency rather than pure efficiency. This indicates that the size of the companies is a factor in affecting efficiency changes. This study found that there were substantial growths in technical components and efficiency change which suggest that TFP in the life insurance industry is due to the innovation in technical components coupled with a considerable improvement in the efficiency aspect. On average, the insurance firms were found to be experiencing a technical progress. Even though there was an improvement in efficiency change, the subcomponent of this efficiency change, namely pure efficiency, did show a slight deterioration (0.7 percent). Due to the positive impact of both efficiency and technical changes, the overall TFP for these firms within the period of study is maintained at a value higher than 1 (reflected by the mean 1.040 of TFP change).

Insert table (3) about here

Insert Figure (1) about here

Insert Figure (2) about here

Figure 1 depicts the mean evolution over time of TFP and its components for the 11 insurance firms measured by the geometric mean of the Malmquist productivity index for each period. The figure displays that on average, TFP experienced the highest growth in technical efficiency. The deterioration of TFP in the following periods (2002-2003 and 2003-2004) was also largely contributed by the deterioration of technical change rather than efficiency change. Finally, Figure 2 presents the visual summary of changes in the mean efficiency and its components which are scale and pure efficiencies for the entire period. Even though throughout the period of 2000-2005, the efficiency change experienced improvements, its deterioration in the period of 2002-2003 made a significant impact on the overall of TFP change. From the figure, it seems that the change in efficiency was mainly attributed by a change in scale efficiency rather than a change in pure efficiency.

5. Conclusions

In this study, DEA is used to explore the contributions of technical and efficiency change to the growth of productivity in the Malaysian and Brunei insurance industries by applying the generalized output-oriented Malmquist index for the year 2000-2005. The efficiency measures of life insurers in Malaysia and Brunei are comparatively measured where it is found that on average, the TFP of the life insurance industry is mainly due to both efficiency and technical changes with 2.8 and 1.2 percents respectively. Furthermore, the efficiency change is largely contributed by the scale efficiency rather than pure efficiency.

This indicates that the size of the companies does matter in affecting efficiency changes. However, this study also found that there were substantial growths in technical components and efficiency change which suggest that TFP in the life insurance industry is due to the innovation in technical components coupled with a considerable improvement on the aspect efficiency. On average, the insurance firms are found to be experiencing a technical progress. Even though there was an improvement in efficiency change, the subcomponent of this efficiency change, namely pure efficiency, did show a slight deterioration (0.7 percent). However, an improvement in the scale efficiency (3.5 percent) offsets the pure efficiency deterioration effect thus giving an improved efficiency change. Hence, this finding indicates that the bigger the size of the companies, the higher the probability for the companies to be more efficient in utilizing their inputs to generate more outputs. Due to the positive impact of both efficiency and technical changes, the overall TFP for these firms within the period of study is maintained at a value higher than 1 (reflected by the mean 1.040 of TFP change).

Overall, American International Assurance Co. Ltd. in Brunei recorded the highest growth in TFP with 16.3 percent and efficiency and technical changes with 14.2 and 1.9 percent respectively. Prudential Assurance Malaysia Bhd., on the other hand, recorded the lowest growth in TFP with -12.8 percent, which is mainly due to efficiency regress (-15.5 percent). The findings of this study give significant benefits to the management of insurance companies in assisting them to make strategies in terms of the operations and management in order to improve the efficiency of both industries in utilizing their inputs to generate more outputs, thus, improving their competitive edge and strengthening their positions in the industry further.A major implication which can be made in reference to the finding of this study is that, the TFP of insurance companies in both Malaysia and Brunei have a positive relationship with the economic growth where it is mainly due to technical growth and an improvement in scale efficiency. This result indicates that both Malaysia's and Brunei's life insurance industries have a great potential to further increase their TFP through improvements in the technical component such as enhancing the use of information and communication technology in order to provide good services to customers.

References

Abu Mansor, S., & Radam, A. (2000). Productivity and efficiency performance of the Malaysian life insurance industry. *Jurnal Ekonomi Malaysia*, 34, 93-105.

Aigner, D.J, Lovell, C.A.K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, 6, 21-37.

Ali, M. M. K. (2000). Provision of micro-insurance for microfinance clients. *Microfinance Newsletter*, **7**, 2-5.

Banker, R.D., Charnes, A., & Cooper, W.W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078-1092.

Berger, A.N, Hunter, W.C., & Timme, S.G. (1993). The efficiency of financial institutions: A review and preview of research past, present and future. *Journal of Banking and Finance*, 17(2&3), 221-250.

Berger, A.N., & Humphrey, D.B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research*, 98, 175-212.

Coelli, T. (1996). A guide to DEAP version 2.1 data envelopment analysis (computer) program. *CEPA Working Paper 96/98*. Armdale, University of New England, CEPA.

Charnes, A., Cooper, W.W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2, 429-444.

Cummins, J.D., Turchetti, G., & Weiss, M.A. (1996). Productivity and technical efficiency in the Italian insurance industry. *Working Paper Series*, The Wharton, University of Pennsylvania.

Cummins, D., & Zi, H. (1998). Comparison of frontier efficiency methods: An application to the U.S. life insurance industry. *Journal of Productivity Analysis*, 10, 131-152.

Cummins, J.D., Tennyson, S., & Weiss, M.A. (1999). Consolidation and efficiency in the U.S life insurance industry. *Journal of Banking & Finance*, 23, 325-357.

Cummins, J.D., & Rubio-Misas, M. (2001). Deregulation, consolidation, and efficiency: Evidence from the Spanish industry. *Working Paper Series*, The Wharton School, University of Pennsylvania.

Cummins, J.D., & Weiss, M.A. (2002). Analysing firm performance in the insurance industry, using frontier efficiency methods. In G. Dionne (Ed), *Handbook of insurance economics* (pp. 767-829). Kluwer, Boston.

Cummins J. D., Weiss M. A., Xiaoying Xie , and Hongmin Zi, 2010. Economies of scope in financial services: A DEA efficiency analysis of the US
insurance industry, *Journal of Banking & Finance*,Vol. 34, No. 7 , 1525–1539.

Diacon, S.R. (2001). The efficiency of UK general insurance companies. *CRIS Discussion paper Series. Centre for Risk & Insurance Studies*. The University of Nottingham.

Diacon, S.R., Starkey, K., & O'Brien, C. (2002). Size and efficiency in European long-term insurance companies: An international comparison. *The Geneva Papers On Risk and Insurance*, 27 (3), 444-466.

Dutta, A. and Sengupta P. P. 2010. Impact of Technological Innovation on Efficiency – An Empirical Study of Indian Life Insurance Industry, A paper presented at the International Conference on Education and Management Technology, ICEMT 2010.

Eling, M., Luhnen, M., 2010. Efficiency in the international insurance industry: A cross-country comparison, Journal of Banking & Finance, Vol. 34, No. 7, 1497–1509.

Fare, R., Shawna, G., Bjorn, L., & Ross, P. (1989). *Productivity development in Swedish hospitals: A Malmquist output index approach*. Mimeo.

Fare, R., Shawna, G., Mary, N., & Zhongyang, Z. (1994). Productivity growth, technical progress and efficiency change in industrialized countries. *American Economic Review*, 84, 66-83.

Farrell, M.J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, Series A, 120 (3), 253-290.

Forsund, F. (1991). The Malmquist productivity index. *Paper Presented at the 2nd European Workshop on Efficiency and Productivity Measurement*. Belgium: Centre of Operations Research & Econometrics, University Catholique de Louvain, Lauvain-la-Neuve.

Fukuyama, H. (1997). Investigating productive efficiency and productivity changes of Japanese life insurance companies. *Pacific-Basin Finance Journal*. 5, 481-509.

Gardner, L.A., & Grace, M. F. (1993). X-efficiency in the US life insurance industry. *Journal of Banking and Finance*, 17, 497-410.

Insurance Annual Report, various issues. http://www.bnm.gov.my

Leong, W.H., Dollery, B., & Coelli, T. (2003). Measuring technical efficiency of banks in Singapore for the period 1993-1999: An application and extension of the Bauer et al. (1997) technique. *ASEAN Economic Bulletin*, 20(3), 195-210.

Mahlberg, B and Url, T., 2010. Single Market effects on productivity in the German insurance industry, *Journal of Banking & Finance* Vol. 34, No. 7, 1540–1548.

Md. Saad, N., Abd. Majid, M.S., Mohd. Yusof, R., Duasa, J., & Abdul Rahman, A.R. (2007). Measuring efficiency of insurance and takaful companies in Malaysia using data envelopment analysis (DEA). *Review of Islamic Economics*, 11(1), 5-26.

Meador, J.W., Ryan, H. E., & Schellhorn, C.D. (2000). Product focus versus diversification: Estimates of X-efficiency for the U.S. life insurance industry. In P.T. Harker & Zenios (Eds.), *Performance of financial institutions: Efficiency, innovation, regulation* (pp. 175-198). Cambridge University Press.

Neal, P. (2004). X-efficiency and productivity change in Australian banking. *Australian Economic Papers*, 13(2), 174-191.

Rees, R., & Kessner, E. (2000). Regulation and efficiency in European insurance markets. *Economic Policy*, 29, Centre for Economic Policy Research, London.

Sabbir, P. (2002). *Takaful and poverty alleviation*, www.icmif.org/takaful

Seale, Jr. J.L. (2000). Stochastic frontier analysis. *Journal of Economics Literature*. 38(4), 936-991.

Takaful Annual Report, various issues. http://www.bnm.gov.my

Worthington, A., & Hurley, E. (2002). Cost efficiency in Australian general insurers: A non-parametric approach. *British Accounting Review* 34(1), 89-108.

Table 1: Descriptive Statistics, 2000-2005

	OUTPUT		INPUT	
	Premium	*Net Investment Income*	*Commission*	*Management Expenses*
Mean	1,365,208	118,041	162,741	44,949
Median	482,770	27,739	19,194	11,284
Std Dev.	2,133,296	243,116	596,651	87,561
Minimum	9,867	606	3,738	2,512
Maximum	8,080,694	1,071,901	3,617,257	358,331

Table 2: Efficiency of the Life Insurance Firms, 2000-2005 (Constant Returns to Scale)

No.	Insurance firm	2000	2001	2002	2003	2004	2005
1	Takaful Nasional Sdn. Bhd.	0.298	0.553	0.664	0.540	0.474	0.625
2	Asia Life (M) Bhd.	0.932	0.968	0.853	1.000	0.834	0.923
3	Great Eastern Life Assurance (M) Bhd.	1.000	1.000	1.000	1.000	1.000	1.000
4	Hong Leong Assurance Bhd.	0.444	0.357	0.495	0.446	0.481	0.497
5	Malaysian Assurance Alliance Bhd.	0.443	0.395	0.440	0.545	0.889	0.770
6	Mayban Life Assurance Bhd.	0.526	0.909	0.875	0.605	0.695	1.000
7	MCIS Zurich Insurance Bhd.	0.469	0.551	0.548	0.521	0.578	0.612
8	Malaysia National Insurance Bhd.	1.000	0.527	1.000	1.000	1.000	1.000
9	Prudential Assurance Malaysia Bhd.	0.520	0.442	0.337	0.263	0.236	0.224
10	American International Assurance Co. Ltd.	0.480	0.588	0.659	0.294	0.545	0.930
11	TM Asia Life Assurance Society Ltd.	1.000	1.000	1.000	0.966	0.839	1.000
	Mean	0.647	0.663	0.716	0.653	0.688	0.780

Table 3: Efficiency of the Insurance Firms, 2000-2005 (Variable Returns to Scale)

No.	Insurance firm	2000	2001	2002	2003	2004	2005
1	Takaful Nasional Sdn. Bhd.	1.000	1.000	1.000	0.550	0.499	0.632
2	Asia Life (M) Bhd.	1.000	1.000	1.000	1.000	1.000	1.000
3	Great Eastern Life Assurance (M) Bhd.	1.000	1.000	1.000	1.000	1.000	1.000
4	Hong Leong Assurance Bhd.	0.514	0.387	0.511	0.446	0.499	0.505
5	Malaysian Assurance Alliance Bhd.	0.487	0.401	0.526	0.858	1.000	0.804
6	Mayban Life Assurance Bhd.	0.910	1.000	1.000	0.643	1.000	1.000
7	MCIS Zurich Insurance Bhd.	0.568	0.562	0.551	0.567	0.579	0.639
8	Malaysia National Insurance Bhd.	1.000	0.680	1.000	1.000	1.000	1.000
9	Prudential Assurance Malaysia Bhd.	0.547	0.459	0.344	0.264	0.236	0.225
10	American International Assurance Co. Ltd.	1.000	1.000	1.000	1.000	1.000	1.000
11	TM Asia Life Assurance Society Ltd.	1.000	1.000	1.000	1.000	1.000	1.000
	Mean	0.820	0.772	0.812	0.757	0.801	0.800

Table 4: Insurance Firms Relative Malmquist TFP Change between Time Period t and t + 1, 2000-2005

No.	Insurance firm	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Mean
1	Takaful Nasional Sdn. Bhd.	1.389	1.524	1.081	0.643	1.325	1.143
2	Asia Life (M) Bhd.	0.867	0.966	1.742	0.621	1.151	1.008
3	Great Eastern Life Assurance (M) Bhd.	1.042	0.945	0.951	1.029	0.985	0.990
4	Hong Leong Assurance Bhd.	0.835	1.498	1.061	0.942	1.044	1.055
5	Malaysian Assurance Alliance Bhd.	0.862	1.411	1.845	1.037	0.866	1.150
6	Mayban Life Assurance Bhd.	1.403	1.270	0.933	0.792	1.422	1.133
7	MCIS Zurich Insurance Bhd.	0.932	1.348	1.261	0.836	1.056	1.069
8	Malaysia National Insurance Bhd.	0.379	2.520	1.540	0.726	0.977	1.008
9	Prudential Assurance Malaysia Bhd.	0.881	0.782	0.825	0.838	1.057	0.872
10	American International Assurance Co. Ltd.	0.961	1.583	0.703	1.106	1.800	1.163
11	TM Asia Life Assurance Society Ltd.	0.935	1.108	1.123	0.638	1.274	0.989
	Mean	0.910	1.297	1.138	0.821	1.154	1.049

Table 5: Insurance Firms Relative Technical Change, 2000-2005

No.	Insurance firm	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Mean
1	Takaful Nasional Sdn. Bhd.	0.748	1.269	1.329	0.732	1.004	0.985
2	Asia Life (M) Bhd.	0.835	1.096	1.486	0.744	1.040	1.010
3	Great Eastern Life Assurance (M) Bhd.	1.042	0.945	0.951	1.029	0.985	0.990
4	Hong Leong Assurance Bhd.	1.038	1.082	1.178	0.873	1.010	1.031
5	Malaysian Assurance Alliance Bhd.	0.967	1.269	1.488	0.636	0.999	1.030
6	Mayban Life Assurance Bhd.	0.811	1.319	1.348	0.690	0.989	0.997
7	MCIS Zurich Insurance Bhd.	0.793	1.355	1.327	0.753	0.997	1.014
8	Malaysia National Insurance Bhd.	0.719	1.329	1.540	0.726	0.977	1.008
9	Prudential Assurance Malaysia Bhd.	1.038	1.024	1.057	0.934	1.114	1.032
10	American International Assurance Co. Ltd.	0.784	1.412	1.575	0.597	1.055	1.019
11	TM Asia Life Assurance Society Ltd.	0.935	1.108	1.163	0.735	1.069	0.989
	Mean	0.875	1.191	1.298	0.759	1.021	1.009

Table 6: Changes in Firms Relative Efficiency, 2000-2005

No.	Insurance firm	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Mean
1	Takaful Nasional Sdn. Bhd.	1.856	1.201	0.813	0.877	1.319	1.160
2	Asia Life (M) Bhd.	1.038	0.882	1.172	0.834	1.106	0.998
3	Great Eastern Life Assurance (M) Bhd.	1.000	1.000	1.000	1.000	1.000	1.000
4	Hong Leong Assurance Bhd.	0.805	1.385	0.901	1.079	1.034	1.023
5	Malaysian Assurance Alliance Bhd.	0.892	1.112	1.239	1.632	0.867	1.117
6	Mayban Life Assurance Bhd.	1.730	0.963	0.692	1.148	1.438	1.137
7	MCIS Zurich Insurance Bhd.	1.174	0.995	0.950	1.110	1.059	1.055
8	Malaysia National Insurance Bhd.	0.527	1.896	1.000	1.000	1.000	1.000
9	Prudential Assurance Malaysia Bhd.	0.849	0.763	0.780	0.898	0.949	0.845
10	American International Assurance Co. Ltd.	1.225	1.121	0.446	1.854	1.706	1.142
11	TM Asia Life Assurance Society Ltd.	1.000	1.000	0.966	0.869	1.192	1.000
	Mean	1.040	1.088	0.877	1.082	1.130	1.039

Table 7: Changes in Efficiency Components by Firms between Time Period t and t + 1, 2000-2005

No	Insurance firm	2000-2001		2001-2002		2002-2003		2003-2004		2004-2005	
		PEch	SEch	PEch	SEch	PEch	SEch	PEch	SEch	PEch	SEch
1	Takaful Nasional Sdn. Bhd.	1.000	1.856	1.000	1.201	0.550	1.480	0.907	0.967	1.266	1.042
2	Asia Life (M) Bhd.	1.000	1.038	1.000	0.882	1.000	1.172	1.000	0.834	1.000	1.106
3	Great Eastern Life Assurance (M) Bhd.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4	Hong Leong Assurance Bhd.	0.742	1.084	1.320	1.049	0.871	1.034	1.121	0.963	1.012	1.022
5	Malaysian Assurance Alliance Bhd.	0.815	1.095	1.314	0.847	1.629	0.760	1.166	1.399	0.804	1.078
6	Mayban Life Assurance Bhd.	1.000	1.730	1.000	0.963	0.643	1.076	1.555	0.738	1.000	1.438
7	MCIS Zurich Insurance Bhd.	0.963	1.219	0.980	1.015	1.029	0.924	1.021	1.087	1.105	0.958
8	Malaysia National Insurance Bhd.	0.691	0.763	1.446	1.311	1.000	1.000	1.000	1.000	1.000	1.000
9	Prudential Assurance Malaysia Bhd.	0.833	1.019	0.750	1.018	0.767	1.017	0.896	1.002	0.952	0.997
10	American International Assurance Co. Ltd.	1.000	1.225	1.000	1.121	1.000	0.446	1.000	1.854	1.000	1.706
11	TM Asia Life Assurance Society Ltd.	1.000	1.000	1.000	1.000	1.000	0.966	1.000	0.869	1.000	1.192
	Mean	0.917	1.134	1.059	1.028	0.919	0.954	1.049	1.032	1.007	1.122

Note: PEch = Pure Efficiency Change, and SEch = Scale Efficiency Change.

Table 8: Summary of the Malmquist Productivity Index of Insurance Firms, 2000-2005

No.	Insurance firm	TFPch	EFFch	TECch	PEch	SEch
1	American International Assurance Co. Ltd.	1.163	1.142	1.019	1.000	1.142
2	Malaysian Assurance Alliance Bhd.	1.150	1.117	1.030	1.103	1.012
3	Takaful Nasional Sdn. Bhd.	1.143	1.160	0.985	0.912	1.271
4	Mayban Life Assurance Bhd.	1.133	1.137	0.997	1.000	1.137
5	MCIS Zurich Insurance Bhd.	1.069	1.055	1.014	1.018	1.036
6	Hong Leong Assurance Bhd.	1.055	1.023	1.031	0.993	1.030
7	Malaysia National Insurance Bhd.	1.008	1.000	1.008	1.000	1.000
8	Asia Life (M) Bhd.	1.008	0.998	1.010	1.000	0.998
9	Great Eastern Life Assurance (M) Bhd.	0.990	1.000	0.990	1.000	1.000
10	TM Asia Life Assurance Society Ltd.	0.989	1.000	0.989	1.000	1.000
11	Prudential Assurance Malaysia Bhd.	0.872	0.845	1.032	0.836	1.011
	Mean	1.040	1.028	1.012	0.993	1.035

Note: TFP = Total Productivity Change; EFFch = Efficiency Change; TECch = Technical Change; PEch = Pure Efficiency Change; and SEch = Scale Efficiency Change.

Figure 1: Changes in Mean TFP and Its Components, 2000-2005

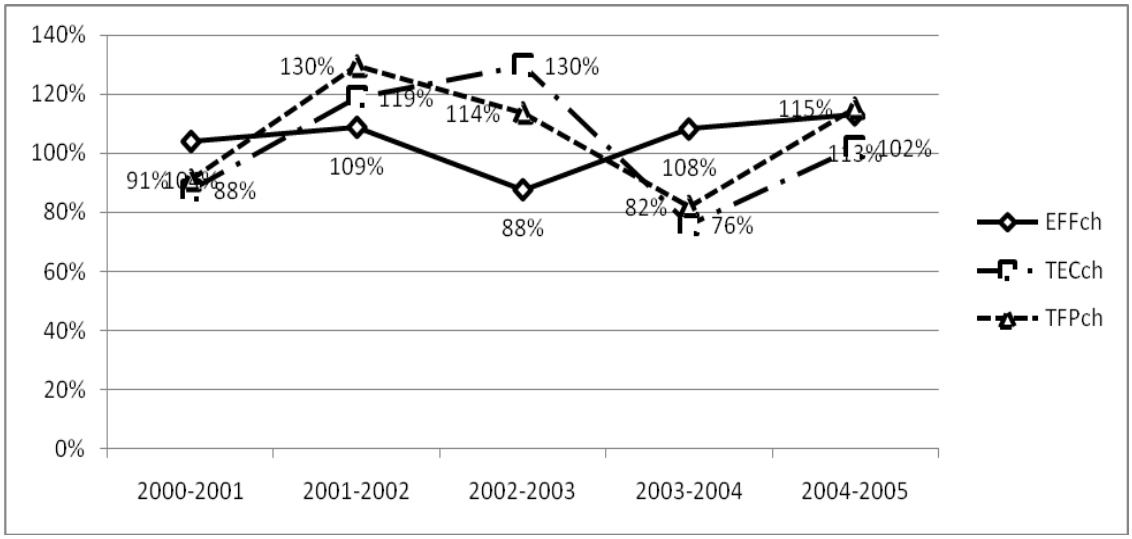

Figure 2: Changes in Mean Efficiency and Its Components, 2000-2005