TECHNICAL EFFICIENCY OF INSURANCE COMPANIES: A STUDY OF MALAYSIA

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ABSTRACT

The insurance industry in Malaysia has evolved to become less fragmented through deregulation and liberalization reforms. The 2009 liberalization in the form of increased foreign equity participation in the industry, resulted in significant mergers and acquisitions among firms. Yet, there has been no evaluation on the efficiency of insurance companies following the transformational changes in the sector. Further, from a theoretical standpoint, there is inadequate evaluation of the complex service process of the Malaysian insurance business. In this respect the application of the intermediary approach has received little attention in insurance studies. This study therefore focuses on the identification of technical efficiency and its determinants within the Malaysian insurance sector. This study applies a new framework to measure the technical efficiency of insurance companies using a dynamic network data envelopment analysis (DEA), namely the dynamic network slack-based measure. This is followed by a truncated regression analysis with a bootstrapping approach to analyze the internal and external factors driving technical efficiency of Malaysian insurers. The study assembles a new panel dataset of insurance companies, compiled from a range of sources, including insurance reports and firm-level data. The efficiency analysis is broken down according to ownership types (local and foreign insurers) and by business segments (life, general and composite insurers). The data spans the period 2008 to 2014. The qualitative analysis indicates a slow pace of development in the Malaysian insurance industry relative to insurance markets worldwide. In particular the market penetration rate of the life segment in Malaysia has not increased in tandem with the growth of economic activity. The main findings from the DEA analysis suggest that Malaysian insurance companies are 80 per cent efficient in overall terms. The decomposition analysis reveals that the observed inefficiency of insurers is mainly caused by investment capability, which recorded an average 79 per cent level of efficiency relative to premium accumulation whose efficiency

level stood at 90 per cent. The results also imply a lack of efficiency among local insurers as compared to their foreign counterparts – largely attributed to a poor investment capability. Further, while composite insurers perform better in the investment capability division, the general segment achieves better efficiency in the premium accumulation division. Overall, the study finds that the 2009 financial liberalization has significantly elevated the efficiency of insurers, including divisional efficiencies. This study broadly supports the use of financial liberalization as a means of promoting technical efficiency of the whole insurance sector, as it directly favors managerial efficiency performance of both foreign and local companies in Malaysia. As such, it indicates to policymakers that precautionary supervision is needed in order to yield further efficiencies in the insurance market. The findings of this study also provide useful insights for insurance companies in terms of resource allocation and strategic decision-making. Local insurance companies need to address the excess usage of inputs and lack of investment capability to improve their position vis-à-vis their foreign counterparts.

ABSTRAK

Sektor insurans di Malaysia telah berkembang menjadi lebih kukuh melalui penyahkawalseliaan dan reformasi liberalisasi. Liberalisasi kewangan yang berlaku pada tahun 2009 telah meningkatkan ekuiti asing dalam sektor ini, dan telah wujudnya penggabungan dan pemerolehan di kalangan syarikat-syarikat insurans di Malaysia. Namun begitu, penilaian efisiensi syarikat-syarikat insurans masih kekurangan berikutan transformasi dalam sektor ini. Di samping itu, penilaian efisiensi untuk proses perkhidmatan insurans sebagai perantara yang kompleks tidak mendapat banyak perhatian di kalangan penyelidik, terutamanya dari sudut teori. Tesis ini memberi tumpuan kepada penilaian efisiensi teknikal dan faktor-faktor penentunya dalam sektor insurans Malaysia. Tesis ini mengaplikasikan satu rangka kerja baru untuk menilai efisiensi teknikal syarikat-syarikat insurans dengan menggunakan "dynamic network data envelopment analysis (DEA)", iaitu "dynamic network slack-based measure". Ini diikuti dengan analisis regresi berpangkas dengan pendekatan butstrap untuk menganalisis impak faktor-faktor penentu dalaman dan luaran atas efisiensi teknikal syarikat-syarikat insurans Malaysia. Tesis ini menggunakan satu set data panel baru syarikat-syarikat insurans, yang diperolehi daripada sumber-sumber yang berbeza, termasuk laporan insurans dan data peringkat firma. Analisis efisiensi dijalankan mengikuti jenis pemilikan (syarikat insurans tempatan dan asing) dan mengikuti jenis syarikat insurans (hayat, am dan komposit). Data ini merangkumi tempoh dari 2008 hingga 2014. Analisis kualitatif menunjukkan bahawa pembangunan sektor insurans Malaysia berada pada kadar yang perlahan berbanding dengan pembangunan sektor insurans di seluruh dunia. Situasi ini bermaksud kadar penetrasi pasaran bagi segmen hayat di Malaysia tidak bertambah selari dengan perkembangan aktiviti ekonomi. Penemuan utama daripada analisis DEA menunjukkan bahawa syarikat-syarikat insurans Malaysia adalah 80 peratus cekap dari segi keseluruhan. Analisis efisiensi yang lebih lanjut mendedahkan bahawa

ketidakcekapan syarikat-syarikat insurans Malaysia adalah disebabkan oleh kekurangan efisiensi keupayaan pelaburan yang mencatat 79 peratus efisiensi secara purata berbanding dengan efisiensi pengumpulan premium yang bernilai 90 peratus. Keputusan DEA juga mengimplikasikan kekurangan efisiensi dalam kalangan syarikat-syarikat insurans milikan tempatan berbanding dengan mililkan asing, di mana sebahagian besarnya disebabkan oleh kekurangan efisiensi keupayaan pelaburan. Di samping itu, walaupun syarikat-syarikat insurans komposit mempunyai efisiensi keupayaan pelaburan yang lebih baik, syarikat-syarikat insurans am telah mencapai efisiensi pengumpulan premium yang lebih baik. Secara keseluruhan, tesis ini mendapati bahawa efisiensi syarikat-syarikat insurans di Malaysia telah meningkat dengan ketaranya sejak liberalisasi kewangan 2009. Secara umumnya, tesis ini menyokong liberalisasi kewangan untuk meningkatkan efisiensi teknikal sektor insurans, kerana initiative sebegini secara langsungnya membolehkan kedua-dua jenis syarikat-syarikat insurans, samada asing ataupun tempatan di Malaysia untuk menikmati prestasi yang bagus. Oleh itu, penggubal dasar boleh mendapat panduan daripada tesis ini bahawa pengawasan berjaga-jaga diperlukan untuk menghasilkan pasaran insurans yang lebih efisien. Hasil tesis ini juga meninggalkan maklumat yang berguna bagi syarikat-syarikat insurans dari segi peruntukan sumber dan penentuan keputusan strategik. Syarikat-syarikat insurans tempatan perlu mengatasi kelebihan penggunaan input dan kekurangan efisiensi keupayaan pelaburan untuk memperbaiki kedudukan mereka berbanding dengan syarikat-syarikat insurans milikan asing.

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LIST OF SYMBOLS AND ABBREVIATIONS

BCC	:	Banker, Charnes and Cooper
BNM	:	Bank Negara Malaysia
CAGR	:	Compound Annual Growth Rate
CCR	:	Charnes, Cooper and Rhodes
CPI	:	Consumer Price Index
CRS	:	Constant Returns to Scale
DDEA	:	Dynamic Data Envelopment Analysis
DEA	:	Data Envelopment Analysis
DFA	:	Distribution-Free Approach
DMU	:	Decision Making Unit
DN-DEA	:	Dynamic Network Data Envelopment Analysis
DNSBM	:	Dynamic Network Slacks-Based Measure
DSBM	:	Dynamic Slacks-Based Measure
ESF	:	European Services Forum
FDI	:	Foreign Direct Investment
FHC	:	Financial Holding Company
FSA	:	Financial Service Act

FSMP	:	Financial Sector Master Plan
GATS	:	General Agreement on Trade in Services
GDP	:	Gross Domestic Product
LP	:	Linear Programming
NDEA	:	Network Data Envelopment Analysis
NSBM	:	Network Slacks-Based Measure
OR	:	Operational Research
PPS	:	Production Possibility Set
ROE	:	Return on Equity
SBM	:	Slacks-Based Measure
SFA	:	Stochastic Frontier Analysis
VIF	:	Variance Inflation Factor
VRS	:	Variable Returns to Scale
WTO	:	World Trade Organization

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND OF STUDY

Insurance markets worldwide continue to undertake pro-competitive reforms. These reforms have become an imperative part of many countries' development strategies. Consequently, there are many examples of countries which have deregulated and liberalized their insurance markets. While deregulation signifies removing or reducing national regulations with the intention of encouraging the efficient operation of markets, liberalization signifies a reduction of government intervention or other barriers to market access, in exchange for greater participation of private and foreign insurers (Skipper, 1996). Both deregulation and liberalization seek to reform a country's international commercial policies in order to improve economic welfare by bringing about a more efficient allocation of a country's resources in the long run. Supporters of deregulation and liberalization claim that opening local markets to foreign competition and foreign direct investment (FDI) can result in the enhancement of productivity related to local industries, which lead to more efficient allocation of resources and greater overall output. On the other hand, critics argue that local firms may not be able to grasp efficiency advantages because they are incapable of effectively adapting foreign technologies to local production, and/or because local firms are generally confronted with limited credit that prevent investments in new technology (Topalova & Khandelwal, 2011).

Likewise, Malaysia has had a rich history of financial sector reforms (Ang & McKibbin, 2007). In line with Malaysia's commitments to the World Trade Organization (WTO), the government has been gradually removing its protection of the service sector in order to create a more liberalized economy. A series of financial restructuring programs aimed at improving the financial system was launched in the 1970s. Immediately after

the Asian Financial Crisis in 1997–98, a series of macroeconomic policy responses, such as capital controls and reflation, were applied in Malaysia. This was followed by restructuring in the corporate and banking sectors including the insurance sector.

In 2009, another round of liberalization measures was announced to strengthen Malaysia's economic inter-linkages with other economies and enhance the role of the financial sector as a key enabler and catalyst of economic growth (BNM, 2009). These measures increased foreign equity participation in the insurance industry, resulting in mergers and acquisitions in order to gain competitive advantage. Consequently the structure of the Malaysian insurance sector has evolved to become less fragmented through the process of consolidation and rationalization. In the process, the number of direct insurers, including life, general and composite insurers, decreased from 40 in 2009 to 33 in 2014 (BNM, 2015). Following this liberalization episode, foreign ownership limits were elevated from 49 per cent to 70 per cent for foreign insurers. The outcome has been that, while foreign insurers dominate the life insurance segment, local companies have a controlling interest in general insurance.

The new liberalization measures are, in large part, consistent with the objectives that Malaysia has committed to undergo its Financial Sector Master Plan (FSMP), launched in 2001 to develop a resilient, diversified and efficient financial sector. The liberalization package of the insurance sector encompasses two major elements: an increase in foreign equity limits and the objective of increasing operational flexibility (allowing foreign financial institutions to open up a certain number of branches throughout Malaysia).

Undeniably, the liberalization of the national insurance market has brought with it stiffer, but healthy business competition (Luhnen, 2009b). But notwithstanding the favorable consequences of a competitive market, it has been acknowledged that poor internal control by managers could lead to a lowering of managerial efficiency (Hwang

& Kao, 2006). Therefore, internal managerial control has become an imperative part of the corporate regulatory framework in which performance evaluation is a necessary measure for the development and improvement of management decision-making. Despite the importance of performance evaluation, there are relatively few studies on managerial efficiency of insurance companies. Previous works on efficiency of the financial sector in Malaysia were confined largely to the banking sector. In spite of the complex service process for the insurance sector and the need for operating efficiently, efficiency analysis of the insurance sector has received surprisingly little attention. Even though the insurance and banking industries share some common characteristics, the service process of these two entities differ significantly, and therefore deserve separate analysis in terms of their performance.

Performance evaluation is a fundamental building block of business excellence in an organization. Traditionally, business entities have assessed their performance using financial information, including profit or cost evaluation techniques. However, these traditional performance techniques render little useful information to businesses for quality control management. In fact, a performance evaluation technique must provide enough information to link with business strategies (Hung & Lu, 2007). Therefore, the performance evaluation system implemented in a particular organization could bring about a change in organizational strategies, and provide useful information for managers in their pursuit of business excellence.

Since the development of frontier methodologies for estimating productivity and efficiency, performance evaluation is accepted as an important advance in modern economic analysis (Bulak & Turkyilmaz, 2014; Cummins & Weiss, 2013; Eling & Luhnen, 2010b; Hung & Lu, 2007). A frontier methodology technique assesses a firm's performance relative to "best practice" frontiers that are specified through the most

efficient or dominant firms in the industry. Charnes, Cooper, and Rhodes (1978) introduced a nonparametric technique called data envelopment analysis (DEA), to evaluate the relative efficiency of a number of decision making units (DMUs) in an industry through an adaptable framework. This allows for production functions with multiple inputs and outputs.

The main motivation of this research is, therefore, to provide an in-depth study on the efficiency of Malaysian insurance companies in light of recent structural changes, and offers an appropriate service process framework, built on a well-defined theoretical basis. Additionally, by unveiling the contributing factors to the efficiency of Malaysian insurance companies, this research provides a useful input into an assessment of whether the underlying objectives outlined in the Financial Sector Blueprint (2011-2020) are being achieved.

1.2 PROBLEM STATEMENT

This study identifies critical issues relevant to the insurance sector in Malaysia. First, the insurance sector has undergone significant deregulation and liberalization reforms. Yet, there has been no evaluation of the efficiency of Malaysian insurance companies following the structural changes in the sector. Second, there are no studies which theoretically evaluates the service process of an insurance business adequately. The following section details these two issues that justify and warrant this study.

The liberalization of the Malaysian insurance sector has intensified competition (Ang & McKibbin, 2007; BNM, 2012). This has two implications, either a firm finds it difficult to sustain itself in the long-run, or it has to become more efficient due to the liberalization process. Greater competition with liberalization poses a challenge to local insurers, particularly when facing rivals from advanced nations. However, the higher resilience of

emerging economies, as compared to their western counterparts, has allowed the insurance sector to experience continuous growth. Thus, with the moderating economic growth in advanced mature economies, the insurance sector become a more attractive higher growth market in developing economies such as Malaysia for both life and general insurers. That is, growth of total premium in the insurance sector tends to be in line with the rising per capita income, and overall economic growth (MARC, 2012). However, the Malaysian insurance sector recorded only a 2.74 per cent growth in 2014 compared to 8.19 per cent in 2009. The sudden drop of the contribution of the insurance sector to economic growth has therefore been a cause of concern.

Additionally, in the context of insurance efficiency, there is little research regarding the important question of what the actual nature of the insurance production mechanism is. Although the recent research has increasingly focused on the empirical evaluation of insurance efficiency, the current literature has followed the traditional measures of efficiency evaluation; a consistent conclusion therefore remains elusive. There are two theoretical streams to evaluate the efficiency of an insurance business, namely the production approach and the financial intermediary approach. Under the production approach, financial institutions are solely service providers to account holders, while under the intermediation approach, financial institutions channel the funds between savers and investors. The current literature has given more emphasis to the use of the production approach which is more appropriate for manufacturing companies, while the application of the intermediation approach has received little attention in insurance studies (Brockett, Cooper, Golden, Rousseau, & Wang, 2004, 2005).

Further, the traditional DEA assumes a production/service process as a single black box that transforms inputs to outputs. However, more than one stage might be involved to complete a production/service process. Therefore, by using traditional DEA

approaches, the internal linking of activities between different stages or divisions is neglected, and there is no scope to determine the decomposed inefficiencies of each stage. Therefore multi-stage DEA approaches are needed to address the issue of efficiency. In this way a methodology is introduced which allows the opening up of black boxes and thereby providing a detailed efficiency measure which describes what happens inside them (Färe, Grosskopf, & Whittaker, 2007). The objective of efficiency measurement using multi-stage models is, therefore, to identify the source of inefficiency in the whole production/service process. In particular the purpose of decomposing the overall efficiency is to identify which of the stages may have a higher impact on overall efficiency.

Although traditional DEA can be a practical technique for measuring the efficiency of DMUs, in many cases the production/service process of DMUs may involve multi-stage structures. In this respect, efficiency scores may overestimate or underestimate if the proper technique is not applied. Therefore, this research proposes an efficiency evaluation framework for the insurance service process supported by the extant theory on insurance literature. The results of this study provide useful insights for insurance companies about resource allocation and strategic decision-making, particularly the strategies needed to operate in today's intensely competitive environment.

1.3 RESEARCH QUESTIONS

The study seeks to answer the following questions:

1) How has the insurance sector in Malaysia evolved over the past decade? Are there distinctive structural changes in terms of business segments and ownership of insurers?
2) What could be the appropriate insurance framework?

3) What is the level of overall efficiency in the Malaysian insurance sector based on the newly proposed framework? Do the efficiency levels differ for the investment capability and premium accumulation divisions?
4) Are there significant differences in efficiency scores across business segments, ownership types and liberalization phases?
5) What are the roles of internal factors (firm's characteristics and ownership) and external factors (macroeconomic factor) on efficiency scores?

1.4 RESEARCH OBJECTIVES

The primary aim of this study is to investigate the performance of the Malaysian insurance sector. In particular, the objectives of this research are as follows:

1) To analyze the structure and progress of the Malaysian insurance sector over the past decade;
2) To propose an appropriate framework to measure the technical efficiency of insurance companies;
3) To empirically estimate and compare the overall and decomposed (premium accumulation and investments capability divisions) technical efficiency of Malaysian insurance companies by business (life, general and composite) segments and ownership (foreign and local) types;
4) To estimate the contributory role of internal factors (firm's characteristics and ownership) and external factors (macroeconomic factor) on overall efficiency and decomposed efficiency scores.

1.5 SIGNIFICANCE OF STUDY

This study contributes to the empirical research on efficiency of insurance companies based on a new measure of efficiency. Specifically, it makes a number of contributions to the empirical and theoretical literature.

First, this study focuses on Malaysia as an emerging insurance market where Islamic insurance is gaining ground as the major local competitor in the sector. The government is trying to expand the insurance market through FDI, through easing regulations and a number of other subsidiary measures. In this regard, Bank Negara Malaysia (BNM, the central bank of Malaysia) has launched a conceptual paper on the introduction of a framework that seeks to provide life insurers greater operational flexibility (Singh, 2013). The government for its part is seeking to define further liberalization measures for the insurance sector. Information about the determinants of the efficiency of insurance firms would therefore be particularly useful at this time to regulators, policy makers and consumers. Consequently this research can assist policymakers to distinguish the best path for the future expansion of Malaysian insurance sector.

Second, previous studies of the Malaysian insurance sector, such as those of Mansor and Radam (2000), Saad, Majid, Yusof, Duasa, and Rahman (2006) and Baharin and Isa (2013), suggest that some insurers overuse inputs (for example, labor, financial capital, and materials) and/or produce the wrong output quantities and, therefore, are less efficient than others, *ceteris paribus.* Analyzing the magnitude of such inefficiency is useful in the sense that it may assist regulators and insurance companies in identifying the inefficient firms and take the necessary remedial actions. If the problem is detected early, the adverse economic impact caused by financially inefficient insurance companies on economic welfare can be minimized. In addition, information about the extent of the inefficiency can lead insurers to adopt a less costly alternative conduct.

This assists insurers in operating more efficiently and in competing locally and internationally.

Third, built on the intermediation approach, this research offers a service process to evaluate the insurance efficiency. While the research to date has left the practitioners with some ambiguities, the strong theoretical foundations make the framework of this study more appropriate to use for insurance efficiency measurement.

1.6 ORGANIZATION OF THE STUDY

Chapter 1 provides a general overview of the research topic and outlines the importance of efficiency analysis in the insurance sector. A statement of the research problem is then outlined in terms of providing the rationale for this research. Research questions and research objectives delineate the methodological path of this study. Finally, the significance of the study concludes the first chapter.

Chapter 2 reviews the relevant literature, both in terms of theory and empirics. It is divided into three main parts. First, the theoretical section provides the basis for understanding the key concepts of the study. Second, interpretative models are described outlining the measures of efficiency analysis – include the DEA model. The meaning of production/service process is also set out. Second, the empirical findings elaborate the state of the current efficiency studies in the financial sector, particularly the insurance sector, providing data on which to base the determinants of insurance efficiency.

Chapter 3 addresses the first objective of this study by tracing the structural changes within the Malaysian insurance sector and which sets the background of this study. The structure of the insurance sector is analyzed based on the business segments. Accordingly the business lines within the segments and their contributions to net premium are

discussed. The chapter also details insurance density, market penetration rate and the regulatory framework for the insurance sector.

Chapter 4 discusses theoretical foundation of insurance activities which are relevant to the proposed framework of this study. It also encompasses the methodological aspects of DEA analysis. Preliminary requirements for a DEA analysis, mathematical model specification and cluster analysis colligate the efficiency analysis of this research. The methodological aspects of regression analysis and its role in the second stage of the analysis are explained.

Chapter 5 presents and discusses the results for the overall efficiency analysis, and the decomposed efficiency analysis for premium accumulation and investment capability. The analyses for the aggregate and decomposed efficiency are consistently conducted for different business segments (life, general and composite) and by ownership types (foreign versus domestic insurers). The clustering and the suggestions to improve the technical efficiency for Malaysian insurers are also set out.

Chapter 6 presents the results for the second-stage analysis which identifies the determining factors affecting insurance efficiency thereby meeting this study's fourth objective. In addition to descriptive statistics, the chapter provides comparative analyses for the differences among ownership types, business segments and liberalization by conducting test of differences. Subsequently, regression analysis using bootstrapping truncated approach and robustness tests are presented.

Chapter 7 summarizes the results of this research as they apply to the research questions. Policy implications and recommendations of benefit to regulatory authorities in further developing the Malaysian insurance sector are articulated in this chapter. Limitations of the research and paths for future studies are then provided.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In the first section the efficiency concept is defined along with its relevant economic components. A discussion of the theoretical cornerstones of firm theory colligates the concepts in terms of the efficiency notion, and provides a validation of the use of the frontier methodology.

Following the theoretical exposition, interpretive models to measure the efficiency are discussed in terms of their methodological differences. This is followed by a brief definition of DEA. The notion of the production/service process of a firm and the different types are then discussed and which unveils the shortcoming of the traditional DEA methodology.

The final section is mainly devoted to an empirical review of previous studies. The first two parts discusses efficiency studies of the financial sector and insurance sector separately. Then, a more detailed literature review of the use of DEA in analyzing the insurance sector is provided. An evaluation of determinants of efficiency is provided followed by an examination of studies of liberalization and insurance efficiency. A setting out of the study's theoretical framework and a discussion on empirical gaps concludes the chapter.

2.2 THEORETICAL EXPOSITION

2.2.1 Neoclassical theory of the firm

Theories of the firm endeavor to conceptualize its intra- and extra-business activities. In the words of Jensen and Meckling (1976), "…the firm operates to meet the relevant marginal conditions with respect to inputs and outputs, thereby maximizing profits, or more accurately, present value". An important stream of the theory of the firm was the pioneering work of Coase (1937) who addressed the important questions on why firms exist and what a firm is. Since this seminal work, these questions were given significant consideration by a large number of economists. Many economists still utilize neoclassical economics[1] to justify the reason on why business activities are executed within a given structure of a firm.

The neoclassical theory of the firm considers the firm as an entry, which possesses hyper-rationality behavior. It assumes that a firm makes rational decisions based on the principle of profit maximization where marginal revenue is equal to marginal cost. The theory recognizes profit maximization or cost minimization as the criteria of efficiency. The theory of the firm examines how firms mix labor and capital in order to minimize the average cost of output through decreasing, increasing or constant returns to scale.

The neoclassical theory of the firm has been established along two different branches, the static and dynamic models (Purvis, 1976). Static models have been utilized to develop profit maximization of input-output combinations and, ultimately, optimal firm size. However, dynamic models have been employed to develop ideal investment policies and

[1] Neoclassical economics has been built on the basis of three assumptions regarding resource allocation, namely, rational preferences, profit maximization and independent acts being made with full and relevant information being available (Weintraub, 1993).

ultimately the optimal growth rate of the firm. The dynamic nature yields a more realistic understanding of business activities of a firm since today's choice of investment affect tomorrow's capital and labor. Therefore, the dynamic analysis provides a convincing extension of the static analysis (Purvis, 1976).

2.2.2 Concept of efficiency

Koopmans (1951) and Debreu (1951) are the pioneers of the efficiency concept. Koopmans is the first scholar who offers a measure of efficiency concept and Debreu empirically evaluates efficiency with the use of an input-output ratio. The fundamental mindset behind efficiency evaluation is to assess a firm's performance relative to "best practice" frontiers that are specified through the most efficient or dominant firms in the industry. The primary theory was initially developed by Farrell (1957). Farrell defines efficiency as the success in producing as large as possible an output from a given set of inputs. He is the first scholar to show that productive or economic efficiency can be divided in two components (Jarraya & Bouri, 2013). The first is the purely technical component, which refers to the ability of a production unit to produce the maximum output quantity. Therefore, the technical efficiency component aims to increase outputs and avoid maximum waste. The second is the price component also called allocative efficiency. This component refers to the capacity of the production unit to mix optimal proportions of inputs and outputs appropriate to their current prices.

However, when discussing about efficiency it is necessary to be clear about the terms used for measuring the performance of companies. In an important study, Sherman and Zhu (2006) explain the relationship between productivity and two components of performance, namely efficiency and effectiveness. They define *Effectiveness* as the ability of a company to define and accomplish its objectives; i.e., to do the right job. However, *Efficiency* is the ability of a company to produce the outputs (or services) with a minimum

required resource level; i.e., to do the job right. *Productivity* is usually specified as the ratio of outputs to inputs and is consequently focused in determining the efficiency of production. While effectiveness and efficiency can be addressed as separate principles, for a company they are narrowly correlated, and indeed efficiency can be regarded as a part of effectiveness (Sherman & Zhu, 2006). The efficiency term could be viewed as a general term given it could be understood as a value judgment of the performance of a manager. Although, most of the time it can be true, poor performance management would not necessarily result in inefficiency, particularly when the causes are out of managerial control. These causes can be socio-economic or technological factors.

The term productivity is rather less ambiguous given it has tended not to be used as a value judgment to describe the performance of a manager. However the terms efficiency and productivity have been used interchangeably in the literature. In terms of evaluating a service the term efficiency is more often focused on and particularly for the insurance industry. Therefore, for the purpose of this study and to avoid confusion, the term efficiency is used.

The concept of economic efficiency flows directly from the microeconomic theory of the firm (Cummins & Weiss, 2013). Under the assumptions of a private firm operating in a competitive market, the primary objective of a firm is maximizing its profits through cost minimization and revenue maximization. Therefore, three objective function can be recommended in efficiency estimation; cost efficiency, revenue efficiency, and profit efficiency. Cost efficiency implicates the minimization of input consumption provisional to the outputs produced (cost minimization), and revenue efficiency implicates the maximization of outputs provisional to the inputs used (revenue maximization). Profit efficiency implicates the optimal choice of inputs and outputs, provisional to output and input prices. With reference to the service sector, three components of efficiency have

been focused on in the literature, which are as follows; scale efficiency, allocative efficiency and technical efficiency. Scale efficiency deals with the optimum volume of production. Maximum efficiency in this context relates to increasing or decreasing the production of services /goods according to an optimum level above or below which creates extra costs. Allocative efficiency is the usage of the optimum combination of inputs for given prices to produce the services or outputs. In a production/service process with more than one input or output, inefficiency may be due to the particular combination of inputs used to produce the combination of outputs (Sherman & Zhu, 2006). With reference to Cummins and Xie (2008), this efficiency concept allows for the determination of either the optimal combination of inputs that minimizes cost or the optimal combination of outputs that maximizes revenue. Technical efficiency is defined as the capacity of a company to produce the maximum outputs constrained by a given level of inputs or the maximum reduction of all inputs allowing continual production of the same output as before. Therefore, the technical efficiency represents the difference between the real production (consumption) level achieved by the company and the ideal output (input) level at the frontier. Most studies refer to the study of Farrell (1957) to measure technical efficiency.

There are two theoretical streams to evaluate the efficiency of an insurance business, namely the production approach and the financial intermediary approach[2].

2.2.2.1 Production approach

Production is the practice of converting inputs to outputs. This relationship between input and output is called production function. For economic modelling, inputs or factors

[2] Sometimes, production and intermediary approaches are called value-added and flow approaches respectively (Leverty & Grace, 2008).

of production are categorized into three general classes; labor, capital and land. Each class may have particular description for its own line of business or economic sector. Additionally, not all production/service processes possess all three inputs nor do all inputs fall uniquely into one of the classes. Outputs are comprised of end products or services, or intermediate goods for the purpose of selling to other firms. A firm produces outputs from different mixes of inputs. To understand the available production choices of a firm, a clear picture is required of the combinations of technologically feasible choices of inputs and outputs that represent the production possibilities of the firm. The most popular production function is called the Cobb-Douglas function, which considers capital and labor as functions of output. A production function could be classified in terms of return to scale – i.e. how output changes according to the change in inputs. Constant returns to scale occurs when the output quantity increases by proportionately the same increase of input quantity. Decreasing (increasing) returns to scale occur when the output quantity increases by less (more) proportionate to the increase in input quantity.

In the production approach, a production/service process should be inferred in a broad concept to cover the production of both physical goods such as vehicles and services such as financial services (Cummins & Zi, 1998a). However, the production approach has its roots in manufacturing systems such as industrial plants. Hence, the production approach treats a financial institution in the same way as a manufacturing company. The objective of an insurer in the production approach is solely maximizing the profit (Leverty & Grace, 2008). A company can be differentiated by various aspects such as industries, scale of production, ownership, organizational structures among others. In grasping the essential characteristics from a study of producer behavior and choices in modern producer theory, it is clear that the main feature of a firm is the production set. That is the set of all production plans that are technologically practicable. It is generally accepted that the producer identifies and selects a production set with the highest portability.

2.2.2.2 Financial intermediary approach

Another important means of defining the production/service process is the financial intermediary approach (Brockett et al., 2004, 2005). In this approach, a financial institution (in this case an insurance firm) is seen to provides an intermediary function by borrowing funds from policyholders and investing those funds in financial assets to generate income. In doing so the single objective of the financial institution is not solely maximizing profit. According to this definition then, the role of an insurer in its service process is viewed as an intermediator rather than a sole producer of a service.

Berger and Humphrey (1997) differentiate production and financial intermediary approaches in identifying how to measure the performance of financial services. Under the production approach, financial institutions are solely service providers to account holders while under the intermediation approach financial institutions channel funds between savers and investors. The production approach is suitable for evaluating financial branches or subsidiaries, while the intermediation approach is appropriate for evaluating the entirety of the financial institutions (Berger & Humphrey, 1997; Brockett et al., 2004). That said, the debate over whether to use the production or intermediation approach applies to banks and financial institutions other than insurers (Brockett et al., 2004).

2.2.3 The concept of financial liberalization

There has been a clearly expressed view which opposes financial regulation and seeks financial liberalization as a means of securing maximum prosperity for financial markets (Goldsmith, 1969). Moreover, according to the seminal works of McKinnon (1973) and Shaw (1973), financial liberalization yields higher overall economic growth through allowing the interest rate levels to rise thereby enhancing competition among market players, and encouraging a more efficient allocation of financial resources. That is, extinguishing interest rate controls induces higher savings and consequently higher

economic growth through raising investment resource quantity and quality (Reinhart & Tokatlidis, 2003).

Abiad, Oomes, and Ueda (2008) divide this rationale of financial liberalization into two benefit categories, a quality effect, explained in terms of greater efficiency in the allocation of capital, and a quantity effect, explained in terms of higher savings and investment capacities. The authors then point to the ambiguity of findings in the latter effect in which the financial liberalization can improve the operating of the financial sector without any certainty of increasing saving or investment (Bandiera, Caprio, Honohan, & Schiantarelli, 2000; Sancak, 2002). As a result of the theoretical ambiguity of the quantity effect, the quality effect – more efficient allocation of capital – becomes a more persuasive argument for financial liberalization (Galindo, Schiantarelli, & Weiss, 2007).

2.2.3.1 Financial openness

Financial liberalization involves various reform measures along with interconnected dimensions such as reducing the reserve requirements, liberalizing interest rates, privatizing the financial institutions and an increasing degree of openness in trade and finance (Reinhart & Tokatlidis, 2003). Financial openness equally implies the derestriction of financial credits and interest rates, relaxing the entry barriers (increasing participation of foreign players), providing competition opportunities (liberating branch establishment) and limitation of state ownership (Hauner & Prati, 2008). Financial openness may enhance the development of local financial institutions by increasing the foreign ownership of local firms which leads to augmented admittance to international financial funds, increased competition, technological enhancement and meliorated regulatory inaccuracy (Bekaert, Harvey, & Lundblad, 2011). That is, foreign investors are likely to demand transparent and equitable corporate governance.

The overall effect of financial openness is seen to lead to increasing national wealth (King & Levine, 1993). That is, a liberalized capital account raises national allocative efficiency through increasing the efficiency of a country's financial sector (Quinn & Inclan, 1997). The degree of capital account liberalization[3] (or financial openness) is associated with the freedom with which local financial assets or liabilities can be changed into foreign financial assets and liabilities and vice versa. Therefore, a country with full capital account liberalization enjoys a free flow of international finance into its local market. The free movement of capital inflows, particularly in the form of direct investment, often benefit the host nation through bringing with it advanced management techniques, higher access to international networks and improved technology (technical efficiency). In the process, the productivity and efficiency of the financial sector is also increased (Forbes, 2007). It is worth mentioning that the capital outflow as a part of capital account liberalization would allow local companies to enjoy a higher diversification of risk reducing the costs of capital (cost efficiency) (Smith & Sofianos, 1997) and delivering higher returns on capital. In this way market discipline is enhanced leading to more efficient resource allocation and productivity. These substantial benefits have been a feature of capital markets in most developed countries and a number of developing countries as a result of lifting capital controls.

In 1997, the International Monetary Fund widely promoted the freeing up of capital movements between countries – both in terms of capital movement and capital account liberalization. However, the Asian financial crisis heavily affected those countries which had recently implemented capital account liberalization. As a result many economists and

[3] Capital account liberalization and financial openness is often used interchangeably in the literature (Chinn & Ito, 2008).

policymakers supported restrictions on capital inflows for developing countries[4] (Forbes, 2007). In this environment, the results of extensive macroeconomic studies on capital account liberalization turned out to be inconclusive. Eichengreen (2001) raised the issue as follows: "Capital account liberalization, it is fair to say, remains one of the most controversial and least understood policies of our day. One reason is that different theoretical perspectives have very different implications for the desirability of liberalizing capital flows. Another is that empirical analysis has failed to yield conclusive results". In addition, cross-country macroeconomic studies have generally adopted the same assumption for all countries regardless of their unique characteristics.

Therefore, the focus of researches on individual countries and detailed consequence of capital controls have made the microeconomic approach to be more attractive in terms of providing more robust results. It is therefore accepted that the microeconomic study level is likely to provide more conclusive data on the consequences of capital account liberalization policies (Karolyi, 1998; Stulz, 1999). Forbes (2007) in a survey of a number of microeconomic studies sought to provide a comprehensive picture on the microeconomic implications of capital controls. The author concluded that, first, the imposed policies on controlling capital are inclined to diminish the supply of capital, increase the financing cost and raise the financial restraints. This applied in particular to smaller companies and those without access to international capital funds. Second, reduction of market discipline in a financial market was likely to be another consequence of capital controls, which ultimately would lead to more inefficient capital and resource allocation. Third, there was a risk that the firms' decision-making might be distorted as they tried to lessen the costs of controls. Fourth, capital controls may have different

[4] The argumentative discussion on the adverse effect of liberalization can be found in Stulz (2005) and Rodrik and Subramanian (2009).

effects on various types of firms and countries. Lastly, capital controls involve complex policies, the associated cost of implementation of which may not be bearable by a government.

2.3 INTERPRETATIVE MODELS

Today's competitive global environment has brought with it profound challenges including where the on-going financial liberalization policies change the structure of financial institutions, particularly insurance companies. These companies need to perform at a highly competitive level. Performance evaluation has therefore emerged as a fundamental building block of business excellence for such an organization. Detailed and accurate measures of performance for a financial intermediation[5] firm is therefore a necessity.

The primary aim of performance evaluation is to separate those institutions with higher production standards from others. A prominent advancement in modern economics has therefore been the development of frontier methodologies for estimating productivity and efficiency. This is achieved through applying parametric or nonparametric frontier methodologies to firms within a sector. In the financial sector, there are different criteria which the information obtained can be used (Berger & Humphrey, 1997). First, the information can be used for the benefit of government policies. Thus evaluating the effects of mergers, deregulation, liberalizations or market structure on firms' efficiency can be used as an assessable indicator by government policy regulators. Second, the information can be used for research purposes such as measuring efficiency of a sector,

[5] The procedure in which a financial entity performs as a middle agent to canalize funds between two groups of investors, particularly from saver to borrowers, and provides both these groups the chance of earning a return (Kitchen, 1986).

ranking its DMUs or firms, checking the efficiency score by study period, or comparing efficiency as measured by different techniques. Third, the managerial performance can be evaluated and improved by using the information to classify firms according to their performance in regard to the production frontier.

Modern frontier efficiency analysis has built a framework to study companies that do not succeed in optimization, and therefore, are not fully efficient (Farrell, 1957). Frontier efficiency methodologies are accepted as being a key means of performance measurement where an individual company is assessed in terms of technical aspects, cost and revenue against the best practice company(s). The efficiency is usually determined by scoring the companies between 0 and 1 in which the most efficient company receives the value of 1. In the literature, two primary methodologies have been developed to estimate efficient frontiers: the econometric approach (parametric) and the mathematical programming approach (nonparametric).

2.3.1 Econometric approach

The econometric approach identifies a production, revenue, profit or cost function making specific assumptions about the distributions of the inefficiency and error terms (Aigner, Lovell, & Schmidt, 1977). Within this methodology there are three major types of econometric frontier approaches although most econometric efficiency applications now employ the stochastic frontier analysis (SFA) (Greene, 2008). Even though all methods specify an efficient frontier form, they vary in their distributional assumptions about inefficiency and the random components.

In the SFA model, inefficiencies are distributed asymmetrically (for example, exponential, half-normal or gamma) and the random error term is distributed symmetrically (for example, normal). Fewer assumptions are made in the distribution-

free approach (DFA) although large data sets are required to produce reliable results. The efficiencies scores of firms are assumed to be stable over time, while the random noise averages out to zero. Compared to the DFA, the thick frontier approach (TFA) does not make distributional assumptions about inefficiencies and the random error term, but assumes different categories of inefficiencies between lowest and highest quartile firms (Eling & Luhnen, 2010b).

The more commonly used econometric approach, SFA, was initially introduced by Aigner et al. (1977). This model can be conceptualized in two stages: first is the estimation of an appropriate function determining the efficient frontier, such as a production, revenue, profit or cost function, using an econometric method such as maximum likelihood, ordinary least squares, non-linear least squares or Bayesian estimation. The second stage is, for individual firms, the separation of the estimated regression error terms into components; usually a two-sided random error component and a one-sided inefficiency component (Cummins & Weiss, 2013).

2.3.2 Mathematical programming approach

The mathematical programming approach, in contrast to the econometric approach, assigns considerably less structure to the measurement of the efficient frontier and does not differentiate the error terms and inefficiency (Eling & Luhnen, 2010a). The most frequent mathematical programming approach is DEA, which was introduced by Charnes et al. (1978). The method utilizes linear programming techniques to quantify the association of products and services (outputs) and allocated resources (inputs). DEA identifies the efficiency score as an optimization result. DEA models can be assigned under two different assumptions: constant returns to scale (CRS) or variable returns to scale (VRS). Moreover, the technique can be utilized to decompose efficiency into its single components such as technical, pure technical, allocative, and scale efficiency.

Another mathematical programming approach is free disposal hull (FDH) which involves less arbitrary assumptions compared to DEA.

A comprehensive study by Eling and Luhnen (2010b) shows that the DEA approach has been most frequently used in insurance studies. Out of the 95 studies, 55 employed DEA, 22 SFA, seven DFA, and one FDH. Ten studies follow the advice given by Cummins and Zi (1998a) in using multiple approaches from both sides of econometric and mathematical programming. Interestingly, many of these studies using multiple approaches find a very high correlation when ranking companies.

2.3.3 Methodological differences

Both approaches, the econometric and mathematical programming, have their pros and cons. The econometric has the disadvantage of making strong assumptions concerning efficient frontiers. It presumes a particular functional form, such as the composite cost or translog, and hence expects a certain fundamental economic behavior, which might not be valid. The mathematical programming approach, on the other hand, has the advantage of imposing less structure on efficient frontiers. However, compared to the econometric approach, it has the drawback of not taking a random error term into account (Eling & Luhnen, 2008). Therefore, the mathematical programming approach creates the risk of considering all deviations from the efficient frontier as inefficiencies, consequently misidentifying a true random error with inefficiency. Another disadvantage of the mathematical programming approach has been the absence of statistical properties.

As mentioned earlier, theoretical researches consider DEA as a nonparametric stochastic frontier technique. Moreover, most DEA applications also allow for random error using second-stage regression analysis. Consequently, allowing for random error is not necessarily a compelling rationale for the econometric approach.

DEA has several desirable properties: (1) DEA is non-parametric. It, therefore, avoids the choice of a functional form for the technical, revenue or cost function and entails no distributional assumptions. (2) DEA is individual-firm based. The efficiency scores are decomposed based on the firms of a sector, which is especially suitable for studying scope economies. That is, DEA solves the optimization problem separately for each firm in the sample and thus optimizes individual firms. However, the econometric approach optimizes the sample as a whole, and the estimated function is expected to apply to all units in the sample, with all of the differences among firms captured through the estimated residuals. Thus, DEA can produce estimates of significant qualities such as economies of scale that apply to specific units of observations (firms), whereas econometric estimations of scale economies are formed according to the same parameter estimates for all units. (3) DEA can be applied in a meaningful way to situations where there are only a few decision-making units, such as the divisions or departments of a firm, whereas the econometric approach requires larger samples to generate statistical reliability. (4) It can simultaneously analyze multiple inputs and multiple outputs. (5) It does not require predetermined models. (6) It employs a mathematical planning model to define weights. (7) The analysis is objective. (8) DEA provides improvement suggestions.

2.3.4 Data envelopment analysis

DEA, introduced by Charnes et al. (1978), measures the technical efficiencies of a set of DMUs. The recognized applicability of DEA is because it allows for multiple inputs and outputs variables in efficiency estimation (Dyson et al., 2001). Due to this major advantage, various models of DEA have been developed to tackle its shortcomings. Methodologically, most common DEA models can be classified into radial and non-radial. The radial models such as Charnes, Cooper and Rhodes (CCR) (Charnes et al., 1978) and Banker, Charnes and Cooper (BCC) (Banker, Charnes, & Cooper, 1984) are

based on the Debreu-Farrell measure (Debreu, 1951; Farrell, 1957) and estimate the relevant technical efficiency based on an efficiency score in the objective function. However the non-radial models such as the additive model (Charnes, Cooper, Golany, Seiford, & Stutz, 1985) and the slacks-based measure (SBM) model (Tone, 2001) are based on the Pareto-Koopmans measure (Koopmans, 1951) and estimate the relevant technical efficiency based on only slacks (increase in outputs and/or decrease in inputs required for a unit to become efficient) without considering the efficiency score in the objective function.

Relative efficiency in DEA fits in with the succeeding definitions, which has the advantage of ignoring the requirement for assigning a priori measure of relative importance to any input or output.

Definition 1: Efficiency – extended Pareto-Koopmans definition. Full (100 per cent) efficiency is achieved by a DMU if and only if none of its inputs/outputs can be improved without worsening other inputs/outputs (Cooper, Seiford, & Zhu, 2011).

Definition 2: Relative efficiency. A DMU is fully (100 per cent) efficient on the basis of available evidence if and only if the performances of other DMUs does not show that some of its inputs/outputs can be improved without worsening other inputs/outputs (Cooper et al., 2011).

2.3.5 The production/service process

The production/service process of an entity/institution/firm is not always a simple one consisting of some inputs producing some outputs. In many examples, it is difficult to ignore the complexity within the production system. Hence, the major drawback of traditional DEA models lies in the treatment of a production/service process as a "black

box" (Färe & Grosskopf, 1996)[6] whereby inputs are transformed to outputs without considering their inner activities, for example, the stages. However, more than one stage might be involved to complete a production/service process. In this case the traditional DEA models do not differentiate the key sub-processes which occur. Therefore, by using traditional DEA models, we are neglecting the internal linking of activities between different stages/divisions, and in which we are not able to determine the decomposed inefficiencies of each.

In a multi-stage model, each stage can be considered as a decision center in which a corporate manager (an overall decision maker) manages the whole production unit (Halkos, Tzeremes, & Kourtzidis, 2014). In fact, identifying the production/service process, whether it is a single stage or multi-stage, needs a careful understanding of the procedure involved in the production unit. In spite of the concept of a "black box" being introduced more than a decade ago, the model development regarding the multi-stage production/service processes is still in its infancy. There exists different classifications to distinguish the multi-stage DEA models (Castelli, Pesenti, & Ukovich, 2010; Cook, Liang, & Zhu, 2010; Halkos et al., 2014). For example, Halkos et al. (2014) (Similar to the classification by Cook et al. (2010)) divide multi-stage models into four categories. The first category is the independent multi-stage approach, which follows the standard DEA methodology by taking each stage separately. This category does not consider the interactions between different stages and only recognizes the multiple stages in the production/service process. The second category is the connected multi-stage approach, which considers the interactions between inputs and outputs. The models in this category are also called network DEA (NDEA). The third category includes the relational multi-

[6] The pioneering work of Färe and Grosskopf (1996) initiated the term "black box".

stage approach where a mathematical relationship between overall efficiency and stage efficiencies is assumed. Finally, the fourth category recognizes game theory as the basis for multi-stage efficiency calculations.

The choice of model derived from any of the above-mentioned category depends on specific circumstances within a particular application setting (Halkos et al., 2014). While the first category does not recognize the activities between the stages, it is less restrictive yielding the largest efficiency scores. The second approach, however, assumes more restrictions and considers the interaction between inputs and outputs to yield more accurate efficiency scores. The third category does not render a model with interacting activities between inputs and outputs but considers the interaction between efficiency scores of different stages. The fourth category is more applicable to the supply chains context and is more suitable when two stages are considered as two players in a cooperative and non-cooperative game. However care must be taken in selecting an appropriate model by taking the underlying structure of the production/service process into account.

Another issue concerning the complexity of the production/service process pertains to the dynamic nature of a business. The consideration of intertemporal changes in efficiency measurement has been an important issue in DEA literature. In accounting terms, a business is a going-concern when it continues to operate in the future, and in which the continuous production/service process will result in resource accumulation. These accumulate resources are carried from one period to another influencing the succeeding operating time period. Therefore, in business, long-term planning is recognized as a major concern. To date, the literature has introduced various models to incorporate time changes in efficiency measurement such as the window analysis (Klopp, 1985) and the Malmquist index (Färe, Grosskopf, Norris, & Zhang, 1994). More recently,

dynamic DEA methodology has identified the importance of linking activates between two succeeding periods. However, the traditional window analysis and Malmquist index neglect the linking of activities and focus on optimizing periodical efficiency separately while taking the time changes into account.

To this end, this thesis segregates the DEA models dividing the complex production/service processes into three types: network, dynamic and dynamic network DEA models.

2.3.5.1 Network structure

In their innovative book, Färe and Grosskopf (1996) initiated the term "black box" and introduced a network framework consisting of interconnected sub-technologies (also refer to Färe and Grosskopf (2000)). The concept of "black box" refers to the network structure of DEA models where the aim is to lay out the underlying activities between the sub-processes. These NDEA models unify the overall efficiency and divisional efficiencies (stage efficiencies) into a single framework. In this approach, the overall efficiency of a DMU is the main objective in which the divisional efficiencies are its components (Tone & Tsutsui, 2009).

There are two basic structures of an NDEA model, viz. the series and the parallel structures (Kao & Hwang, 2010). The series structure recognizes a production/service process with two or more internal sub-processes in which intermediate products connect the stages. In a simple setting, some inputs produce some intermediate products in the first stage, and then, the intermediate products are used to produce some final outputs in the second stage. The parallel structure identifies the way in which production stages operate in parallel and independently to each other and where there is no intermediate

activity involved. A shared flows system[7] is an extension to this structure in which some inputs are shared among the stages. The structure of a production unit could be a combination of both series and parallel structures (Avkiran, 2009; Lin & Chiu, 2013; Moreno & Lozano, 2014). Figure 2.1 is an illustrative example of a series structure. Kao and Hwang (2010) provides further examples of other structures.

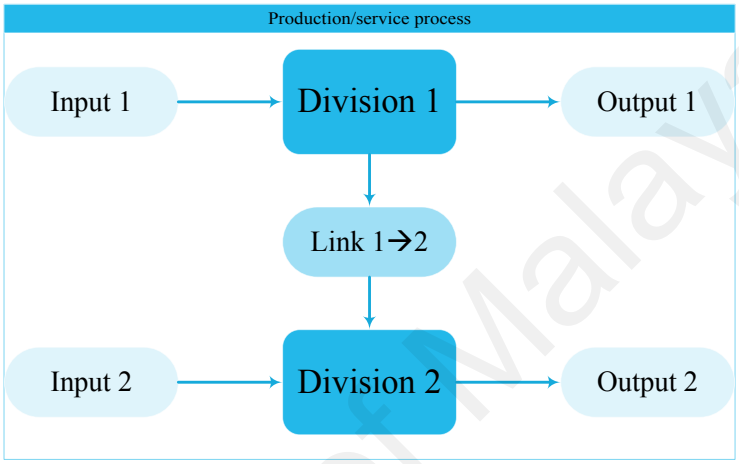

Figure 2.1: Network structure

2.3.5.2 Dynamic structure

The business activities of a company continue across subsequent periods. The dynamic structure of a business therefore emphasizes the potential effect of intertemporal changes on efficiency measurement. Although the dynamic attribute of a DEA model has been recognized as a part of a network DEA framework (Färe & Grosskopf, 1996, 2000), it highlights a distinct ideology dealing with the effect of time in an efficiency evaluation. The advantage of dynamic DEA models lies in the ability to consider the linking activities between subsequent periods as compared to traditional methods, viz. window analysis and the Malmquist index. These linking activities are also called carry-over activities and

[7] According to Kao and Hwang (2010), a university is a typical example for shared flow system.

relate to the fact that some variables are carried from one period to another (Tone & Tsutsui, 2010). A dynamic DEA (DDEA) model has the property that a decision made in one period of time influences on the succeeding periods (Färe, Grosskopf, & Whittaker, 2014). There are at least two possible alternatives for a dynamic process. One can be a situation where an output at the time *t* plays the role of an input for the succeeding period (*t*+1) (see for example, Chen (2009)). Another alternative is where the lag effect of a given input at the time *t* is considered as the input at the time *t*+1 (see for example, Tone and Tsutsui (2010)). An illustrative example of latter type is provided in Figure 2.2.

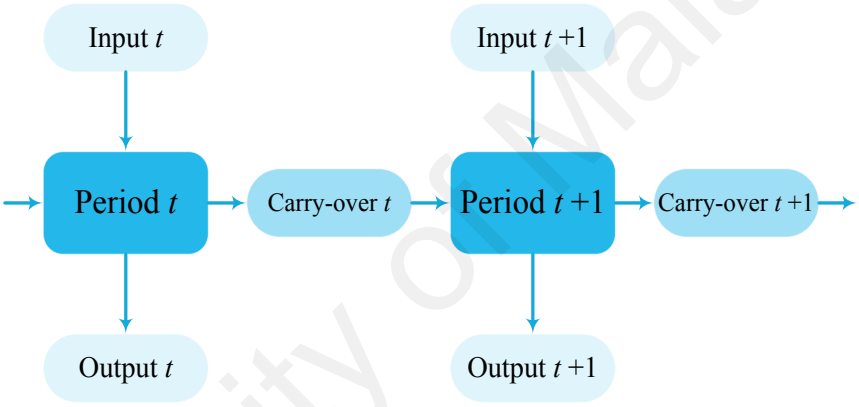

Figure 2.2: Dynamic structure

2.3.5.3 Dynamic network structure

A production/service process that demands both above structures, namely network and dynamic, may occur in a real business application. The models associated with this situation are called dynamic network DEA (DN-DEA) and are treated differently. A DN-DEA models allow a researcher to reach a more accurate efficiency estimate by incorporating both divisional links (intermediate products) as well as intertemporal links (carry-over activities) (see Figure 2.3 for illustrative purpose). In other words, when both dynamic and network structures of a business are accounted for in the same linear programming (a DEA model), a more comprehensive efficiency evaluation is rendered

by which the efficiency analysis reflects both divisions and periodic interactions (Avkiran, 2014). As a result, a more detailed and accurate efficiency analysis offers a decision analyst with ample information for policy recommendations and potential areas of improvement.

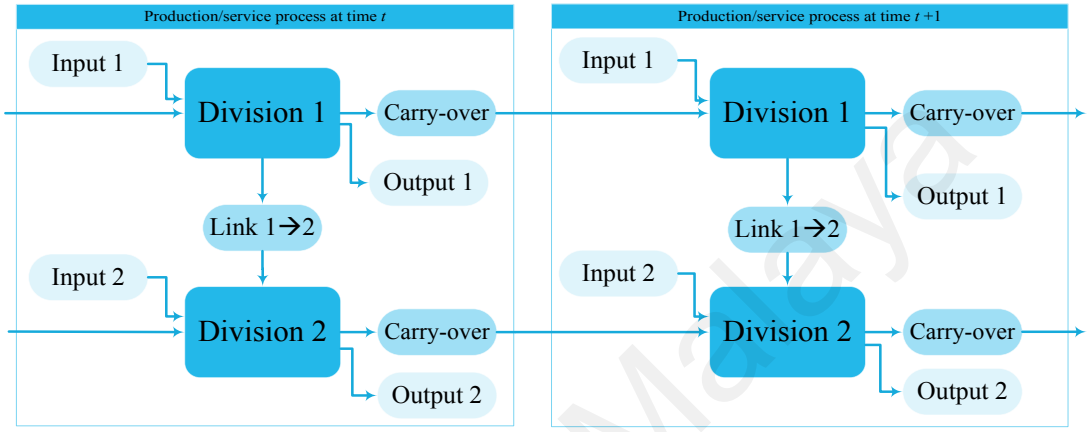

Figure 2.3: Dynamic network structure

2.4 EMPIRICAL FINDINGS

For the purpose of this thesis, a focus is placed on insurance efficiency studies and on other fields of application where necessary – in particular the financial service sector. Because of the similar nature of business lines in the financial service sector a literature study therefore provides useful insights. The following subsections presents a discussion of several studies focused on efficiency of the financial service sector as well as the insurance sector.

2.4.1 Efficiency studies of the financial sector

The literature on frontier efficiency methodology, particularly DEA[8], provides numerous research works focusing on methodological development, application-centered and both theory and application studies (see Cook and Seiford (2009) and Emrouznejad, Parker, and Tavares (2008) for methodological and theoretical developments and see Liu, Lu, Lu, and Lin (2013) for a survey of application-embedded studies). Liu et al. (2013), who review high-ranked DEA papers published from 1978 to 2010, indicate that application-embedded papers account for nearly two-thirds of all those published and that banking studies cover 10.3 per cent of this category[9] (the most popular field). Since the invention of the novel DEA by Charnes et al. (1978), the groundbreaking work of Sherman and Gold (1985) (where the authors examine the operating efficiency of bank branches), paved the way for the application of DEA to the banking sector. Sherman and Gold's argument about the uniqueness of the DEA technique is embraced by a number of banking researchers (Barth, Lin, Ma, Seade, & Song, 2013; Berg, Førsund, Hjalmarsson, & Suominen, 1993; Elyasiani & Mehdian, 1990; Parkan, 1987; Pasiouras, 2008; Rangan, Grabowski, Aly, & Pasurka, 1988). Berger and Humphrey (1997), in a survey-based study, and Thanassoulis (1999), in a further informative study, has provided the research motivation by providing the potential areas that need to be addressed in the domain of banking efficiency and the scope for enhancing the role of DEA in banking.

The study by Berger and Humphrey (1997) comprehensively evaluates 122 frontier studies which apply efficiency analysis to depositary financial institutions. Based on their

[8] According to a comprehensive survey of frontier efficiency analysis in financial institutions (largely banking) by Berger and Humphrey (1997), DEA is the most frequently used approach for efficiency evaluation.

[9] This reason was highlighted due to better data accessibility compared to other application areas (Liu et al., 2013).

findings, the efficiency values of studies using nonparametric models (DEA and FDH) are shown to be analogous to those using parametric models (SFA, TFA and DFA). However, they point out that nonparametric models tend to have lower mean efficiency values with higher dispersion. Berger and Humphrey also investigate the use of efficiency analysis in different application criteria in financial institutions. They find that the banking efficiency literature confirms the heterogeneity of the deregulation effect on efficiency estimates (both improving and worsening effects) and which depends on the industry condition in pre deregulation era. Sathye (2003) provides an analysis of the evolution of technical efficiency during the pre and post liberalization eras in two developing countries, India and Pakistan. The results using DEA, a nonparametric analysis, confirm the presence of positive efficiency change during the liberalization eras in both countries.

Earlier literature suggests that local banks outperform foreign banks in developed nations. For instance, research studies of efficiency analysis show that the United States (U.S.) foreign owned banks have a significantly lower efficiency scores than local owned banks (Mahajan, Rangan, & Zardkoohi, 1996; Miller & Parkhe, 2002). Regardless of the unsatisfactory performance of foreign banks in developed countries, many studies confirm the superiority of foreign owned banks in developing and transition countries (Sathye, 2003; Sufian, 2011).

2.4.2 Efficiency studies of the insurance sector

Recent research works are increasingly oriented towards studies focused on efficiency measurement. This is particularly the case of the insurance industry where a growing number of research papers have been published using frontier efficiency techniques. The introduction of modern frontier efficiency methodologies has significant implications for insurance firms. Traditionally, conventional financial ratios (for example, return on assets

and return on equity) were popular among researchers to evaluate the performance of the insurance sectors. The evolution of frontier techniques has made this increasingly obsolete, and in particular for the analyses of book values rather than market values. Frontier efficiency techniques prevail over traditional techniques in terms of deriving reliable and meaningful measurements of firm performance. These techniques create a single measure of a firm's performance, which controls for differences among firms in a sophisticated multidimensional framework that has its roots in economic theory.

In their review of 95 top studies of insurance efficiency, Eling and Luhnen (2010b) identify 30 studies focused on the U.S., 44 studies focused on European countries, and 14 studies focused on Asian countries. However there is only one study on the Malaysian insurance market. Cummins and Weiss (2013) likewise investigated 74 studies in the same field with 35 studies focused on U.S. insurance sector with 27 studies evaluating the efficiency of European insurers in either single or multi country studies. The other 12 studies were of Asian countries. Thus, the unequal dispersal of the studies in favor of technologically advanced nations is confirmed by the existing surveys.

2.4.3 Data envelopment analysis in the insurance sector

The history of efficiency studies using DEA technique among insurance companies can be traced back to the early works of a number of researchers (Bjurek, Hjalmarsson, & Forsund, 1990; Cummins, Turchetti, & Weiss, 1996; Cummins, Weiss, & Zi, 1999; Cummins & Zi, 1998b; Fecher & Pestieau, 1993; Mahajan, 1991). A study by Liu et al. (2013), evaluating the DEA application studies from 1978 to 2010 (published in the Web of Science) shows that only 44 (equivalent to 1.4 per cent) of application studies were conducted on the insurance sector whereas 323 were on the banking sector (equivalent to 10.3 per cent) papers. This indicates a need for further quality efficiency studies on

insurance sector, which has a substantial contribution to stimulating a country's economic growth.

The majority of efficiency studies on insurance sectors use traditional DEA techniques to measure the performance of companies. This methodology assumes a production/service process as a single black box that transforms inputs to outputs. However, more than one stage may be involved to complete a production/service process. Therefore, by using traditional DEA approaches, we are neglecting the internal linking of activities between different stages or divisions, in which we are not able to determine the decomposed inefficiencies of each stage. For example, insurers use assets and expenditures to generate premiums, which are meant to be utilized for investments plans. As such the premiums play a dual role in the service process. In the first stage, premiums are the outputs, and then become the inputs in the second stage. The first stage outputs, which are the second stage inputs, are the intermediate measures of production processes that link the two stages (Färe & Whittaker, 1995). The NDEA approaches, open up black boxes to provide more detailed efficiency measures of what happens inside them (Färe et al., 2007).

The objective of efficiency measurement using multi-stage models is to identify the source of inefficiency in the whole production/service process. Kao and Hwang (2008) differentiate the independent two-stage DEA model (two stages are independent of each other) and the rational two-stage DEA model (the output of the first stage is the input of the second stage). In a study of a set of Taiwanese non-life insurance companies, they find that the latter methodology produces meaningful results both for the whole process and sub-process efficiencies. However, the former produces unusual results for a number of insurers. As noted by Chen, Cook, Li, and Zhu (2009), the proposed model of Kao and Hwang (2008) limits the efficiency estimation to CRS only. Moreover, the overall

efficiency is the geometric average of efficiencies of individual stages, and the same weights are assumed for the intermediate measure in order to link the two stages together. Otherwise, the resulting model is analogous to the independent two-stage DEA model.

To overcome the problem, Chen et al. (2009) introduce an additive approach for aggregating the stages of a production/service process, in which the efficiency can be decomposed under both CRS and VRS, and the overall efficiency is the weighted sum of efficiencies in the sub processes. While models by Chen et al. (2009) and Kao and Hwang (2008) are effective in evaluating two-stage efficiencies, the proposed NDEA model (termed network slacks-based measure (NSBM) by Tone and Tsutsui (2009)) allows new inputs to the second stage in addition to intermediate measures. The superiority of this model is its ability to account for the slacks while measuring the overall and divisional efficiencies. Additionally, the NSBM is a non-radial method, which considers the possibility of non-proportional changes of inputs and outputs. Exogenous weights are assigned to stages in order to incorporate the importance of each stage. However, it is also important for insurance companies to incorporate a measure of efficiency across multiple periods (dynamic structure).

Recently, Tone and Tsutsui (2014a) introduced a DN-DEA model – the dynamic network slacks-based measure (DNSBM) – that is a combination of NSBM (Tone & Tsutsui, 2009) and dynamic SBM (DSBM) (Tone & Tsutsui, 2010). As mentioned by Tone and Tsutsui (2014b), DNSBM deals with multiple divisions connected by links of network structure within each period vertically. It also combines the network structure by means of carry-over activities between two succeeding periods horizontally. In fact, the combination of network and dynamic structures offers a more comprehensive analysis in which enables an analysis of both divisional and periodical interactions at the same time.

To date, the DEA literature on the insurance domain has mostly focused on dynamic aspects or more recently the network aspects of firms. However, the vibrant and complex service processes of insurance companies demand the consideration of both structures in efficiency evaluation. Hence, the application of DN-DEA in the insurance sector is still in its infancy and which has received little attention among researchers. To the author's knowledge, Kuo, Kweh, Ting, and Azizan (2015) provide the first and only illustrative work that applies DN-DEA to insurance companies, by decomposing the insurance efficiency into marketability and profitability stages similar to Seiford and Zhu (1999) study of banking institutions. The results are promising in the sense that there is a need for a more in-depth analysis of DN-DEA among insurance studies.

2.4.4 Determinants of efficiency

With the purpose of evaluating the efficiency of an insurance sector, the studies by Eling and Luhnen (2010b), who categorized 95 studies into 10 different areas of application, and Cummins and Weiss (2013), who categorized 74 studies into 9 areas, provide useful information on the importance of determining factors on efficiency scores. Both of the studies emphasize the significance of exploring the determinants of the efficiency of the insurance sector using DEA. The literature identifies a number of determinants that drive the efficiency scores. The aim of this section is to review the studies as they related to insurance efficiency.

Table 2.1 summarizes the determinants of insurance efficiency and the driving factors which are categorized into three groups – a firm's characteristics, a firm's ownership and a firm's macroeconomic factor. The hypothesized sign are derived based from the existing theories where appropriate. The measurements of each variable are based on the past studies for which references are given in the next column. The influence of financial

liberalization as another driving factor of insurance efficiency has been extensively discussed separately.

Table 2.1: Determinants of insurance efficiency

Type	Variable	Hypothesized sign	Measurement	References	Theory
Firm's Characteristics	Firm size	Positive	Natural logarithm of total asset	(Cummins, 1999), (Luhnen, 2009a)	Economies of scale
	Firm age	Positive	Year of establishment	(Jovanovic, 1982), (Mester, 1996), (Berger & Mester, 1997)	Theory of firm growth
	Profitability	Positive	Return on equity (ROE)	(Choi & Elyasiani, 2011), (Huang & Eling, 2013)	
	Distribution channels	Positive	Dummy: 1- Bancassurance 0- Direct/agent/mix	(Mahlberg & Url, 2003), (Luhnen, 2009a), (Fiordelisi & Ricci, 2011)	
	Specialization	Positive	Dummy: 1- Life and non-life 0- Life or non-life	(Meador, Ryan Jr, & Schellhorn, 2000), (Cummins, Weiss, Xie, & Zi, 2010), (Berger, Cummins, Weiss, & Zi, 2000a)	Economies of scope - strategic focus hypothesis versus conglomeration hypothesis
	Financial leverage	Negative	Total liabilities/total assets	(Luhnen, 2009a), (Lin, 2002)	
Firm's Ownership	Foreign versus local	Positive	Dummy: 1- Foreign 0- Local	(Huang, Ma, & Pope, 2012), (Lin, 2002)	Global advantage hypothesis (general form), low price strategy, global market participation, concentration strategy
	Country of origin	Positive for advanced regions	Dummy: 1- America/0-Others 2- Europe/0-Others 3- Asia/0-Others	(Berger, DeYoung, Genay, & Udell, 2000b), (Sufian, 2011)	Global advantage hypothesis (limited form)
Macroeconomic factor	GDP	Positive	GDP	(Enz, 2000), (Eling & Luhnen, 2008)	
	CPI	Negative	Yearly CPI	(Ravin & Fowlds, 2010), (Huang & Eling, 2013)	
	Financial Liberalization periods	Positive	Dummy: 1- After 2009 0- 2009 and before		

Source: Compiled from the literature.

2.4.4.1 Firm's characteristics

(a) ***Firm size***

The primary factor evaluated by most researchers is the firm's size or in a general context the firm's economies of scale. The size factor has been investigated from various perspectives. For instance, Fama and Jensen (1983) claim that important managerial tasks – such as coordinating organizational activities and making resource allocation decisions – are more difficult and even inefficient in larger companies. Another perspective is that efficiency gains can be enhanced through increasing the firm's size when economies of scale and market share become competitive advantages (Cummins, 1999). Firms with inappropriate size, whether too large or too small, might show what is called "scale inefficiency" (Cummins, 1999). Diacon, Starkey, and O'Brien (2002) explored 450 insurers licensed in 15 European countries, found that technical and scale efficiency are significantly associated with firms' size. That is both small and large insurance firms show higher technical efficiency and lower scale efficiency as they become bigger. Using a large unbalanced panel data of 295 German property liability insurance companies, Luhnen (2009a) found higher efficiency scores among large insurers as compared to medium and small insurers. Many researchers found higher technical, allocative and cost efficiency for larger insurers (Bikker & Van Leuvensteijn, 2008; Cummins & Rubio-Misas, 2006; Eling & Luhnen, 2010a; Huang & Eling, 2013; Worthington & Hurley, 2002) while few studies found decreasing scale economies as size grew (Choi & Elyasiani, 2011). Mixed results also occur in insurance efficiency studies. In an analysis of the U.S. insurance industry, Cummins et al. (2010) concluded that firm size is positively associated to revenue, cost and profit efficiency while negatively linked to scale efficiency. Additionally, larger insurance companies may experience lower rates of insolvency (Pottier, 2011). Thus the efficiency of firms can be indirectly affected by size. For instance, a large firm could have lower operating costs, which increase the revenue

and result in a higher net cash flow, and therefore, decrease the firm's risk and increasing its efficiency.

(b) ***Firm Age***[10]

The traditional neo classical theory of the firm does not make any assumption about the effect of a firm's age on efficiency measurements. However, the theory of firm growth proposed by Jovanovic (1982), states that efficient firms survive and grow over time while inefficient ones fail and deteriorate. Due to the effect of time, older firms carry higher efficiency scores compared to younger firms which implies a positive association between a firm's age and efficiency (Lundvall & Battese, 2000). A study of bank branches by Mester (1996) indicates that inefficient banks tends to be younger than efficient banks which implies two possible scenarios; either a banks' service processes involve "learning by doing" or the efficient banks have a higher chance of survival. In regard to the learning by doing hypothesis, technical efficiency is said to be associated with the age of a firm (Berger & Mester, 1997). To date, there is no empirical evidence on the relationship between firm age and efficiency among insurance companies.

(c) ***Profitability***

Profitability is regarded as a measure of performance; however, profit efficiency (using frontier methodologies) is substituted with a simple profitability measurement if the purpose is performance evaluation. Choi and Elyasiani (2011) ascertained profitability as a significant predictor of companies' performance. In a study of BRIC (Brazil, Russia, India and China) countries, Huang and Eling (2013) measured the profitability by return on equity (ROE) and found a significant positive link between ROE and efficiency scores of insurers. Profitability can also be measured as the ratio of profits on ordinary activities

[10] Sometimes referred to firm's experience (Ajuzie et al., 2011).

to total premiums (Choi & Elyasiani, 2011) and as the inverse of the loss ratio – i.e. premium earned divided by incurred loss and loss adjustment expenses (Mahlberg & Url, 2003). The latter authors found that because of falling premium levels, the reduction of profitability lowered the efficiency score of the Austrian insurance industry. Among the studies that found a positive effect of profitability, Diacon et al. (2002) observed the negative influence of profitability only on scale efficiency and not technical efficiency.

(d) ***Distribution Channels***

The distribution channels can be evaluated from two different angles. On the one hand, an insurer makes distribution of its policy either directly or through an agent or both (Luhnen, 2009a). On the other hand, the distribution could be performed with the help of a banking institute (Mahlberg & Url, 2003), that is called bancassurance. In the former case, Luhnen (2009a) concluded that those firms which exclusively focus on an agent possess higher efficiency scores than independent insurers. Bancassurance, however, is expected to increase the efficiency level in the financial services sector. A study by Mahlberg and Url (2003) shows that insurers relying on banks to distribute their product had a higher level of efficiency and productivity. Additionally, Fiordelisi and Ricci (2011) highlight the competitive advantage of bancassurance in the cost efficiency gain of Italian insurers, although the banks are not the beneficiary of such cooperation. Conversely, too much reliance on banks appears to not always be a profitable decision. The Taiwanese insurance sector has been shown to perform more efficiency when the insurers work independently rather than using banks as the channel of distribution (Chang, Peng, & Fan, 2011). For the Malaysian insurance sector, insurers mostly use the direct and agent methods to market their policies, hence, there is no distinguishing line between the extents to which direct or agent methods are used. However, some insurers cooperate with banks which provides this study with useful data. Therefore, the bancassurance method is included in this study as a distribution channel.

(e) ***Specialization (scope economies)***

The degree of product specialization is another highlighted factor in the literature, which may influence the efficiency of insurance companies. Generally, in regard to the notion of cost subadditivity, a firm producing a set of products has to be more cost efficient in comparison to a set of firms producing various products (Worthington & Hurley, 2002). Therefore, it is expected that, with product diversification, an efficiency enhancement will be observed. However, evidence to date is mixed. Meador et al. (2000) found greater X-efficiency among diversified U.S. life insurers compared to focused firms. They further demonstrate that the higher cost efficiency by multi-product firms is achieved through sharing input and resource allocation across different product lines.

The strategic focus hypothesis has gained a number of advocators in examining the efficiency of specialized insurers. Luhnen (2009a) defined a specialized insurer as a company that earns more than two third of its premium in one line of business. In his study of German insurers, the companies focusing on one line of business gained higher cost efficiency scores while no significant technical efficiency difference was found among specialized and non-specialized companies. Likewise, Cummins et al. (2010) concluded that a strategic focus is generally superior to conglomeration in U.S. property liability insurance. In his analysis on economies of scope among U.S. life and non-life insurers, Berger et al. (2000b) supported conglomeration for some type of insurance companies (according to the line of business and to size) and specialization for the rest. However, Hao and Chou (2005) found no association between a diversification strategy and efficiency improvement. For the Malaysian insurance sector, insurers are either specialized or non-specialized with some insurers focusing on only life or non-life and some on both.

(f) ***Financial leverage***

Financial leverage is the amount of debt employed to fund a company's asset. Hence, a company is highly leveraged if it holds significantly higher debt compared to equity. Insurers' soundness can be secured using the leverage ratio – i.e. the ratio of premiums and equity – which often take the form of constraints such as a minimum capital requirement (Kahane, 1979). The insurance leverage is sometimes called the Kenney ratio where the ratio is calculated as net premium written divided by policyholders' surplus (Beckmas & Tremelling II, 1972). Choi and Elyasiani (2011) have observed that with an increase in leverage ratio, the ability of insurers to cover unexpected losses will be diminished. As a result, a higher cost of funding will result in lowering the efficiency scores. According to Rai (1996), cost efficiency is linked with higher levels of capital, i.e. lower leverage, since low leverage reflects a less risky tactic in managing the liabilities and can possibly lead to lowering of funding costs and an increase in demand for products. The same scenario is associated with revenue efficiency, because a low leveraged firm (higher capital) will be more prepared for the possible market shocks. Therefore, the stronger the firm's financial condition, the more demand for its products which results in higher revenue gain and higher efficiency. Weiss and Chung (2004) highlight the importance of lowering the leverage ratio because policyholders' surplus largely softens the adverse fluctuations in loss liabilities, and therefore, lowers the risk. The authors also found a significant effect of financial quality (inverse leverage ratio) on reinsurers' price. Additionally, the leverage performance relationship is found to move in the opposite direction among Malaysian general insurers where debt to equity ratio is used as the measurement for the leverage ratio (Soon-Yau & Razak, 2012).

Choi and Elyasiani (2011) found mixed results where the highly leverage firms ended up with lower cost X-efficiency and revenue scale efficiency but higher revenue X-efficiency and cost scale efficiency. Luhnen (2009a) used the ratio of equity to assets to

measure the financial leverage of German insurance companies. Due to the fact that a higher equity/asset ratio produces a higher level of safety for an insurer, the high magnitude of the ratio shows the low financial leverage and vice versa. The result of their study supports the primary hypothesis that the low leverage firms are more efficient, in both technical and cost aspects. Likewise, a study by Lin (2002) supports the same hypothesis although the leverage ratio was taken as the fraction of total liabilities over total assets. The author concluded that the lower leverage ratio is associated with higher overall technical efficiency and scale efficiency.

2.4.4.2 Firm's ownership

Nowadays, the appropriate role of foreign ownership in the local insurance market has become a matter of considerable concern for policy authorities. Indeed, the debate on foreign dominance has been controversial. In particular, emerging economies tend to more tightly control the foreign insurers as compared to developed economies (Skipper, 1997). On the other hand, developed sound economies are more open to FDI – a factor which, it is held, could further advance local financial systems. The situation is however changing. Emerging and less advanced countries have gradually become aware of the advantages of external investment in local insurance markets. With state-ownership beginning to be replaced with private ownership, more room is being made for foreign investors. Facilitating this process are deregulation policies which have increasingly replaced restrictive rules and regulations. However this process of opening up to foreign ownership has yet to take hold in many economies and only partially in others. Consequently most insurance sectors in emerging countries have not been fully liberalized.

The arguments favoring greater foreign participation have accentuated the remarkable contribution of these players in the local market. In fact, foreign insurers are able to boost

the insurance sectors in transforming the economies towards more advanced markets. For example advocates argue that the greater the foreign participation is, the greater the enhancement of customer services, the more advanced technological know-how is, the more improved are insurance regulations, the more local savings get promoted. On the contrary, the critics argue that foreign dominance of the local market may produce an adverse impact on economic development. In addition, the contribution of foreign insurers could be short-run. Moreover, the higher presence of foreign insurers the greater the foreign exchange outflow can be. Likewise, due to higher technological advancement of parent companies, foreign insurers have a greater opportunity to lead local players thereby encouraging them to develop greater competitive power.

Modern companies have various types of ownership patterns. Studies on organizational ownership show that equity shareholders are not homogenous and that different groups of shareholders can disproportionately affect organizational efficiency (Kang & Sorensen, 1999). Based on the literature survey, this study segregates insurance firm's ownership into two different categories, namely foreign versus local and country of origin. This study uses the notion of country of origin[11] to hypothesize both ownership types (Berger et al., 2000b). This notion encompasses two hypotheses: the home field advantage hypothesis and the global advantage hypothesis. It should be noted that, to the best of the researcher's knowledge, the country of origin has not been used in insurance research with the existing studies focused on banking institutions.

Local firms are more efficient than foreign firms when the home field advantage hypothesis operates. This is commonly due to difficulties of monitoring and operating a firm from a distance and due to cultural, language, currency and regulatory barriers.

[11] The original idea developed by Grosse and Goldberg (1991).

Under this hypothesis, foreign institutions are in a disadvantageous position, resulting in lower revenue and higher cost for providing the same service compared to local institutions. Under the global advantage hypothesis, foreign firms take advantage of their superior managerial skills, better performing policies, greater investment skills and risk management decisions, which produce lower costs and greater revenue raising. The global advantage hypothesis is divided into two forms, the general form and the limited form. In regard to operating efficiently, the former assumes the superiority of a foreign institution regardless of its home base country and the latter assumes that a foreign firm in a limited number of home base countries or regions with particular favorable markets, supervisory and regulatory conditions can be superior to local institutions.

(a) ***Foreign versus local***

This category differentiates between a foreign and locally owned firm. A company is foreign-owned if more than fifty per cent of its equity is owned by foreign individuals or foreign companies. In the insurance field, some studies highlight the comparative efficiency of foreign insurers. A study by Huang et al. (2012) evaluates the institutional ownership of Japanese non-life insurance industry. The study findings show a significant relationship between the influence of foreign shareholdings with efficiency (cost, technical and allocative efficiency) of insurers as well as the association of local shareholding with inefficiency of Japanese insurers. The low price strategy of foreign-owned insurers in U.S. markets seems to be beneficial for international firms in taking over a substantial amount of industry market share in foreign markets they operate and which leads to gaining a competitive advantage in achieving higher cost and revenue efficiencies as compared to local insurers (Choi & Elyasiani, 2011). Lin (2002) concludes that the new foreign insurers, as a result of deregulation of the Taiwanese insurance market, gained a very high level of pure technical efficiency. This demonstrated the technological advantages of international players due to their greater experience in global

marketplaces. Interestingly, the author found that high potential local insurers learned from their foreign competitors and finally overtook them in terms of efficiency scores. The same conclusion is drawn from an efficiency study of BRIC countries where foreign insurers helped to increase the efficiency of production technology (Huang & Eling, 2013). This should not be surprising due to the higher capability of foreign insurers to take advantage of their access to superior operational and risk management techniques derived from their participations in global markets.

However, foreign insurers may not always exhibit higher efficiency scores or even not participating in leading technological advancements. For insurance, Barros, Nektarios, and Assaf (2010) could not find any evidence that the foreign rivals play an important role in the Greek insurance sector and found their efficiency scores were no higher than that of the local players. Nevertheless, locally incorporated foreign-owned insurers can bring additional and possibly innovative marketing and product competition to the national market. The insurance literature to date is mixed although it mostly rejects the home field advantage hypothesis. The general form of global advantage hypothesis takes the opposite of the home field advantage hypothesis.

(b) ***Country of origin***

Based on the limited form of global advantage hypothesis suggested by Berger et al. (2000b), Sufian (2011) divides the Malaysian foreign banks into three groups, American, European and Asian. The efficiency of each group is tested for statistically significantly differences. The results imply that only foreign banks from European nations are significantly the least productive group. Hence, this study investigates the limited form of global advantage hypothesis where the researcher assumes the superiority of insurers headquartered in advanced markets as compared to other insurers.

2.4.4.3 Macroeconomic factor

(a) ***Gross domestic product (GDP)***

The insurance premium growth of any nation with an income elasticity larger than one, is intimately connected to gross domestic product (GDP) growth. Therefore, GDP can be a significant driver of life and non-life insurance expansion (Enz, 2000). However, Luhnen (2009b) could find no significant association between changes in real GDP and premium changes in the German insurance market, which was in contrast to the findings of Lamm-Tennant and Weiss (1997) in their study of the U.S. insurance market. A study of BRIC non-life insurance companies revealed that GDP growth has a positive significant influence on input slacks which can be translated as a negative influence on efficiency scores (Huang & Eling, 2013). Eling and Luhnen (2008) find a negative but not significant effect of GDP on technical and cost efficiencies of non-life insurers of 34 countries. However, the GDP positively and significantly affected the technical and cost efficiencies of life insurers. While the results are not consistent, it is expected that the greater the economic growth of an economy, the tendency to purchase insurance products will be higher as a result of higher living standards.

(b) ***Consumer price index (CPI)***

The consumer price index (CPI), which reflects inflation, affects the operations of insurers in different ways such as policy designations, price and reserve determination, cost of claims, and risk and capital management (Ravin & Fowlds, 2010). Therefore, a higher CPI can result in higher inflation risk, requiring more inputs and therefore lower the efficiency scores of insurance companies (Huang & Eling, 2013). However, Luhnen (2009b) concluded that the CPI is a better explanatory variable of premium growth compared to real GDP for German insurers. Additionally, inflation itself can affect the efficiency of insurance companies because inflation erodes the value of a country's

currency, therefore, more coverage (higher value of premiums) is needed for covering the policies under non-life category (Beckmas & Tremelling II, 1972).

(c) ***Financial liberalization***

Liberalization policies can be defined as well-intentioned strategies used to stimulate the economic growth of a nation (McKinnon, 1973). Theoretically, financial liberalization measures, as opposed to financial repression, enhance competition, which will result in increased saving and investment, thereby raising the efficiency of the allocation of capital. In this way the importance of insurance to economic development is unveiled. In particular, the higher the development and efficiency of a country's insurance market the greater the contribution to economic growth. Therefore, a fully liberalized insurance market is expected to be more efficient than partial or non-liberalized market.

Financial service sectors typically undergo liberalization and deregulation with the objective of enhancing consumer choice and improving the market efficiency (Berger & Humphrey, 1997): however, the empirical evidence indicate otherwise. Among the fourteen analyzed studies, the majority used non-parametric techniques to evaluate efficiency. Six studies focused on life insurers while seven studies focused on both life and nonlife insurers. The year of publication varies from 1999 to 2012 and the average number of years of the samples used in the analysis equals to 8.35 years. The review of these studies lead to three outcomes: positive influence, negative influence and neutral influence.

Firstly, the dominant group of studies found a stimulating effect of regulation change on insurers' efficiency (Badunenko, Grechanyuk, & Talavera, 2009; Boonyasai, Grace, & Skipper Jr., 2002; Cummins & Rubio-Misas, 2006; Ennsfellner, Lewis, & Anderson, 2004; Gamarra, 2008; Hussels & Ward, 2007; Rees & Kessner, 1999; Turchetti & Daraio,

2004). Followed by the European insurance market liberalization in 1994, the studies of insurance efficiency received considerable attention. A study by Cummins and Rubio-Misas (2006) conducted on the Spanish insurance market investigated the efficiency of life and non-life insurers using DEA to estimate cost, technical, and allocative efficiency, as well as using a Malmquist analysis. As the result of deregulation, the authors found that consolidation leads to higher efficiency and increases the number of firms operating decreasing return to scale. Rees and Kessner (1999) survey pre-1994 regulation in Germany and the UK and the Commission's policy and conclude that looser regulation and augmented competition increased efficiency. Another study by Gamarra (2008) with focuses on German life insurers during 1995 to 2002 found significant positive scale efficiency change. Similarly studies of the Italian, Austrian and Ukrainian insurance markets indicate an upswing in efficiency scores caused by deregulation (Badunenko et al., 2009; Ennsfellner et al., 2004; Turchetti & Daraio, 2004). To the researcher's knowledge, the only scholarly study showing a positive influence of deregulation in Asian insurance markets is that of Boonyasai et al. (2002). The authors highlight that the existence of liberalization and deregulation together promote competition, which leads to efficiency. This coexistence has enabled Korean and Pilipino life insurance industries to improve productivity (Boonyasai et al., 2002).

The second group of studies found a negative role of regulation change in efficiency enhancement of the insurance sector. Surprisingly, in contrast to the results of Gamarra (2008) who studied German insurers, a more recent study by Mahlberg and Url (2010) concludes that increased competitive pressure as the result of deregulation did not systematically force the most inefficient firms to improve their position relative to the benchmark firms. The study by Mahlberg and Url (2010) seems to be more accurate and conclusive where the authors take both life and nonlife industry into account. Furthermore, a very large span of time (1991-2006) covering both the pre and post

deregulation era is considered by the authors thereby decreasing the systematic bias. Lastly, the choice of methodology may well account for their findings given Mahlberg and Url (2010) utilized DEA and Gamarra (2008) applied SFA. Another contrary result is observed in the Austrian insurance market where Mahlberg and Url (2003) found considerable inefficiency prevailing in the market. On the other hand, as previously mentioned, Ennsfellner et al. (2004) provides strong evidence that the process of deregulation had positive effects on the production efficiency of Austrian insurers. The major difference among these two studies are the choice of methods, i.e. DEA or SFA (Mahlberg and Url (2003) used the former while Ennsfellner et al. (2004) used the latter). A study by Barros et al. (2010) shows that Greece – a member of European Union and a developed nation – had declining efficiency scores during the deregulation era in its insurance sector. The authors blame the degree of consolidation that had not been adequate enough to progress the efficiency of the insurers. Likewise, a DEA analysis among Iranian insurers points to a declining efficiency over the entrance deregulation period (Naini & Nouralizadeh, 2012).

The last group found no influence of deregulation on insurers' efficiency. A study of the U.S. life insurers examining the impact of risk based capital regulation change shows no effect of efficiency change during the study period (Ryan Jr & Schellhorn, 2000). Hussels and Ward (2007) provide a comprehensive assessment of deregulation efficiency in the UK and Germany using DEA and DFA. The authors could find no clear linkage between deregulation and improved efficiency levels or even total factor productivity. According to the study by Jeng and Lai (2008), the Taiwanese insurance market has not gained efficiency benefits from deregulation and liberalization.

The majority of studies on deregulation and liberalization have concentrated on European countries where diverse regulation change happened in the mid-1990s. The

choice of method used in the study, the line of business and the sample period appears to have a substantial influence on the efficiency scores of insurance companies. Deregulation was greatly expected to bring the beneficial consequences to the industry. For instance, through lowering the level of regulation, lower level of administrative resources were expected which would result in higher output generation (Hussels & Ward, 2007). Additionally, higher competition was envisaged through more foreign participations and removal of pricing regulations, which would enhance operating efficiency. According to previous studies (Cummins & Rubio-Misas, 2006; Mahlberg & Url, 2003), the most evident consequence of deregulation to be expected is a higher level of competition. Technological improvement is also identified as a leading factor in insurers' efficiency gains (Cummins & Rubio-Misas, 2006; Hussels & Ward, 2007; Mahlberg & Url, 2010). However, this choice is not an easy task for a firm to pursue on its own. Therefore, as indicated in a number of studies (Cummins & Rubio-Misas, 2006; Jeng & Lai, 2008), the acquisition of inefficient firms by efficient rivals is a key means of producing efficiency gains. Overall, they find, technological improvements increases efficiency.

Table 2.2 summarized the studies of liberalization and insurers' efficiency using frontier efficiency techniques. Most of the studies used DEA to measure the efficiency of insurers. It is notable that life insurers received higher attention among researchers. The average sample used for the analysis is 8.35 years. The findings of these studies lead to three different outcomes: positive influence, negative influence and neutral influence. The efficiency scores are considerably influenced by the choice of method used in the study, the line of business and the timespan used for the analytical sample. Most of the studies focused on European insurance sectors and few on Asian sectors.

Table 2.2: Key studies on liberalization and insurance efficiency

Authors	Year	Country	No. insurers	Sample period	Lines of business	Methods
Badunenko et al.	2006	Ukraine	163	2003–2005	Life, Non-life	DEA
Barros et al.	2010	Greece	71	1994–2003	Life, Non-life, Mixed	DEA
Boonyasai et al.	2002	Korea, Philippines, Taiwan, Thailand	49–110	1978–1997	Life	DEA
Cummins and Rubio-Misas	2006	Spain	331–508	1989–1998	Life, Non-life	DEA
Ennsfellner et al.	2004	Austria	100	1994-1999	Life, Non-life	SFA
Gamarra	2008	Germany	n.a.	1995–2002	Life	SFA
Hussels and Ward	2007	UK, Germany	78	1991–2002	Life	DEA, DFA
Jeng and Lai	2008	Taiwan	96	1981-2004	Life	DEA
Mahlberg and Url	2003	Austria	70	1992–1999	Life, Non-life	DEA
Mahlberg and Url	2010	Germany	138	1991-2006	Life, Non-life	DEA
Naini and Nouralizadeh	2012	Iran	4	2003-2010	Mixed	DEA
Rees and Kessner	1999	UK, Germany	n.a.	1992–1994	Life	DEA
Ryan and Schellhorn	2000	U.S.	321	1990–1995	Life	DFA
Turchetti and Daraio	2004	Italy	45	1982–2000	Non-life	DEA

Source: Compiled from the literature.

2.4.5 Empirical Gaps

Through increasing the popularity of frontier efficiency methodologies, a number of researchers have explored the use of various efficiency techniques in insurance sectors. In doing so, different efficiency determinants, financial liberalization measures and variations in efficiency scores are investigated. However, most of the existing studies on performance analysis have estimated the efficiency of insurance companies using traditional DEA techniques while the complex insurance service process demands more sophisticated techniques in order to yield greater validity. Additionally, the extant studies have mainly focused on the U.S. or other developed countries (Cummins & Rubio-Misas, 2006; Gamarra, 2008; Hussels & Ward, 2007; Mahlberg & Url, 2010; Ryan Jr & Schellhorn, 2000; Turchetti & Daraio, 2004). However findings of studies about developed countries are not generalizable to developing countries, which often lack a well-defined market for corporate control and possess weak property rights (Sufian, 2011). Hence, this study aims to fill the gap in the literature on insurance efficiency by providing a more validated efficiency analysis of the Malaysian insurance sector built on the intermediation approach, and which has received less attention among academic researchers.

Given the breadth of attention directed at the efficiency of the insurance sector in the above literature review, the absence of empirical validation for a country specific evaluation is of concern. The extensive literature on liberalization has tended to be written by macroeconomists with a stress on macro level development and growth. Therefore analysis at the microeconomic level could provide more conclusive evidence of the influence of liberalization policies (Eichengreen, 2001). Certainly, in order to attain a more conclusive answer to the major macro questions such as the effect of liberalization on economic growth, the outcomes of microeconomic research need to be integrated into

macroeconomic analysis. Therefore, a country specific study can help to fill the existing gap in the literature.

2.5 SUMMARY

The basic logic of the efficiency concept measures the performance of a financial institution relative to the best practice frontier, which is the most efficient firm or firms in a particular market. Under the microeconomic theory of the firm, a firm aims to maximize its profit through cost minimization and revenue maximization. In accordance to a specific objective function, three components of efficiency measurement are introduced in the literature, scale efficiency, allocative efficiency and technical efficiency. Subsequently, there are two theoretical streams to evaluate the efficiency of an insurance business, namely the production approach and the financial intermediary approach. Under the production approach, financial institutions are solely service providers to account holders while under the intermediation approach financial institutions channel the funds between savers and investors.

Frontier efficiency methodologies enjoy a high popularity among the researchers when the objective is to access the performance of individual companies. Two different types of techniques with dissimilar assumptions, namely, the econometric approach (parametric) and mathematical programing approach (nonparametric), build the frontiers to distinguish the efficient and inefficient firms in a market. Among the pros and cons of each technique, the mathematical programing approach, particularly DEA, has become the predominant method due to fewer structural assumptions on the efficient frontier, ability to decompose efficiency by firms, the convenient way of decomposing efficiency components and flexibility for measuring the efficiency of markets with few decision-making units.

The popularity of frontier efficiency techniques is far more prevalent in the banking sector compared to the insurance sector. For instance, the number of high rank published papers on the banking domain is seven times than that of insurance studies, where DEA is used as a method of efficiency estimation. Among DEA studies, researchers mainly focused on traditional methods in which the complex service processes of insurance activities are neglected. In addition, most of the insurance studies have focused on developed countries and less attention given to emerging countries in which the insurance sector is becoming an important contributor to economic growth. Furthermore, most of these developing countries are gradually opening up their markets to international firms through introducing liberalization policies. Therefore, there is a particular need for evaluating the effects of liberalization policies on the insurance industry in these developing countries.

Liberalization in the financial sector, especially the insurance sector, accentuates lessening government barriers to market access with the promise of financial prosperity for the targeted market as well as in terms of economic growth. Financial liberalization is aimed at bringing more competition, higher investment and saving and more efficient allocation of resources. As a result of financial liberalization, the openness of financial trade can also benefit the financial sector through various measures such as relieving entry barriers and providing more competition opportunities. A country with full capital account liberalization can enjoy greater freedom of capital flows through the removal of financial restrictions. Consequently, the capital flows within the economy can produce technological advancement (technical efficiency), capital cost reduction (cost efficiency) and higher market productivity. Recently, the results of a number of macroeconomic studies on financial liberalization have led to equivocal findings, in particular due to economic damages relevant to liberalized nations during the Asian financial crisis. The unique characteristics of each country and their markets mean there is a need for more

microeconomic studies to resolve the ambiguities. Hence, this study aims to offer an appropriate measure of efficiency analysis for the insurance sector in which its determinants and the role of financial liberalization unveil the incentives and hindrances to the creation of a more efficient insurance market. The particular case of the Malaysian insurance sector, as a high potential emerging insurance market, is seen as providing a basis for other insurance sectors to achieve higher efficiency in their development path.

CHAPTER 3: THE MALAYSIAN INSURANCE SECTOR

3.1 INTRODUCTION

According to Outreville (1998, p. 131), the most pervasively used legal definition of insurance is as follows: "a contract of insurance is that whereby one party, the insurer, undertakes, for a premium or an assessment, to make a payment to another party, the policyholder or a third party, if an event that is the object of a risk occurs". The purpose of policyholder is not to make profit but to be reimbursed in the case of possible damage or loss. Insurance is a dual purpose tool to both share and shift the risk (Skipper & Barfield, 2001). The insured party or policyholder simultaneously shares and shifts the risk of a covered event to the insurer for an agreed premium. The insuring company continues its operation as long as it insures an adequate number of policies along with a reasonable prediction of the number of future claims. As a general rule, the higher number of insureds implies a more experienced insurer. However, the rule does not hold where covered events have a high potential of irremediable catastrophes. Moreover, unpredictable environmental events may disrupt the pricing anticipations of insurers, which may lead to a company's failure. Regardless of these types of possible events, the insurance industry is growing rapidly in many developed and developing countries. The aim of this chapter is to evaluate the overall trend and performance of the Malaysian insurance sector at both national and international levels.

This chapter discusses the progress of Malaysian insurance sector and maps out its current and historical performance. Hence, an historical understanding allows for the provision of policy recommendations and future paths of developments for Malaysian insurance sector.

3.2 GROWTH IN THE MALAYSIAN SERVICE SECTOR

As an upper-middle income country (World Bank, 2014), Malaysia is regarded as highly but not fully open economy. The spectacular performance growth of the national economy during 1967 to 1997 and the implementation of various structural reform policies favorably assisted a number of the country's economic sectors. Malaysia's long-term plan is to boost economic growth further so as to be an advanced nation by 2020. In doing so, the government introduced the New Economic Model to better address developmental obstacles. Overall, its GDP has grown at a modest pace in recent years with uneven performance across the various economic sectors. The service sector is seen to be the best performer followed by manufacturing (Figure 3.1). As Figure 3.1 shows, not only does the service sector account for the highest portion of national GDP but also its trend line shows the strongest indications of higher future growth.

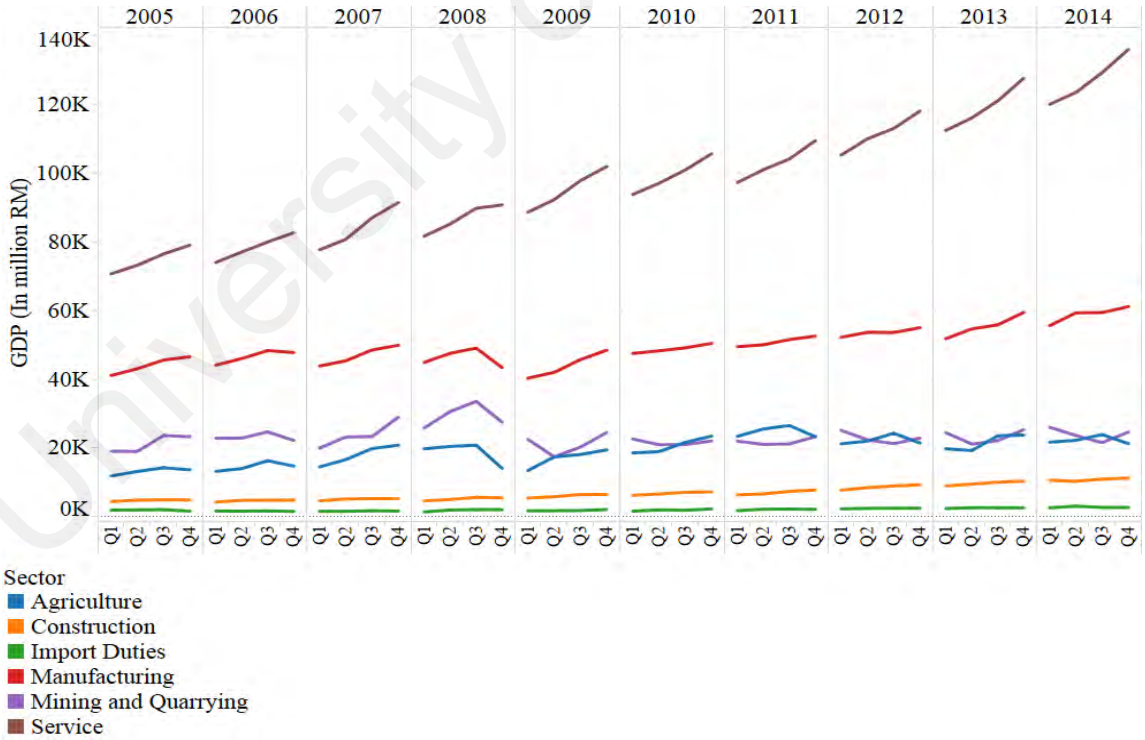

Figure 3.1: Malaysia's sectorial GDP, 2005 - 2014

Source: Computed from Bank Negara Malaysia.
Notes: The line graph shows the discrete trend of GDP for each year.
GDP is deflated to 2010 constant price using GDP deflator.

Figure 3.2 breaks down the service sector into different sub-sectors and shows the average contribution to the services GDP over the past ten years. Among all the sub-sectors, government services, wholesale trade and finance dominate accounting for approximately 15 per cent, 12 per cent and 11 per cent of service GDP respectively. However, the insurance sub-sector accounts for only 3.64 per cent of the services sector. The development of the finance sub-sector owes much to the implementation of the 10 year FSMP, which was launched in 2001. In order to chart the future direction of the financial system, the Malaysian government introduced the Financial Sector Blueprint in 2011 as a way of achieving a high-income and high value-added economy. These plans are designed to encompass the entire financial system including the insurance sub-sector.

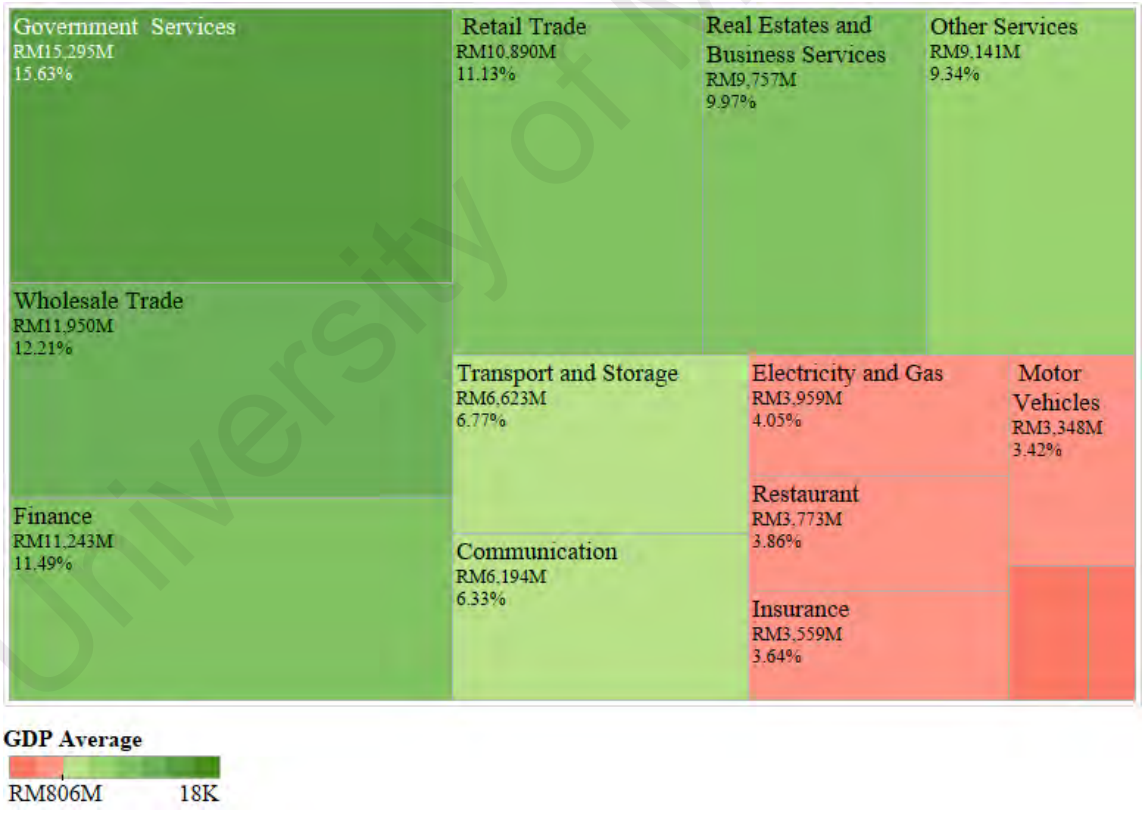

Figure 3.2: Average contribution of service sub-sectors to Malaysia's service GDP, 2005 - 2014

Source: Computed from Bank Negara Malaysia.
Notes: The figure represents the average of GDP over the ten years (2005-2014) for all service sub-sectors.
Size and color saturation show the average of GDP related to each subsector.
GDP is deflated to 2010 constant price using GDP deflator.

Although Figure 3.2 identifies the major contributors to service sector, the annual GDP growth[12] of the sub-sectors helps further to delineate the effectiveness of government financial plans related to finance and insurance sub-sectors and provides a comparison with other sub-sectors. As Table 3.1 shows, the insurance sub-sector recorded 16.69 per cent GDP growth in 2012 compared to a fall of -3.30 per cent in 2007. However, the growth of the insurance sector dropped sharply to 3.42 per cent in 2013 followed by a slight decrease in growth in 2014 (2.74 per cent). It is apparent that the Asian financial crisis negatively affected the service industry since the GDP growth rates of insurance, finance and other sub-sectors have been more subdued since the boom year of 2009.

Table 3.1: Annual GDP growth of Malaysia's selected service sub-sectors

Sub-Sector	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Insurance		-0.29%	-3.30%	3.41%	8.19%	2.16%	4.25%	16.69%	3.42%	2.74%
Finance		8.52%	8.27%	-0.16%	11.29%	3.46%	-2.62%	5.95%	3.13%	1.20%
Government Services		8.01%	10.02%	7.18%	10.10%	2.04%	7.45%	16.55%	6.07%	4.29%
Communication		4.04%	1.66%	-2.94%	13.08%	6.74%	3.66%	8.91%	9.82%	7.92%
Real Estates and Business Services		4.71%	7.60%	1.15%	12.83%	4.87%	1.63%	8.13%	8.76%	6.59%
Wholesale Trade		8.10%	8.98%	7.98%	1.85%	6.93%	12.05%	4.97%	6.69%	11.15%

% Difference in GDP

-3.30% 16.69%

Source: Computed from Bank Negara Malaysia.
Note: GDP is deflated to 2010 constant price using GDP deflator.

In the 1990s, provision of authoritative guidance, market conduct and a reinforced regulatory framework were applied to boost the professional standards in the insurance sector and customer assurance (BNM, 2001). Following the changes, the insurance GDP growth has shown a fluctuating trend in recent years, as has the finance industry generally. Figure 3.3 shows the growth rate of insurance and finance during the base year of 2005 to 2014. The trend lines draw a clear picture of growth movement during the study period. The finance sub-sector, including banking and other financial institutions show a

[12] The GDP growth of a sector/sub-sector refers to the growth of sector's/sub-sector's contribution into the national GDP.

downward trend line in growth while the insurance sector exhibits an upward trend line - an indication of the insurance sub-sector's high future growth potential. The spectacular jump in growth of the insurance sector in 2012 may be due to the new liberalization measures introduced in 2009. However, the GDP growth of insurance sector as well as the finance was substantially lower in 2013 and 2014.

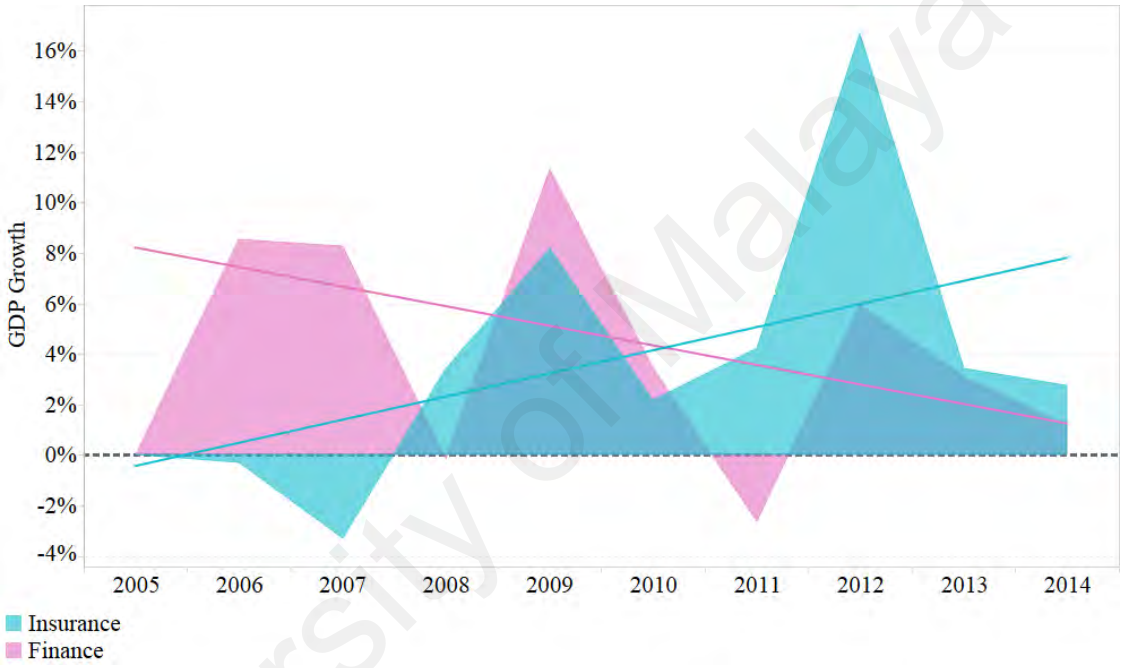

Figure 3.3: GDP growth of insurance and finance sub-sectors

Source: Authors computed from Bank Negara Malaysia.
Notes: The area within the chart compares the GDP growth of insurance and finance sub-sectors along with their trend lines through the years.
GDP is deflated to 2010 constant price using GDP deflator.

Despite the insurance sector's marginal contribution to the total national GDP, Malaysia's economic development owes a lot to the insurance sector as one of the most important supporting sources to the economy. The importance of insurance originates in its ability to provide a financial shield for the insured, which could cover variety of life, non-life and business matters. Under Malaysia's commitment to the WTO, the government is gradually removing its protection of services in order to have a more liberalized economy. Increasing competition derived from a highly liberalized

environment poses a challenge to the insurance sector to operate efficiently when facing rivals from advanced economies.

3.3 THE IMPORTANCE OF THE INSURANCE SECTOR

The importance of the insurance sector depends on the economic, social and political condition of its country of residence. However, promoting the insurance sector is a praiseworthy policy for a country because this sector will smooth the running of the economic development engine. Skipper and Barfield (2001) mention seven categories of insurance contributions to economic growth. Firstly, insurance sector help stabilize the financial conditions of individuals and businesses. In the presence of insurance, insured parties who suffer from loss will be indemnified from the accumulated pool of funds. An individual that is not insured has to seek for help from his/her family members, friends or government to recoup his/her loss. The situation is typically worse for an organization where the amount of uninsured losses may be very large and threaten business failure. Accordingly, failure not only affects the business but also the wider economy given resulting unemployment, reduced business for suppliers/customers and no tax revenues for government. Second, the insurance can be a good substitute for government security programs. The government's social welfare systems acts as a sort of life insurance businesses, however, it is argued that the quality of the systems would be enhanced if individuals could tailor the programs according to their preferences. Third, insurance can act as the catalyzer for business transactions. Nowadays, without a proper insurance policy, there is no market for certain products due to high risk of failure. Fourth, insurance can act as a useful channel for people's savings to be directed into investments. Therefore, insurance boosts the efficiency of the financial system through reducing the transaction cost, enhancing the liquidity, and facilitating the investment opportunities. Fifth, insurers have expertise in managing risk more efficiently. In fact, the primary requirement for an

insurer is risk pricing - that is the evaluation of potential losses by individuals or businesses. Sixth, insurance promotes loss mitigation through providing promotion policies to individuals and businesses to reduce the possible losses. Lastly, insurance promotes efficient capital allocation. For the purpose of their own safety, insurers gather and closely scrutinized a companies' information, and can, therefore, indirectly signal the market views about the health of a company's balance sheet, and ultimately lead to more efficient allocation of financial capital.

3.3.1 The Insurance market worldwide

Generally, bigger economies have larger insurance markets. Moreover, the structure of insurance market is tied to different environmental factors affecting the whole economy. Therefore, the insurance market of a specific country aims to feed the needs of its local market. Put differently, the supply and demand of insurance policies shape the structure of the insurance market. Factors such as cultural divergence, social conditions, financial status and the price of policies can strongly affect the demand of insurance products. Moreover, previous studies highlight the influence of national per capita income on insurance demand (Skipper, 1998). However, as mentioned by the same author, the income elasticity of insurance is usually more than one, meaning that the premium income tends to increase at a higher rate compared to gross national income. Obviously, higher income economies generate more income premiums in both life and non-life insurance policies. People in lower income economies are more engaged with basic needs rather than purchasing insurance for various types of protection.

It is therefore useful to make a comparison of premium proportions in global regional economies. The following stacked bar chart shows the proportion and the magnitude of total premiums of life and non-life policies in each regional market in 2014. Substantial regional diversity is obvious between the life and non-life segments, as Figure 3.4

suggests. The chart shows the dominance of life insurance premiums in advanced and emerging Asian markets, reflecting the tendency of Asians to invest through life insurance policies. However, the magnitude of life premiums, shown by the thickness of each bar, is more than twice that of emerging Asia. Indeed, the life insurance segment of advanced Asian markets is even larger than the North American life insurance market where advanced nations include the United States and Canada. Life insurance markets in Africa, Western Europe and Oceania account for more than 50 per cent of total premiums. The magnitude of Africa's market is small because of its high number of poor counties while Oceania's small premium proportion is because there are few countries in the region. Adding to that, Africa's proportion of life and non-life insurance premiums could be biased since South Africa accounts for 75 per cent of total African insurance market and 82 per cent of life insurance premium (Swiss RE, 2014). The political instability and high inflation rate hinder the growth of insurance in Latin America and Middle East, especially in the life insurance segment. However, Latin American countries such as Brazil and Mexico have been catching up more recently. The magnitude of Latin American and Middle East markets are very small due to their low-income economies. Western Europe, where the high-income economies reside, has the highest insurance premium with almost 60 per cent for the life insurance segment.

The premium breakdown sheds some light on the insurance purchasing power of various regional economies. It is apparent that the stronger the economy the bigger is the insurance market. The tendency of Asians to purchase more life protection plans also highlights the growing standard of living in the region.

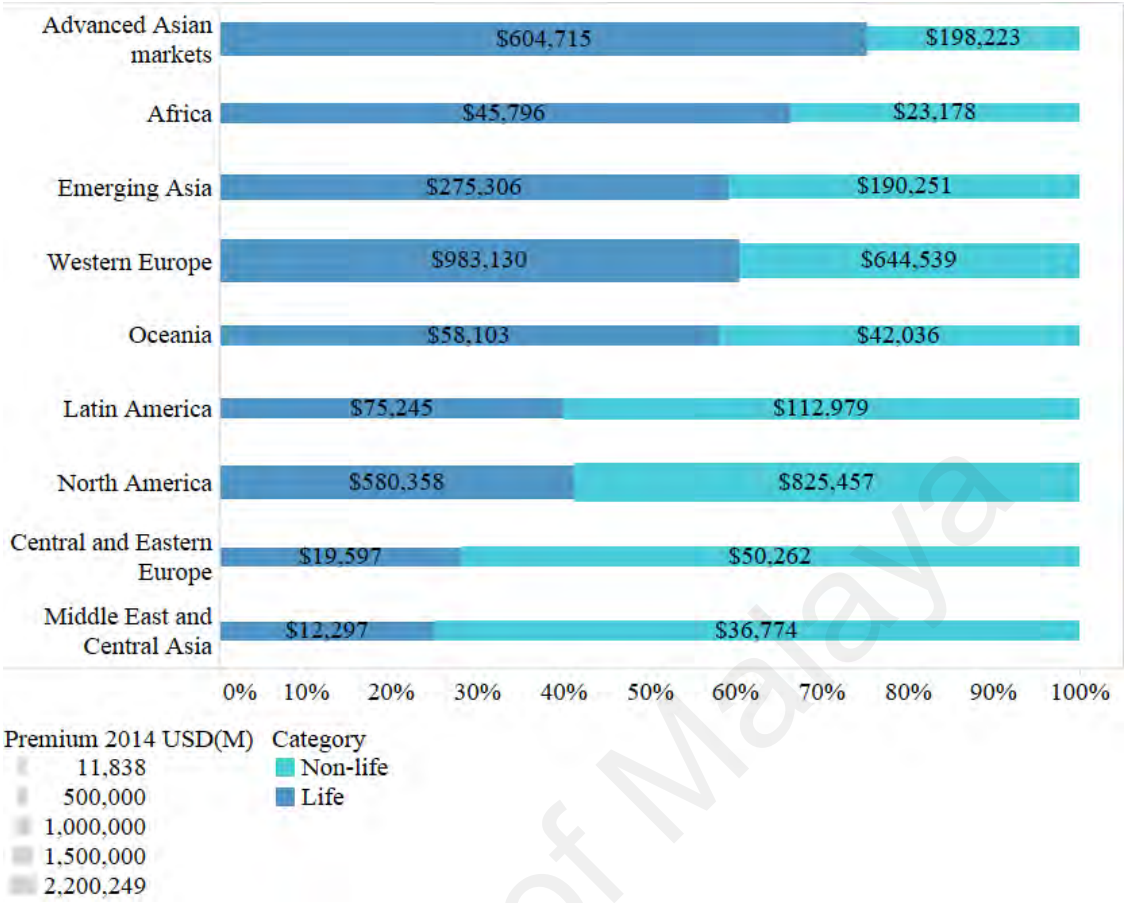

Figure 3.4: Life/non-life premium proportions worldwide, 2014

Source: Computed from Swiss RE (2015).
Notes: Color shows the category of premium in 2014.
Size shows the magnitude of premium.

As reported by Swiss RE (2015), the inflation-adjusted world premium growth has improved from 0.1 per cent in 2013 to 3.7 per cent in 2014. Figure 3.5 presents the real premium growth in 2014 around the globe. The advanced markets in North America show a positive real premium growth in 2014. Surprisingly, insurance sectors in Latin American countries perform satisfactory, which confirms the high potential of the market for future development. European markets seem to be saturated with a few countries showing negative growth rates such as Spain and Netherlands. Additional growth can only be attained via product diversification and improvements, gains in market share or increase in consumer demand. The South East Asian and Oceania insurance markets show energetic growth in which the Philippines, Vietnam and Australia achieved growth rates

above 10 per cent. Middle Eastern countries are also growing at positive rates, signifying the potentiality of these emerging markets in the future.

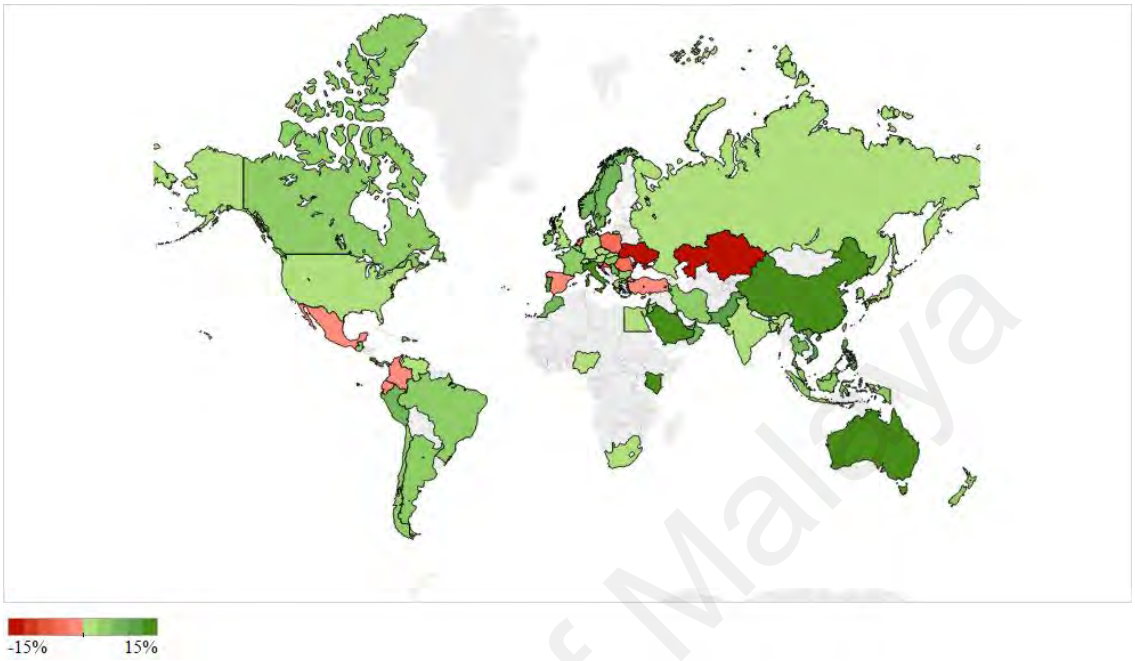

Figure 3.5: Real premium growth, 2014

Source: Computed from Swiss RE (2015).
Notes: Color shows the magnitude of premium growth in 2014.
The data are inflation adjusted for all countries.
No data available for colorless countries.

Figure 3.6 shows the scatter plot of real GDP growth and real premium growth of 75 countries. The plot depicts sporadic dots for both life and non-life above and below the equal GDP growth line. In total, 63 per cent (53 per cent) of life (non-life) insurance markets gained premium growth that is above GDP growth. This result indicates that the insurance markets above the equal GDP line are increasing their penetration of the economy. A number of European countries are suffering from declining premiums faster than economic activity such as Netherland, Spain, Switzerland. On the other hand, Asian insurance markets have expanded more rapidly than GDP growth indicating the high potential of these markets.

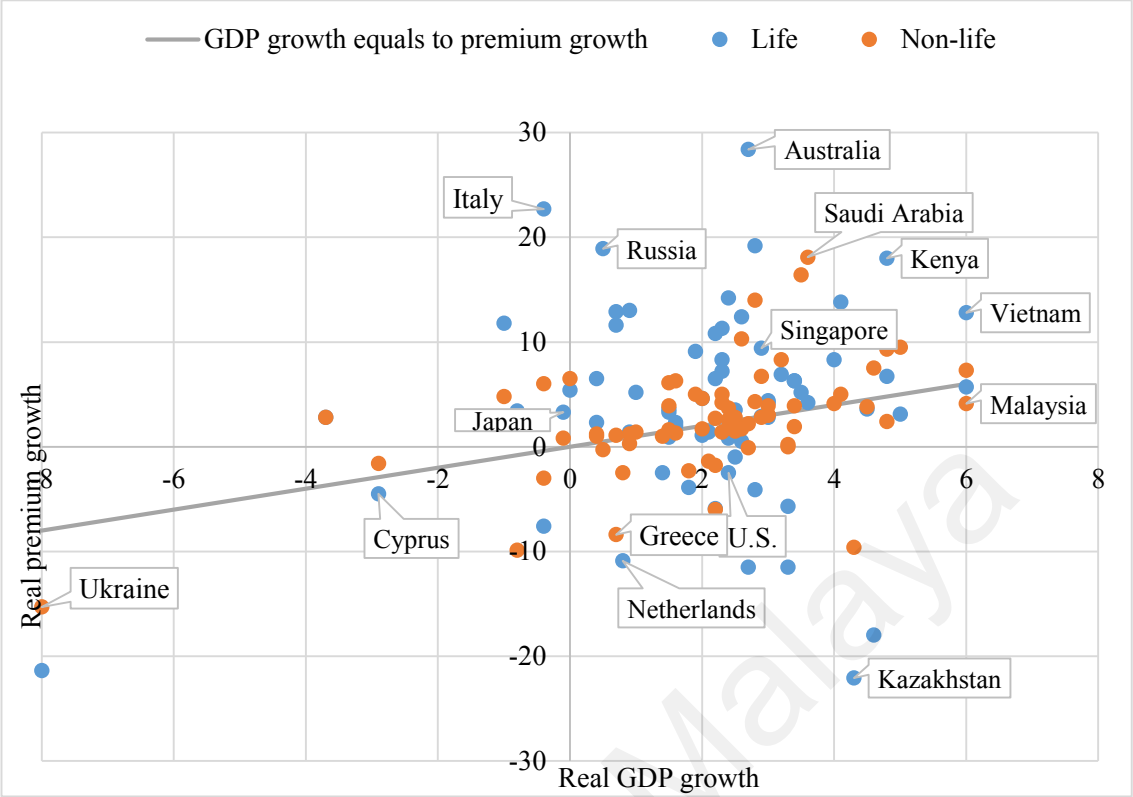

Figure 3.6: Life and non-life premiums and GDP growth in worldwide insurance markets, 2014

Source: Computed from Swiss RE (2015).
Note: The data are inflation adjusted for all countries.

3.3.2 Position of the Malaysian insurance sector internationally

The above analysis provides a general understanding of insurance markets worldwide. In this section, the Malaysian insurance market is compared with those of other countries. There exist two important indicators, namely, insurance density and market penetration rate, which can provide us with more impartial comparisons between the insurance markets. While the market penetration rate represents the percentage share of insurance premium in the nation's GDP, the insurance density describes the level of insurance premium per capita. Obviously, Malaysia is not a competitor to the world's advanced markets as indicted by the relatively low insurance density in both life and non-life markets (Figure 3.7). Thus while Malaysia's insurance density is notably higher than ASEAN average, it is still lower than the world average by USD 138. In terms of contribution to national income (market penetration rate), there is much room for

improvement in the Malaysian insurance market. Advanced markets in Asia have recorded approximately 11 per cent penetration on average led by Taiwan (14 per cent), South Korea (11 per cent) and Japan (11 per cent). However, the United States, known as having one of the most advanced insurance markets, recorded a 7 per cent market penetration in 2013, considerably less than that of many other of the world's advanced markets.

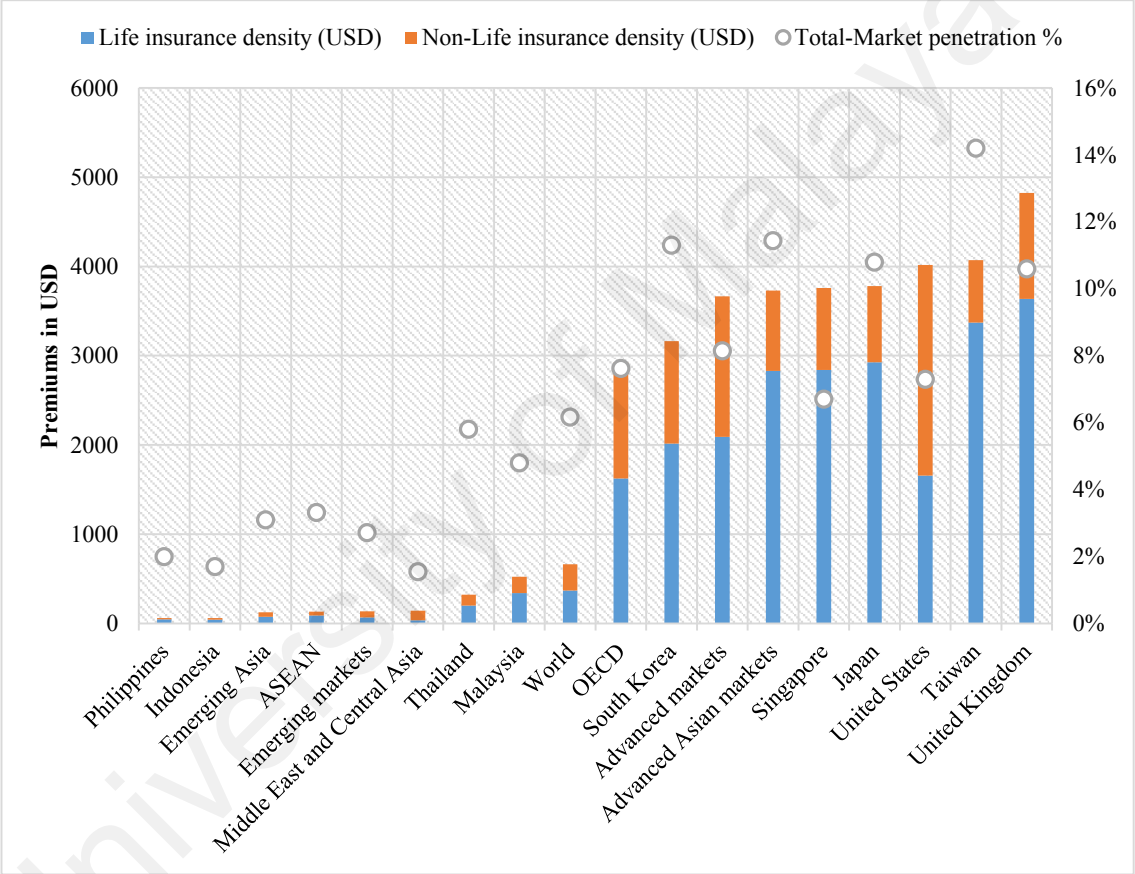

Figure 3.7: Insurance density and market penetration rate in world markets, 2014

Source: Computed from Swiss RE (2015).

A wide gap between advanced and emerging insurance markets is graphically illustrated in Figure 3.7. This shows that Malaysia's insurance market has performed comparatively better than that of emerging Asian markets as well as those of the Middle East and Central Asian markets (Figure 3.8). In terms of tapping into national income, Malaysia still lags the world average by around one per cent. Interestingly, Thailand has

surpassed Malaysia in terms of market penetration but not insurance density. Philippines and Indonesia are relatively underdeveloped compared to other ASEAN members.

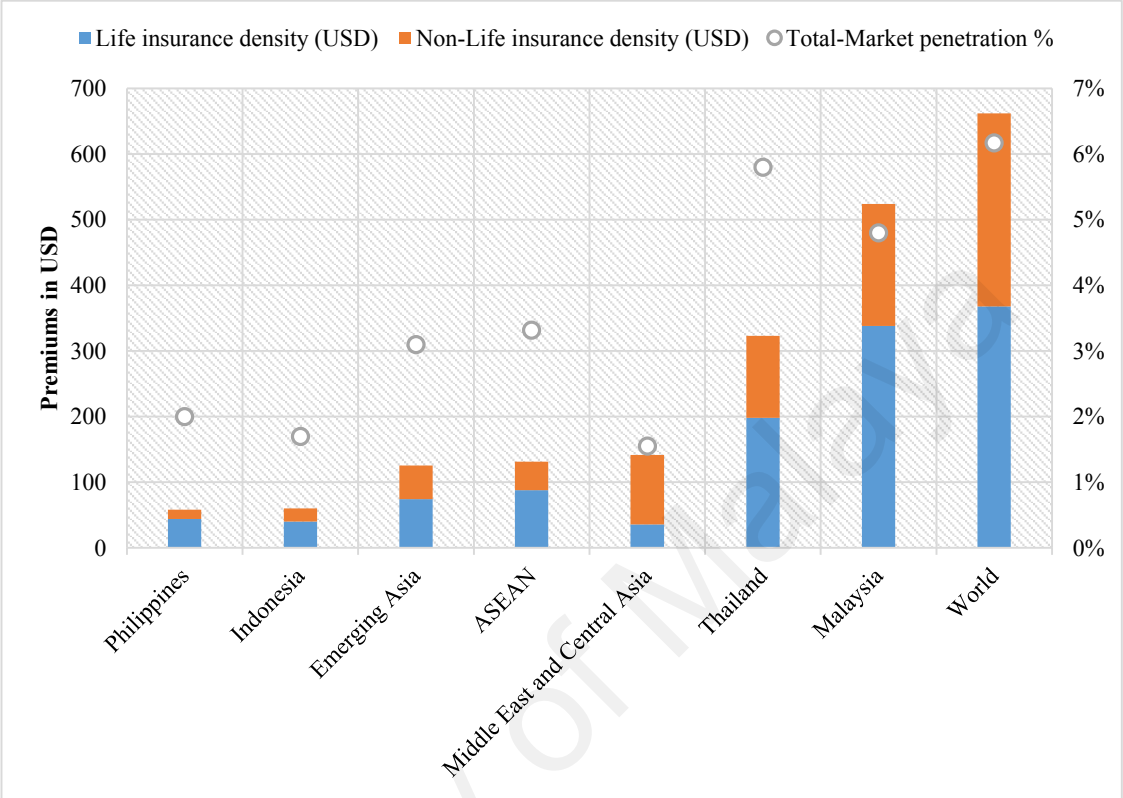

Figure 3.8: Insurance density and market penetration rate in emerging markets, 2014

Source: Computed from Swiss RE (2015).

Compound annual growth rate (CAGR) measures the growth over multiple periods. Although CAGR assumes compound growth, it is an appropriate measure for the time period. Insurance sectors around the world have experienced stable growth in the years 2005 to 2014 which is graphically illustrated in Figure 3.9. It shows the low CAGR of the advanced insurance markets which had high growth well before 2005. This indicates that a mature market cannot be expected to continue to grow at a high rate. On the other hand, Philippines, Indonesia and Thailand are shown to have relatively higher CAGR especially for the life insurance segment. This reflects the increase in quality of life in these countries in tandem with higher income per capita. For its part Malaysia has steadily expanded its insurance market. Both life and non-life insurance segments have had a CAGR of nearly

7 per cent during 2005 to 2014. This in turn reflects Malaysia's rapid pace of economic development, rising income levels and living standards.

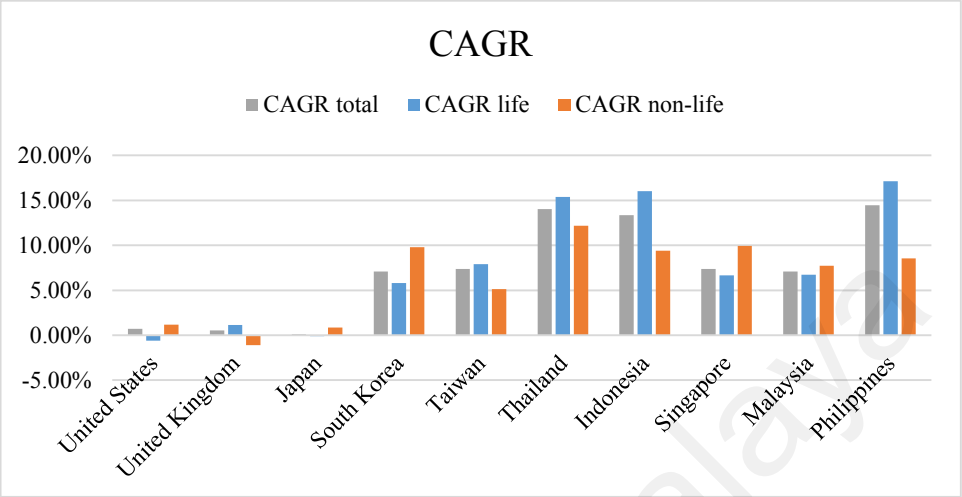

Figure 3.9: CAGR for insurance premiums per capita, 2005 - 2014

Source: Computed from Swiss RE (2006) and Swiss RE (2015).

3.4 STRUCTURE OF THE MALAYSIAN INSURANCE SECTOR

The insurance sector of Malaysia is divided into two main categories, life and non-life or general (hereafter general insurance). A company licensed under the Insurance Act 1996 may carry on life or general insurance business or both life and general or composite insurance business (hereafter composite insurance). Under the Financial Service Act (FSA) 2013 discussed in section 3.5.2, composite insurance businesses are not allowed in Malaysia. However, there are few composite insurers operating currently, and their decomposition will not occur immediately. Meanwhile, the Islamic financial market has made the takaful–Islamic insurance– a fast-growing part of the sector during 2007 to 2009, although its growth has cooled more recently (BMI, 2013). The contribution of the takaful sector is 8.4 per cent of total conventional insurers and takaful operators (BNM, 2013c). Figure 3.10 shows the changes in number of insurers for the period of 2005 to 2014. The number of general insurers has decreased from 26 to 19 during this period.

Particularly after 2009, the structure of the general insurance segment has become less fragmented through a number of merger and acquisitions.

The life insurance segment has not seen significant changes but the number of composite insurers has decreased from nine to five. As the new Act has been implemented (FSA), the composite insurers are no longer allowed in the Malaysian insurance sector and have to be divided into two separate businesses, life and general. Therefore, in this chapter, for the purpose of consistency in using the aggregate data provided by BNM, we discuss the two main businesses, life and general. This is possible given BNM has segregated and assigned the financial information of composite insurers into life and general segments.

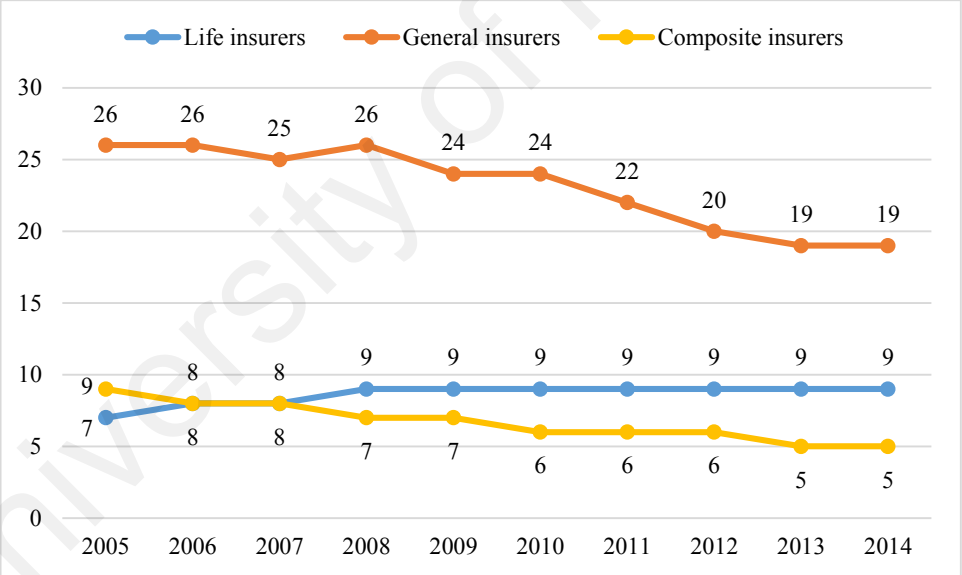

Figure 3.10: Changes in number of insurers, 2005 - 2014

Source: Computed from Bank Negara Malaysia.
Notes: Exclusive of insurers which were running off their insurance businesses.
Life insurers: AXA Affin Life Insurance Berhad; Allianz Life Insurance Malaysia Berhad; AmMetLife Insurance Berhad; Gibraltar BSN Life Berhad (formerly known as Uni.Asia Life Assurance Berhad); Great Eastern Life Assurance (Malaysia) Berhad; Hong Leong Assurance Berhad; Manulife Insurance Berhad; Sun Life Malaysia Assurance Berhad; Tokio Marine Life Insurance Malaysia Berhad.
General insurers: ACE Jerneh Insurance Berhad; AIG Malaysia Insurance Berhad; AXA Affin General Insurance Berhad; Allianz General Insurance Company (Malaysia) Berhad; AmGeneral Insurance Berhad; Berjaya Sompo Insurance Berhad; Danajamin Nasional Berhad; Lonpac Insurance Berhad; MSIG Insurance (Malaysia) Berhad; Multi-Purpose Insurans Berhad; Overseas Assurance Corporation (Malaysia) Berhad; Pacific & Orient Insurance Co. Berhad; The Pacific Insurance Berhad; Progressive Insurance Berhad; QBE Insurance (Malaysia) Berhad; RHB Insurance Berhad; Tokio Marine Insurans (Malaysia)

Berhad; Tune Insurance Malaysia Berhad; Liberty Insurance Berhad (formerly known as Uni.Asia General Insurance Berhad).
Composite insurers: AIA Berhad; Etiqa Insurance Berhad; MCIS Insurance Berhad; Prudential Assurance Malaysia Berhad; Zurich Insurance Malaysia Berhad.

Figure 3.11 compares the net premiums of life and general insurance segments showing the incremental upward trends for both. Noted is that the life segment experienced a decline in 2008. Clearly shown are the breaking points for both general and life insurers at year 2010 where the net premiums surpass the average lines. Afterwards, the net premiums hold increasing trends for both segments until the end period.

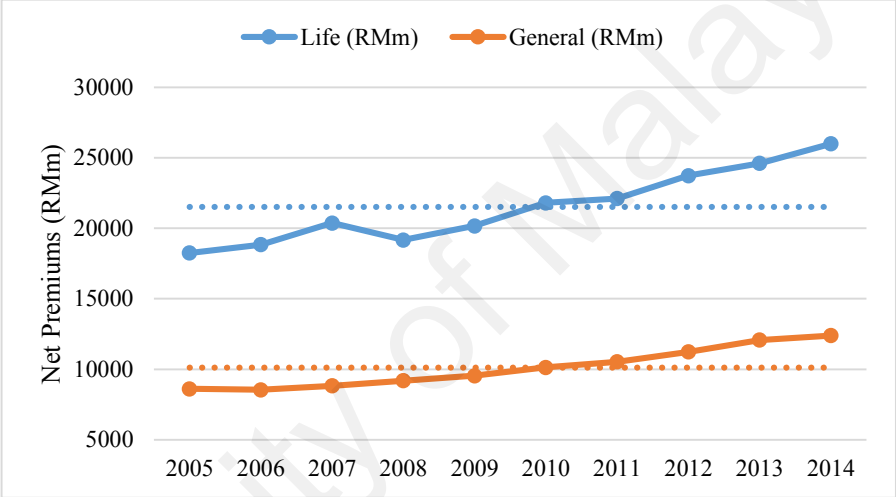

Figure 3.11: Net premiums for life and general segments

Source: Computed from Bank Negara Malaysia.
Note: Net premiums are deflated to 2010 constant price using CPI.

3.4.1 The general insurance segment

As of 2014, there were 19 general insurers in Malaysia (Figure 3.10). Similar to other financial subsectors, the liberalization has intensified the competition in a market where the top five general insurers accumulated about 50 per cent of net premiums in 2014[13]. This consolidation has been the inevitable product of the enhancement of the competitive power of the major players using their economies of scale against the rivals (MARC,

[13] Computed from insurers' annual report.

2010). Therefore, small insurers have become attractive targets for foreign insurers in light of higher foreign equity limits granted in 2009. For example, the general insurance segment has witnessed a number of mergers and acquisitions recently. Among them, PanGlobal Insurance Berhad (local) was acquired by Tokio Marine Insurans Malaysia Berhad (foreign) in 2009; Zurich Insurance Malaysia Berhad (foreign) announced the completion of its acquisition of Malaysian Assurance Alliance Berhad (local), a Malaysian composite insurer, in 2012; AIA Berhad (foreign) expanded its business in Malaysia by acquiring ING Insurance Berhad (foreign) in 2013; The general insurance of Hong Leong Assurance Berhad (foreign) formed a strategic merger with MSIG Insurance Berhad (foreign) in 2010. It is widely expected that the insurance market will see yet further consolidations in the following years.

Figure 3.12 shows the net premiums of general insurance and Malaysia's GDP for the years 2005 to 2014. Because of the changes in the sector, the volume of net premiums is rising in tandem with the increase in GDP (Figure 3.12). Thus the number of net premiums rose rapidly throughout the period with a steep increase after 2009.

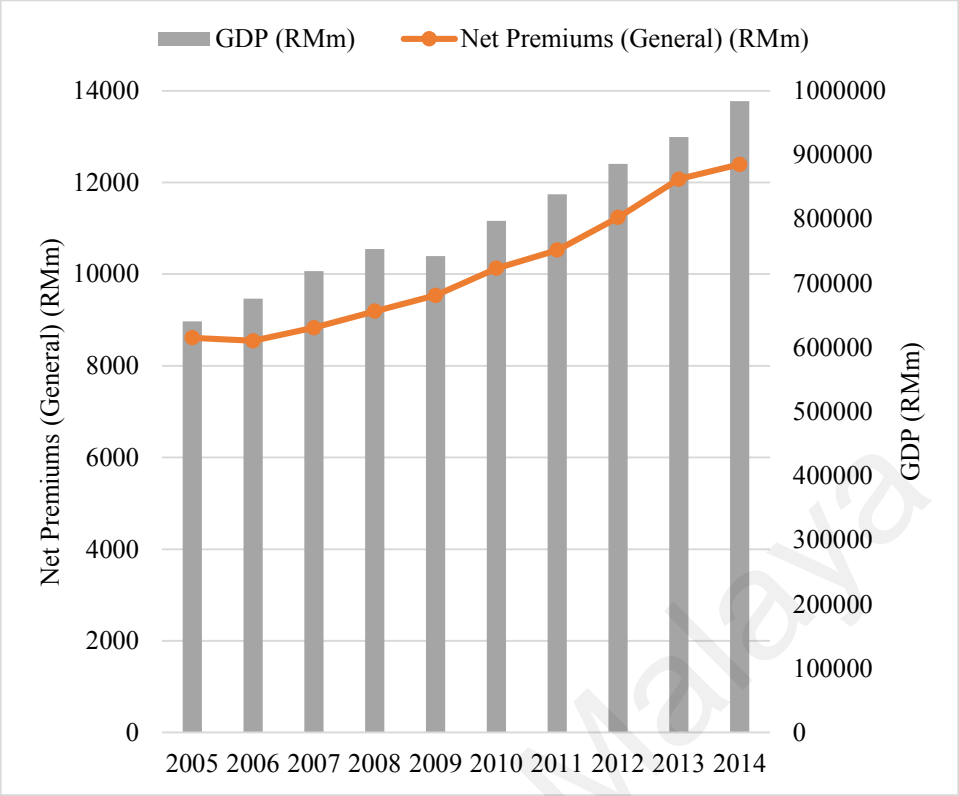

Figure 3.12: General insurance net premiums and GDP

Source: Computed from Bank Negara Malaysia.
Note: GDP and net premium are deflated to 2010 constant price using GDP deflator and CPI, respectively.

In order to visually depict the trend between net premiums and GDP, the regression line was calculated ceteris paribus. The linear equation shown in Figure 3.13 represents the relationship between net premium (y) and GDP (x) for the period under study. The regression line can be considered an acceptable estimation of the true relationship between the two where the R^2 is equal to 0.9105. This figure indicates that a greater contribution of net premium to GDP can be expected in the future.

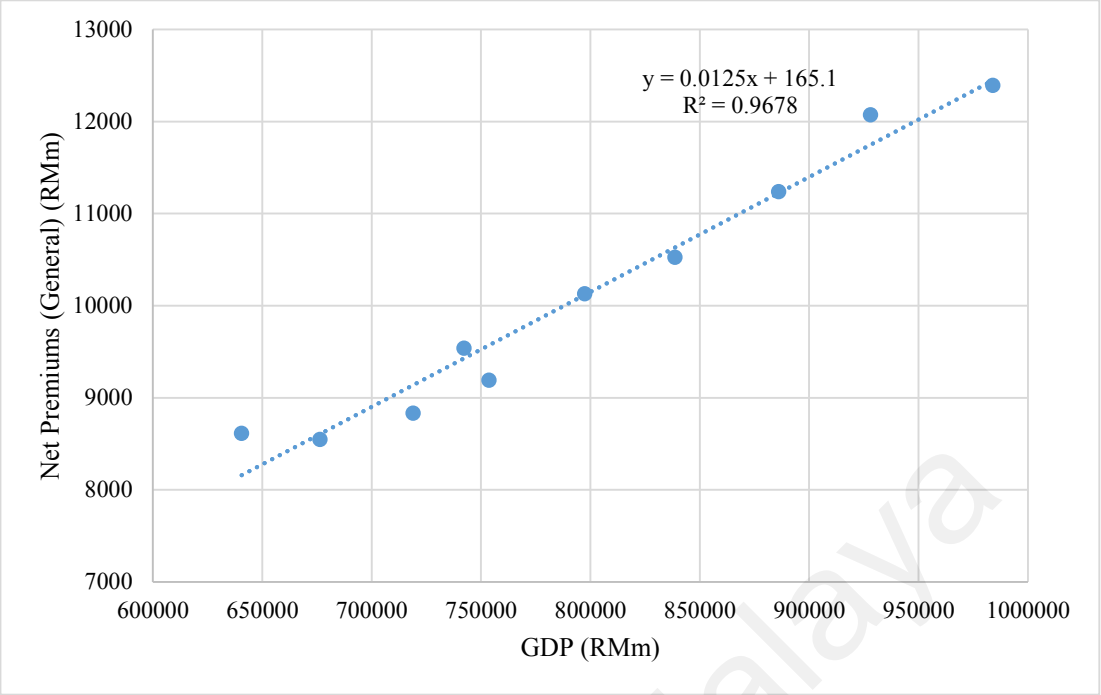

Figure 3.13: Scatter plot of net premiums and GDP

Source: Computed from Bank Negara Malaysia.
Notes: GDP and net premiums are deflated to 2010 constant price using GDP deflator and CPI, respectively. "y" represents the net premium and "x" represents the GDP.

Figure 3.14 depicts the breakdown of the general insurance segment into its various business lines for the two periods of 2006 to 2009 and 2010 to 2014. The reason for this segregation is the liberalization policies implemented in 2009 and therefore different scenarios are expected between these two periods. Indeed, there exists a remarkable difference between the average growths of the two periods for most of the business lines. In particular, the average growth rates of MAT, Fire, Motor, CAR engineering and WC and EL have considerably increased in line with the general segment average and GDP growth in the second period. On the other hand growth rates of ME and PA and Liability have decreased in the same period. Figure 3.15 shows that Motor is the main source of gross direct premiums for the general insurance segment followed by Fire and ME and PA. While the Motor and Fire are positively contributing to the growth of the general insurance segment, the contribution of ME and PA have not been strong in recent years (Figure 3.14). However, the significant contribution of Motor, i.e. more than 50 per cent

(Figure 3.15), has offset the negative contribution of other business lines, and allowed the general insurance segment to record higher growth in the second period.

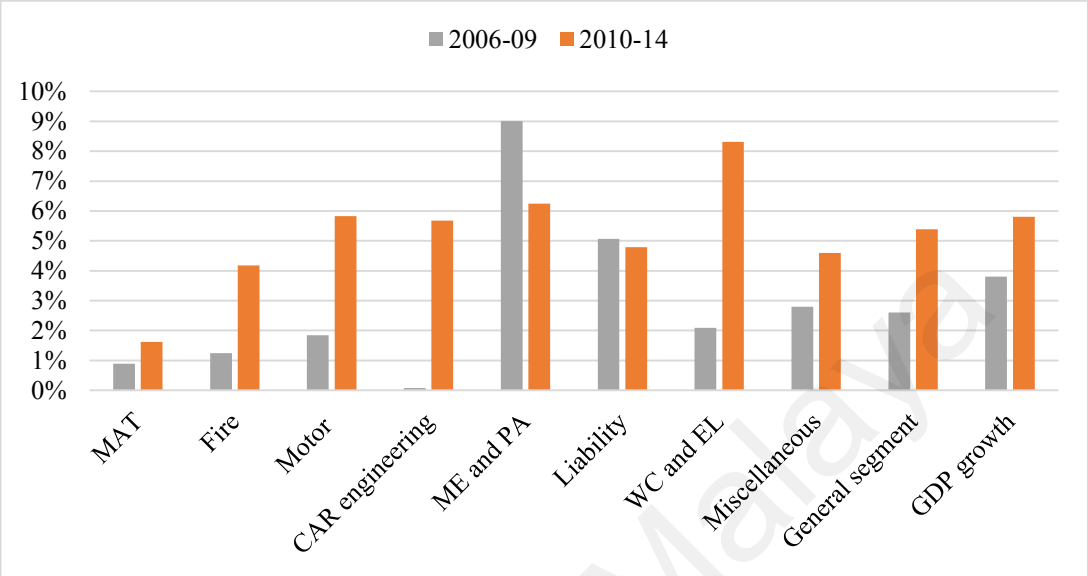

Figure 3.14: Average growth of net premiums for general insurance business lines and GDP, 2006 - 2009 and 2010 - 2014

Source: Computed from Bank Negara Malaysia.
Notes: GDP and net premiums of general insurers are deflated to 2010 constant price using GDP deflator and CPI, respectively.
'MAT' stands for marine, aviation and transit; 'CAR' engineering stands for contractors' all risks and engineering; 'ME and PA' stands for medical expenses and personal accident; 'WC and EL' stands for workmen's compensation and employers' Liability.

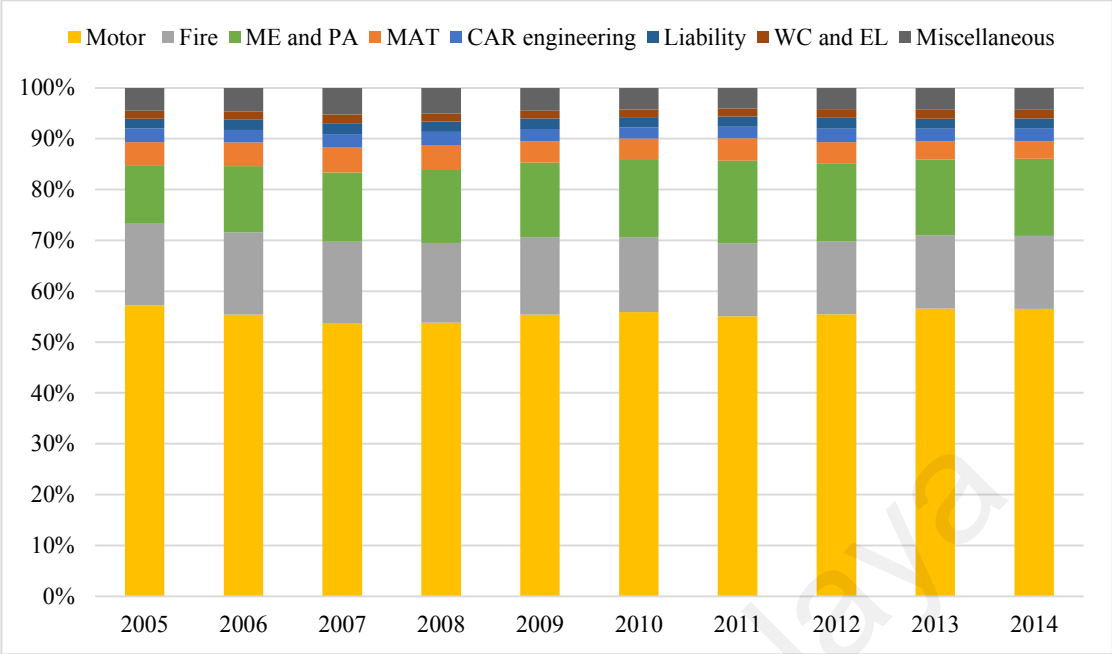

Figure 3.15: Ratio of general insurance segments to total net premiums

Source: Computed from Bank Negara Malaysia.
Note: All values are deflated to 2010 constant price using CPI.

3.4.2 The life insurance segment

Currently, nine life insurers constitute 67 per cent premium share of the total insurance sector[14], making it the largest segment in the sector. Also, the segment is one of the fastest growing life insurance market in the Asia-Pacific region (BMI, 2013). There are a number of factors explaining the successfulness of the Malaysian life insurance sector such as the government tax reduction, consumers' knowledge and understanding about the benefits of life insurance and the positive attitude towards savings by consumers (BusinessWire, 2013). As the economy develops, the income level rises and hence, the individuals' responsibility towards sound financial planning increases. Investment decisions need careful consideration to secure future financial necessities. Accordingly, Malaysians have recognized that insurance firms are attractive means of financial protection. This greater

[14] Computed from BNM data.

awareness has provided life insurers with the opportunity to tap into this high potential market. In spite of being a well-developed market, there is a substantial growth potential for the life insurance segment given those insured account for only 41.3 per cent[15] of total population in 2013.

Figure 3.16 shows the net premium of life insurance and Malaysia's GDP for the years 2005 to 2014. The fall in net premium in 2008 is clearly inconsistent with the rising Malaysian GDP. Apart from this year, the increase in net premium after 2009 is in line with the increase in the value of GDP.

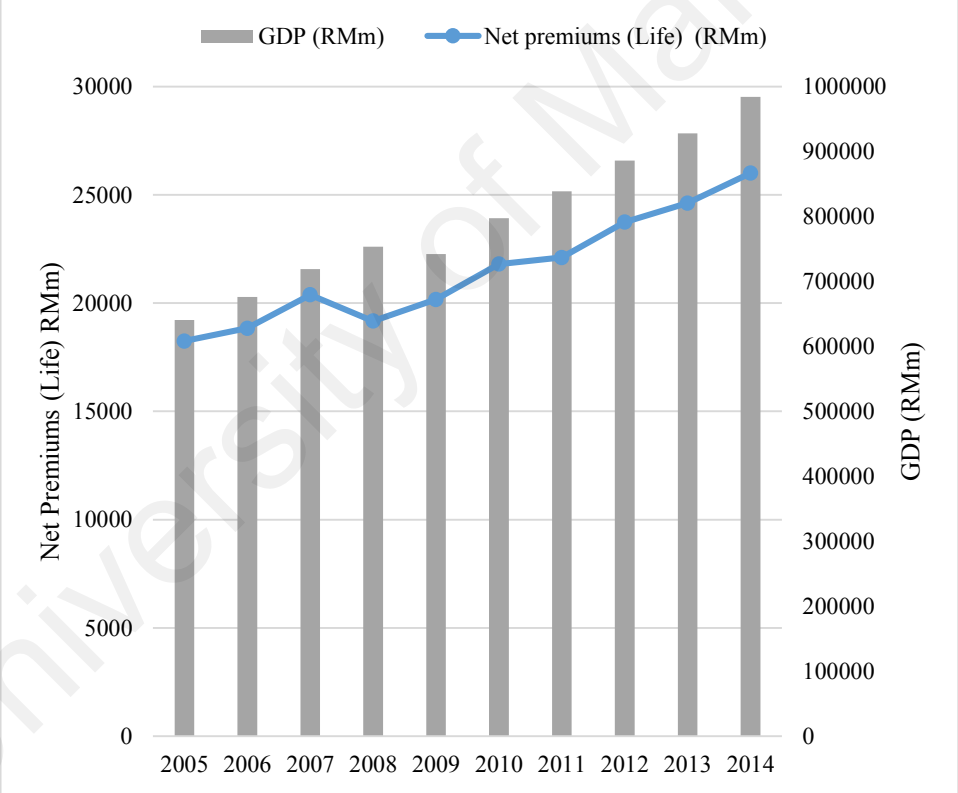

Figure 3.16: Life insurance net premiums and GDP

Source: Computed from Bank Negara Malaysia.
Note: GDP and net premium are deflated to 2010 constant price using GDP deflator and CPI, respectively.

[15] Computed from BNM data.

In line with the overall upward trend in Figure 3.16, the regression line, depicted in Figure 3.17, also suggests a positive relationship between life insurance net premiums and GDP, ceteris paribus. The value of R^2 is equal to 0.9137 signifying the validity of the model.

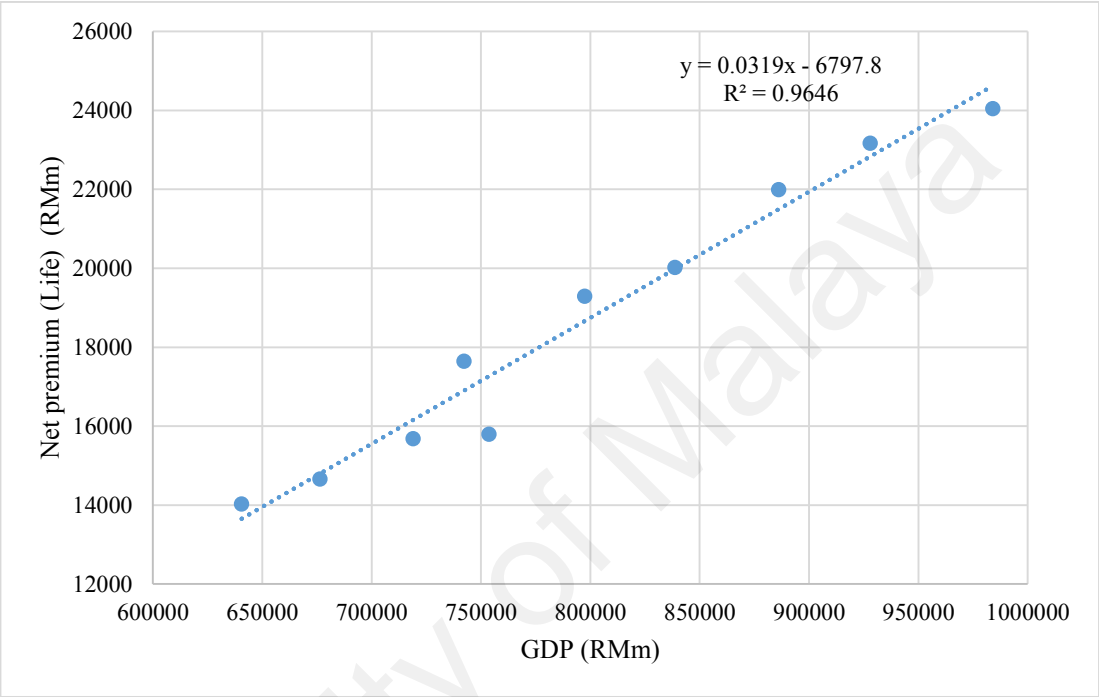

Figure 3.17: Scatter plot of life insurance net premiums and GDP

Source: Computed from Bank Negara Malaysia.
Notes: GDP and net premium are deflated to 2010 constant price using GDP deflator and CPI, respectively. "y" represents the new business total premium and "x" represents the GDP.

The periodic growth analysis of different business lines can provide a better understanding on the growth of net premiums in the life segment. Figure 3.18 indicates the significant negative growth of Whole life and Endowment in the second half (2010 to 2014). The combined contribution of Whole life and Endowment has decreased from nearly 30 per cent in 2005 to around 20 per cent in 2014 (Figure 3.19). Meanwhile, the growth of Temporary life insurance increased in the second period in line with GDP growth and the overall life segment (Figure 3.18).

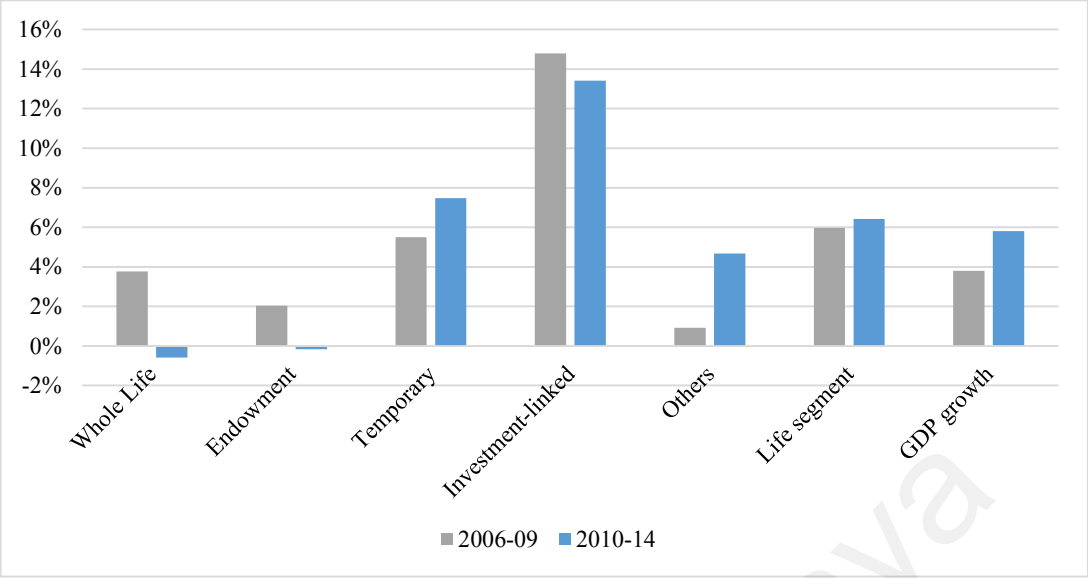

Figure 3.18: Average growth of life insurance segments and GDP, 2006-09 and 2010-14

Source: Computed from Bank Negara Malaysia.
Note: GDP and new business premiums of life insurers are deflated to 2010 constant price using GDP deflator and CPI, respectively.

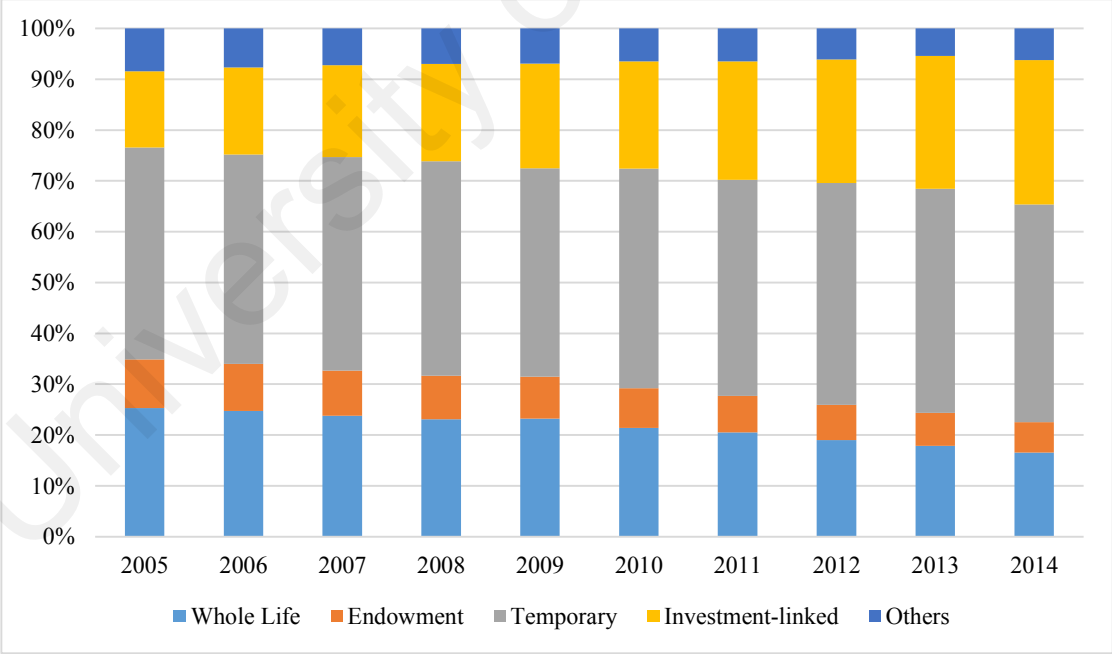

Figure 3.19: Ratio of life insurance segments to total net premiums

Source: Computed from Bank Negara Malaysia.
Note: All values are deflated to 2010 constant price using CPI.

3.4.3 Insurance density and market penetration rate

The premium values of Malaysian life and general insurance was acquired from BNM data. Due to different evaluation methods and reporting standards, there are slight differences between BNM data discussed here and the Swiss RE data discussed in section 3.3.2. However, the differences are negligible for two indicators examined.

In this section, we aim to map out the yearly trends of the Malaysian insurance density and market penetration rate for the period under study. As mentioned above, the market penetration rate represents the percentage share of insurance premiums in the nation's GDP and the insurance density signifies the insurance premium per capita.

It is expected that the contribution of the insurance sector in the economy will increase in tandem with higher economic development and standard of living. However, the market penetration rate of the Malaysian insurance sector has seen a steady and even decreasing trend over the period of study (Figure 3.20). In particularly, a drop is observable - from 4.07 per cent in 2007 to 3.60 per cent in 2008 - in the insurance sector, which is mainly caused by the decrease in market penetration of the life segment. Overall, the general segment growth is more stable (but not increasing) as compared to the life segment.

On the other hand, the higher living standard has boosted the Malaysian insurance density. Figure 3.21 clearly depicts the consistent upturn of life insurance density except for the year 2008. The premium per capita for the life segment has increased from RM 707 in 2005 to RM 835 in 2013. The general segment has also seen an increase during the period but at a slower rate.

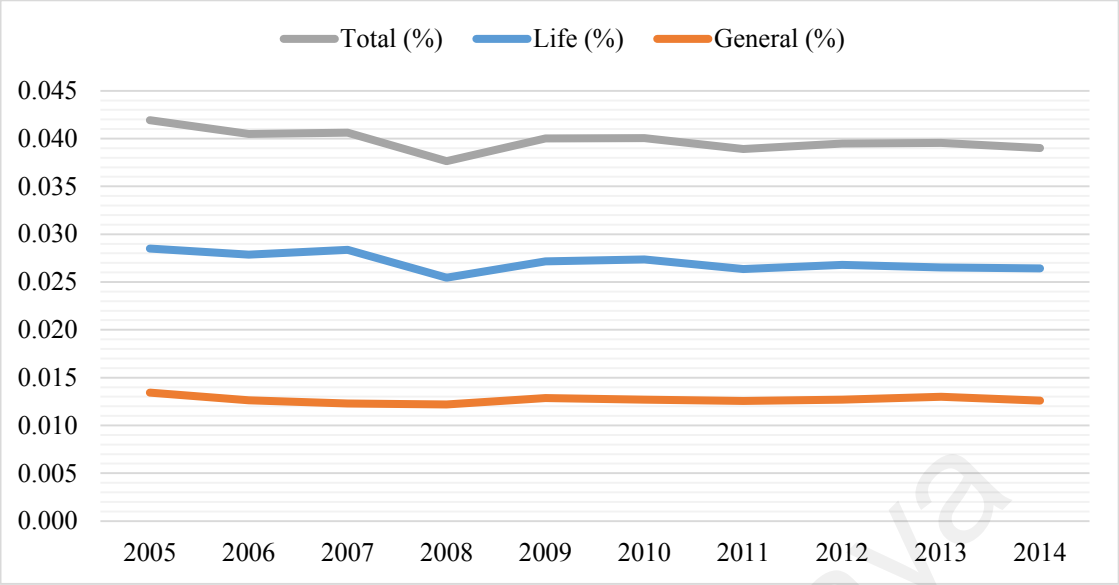

Figure 3.20: Market penetration rate of the Malaysian insurance sector

Source: Computed from Bank Negara Malaysia and World Bank data.
Notes: The line chart is the penetration rate of Malaysian conventional insurance companies only.
Values are deflated to 2010 constant price using GDP deflator and CPI.

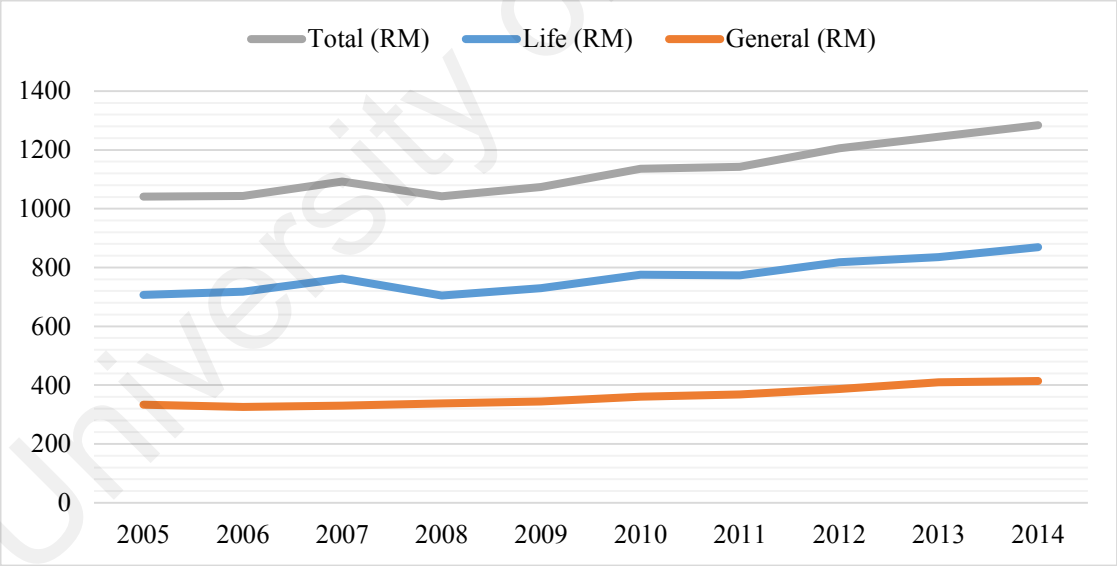

Figure 3.21: Insurance density of the Malaysian insurance sector

Source: Computed from Bank Negara Malaysia and World Bank data.
Notes: The line chart is the insurance density of Malaysian conventional insurance companies only.
Values are deflated to 2010 constant price using CPI.

3.5 REGULATORY FRAMEWORK

3.5.1 Equity ownership

Prior to the Insurance Act 1963, a number of foreign insurers were operating in the major cities and in the branches of the U.S., British and other foreign insurance companies which controlled the insurance business. Following the Act, more local firms participated in the insurance sector rising from six in 1963 to 51 in 1997 (Mansor & Radam, 2000). On the other hand, the number of foreign firms fell from 67 in 1970 to seven in 1997 (Mansor & Radam, 2000). The government has played a critical role in stimulating the participation of local insurers in the sector. In compliance with the Insurance Act 1996, only two foreign insurers were left in the Malaysian insurance market in 1999. Yet, these two companies held 45.8 per cent of total equity of insurance companies (Mansor & Radam, 2000). Today, following the new liberalization policy governing the financial sector, the number of foreign players in the market reached 26 active companies (BNM, 2013b). While foreign insurers dominate the life insurance segment, local companies have taken control of general insurance. Figure 3.22 shows how the structure of the Malaysian insurance sector has evolved to become less fragmented between 1986 and 2014. In particular, the insurance sector, excluding takaful operators, has become almost equally divided between foreign and local insurers in terms of number of insurers.

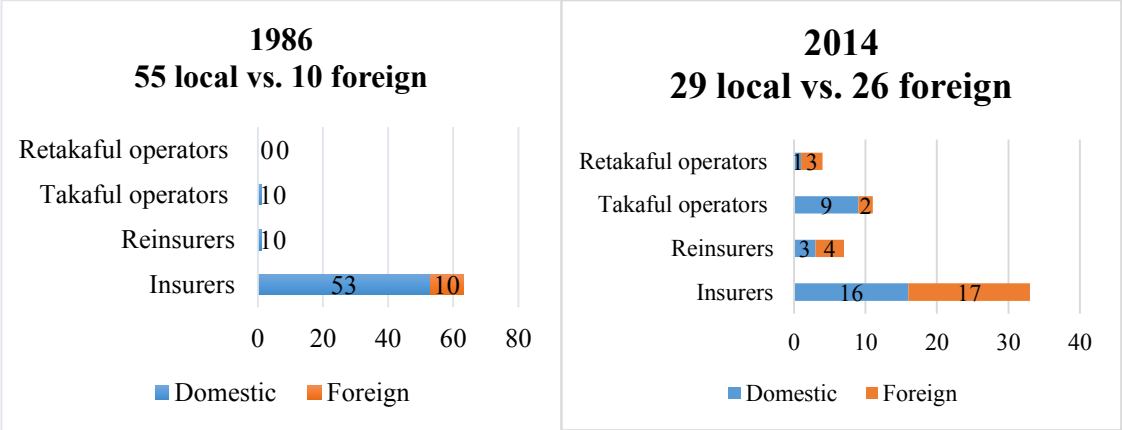

Figure 3.22: Ownership changes in the Malaysian insurance sector, 1986 and 2014

Source: Authors computed from Bank Negara Malaysia.

Foreign owners are intensively tapping into the local insurance market given they are aware of the value residing in the insurance sector (Dhesi, 2013). Simultaneously, local insurers are planning to carve a greater market share in this increasing competitive sector. Further, as a result of the growth of foreign firms, the insurance sector has realized a series of mergers and acquisitions facilitated by the government's liberalization. That is, the liberalization of financial services in 2009[16] encouraged mergers and acquisitions by raising foreign shareholding in the insurance sector (BNM, 2009). Figure 3.23 indicates the distribution of paid-up capital that is funded by a company's shareholders. It is apparent that the foreign shareholding in the Malaysian insurance market has dramatically increased from 2009 to 2013 leaving Malaysian shareholders with roughly a 30 per cent shares in 2013. However, the local participation in the paid-up capital seems to have regained its share in 2014 as compared to that of 2013.

[16] In April 2009, the government announced a liberalization plan for Malaysia's insurance sector, including the increase of the foreign equity participation threshold in insurance firms from 49 to 70 per cent and allowing foreign incorporated insurance companies and takaful operators to establish branches nationwide without restrictions.

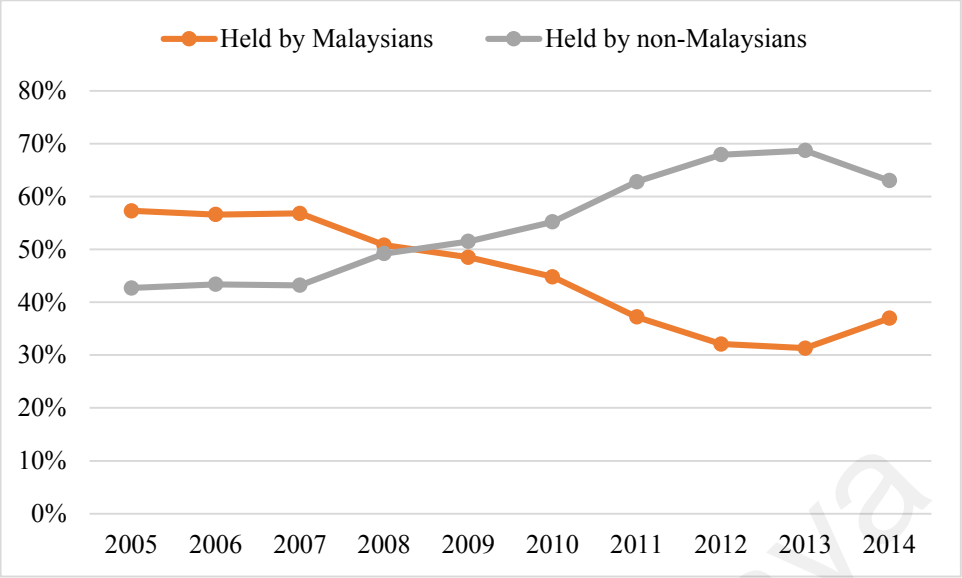

Figure 3.23: Distribution of paid-up capital of the Malaysian-incorporated insurers

Source: Authors computed from Bank Negara Malaysia.

3.5.2 Legislative Regime

In practice, BNM has supervised the insurance sector since 1988 when the insurance sector came under its control. Before 30 June 2013, the insurance industry in Malaysia had been governed by the Insurance Act 1996 (Laws of Malaysia, 1996) and the Insurance Act 1963. Recently, the FSA 2013 amalgamated several separate laws thereby governing the financial sector under a single legislative framework (Laws of Malaysia, 2013). FSA encompasses both the Banking and Financial Institutions Act 1989 and the Insurance Act 1996. There has been no major change to the licensing regime governing undertaking an insurance business. This continues to be an issue for the Ministry of Finance and BNM.

Under FSA, however, a few changes have taken place (Laws of Malaysia, 2013). First, the concept of a Financial Holding Company (FHC) has been introduced. Companies holding or proposing to hold more than 50 per cent equity in an insurance company have to apply to become a FHC, which is subject to the approval of BNM. Further, only shareholders incorporating inside Malaysia are allowed to apply to become a FHC. Second, the composite insurance business is prohibited under the new legislation. The

incumbent composite insurers have been granted the opportunity to demerge into life and general businesses. This new law will align the Malaysian insurance sector with the advanced insurance markets. Third, the legislative regime has been tightened under FSA. Following the new law, BNM has been given more power over the entire insurance businesses, including financial monitoring and managerial control. More precisely, the BNM appoints any person on its behalf to watch over the financial stability of a particular insurer, if and only if the BNM assumes that particular financial institution is at risk.

3.5.3 Deregulation and liberalization

As economists routinely argue that restrictions reduce industrial sector efficiency, many Asian countries are progressively removing regulatory controls and opening up market access toward more liberalized economies. For this reason, Malaysia has been actively pursuing a policy of liberalization and deregulation to promote efficiency and competitiveness. Undoubtedly, Malaysia's commitment to WTO has triggered this development. However, the greater competitive environment may or may not be a blessing in disguise. On the one hand, there exists substantial capital inflows into the host countries (Chan & Karim, 2011). In addition, the increased competition as the consequence of liberalization policies stimulates firms to put more active in prudent management measures such cost management, risk monitoring, and resource allocation (Gardener, Molyneux, & Nguyen-Linh, 2011). That is, opening up the economy to international investors leads to higher efficiency of firms by means of intensifying the competition within a local market. According to the seminal works of McKinnon (1973) and Shaw (1973), financial liberalization yields higher economic growth through increasing the interest rate level which in turn enhances the competition among the market players, while at the same time improving the allocation of resources. On the other hand, liberalization enhances competition, which dampens firms' profitability. Therefore,

underperforming firms will be expelled from the marketplace because lower profitability increases the risk of bankruptcy (Baik, Kwak, & Lee, 2011; Becchetti & Sierra, 2003; Bolt, De Haan, Hoeberichts, Van Oordt, & Swank, 2012). The challenge is more apparent for local firms where the lack of financial resources to back up the firm in a competitive environment, is more prominent.

Malaysia has a deep history of financial sector reforms. During 1970s, a number of financial restructuring agendas were implemented with the objective of improving the financial system. The gradual and cautious financial market liberalization in Malaysia was begun in the early 1980s. As a result, structural deregulation and prudential reregulation appeared to strengthen financial system with more stability and competitiveness (Yusof, Hussin, Alowi, Lim, & Singh, 1994). With the occurrence of the Asian financial crisis in 1997, Malaysian authorities introduced a series of macroeconomic policies such as reflationary and capital controls (Ang & McKibbin, 2007). Accordingly, a new chapter of restructuring the financial systems was launched in corporate, banking and insurance sectors.

In 1997, 51 per cent foreign equity ownership was allowed for all insurance companies. In 2001, with the promise of holding requisite minimum risk management and security systems, insurers were granted a right to offer the full range of life and general insurance products (BNM, 2004). In 2003, foreign-owned insurers with foreign shareholding not exceeding 51 per cent were allowed to open up to two new branch offices in a year (BNM, 2004). The liberalization policies continued to focus on reducing limitations on foreign equity, facilitating restrictions on branching of incumbent foreign financial institutions and issuing new licenses to foreign Islamic financial players. These liberalization measures were intended to develop an efficient and diversified financial sector (WTO, 2009).

This gradual ongoing liberalization has increased the foreign equity participation as well as producing a higher number of merger and acquisition (in order to gain the competitive advantages in the market). In April 2009, a new liberalization agenda for the financial sector was announced to strengthen Malaysia's economic inter-linkages with other economies and enhance the role of the financial sector as a key enabler and catalyst of economic growth (BNM, 2009). These liberalization policies were consistent with the objectives committed to under the FSMP issued in 2001 to develop a resilient, diversified and efficient financial sector. The liberalization package for the insurance sector encompasses two major goals; an increase in foreign equity limits and operational flexibilities. As a part of new agenda, foreign ownership limits were raised from 49 to 70 per cent. A foreign equity limit higher than 70 per cent would be considered on a case-to-case for those who could facilitate consolidation and rationalization in the insurance sector (BNM, 2009). Locally-incorporated foreign insurance companies were also allowed to establish branches throughout the country with no restrictions (BNM, 2009). Since the introduction of the new liberalization measures, the structure of the Malaysian insurance sector has changed to become less fragmented through rationalization and consolidation. Consequently, the number of direct insurers, including life, general and composite insurers, decreased from 40 in 2009 to 33 in 2013 (BNM, 2013a).

The liberalization of the sector continues to be a focus of the nation's plan under the Financial Sector Blueprint (2011-2020). No doubt, the new liberalization measures of the insurance sector served to heat up the competition among insurers and led to consolidation of some companies to gain the benefits of economies of scale in operations, underwriting, capital management and portfolio diversification (Foong & Razak, 2012). Many small companies are considered as the potential targets for takeover, particularly, by foreign-incorporated insurance companies. While the government has played a critical role in stimulating the participation of local companies in the insurance sector, foreign

insurers dominate the life segment whereas local insurers have taken control of the general segment. Apart from the favorable consequences of a competitive market, excessive risk taking by managers is seen as a major drawback that can cause economic fragilities (Ng, Chong, & Ismail, 2013). Considering the lower profitability of underperforming firms and excessive risk taking behaviors, internal managerial control has become an imperative part of a corporation's regulatory framework. In formulating internal managerial control, performance evaluation is essential for any development and improvement in corporate decision-making strategies.

3.5.4 GATS and the Malaysian insurance

The General Agreement on Trade in Services (GATS) is a part of the agreement founded by the WTO, and which established the first legally enforceable rules covering international trade in services (Skipper & Barfield, 2001). The GATS framework articulates two types of obligations; general obligations which are applied to all parties and all sectors of service and specific obligations which are applied to specific sectors in the schedules of commitments (Ling, Zainal Abidin, & Heng, 2000). The general obligations are as follows: 1) Most Favored Nation (MFN) commitment. This means that there is no privilege given to any particular party and all have to be treated equally between member countries. 2) Transparency. All the regulatory policies must be clearly disclosed by member countries. 3) Progressive Liberalization. All member countries are obliged to pursue further actions in support of ongoing liberalization policies. 4) Domestic regulations have to be in line with the progressive liberalization policies. Specific Obligations require two types of commitments to be made by a signatory government. First, market access refers to the service supply from one party to another based on four defined modes of supply including cross border trade, movement of consumers, commercial presence and movement of personnel. Examples are the number of foreign

branches of insurance companies allowed to operate in local market and the percentage of foreign equity capital participation. Second, national treatment refers to the obligations granted by a member country to other members, which are not less favorable than local service suppliers. Examples are subsidies that are reserved for local insurance companies and tax discriminatory system for local operators.

Malaysia became a signatory to GATS as of the 1995 Uruguay Round. The fundamental general obligations have been fulfilled by the Malaysian government in all sectors including financial services. However, the specific obligations have posed a challenge where there exist many limitations in regard to financial services including the insurance sector. Note that Malaysia is the European Union's second largest trading partner within the ASEAN countries. European Services Forum, ESF (2011, July) has highlighted its interest in better access to Malaysia's service sectors. Specifically, in a report published by ESF (2011), the major concerns related to finance sector are as follows:

> "Despite the encouraging signs [the liberalization measure announced in April 2009], much more needs to be achieved. Off-shore regimes and geographical limitations applied to foreign companies are archaic regulatory tools. Malaysia should remove current restrictions on branching, abolish non-prudential authorization requirements and most importantly eliminate the restrictive foreign equity caps. Off-shore regimes and geographical limitations to do business applied to foreign companies should also be removed. The country should undertake liberalization measures in the auxiliary financial services of both banking and insurance. Additionally, Marine, Aviation and Transport (MAT) insurance should be liberalized". (ESF, 2011, p. 10)

The above statement shows the concerns of Malaysia's key trade partners. In fact, because of highly protective policies in the service sector, Malaysia has been regarded as taking a defensive strategy in GATS negotiations (Shivee Ranjanee & Kaliappan, 2009). The logic for this high level of protection lies in the less competitive nature of local players in the service sector as compared to other sectors in the economy. While Malaysia has chosen the policy of gradual liberalization in the service sector to support the local operators, its development plan risks being adversely affected. In the insurance sector, the restriction on foreign equity capital, restriction on the provision of reinsurers, preferential treatment of licensed reinsurers are among the restrictive policies documented in the GATS Agreement[17]. The removal of these restrictions with a precautionary supervision could provide the insurance sector with better opportunities.

There is still room for further liberalization of the insurance sector in spite the substantial steps taken by Malaysian authorities in the last decade under the GATS commitment. However, it is apparent that the future liberalization of the insurance sector is reliant on the capacity of local insurers to compete with foreign insurers. Hence, there is need for big strides in developing the capacity and quality of local players through adequate government interventions but not tight and discriminative policies. The fear of a fully liberalized market seems to be well-founded given the marginalization of local firms is the main threat. However, the liberalization can be an opportunity if the sources of weaknesses hindering local firms can be identified. For example, higher investment in capital and human resources and lack of managerial and organizational techniques could significantly leverage the competitiveness of local insurers (World Bank, 2013).

[17] For more information, see Comité 133 (2002), ESF (2006) and World Bank (2015).

3.6 SHORTCOMINGS IN THE INSURANCE SECTOR

3.6.1 Need for a more efficient market

As BNM has reported, the insurance sector is required to move towards the international standard of best practices in regard to such issues as efficiency, stability and effectiveness (BNM, 2009). In this setting, skills and size have become the main drivers of larger efficiency, stability and effectiveness. The general aim of the Malaysian government is making an efficient, effective and stable insurance sector that props up both the advancement of national economy and the socio-economic goals of the country.

In this vein, this chapter evaluates the Malaysian insurance sector at both national and international levels. Notably, within the positive growth of the service sector in the economy, the insurance sector has shown a promising record and has a good future outlook. However, a comparative analysis shows that the Malaysian insurance market is still far from being an advanced insurance market. In particular, its insurance density and market penetration rate is lower than the world average. Thus, while Malaysia has observed a steady pace of development in its insurance market, further development of this sector needs careful study for its efficient operation in the economy.

The analysis of two insurance segments in Malaysia has provided this study with clear insights into the sector's strengths and weaknesses. This study observes an increasing trend in growing net premiums in life and general insurance segments in line with the country's GDP. Whole life and endowments are the two main weak business lines for life insurance while motor and fire are the strongest sectors for general insurance. In the life segment, the insurance density has increased because of higher income per capita and a tendency towards a higher standard of living. However the market penetration rate has declined which indicates the development of this segment is not in line with the growth

of economic activity. In a situation that the economy has gone under many deregulation and liberalization policies, market efficiency is clearly necessary for future development of the sector. Consequently solid and accurate measures of efficiency evaluations in the Malaysian context are needed to assure the future path of its development.

3.6.2 Leveraging local insurers

The recent transformation of the Malaysian insurance sector to a more liberalized state has changed the structure of life and general insurers. More foreign insurers have been involved in acquiring local insurers. In fact, this high potential sector has become a tempting target for big insurance players in the international market. The distribution of paid-up capital in the sector indicates that Malaysians are losing market share to foreign investors. Particularly, following the liberalization policy implemented in 2009, there has been a steep increase in the shareholding of foreign insurers in the market. This clearly reflects the lesser ability of local insurers to compete with foreign counterparts. No doubt, foreign insurers have accumulated value-added intellectual as well as financial resources through years of experience, which enables them to build efficiency in human capital, structural capital and physical capital. This may reflect Malaysia's current less efficient human capital due to a lack of proper training, skills, education, etc. (The World Bank, 2013). Indeed, a brain drain has been a major issue of concern in Malaysia (Cheok, Leng, Noh, Singaraveloo, & Aun, 2014; Foo, 2011). Within the insurance industry, university graduates often choose the higher salaries offered by neighboring countries or further afield (Oxford Business Group, 2012).

In Malaysia, structural transformation is therefore needed to align human capital training and education towards serving the insurance sector. Moreover, lack of financial resources provides opportunities for foreign investors as underperforming local firms become targets for acquisitions. Quick detection of the sources of inefficiency, which

might lead to business failure and deteriorating competitive capability, could provide an opportunity for government authorities to support the local insurers in different ways.

3.6.3 Precautionary supervision but not tight control

Although the above discussion has concluded that supporting local insurers is necessary to some extent, tight controls would tend to keep foreign investors away from the insurance market. In fact, the Malaysian government has used a tight control policy to maintain local shareholding in the insurance sector. Even though the liberalization policy in 2009 was aimed at opening up the market for more investment opportunities, there are still many discriminative policies in regard to the participation requirements in the insurance sector. For example, the participation of *bumiputeras*[18] is compulsory for directors, representatives and employees in an insurance business in Malaysia (SCM, 2015).

While in Malaysia, then, the insurance sector is a highly regulated sector and played a key role in stimulating the local insurers, it has not been a favorable environment for foreign incumbents and potential new entrants. The new changes have been aimed at bringing prudential regulation into the financial system. This has empowered the BNM to make more interventions, where necessary, and which go beyond the international standards (Wong & Partners, 2013 September). At the same time, the FSA undoubtedly fulfills the objectives of the BNM to strengthen the legal framework and enhance the risk management for the financial sector. Yet, the tight control policy adversely affects the bilateral service trades with other countries. This fact has appeared in some complaints from Malaysia's key partners in regard to Malaysia's non-compliance to GATS

[18] *bumiputera* is a Malaysian term to describe the Malay race.

principles. Conversely, the precautionary supervision has had to be replaced with a tighter form of control in order to yield a more efficient insurance market.

3.7 SUMMARY

Insurance markets worldwide continue to undertake pro-competitive reforms as an imperative part of development strategies. Malaysia, in a similar vein, has liberalized its insurance market, with the implementation of new measures in 2009. This change in policy, resulted in a number of structural transformations in the insurance sector that was yet to be analyzed. This chapter traced the changing structure of conventional insurance companies in Malaysia to identify the ongoing trends and shortcomings in which further development of the Malaysian insurance sector can be realized. The findings suggest that the 2009 post liberalization measure has resulted in some consolidation and rationalization within the sector. The insurance sector has become less fragmented, but segmented between local and foreign insurers. It has exposed the weaknesses of local insurers in the life segment more specifically, thereby demanding a rigorous assessment of efficiency evaluation between local insurers and their foreign counterparts.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter starts with an analysis of the theoretical foundations of insurance activities from which an insurance service process is constructed. The identification of such a framework enables the choice of the appropriate inputs and outputs for DEA analysis.

With the increased popularity of efficiency measurement analysis, and in particular DEA, such a choice is often made without considering the fundamental procedures behind the selected model. The selected model can directly influence the efficiency scores, rankings and benchmarking of DMUs. Numerous applications of the CCR model in the literature lack a systematic way of selecting a DEA model. Many of the fundamental steps in choosing an appropriate model for a particular application are not taken into account and this greatly increases the chance of wrong interpretation and possibly wrong policy recommendations. In regard to insurance studies, there has been little attention to model selection based on objectives of the efficiency analysis.

In the second part of this chapter, therefore, decision-making analysis in the insurance sector is discussed and the preliminary requirements of a DEA analysis are presented. This is followed by specification of the model chosen for this study. Next, the clustering algorithm used to group the insurance companies based on their efficiency scores is explained.

This third part of this chapter discusses the second-stage analysis. Specifically, the researcher justifies the use of an appropriate regression model and provides the models used to examine the role of determinants on insurance efficiency. Following which, a

correlation analysis between dependent and independent variables is conducted to ensure the nonexistence of multicollinearity. Finally, the sources of data are briefly explained.

4.2 INSURANCE SERVICE PROCESS

The traditional way of thinking about a production process has its root in manufacturing systems such as industrial plants. However, the service process of an insurance business denotes a special type of service but not a material good. This is why, the insurance activities are here described as service processes and not production processes. Thus, the service generation process and economic conditions of insurance hold their own distinctive properties (Müller, 1981). It is useful to examine the basic definition of insurance to fully grasp its underlying function, and which can help in the conceptualization of its service process. Pfeffer and Klock (1974, p. 3) define insurance as follows: "Insurance is a device for the reduction of uncertainty of one party, called the insured, through the transfer of particular risks to another party, called the insurer, who offers a restoration, at least in part, of economic losses suffered by the insured". This definition highlights the fundamental function of an insurance business, i.e. the reduction of risk through some forms of transfer mechanisms. However, the concept of risk transfer is just a theoretical phenomenon, it is not operational or practical to the needs of an insurance business (Müller, 1981). Flowing from the insurance definition is the identification of a process where risk transfer occurs. It is not sufficient however to state that insureds assume a certain premium in an exchange for the transfer of risk. There is a need to explain what is happening in the risk transfer mechanism. The process of operationalizing the insurance business points to the economic loss coverage (Pfeffer & Klock, 1974) and the flow of money into the insurance system from premium contributors and from the insurance system to claimants (Trowbridge, 1975). The insurance business favors the money transfer definition of the insurance arrangement (Müller, 1981). Since

the flow of money in business requires the regeneration of money through investment, the insurance and financial investment businesses are entwined. Both businesses share the same concerns of risk-return association. Notably, not only is the insurance business involved with the risk in investment activities but it is also challenged with pricing the risk through premium accumulation.

Here, the concept of the service process of an insurer relates to the business activities occurring from the beginning to the end of a defined time period. There are a number of theories trying to explain the full insurance service process. The injection of production theory into the insurance business provides only a shallow picture of insurance activities bearing in mind its nature of non-material status. Hence, management science theories, having roots in traditional production theory, cannot capture the detailed service process of an insurance business. The contribution of actuarial sciences to insurance can provide provisional risk estimation and forecasting, yet the service process is bounded to probability distributions and stochastic processes (Müller, 1981). By applying financial portfolio theory to the insurance business, an insurer is viewed as a "levered investment operation" which borrows funds by issuing risky obligations (premium accumulation) and invests part of these funds in securities (investment activities) (Biger & Kahane, 1978; Doherty, 1980). Relying on the same theoretical concept, Haugen and Kroncke (1970) assume that the insurance business, as a financial intermediary, generates capital by selling a diversified portfolio of insurance claims (capital generating opportunities) and invests the funds in a balanced portfolio of financial instruments (investment opportunities). Likewise, MacMinn and Witt (1987) consider an insurance firm to make two decisions; the first involves the process of selling a number of policies pertaining to the underwriting activities and the accumulation of the resulting premiums and the second one involves how to invest these generated funds in an investment portfolio to yield highest profit.

While the "levered investment operation" view of insurance production has received criticism[19], it appears to be the most rationally plausible view of the insurance production mechanism. From this perspective, a firm-level analysis considers the cash flow activities and views an insurance firm as a financial intermediary, which aims to maximize its profitability. The following figure represents the insurance cash flow activities as a financial intermediary entity (Brockett et al., 2004, 2005).

The role of insurance as a financial intermediary allows for the drawing up of a financial cash flow of an insurer as a fund receiver and a fund investor, chronologically. Figure 4.1 sets out the flows of fund in the insurance production mechanism.

Based on the discussion above, the following sub-sections discuss the two key divisions of the insurance service process. Additionally, the important role of time in the insurance service process is considered since the production/service process is not a static but rather an ongoing phenomenon, which continues until the termination of business activities of an insurer.

[19] It is argued that insurance activities are reduced to decisions on financial operations (Müller, 1981). However, in the same article, Müller (1981) stated that there is no single approach to define the input-output process and organizational arrangement for an insurance production process.

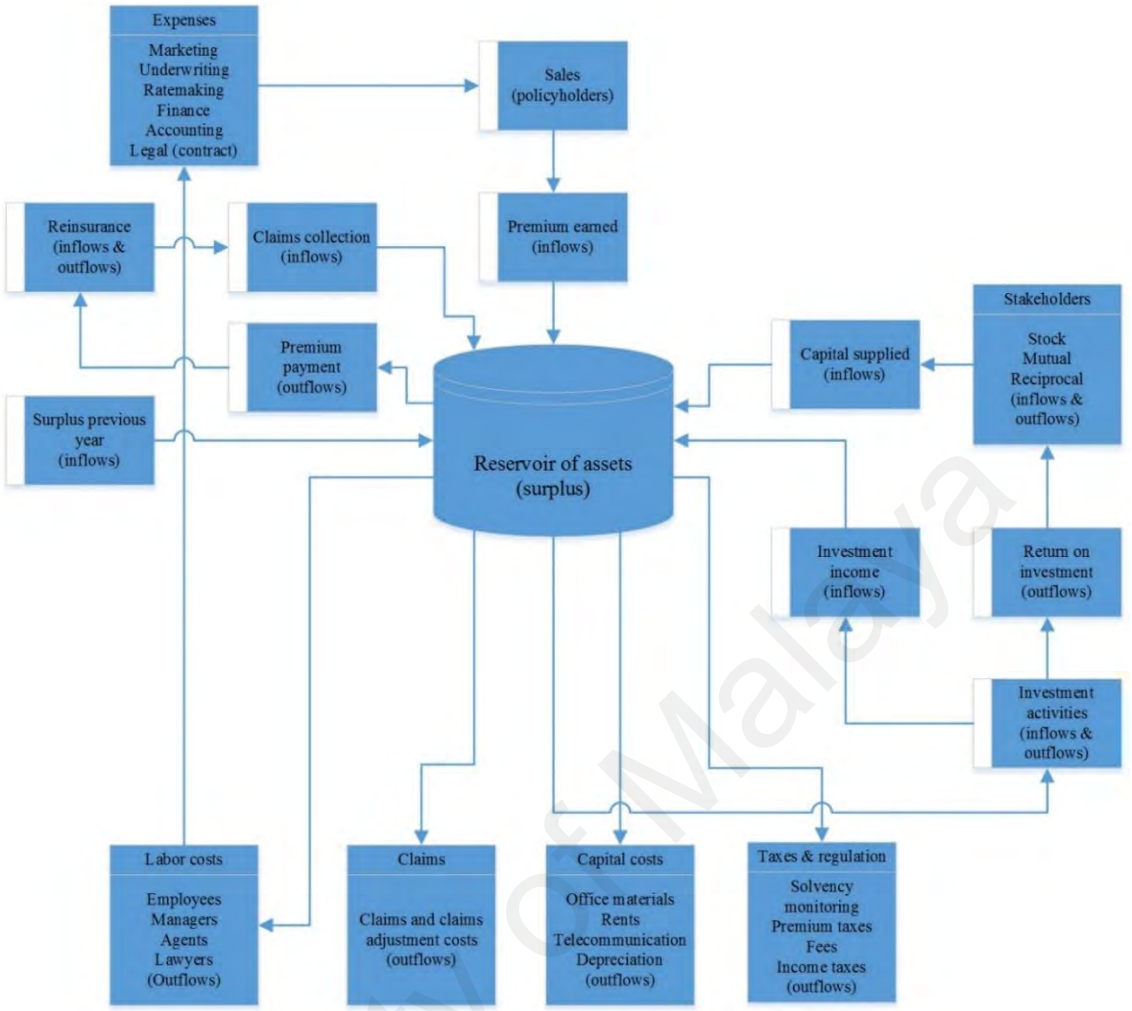

Figure 4.1: Insurance cash flow as a financial intermediary

Source: Retrieved and modified from Brockett et al. (2004, 2005).

4.2.1 Premium accumulation division

The first stage of the insurance service process involves activities to accumulate and/or generate funds. Being a financial intermediary entity, insurance business issues contingent claims to policyholders. More precisely, insurers borrow money from policyholders to feed the reservoir of assets. Ultimately, a part of borrowed funds will be returned to claimants as the cost of claims. As shown in Figure 4.1, these activities provide inflows and outflows into the same reservoir as the premium accumulation division.

4.2.2 Investment capability division

As discussed above, the second stage of the insurance service process involves the investment activities of an insurer. An insurance business uses a part of the capital accumulated from policyholders (premiums) and stakeholders (capital supplied) to purchase a portfolio of assets.

4.2.3 Time dimension

Von Lanzenauer and Wright (1977) point out that there is a need to explicitly model the interactions in insurance activities in a dynamic manner because the stationary condition is a rather a weak assumption. While the study by Müller (1981) implicitly discusses the time dimension in the insurance information model, the literature, to date, has not dealt explicitly with the issue of the time dimension in the context of the insurance service process. Particularly, there are some input factors within the service process which may not deliver their effects at the postulated time. More precisely, these factors present their lag effect in the service process. These input factors are so called carry-over inputs (Tone & Tsutsui, 2010). Moreover, the service cycle of an insurance firm (or any financial institution) is an ongoing process and not a static one. However the service process of an insurer often is evaluated in a static manner without much consideration given to the time dynamics. Hence, it is important to incorporate the evolutionary perspective[20] of firms (time dimension) into the insurance service process.

[20] In this aspect, this study incorporates the time dimension to qualify the evolutionary perspective of the firm. Refer to Hodgson (1998) for more details on the evolutionary and competence-based theory of firms. Nelson and Winter (1982) provide a detailed discussion on the evolutionary perspective and mention that "it [the evolutionary perspective] enhances a concern with irreversible and ongoing processes in time…"

4.3 FRAMEWORK FOR INSURANCE BUSINESS

Based on the discussion above, this study divides the insurance service process into two divisions, namely the premium accumulation division and the investment capability division. Therefore, the service function of insurance companies as elaborated requires series network structures consisting of two divisions, which are connected through intermediate measures. Moreover, the time dimension within the insurance service process requires the linking activities, or carry-over factors, in order to consider the dynamic nature of businesses. Hence, in regard to the performance evaluation problem using DEA, both network and dynamic structures of the insurance service process have to be placed in the same framework to deliver a meaningful conclusion, To this end, the insurance service process, in the form of an underlying DN-DEA problem, requires the identification of input, intermediate, carry-over and output factors. The following subsections discuss these issues in details.

4.3.1 Choice of input and output factors

An important step in performance evaluation is identifying the contributing factors. This issue is particularly critical for a service sector such as insurance as opposed to manufacturing sectors where physical resources produce physical products. In general, the resources used in the production/service process are the inputs and the outcomes are the outputs irrelevant to the nature of a firm (Zhu, 2014). Based on the discussion about the insurance service process, this study views an insurance business as a financial intermediary and the input and output factors are selected accordingly. In the literature, however, the production approach has been widely used, which treats a financial institution in the same way as a manufacturing company (Cummins, 1999; Cummins et al., 1996; Cummins et al., 2010). Berger and Humphrey (1997) differentiate the two approaches in identifying how to measure the performance of financial services. Under

the production approach, financial institutions are solely service providers to account holders. Under intermediation approach, however, financial institutions channel the funds between savers and investors. The production approach is suitable for evaluating financial branches or subsidiaries, while the intermediation approach is appropriate for evaluating entire financial institutions (Berger & Humphrey, 1997; Brockett et al., 2004). Having said that, the controversy over the choice of production and intermediation approaches applies to banks and financial institutions other than insurers (Brockett et al., 2004). Therefore, this study follows the financial intermediary approach in line with Brockett et al. (2004, 2005).

There are three main insurance inputs, namely labor, business services and materials, and capital (Brockett et al., 2004, 2005; Cummins & Weiss, 2013). Labor can be described as the home-office expenses. The category of business services and materials includes items such as resources used to operate the insurance business activities. At least three categories of capital can be distinguished, namely physical, debt, and equity capital. Because physical capital expenditures are a small proportion of the total, they are often lumped together with business services and materials. Insurance efficiency studies rarely utilize more than four inputs.

The selection of output quantities is associated with the insurance service process. As discussed above, the study uses the financial intermediary approach. The production approach uses the value of losses incurred as an output (Cummins et al., 1999). Brockett et al. (2004, 2005) assert that the inclusion of incurred losses as an output counters the general notion of efficiency because any catastrophic event can make higher loss-paying insurers more efficient. Instead, Brockett et al. (2004, 2005) used claim-paying abilities, the ratio of liquid assets to liability, as the output in the insurance efficiency measurement.

However, the dynamic network process along with the financial intermediary approach enables this study to provide a clearer picture of insurance activities.

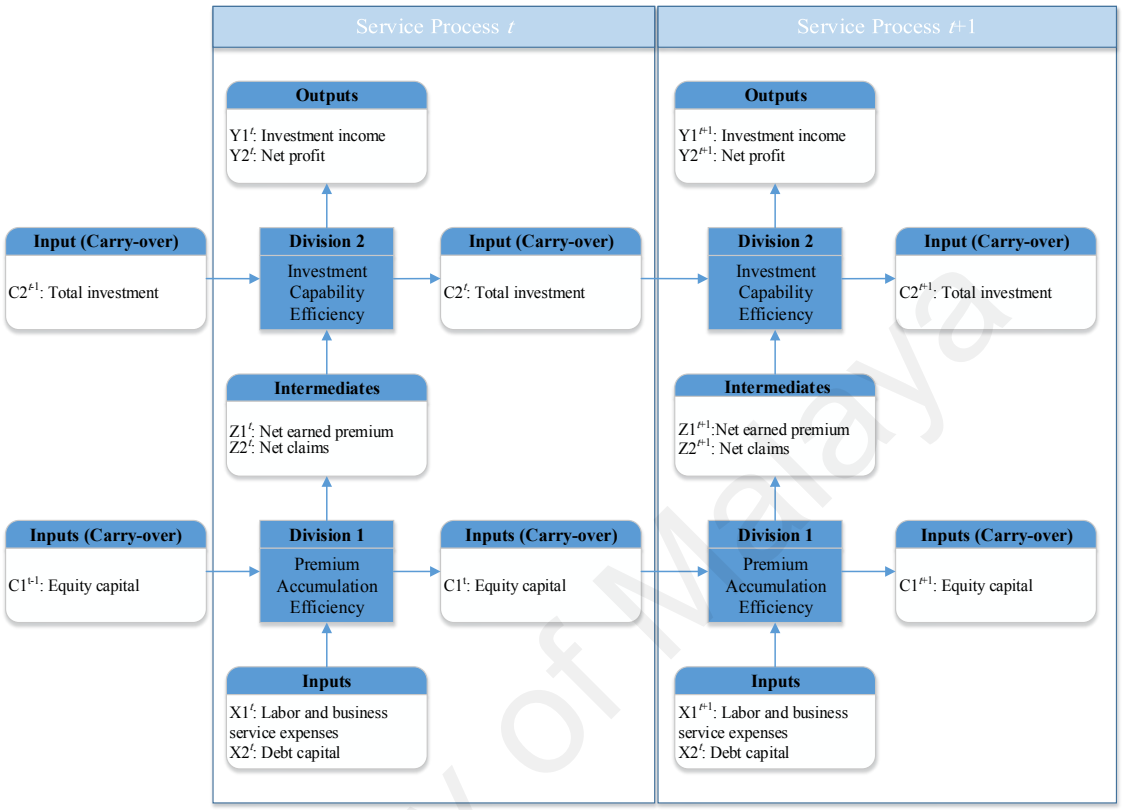

Figure 4.2: Insurance service process framework

Figure 4.2 illustrates the framework for the dynamic network service process of insurance activities. In the first stage of the insurance business, an insurer accumulates premiums by utilizing the inputs that are commonly used by both production and financial intermediary approaches (Brockett et al., 2004, 2005; Cummins & Weiss, 2013). More precisely, this study utilizes labor and business service expenses, equity capital and debt capital as the inputs for the premium accumulation division. Brockett et al. (2004, 2005) used the owners' stake or equity of the previous year for DEA analysis. The reason for this is the lag effect of equity capital in the insurance service process. Hence, this study includes equity capital as the carry-over input in the first stage. The utilized inputs in the first stage produce the net earned premium (positive) and net claims (negative). These two factors are intermediate items since these are also the input factors for the second

stage of insurance production. The aim of the second stage is to gain profit and add value to the business through investment activities. Therefore, the investment stage uses two intermediate factors along with total investment, which are accumulated from previous year insurance activities, to produce the two final outputs - investment income and net profit. It is worth noting that total investment is an input quantity, the immediate effect of which cannot be expected to be seen in achieving the profit/loss for a business firm; what is invested today may result in a gain tomorrow. Subsequently, this study includes total investment as a carry-over item in the second stage. Table 4.1 provides the summary of the variables used in the two-stage insurance service process. The descriptions for each input factor are provided as follows:

Input 1: Labor and business service expenses include total amount of operating expenses, employee benefit expenses and key management personnel compensation. These are usually the main costs to an insurance company (particularly, Malaysian insurers) to accomplish the objective of their business (Eling & Luhnen, 2010a).

Input 2: Debt capital consists primarily of borrowed funds from policyholders (Brockett et al., 2004, 2005; Cummins et al., 1999). This study measures debt capital as the sum of insurance contract liabilities, financial liabilities, insurance payables and tax liabilities. Given there is no lag in the effect of debt capital (Brockett et al., 2004, 2005), it becomes a direct input in the premium accumulation division.

Carry-over input 1: Equity capital represents the owner's stake or equity in an insurer, which includes share capital, retained earnings and other reserves. This carry-over item provides assurance that a company is able to meet the obligations (claims) to policyholders even if those obligations are higher than expected (Brockett et al., 2004, 2005; Cummins et al., 1999). Following Brockett et al. (2004, 2005), this study considers

this item to have a lag effect in the efficiency evaluation because the accumulated equity capital for the current year will be effective for the next period.

Carry-over input 2: Total investment consists of all government and non-government securities and other investments of an insurance business. The sources of investments are not solely from the current year, yet managerial discretion is involved. Therefore, this input factor is not a direct outcome of premium accumulation division and has to be regarded as an individual input to the investment capability division. Moreover, the invested capital will not eventuate immediately. Hence, this study considers investment assets as the carry-over item to reflect its lag effect on the efficiency evaluation.

Intermediate 1: Net earned premiums are equal to the gross earned premiums minus premiums ceded to reinsurers. This intermediate factor is the direct output of the premium accumulation division (Kao & Hwang, 2008) and the direct input of the investment capability division. For an insurance business, the higher net earned premiums convey the higher value; hence, it is a favorable intermediate factor which an insurer may wish to increase.

Intermediate 2: Net claims equal the gross benefits and claims paid minus the claims ceded to reinsurers. It is a direct output of the premium accumulation division and the direct input of the investment capability division. Unlike net premiums, insurers prefer to lessen the claims paid to policyholders. This study agrees with the viewpoint of Brockett et al. (2004, 2005); Brockett and Xiat (1995) that the inclusion of claims as the positive outcome is opposed to the notion of efficiency. As a package of features for customers, loss payments or claims are considered an intermediate step that insurers promise to quickly pay back once the losses occur (Leverty & Grace, 2008). Hence, this study includes net claims as an unfavorable intermediate factor into the efficiency evaluation.

Output 1: Investment income is the proxy for the quality of insurer's investment (Brockett et al., 2004, 2005). The investment income includes the generated income from all the investment activities. This study considers this item as the final output of the insurance service process.

Output 2: Net profit is the final outcome of the income statement of an insurance business after deducting all the operating and tax expenses.

Table 4.1: Definitions of the input, carry-over, intermediate, and output variables

Variable	Symbol	Definition	Source
Inputs			
Labor and business service expenses	X1	The total amount of labor and business service expenses including employee benefit expenses and key management personnel compensation for the year.	Income statement
Debt capital	X2	The total amount of insurance contract liabilities, financial liabilities, insurance payables and tax liabilities of the year.	Balance sheet
Carry-over inputs			
Equity capital	C1	The total amount of shareholders' equity including share capital, retained earnings and other reserves at the beginning of the year.	Balance sheet
Total investment	C2	The total amount of all government and non-government securities and other investments of an insurance business at the beginning of the year.	Balance sheet
Intermediates			
Net earned premiums	Z1	The total amount of gross earned premiums minus premiums ceded to reinsurers for the year.	Income statement
Net claims	Z2	The total amount of gross benefits and claims paid minus the claims ceded to reinsurers for the year.	Income statement
Outputs			
Investment income	Y1	The total amount of generated income from all the investment activities for the year.	Income statement
Net profit	Y2	The total amount of income after deducting all the operating and tax expenses for the year.	Income statement

Table 4.2 shows the descriptive statistics for all inputs, carry-overs, intermediates and outputs for 217 observations. In line with prior literature (Chen, Liu, & Kweh, 2014; Lu, Wang, & Kweh, 2014), this study deflates all the factors to acquire constant values

throughout the sample. In this case, all the factors are deflated to 2010 Malaysia's Consumer CPI. Note that the ranges (differences between minimum and maximum) for all variables are fairly large. It indicates the differences in operating scales of the sampled insurers. Given the large differences, Du, Wang, Chen, Chou, and Zhu (2014) have argued that the use of unit-invariant in efficiency analysis is justifiable.

Table 4.2: Summary statistics of the input, carry-over, intermediate, and output variables

Variable	Mean	Median	Std. Dev.	CV	Range
X1	107835	70115	99281	0.92	622892
X2	4395794	1181206	9646814	2.19	58952778
C1	829592	394831	1221174	1.47	6332665
C2	735913	269531	1279446	1.74	7952759
Z1	511809	306143	520414	1.02	3612709
Z2	3995068	953953	8830321	2.21	57429577
Y1	198029	53411	409743	2.07	2439690
Y2	98078	45309	144014	1.47	986693

Notes: Please refer to Table 4.1 for definition of variables.
Std. Dev.: Standard deviation
CV: Coefficient of variation (standard deviation/mean)
The yearly summary of variables are provided in Appendix B.

4.4 DATA ENVELOPMENT ANALYSIS

4.4.1 Decision making analysis in the insurance business

The decision-making situation is the most accepted paradigm in economic theory (Müller, 1981). This situation is crucial for an insurance business where management discretion is involved in every activity. Insurance is a traditional industry in which budgeting, planning, controlling and decision analysis have become noteworthy (van

Gelder, 1982). However, a search of the literature clearly shows that the field of insurance has received comparatively less attention among OR/MS/DM[21] journals.

Operational research (OR) has served to solve a variety of problems of insurance business activities. OR has contributed to problem solving of different functional fields in insurance such as premium calculation, underwriting and marketing to reserving, reinsurance and investment (von Lanzenauer & Wright, 1991). Brockett and Xiat (1995) comprehensively reviewed various OR methods in insurance. As mentioned by Brockett and Xiat (1995), the major direction of practical research in OR studies is the mathematical programming approaches which can solve minimization and maximization problems. Unsurprisingly, linear programming (LP) is the basis for many mathematical programming approaches. LP formulation can incorporate multiple decision variables needed to solve a problem. As a mathematical tool, it has proved to be extremely useful in many different fields including insurance (Borch, 1967). Traditionally, the LP formulation is used to determine the costs of whole life insurance (Schleef, 1989). LP, as a general category of programming problem, has infiltrated into various application of insurance problems, for example, policyholder value (Conwill, 1991), profitability, capacity and regulation problems (Hofflander & Drandell, 1969) and investment immunization problems (Navarro & Nave, 1994). Indeed, there exists many application of LP formulation which are used to solve decision-making issues in insurance.

There are an increasing number of management decision-making issues relevant to insurance business activities. OR and LP formulations have offered methodologies for the performance evaluation of service processes. Among them, frontier efficiency methodologies have recently gained popularity and recognition (Cummins & Weiss,

[21] Operational research/management science/decision making

2013). As discussed in Chapter 2, DEA has been considered as the most appropriate mathematical programming approach to measure the performance, and in particular the efficiency, of insurance firms (Eling & Luhnen, 2010b). The ability of DEA to handle multiple inputs and outputs makes it a distinctive technique for analyzing the insurance service process because different firms may place an emphasis on different input and output factors in their management strategy. In these cases DEA is the best technique for comparison purposes (Brockett & Xiat, 1995). Additionally, it provides a relative comparison of a firm's performance within a target group operating in the same application domain.

4.4.2 Preliminary requirements of DEA

The user of DEA is required to fulfill a number of requirements which are met in this study. First, the DMUs of a DEA analysis must fulfill the homogeneity assumption. Farrell (1957) proposes that evaluation results would be significant only when DMUs are homogenous. Considering that DMUs of a DEA model must possess identical attributes, similar objectives and the same market conditions (Golany & Roll, 1989), this study therefore only selects conventional insurers publicly traded on Malaysian market as DMUs. In line with the proposed framework, where this study focuses on the premium accumulation and investment capability divisions of insurance companies, it is argued that all insurers, namely life, general and life and general insurers, are the same in operating the two divisions.

Second, Golany and Roll (1989) show that the number of DMUs should be at least twice the number of input and output factors. In this study, the number of DMUs - 31 -

satisfy this requirement for the minimum number of DMUs in the two stages [i.e., 31 > 2×(4+2+2)][22].

Third, DEA analysis requires an 'isotonic' assumption - that input and output factors should have a positive correlation (Golany & Roll, 1989). More specifically, a proportional increase in an input variable should result in a proportional increase in an output variable. Based on the Spearman's rho correlation test reported in Table 4.3, significantly positive relationships exist between the input and output factors. This result affirms the satisfaction of the isotonic assumption for the DEA analysis. Thus, the developed DN-DEA framework has a high level of construct validity.

Table 4.3: Spearman's rho correlation coefficients

Variable	X1	X2	Z1	Z2	C1	C2	Y1	Y2
X1	1.000							
X2	.737**	1.000						
Z1	.832**	.875**	1.000					
Z2	.835**	.894**	.892**	1.000				
C1	.808**	.592**	.688**	.652**	1.000			
C2	.722**	.873**	.763**	.862**	.603**	1.000		
Y1	.784**	.903**	.809**	.908**	.636**	.954**	1.000	
Y2	.750**	.619**	.688**	.654**	.788**	.577**	.612**	1.000

Notes: Please refer to Table 4.1 for definition of variables.
**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4.4.3 Mathematical model specification of dynamic network DEA

A DEA model provides the efficiency scores as well as the frontier projections, based on slack values, for inefficient DMUs. In doing so, the selected model defines the

[22] DEA is not a form of a regression model but is a frontier linear programming technique (Cook, Tone, & Zhu, 2014). While the sample size is an important factor in regression analysis, the DEA model focuses on the individual DMU performance in which the number of DMUs under evaluation may be immaterial (Zhu, 2014). In any case, the number of DMUs in this study satisfies even the strictest requirement posed by Banker, Charnes, Cooper, Swarts, and Thomas (1989) where the number of DMUs should be at least three times the number of inputs and outputs combined.

reference set for inefficient DMUs. That is, they have to adopt the characteristics of a certain efficient DMU in order to become efficient units. In essence, there are two types of efficiency measure models, namely radial and non-radial. Each type may provide a unique result and an indication of inefficient units. There are differences in the characterization of input and output factors. The radial approach, mostly observed in traditional models, produces an efficiency measurement which reflects proportional reduction (or enlargement) of inputs (or outputs) on the best practice frontier. In contrast, the non-radial approach deals directly with slacks in which the models take input excesses and output shortfalls into account without assuming proportional changes of inputs/outputs.

CCR model (Charnes et al., 1978) is the basis of the radial approach and the SBM model (Tone, 2001) represents the non-radial approach[23]. While radial models neglect the non-radial input and output slacks, non-radial models overlook the radial characteristics of inputs and outputs, if any (Cooper, Seiford, & Tone, 2007). The radial models may lack objectivity in terms of reflecting the real input/output conditions for each organization and are based on the assumption that inputs or outputs undergo proportional changes. Hence, non-radial measures, rather than radial measures (which deal directly with input excesses and output shortfalls and do not change proportionally), may lead to results that are more realistic. More importantly, the operational preferences of firms which are changing over time in today's dynamic business world, makes the choice of non-radial approach more logical for the real world (Avkiran, 2009). Hence, this study aims to measure the efficiency of insurance companies using a non-radial approach given

[23] Additive DEA models introduced by Charnes et al. (1985) also measure non-radial inefficiency but are unable to report the efficiency unit in a scalar value (Avkiran, Tone, & Tsutsui, 2008) or have no means of gauging the depth of inefficiency (Tone, 2001); hence, the SBM is the successor of additive models.

input excesses and output shortfalls are taken into account in the analysis. Specifically, the SBM model proposed by Tone (2001) appears to be the more reliable non-radial measure.

For the purpose of the proposed insurance service process, it is accepted that a DN-DEA model is needed. The network feature overcomes the shortcoming of traditional DEA models by considering multiple divisions of production within the black box while also evaluating the overall efficiency. The network structure allows the evaluation of the connectivity between inner linking activities (Kao, 2009; Tone & Tsutsui, 2009), hence enabling the building of an insurance efficiency framework. The dynamic feature allows the long-term fluctuated trends of firms to be observed over time (Tone & Tsutsui, 2010). In essence, under DN-DEA, a framework can be built to incorporate the connectivity between stages (network structure) as well as linking activities between two succeeding periods (dynamic structure). Tone and Tsutsui (2009) introduced the NSBM model and Tone and Tsutsui (2010) proposed the DSBM model in which both models account for slacks where measuring efficiency (non-radial). As a combination of both models, Tone and Tsutsui (2014b) formulated the dynamic DEA with network structure called DNSBM that takes into account the possibility of non-proportional changes of inputs and outputs. Hence, this study selects the DNSBM model to measure the efficiency of insurance companies.

The following sub-sections proceed with this study's specification of the DNSBM model. As such, explained is the use of an appropriate objective function and production technology as the prerequisite for model formulation.

4.4.3.1 Objective function

An important aim of DEA analysis is to provide information on inefficient DMUs based on the production frontiers. In fact, the difference between productivity measures and technical efficiency measures lies in identifying the underlying objective function which makes the technical efficiency more useful (Ray, 2004). There are three main objective function to follow, input-oriented, output-oriented and non-oriented (Cooper et al., 2007). The input-oriented approach aims to minimize the input quantities while satisfying at least the given level of output quantities. In contrast, the output-oriented approach aims to maximize the output quantities while maintaining the observed level of input consumption. The third non-oriented approach, deals with input excesses and output shortfalls at the same time in order to maximize both. Hence, the choice of the objective function will determine the projection path to the envelope surface by which a DEA analyst can suggest the area of improvements in both inputs and outputs. Whether to choose the input, output or non-oriented approach depends on the way in which the service process portrays the firm's operation. For the purpose of the insurance service process, the objective is to identify both over-utilization of input quantities and shortage of output quantities. Therefore, the non-oriented approach for the objective function is chosen.

4.4.3.2 Production technology

The envelopment surface, which defines the production possibility set (PPS)[24], will differ depending on the scale assumptions relevant to the production technology. Two

[24] The set of feasible activities is called the PPS and is denoted by *P*. Cooper et al. (2007, p. 42) postulates the properties of *P* as follows: 1) the observed activities (x_i, y_i) ($i = 1, 2, \ldots, n$) belong to *P*. 2) if any activity (x_i, y_i) belongs to *P*, then the activity (tx_i, ty_i) belongs to *P* for positive value of *t*. This is true in CRS technology. 3) Any activity having an input less than *x* and output no greater than *y* is feasible, i.e. falling into the PPS boundary. 4) Any semi-positive (all data are assumed to be nonnegative but at least one component of every input and output vector is positive) linear combination of activities in *P* belongs to *P*.

general scale assumptions exist: CRS and VRS. CRS defines the proportional changes of inputs and outputs; for example, doubling all inputs will result in doubling all outputs. On the other hand, VRS does not assume such proportional changes. There is a need to take care when choosing a return to scale type, though the identification will not be an easy one since DEA is a data oriented and non-parametric technique. Cooper et al. (2007, p. 334) suggest "…if the data set includes numeric values with a large difference in magnitude, for example, comparing big companies with small ones, the VRS model may be a choice. However, if the data set consists of normalized numbers, for example, per capita acre and hour, the CRS model might be an appropriate candidate." Here this study chooses VRS technology to offset the possible influence of different scales of inputs and outputs on the efficiency results. Following Lu, Kweh, Nourani, and Huang (2016), this study also conducted statistical tests on the efficiency scores under CRS and VRS technologies for the two stages. The results further support the use of VRS technology where the significant difference exists between the two groups of scores.

4.4.3.3 Dynamic network SBM

This study selects the non-oriented, VRS, DNSBM model to evaluate the efficiency of insurance companies. Among other LP packages, as suggested by Cooper et al. (2007), this study runs the efficiency analysis with the help of DEA SolverPro™ V.11 developed by SAITECH, which encompasses all the new models including the DNSBM. The DNSBM formulation proposed by Tone and Tsutsui (2014b) is as follows:

Consider the dynamic network processes presented in Figure 4.2 that deals with n insurers ($j = 1,\ldots,n$) consisting of k divisions ($k = 1,...,K$) over T terms ($t = 1,\ldots,T$). At each term, insurers have common m_k inputs ($i = 1,\ldots, m_k$), q link variables ($p = 1,...,q$), r_k outputs ($h = 1,...,r_k$) and c_k ($w = 1,...,c_k$) carry-overs from period t-1

to period t consisting of k divisions. Let x_{ijt}^{t}, y_{hjk}^{t} and $v_{pjk}^{t(b-g)}$ denote the input, output, and link from division b to division g values of insurer j consisting of k divisions at term t, respectively. $z_{wjk}^{t,t+1}$ denotes the continuity of link flows (carry-overs) between terms t and t+1. This study defines the non-oriented efficiency by solving the program as follows;

$$\phi_o = Min \frac{\frac{1}{T}\sum_{t=1}^{T}\frac{1}{K}\sum_{k=1}^{K}\left[1-\frac{1}{m_k+c_k+q}\left(\sum_{i=1}^{m_k}\frac{s_{iot}^{k^-}}{x_{iot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t-}}{v_{po}^{t(b-g)}}+\sum_{w=1}^{c_k}\frac{s_{wok}^{t,t+1}}{x_{iot}^{k}}\right)\right]}{\frac{1}{T}\sum_{t=1}^{T}\frac{1}{K}\sum_{k=1}^{K}\left[1+\frac{1}{r_k+q}\left(\sum_{h=1}^{r_k}\frac{s_{hot}^{k^+}}{y_{hot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t+}}{v_{po}^{t(b-g)}}\right)\right]} \quad (1)$$

$s.t.$

$$x_{iot}^{k} = \sum_{j=1}^{n} x_{ijt}^{k}\lambda_{jt}^{k} + s_{iot}^{k^-},\ (i=1,...,m_k; k=1,...,K;\ t=1,\ldots,T), \quad (2)$$

$$y_{hot}^{k} = \sum_{j=1}^{n} y_{hjt}^{k}\lambda_{jt}^{k} - s_{hot}^{k^+},\ (h=1,...,r_k; k=1,...,K;\ t=1,\ldots,T), \quad (3)$$

$$\sum_{j=1}^{n}\lambda_{jt}^{k} = 1, \qquad (k=1,...,K;\ t=1,\ldots,T), \quad (4)$$

$$v_{po}^{t(b-g)}\lambda_{jt}^{g} = \sum_{j=1}^{n} v_{pj}^{t(b-g)}\lambda_{jt}^{b} + s_{po}^{t-},\ \forall\ (b,g)\ (t=1,\ldots,T;\ p=1,...,q), \quad (5)$$

$$v_{po}^{t(b-g)}\lambda_{jt}^{g} = \sum_{j=1}^{n} v_{pj}^{t(b-g)}\lambda_{jt}^{b} - s_{po}^{t+},\ \forall\ (b,g)\ (t=1,\ldots,T;\ p=1,...,q), \quad (6)$$

$$z_{wok}^{t,t+1} = \sum_{j=1}^{n} z_{wjk}^{t,t+1}\lambda_{jt}^{k} + s_{wok}^{t,t+1} (w=1,\ldots,c_k; t=1,\ldots,T; k=1,...,K), \quad (7)$$

$$\lambda_{jt}^{k} \geq 0,\ s_{iot}^{k^-} \geq 0,\ s_{hot}^{k^+} \geq 0, s_{po}^{t-} \geq 0\ , s_{po}^{t+} \geq 0\ , s_{wok}^{t,t+1} \geq 0.$$

where $s_{iot}^{k^-}$ and $s_{hot}^{k^+}$ are respectively input/output slacks, s_{po}^{t-} and s_{po}^{t+} are respectively as-input/as-output link slacks, and $s_{wok}^{t,t+1}$ is carry-over excess slacks. (4) suggests that the constructed best practice frontier exhibits VRS technology at stages. (5) points out that the linking activities are treated as input for the succeeding division and excesses are accounted for in the input inefficiency. (6) shows that the linking activities are treated as output from the preceding division and shortages are accounted for in the output inefficiency. (7) shows that the carry-overs are treated as inputs and their values are

restricted to be no greater than the observed ones. Comparative excess in carry-overs is accounted as inefficiency. The PPS for the objective DMU_o $(o=1,...,n)$ is expressed by (2), (3), (4), (5), (6) and (7).

Let an optimal solution (1) be subject to (2), (3), (4), (5), (6) and (7) be;

$$\{\lambda_{jt}^{k*},\ j=1,...,n;\ s_{iot}^{k^-},i=1,...,m_k;\ s_{hot}^{k^+*},\ h=1,...,r_k;\ s_{po}^{t-*},s_{po}^{t+*},$$
$$p=1,...,q;\ s_{wok}^{t,t+1},w=1,\ldots,c_k;k=1,...,K,\ t=1,...,T\}$$

The non-oriented overall efficiency during the term *T* for the objective DMU_o can be defined by;

$$\phi_o^* = \frac{\frac{1}{T}\sum_{t=1}^{T}\frac{1}{K}\sum_{k=1}^{K}\left[1-\frac{1}{m_k+c_k+q}\left(\sum_{i=1}^{m_k}\frac{s_{iot}^{k^-}}{x_{iot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t-*}}{v_{po}^{t(b-g)}}+\sum_{w=1}^{c_k}\frac{s_{wok}^{t,t+1*}}{x_{iot}^{k}}\right)\right]}{\frac{1}{T}\sum_{t=1}^{T}\frac{1}{K}\sum_{k=1}^{K}\left[1+\frac{1}{r_k+q}\left(\sum_{h=1}^{r_k}\frac{s_{hot}^{k^+*}}{y_{hot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t+*}}{v_{po}^{t(b-g)}}\right)\right]}, \qquad (8)$$

This objective function (8) is an extension of the non-oriented SBM model (Tone, 2001) and deals with excesses in both input resources and undesirable (bad) links. The numerator is the average input efficiency and the denominator is the inverse of the average output efficiency. This study defines the non-oriented overall efficiency as a ratio that ranges between 0 and 1, and attains 1 when all slacks are zero. This objective function value is also units-invariant.

Period efficiency is defined for the objective DMU_o by;

$$\pi_o^{t*} = \frac{\frac{1}{K}\sum_{k=1}^{K}\left[1-\frac{1}{m_k+c_k+q}\left(\sum_{i=1}^{m_k}\frac{s_{iot}^{k^-}}{x_{iot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t-*}}{v_{po}^{t(b-g)}}+\sum_{w=1}^{c_k}\frac{s_{wok}^{t,t+1*}}{x_{iot}^{k}}\right)\right]}{\frac{1}{K}\sum_{k=1}^{K}\left[1+\frac{1}{r_k+q}\left(\sum_{h=1}^{r_k}\frac{s_{hot}^{k^+*}}{y_{hot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t+*}}{v_{po}^{t(b-g)}}\right)\right]},(\forall t) \qquad (9)$$

Divisional efficiency for the objective DMU_o is defined by;

$$\eta_o^{k*} = \frac{\frac{1}{T}\sum_{t=1}^{T}\left[1-\frac{1}{m_k+c_k+q}\left(\sum_{i=1}^{m_k}\frac{s_{iot}^{k-*}}{x_{iot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t-*}}{v_{po}^{t(b-g)}}+\sum_{w=1}^{c_k}\frac{s_{wok}^{t,t+1*}}{x_{iot}^{k}}\right)\right]}{\frac{1}{T}\sum_{t=1}^{T}\left[1+\frac{1}{r_k+q}\left(\sum_{h=1}^{r_k}\frac{s_{hot}^{k+*}}{y_{hot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t+*}}{v_{po}^{t(b-g)}}\right)\right]}, (\forall k) \quad (10)$$

Finally, period-divisional efficiency (premium accumulation efficiency or investment capability efficiency at time *t*) for the objective DMU_o is defined by;

$$\varphi_{ko}^{t*} = \frac{\left[1-\frac{1}{m_k+c_k+q}\left(\sum_{i=1}^{m_k}\frac{s_{iot}^{k-*}}{x_{iot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t-*}}{v_{po}^{t(b-g)}}+\sum_{w=1}^{c_k}\frac{s_{wok}^{t,t+1*}}{x_{iot}^{k}}\right)\right]}{\left[1+\frac{1}{r_k+q}\left(\sum_{h=1}^{r_k}\frac{s_{hot}^{k+*}}{y_{hot}^{k}}+\sum_{p=1}^{q}\frac{s_{po}^{t+*}}{v_{po}^{t(b-g)}}\right)\right]}, (\forall k, t) \quad (11)$$

The projection of a target insurer is defined by;

$$\begin{aligned}
&\hat{x}_{iot}^{k} = x_{iot}^{k} - s_{iot}^{k-} (i = 1,...,m_k; k = 1,...,K; t = 1,...,T)\\
&\hat{y}_{hok}^{t} = y_{hok}^{t} + s_{hok}^{t+} (h = 1,...,r_k; k = 1,...,K; t = 1,...,T)\\
&\hat{v}_{po}^{t(b-g)} = v_{po}^{t(b-g)} + s_{po}^{t+} \ \forall\ (b,g)\ (t = 1,\ldots,T;\ p = 1,...,q)\\
&\hat{z}_{wok}^{t,t+1} = z_{wok}^{t,t+1} - s_{wok}^{t,t+1} (w = 1,\ldots,c_k; t = 1,\ldots,T; k = 1,...,K)
\end{aligned} \quad (12)$$

4.4.4 Cluster Analysis

For the discussion purpose, the study also groups insurers according to the efficiency score obtained in the two stages and overall efficiency using the cluster analysis. Hence, this section explains the clustering algorithm used in this thesis. Cluster analysis distinguishes the natural grouping, based on similar attributes of a set of objects (Hair, Black, Babin, & Anderson, 2009). Two algorithm approaches are available in identifying the groups: hierarchical and partitional. While the former creates a nested series of partitions to form a cluster hierarchy, the latter produces only one partition of data without imposing a hierarchical structure (Jain, Murty, & Flynn, 1999). In a comprehensive review of the cluster analysis application, Punj and Stewart (1983) concluded that

partitional clustering algorithms are preferable to the hierarchical methods, however, the arbitrary number of output clusters may pose a problem (Punj & Stewart, 1983). However, this problem can be overcome by running multiple algorithms with different numbers of clusters and selecting the best configuration obtained from all of the runs. K-means has been known as the most reliable and popular partitional method due to its simplicity, ease of implementation, empirical success and efficiency (Jain, 2010; Punj & Stewart, 1983). This study therefore uses the K-means analysis. The procedures are as follow.

Let x_i be the set of d-dimensional objects. Therefore, K-means analysis segments the n objects ($i= 1,...,n$) into k clusters ($k=1,...,K$) such that the squared error of each cluster mean and the objects in a cluster are minimized. If μ_k is the mean of cluster c_k, then the squared error between the mean and points is defined as (Jain, 2010);

$$J(c_k) = \sum_{x_i \in c_k}^{n} (x_i - \mu_X)^2 \tag{13}$$

Consequently, K-means algorithm aims to minimize the summation of squared error over all k clusters (Jain, 2010);

$$J(C) = \sum_{k=1}^{k} \sum_{x_i \in c_k}^{n} (x_i - \mu_X)^2 \tag{14}$$

Therefore, using the average efficiency scores for premium accumulation, investment capability and overall efficiency, this study runs a K-means cluster analysis to categorize the homogeneous insurers into different groups. Hence, this study executes the K-means cluster analysis using the Matlab Statistics Toolbox™ (the Matlab codes are available at Appendix A). In doing so, the Euclidean distance function is used given it is the best

method for computing the distance between objects and centroid[25] (Hair et al., 2009). As mentioned above, the arbitrary number of clusters may be the most critical choice in performing K-means. Hence, the researcher ran the K-means for *k* equals to 2, 3 and 4 clusters. In order to find the best solution, the researcher computed the average silhouette values[26] of all three possible options. The higher average silhouette values indicate a better cluster separation in that particular *k* number of clusters. Consequently, the comparison shows that the 4-cluster algorithm provides us with higher average silhouette values[27] (0.7040).

4.5 SECOND-STAGE ANALYSIS

4.5.1 Contextual factors in DEA analysis

For managerial decision makers, the identification of contextual factors that might improve or deteriorate the efficiency results demands careful scrutiny (Liu, Lu, & Lu, 2016). These factors, such as environmental issues, could be responsible for inefficiencies observed in a DEA analysis. Hence, for efficiency improvement purposes, a policy recommendation could take aim at governmental regulations or a firm's specific characteristics instead of a firm's internal policies (those that are involved in the service process). To achieve the efficiency objective, there is a need for some form of statistical analysis to determine the influence of exogenous factors affecting the efficiency scores. This is commonly performed by a second-stage analysis whereby the efficiency estimates

[25] The centroid or center point of a cluster is the average point of all the objects within a particular cluster.

[26] The silhouette value shows the similarity of each object relevant to its peers in its cluster compared to objects in neighboring clusters.

[27] The average silhouette values for 2-cluster and 3-cluster algorithm stood at 0.6327 and 0.6241 respectively.

obtained in the initial level of analysis are regressed in the second stage against the potential additional factors to identify their effects on efficiency.

Following the work of Ray (1991) who used standard regression estimation to find the effect of key socioeconomic factors on performance of school districts, there are two main recent streams for second-stage analysis. The first approach uses a maximum likelihood estimation of a truncated regression, as proposed by Simar and Wilson (2007). The second approach advocates the use of maximum likelihood estimation of ordinary least squares (OLS) or Tobit regression, as proposed by Banker and Natarajan (2008).

Banker and Natarajan (2008) explain that contextual factors have to be independent of the input factors of the first stage analysis; however, the contextual factors can be correlated with each other. They assert that the DEA analysis followed by the second-stage analysis involving OLS, maximum likelihood, or even Tobit regression could yield a valid estimation of the significant factors and be similar in results to the best methods using parametric analysis. However Simar and Wilson (2007) argue that the OLS and Tobit regressions are comparatively inefficient tools for identifying the effects of contextual factors. Recall that efficiency measures of a DEA model range from zero to one. Due to the unknown serial correlation among the efficiency scores, a direct regression analysis in the second phase is invalid. According to Simar and Wilson (2011), the OLS regression in the second-phase estimation is consistent only under very peculiar and unusual assumptions about the data-generating process that limit its applicability, which might result in having biased estimated coefficients. To address the issue, Simar and Wilson (2007) proposed a truncated regression approach that is able to offset the bias involved in estimating such parameters. Simar and Wilson (2011) compare the approaches by Simar and Wilson (2007) and Banker and Natarajan (2008). In this comparative study, Simar and Wilson (2011) show that the regression models proposed

by Banker and Natarajan (2008) in the second stage pose many restrictive assumptions. For example, OLS and Tobit regressions make assumptions about the monotonic effects of contextual variables while truncated regression does not. Also, Banker and Natarajan (2008) models require the contextual variable to be independent of the input variables, while the Simar and Wilson (2007) model does not. The inefficiency process is likewise independent of the input variable in Banker and Natarajan (2008) study, while there is no such assumption in Simar and Wilson (2007). Additionally, Banker and Natarajan (2008) assume that the contextual variables solely influence the frontier but do not affect the inefficiency process. However, Simar and Wilson (2007) make reverse assumption on this matter, meaning that the contextual variable only influence the inefficiency process but do not affect the frontier. Simar and Wilson (2011) argue that the bootstrapping procedure is required for valid inference.

As mentioned by Liu et al. (2016), the status of development in the second-stage analysis for DEA studies has left practitioners with some confusion about the appropriate use of a methodology. Although, the abovementioned evidence suggests the use of truncated regression with a bootstrapping approach (Simar & Wilson, 2007, 2011), many research works have used the suggested approaches by Banker and Natarajan (2008) for a robustness check. Thus, this thesis follows the truncated regression with a bootstrapping approach (Simar & Wilson, 2007, 2011) and performs the OLS regression (Banker & Natarajan, 2008) as a robustness check.

Suppose the regression is as follows:

$$\delta_j = \beta_0 + \beta_1 X_j + \varepsilon_j, j = 1,...,n \tag{14}$$

where β_0 is the intercept and ε_j is the error term. X_j denotes to the observed variable (independent) for insurer *j* and δ_j represents the efficiency of a particular insurance company. Hence, unknown parameters, scalar β_0 and vector β_1, need to be estimated.

As discussed above, Simar and Wilson (2007, 2011) propose to estimate equation 7.1 using the truncated regression with the bootstrapping approach. As such, as discussed in Simar and Wilson (2011), the output efficiency measure of δ_j is assumed to be a function of $\psi(Z_j, \beta)$, in which Z_j represents the observed (environmental or contextual) variables, and an independently distributed random variable ε_j denotes a part of inefficiency that is not explained by Z_j (assumption A2, Simar and Wilson (2007)). Additionally, ε_j is distributed $\mathrm{N}(0, \sigma_\varepsilon^2)$ with left-truncation at $1-\psi(Z_j, \beta)$ (assumption A3, Simar and Wilson (2007)). Hence, ε_j is restricted by the condition $\varepsilon_j \geq 1-\psi(Z_j, \beta)$. Accordingly, this thesis modifies equation 7.1 as follows:

$$\hat{\delta}_j \approx \beta_0 + \beta_1 Z_j + \varepsilon_j, j = 1, ..., n$$
$$\textit{where} \qquad (15)$$
$$\varepsilon_j : N(0, \sigma_\varepsilon^2), \varepsilon_j \geq 1 - \beta_0 - \psi(Z_j, \beta_1), j = 1, ..., n$$

4.5.2 Regression model specification

To test the hypothetical effects of determinants on technical efficiency (EFF) scores of Malaysian insurance companies obtained from the preceding analysis, in accordance to the literature review discussed in Section 2.4.4, this thesis develops four regression models for which the differences lies in the firm's ownership variable. While equation 16 includes ownership *(OWN)*, foreign versus local, equations 17, 18, and 19 include the three country of origin variables, viz. North American *(AMER)* insurers, European

(EURO) insurers, and Asian *(ASIA)* insurers, respectively. Table 4.4 defines the variables in the regression analysis. The expected signs of the coefficients of each determinant are also set out in Table 4.4 in accordance to the literature review chapter. This thesis examines the application of regression models - with and without year dummies - on efficiency score. As such, Yr_j embeds in the regression models to control for the year effect. However, the results are shown with and without year effects.

$$EFF_{jt} = \beta_0 + \beta_1 SIZE_{jt} + \beta_2 AGE_{jt} + \beta_3 PRFT_{jt} + \beta_4 DIST_{jt} + \beta_5 SPEC_{jt} + \beta_6 LEVG_{jt} + \beta_7 OWN_{jt} + \beta_8 GDP_{jt} + \beta_9 CPIS_{jt} + \beta_{10} LIBDUM_{jt} + \sum \beta_j Yr_j + \varepsilon_{jt} \quad (16)$$

$$EFF_{jt} = \beta_0 + \beta_1 SIZE_{jt} + \beta_2 AGE_{jt} + \beta_3 PRFT_{jt} + \beta_4 DIST_{jt} + \beta_5 SPEC_{jt} + \beta_6 LEVG_{jt} + \beta_7 AMER_{jt} + \beta_8 GDP_{jt} + \beta_9 CPIS_{jt} + \beta_{10} LIBDUM_{jt} + \sum \beta_j Yr_j + \varepsilon_{jt} \quad (17)$$

$$EFF_{jt} = \beta_0 + \beta_1 SIZE_{jt} + \beta_2 AGE_{jt} + \beta_3 PRFT_{jt} + \beta_4 DIST_{jt} + \beta_5 SPEC_{jt} + \beta_6 LEVG_{jt} + \beta_7 EURO_{jt} + \beta_8 GDP_{jt} + \beta_9 CPIS_{jt} + \beta_{10} LIBDUM_{jt} + \sum \beta_j Yr_j + \varepsilon_{jt} \quad (18)$$

$$EFF_{jt} = \beta_0 + \beta_1 SIZE_{jt} + \beta_2 AGE_{jt} + \beta_3 PRFT_{jt} + \beta_4 DIST_{jt} + \beta_5 SPEC_{jt} + \beta_6 LEVG_{jt} + \beta_7 ASIA_{jt} + \beta_8 GDP_{jt} + \beta_9 CPIS_{jt} + \beta_{10} LIBDUM_{jt} + \sum \beta_j Yr_j + \varepsilon_{jt} \quad (19)$$

The EFF in the above equations can be disaggregated into OEFF, PEFF and IEFF, the three efficiency scores that represent overall efficiency, premium accumulation efficiency and investment capability efficiency, and they are used independently as the dependent variables in separate regressions.

Table 4.4: Definitions of variables for regression analysis

Variable	Symbol	Hypothesized	Definition	Type	Source
Dependent variable					
Efficiency score	EFF	-	EFF denotes the efficiency scores obtained from the DNSBM model. It takes three forms, viz. overall efficiency (OEFF), premium efficiency (PEFF) and investment efficiency (IEFF)	Continuous	DNSBM model
Independent variables					
Firm characteristics					
Firm size	SIZE	Positive	Firm size is calculated using the natural logarithm of the total asset	Continuous	Balance sheet
Firm age	AGE	Positive	Firm age is calculated by subtracting the year of establishment in Malaysia with the year of obtained data	Continuous	Bloomberg business[28]
Profitability	PRFT	Positive	Profitability is measured by return on equity (ROE)	Continuous	Balance sheet and income statement
Distribution channel	DIST	Positive	Distribution channel is a dummy variable and an insurer receives 1 if using a bank as a distribution channel and 0 otherwise.	Dummy	Company profile
Specialization	SPEC	Positive	Specialization is a dummy variable and an insurer receives 1 if it is either life or general and receives 0 if it focuses on both.	Dummy	Bank Negara Malaysia
Financial leverage	LEVG	Negative	Financial leverage is measured as the ratio of total liabilities to total assets	Continuous	Balance sheet
Firm ownership					
Foreign versus local	OWN	Positive	Foreign versus local is a dummy variable and an insurer receives 1 if more than 50 per cent of its equity is owned by foreign firms and 0 otherwise.	Dummy	Company profile
Country of origin	ORG	Positive for advanced regions	Country of origin is a dummy variable which includes three groups of foreign insurers; AMER is a dummy of American insurers versus others, EURO is a dummy of European versus other insurers, and ASIA is a dummy of Asian insurers versus others.	Dummy	Company profile
Macroeconomic factor					
GDP	LNGDPHAT	Positive	GDP is the natural logarithm of GDP	Continuous	Department of Statistic Malaysia
CPI for services	CPISHAT	Negative	Yearly CPI for service industry constant in year 2010.	Continuous	Department of Statistic Malaysia
Financial liberalization periods	LIBDUM	Positive	Financial liberalization is a dummy variable and an insurer receives 1 if it operates in years 2010, 2011, 2012, 2013, 2014 and receives 0 if it operates in years 2008 and 2009.	Dummy	Bank Negara Malaysia

[28] The information can be obtained from the following website: http://www.bloomberg.com/.

4.5.3 Correlation analysis between dependent and independent variables

The small sample size for the regression analysis may be questioned in regard to its appropriateness for the analysis. While the preliminary requirements of DEA and the use of the bootstrapping method ensure the suitability of the sample size, in this section, the researcher conducts a correlation analysis between dependent and independent variables to investigate the existence of any multicollinearity in the regression models. As mentioned by Chen, Sun, and Wu (2010), a correlation below 0.8 is not considered as having a multicollinearity problem.

In Table 4.5, the results of Pearson correlations among dependent and independent variables show that the highest correlation exists between size and leverage being at 0.673. All the correlation coefficients are generally low, and below the threshold level of 0.8. Hence, it can be concluded that there is no multicollinearity issue present. However, for the purpose of robustness, a diagnostic test is carried out using variance inflation factors (VIFs) in Chapter 6. Note that OEFF, PEFF and IEFF are the three efficiency scores viz. overall efficiency, premium accumulation efficiency and investment capability efficiency, which are used as the dependent variables included separately in the regression analyses.

Table 4.5: Pearson correlation coefficients of dependent and independent variables

	OEFF	PEFF	IEFF	SIZE	AGE	PRFT	DIST	SPEC	LEVG	OWN	AMER	EURO	LIBDUM	LNGDPHAT	CPISHAT
OEFF	1														
PEFF	0.61***	1													
IEFF	0.88***	0.20**	1												
SIZE	0.28***	-0.01	0.34***	1											
AGE	0.32***	0.34***	0.21**	0.25***	1										
PRFT	-0.07	0.14*	-0.17*	-0.53***	0.09	1									
DIST	0.02	-0.02	0.04	0.30***	-0.07	-0.28***	1								
SPEC	0.02	0.38***	-0.21**	-0.47***	-0.05	0.25***	0.04	1							
LEVG	0.06	-0.06	0.07	0.64***	0.12	0.10	0.13	-0.27***	1						
OWN	0.23***	0.21**	0.17*	0.30***	0.34***	-0.06	-0.17*	-0.13	0.17**	1					
AMER	0.083	0.10	0.04	0.032	0.38***	0.05	-0.27***	-0.09	0.08	0.42***	1				
EURO	-0.061	-0.05	-0.04	0.19**	-0.39***	-0.10	0.14*	-0.15*	0.26***	0.36***	-0.13				
LIBDUM	0.27***	0.13	0.22**	0.28***	0.06	-0.33***	0.04	0.00	0.18**	-3.6E-8	1.8E-8	2.9E-8	1		
LNGDPHAT	0.11	0.01	0.12	0.07	0.05	-0.20**	0.04	0.00	-0.02	-3.6E-8	-1.8E-8	2.9E-8	0.00	1	
CPISHAT	0.09	0.14*	0.03	0.13	0.01	-0.09	0.01	0.00	0.12	-3.6E-8	-1.8E-8	-2.9E-8	0.38***	-0.46***	1

* p<0.05, **p<0.01, *** p<0.001

4.6 DATA DESCRIPTION

For the comparative analysis of different insurance sectors around the world, this study handpicked the information from insurance research conducted by Swiss Re Company[29]. Further data was sourced from BNM[30] (the Central Bank of Malaysia) and used to compare the segments within the Malaysian insurance sector.

The efficiency analysis requires firm-level data of insurance companies. Therefore, special efforts are taken to handpick and compile firm-level data from annual reports of publicly-traded insurance companies in Malaysia, including companies in general insurance business, life and general insurance business, and life insurance business. As of 2014, there were 33 insurers operating in the Malaysian insurance sector. However, after excluding the insurers with missing values, 31 insurers including 19 general insurers, 9 life insurers and 5 life and general insurers were used in this study. The data covers 8 years, the period of 2007 to 2014. However, the time span of 7 years is used for the analysis due to the lag effect of carry-over items, making 217 observation for the sample. The reason for this selection is to cover as many as possible insurers operating in the sector and to cover the period before and after the liberalization policy implemented at the end of 2009. The total net premiums earned by the 31 sampled companies make up 98.28 per cent of the total held by the 33 companies, suggesting that the sample is representative of the Malaysian insurance sector.

The required data for determinants of insurance efficiency were collected from various sources. This is summarized in Table 4.4, and includes sources of data from the

[29] The reports can be downloaded from the following website: http://www.swissre.com/sigma/.

[30] The data can be downloaded from the following website: http://www.bnm.gov.my/.

Department of Statistics Malaysia, Bloomberg Business, Bank Negara Malaysia, companies' balance sheets, income statements, and profiles.

4.7 SUMMARY

Before applying any model to efficiency analysis, the service process of the business under study must be well explored. The complex service process of insurance activities requires an appropriate approach to yield a more meaningful efficiency evaluation. As such, using an intermediation approach, this chapter develops an insurance service process based on the financial portfolio theory. According to this theory, insurance is viewed as a levered investment operation. That is, an insurance service process borrows the funds in the first stage and then invests the funds to generate income. The proposed framework consists of two inputs (labor and business service expenses and debt capital), two carry-over inputs (equity capital and total investment), two intermediates (net earned premiums and net claims), and two outputs (investment income and net profit).

Next, the basic requirements to run DEA to ensure the accuracy of the analysis are presented. To measure the efficiency of insurance companies in the dynamic and network structures, this study selects the non-oriented, VRS, DNSBM methodology to measure the premium accumulation efficiency and investment capability efficiency.

For the second-stage analysis, this study reviews the controversy over the use of regression analysis for DEA analysis. While the discussion has left the practitioners with some ambiguity, it is found that truncated regression with a bootstrapping approach may yield more reliable outcomes.

In order to identify the influence of determinants on insurance efficiency, four regression models are examined. Additionally, to ensure the absence of multicollinearity,

a correlation analysis is carried out which confirms the validity of the factors to be used in the subsequent regression analysis. Figure 4.3 depicts the theoretical framework to identify the determinants of insurance efficiency which are categorized into three themes.

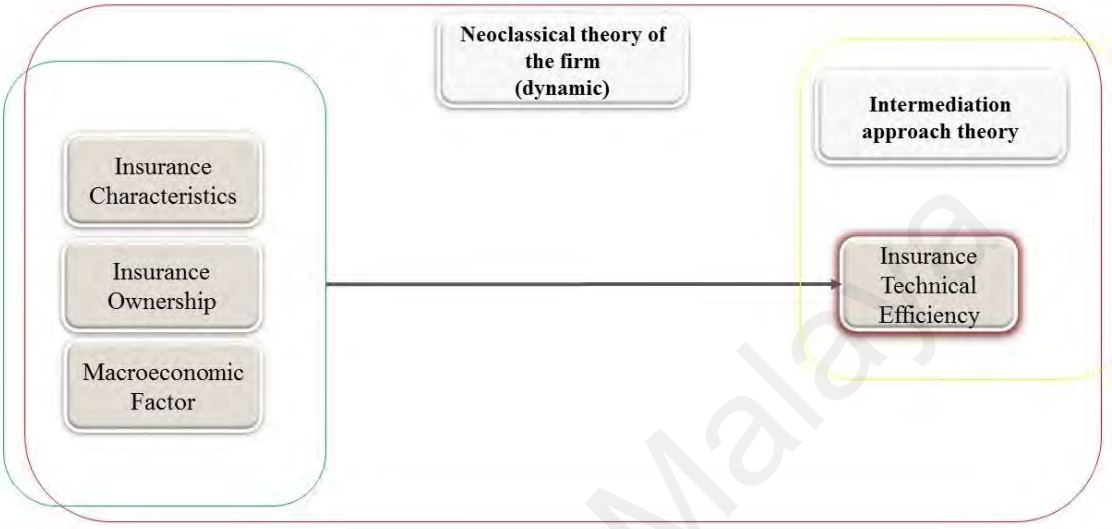

Figure 4.3: Theoretical framework

CHAPTER 5: TECHNICAL EFFICIENCY OF THE INSURANCE SECTOR

5.1 INTRODUCTION

This chapter discusses the findings of efficiency analysis followed by two subsections, dealing with the clustering of insurance firms and the potential areas of improvements. The technical efficiency of Malaysian insurance companies is tabulated showing overall efficiency, premium accumulation efficiency and investment capability efficiency. The results are also discussed based on ownership types and business segments of insurers. In the second section, the results are discussed more in detail. The insurance firms are then grouped using the K-means clustering algorithm. Finally, the directions for improving the efficiency of Malaysian insurance companies is discussed in detail.

5.2 EFFICIENCY ANALYSIS OF INSURANCE COMPANIES

5.2.1 Overall efficiency analysis

The overall efficiency of insurance companies in Malaysia is described in Table 5.1 which covers the years of the study, 2008 to 2014. The findings show that specialized insurers achieved higher average overall efficiency, being at 82.86 per cent for life insurers and 79.72 per cent for general insurers. This compares to non-specialized insurers' efficiency score of 77.67 per cent (composite insurers). Figure 5.1 also sets out the average overall efficiency of the three business segments of insurers as well as the industry average. It is interesting to observe that the overall efficiency of general insurers surpasses the other segments throughout the study timeframe in which the upward trend holds more or less consistently as compared to the fluctuations observed in the life and composite segments. The efficiency of life insurers is somewhat above the average overall

efficiency of the sector while general insurers are slightly less efficient than the sector's average.

To statistically examine the difference between the three groups of life, general and composite insurance companies, as well as the two group of ownership, foreign and local, the Mann–Whitney U test[31] on the equality of means is used following Avkiran (2015) study. This test does not reveal a significant difference between three business segments of insurers in terms of overall efficiency (Table 5.5).

Foreign insurers' average overall efficiency score (84.75 per cent) is comparatively higher than local insurers (76.64 per cent) and that of the overall sample average (80.30 per cent). Likewise, the yearly averages of insurers' overall efficiency indicate the superiority of foreign players in the market (Figure 5.2). Alternatively, the Mann-Whitney U test indicates significant differences in the efficiency scores between foreign and local insurers at the 1 per cent significant level (Table 5.4).

The Progressive Insurance Bhd, with a long history of operation in Malaysia, is the only general insurer that gained an efficiency score of one for all the years. The Great Eastern Life Assurance Bhd, a Singaporean based company and the biggest insurance company in terms of total assets, was the most efficient among all life insurers surveyed.

[31] The Mann–Whitney U test is a statistical hypothesis test that is used to interpret a single decision rule where the null hypothesis assumes the equality of means for two groups. In general, this test will often be asymptotically more powerful than t-test for real data (Fay & Proschan, 2010).

Table 5.1: Overall efficiency scores for Malaysian insurers

Insurer	Own.	Rank	2008	2009	2010	2011	2012	2013	2014	Avg.
General insurers										
Allianz General Insurance Co. Bhd	F	9	.9280	.9998	.9999	.9116	.9999	.9998	.9999	.9762
AmGeneral Insurance Bhd	D	13	1	.5665	.7733	.7435	.9053	.9999	.9998	.8233
AXA Affin General Insurance Bhd	D	29	.4886	.4665	.5726	.5808	.6977	.6317	.7295	.5843
Berjaya Sompo Insurance Bhd	D	28	.5191	.4766	.5278	.6871	.7056	.7046	.7482	.6092
AIG Malaysia Insurance Bhd	F	12	.5935	.7806	.9047	.8288	.9351	1	.9204	.8316
Lonpac Insurance Bhd	D	7	.9122	1	1	1	1	1	1	.9875
MSIG Insurance Bhd	F	4	1	.9983	.9998	.9999	.9999	.9999	.9999	.9997
Multi-Purpose Insurans Bhd	D	24	.5242	.5409	.7617	.7271	.7390	.6856	.7449	.6618
Overseas Assurance Corporation Bhd	F	11	.6750	.7158	.9056	1	.9577	.8357	1	.8524
Tune Insurance Malaysia Bhd	D	16	.6834	.7652	.7558	.8554	.8964	.8321	.8815	.8022
Pacific & Orient Insurance Co. Bhd	D	26	.5216	.5803	.6248	.7244	.6907	.6743	.7498	.6442
The Pacific Insurance Bhd	F	15	.6480	.7392	.7653	.8379	.8922	.9013	1	.8115
Progressive Insurance Bhd	D	1	1	1	1	1	1	1	1	1
QBE Insurance Bhd	F	3	.9992	1	1	1	1	1	1	.9999
RHB Insurance Bhd	D	18	.6151	.6826	.7638	.7950	.8091	.7562	.9086	.7528
Tokio Marine Insurans Bhd	F	25	.4258	.5591	.6357	.7236	.7397	.7740	.8089	.6443
Uni.Asia General Insurance Bhd	D	31	.4448	.4234	.4676	.6655	.7605	.7365	.7512	.5718
Composite Insurers										
AIA Bhd	F	6	1	1	.9999	.9235	.9998	1	1	.9890
Etiqa Insurance Bhd	D	23	.4053	.6155	.8343	.8633	.8719	.8334	.8322	.6921
MCIS Insurance Bhd	D	27	.8298	.3505	.6921	.6064	.7145	.7306	.7225	.6194
Prudential Assurance Malaysia Bhd	F	5	.9960	1	1	1	1	1	1	.9994
Zurich Insurance Malaysia Bhd	F	30	.2841	.6918	.6283	.8371	.6703	.7568	.7058	.5838
Life Insurers										
Allianz Life Insurance Malaysia Bhd	F	22	.7733	.7329	.6904	.5968	.8026	.7668	.7455	.7237
AmMetLife insurance Bhd	D	14	.8915	.7625	.7911	.6706	.8745	1	.8464	.8225
AXA Affin Life Insurance Bhd	D	19	1	.6422	.6867	.7373	.6772	.7909	.7195	.7397
Sun Life Malaysia Assurance Bhd	D	17	.5079	.7791	.7037	.9268	.8774	.9114	.9233	.7786
Great Eastern Life Assurance Bhd	F	1	1	1	1	1	1	1	1	1
Hong Leong Assurance Bhd	D	10	.8303	1	1	1	1	1	.8976	.9589
Manulife Insurance Bhd	F	21	.4857	.8871	.8736	.8323	.7699	.7134	.7095	.7253
Tokio Marine Life Insurance Bhd	F	20	.8731	.8427	.8012	.5629	.7099	.6849	.7099	.7286
Gibraltar BSN Life Bhd	D	8	.8738	1	1	1	1	1	1	.9798
Average			.7332	.7613	.8116	.8270	.8612	.8619	.8727	.8030
Average Foreign			.7630	.8534	.8717	.8610	.8912	.8880	.9000	.8475
Average Local			.7087	.6854	.7621	.7990	.8365	.8404	.8503	.7664
Average General			.7047	.7232	.7917	.8283	.8664	.8548	.8966	.7972
Average Composite			.7030	.7316	.8309	.8461	.8513	.8642	.8521	.7767
Average Life			.8040	.8496	.8385	.8141	.8568	.8742	.8391	.8286
Max			1	1	1	1	1	1	1	1
Min			.2841	.3505	.4676	.5629	.6703	.6317	.7058	.5718
SD			.2281	.2044	.1633	.1469	.1240	.1327	.1201	.1506
No. efficient			6	8	7	8	7	10	9	2

Note: Own. – Ownership type. Avg. – Average.

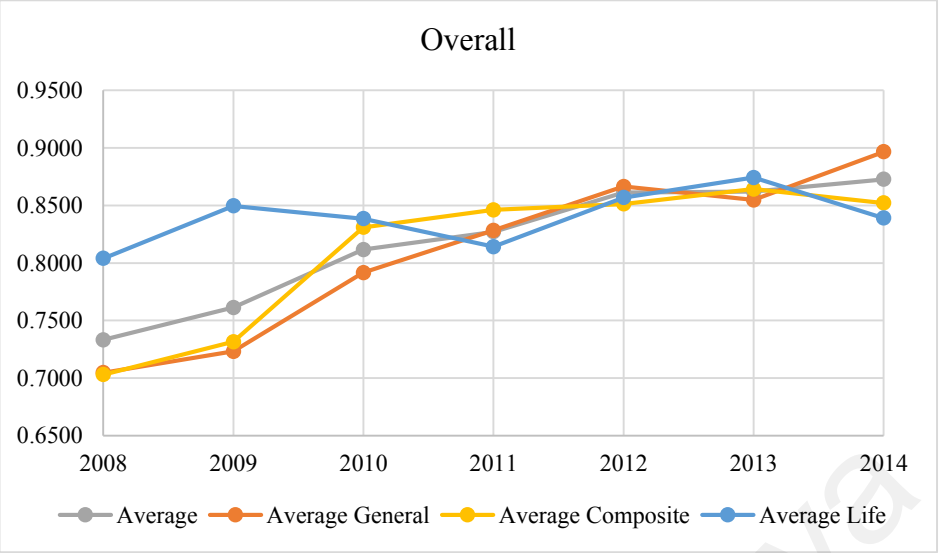

Figure 5.1: Average overall efficiency of general, life and composite insurers

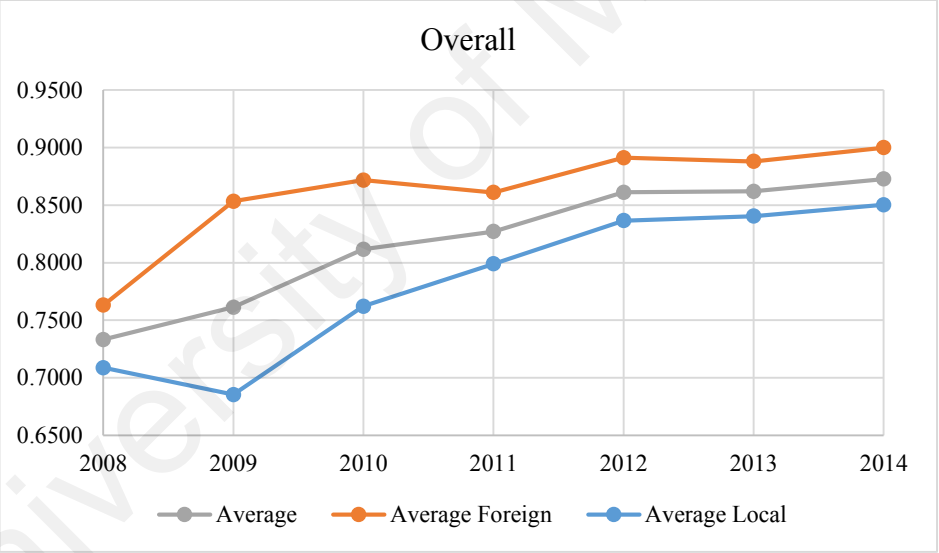

Figure 5.2: Average overall efficiency of foreign and local insurers

5.2.2 Divisional efficiency analysis

Based on the framework constructed, this research segregates insurance efficiency into two divisions, namely, premium accumulation efficiency and investment capability efficiency. The results of each division are presented in Table 5.2 and Table 5.3, respectively. From the tables, it is apparent that the main driver of overall efficiency in the Malaysian insurance sector is the premium accumulation efficiency. In other words,

Malaysian insurers appear to be more efficient in terms of accumulating premiums (89.58 per cent) rather than their investment strategies (78.80 per cent). This finding holds true for both foreign and local insurers in which the average and periodic efficiencies of premium accumulation division are higher than those of investment capability division. However, when the business segments of insurers are examined, this result is consistent for specialized insurers but not for non-specialized, meaning that the composite insurers have on average better investment capabilities (89.24 per cent) than for accumulating premiums (76.35 per cent).

Over the sample period, the composite segment is comparatively weaker than the general and life segments (Figure 5.3) in the premium accumulation division. However, this segment is the best in terms of the investment capability division (Figure 5.5). As Table 5.5 shows, the efficiency scores of the composite segment statistically differ from the other two segments which may therefore support the conglomeration hypothesis (Cummins et al., 2010) in terms of the investment capability division. It may also support the strategic focus hypothesis (Cummins et al., 2010) for premium accumulation division. This is a major advantage of a network structure given it is able to extract the underlying reasons for any inefficiency in a company. However, in order to be reliable, these results must be further validated by regression analysis.

Similar to overall efficiency, foreign insurers are superior in both premium accumulation and investment capability divisions as compared to local insurers in all periods (see Figure 5.4 and Figure 5.6 for illustrative purposes, and Table 5.4 for the Mann Whitney U test). While the investment capability of Malaysian insurers is shown to be improving over the survey period, local insurers showing an upward trend in all years with the exception of 2009. However, the premium accumulation of insurers is

consistent through the sample period (although it is at times decreasing) particularly for foreign insurers.

Table 5.2: Premium accumulation efficiency scores for Malaysian insurers

Insurer	Own.	Rank	2008	2009	2010	2011	2012	2013	2014	Avg.
General insurers										
Allianz General Insurance Co. Bhd	F	9	.8579	.9999	.9999	.9999	.9999	.9999	1	.9796
AmGeneral Insurance Bhd	D	11	1	1	1	.8489	.9948	1	1	.9777
AXA Affin General Insurance Bhd	D	21	.7467	.8071	.7760	.9248	.9878	.9286	.9284	.8713
Berjaya Sompo Insurance Bhd	D	19	.6635	.7116	.9960	1	1	.9634	.9989	.9048
AIG Malaysia Insurance Bhd	F	20	.5672	.8770	.9387	.9358	1	1	1	.9027
Lonpac Insurance Bhd	D	13	.8244	1	1	1	1	1	1	.9749
MSIG Insurance Bhd	F	1	1	1	1	1	1	1	1	1
Multi-Purpose Insurans Bhd	D	28	.5880	.6959	.7722	.8190	.8049	.7270	.7977	.7435
Overseas Assurance Corporation Bhd	F	16	.8862	1	.9559	1	.9156	.8806	1	.9483
Tune Insurance Malaysia Bhd	D	18	1	1	1	1	1	.7070	.7811	.9269
Pacific & Orient Insurance Co. Bhd	D	14	.7807	1	1	1	1	1	1	.9687
The Pacific Insurance Bhd	F	1	1	1	1	1	1	1	1	1
Progressive Insurance Bhd	D	1	1	1	1	1	1	1	1	1
QBE Insurance Bhd	F	1	1	1	1	1	1	1	1	1
RHB Insurance Bhd	D	12	.8738	1	1	1	1	.9531	1	.9753
Tokio Marine Insurans Bhd	F	17	.7318	.9548	.9460	1	1	1	.9649	.9425
Uni.Asia General Insurance Bhd	D	24	.7646	.7967	.7565	.8131	.8219	.8134	.8872	.8076
Composite Insurers										
AIA Bhd	F	10	1	1	.9999	.8469	.9997	1	1	.9781
Etiqa Insurance Bhd	D	31	.2609	.4518	.6686	.7266	.7437	.6668	.6645	.5976
MCIS Insurance Bhd	D	30	.6596	.1970	.6156	.7020	.6866	.72	.6646	.6065
Prudential Assurance Malaysia Bhd	F	8	.9921	1	1	1	1	1	1	.9989
Zurich Insurance Malaysia Bhd	F	29	.1649	.7842	.7518	.7121	.6874	.6501	.7029	.6362
Life Insurers										
Allianz Life Insurance Malaysia Bhd	F	1	1	1	1	1	1	1	1	1
AmMetLife insurance Bhd	D	22	1	1	.7763	.8178	.7491	1	.6927	.8623
AXA Affin Life Insurance Bhd	D	27	1	.6659	.6631	.6469	.6982	.8638	.8429	.7687
Sun Life Malaysia Assurance Bhd	D	26	.5897	.9462	.6785	.8535	.7547	.8228	.8465	.7846
Great Eastern Life Assurance Bhd	F	1	1	1	1	1	1	1	1	1
Hong Leong Assurance Bhd	D	15	.7589	1	1	1	1	1	1	.9656
Manulife Insurance Bhd	F	23	1	1	.8053	.9437	.7203	.7484	.7805	.8569
Tokio Marine Life Insurance Bhd	F	25	1	1	.8158	.7321	.6382	.6617	.6810	.7898
Gibraltar BSN Life Bhd	D	1	1	1	1	1	1	1	1	1
Average			.8294	.8996	.9005	.9136	.9098	.9067	.9108	.8958
Average Foreign			.8714	.9726	.9438	.9408	.9258	.9243	.9378	.9309
Average Local			.7948	.8395	.8649	.8913	.8966	.8921	.8885	.8668
Average General			.8403	.9319	.9495	.9613	.9721	.9396	.9622	.9367
Average Composite			.6155	.6866	.8072	.7975	.8235	.8074	.8064	.7635
Average Life			.9276	.9569	.8599	.8882	.8401	.8996	.8715	.8920
Max			1	1	1	1	1	1	1	1
Min			.1649	.197	.6156	.6469	.6382	.6501	.6645	.5976
SD			.2216	.1884	.1318	.1145	.1303	.1275	.1248	.1225
No. efficient			14	19	14	16	16	16	17	7

Note: Own. – Ownership type. Avg. – Average.

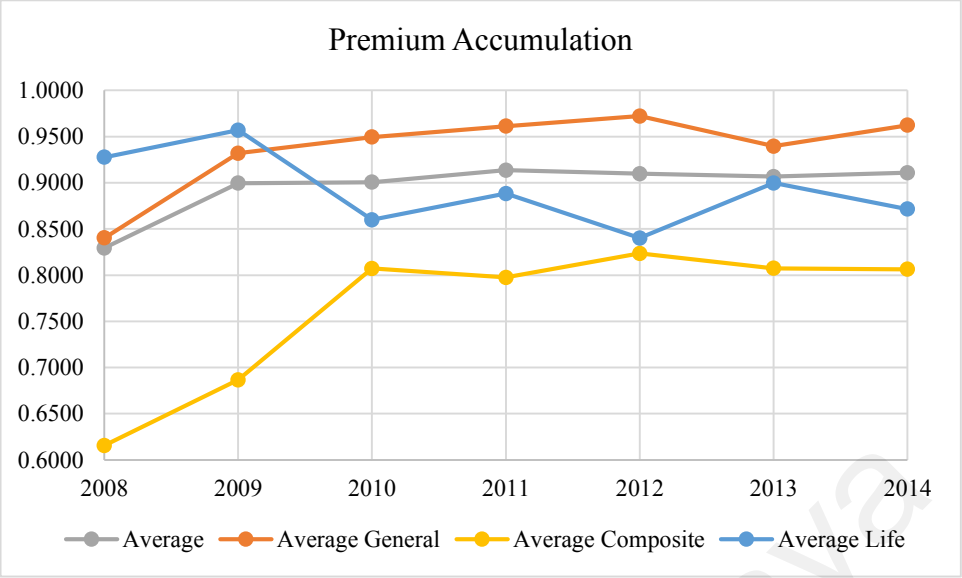

Figure 5.3: Average premium accumulation efficiency of general, life and composite insurers

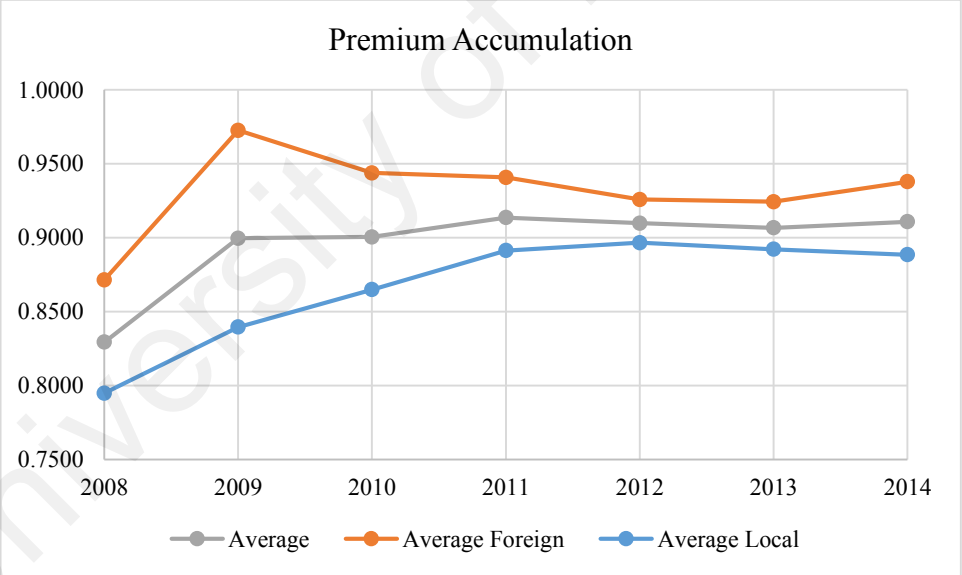

Figure 5.4: Average premium accumulation efficiency of foreign and local insurers

Table 5.3: Investment capability efficiency scores for Malaysian insurers

Insurer	Own.	Rank	2008	2009	2010	2011	2012	2013	2014	Avg.
General insurers										
Allianz General Insurance Co. Bhd	F	8	.9994	.9996	.9999	.8377	.9999	.9997	.9999	.9766
AmGeneral Insurance Bhd	D	16	1	.3952	.6304	.668	.8309	.9998	.9996	.7891
AXA Affin General Insurance Bhd	D	31	.3832	.348	.4758	.4311	.5408	.4844	.607	.4672
Berjaya Sompo Insurance Bhd	D	30	.432	.3785	.3591	.5234	.5451	.5569	.5982	.4847
AIG Malaysia Insurance Bhd	F	15	.6206	.712	.8748	.7487	.8781	1	.8526	.8124
Lonpac Insurance Bhd	D	1	.9999	1	1	1	1	1	1	1
MSIG Insurance Bhd	F	7	1	.9966	.9996	.9998	.9998	.9997	.9998	.9993
Multi-Purpose Insurans Bhd	D	25	.4828	.4684	.7537	.6659	.6933	.6544	.7075	.6323
Overseas Assurance Corporation Bhd	F	14	.5573	.5574	.8622	1	1	.7973	1	.8249
Tune Insurance Malaysia Bhd	D	18	.5191	.6198	.6075	.7473	.8123	.9834	.9884	.754
Pacific & Orient Insurance Co. Bhd	D	29	.4026	.4087	.4544	.5679	.5275	.5087	.5998	.4957
The Pacific Insurance Bhd	F	21	.4793	.5863	.6198	.7211	.8055	.8204	1	.7189
Progressive Insurance Bhd	D	1	1	1	1	1	1	1	1	1
QBE Insurance Bhd	F	6	.9983	1	1	1	1	1	1	.9998
RHB Insurance Bhd	D	24	.4886	.5181	.6178	.6597	.6795	.6318	.8325	.6326
Tokio Marine Insurans Bhd	F	27	.3261	.4006	.4852	.567	.5869	.6314	.6997	.5281
Uni.Asia General Insurance Bhd	D	28	.3339	.3058	.3384	.5775	.7165	.6794	.6572	.5155
Composite Insurers										
AIA Bhd	F	1	1	1	1	1	1	1	1	1
Etiqa Insurance Bhd	D	11	.7775	.8858	1	1	1	1	1	.9519
MCIS Insurance Bhd	D	17	1	.8803	.7668	.5425	.7414	.7394	.78	.7786
Prudential Assurance Malaysia Bhd	F	1	.9999	.9999	.9999	1	1	1	1	1
Zurich Insurance Malaysia Bhd	F	20	.6995	.6333	.5534	1	.6575	.8672	.7079	.7313
Life Insurers										
Allianz Life Insurance Malaysia Bhd	F	26	.6304	.5785	.5272	.4253	.6702	.6218	.5942	.5782
AmMetLife insurance Bhd	D	13	.8043	.6161	.804	.5767	1	1	1	.8287
AXA Affin Life Insurance Bhd	D	19	1	.624	.7094	.832	.6615	.7297	.6283	.7407
Sun Life Malaysia Assurance Bhd	D	12	.4695	.6676	.7279	1	1	1	1	.8379
Great Eastern Life Assurance Bhd	F	1	1	1	1	1	1	1	1	1
Hong Leong Assurance Bhd	D	10	.895	1	1	1	1	.9999	.8142	.9584
Manulife Insurance Bhd	F	23	.3207	.7971	.9516	.7462	.8232	.6817	.6513	.7103
Tokio Marine Life Insurance Bhd	F	22	.7748	.7282	.7894	.4685	.7834	.707	.7354	.7124
Gibraltar BSN Life Bhd	D	9	.7759	1	1	.9999	1	1	1	.968
Average			.7152	.7131	.7712	.7841	.8372	.8417	.8533	.7880
Average Foreign			.7433	.7850	.8331	.8225	.8718	.8662	.8743	.8280
Average Local			.6920	.6539	.7203	.7525	.8088	.8216	.8360	.7550
Average General			.6484	.6291	.7105	.7479	.8009	.8087	.8554	.7430
Average Composite			.8954	.8799	.8640	.9085	.8798	.9213	.8976	.8924
Average Life			.7412	.7791	.8344	.7832	.8820	.8600	.8248	.8150
Max			1	1	1	1	1	1	1	1
Min			.3207	.3058	.3384	.4253	.5275	.4844	.5942	.4672
SD			.2572	.2435	.2207	.2098	.1702	.1810	.1648	.1809
No. efficient			7	7	8	11	12	11	12	5

Note: Own. – Ownership type. Avg. – Average.

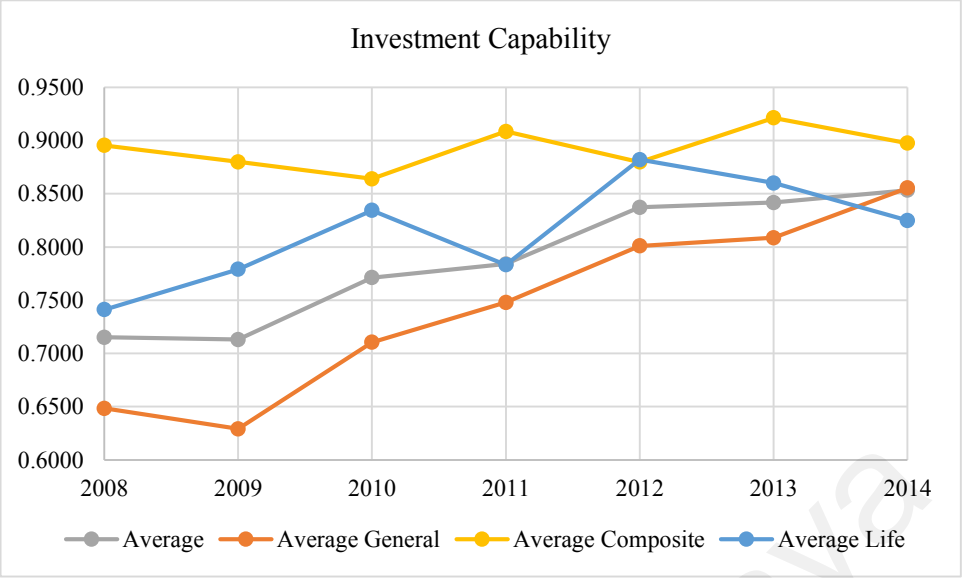

Figure 5.5: Average investment capability efficiency of general, life and composite insurers

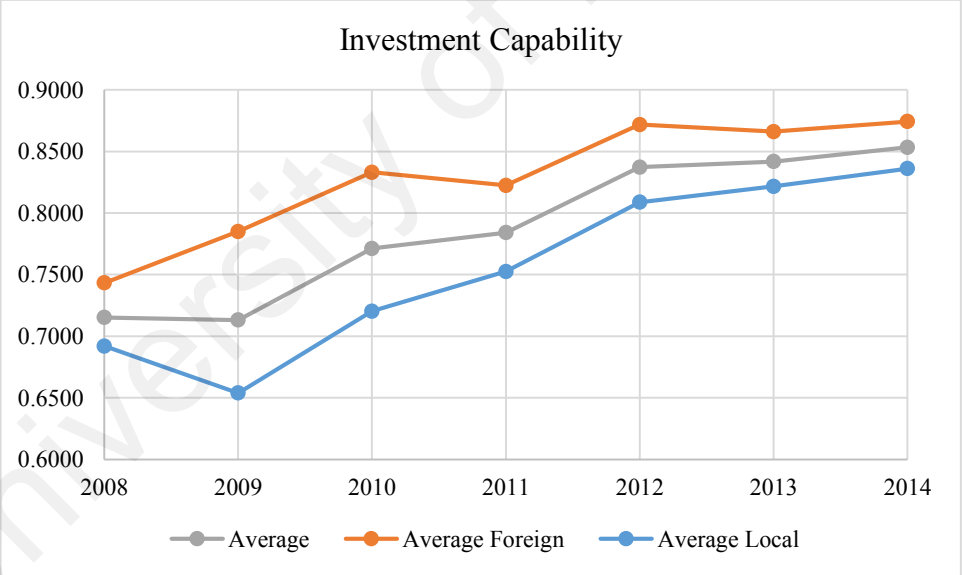

Figure 5.6: Average investment capability efficiency of foreign and local insurers

Table 5.4: Differences in efficiency scores based on ownership type

Efficiency	Efficiency average		Test of difference-p-value
	Foreign (N = 98)	Local (N = 119)	
Overall efficiency	0.8475	0.7664	0.0007***
Premium efficiency	0.9309	0.8668	0.0005***
Investment efficiency	0.8280	0.7550	0.0193**

* p<0.1, **p<0.05, *** p<0.01

Table 5.5: Differences in efficiency scores based on business segment

Efficiency	Efficiency average (p-value)		
	General (N=119)	Composite (N=35)	Life (N=63)
Overall efficiency	0.8095 (0.4045)	0.8113 (0.9857)	0.8395 (0.3684)
Premium efficiency	0.9367 (0.0007***)	0.7635 (0.0000***)	0.8920 (0.7544)
Investment efficiency	0.7430 (0.0006***)	0.8924 (0.0012***)	0.8149 (0.2502)

* p<0.1, **p<0.05, *** p<0.01

5.3 DISCUSSION

The efficiency analysis of Malaysian insurance companies using the DN-DEA model provided three efficiency scores, viz. overall efficiency, premium accumulation efficiency and investment capability efficiency. For the period 2008 to 2014, the average overall efficiency of the Malaysian insurance market is 80.3 per cent. This result suggests that inefficient insurers - 29 out of 31 - have a 19.7 per cent room for improvement to enhance their overall managerial efficiency. Two insurance companies are chosen as the benchmarks in the sample period - Progressive Insurance Bhd (a local insurer) and Great Eastern Life Assurance Bhd (a foreign insurer). The Mann-Whitney U test indicates that foreign insurers are more efficient in overall efficiency than their local counterparts. During the sample period, 2008-2014, the overall efficiency of foreign insurers remained higher compared to their local counterparts for all years. This, it is argued, is because foreign insurers possess a competitive advantage from being more technologically advanced (BNM, 2006; Leverty, Lin, & Zhou, 2009) having access to technological and financial supports from their parent companies. Similar to the findings of Huang et al. (2012) and Choi and Elyasiani (2011), it appears that foreign insurers are able to better utilize their resources due to this technological superiority (Huang et al., 2012) and thereby provide higher quality services (Choi & Elyasiani, 2011). In this regard,

ownership matters and policymakers should consider the role of ownership in designing policies to improve the efficiency of the sector as a whole. Although on average, foreign insurers were doing better than local ones, the two best insurers were in fact drawn from both the local and the foreign groups. When a robustness check is made by removing two worst local insurers from the sample, the unreported results remain validated. Moreover, the average superiority of foreign insurers remains even when the four worst local insurers are removed from the sample. These findings suggest that policymakers should encourage local insurers to learn and understand the best practice of foreign insurers. However, it is important to note that policy makers should not overlook the advantage of local insurers. As a result, institutional arrangements, both formal and informal are needed to facilitate this learning.

Importantly, on average, the results indicate an increasing overall efficiency trend for all insurers. Interestingly, based on yearly average scores, insurers became more efficient after 2009 with a majority of insurers experiencing growth of overall efficiency scores in 2010. The government's aim of promoting the insurance sector through the financial liberalization policy of 2009 therefore seems to have been successful. Moreover, the global financial crisis does not appear to have affected the overall efficiency of insurance companies ceteris paribus. Research evidence shows that firms which have adopted advanced technology withstood the impact of the crisis much better than those who did not (Guellec & Wunsch-Vincent, 2009; Hausman & Johnston, 2014; Stefaniak-Kopoboru & Kuczewska, 2013). However, these results are not statistically conclusive. Decomposing the overall efficiency provides more insights about the inefficiencies of insurance companies in Malaysia.

In the Malaysian insurance market, as noted, insurers tend to be more efficient in premium accumulation division as compared to investment capability division. Recalling

the financial portfolio theory, an insurance company is viewed as a levered investment operation in which it first borrows funds by the issuance of risky obligation (premium accumulation division) and then invests parts of those funds to obtain profit (investment capability division) (Biger & Kahane, 1978; Doherty, 1980; Haugen & Kroncke, 1970; MacMinn & Witt, 1987). Hence, the investment decision is ultimately the most important step to achieve higher profitability and managerial efficiency. The findings of this thesis reveal a lack of efficiently transforming the accumulation of risk funds to investment income and profit in the Malaysian insurance market. Consequently, investment policies need to be restructured in order to raise investment incomes. It seems that the investment capabilities have posed a problem for the insurance industry to achieve higher overall efficiency. This finding is similar to the work of Kao and Hwang (2008) who found that the premium generation of Taiwanese insurance firms are better than their profit generation (comparable to the shortage of investment capability efficiency in this thesis). However, this thesis is unable to make a concrete comparison since it is the first study to utilize intermediation approach in DN-DEA context.

5.3.1 Cluster analysis

To further elaborate the discussions above, this thesis conducts cluster analysis to classify the insurance companies using a more detailed approach. By means of a K-means clustering algorithm, insurers are grouped based on similar attributes. The four groups are top, middle-high, middle-low and bottom clusters. Figure 5.7 illustrates the visual composition using the coordinates (average divisional efficiency and overall efficiency scores) of each insurer into a 3D plot (refer to Appendix C for insurers' codes). The cluster analysis assigned 10 insurers to the top cluster, eight insurers to the middle-high cluster, seven insurers to the middle-low cluster and six insurers to the bottom cluster.

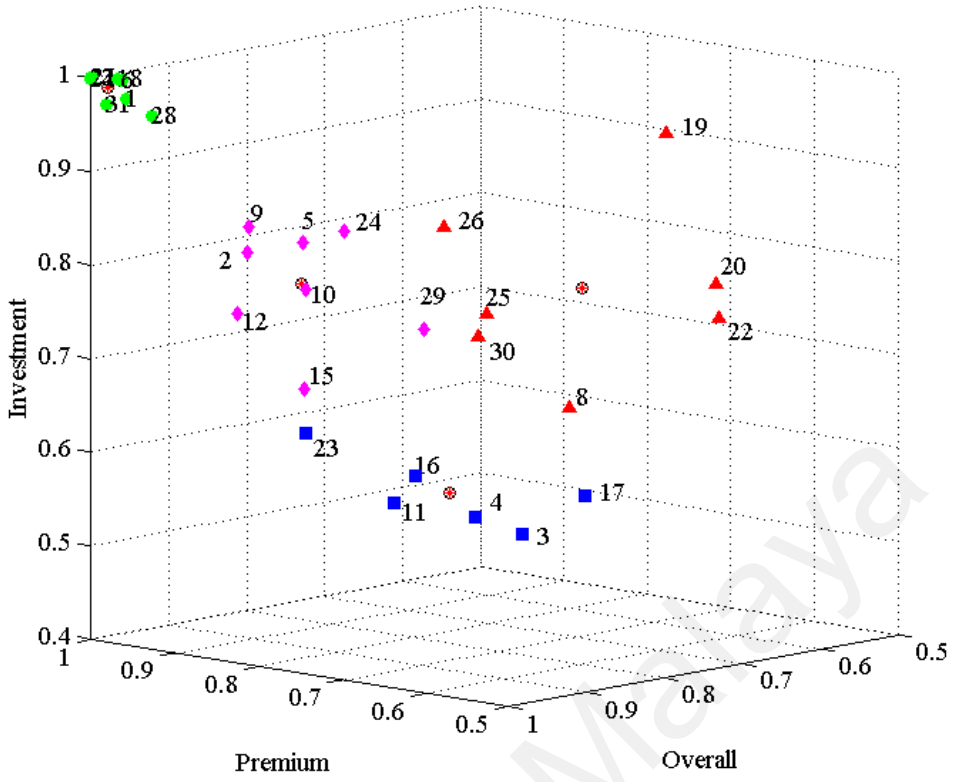

Figure 5.7: 3D plot for K-means cluster analysis

Notes: Four clusters are shown with green (top), purple (middle high), red (middle low), and blue (bottom) colors. See Appendix C for insurers' codes.

Further, Table 5.6 provides the average analysis of the clusters according to ownership type and business segment. The top cluster consists of 10 insurers with an average overall efficiency of 98.90 per cent that is higher than the sectorial and other clusters averages. This cluster takes the lead in the average divisional efficiency of sectorial and other clusters. The middle-high cluster exhibits a higher average efficiency in both premium accumulation division and overall efficiency yet it achieved a slightly lower average in the investment capability division as compared to the middle-low cluster. While the average premium accumulation of six insurers in the bottom cluster is higher than middle-low group, the investment capability efficiency and overall efficiency are lower than other clusters.

Due the relatively small number of insurers in the sample, this study merged top and middle-high groups and also middle-low and bottom groups in order to achieve more

reliable results for ownership type and business segment analyses. The results reveal that foreign insurers outstripped their local counterparts in divisional and overall efficiencies in cluster 1&2. However, within the lower clusters, local insurers are shown to manage their investment strategies better than their foreign counterparts. The total number of foreign insurers as compared to local insurers in the upper clusters (10 versus 8) and lower clusters (4 versus 9) warrants attention and indicates the need to boost the efficiencies of local firms. This finding is consistent with the results that show a superiority of foreign insurers in achieving higher periodic efficiency scores as compared to their local counterparts.

When the business segments of insurers is examined, among the good performers, general insurers displayed better premium accumulation efficiency, life insurers outperformed in investment capability and overall efficiencies and composite insurers stood in the middle. This result remained the same for general insurers in the weak performers groups. However, composite insurers comparatively did better in investment capability division. The majority of general insurers found their place among good-performer clusters, however, this does not hold true for composite insurers.

Table 5.6: K-means clustering average of efficiencies based on cluster, ownership type and business segment

Cluster	Ownership type	Business segment	Average			No. of insurers
			Premium Accumulation	Investment Capability	Overall	
All	All	All	0.8958	0.7880	0.8030	31
1 (top)	All	All	0.9897	0.9902	0.9890	10
2 (middle-high)	All	All	0.9313	0.7589	0.8027	8
3 (middle-low)	All	All	0.7038	0.7693	0.6863	7
4 (bottom)	All	All	0.9158	0.5116	0.6296	6
1&2	Foreign	All	0.9665	0.9042	0.9185	10
1&2	Local	All	0.9603	0.8664	0.8909	8
3&4	Foreign	All	0.8421	0.6375	0.6701	4
3&4	Local	All	0.7837	0.6561	0.6557	9
1&2	All	General	0.9714	0.8643	0.8943	11
1&2	All	Composite	0.6590	0.6667	0.6628	2
1&2	All	Life	0.9370	0.8931	0.8973	5
3&4	All	General	0.8731	0.5206	0.6193	6
3&4	All	Composite	0.6134	0.8206	0.6318	3
3&4	All	Life	0.8358	0.7173	0.7427	4

5.3.2 Frontier Projection Analysis

Given the level of efficiency scores in the Malaysian insurance sector, using frontier projection analysis this study identifies the potential areas of improvements for the input, output, intermediate and carry-over variables, segregated by year, ownership type and business segment. Specifically, identified are the marginal contributions of a decrease in input amounts or an increase in output amounts in improving the efficiency scores. Table 5.7 provides the average excess and shortage of each variable. The positive and negative percentage values imply the shortage and excess of resources respectively.

To improve the premium accumulation efficiency, the insurers, on average, have to reduce business service expenses (X1) by 8.45 per cent, debt capital (X2) by 9.73 per cent and net claims (Z2) by 1.37 per cent while increasing their equity capital (C1) and net premium earned (Z1) by 9.28 per cent and 8.75 per cent, respectively. Interestingly, over the years, the Malaysian insurance sector has been able to more efficiently manage the

intermediate factors where the need to increase net premium earned and to decrease the net claims became less important.

The main deficiency of local insurers in regard to the premium accumulation division, as observed in divisional efficiency analysis, is due to excess usage of input quantities (consistent through the years) that is directly related to inadequate managerial abilities to allocate of resources in an efficient manner. The excess usage of inputs is also a reason for the low efficiency of composite insurers. Nevertheless, composite insurers have suffered from the lower net premiums earned. Another important weakness within the composite segment is what appears to be an over utilization of their equity capital, particularly from 2012 to 2014, as opposed to the shortage of this carry-over item in the life and general segments.

The lack of investment funds by local insurers can explain their low efficiency scores. On average, local insurers have to increase their investment by 77.15 per cent. Subsequently, their investment income must increase by approximately the same percentage. This suggests investment capabilities pose a serious problem for the local insurance businesses. The poorer performance when compared to foreign insurers can be explained by the latter's access to financial support from their parent companies, which are usually well stablished with an accumulated expertise in insurance sector investment. To tackle the problem, local insurers must restructure their investment policies to be able to increase their investment skills. Among different segments of insurance businesses, the general segment is shown to have suffered severely from a shortage of investment funds, being at 92.39 per cent on average. This has significantly reduced the investment capability efficiency of general insurers among others segments. Likewise, the low level of investment quantities has been accompanied by low levels of investment income by the segment. Composite insurers, however, performed well in terms of efficiently

utilizing their total investment and the gain from investment income, but they did not outperform in in terms of net profit. In fact, increasing the net profit is clearly a concern for life and composite insurers although not for general insurers. The detailed suggestions for each insurance company to become efficient are included in Appendix C.

Table 5.7: Potential area of improvement segregated by year, ownership type and business segment

	X1						X2						C1					
	Foreign	Local	General	Comp.	Life	All	Foreign	Local	General	Comp.	Life	All	Foreign	Local	General	Comp.	Life	All
2008	-9.30	-18.01	-19.12	-22.26	0.00	-14.08	-1.44	-12.09	-2.86	-7.20	-15.68	-7.28	10.78	57.64	29.67	7.05	65.68	36.48
2009	-5.91	-9.31	-8.04	-19.12	-0.98	-7.77	-2.32	-16.60	-10.67	-14.30	-6.85	-10.15	1.40	-1.76	-0.80	2.53	-1.02	-0.33
2010	-4.55	-7.38	-5.49	-17.52	-0.93	-6.10	-5.25	-16.67	-5.30	-26.00	-15.20	-11.51	5.58	6.49	4.34	3.48	10.80	6.08
2011	-4.54	-10.93	-5.56	-15.82	-8.41	-8.04	-4.55	-12.60	-4.37	-22.13	-10.33	-8.97	8.37	11.09	6.03	-4.17	24.89	9.86
2012	-4.98	-12.94	-4.15	-16.70	-15.08	-9.34	-6.31	-12.95	-4.18	-18.37	-16.17	-9.95	-2.55	9.88	10.76	-18.60	4.69	4.26
2013	-2.99	-5.15	-2.36	-16.18	-0.93	-4.17	-5.49	-15.25	-7.46	-25.61	-9.03	-10.84	-0.10	8.16	9.35	-16.45	6.74	4.43
2014	-6.21	-12.45	-4.56	-24.68	-10.86	-9.63	-5.15	-12.89	-4.63	-22.53	-11.10	-9.40	2.01	5.95	7.77	-17.86	9.62	4.17
Average	-5.50	-10.88	-7.04	-18.90	-5.31	-8.45	-4.36	-14.15	-5.64	-19.45	-12.05	-9.73	3.64	13.92	9.59	-6.29	17.34	9.28
	C2						Z1						Z2					
	Foreign	Local	General	Comp.	Life	All	Foreign	Local	General	Comp.	Life	All	Foreign	Local	General	Comp.	Life	All
2008	29.07	70.11	85.64	5.24	12.97	51.57	33.19	19.48	9.65	126.10	0.13	25.67	-5.63	-9.13	-7.84	-9.82	-5.74	-7.55
2009	64.53	61.71	102.66	11.88	16.43	62.98	0.00	24.40	0.78	75.72	2.55	13.38	0.00	-0.77	0.00	-2.63	0.00	-0.42
2010	23.32	167.73	187.03	-0.83	0.28	102.51	2.30	7.99	1.92	7.34	10.98	5.42	-1.59	0.00	0.00	0.00	-2.47	-0.72
2011	17.38	111.17	119.92	6.11	7.12	68.81	3.78	4.19	0.67	10.74	6.57	4.00	-0.36	0.00	0.00	0.00	-0.56	-0.16
2012	21.41	44.90	56.51	7.08	7.43	34.29	5.37	2.48	0.02	8.68	8.18	3.78	0.00	0.00	0.00	0.00	0.00	0.00
2013	14.03	40.20	47.31	3.88	6.23	28.38	6.72	4.69	3.50	6.37	9.17	5.61	0.00	-1.13	-0.23	-3.05	0.00	-0.62
2014	17.46	44.22	47.65	2.29	19.41	32.14	3.30	3.49	0.85	5.45	7.10	3.41	0.00	-0.16	-0.01	0.00	-0.28	-0.09
Average	26.74	77.15	92.39	5.09	9.98	54.38	7.81	9.53	2.48	34.34	6.38	8.75	-1.08	-1.60	-1.15	-2.21	-1.29	-1.37
	Y1						Y2											
	Foreign	Local	General	Comp.	Life	All	Foreign	Local	General	Comp.	Life	All						
2008	101.77	113.24	156.97	7.13	71.75	108.06	12.31	22.21	7.85	21.50	34.34	17.74						
2009	54.95	138.00	158.80	12.66	39.14	100.49	21.34	20.00	15.85	21.09	29.31	20.60						
2010	36.03	97.12	110.23	12.05	24.58	69.53	21.10	15.26	9.76	32.39	25.23	17.90						
2011	22.34	50.04	64.03	0.67	7.96	37.53	42.03	36.49	21.33	33.07	75.63	38.99						
2012	17.02	50.33	55.43	3.46	14.93	35.29	19.97	10.65	8.19	31.33	18.29	14.86						
2013	23.43	52.78	61.27	4.78	17.76	39.53	15.14	7.79	3.24	15.44	23.57	11.11						
2014	11.36	39.11	36.65	0.62	21.96	26.58	25.68	10.73	7.31	27.16	31.32	17.48						
Average	38.13	77.23	91.91	5.91	28.30	59.57	22.51	17.59	10.50	26.00	33.96	19.81						

Notes: labor and business service expenses (x1), debt capital (x2), equity capital (c1), total investment (c2), net earned premiums (z1), net claims (z2), investment income (y1), net profit (y2). Negative values: excess of resources. Positive values: shortage of resources. Comp. – composite.

5.3.3 Comparing the results using different models

While the insurance efficiency framework justifies the use of a DN-DEA model, this study compares the discriminating power and the average efficiency score between various DEA models in Table 5.8. In the traditional models - CCR and BCC - and SBM, the carry-over and intermediate variables are removed. The intermediate variables in the DSBM model and the carry-over variables in the NSBM model are not included in the analyses. Within traditional models, the CCR shows lower efficiency scores and less efficient DMUs, illustrating the higher discriminating power of this model (Banker et al., 1984). However, the network approach introduced to reveal the underlying function of a production or service process, brings about higher discrimination because it literally expands the sample through a factor of the number of processes in the framework (Kao, 2009). On the other hand, the dynamic approach poorly performs in terms of discriminating between the efficient insurers where it has the highest number of efficient DMUs among all the models. However, with the inclusion of a dynamic structure in the network approach, the discriminating power lessens as compared to the network approach alone and is far better than the dynamic approach alone. As mentioned by Avkiran (2015), this issue warrants the dimensionality in an efficiency analysis with the greater emphasis on input quantities.

Table 5.8: Comparison of efficiency evaluation between traditional and SBM models

Models	2008	2009	2010	2011	2012	2013	2014
CCR	6 (0.5986)	8 (0.6770)	6 (0.8189)	5 (0.8305)	5 (0.8175)	5 (0.8202)	7 (0.8406)
BCC	9 (0.8080)	12 (0.8807)	13 (0.9153)	9 (0.8980)	10 (0.9090)	16 (0.9699)	11 (0.9491)
SBM	6 (0.5180)	12 (0.7686)	13 (0.8074)	9 (0.8662)	9 (0.8005)	16 (0.9489)	11 (0.8413)
DSBM	11 (0.7090)	16 (0.7801)	17 (0.8954)	14 (0.8730)	14 (0.9057)	19 (0.9398)	11 (0.9003)
NSBM	3 (0.5446)	6 (0.6508)	4 (0.7424)	7 (0.7727)	5 (0.8241)	6 (0.7945)	7 (0.8358)
DNSBM	6 (0.7332)	8 (0.7613)	7 (0.8116)	8 (0.8270)	7 (0.8612)	10 (0.8619)	9 (0.8727)

Notes: Number of efficient insurers (average period efficiency score).
CCR and BCC are output oriented.
SBM, DSBM, NSBM, and DNSBM are non-oriented, VRS.

5.4 SUMMARY

In summary, the evidence shows the lack of overall and divisional efficiencies among local insurers. The lack of overall efficiency is mainly due to the poor performance in the investment capability division. Despite the government's policy to attract more FDI through liberalization measure introduced in 2009, there is still a lack of improvement in investment strategies, particularly among local insurers. On average, life insurers stand above the average overall efficiency, while general insurers are superior in premium accumulation and composite insurers are better in terms of investment capability. The yearly results show an upward trend for local insurers in the investment capability division, however, they achieve only consistent efficiency scores in the premium accumulation division.

This study also conducts cluster analysis to distinguish the positive and negative attributes of different groups of insurers. Interestingly, in the upper clusters, foreign insurers show better average efficiency scores than their local counterparts, while the local insurers in the lower clusters perform better in investment capability only. Consistent with the efficiency results obtained in the first section, the high number of

local insurers among low performers calls for special attention. Among the upper clusters, general insurers dominate being superior in terms of premium accumulation efficiency.

In addition, this study provides the potential areas of improvement for insurers to tackle the inefficiencies in their operating activities. Overuse of input resources is the main reason for low premium accumulation efficiencies of local insurers. In addition to the excess usage of input quantities, the wastage of equity capital by composite insurers appear to be the reason behind their comparative inefficiency in premium accumulation. To enhance the efficiency of the investment capability division, insurers need to increase their total investments and subsequently investment income. This has been a major deficiency in local insurers' management. Consequently, investment policies need to be restructured in order to accrue higher levels of investment income.

CHAPTER 6: DETERMINANTS OF INSURANCE EFFICIENCY

6.1 INTRODUCTION

This chapter describes the regression analysis used to identify the determinants of insurance efficiency. It contains five sections. The first two sections report the descriptive statistics of the dependent variables and test of differences among plausible dependent variables based on ownership type, business segment and liberalization. The next two sections present the results of the regression analysis using a bootstrapping truncated approach and robustness tests. Section 6.6 discusses the findings obtained from the regression analysis and discusses them by linking them with the extant literature.

6.2 DESCRIPTIVE ANALYSIS

Table 6.1 shows the descriptive statistics for all dependent variables, including continuous and categorical variables. The mean logged value of size (SIZE) of Malaysian insurance companies is 14.513, being at MYR 4.977 billion. The average age (AGE) of insurers is 34 years of establishment. Interestingly, insurance companies have made 70.5 per cent profit (PRFT) on shareholders' equity. The mean value of financial leverage (LEVG) is 74.1 per cent suggesting that insurers have relied on debt funding for approximately three quarter of their total assets. The other two continuous variables are the predicted values of economic factors, viz. LNGDPHAT and CPISHAT in which the mean values are 0.063 and 0.717, respectively.

With regards to categorical variables, 14 insurers used links with banks as a mean for their distribution channel (DIST). Nearly 84 per cent of the Malaysian insurance market is focused on either life or general businesses as the insurers' specialization (SPEC) reveals. In terms of ownership (OWN), as pointed earlier, 14 insurers are foreign

companies incorporated in Malaysia (45.2 per cent) and the 17 remaining are locally owned. Out of 14 foreign insurers, four companies are North American owned (U.S. and Canada), three are European owned companies, and seven insurers are headquartered in the Asian region. Finally, 71.4 per cent of the sample falls in the post-liberalization (LIBDUM) period.

Table 6.1: Descriptive statistics of determinants

				Quantiles				
Variable	N	Mean	S.D.	Min	0.25	Median	0.75	Max
Continuous variables								
SIZE	217	14.513	1.219	12.551	13.611	14.354	15.209	17.918
AGE	217	34	24.086	1	14	34	46	106
PRFT	217	0.705	0.37	0	0.43	0.648	0.976	1.828
LEVG	217	0.741	0.155	0.339	0.628	0.731	0.887	0.983
LNGDPHAT	217	0	0.063	-0.104	-0.053	0.002	0.048	0.107
CPISHAT	217	0	0.717	-1.329	-0.465	0.198	0.643	0.878
Categorical variables				N with value of 1		Percentage		
DIST	217	0.452	0.499	98		45.2		
SPEC	217	0.839	0.369	182		83.9		
LIBDUM	217	0.714	0.453	155		71.4		
OWN	217	0.452	0.499	98		45.2		
AMER	217	0.129	0.336	28		12.9		
EURO	217	0.097	0.296	21		9.7		
ASIA	217	0.226	0.419	49		22.6		

6.3 TEST OF DIFFERENCES FOR OWNERSHIP TYPE, BUSINESS SEGMENT AND LIBERALIZATION

This thesis compares the mean values of various groups including ownership type, business segment and liberalization in terms of those independent variables that are meaningful for the particular group. This study utilizes Mann–Whitney U test on the equality of means. From Table 6.2, it is apparent that foreign firms are significantly larger than local insurers. Additionally, the average age of foreign firms is about 43 years compared to 27 years for their local counterparts. Local insurers mostly use banks as the

distribution channel and tend to be more specialized in one line of business as compared to foreign firms. Debt financing is more prevalent among foreign insurers comparatively.

Table 6.2: Differences between independent variables based on ownership type

Variables	Average values		Test of difference-p-value
	Foreign (N = 98)	Local (N = 119)	
SIZE	14.9155	14.1815	0.000***
AGE	43.0714	26.5294	0.000***
PRFT	0.6818	0.7249	0.413
DIST	0.3571	0.5294	0.011**
SPEC	0.7857	0.8823	0.055*
LEVG	0.7711	0.7169	0.009***

* p<0.1, **p<0.05, *** p<0.01

Table 6.3 compares the differences among three insurance segments. The results show that composite insurers followed by life insurers are significantly larger than general insurers. While the composite segment appears to be older in terms of age, the result is not significant. The general line of business shows higher profitability while the composite gained the lowest. As opposed to general insurers, life insurance companies are more in favor of using banks as their distribution channel. On average, the life segment is higher risk as its financial leverage is significantly higher than other segments, being at 86.63 per cent. On the other hand, the general segment is the least risky business line, being at 64.69 per cent.

Table 6.3: Differences between independent variables based on business segment

Variables	Average values (p-value)		
	General (N=119)	Composite (N=35)	Life (N=63)
SIZE	13.8324 (0.000***)	15.8044 (0.000***)	15.0810 (0.000***)
AGE	34.2352 (0.158)	36.6 (0.798)	32.1111 (0.180)
PRFT	0.7512 (0.042**)	0.4917 (0.000***)	0.7376 (0.459)
DIST	0.3277 (0.000***)	0.4000 (0.504)	0.7143 (0.000***)
LEVG	0.6469 (0.000***)	0.8377 (0.000***)	0.8663 (0.000***)

* p<0.1, **p<0.05, *** p<0.01

Three of the independent variables are appropriate for examination using the Mann-Whitney U test based on liberalization periods. The results in Table 6.4 show that insurers have expanded in terms of asset size after the liberalization policy was implemented. However, the profitability significantly decreases in the post-liberalization era. Thus, before the liberalization, on average insurers generated 89.96 per cent profit as a portion of shareholders' equity, while this figure was 62.77 per cent after liberalization. Moreover, as the profitability decreased, the financial leverage of Malaysian insurance companies increased, meaning that the debt financing was being increased.

Table 6.4: Differences between independent variables based on liberalization periods

Variables	Average values		Test of difference-p-value
	Pre-liberalization (N =62)	Post-liberalization (N =155)	
SIZE	13.9697	14.7303	0.000***
PRFT	0.8996	0.6277	0.000***
LEVG	.06973	0.7590	0.014**

* p<0.1, **p<0.05, *** p<0.01

6.4 REGRESSION ANALYSIS

While the truncated regression with the bootstrapping approach may tackle the small sample size issue, there is a need for a further robustness check to ensure the suitability

of the sample. In the previous chapter, the possibility of multicollinearity was checked by conducting a Pearson correlation analysis (depicted in Table 4.5) among dependent and independent variables. The results did not show multicollinearity among the variables. For additional robustness, VIFs were performed on the regression models. However, the VIFs cannot be run for truncated regression models. Hence, this thesis conducts the VIF tests on OLS regression results in which the R-squared value of a regression model is used to identify the VIF of a particular dependent variable on all other dependent variable in that regression model. If the VIF test values are below 10, there is no multicollinearity issue (Kennedy, 1998). The results of the VIFs tests showed that all values are below 10 for all regression models. There is no substantial difference between the results with and without the year dummies. Table 6.11 provides the results of VIF tests performed on OLS regressions for overall efficiency. Additionally, tests are made for the presence of heteroscedasticity, i.e. the error terms do not have constant variance. The White (1980) test did reveal evidence of heteroscedasticity and therefore robust standard errors were calculated in order to present unbiased estimates.

6.4.1 Truncated regression on overall efficiency

Table 6.5 shows the results of truncated regression on overall efficiency scores. The results are presented with and without the year dummies in the regression models. However, there is no significant difference when the year dummies are included. Among the firm's characteristics, the table shows that SIZE, PRFT, SPEC and LEVG are significantly related to the overall efficiency in all four models. While SIZE, PRFT and SPEC have positive impacts on overall efficiency, LEVG has negatively influenced the overall efficiency. Specifically, the results suggest that larger, more profitable and specialized firms are more overall efficient while highly leverage firms are less efficient overall. These findings in Table 6.5 strongly support the majority of the thesis hypotheses

relating to the firm's characteristics. SIZE, PRFT and LEVG are significant at the 1 percent level. SPEC is significant at the 5 percent level for models 2 and 3 and at the 10 percent level for models 1 and 4. AGE is also significant at the 10 percent level for model 3 only. DIST shows no sign of significance for any of the models, suggesting that the distribution channel does not play a role in the overall efficiency of insurance companies.

As for the firm's ownership, none of the testing variables show significant association to overall efficiency scores. These findings therefore demonstrate that ownership (foreign versus local) and country of origin are not the significant predictors for overall efficiency.

The three testing variables for macroeconomic factor yield interesting results. The efficiency scores of insurers increased with higher levels of GDP (LNGDPHAT) over the study period given that the coefficient is positive and significant at the 5 percent level. Interestingly, following the new liberalization policy measures, the efficiency of insurance companies increased (the coefficient of LIBDUM is positively and significant at the 1 percent level). However, no association between CPISHAT and overall efficiency was found.

Table 6.5: Bootstrapped truncated regression–overall efficiency

	Model 1		Model 2		Model 3		Model 4	
SIZE	0.116***	0.117***	0.125***	0.127***	0.121***	0.122***	0.118***	0.120***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
AGE	0.001	0.001	0.001	0.001	0.001*	0.001*	0.001	0.001
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
PRFT	0.237***	0.241***	0.247***	0.250***	0.238***	0.241***	0.234***	0.238***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
DIST	-0.002	-0.003	-0.007	-0.007	-0.012	-0.013	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
SPEC	0.063*	0.063*	0.068**	0.068**	0.067**	0.068**	0.063*	0.063*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
LEVG	-0.624***	-0.630***	-0.652***	-0.659***	-0.643***	-0.649***	-0.612***	-0.618***
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)
LNGDPHAT	0.463**	0.425**	0.458**	0.421**	0.449**	0.412**	0.452**	0.415**
	(0.19)	(0.19)	(0.19)	(0.19)	(0.2)	(0.19)	(0.19)	(0.19)
CPISHAT	0.017	0.014	0.017	0.012	0.017	0.013	0.016	0.012
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
LIBDUM	0.102***	0.096***	0.100***	0.094***	0.100***	0.093***	0.099***	0.093***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
OWN	0.033	0.033						
	(0.03)	(0.03)						
AMER			0.029	0.029				
			(0.03)	(0.03)				
EURO					0.032	0.032		
					(0.04)	(0.04)		
ASIA							0.014	0.014
							(0.03)	(0.03)
Year dummies	No	Yes	No	Yes	No	Yes	No	Yes
constant	-0.727**	-0.743***	-0.837***	-0.855***	-0.779***	-0.797***	-0.756***	-0.774***
	(0.29)	(0.29)	(0.28)	(0.29)	(0.28)	(0.28)	(0.29)	(0.29)
sigma								
constant	0.140***	0.140***	0.141***	0.141***	0.141***	0.141***	0.141***	0.141***
N	217	217	217	217	217	217	217	217
Log likelihood	118.092	118.463	117.322	117.714	117.304	117.686	117.082	117.457

Notes: * p<0.1, **p<0.05, *** p<0.01.
Standard error is shown in parentheses.
Overall efficiency score is the dependent variable for all testing models.

6.4.2 Truncated regression on divisional efficiencies

Table 6.6 and Table 6.7 depict the truncated regression results using divisional efficiencies as the dependent variables. Specifically, Table 6.6 reports the bootstrapped truncated regression for premium accumulation efficiency stage and Table 6.7 reports the bootstrapped truncated regression for investment capability efficiency stage.

In terms of a firm's characteristics, Table 6.6 and Table 6.7 show that SIZE is the significant positive predictor for both premium accumulation and investment capability efficiency divisions at the 1 percent level of significance. This suggests that the larger firms are more efficient at divisional levels. AGE is significantly and positively associated to premium accumulation efficiency (at the 1 percent level) but not to investment capability efficiency. This implies that older firms are more efficient in terms of accumulating premiums. However, a firm's age does not play a role in the efficiency of firms when it comes to investment capabilities. Profitable firms are more efficient in both divisions given the coefficients of PRFT are significantly positive for all models at the 1 percent level. The coefficients of DIST are not significant for any of the efficiency stages, meaning that distribution channels are not a contributing factor for the efficiency of Malaysian insurance companies. SPEC is significantly associated to both premium and investment divisions at the 1 and 5 percent levels respectively: however, the direction of effect differs among the two divisions. While specialized insurers are more efficient in the premium accumulation division (positive coefficients), they are less efficient when it comes to the investment capability division (negative coefficients). LEVG is significantly and negatively related to both efficiency stages, suggesting that highly leveraged firms are less efficient in the premium and investment divisions.

As far as the ownership is concerned, foreign firms are more efficient at the premium stage at the 5 percent level indicated by the positive coefficient of OWN. However, ownership has no influence on the investment capability efficiency of Malaysian insurance companies. European insurers are more premium efficient as compared to other insurers in the sample. The positive coefficient of EURO is significant at the 1 percent level. No significance association is found for AMER and ASIA in the premium accumulation division. Furthermore, the country of origin variable failed to be a significant coefficient in the investment capability stage.

The macroeconomic factor shows inconsistency of results at the premium accumulation stage. CPISHAT is positively and significantly influencing premium efficiency, however, when the year dummies are included the results become insignificant. With regards to LIBDUM, model 1 shows the positive significant effect of liberalization on premium efficiency and model 3 shows a similarly significant and positive effect but without the year dummies. The results of the macroeconomic factor for the investment capability division show the significant and positive effects of LNGDPHAT (at the 5 percent level without year dummies and at the 10 percent level with year dummies) and LIBDUM (at the 1 percent level) on efficiency scores. Specifically, when the GDP is higher and the market is more liberalized, insurers are more investment efficient.

Table 6.6: Bootstrapped truncated regression–premium accumulation efficiency

	Model 1		Model 2		Model 3		Model 4	
SIZE	0.070***	0.069***	0.080***	0.079***	0.073***	0.072***	0.079***	0.078***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
AGE	0.001***	0.001***	0.001**	0.001**	0.002***	0.002***	0.001***	0.001***
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
PRFT	0.179***	0.178***	0.187***	0.186***	0.178***	0.177***	0.182***	0.181***
	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)	(0.05)
DIST	-0.001	-0.001	-0.009	-0.008	-0.015	-0.015	-0.014	-0.013
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
SPEC	0.182***	0.181***	0.188***	0.188***	0.191***	0.190***	0.188***	0.187***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
LEVG	-0.420***	-0.417***	-0.448***	-0.446***	-0.468***	-0.466***	-0.437***	-0.434***
	(0.10)	(0.10)	(0.10)	(0.10)	(0.09)	(0.10)	(0.11)	(0.11)
LNGDPHAT	0.251	0.243	0.243	0.235	0.232	0.225	0.235	0.227
	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.15)	(0.16)	(0.16)
CPISHAT	0.032*	0.039	0.032*	0.038	0.032*	0.039	0.031*	0.038
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
LIBDUM	0.042*	0.040*	0.039	0.037	0.040*	0.038	0.037	0.035
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
OWN	0.042**	0.042**						
	(0.02)	(0.02)						
AMER			0.026	0.026				
			(0.03)	(0.03)				
EURO					0.104***	0.105***		
					(0.04)	(0.04)		
ASIA							-0.007	-0.006
							(0.02)	(0.02)
Year dummies	No	Yes	No	Yes	No	Yes	No	Yes
constant	-0.167	-0.152	-0.292	-0.28	-0.198	-0.184	-0.276	-0.262
	(0.30)	(0.30)	(0.29)	(0.29)	(0.29)	(0.29)	(0.30)	(0.30)
sigma								
constant	0.120***	0.120***	0.121***	0.121***	0.119***	0.119***	0.122***	0.122***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N	217	217	217	217	217	217	217	217
Log likelihood	151.574	151.847	149.522	149.742	154.267	154.524	149.145	149.361

Notes: * p<0.1, **p<0.05, *** p<0.01.
Standard error is shown in parentheses.
Premium accumulation efficiency score is the dependent variable for all testing models.

Table 6.7: Bootstrapped truncated regression–investment capability efficiency

	Model 1		Model 2		Model 3		Model 4	
SIZE	0.135***	0.138***	0.141***	0.143***	0.139***	0.142***	0.133***	0.135***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
AGE	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
PRFT	0.246***	0.252***	0.252***	0.258***	0.247***	0.253***	0.240***	0.245***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
DIST	-0.001	-0.002	-0.003	-0.004	-0.006	-0.006	-0.003	-0.004
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
SPEC	-0.062**	-0.061**	-0.059**	-0.058**	-0.061**	-0.060**	-0.065**	-0.064**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
LEVG	-0.754***	-0.765***	-0.772***	-0.783***	-0.752***	-0.762***	-0.727***	-0.739***
	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.17)	(0.16)
LNGDPHAT	0.518**	0.466*	0.516**	0.465*	0.512**	0.460*	0.514**	0.463*
	(0.24)	(0.25)	(0.24)	(0.24)	(0.25)	(0.26)	(0.25)	(0.25)
CPISHAT	0.005	-0.004	0.005	-0.005	0.004	-0.005	0.005	-0.004
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
LIBDUM	0.111***	0.102***	0.110***	0.101***	0.108***	0.100***	0.110***	0.101***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
OWN	0.019	0.019						
	(0.03)	(0.03)						
AMER			0.019	0.019				
			(0.04)	(0.04)				
EURO					-0.015	-0.015		
					(0.05)	(0.05)		
ASIA							0.023	0.022
							(0.03)	(0.03)
Year dummies	No	Yes	No	Yes	No	Yes	No	Yes
constant	-0.824***	-0.858***	-0.891***	-0.925***	-0.873***	-0.907***	-0.797***	-0.832***
	(0.27)	(0.27)	(0.28)	(0.28)	(0.27)	(0.27)	(0.28)	(0.29)
sigma								
constant	0.184***	0.184***	0.184***	0.184***	0.184***	0.184***	0.184***	0.184***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N	217	217	217	217	217	217	217	217
Log likelihood	59.319	59.874	59.195	59.768	59.143	59.712	59.315	59.864

Notes: * p<0.1, **p<0.05, *** p<0.01.
Standard error is shown in parentheses.
Investment capability efficiency score is the dependent variable for all testing models.

6.5 ROBUSTNESS TESTS

As discussed in section 4.5.1, the choice of truncated regression is appropriate for the main analytical approach. For the purpose of a robustness check, this section presents the OLS results in Table 6.8, Table 6.9 and Table 6.10. Additionally, to ensure the

nonexistence of multicollinearity, the diagnostic tests of VIFs on OLS regression results are also shown in Table 6.11.

Comparing the results of truncated regression and OLS regression, no significant changes are observed. In fact, the coefficients remain the same for all testing models. Only the p-values differ in a few cases.

Table 6.8: Ordinary least squares regression–overall efficiency

	Model 1		Model 2		Model 3		Model 4	
SIZE	0.116***	0.117***	0.125***	0.127***	0.121***	0.122***	0.118***	0.120***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
AGE	0.001	0.001	0.001	0.001	0.001*	0.001*	0.001	0.001
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
PRFT	0.237***	0.241***	0.247***	0.250***	0.238***	0.241***	0.234***	0.238***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
DIST	-0.002	-0.003	-0.007	-0.007	-0.012	-0.013	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
SPEC	0.063**	0.063*	0.068**	0.068**	0.067**	0.068**	0.063*	0.063*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
LEVG	-0.624***	-0.630***	-0.652***	-0.659***	-0.643***	-0.649***	-0.612***	-0.618***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.13)	(0.13)
LNGDPHAT	0.463**	0.425**	0.458**	0.421**	0.449**	0.412**	0.452**	0.415**
	(0.19)	(0.20)	(0.19)	(0.20)	(0.19)	(0.20)	(0.19)	(0.20)
CPISHAT	0.017	0.014	0.017	0.012	0.017	0.013	0.016	0.012
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
LIBDUM	0.102***	0.096***	0.100***	0.094***	0.100***	0.093***	0.099***	0.093***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
OWN	0.033	0.033						
	(0.02)	(0.02)						
AMER			0.029	0.029				
			(0.03)	(0.03)				
EURO					0.032	0.032		
					(0.04)	(0.04)		
ASIA							0.014	0.014
							(0.03)	(0.03)
Year dummies	No	Yes	No	Yes	No	Yes	No	Yes
constant	-0.727***	-0.743***	-0.837***	-0.855***	-0.779***	-0.797***	-0.756***	-0.774***
	(0.25)	(0.26)	(0.25)	(0.26)	(0.25)	(0.25)	(0.26)	(0.26)
N	217	217	217	217	217	217	217	217
F	9.34***	7.158	9.129***	7.001	9.124***	6.995	9.063***	6.948
Log likelihood	118.092	118.463	117.322	117.714	117.304	117.686	117.082	117.457
r2	0.312	0.314	0.307	0.31	0.307	0.309	0.306	0.308
r2_a	0.279	0.27	0.273	0.265	0.273	0.265	0.272	0.264

Notes: * p<0.1, **p<0.05, *** p<0.01
Standard error is shown in parentheses.

Table 6.9: Ordinary least squares regression–premium accumulation efficiency

	Model 1		Model 2		Model 3		Model 4	
SIZE	0.070***	0.069***	0.080***	0.079***	0.073***	0.072***	0.079***	0.078***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
AGE	0.001***	0.001***	0.001***	0.001***	0.002***	0.002***	0.001***	0.001***
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
PRFT	0.179***	0.178***	0.187***	0.186***	0.178***	0.177***	0.182***	0.181***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
DIST	-0.001	-0.001	-0.009	-0.008	-0.015	-0.015	-0.014	-0.013
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
SPEC	0.182***	0.181***	0.188***	0.188***	0.191***	0.190***	0.188***	0.187***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
LEVG	-0.420***	-0.417***	-0.448***	-0.446***	-0.468***	-0.466***	-0.437***	-0.434***
	(0.10)	(0.10)	(0.11)	(0.11)	(0.10)	(0.10)	(0.11)	(0.11)
LNGDPHAT	0.251	0.243	0.243	0.235	0.232	0.225	0.235	0.227
	(0.16)	(0.17)	(0.16)	(0.17)	(0.16)	(0.17)	(0.16)	(0.17)
CPISHAT	0.032**	0.039**	0.032**	0.038**	0.032**	0.039**	0.031**	0.038**
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
LIBDUM	0.042*	0.04	0.039*	0.037	0.040*	0.038	0.037	0.035
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
OWN	0.042**	0.042**						
	(0.02)	(0.02)						
AMER			0.026	0.026				
			(0.03)	(0.03)				
EURO					0.104***	0.105***		
					(0.03)	(0.03)		
ASIA							-0.007	-0.006
							(0.02)	(0.02)
Year dummies	No	Yes	No	Yes	No	Yes	No	Yes
constant	-0.167	-0.152	-0.292	-0.28	-0.198	-0.184	-0.276	-0.262
	(0.22)	(0.22)	(0.22)	(0.22)	(0.21)	(0.21)	(0.23)	(0.23)
N	217	217	217	217	217	217	217	217
F	12.696	9.688	12.072	9.201	13.533	10.32	11.959	9.115
Log likelihood	151.574	151.847	149.522	149.742	154.267	154.524	149.145	149.361
r2	0.381	0.383	0.369	0.371	0.396	0.398	0.367	0.369
r2_a	0.351	0.343	0.339	0.33	0.367	0.359	0.337	0.328

Notes: * p<0.1, **p<0.05, *** p<0.01.
Standard error is shown in parentheses.

Table 6.10: Ordinary least squares regression–investment capability efficiency

	Model 1		Model 2		Model 3		Model 4	
SIZE	0.135***	0.138***	0.141***	0.143***	0.139***	0.142***	0.133***	0.135***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
AGE	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
PRFT	0.246***	0.252***	0.252***	0.258***	0.247***	0.253***	0.240***	0.245***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
DIST	-0.001	-0.002	-0.003	-0.004	-0.006	-0.006	-0.003	-0.004
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
SPEC	-0.062	-0.061	-0.059	-0.058	-0.061	-0.06	-0.065	-0.064
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
LEVG	-0.754***	-0.765***	-0.772***	-0.783***	-0.752***	-0.762***	-0.727***	-0.739***
	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.17)	(0.17)
LNGDPHAT	0.518**	0.466*	0.516**	0.465*	0.512**	0.460*	0.514**	0.463*
	(0.25)	(0.26)	(0.25)	(0.26)	(0.25)	(0.26)	(0.25)	(0.26)
CPISHAT	0.005	-0.004	0.005	-0.005	0.004	-0.005	0.005	-0.004
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
LIBDUM	0.111***	0.102***	0.110***	0.101***	0.108***	0.100***	0.110***	0.101***
	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
OWN	0.019	0.019						
	(0.03)	(0.03)						
AMER			0.019	0.019				
			(0.04)	(0.04)				
EURO					-0.015	-0.015		
					(0.05)	(0.05)		
ASIA							0.023	0.022
							(0.04)	(0.04)
Year dummies	No	Yes	No	Yes	No	Yes	No	Yes
constant	-0.824**	-0.858**	-0.891***	-0.925***	-0.873***	-0.907***	-0.797**	-0.832**
	(0.33)	(0.33)	(0.33)	(0.33)	(0.33)	(0.33)	(0.34)	(0.35)
N	217	217	217	217	217	217	217	217
F	7.011	5.421	6.979	5.401	6.966	5.39	7.01	5.42
Log likelihood	59.319	59.874	59.195	59.768	59.143	59.712	59.315	59.864
r2	0.254	0.258	0.253	0.257	0.253	0.257	0.254	0.258
r2_a	0.218	0.21	0.217	0.209	0.216	0.209	0.218	0.21

Notes: * p<0.1, **p<0.05, *** p<0.01.
Standard error is shown in parentheses.

For the purpose of brevity, only the VIF results for the OLS regression of overall efficiency are reported. The further models used for testing premium and investment divisions also produced satisfactory results. As Table 6.11 shows, all the scores are below the threshold level of 10 (Kennedy, 1998), indicating the absence of multicollinearity.

Table 6.11: Variance inflation factors for OLS results–overall efficiency

	Model 1	Model 2	Model 3	Model 4
SIZE	6.21	6.18	5.99	6.71
LEVG	3.62	3.78	3.67	3.95
PRFT	3.59	3.73	3.59	3.69
CPISHAT	1.58	1.62	1.65	1.58
LIBDUM	1.46	1.58	1.58	1.46
LNGDPHAT	1.44	1.45	1.45	1.45
AGE	1.43	1.44	1.44	1.44
SPEC	1.42	1.42	1.42	1.43
DIST	1.32	1.30	1.23	1.26
FORN	1.31			
AMER		1.32		
EURO			1.38	
ASIA				1.37

6.6 DISCUSSION

As for the fourth objective of this thesis, multiple regression analyses were performed to identify the contributory roles of internal and external factors on overall and divisional efficiencies. Through the literature survey, identified are a number of contributory factors that may influence the efficiency of insurance companies. Before conducting the regression analysis, a test of differences uncovered some interesting results. The Mann–Whitney U test revealed that, when compared to local insurance companies, foreign players are larger, older, greater risk-takers, less specialized and more independent on banks for their distribution channels. Not surprisingly, composite insurers, where both life and general business lines are combined, are larger than other insurers with one business line. However, general insurance companies are more profitable while being less risky than other business segments. Life insurers preferred to use banks as the means of acquiring more policies. The final test of differences showed that insurers became larger after liberalization policies were implemented. This appears to be due to the new regulatory policy allowing more FDI to flow in to the insurance market. Greater competition as a result of financial liberalization seems to have dampened the profitability

of Malaysian insurance companies (after liberalization breakpoint) while it has made insurers more risk takers in terms of debt financing.

To proceed with identifying the determinant of insurance efficiency in the Malaysian market, this thesis ran a truncated regression analysis on divisional and overall efficiency scores. The first testing variable was from the firm's characteristics group, i.e. firm size. The regression results proved that larger insurance companies are more efficient in terms of divisional and overall efficiencies. This finding are in line with the past studies (Bikker & Van Leuvensteijn, 2008; Cummins, 1999; Cummins & Rubio-Misas, 2006; Diacon et al., 2002; Eling & Luhnen, 2010a; Huang & Eling, 2013; Luhnen, 2009b; Worthington & Hurley, 2002). For example, Cummins (1999) claimed that efficiency increases with the growth in firm's size because economies of scale and market share become competitive advantages. The next firm's characteristic variable is age. The results reveal that older firms are more efficient in premium accumulation but not in investment capability. Also, older firms appeared to gain significantly higher overall efficiency when European firms are included only. This finding supports the theory of firm growth (Jovanovic, 1982) where the efficient firms are supposed to grow and survive over time, at least in terms of premium accumulation efficiency. While this hypothesis was previously tested for only banking institutions, this thesis corroborates the findings of Mester (1996) and Berger and Mester (1997) and affirms that firm age is likely to increase premium accumulation efficiency of insurance companies. Profitability, another determinant of efficiency used in the study, is a further firm group characteristic. The truncated regression analysis in this thesis supports the consensus in the literature on insurance efficiency. More precisely, it is observed that ROE, as a measure of profitability, exhibits a statistically significant and positive relationship in overall and divisional efficiencies. This result indicates that the more profitable insurance companies tend to exhibit higher efficiency scores, which corroborates similar study findings of some

of the previous literature (Choi & Elyasiani, 2011; Huang & Eling, 2013; Mahlberg & Url, 2003). In fact, insurers with higher ROE ratios are typically favored by customers, and hence, they invite the larger share of premiums along with the preeminent and high-potential creditworthy clients. Not surprisingly, a profitable insurer in such situations enjoys a favorable environment in which to achieve efficiency in overall and divisional terms. The hypothetical expectation that insurers using banks as their distribution channel will perform better is not backed up by this current study. More precisely, the regression result on testing the influence of distribution channel on insurance efficiency does not show any significant coefficient. This in turn means that distribution channels through use of bancassurance is not a determinant for overall or divisional efficiencies of insurance companies in Malaysia. Hence, this thesis does not support the findings of past studies (for example Mahlberg and Url (2003) and Fiordelisi and Ricci (2011) which did find a positive correlation, nor of those by Chang et al. (2011) who reject the hypothesis. When testing the strategic focus hypothesis versus conglomeration hypothesis, this thesis found a mixed result with regards to the specialization factor. The finding reveals that specialized insurers are more efficient when overall efficiency and premium accumulation efficiency are the dependent variables, meaning that the strategic focus hypothesis is supported. However, non-specialized insurers have advocated the conglomeration hypothesis for investment capability efficiency. However the literature on insurance efficiency to date has found mixed evidence for this notion. By means of decomposing the insurance efficiency into premium accumulation and investment capability efficiencies, this thesis found the answer to this un-researched question. In fact, specialized insurers are shown to be more successful in terms of premium efficiency enhancement (Cummins et al., 2010) while non-specialized insurers have exhibited a better performance in regard to investment efficiency improvement (Meador et al., 2000). The final testing variable in a firm's characteristic group deals with the amount of risk

taken on by an insurance company, i.e. financial leverage. Assumed here is that the more risky a company is, the more vulnerable is its financial situation (Rai, 1996). Similar to past studies on leverage performance relationship (Lin, 2002; Luhnen, 2009a; Soon-Yau & Razak, 2012; Weiss & Chung, 2004), this thesis also finds negative interaction between financial leverage and insurance efficiency. In detail, significant negative association is found between financial leverage and overall and divisional efficiency. This means that lowering the leverage will ultimately result in efficiency enhancement of insurance companies in Malaysia.

The next group of insurance efficiency determinants is the firm's ownership. It deals with two main factors, viz. foreign versus local and country of origin. In the first category, the general form of global advantage hypothesis was tested to identify if foreign-owned insurance companies are more efficient than local ones. This thesis finds that foreign insurers are only significantly superior to their local counterparts in premium accumulation efficiency. While positive coefficients were observed for overall and investment efficiencies, they were not significant. Hence, this thesis corroborates the findings of previous studies (Huang et al., 2012; Huang & Eling, 2013; Lin, 2002) and supports the general form of global advantage hypothesis when it comes to premium accumulation efficiency. This result implies that foreign insurers are in as comparatively advantageous position to efficiently acquire premiums from their clients as are local insurers. In regard to the issue of a firm's country of origin, this thesis examines whether the limited form of global advantage hypothesis holds true. The regression result reveals that, among foreign insurers, European insurers significantly outperform other insurance companies but only in terms of premium accumulation efficiency. According to a literature search this is the first study to investigate the limited form of global advantage hypothesis in insurance literature.

Finally, this thesis examines if external macroeconomic factors influence the efficiency of insurance companies in Malaysia. For this purpose, three variables were chosen in this group, viz. GDP, CPIS and financial liberalization periods. There is the expectation that the efficiency of insurance companies will be higher as a result of a rise in purchasing power and living standards of the country in which it is operating. Hence, this greater affluence produces greater sales of insurance products relating to both life and non-life. In line with the study by Lamm-Tennant and Weiss (1997) and in contrast to Huang and Eling (2013), this thesis affirms this hypothesis finding that GDP positively influences the overall and investment capability efficiencies of Malaysian insurance companies. These findings assert that in overall terms, the insurance efficiency will be higher when the macroeconomic factor as represented by GDP growth are improving. However, while higher GDP helps to improve the investment efficiency of insurers there is not the same effect on their premium efficiency. With regards to the relationship between CPIS and insurance efficiency, this thesis does not make any concrete assertion as the coefficients are not significant with the inclusion of year dummies. Hence, in the Malaysian insurance market, where the economy has experienced not great fluctuations particularly in terms of inflation, the efficiency of insurance companies is not determined by the variations in the yearly CPISs. As such, this finding does not support any of past studies, which find either positive (Luhnen, 2009b) or negative associations (Huang & Eling, 2013). Rather it indicates there are no significant links between CPIS and insurance efficiency in the Malaysian market.

The final testing variable, financial liberalization, was included in the truncated regression analysis. For this purpose, the breaking point of new liberalization policy implemented by Malaysian authorities in 2009 was considered. Hence, the sample was divided into two, pre- and post-liberalization periods. This regression result confirms the positive influence on insurance efficiency of opening up the market to foreign

competitors. In particular, significant and positive coefficients were observed in overall and investment capability efficiencies in all testing models. For premium accumulation efficiency, with the inclusion of year dummies, the financial liberalization increases the efficiency scores in the first model only, i.e. when the foreign and local insurers are considered. This finding implies that the looser the regulatory changes are, the more they contribute to investment efficiency of Malaysian insurance companies but not to their premium efficiency. This is not surprising because financial liberalization opens up new opportunities for investment flows into the market. Given the literature to date has not investigated the relationship between financial liberalization and efficiency in the Malaysian insurance market, there is no study to directly compare this study's results in the same environmental context. However, this thesis lends support to the majority of insurance literature which finds a positive influence of regulation change on insurers' efficiency (Badunenko et al., 2009; Boonyasai et al., 2002; Cummins & Rubio-Misas, 2006; Ennsfellner et al., 2004; Gamarra, 2008; Hussels & Ward, 2007; Rees & Kessner, 1999; Turchetti & Daraio, 2004). Importantly this study provides a far more detailed understanding of the role of financial liberalization on insurance efficiency.

6.7 SUMMARY

This chapter discusses the results of second-stage analysis used to discover the drivers of insurance efficiency. Before proceeding with the regression analysis, descriptive statistics and test of differences provided insights about the variables used. From descriptive statistics, the average age of insurance companies was shown to be 34; insurers were highly leveraged; 14 insurers used banks in their distribution system; 84 per cent of insurers were specialized in one line of business, and 14 insurers were foreign owned half of which were headquartered in Asia. From the test of differences, the findings reveal that foreign firms are larger, older and riskier than local firms. Also, composite

insurers are larger while general insurers are more profitable. Life insurers are more risk takers and mostly use bank as their distribution channel. Furthermore, after the liberalization policy in 2009, insurance companies became larger in terms of their assets, however, their profitability decreased and their financial leverage increased.

The findings of truncated regression with bootstrapping yield some interesting results about the determinants of insurance efficiency. Firm size, profitability, specialization, financial leverage, GDP and liberalization are shown to be the significant contributors of overall efficiency as well as investment capability efficiency of insurance companies. Additionally, the findings also revealed that firm age and ownership are the significant determinants of premium accumulation efficiency. The robustness check confirmed the accuracy of results where there were no significant changes in the findings.

CHAPTER 7: CONCLUSION AND IMPLICATIONS

7.1 OVERVIEW OF STUDY

In recent years there has been a global trend towards liberalization of the insurance industry (Swiss RE, 2012, 2013). Reforms in international policies that promote liberalization are aimed at improving economic welfare through efficient allocation of resources in the long-run. Thus, proponents of liberalization claim that opening local markets to foreign competition and FDI can result in the enhancement of productivity. On the other hand, critics argue that local firms may not be able to grasp efficient advantages of liberalization, because they are incapable of effectively adapting foreign technologies to local production, and/or because local firms are generally confronted with limited credit that prevents investments in new technology (Topalova & Khandelwal, 2011). Indeed, the transfer of technological advances from foreign insurers to local firms has always been a major concern for Malaysian authorities. The Malaysian government's FSMP 2001-2010 (BNM, 2001), contains a number of initiatives aimed at promoting the transfer of technical expertise and skills to the local segment. Additionally, BNM, the central bank of Malaysia, placed a great deal of emphasis on this issue at the 10th Malaysian Banking, Finance & Insurance Summit (BNM, 2006). In general then, it is recognized that regulatory changes can have a profound impact on the structure and performance of the insurance industry.

Hence, in line with its first objective, this thesis investigates the structure of the Malaysian insurance sector in order to identify the strengths and weaknesses of the sector. Next, the overall objective of this thesis is aimed at examining the managerial efficiency of Malaysian insurance companies. However, a true measurement of efficiency evaluation poses a particular problem in research methodology. Therefore, the second

objective aims at proposing a new framework for performance efficiency, built on the intermediation approach, by decomposing the complex service processes of insurance companies into two functional divisions, premium accumulation and investment capability. The third research objective deals with insurance efficiency evaluation of the Malaysian market. Following which, this study employs a DN-DEA model for performance evaluation of insurers (life, general and composite insurers) and ownership (local and foreign) types, spanning the period 2007-2014. The final objective of this thesis aims at identifying the drivers of insurance efficiency in terms of internal factors (firm's characteristics and ownership) and external factors (macroeconomic factor). A truncated regression analysis with a bootstrapping approach is used to conduct the analysis.

This chapter presents the concluding remarks. Following the overview of study, an overall brief summary is provided containing the key points and findings. The next section discusses the contributions and implications of this study. Limitation of research and direction for future research are then set out.

7.2 SUMMARY OF KEY FINDINGS

A review of developments shows that in Malaysia there has been a slow pace of development of the insurance market compared to global trends. This has been despite the Malaysian government's endeavors to achieve the highest international standards in terms of efficiency, stability and effectiveness for the Malaysian insurance sector (BNM, 2009). For example, market penetration rate of the life segment in the Malaysian insurance sector has declined, which indicates the development of this segment is not in line with growth of economic activity. Moreover given that the government has taken a number of initiatives to liberalize the financial sector, parallel improvements to

managerial efficiency seems necessary for future development of the country's insurance sector.

Given the service generation process and economic conditions of insurance have their own distinctive properties (Müller, 1981), a majority of extant studies on insurance efficiency apply the production approach (Cummins, 1999; Cummins et al., 1996; Cummins et al., 2010), which is more appropriate for manufacturing businesses. In resolving this problem, the second objective of this thesis is realized. Following Brockett et al. (2004, 2005), the intermediation approach to evaluate the efficiency of insurance companies is used together with an insurance efficiency framework based on intermediation approach. Additionally, from the various managerial decision-making approaches, frontier efficiency methodologies, which have recently gained more popularity and recognition (Cummins & Weiss, 2013), DEA is adopted. This method is the now widely used mathematical programming approach to measure the efficiency performance of insurance companies (Eling & Luhnen, 2010b). However, traditional DEA models conceptualize the service process as a single 'black box' (Färe & Grosskopf, 1996) whereby inputs are transformed into outputs without considering the inner activities, for example, the stages. The traditional DEA models do not differentiate the key sub-processes engaged within the insurance service process (Avkiran, 2015). Given the nature of proposed insurance framework, the DN-DEA suits the objective of this thesis. In essence, using DN-DEA, this thesis builds a framework to incorporate the connectivity between divisions (network structure) (Tone & Tsutsui, 2009) as well as linking activities between two succeeding periods (dynamic structure) (Tone & Tsutsui, 2010). Under the DN-DEA, DNSBM model is utilized to decompose the Malaysian insurance efficiency into premium accumulation and investment capability divisions. This thesis is therefore the first to apply the DNSBM model using an intermediation

approach for insurance companies. Hence, the researcher is unable to make any direct comparison of the results of divisional efficiencies with that of past insurance studies.

In accordance to the second objective, an appropriate insurance efficiency framework is proposed based on intermediation approach. This framework divides insurance efficiency into two divisions, viz. premium accumulation efficiency and investment capability efficiency. Following which, an evaluation is carried out of insurance efficiency using the DNSBM model. The study findings reveal that Malaysian insurance companies are 80.30 per cent efficient in overall terms, meaning that there is 19.70 per cent room for improvement, on average. By means of decomposing the insurance efficiency (opening up the 'black box' process), this thesis reveals that the observed inefficiency of sampled insurers is mainly caused by the investment capability division, being at 78.80 per cent efficient on average, as compared to the premium accumulation division, at 89.58 per cent on average. The comparison between foreign and local insurers shows that foreign insurers are comparatively superior in overall and divisional efficiencies, which imply that foreign insurers are able to better utilize the resources due to their technological advancement. Additionally, the comparison among different insurance businesses reveals that each segment of business has its own level of superiority in the various efficiency categories. For example, in the premium accumulation division, the general insurance segment is shown to be the most efficient segment; in the investment capability division, composite insurers had the highest level of efficiency, and in overall terms, the life segment was the most efficient although this finding was not statistically significant. The low premium efficiency for insurers is shown to be mainly due to the overuse of input resources. Additionally, it is shown that total investments and investment income need to be increased if investment capability efficiency is to be improved, particularly in the case of the less well performing local insurers.

The findings of regression analysis reveal that the determinants of insurance efficiency differ for various efficiency types. While there are some efficiency drivers common among overall and divisional efficiencies, some factors are only significant for a particular efficiency type. Among firm's characteristics, firm size, profitability and financial leverage support the hypothetical signs defined earlier and are consistent for overall and divisional efficiencies. However, firm age increases the premium efficiency but not overall and investment efficiency; specialization enhances the overall and premium efficiencies but reduces the investment efficiency. Additionally, the nature of distribution channels is shown not to be a significant influence on any of the efficiency types of Malaysian insurance companies. In the firm's ownership group, it is apparent that foreign ownership leads to greater efficiency only in regard to premium efficiency, and there is no significant difference among foreign and local insurers for overall and investment efficiencies. Also, European-owned companies show a higher premium efficiency compared to other sampled insurers. Finally, in terms of the influence of the macroeconomic factor group, GDP appears to be a key driver of insurance efficiency in terms of overall and investment efficiencies. This thesis does not find any association between CPIS and efficiency of Malaysian insurance companies. However the recent financial liberalization in Malaysian insurance industry appears to have significantly elevated the efficiency of insurers for overall and divisional efficiencies. Table 7.1 summaries the hypothetical signs and the obtained results.

Table 7.1: Summary of results on determinants of insurance efficiency

Determinant	Symbol	Hypothesized	Finding		
			Overall	Premium	Investment
Firm's characteristics					
Firm size	SIZE	Positive	Significantly positive	Significantly positive	Significantly positive
Firm age	AGE	Positive	Not supported	Significantly positive	Not supported
Profitability	PRFT	Positive	Significantly positive	Significantly positive	Significantly positive
Distribution channel	DIST	Positive	Not supported	Not supported	Not supported
Specialization	SPEC	Positive	Significantly positive	Significantly positive	Significantly negative
Financial leverage	LEVG	Negative	Significantly negative	Significantly negative	Significantly negative
Firm's ownership					
Foreign versus local	OWN	Positive	Not supported	Significantly positive	Not supported
Country of origin	ORG	Positive for advanced regions	Not supported	Significantly positive for EURO	Not supported
Macroeconomic factor					
Gross local product	LNGDPHAT	Positive	Significantly positive	Not supported	Significantly positive
Consumer price index for services	CPISHAT	Negative	Not supported	Not supported	Not supported
Financial Liberalization	LIBDUM	Positive	Significantly positive	Significantly positive for model one only	Significantly positive

7.3 IMPLICATIONS OF STUDY

It is pertinent to note that government policy, particularly financial liberalization, may assist insurers in improving their efficiency levels, as explained in the literature review. However, until management decision makers leverage their inner capabilities as competitive powers, the improvement in their efficiency performance is set to be modest. The findings of this thesis provide some managerial implications for insurance companies as well as for the Malaysian government's role. As the efficiency results show, Progressive Insurance Bhd, a general local insurer, and Great Eastern Life Assurance Bhd, a life foreign insurer, are the two companies that obtained full efficiency scores in

overall and divisional efficiencies. These two players could be considered as the benchmarks for insurance companies in Malaysia in order to increase their efficiency levels. Specifically, from the frontier projection analysis, as provided in Chapter 5, an instruction manual could be constructed for managers to investigate their strengths and weaknesses. Additionally, managers could benefit from the new insurance framework presented in this thesis. In particular the decomposed efficiency evaluation gives a better evaluation of efficiency as compared to ratio analysis or other traditional measures. By adopting such a framework, managers can measure their corporate performance through an understanding of the inner activities in the black box process. Hence, a more inclusive picture of the contributors (premium accumulation efficiency or investment capability efficiency) to overall efficiency can provide managers with the type of information needed to improve their performance. In this vein, if an insurer is inefficient overall, the manager would be able to find the cause; either the service process in which its premium accumulation division or investment capability division or both may be the problem. For example, Uni.Asia General Insurance Bhd, which has the lowest overall efficiency of all companies, could first focus on improving its investment strategies as the investment capability division is the main reason for its low overall efficiency.

The findings of this thesis can provide the BNM with useful detailed information about the nature of insurance companies in Malaysia and changes over time. The analysis on the progress of the Malaysian insurance sector has shown that this sector is still far away from an advanced insurance market, and therefore highlights the need for a policy review by government. The structural analysis shows that local insurers are losing market share against foreign competitors. Also, further analyses confirms the superiority of foreign insurers in the marketplace. This study would aid the quick detection of the sources of inefficiency, which might lead to business failure and or a deterioration in competitive capability. The proposed efficiency framework in this study could be a more detailed

approach for BNM to closely monitor the insurance companies in Malaysia. A monitoring team to observe the decomposed efficiency of insurers, by opening up the black box process hidden within the insurance service process, will provide the BNM authorities with better ideas about the operation of insurance companies in the sector. In this way an early warning system could be provided to allow government authorities to step in a support the local insurers in an early, timely manner. Furthermore, this thesis supports the financial liberalization policy implemented in 2009 as a means to increase the efficiency of the insurance sector in general. Despite the fact that this policy has opened up the doors for a greater foreign market share, it has benefited the managerial efficiency performance of both foreign and local insurance companies in Malaysia. As mentioned in Chapter 3, any tight policy control could well lead to an exodus of foreign investors from the insurance market. Hence, precautionary supervision could be a more efficient solution to yielding a more efficient insurance market.

7.4 CONTRIBUTIONS OF STUDY

7.4.1 Theoretical contributions

This thesis creates a methodologically more logical and sound theoretical pathway to evaluate the efficiency of insurance companies. As mentioned in Chapter 4, the service process of an insurance company requires a unique approach which differs fundamentally from a manufacturing company (Müller, 1981). Built on financial portfolio theory, this thesis constructs an insurance efficiency framework using the intermediation approach. The intermediation approach was previously incorporated in the study of Brockett et al. (2004). However, these authors used the traditional DEA approach to measure the efficiency of insurance companies. This thesis expands their research by considering the intermediation approach in the context of DN-DEA for insurance companies. To the

knowledge of the researcher of this thesis, it is the first study that considers such approach in the insurance literature. This thesis invites new discussions for researchers and practitioners to further investigate the current measurements to accurately evaluate the efficiency of insurers, particularly using intermediation approach.

The regression analysis unveils some theoretical myths about the determinants of insurance efficiency in the Malaysian marketplace. This results of this thesis support some of the mainstream theoretical assumptions in insurance efficiency literature. In line with the past studies (Cummins, 1999; Luhnen, 2009a), this thesis supports the notion of economy of scale in which efficiency gains can be realized through increasing the firm's size. This thesis also finds evidence for the theory of firm growth (Jovanovic, 1982) in the context of the age-efficiency relationship in insurance companies. This is the first study that supports such a theoretical phenomenon in the insurance literature. The findings of the current study reveal that older firms are more efficient in premium accumulation division. Interestingly, the outcomes of this thesis provide evidences for and against the notion of economy of scope in the insurance efficiency literature. In fact, product diversification is shown to enhance the efficiency of insurers in regard to their investment capability division, thus supporting the notion of economy of scope. However, it reduces the efficiency in terms of overall and premium accumulation, in this case rejecting the notion economy of scope. Hence, the strategic focus hypothesis versus conglomeration hypothesis better fits into the insurance context because there are two opposite concepts by which either can play a role in efficiency gains. Through decomposing the insurance efficiency, the theoretical understanding can be explained more logically. In the case of the specialization-efficiency relationship, insurers using a strategic focus approach perform better in regard to premium accumulation efficiencies while insurers with a conglomeration approach show a superior investment capability

efficiency. The global advantage hypothesis (both general and limited forms) was also supported in this thesis when the premium accumulation division is considered.

7.4.2 Empirical contributions

This thesis performs a two-stage empirical analysis which is different from the prior studies in insurance efficiency domain. In the first stage, a dynamic network process was employed to measure the efficiency of insurance companies in two divisions, viz. premium accumulation efficiency and investment capability efficiency. While the current literature has focused on the use of traditional approaches for efficiency evaluation, this thesis focusses on the use of decision-making analysis in the insurance sector. Hence, an appropriate model which can take into account technological advancement and the particular needs of insurance companies was selected to perform the efficiency analysis.

Specifically, the network feature allows for the existence of multiple divisions in the service process of insurance activities. In contrast, the majority of prior studies considered the insurance service process as a single black box. As well the use of a dynamic feature allows the important connectivity between succeeding periods to be taken into account and in particular any long-term fluctuations over a number of years. In today's dynamic business world, the operational activities of insurance companies require the use of such methods which can integrate the multidimensional perspective over time. Additionally, the incorporation of the SBM approach in the dynamic network model creates a particular advantage by taking input excesses and output shortfalls into account in the analysis. This thesis is possibly the first study in the insurance efficiency literature that utilizes the DNSBM model (Tone & Tsutsui, 2014b) and which considers all the above mentioned features. This provides a trail for future studies to further investigate use of such methods to measure the efficiency of insurance companies.

In the second stage, this thesis uses a truncated regression approach to identify the determinants of insurance efficiency in Malaysia. From a methodological point of view, there are two approaches – that of Simar and Wilson (2007) and that of Banker and Natarajan (2008) which can be used to identify the contextual factors influencing the efficiency results, as the discussion in Chapter 4 shows. However, the literature to date has not provided any concrete indication as to which method gives a better and more accurate estimation (Liu et al., 2016). The empirical results of the two approaches in this thesis could provide some insights for application oriented studies in insurance efficiency literature, particularly using the DEA method. As the findings of this thesis remain the same for both approaches, this thesis contends that there is no statistically significant difference between using truncated regression approach and the OLS approach when the DEA scores are used as dependent variables. While this thesis has not used the Tobit regression model, it make no claim on the appropriateness of this model in this context.

7.5 LIMITATIONS AND FUTURE RESEARCHES

This study addressed several questions in regard to insurance efficiency and its determinants in the Malaysian insurance sector. However, due to the limitations faced by the researcher, there remain a number of unanswered questions and the opening up of potential directions for future studies. First, this researcher was constrained by the available data provided by the BNM and annual reports of insurance companies. For insurance data, this thesis compiled the data spanning 2007 to 2014 in Malaysia. However, due to unreported observations, the researcher had to remove a few companies from the dataset. Also, the time span has to be shortened to achieve a complete dataset. A longer period of data could provide a more comprehensive picture particularly before the 2009 financial liberalization policy and thereby uncover the effects of other government policies implemented in the last decade. Additionally, the gathered insurance

data lacks information with regards to reinsurance business activities of insurance companies in Malaysia. Such information could greatly improve the proposed insurance efficiency framework. Future studies are encouraged to investigate these possibilities through exploring other sources of data such as A.M Best database and ISIS database by Bureau van Dijk (if the financial support is available). Lack of data has also affected the viability of pursuing any comparative analysis of the influence of financial liberalization on insurance efficiency. This thesis only focused on pre- and post-liberalization periods to assess changes to insurance industry efficiency. However, there are other methods to evaluate the financial liberalization policy by extracting specific measures from various data sources. While the attempts were made, the researcher could not gather enough information to create a financial liberalization index for the Malaysian insurance/finance sector. Such research would require substantial support from government or industry to collect first-hand information. Future researchers may wish to consider such a project.

A new insurance efficiency framework, based on the intermediation approach, was employed in this thesis. Within the context of DN-DEA, a direction for future research could be a comparison between previously introduced frameworks built on the value-added approach and the framework developed for this study. Furthermore, potential researchers are encouraged to employ the employed new framework analysis efficiency of insurance markets in other countries. However any such cross country research should be approached with caution given the DN-DEA methodology used in this study may be suitable for single country analyses only. A metafrontier approach is mostly suggested by past studies for any cross-country analysis; however, to the researcher's knowledge, the literature to date has not proposed a metafrontier DN-DEA approach. A direction to be explored is the use of other DN-DEA methods for a comparative study. Thus while this thesis has employed in the second-stage analysis the truncated and OLS models, future studies are encouraged to explore the use of a Tobit model for comparative purposes.

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