ESSAYS ON ORGANIZATIONAL FORM AND EFFICIENCY IN THE TAKAFUL INSURANCE INDUSTRY

A Dissertation
Submitted to
the Temple University Graduate Board

In Partial Fulfillment
of the Requirements for the Degree
DOCTOR OF PHILOSOPHY

By
Khalid Al-Amri
August, 2013

Examining Committee Members:

Mary A. Weiss, Advisory Chair, Department of Risk, Insurance, and Healthcare Management
J. David Cummins, Department of Risk, Insurance, and Healthcare Management
Krupa S. Viswanathan, Department of Risk, Insurance, and Healthcare Management
Elyas Elyasiani, Department of Finance
Lalitha Naveen, External Reader, Department of Finance

ABSTRACT

Many studies have focused on the insurance industry in the US and other developed countries. Few studies have investigated the efficiency and organizational form in developing countries. This is particularly true for the Takaful insurance industry. Takaful insurance is mutual insurance based on Islamic principles. The rapid growth of Takaful insurers in many countries around the world and their long existence make it important to examine them.

Chapter 1 discusses the history and the practice of insurance during the time of ancient Arabs tribes. I discuss the conduct of the Holy Prophet (SAW) relating to insurance practice. I also briefly outlines the development of Islamic insurance in the fourteenth to the seventh centuries, nineteenth century, and the development in the twentieth century.

Chapter 2 investigates economies of scope and agency problems for Takaful insurance companies operating in 19 countries. I test the conglomeration hypothesis, which holds that firms can optimize by diversifying across businesses, versus the strategic focus hypothesis, which holds that firms improve by focusing on core businesses. More specifically, I analyze whether it is advantageous for insurers to offer both property-liability insurance and family insurance (life insurance), or to specialize in one major industry segment. I also test for agency problems, which imply that firms must motivate the agent to ensure compliance with the principal's wealth maximization objectives. That is, I analyze whether it is advantageous for insurers to operate under a *Mudharaba* (profit sharing) model or operate under a *Wakala* (fee based) model. I

estimate cost efficiency utilizing data envelopment analysis (DEA). Then, I test for scope economies and agency problems by regressing efficiency scores on control variables and indicators for strategic focus and the operating model. The results show that the *Wakala* operating model is cost inefficient and focused Takaful insurers are associated with higher cost efficiency.

Chapter 3 investigates the relationship between insolvency risk and efficiency for Takaful insurers. I measure the insolvency risk by computing the z-score which measure distance to default. I calculate the efficiency scores using Data Envelopment Analysis (DEA). I find that efficient firms have a higher distance to default. I also find that firms which operate in multiple lines are penalized for diversification by being more likely to become insolvent. In addition, I show that investing in *sukkuk* and real-estate increase the insolvency risk.

Chapter 4 analyzes the coexistence of Takaful and conventional insurance. I analyze the efficiency of different organizational forms in 13 countries. Technical, allocative, cost, and revenue frontiers were estimated using data envelopment analysis. I test the expense preference hypothesis and efficient structure hypothesis. I find evidence for the efficient structure hypothesis which claims that the two organizational forms serve different market segments due to differences in managerial discretion and access to capital. I also find evidence for the expense preference hypothesis which states that mutual insurers are less cost efficient than stock insurers due to unresolved agency conflicts (e.g., higher bonus consumption by mutual managers). The results provide insight into the competitiveness of conventional and Takaful insurers from different countries. Finally, chapter 5 concludes the main results of the study.

Dedicated to my parents, Said and Aisha, and to my children, Eyad and Mallak.

ACKNOWLEDGMENTS

This dissertation would not have been written without the assistance of my committee members, support from my family, and help from friends.

First and foremost I want to thank my advisor, Dr. May Weiss, for her guidance, suggestion and support in preparation of this dissertation. This dissertation would not have been completed in such a timely fashion without her generous commitment to the process. I am also very grateful to Dr. J. David Cummins for his valuable comments. I want to thank the other members of my dissertation committee, Dr. Krupa Viswanathan and Dr. Elyas Elyasiani and Dr. Lalitha Naveen for their insightful comments and advice.

I would like to thank my colleagues and friends at Temple University for their help and encouragement throughout my PhD studies.

I owe my deepest appreciation to my parents and my brother Ibraheem. They always believed in me and helped me reach my goals. None of these would have been done without their love and support.

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THE HISTORY OF TAKAFUL INSURANCE

It is challenging to clearly determine the origins of insurance in Islam. However, from the nature of the insurance contract today, we can say that insurance transactions had been practiced since before the time of the Holy Prophet Mohammad (SAW)[1]. Ever since, insurance in the Muslim world gradually developed until the beginning of the nineteenth century when a Hanafi lawyer, Ibn Abidin (1784-1836), became the first Islamic scholar who came up with the meaning, concept and legal entity of the insurance contract[2]. As a result, a number of insurance companies in the world today are operating based on Islamic principles. The development of Islamic insurance can be categorized into five periods[3]:

(1) The development of the doctrine of *Aqila* among the ancient Arab tribes as a tribal custom;

(2) The conduct of the Holy Prophet (SAW);

(3) The development in the fourteenth to the seventeenth centuries;

(4) The development in the nineteenth century; and

(5) The development in the twentieth century

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[1] Rispler-Chaim, V. (1991). Insurance and Semi-Insurance Transactions in Islamic History until the 19th Century. *Journal of the Economic and Social History of the Orient/Journal de l'histoire economique et sociale de l'Orient*, 142-158.

[2] Kling Muller, Ernest, "The concept and development of insurance in Islamic countries" in *Islamic Culture*, Vol. 43, January 1969, at 30.

[3] See Mohd. Masum Billah. (1998). Islamic Insurance: Its Origins and Development. Arab Law Quarterly, 386-422.

The development of the doctrine of *Aqila* among the ancient Arab tribes as a tribal custom

There are many encyclopedias pointing out that the nature of insurance practice was initiated from ancient Arab's practices[4].

It became a tradition among the tribes of Arabs that if any member of a tribe was killed by a member of a different tribe, the heir of the victim would be paid an amount of blood money as compensation by close relatives of the killer. Those close relatives of the killer were addressed as *aqila* in Arab terminology[5], and were supposed to pay the blood money[6] on behalf of the killer. Therefore, the essential idea of the doctrine of *aqila* was adapted among the ancient Arab tribes. Such monetary contributions were known as blood money. Willingness of the ancient Arabs at that time to pay compensation to the heir of the victim represented a kind of insurance practice and such compensation seemed to be a kind of financial protection for the heir of the deceased against the unexpected death of the victim.

The conduct of the Holy Prophet (SAW)

The progress of insurance practices during the time of the Holy Prophet (SAW) can be assessed from two situations:

(1) The recognition of the ancient Arab's practices of *aqila*. The Prophet (SAW) himself recognized the concept of *aqila* as practiced by the ancient Arab tribes. This can be seen from several decisions of his deeds of the Prophet (SAW).

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[4]See *Aqila* in Gibb, H.A.R., et al., The Encyclopedia of Islam, E.J. Bril, Leiden, 1979.

[5]See Aqilain Hughes, Thomas Patrick, *Dictionary of Islam*, Cosmo Publications, New Delhi, India, 1982.

[6]See Murghinani, Ali Ibn Sakar, al-Hedaya (trans. Eng.) Charles Hamilton, *The Hedaya*,Vol. 4, Book 51, Premier Book House, Lahore, Pakistan, 1982, at 670.

(2) The applicable legislation, approved in the first Constitution of Medina in 622 BC, was prepared by the Holy Prophet Muhammad (SAW) shortly after the migration to Medina. The Constitution was meant for the people of Medina (i.e. the Muhajireen, the Ansar, the Jews and the Christians), and it comprised and announced in it a kind of social insurance which takes three parts[7]:

(i) The conduct of *Dyat*: *dyat* (blood money) *aqila* (close relative of the killer) has to pay mutually to the heir of the deceased (victim) in order to save the killer from legal consequences[8].

(ii) The *Fidya* (ransom): The article in the constitution regarding saving the life of prisoners was endorsed by the Prophet (SAW). The article stated that should there be any person made a prisoner of war by an enemy; the *aqila* of the prisoner shall contribute to a ransom to be paid to the enemy in order to permit the captive to be freed[9]. Such support could be considered as an additional practice of social insurance.

(iii) Other ways of social insurance involved in the first constitution: this stated that society should be accountable for establishing a joint venture with a shared empathetic towards providing essential help for the needy, ill and poor[10].

The Development in the fourteenth to the seventeenth centuries

Between the fourteenth and seventeenth centuries, a Sufi Order of the Kazeruniyya was very active particularly in port cities in Malabar and in China. This order served as a kind of marine travel insurance company.

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[7]Vardit, Rispler, *Insurance in the world of Islam, Origins and Current Practice*, UMI, USA, 1985, at 28.

[8]Rahim, M.A., *Islamie Arthanaitik Nirapatta wa Bima* (Bangla), Islamic Foundation, Bangladesh, Dhaka, 1983, at 106.

[9]Hamidullah, D r M., *Introduction to Islam*, Sh Muhammad Ashraf, Lahore, 1983, at para3 62, at 146.

[10]Islam de Deviet Butcesi, pp. 382-83 as cited by Vardit, *op. cit*., n. 84, at 28.

The Development in the nineteenth century

Ibn Abidin (1784-1836), a Hanafi lawyer, was the first person to discuss the awareness of insurance and its legal existence during the nineteenth century. He is the first person who defined insurance in the framework of a legal institution[11]. Ibn Abidin's view on insurance practice being a legal institution served as a foundation to many Muslims who did not accept the validity of insurance practice, and it impelled other Muslims to accept the idea of involvement in insurance business.

The development in the twentieth century

During the twentieth century (1900-1901), a renowned Islamic jurist, Muhammad Abduh, issued two fatwas allowing insurance practice. One of those fatwas stated that an insurance transaction is similar to the contract of the al-Mudharabah financing practice, while the other stated that a transaction which is akin to endowment or life insurance is legal[12].

The ongoing evolution of Shari'a-based insurance practices in the twentieth century in both Muslim and non-Muslim countries is acceptable, despite the fact that there are still some areas which need developing in this field to meet the necessities of society today. However, there are some characteristics of conventional insurance which could not be adopted by Muslims due to its involvement of some unlawful elements according the Shari‘a. It is now the duty of contemporary Islamic scholars to be innovative and come up with an alternative model of Islamic insurance which removes all the elements prohibited by Islamic law (Billah, 1998).

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[12]See in Al-Dasuqi, Mohammad Al-Sayed, *Al-Tamim wa Mawqif Al-Shariyyah Al-Islamiyyah Min Hu*, Cairo, 1967, at 74ff.

[11]See Kling Muller, E., "The Concept and Development of Insurance in Islamic Countries" in *Islamic Culture*, Vol. XLIII, 1969, at 30.

The following table illustrates the development of modern Islamic financial services.

Table 1: Development of Modern Islamic Financial Services

Year	
1963	First Islamic banks established in Egypt
1975	The World's first fully fledged Islamic bank is established - Dubai Islamic Bank
1977	Fatwa issued by the Fiqh Council of Muslim World League in favor of Islamic insurance
1979	Sudanese Islamic Insurance Company is established as the world's 1st Takaful company by Faisal Islamic Bank of Sudan
	Arab Islamic Insurance Company (AIIC) is established in Dubai by the Dubai Islamic Bank
1984	Malaysian Takaful Act comes into effect
	The first Takaful company is established in Malaysia - "Takaful Malaysia"
1985	Fiqh Council of the OIC approves the Takaful system in 1985 as the correct alternative to conventional insurance in full compliance with Shari'a
	National Company of Co-operative Insurance is established in Saudi Arabia by Royal decree and is 100% owned by the government
1997	Asean ReTakaful International Limited (ARIL) the first active Islamic reinsurer is formed
2006	Worldwide re-insurance operators enter the Re-Takaful market: Hannover Re Takaful, Bahrain; Munich Re, Malaysia

Source: Adapted from Ernst & Young, 2008

CHAPTER 2

ECONOMIES OF SCOPE AND AGENCY PROBLEMS: EVIDENCE FROM THE TAKAFUL INSURANCE INDUSTRY

2.1 Introduction

Takaful (Islamic insurance) offers an alternative way of conducting insurance that is based on co-operative risk sharing and clear segregation between participant and operator (Alamasi, 2010). The unique structural form of Takaful firms differentiates them from conventional insurance. Takaful has developed hand-in-hand with the global expansion of Islamic banking. Islamic banks have been instrumental in the establishment of approximately one-half of the Takaful companies and in promoting this business concept (Billah, 2007). According to the World Takaful Report 2011, global Takaful contributions grew 31% in 2009, and continued strong growth in the Takaful industry suggests that global contributions should reach US$12 billion by 2011. Given the structural form and increasing growth and development of the Takaful industry, I believe it is important to investigate the factors that influence the efficiencies of Takaful insurance companies.

The aim of this paper is to provide new evidence about economies of scope and agency problems by analyzing Takaful insurance companies in 19 different countries[1]. I examine two main opposing hypotheses – the conglomeration hypothesis, which holds that operating a diversity of businesses can add value by exploiting cost scope economies, versus the strategic focus hypothesis, which holds that firms can best add value by focusing on core businesses and core competencies.

[1]Bahrain, Bangladesh, Brunei, Egypt, Indonesia, Iran, Jordan, Kuwait, Malaysia, Pakistan, Qatar, Saudi, Senegal, Sri Lanka, Sudan, Syria, Tunisia, UAE, Yemen.

Also, I test for agency problems in Takaful industry.I test whether it is best for firms to operate under a *Mudharaba* (profit sharing) model or operate under a *Wakala* (fee based) model. In particular, I examine whether Takaful firms would become more efficient by adopting the *Mudharaba* (profit sharing) model.

I analyze economies of scope and agency problems using a two-stage procedure where I first estimate DEA efficiency scores, and then I regress the scores on variables representing firm characteristics to control for heterogeneity across the firms in the sample. Banker and Natarajan (2008) demonstrate that this two-stage procedure yields consistent estimates of the impact of these contextual variables on efficiency. The primary variable used to test for scope economies in the second stage regressions is a dummy variable set equal to 1 for focused firms and equal to zero for diversified firms. The variables used to test for agency problems is a dummy variable set equal to 1 for firms that operate under a *Mudharaba* (profit sharing) model and equal to zero for firms that operate under a *Wakala* model (fee based). If conglomeration is the dominant strategy, I would expect focused firms to be less efficient than diversified firms; whereas if strategic focus is the dominant strategy, then focused firms should be more efficient than diversified firms. I also expect the *Mudharaba* model to be more efficient than the Wakala model because under the *Mudharaba* model policyholders share the profit with the agents (managers) thus mitigating the agency problem.

DEA measures efficiency by comparing each firm in an industry to a ‘‘best practice” frontier formed by the most efficient firms in the industry. A firm is fully efficient (efficiency score of 1.0) if it is on the frontier and inefficient (efficiency < 1) if it is not on the frontier. In this paper, I estimate cost and scale efficiency using DEA. The main alternative to DEA is a stochastic frontier analysis (SFA). I adopt DEA because it has several advantages over SFA: (1) it avoids the choice of a functional form for the cost function and requires no distributional assumptions. Such assumptions can create specification errors; and (2) DEA is individual-firm based, making it easy to decompose efficiency by firm, which is particularly convenient for studying scope economies because it allows separating the effects of scale and scope economies.

The primary contribution of this paper is to provide the first DEA analysis of scope economies and agency problems in the Takaful industry. To the best of my knowledge, this is the first study on the Takaful insurance industry that tests for both economies of scope and agency problems. I use a longer sample period and more recent data than previous Takaful studies. This study shows the operating status of the Takaful industry in terms of efficiency. Hence, it would be useful for managers and regulators in taking steps to improve Takaful efficiency.

The regression results provide evidence of both scope economies and agency problems in the Takaful industry. Focused insurers are positively associated with cost scope economies. Therefore, strategic focus is generally superior to conglomeration in the Takaful industry. Also, the *Mudharaba* (profit sharing) operating model is characterized by higher cost efficiency. Therefore, the *Mudharaba* (profit sharing) model is generally superior to the *Wakala* (fee based) model in the Takaful industry over the sample period.

The remainder of this article is organized as follows. Section II summarizes the empirical literature on Takafuls and provides a background for understanding Takaful operations. Section III gives details of the hypotheses, methodology, and model specification. Section IV discusses data, i.e., the measurement of inputs, outputs, and prices for the DEA analysis. Section V presents regression results and the results for the hypothesis tests, and Section VI offers the conclusions.

2.2 Literature Review and Takaful Background

In this section I review the empirical studies for Takaful insurance. I start with defining Takaful insurance, describing the different Takaful models, and explaining how Takaful is different from conventional insurance. Then I review the prior empirical studies.

2.2.1 Takaful Insurance

In the late 1970s, a number of Islamic insurance companies, called Takaful insurers, were established to offer Muslim individuals and businesses insurance coverage both in the life and non-life sectors under Islamic principles (Shariah principles). Takaful is a type of joint guarantee insurance mechanism; it is based on the law of large numbers in which a group of societal members pool their financial resources together against specific loss exposures. These insurers are found not only in Islamic countries and other countries with a major Muslim population, but also in North America, Australia, and selected European countries. Takaful insurance is now acceptable in many, yet not all, Islamic countries as well as in other countries with a significant Muslim population, e.g., Brunei, Indonesia, Malaysia, and Singapore. Interestingly, Takaful arrangements are also found in Luxembourg and Switzerland. Growth was forecast to be especially rapid after the turn of this century (Maysami and Kwon, 1999).

The future for Takaful business is demonstrated by the fact that almost all new insurance license applications in the Middle East are for Takaful companies. Even many Western insurers, such as American International Group (AIG), have realized the potential of Takaful and have set up their own Takaful operations. AIG Takaful, known as *Enaya*, which means "care," was established in 2006 in Bahrain with $15 million in paid-up capital (White, 2010). According to Ernst & Young (2012) global gross Takaful contributions reached US$ 8.3b in 2010, and it is expected that the gross contribution will reach US$12b by 2012. The compound annual growth rate (CAGR) of Takaful between 2005 to 2009 was 41% and 16% for 2010.

As Islamic principles differ from those of Western society, people who are unfamiliar with these principles may falsely conclude that Islam does not promote profit-oriented business transactions. In fact, Islamic principles do encourage people to engage in business transactions as long as they do not expect a predetermined return even when the outcomes of such transactions are uncertain (Maysami and Kwon, 1999).

2.2.2 Why Conventional Insurance is not Permissible in Islam

Wahab, Lewis, and Hassan (2007) state that from the standpoint of Islamic law (*Sharia'* principles), the opposition to conventional insurance is that conventional insurance is a gamble upon the incidence of the contingency that is being insured against; that is the interests of both parties (the insured and the insurer) are entirely opposed, and both parties do not know their respective rights and liabilities until the occurrence of the insured events. Overall, according to Islamic scholars, there are three main problems with conventional insurance, especially life insurance (Lewis, 2005).

First, typical insurance violates the prohibition of *gharar* (uncertainty) since the benefits to be paid rely on the outcome of future events that are not known at the time of the signing of the contract. It would appear that the *gharar* or uncertainty that is objected to by certain scholars arises from the delivery aspect of the subject matter. Uncertainty exists as to whether the insured will get the compensation that has been promised, how much the insured will get, and when the compensation can be paid. This prohibition in predetermined benefits invalidates a conventional whole life policy contract because this type of policy is based on a time frame, the lifetime of the insured, which is not known and cannot be known until the event (death) itself occurs. *Gharar* is objected to in any transaction because it is said to undermine the element of consent necessary for a valid contract. There cannot be mutual consent when one party, because of inadequate information, does not know material aspects of the contract. It would not be fair to expect that a party can consent to something of which the essential elements are not known. Mutual consent and honesty of the parties bound by a contract is therefore a moral obligation and a basic requirement for a valid contract in Islam. (Wahab, Lewis, and Hassan, 2007).

Second, insurance is regarded as *maysir* (gambling) because policyholders are essentially betting the premium that the insurer will make payment (indemnity) consequent to the occurrence of a specified event. For example, when policyholders take out a pure endowment policy, they are taking a gamble that they will still be alive by the end of the term of the policy to receive the benefits stated in the contract. According to Wahab, Lewis, Hassan (2007), there are similarities between conventional insurance contract and gambling. The amount insured is paid back to the insurer when certain events occur. If the event never occurs, the insurance company keeps the premium. It’s like putting money in a pot and rolling the dice, the lucky winner takes the pot. In the case of conventional insurance companies, they play the role of the “House” and the insured plays the role of the gambler by placing a bet. The gain for the “House” is always certain, while the gain for the better is doubtful; the person may gain or lose. Overall, the "House" is against the gamblers, and the insurance company is against the insured; the "House" and the insurance company are always winners.

Third, all insurance policies have an important investment or savings element built into them, as the insurer invests prepaid premiums on behalf of those insured. Many forms of life insurance in particular are merely thinly disguised investment vehicles, and the insurance companies conduct their business by investing collected premiums in a mix of investments that includes interest-based or other such investments, thereby contravening the Islamic laws regarding *riba* (usury) along with *gharar* and *maysir*.

2.2.3 Type of Takaful

Kwon (2008) pointed out that the Takaful operations in the primary insurance market can be broadly classified into one of three models: a *Mudharaba* model, a *Wakala* model and a hybrid model. In the *Mudharaba* model, both the policyholder and the insurer share profits from Takaful operations. With the *Wakala* model, there is a complete separation between the insurer's capital and the policyholders fund, and the insurer receives a fixed fee for managing/investing the fund on the policyholders' behalf; that is, all profits from Takaful operations, less fixed fees for underwriting and investment services, belong exclusively to policyholders. Under the hybrid plan, the insurer may use a *Mudharaba* model for underwriting activities and a *Wakala* model for investment activities (e.g., Pakistan).

2.2.4 Previous Studies on Takaful Insurance

Unlike the conventional insurance literature, the Takaful insurance literature is limited because this insurance has not been on the market for a long time and because

Figure 1: Mudharaba Model

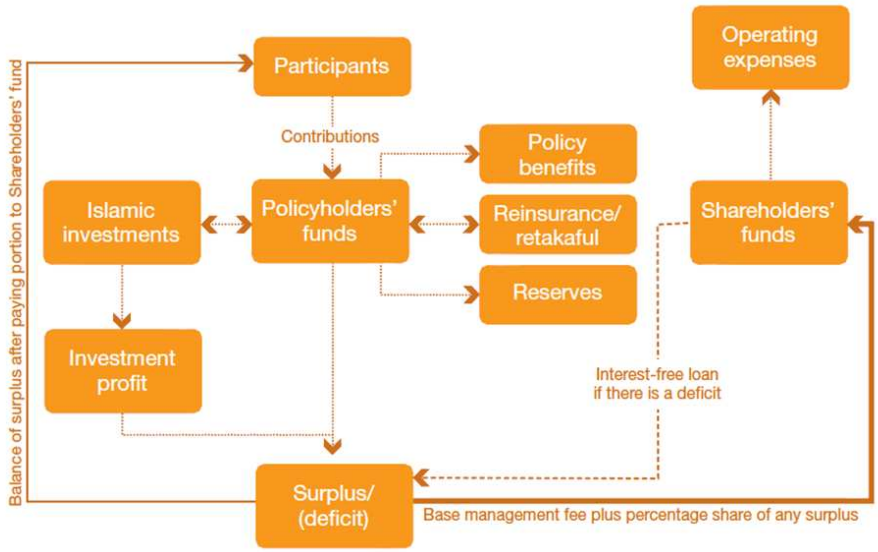
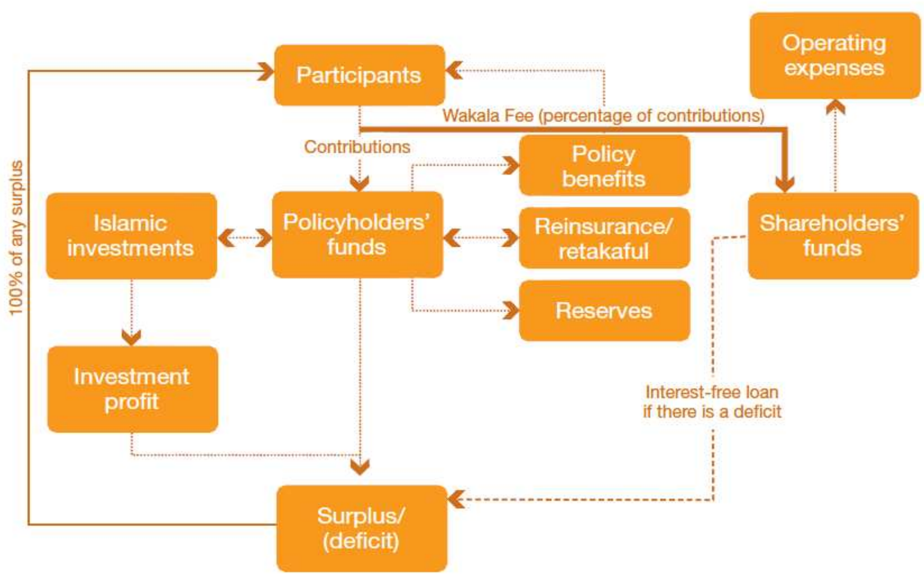


Figure 2: Wakala Model



Source: PricewaterhouseCoopers. (2008). Takaful: Growth opportunities in a dynamic market.

there are few experts in this special type of insurance. Most of the studies of Takaful insurance have focused on the concepts and the framework of the Takaful companies because people have had little or no information about Takaful insurance both in Islamic countries and in western countries. Concept papers have tried to: explain how Takaful works; illustrate the differences between conventional insurance and Takaful insurance; and describe different Takaful models (Wahab, Lewis, and Hassan, 2007; Alamasi, 2010; Taylor, 2004; Maysami and Kwon 1999; Kwon, 2008; Yazid et al, 2012). There are a few studies that focus on the *microtakaful* (Altuntas, Berry-Stölzle, Erlbeck, 2010; Kwon, 2010).

Altuntas, Berry-Stölzle and Erlbeck (2011) explore the question, 'can Takaful insurance companies be profit-maximizing firms?' The authors compare a Takaful operator with a clear business objective with a Takaful operator that focuses on non-business related objectives (i.e., to support the needy) in an environment that makes it difficult to generate profits: the Indonesian microinsurance market. The study shows that Takaful insurance can indeed be successfully offered on a for-profit basis. The authors conclude that the growing Muslim population in the U.S. represents an interesting business opportunity for U.S. insurers in their home country.

Another line of research about Takaful is found in efficiency studies and their applications in corporate governance and organizational form. Kader, Adams, and Hardwick (2010) examine the cost efficiency of non-life Takaful insurance firms. They find that separating the functions of nonexecutive directors, Chief Executive Officer and Chairman does not improve cost efficiency. However, board size, firm size and product specialization has positive effects on the cost efficiency of Takaful insurers.

Saad, et al. (2006) investigates productivity and efficiency of the life insurance industry in Malaysia. Both conventional insurance and Takaful companies are comparatively analyzed. Overall, Takaful National[2] was found to be below average in TFP but slightly above average for technical change (TEch). However, in the case of efficiency and pure efficiency change, Takaful National was below average. Ismail, Alhabshi, and Bacha (2011) conduct an efficiency analysis for the coexistence of family Takaful and conventional insurance. They find that Takafuls have lower technical efficiency than conventional insurance.

Yakob et al. (2012) identifies factors that affect the solvency of the insurers/Takaful operators in Malaysia. It is determined that investment income, the total benefit paid to capital, the surplus ratio, financial leverage, and liquidity are significantly related to solvency. Investment income has a positive relationship with solvency, while the other four are negatively related with solvency.

2.3 Hypotheses and Methodology

2.3.1 Conglomeration Versus Strategic Focus Hypothesis Development

One main research interest is understanding why some financial firms follow a conglomeration policy whereas others follow a focused strategy, despite the fact that multiple financial services have been officially permitted for long periods of time.

In the empirical application, I examine the Takaful insurance industry in 19 countries, where firms have never been restricted from providing both family (life) insurance and property liability (P-L) insurance.

[2] The only Takaful firm that being analyzed in the study.

Even so, some firms choose to produce jointly, while others choose to specialize in one insurance business or the other. Firms following an inefficient strategy should be compelled by market forces to change strategy or exit the industry. Yet, I observe that large, mature firms follow both strategies for long periods of time.

The finance literature is mixed concerning the pros and cons of integrating different lines of business in one firm as opposed to having firms focus on their areas of expertise. Advocates of the conglomeration hypothesis argue that operating in different lines of business can enhance value from utilizing cost scope economies resulting from sharing inputs in integrated production (e.g., Teece, 1980). For example, cost complementarities may arise from the sharing of customer lists and managerial expertise (Berger et al., 2000). In addition, conglomeration can improve efficiency by generating internal capital markets which may be less exposed than external markets to imperfections such as information asymmetries (e.g., Williamson, 1970; Gertner, Scharfstein, and Stein, 1994). Also, conglomeration may diversify risk, reducing the expected costs of financial distress or bankruptcy, allowing greater financial leverage and/or permitting firms to earn higher revenues from risk-sensitive customers who are willing to pay more or accept reduced services in return for lower default risk (e.g., Lewellen, 1971). Conglomeration also may exacerbate agency problems by permitting extra cash flow to weak subsidiaries and reducing the market control that would otherwise block negative net present value investments (Jensen, 1986; Meyer, Milgrom, and Roberts, 1992).

Some countries have financial systems that have permitted firms to offer many types of financial services in the same firm for many years, while other countries have restricted integration of financial services—mostly commercial banking with other activities—due to issues of systemic risk and monopoly. A recent mergers and acquisitions (M&As) wave has been driven by liberalization of product restrictions in some countries forming financial service firms of large size and scope (Berger et al, 2000).

On the other hand, advocates of the strategic focus hypothesis argue that firms can exploit value by focusing on core businesses and core expertise. According to this hypothesis, conglomeration may result in agency problems in which managers may add businesses to shield the value of their human capital (Amihud and Lev, 1981) or to increase their personal benefits (Jensen, 1986).

Most of the literature that evaluates economies of scope is focused in the US and European countries. No research that I am aware of has covered this issue in the Takaful context. Because Takaful insurers have existed for more than 30 years, a study of Takaful insurance is long overdue. Despite the importance of the economies of scope issue in insurance, rigorous research on the topic has been limited. Berger, et al., (2000) and Cummins, et al., (2010) are the main studies to analyze economies of scope for both life-health (L-H) and property-liability (P-L) insurance using US data. Berger, et al. (2000) utilized SFA for the sample period 1988–1992 and found that conglomeration dominates for some types of insurers (depending upon size and lines of business) while strategic focus dominates for other types of insurers. Cummins, et al. (2010) investigates economies of scope in the US insurance industry over the period 1993–2006. They estimate cost, revenue, and profit efficiency utilizing data envelopment analysis (DEA) and test for scope economies. They find that property-liability insurers realize cost scope economies, but they are more than offset by revenue scope diseconomies. Life-health insurers realize both cost and revenue scope diseconomies. Hence, strategic focus appears to be superior to conglomeration in the US life insurance industry. I test the following hypothesis regarding conglomeration and strategic focus:

***H1**: The efficiency scores of Takaful insurance firms are positively related to strategic focus.*

2.3.2 Agency Theory Hypothesis Development

In the modern theory of the firm, agency costs provide an explanation of the structure of organizations. Organizations that survive in any economic activity are the ones that deliver the desired product at the lowest price while covering agency costs and the costs of production (Jensen and Meckling, 1976). Agency problems, especially the principal-agent problem, could exist in any form of organization, thus Takaful insurance is not an exception. The Takaful insurance industry provides an interesting environment for studying agency hypotheses because different organizational forms coexist in the industry. Several factors contribute to (affect) agency problems[3].

Most of the literature in insurance has focused on organizational form and how it is related to the performance and characteristics of each type of organization. This is the first study to investigate the agency problem and organizational form in the Takaful industry. The focus of this study is on the coexistence between the *Mudharaba* (profit sharing) and the *Wakala* (fee based) models. The agency problem, in the context of Takaful insurance, occurs when the insurer/shareholders (agent) does not work in the best of policyholders (principal). Kwon (2007) posits:

[3]For example, Cummins, et al., (1999) argue that the intensity of agency problems depends on the type of organizational form. Specifically, mutual insurers tend to have more agency problems than stock insurance companies.

> “A principal-agency conflict may exist in Takaful fund investment. On the one hand, Takaful operators are expected to exercise prudence in making investment decisions and not to subject their policyholders’ funds to potentially high return and high risk situations. On the other hand, policyholders would prefer higher investment returns; so would the shareholders and insurance agents as their compensations are directly related to the investment performance of the insurer. All these could lead some Takaful insurers to invest their funds in the riskiest, yet *halal*, areas, ceteris paribus. Others may operate over their underwriting capacity—that is, accepting risks over the insurer capital loan capacity to cover deficiencies in underwriting—for the sake of scale and scope economies in investment, thereby likely resulting in a rise in invested asset concentration risk and bankruptcy risk of the insurer. This issue has not been strongly addressed by regulators other than the International Association of Insurance Supervisors and the Islamic Financial Services Board (IAIS, 2006) in the form of joint issues report”

Wahab, Lewis, and Hassan (2007) point out an issue in Takaful relating to the incentive fee in underwriting surplus[4]. They argue that the agency problem may arise more frequently in some types of Takaful models than in other models of Takaful. Ismail, Alhabshi, and Bacha (2011) provide empirical evidence for the coexistence of two different organizational forms, family Takaful and life conventional insurance in Malaysia. The findings indicate that there is a significant difference in technical efficiency between the Takaful industry and traditional insurance. It is found that Takaful insurers have lower technical efficiency than conventional insurance. In other words, it shows the organizational form is associated with efficiency.

Perhaps the most influential problem that arises from *Wakala* and *Mudharaba* models is the principal-agent problem. According to this problem, the contract structures of most organizational forms limit the risks undertaken by most agents by specifying

[4]When a person passes away, the death benefit is paid from the risk fund or tabarru fund (donation fund that has been setup as a contingency plan) and if the contribution collected is more than the death benefit paid out as compensation, this is when the Takaful operator will realize its underwriting surplus (Doud, 2009).

either fixed promised payoffs or incentive payoffs tied to specific measures of performance (Fama and Jensen, 1983).

The potential agency problem exists in all types of Takaful insurance (*Mudharaba* and *Wakala*). However, I assume that the problem will be even more severe in the case of the *Wakala* model. This is because the structure of the *Wakala* model represents a complete separation between the insurer's capital and the policyholders' fund. The insurer receives a fixed fee for managing/investing the fund on the policyholders' behalf; that is, all profits from Takaful operations less fixed fees for underwriting and investment services belong exclusively to policyholders (Kwon, 2007). Since the agents are not properly incentivized, they may take actions such as investing in lower risk-investment or low investment return. The *Mudharaba* model, on the other hand, eliminates or reduces the principal-agent conflict by aligning the interest for both policyholders and agents through sharing the profit from investments. Thus, I predict the *Wakala* model to be relatively less efficient than *Mudharaba* model. Therefore, I test the following agency hypothesis:

H2*: The efficiency scores of Takaful insurance firms will be positively related to the Mudharaba (profit sharing) model.*

2.3.3 Methodology

For a given Takaful insurer, an overall cost efficiency score reflects both ‘‘technical’’ and ‘‘allocative’’ efficiency. Technical efficiency (TE) measures how efficiently technology is employed in the use of inputs to achieve a given level of output. Allocative efficiency (AE) refers to how efficiently management chooses the mix of inputs at given input prices. A cost frontier shows the minimum cost of producing any given quantity of output for a perfectly efficient firm. Takaful insurance firms may fail to reach the production and cost frontiers because of technical and/or allocative inefficiencies— that is, because they fail to get the best out of their inputs and/or they fail to employ the cost-minimizing combination of inputs.

Technical efficiency can be further sub-divided into ‘‘pure technical efficiency’’ (PTE) and scale efficiency (SE). PTE measures how far a Takaful insurer is away from the production or cost frontier under conditions of variable returns to scale, while SE measures the relative production loss (or cost increase) caused by a deviation from a constant returns to scale (CRS) frontier. Thus, scale inefficiency may be associated with either increasing returns to scale (economies of scale) or decreasing returns to scale (diseconomies of scale).

Cost efficiency for a given firm is defined as the ratio of the costs of a fully efficient firm (a firm operating on the efficient cost frontier) with the same output quantities and input prices to the given firm’s actual costs. Firms achieve cost efficiency by adopting the best practice technology (becoming technically efficient) and choosing the optimal mix of inputs (becoming allocatively efficient (AE)) (Banker and Maindiratta, 1988). Cost efficiency is the product of pure technical, scale, and allocative efficiency: CE = PTE * AE * SE.

To separate the effects of scale and scope economies, I include regressions where the dependent variable is purged of the effects of scale inefficiency, i.e., regressions where the dependent variable is CEScope = CECRS/SE = PTE*AE, and where CEScope = CRS cost efficiency purged of scale inefficiency. This effectively treats every firm in the sample as if it were fully scale efficient for costs. Thus, the coefficients of the focus variable (either property liability or family insurance) in these regressions indicate the effects of focus on efficiency net of any scale efficiency effect and thus help to isolate economies of scope.

In applying DEA, I assume that Takaful insurers attempt to minimize the cost of employing various inputs to produce outputs, which are sold to policyholders in an attempt to maximize profits. The minimum cost function or cost frontier is defined using the distance function approach (e.g., Cooper et al., 2004). Let $x_j = (x_{1j}, x_{2j}, \dots ,x_{mj})^T \in \Re_+^m$ denote the input vector from Takaful firm j, $y_j = (y_{1j}, y_{2j}, \dots ,y_{nj})^T \in \Re_+^m$ denote the output vector from firm j, and $w_j = (w_{1j}, w_{2j}, \dots ,w_{mj})^T \in \Re_+^m$ denote the input price vector from Takaful firm j. Then the cost frontier is: $C(y_j, w_j) = Min_{xj}\{w_j^T x_j : x_j \in V(y_j)\}$,

Where $C(y_j, w_j)$ = the cost frontier Takaful firm j with output-input vector (y_i, x_j). The optimal vector x_j^* minimizes the costs of producing y_j given the input prices w_j. Cost efficiency from Takaful firm j is calculated as $\eta_j = w_j^T x_j^* / w_j^T x_j$, where x_j represents actual input usage and $0 < \eta_j \leq 1$.

2.4 Sample Data, Outputs, and Inputs

This section describes the data and discusses the measurement of outputs, inputs, and prices used in estimating efficiency. The section concludes by presenting summary statistics. To conduct the analysis I use an unbalanced panel data set of 269 firm-year observations for the period 2004–2009, including Takaful insurance companies of varying size, ownership structure and product-mix in each year. Financial data for these sample firms are reported in the *World Islamic Insurance Directory* 2008, which covers 2004-2006, and *World Islamic Insurance Directory* 2011, which covers 2007-2009. The analysis is based on "best practice" efficient frontiers estimated for a sample of (196)

Wakala and (73) *Mudharaba* insurance companies over the period 2004-2009. To allow standardization of the financial data, all monetary amounts were converted to U.S. dollars at the end-of-year exchange rates reported by the World Bank and deflated by the Consumer Price index (CPI) to year 2005.

I assume that Takaful insurers employ inputs to produce outputs in the form of insurance policies. Since these outputs are intangible, they are difficult to measure. One approach is to identify the services that Takaful insurance companies provide and then derive proxies that are likely to be closely correlated with these services. Takaful insurance companies, like their Western counterparts, are involved in risk-pooling and risk-bearing by selling insurance products in various lines of business such as motor and property insurance.

I assume Takaful insurance firms produce six major risk-pooling and risk-bearing outputs proxied by premium income: (a) motor vehicle insurance premium, (b) property (fire) insurance premium, (c) accident insurance premium, (d) marine and aviation insurance premium, (e) family (life insurance) premium, and (f) other insurance premium. In addition to considering risk-pooling/risk-bearing services, I also account for the intermediation function of borrowing from policyholders and investing the funds in marketable securities. Investments, representing intermediation services, are used here as another output.

Given the limited availability of data, I use ‘‘gross contributions’’ (i.e., gross premiums) to proxy the risk-pooling and risk-bearing outputs because these are available in the data. I recognize that premium income as an output indicator is a measure of revenue (i.e., price multiplied by quantity). The use of ‘‘incurred benefits’’ as a proxy for expected claims or losses has also been used in the academic literature on the efficiency of insurance companies. Unfortunately, incurred benefits are not included in the data. However, I can rationalize the use of premiums as an output proxy since premiums are likely to be highly correlated with a company's expected losses.

I specify the inputs of Takaful insurance companies to be: number of employees, shareholders equity, and technical provisions. The price of labor is proxied by taking the operating expenses divided by the number of employees. The price of shareholders equity is proxied by the expected rate of return on the stock market which were obtained from Bloomberg. The price for technical provisions is proxied by the annual lending interest rate. These definitions enable us to compute input prices and quantities that vary across the Takaful insurance firms in the sample as well as over time. The summary of inputs and outputs are presented in *Table 2*.

2.4.1Technical Efficiency and its Decomposition

The DEA results are based on the output maximization model, known as the output-oriented approach. In this approach, the output is determined while holding input constant. The DEA model was run twice, once under the constant returns to scale (CRS) assumption and then under the variable returns to scale (VRS) assumption. CRS assumes that there is no significant relationship between the scale of operations and efficiency, thus small insurance firms can be as efficient as large insurance firms in converting the specified inputs into the specified outputs. DEA under a VRS assumption is run to check for scale inefficiency. Using the preceding DEA methodology and data for the 89 insurance firms, Cost Efficiency (CE) and Scale Efficiency (SE) annual scores are calculated for the period from 2004 to 2009. A summary of these are presented in *Table 3*.

Table 2: Inputs and Outputs for Cost Efficiency

Panel A: Definition of inputs, input prices, and outputs

Inputs	Proxy
Labor	Number of employees
Debt Capital	Technical provision
Equity capital	Shareholders' equity
Input Prices	
Price of labor	Operating expenses/Number of employee
Price of debt capital	Rate of return on debt
Price of equity capital	Long-term average stock market return indices
Outputs	
Incurred benefits	Premium income: motor, fire, accident, marine & aviation, family, and other
Investments	Total investment

Panel B: Summary statistics for variables used

Variable	Unit	Mean	Std. Dev.	Min	Max
Labor	Quantity	183.429	281.89	5	1,565
Debt capital	Million $	270.891	1,741	252	22,100
Equity capital	Million $	462.822	4,529.41	6.15	74,300
Price of labor	$	281.0448	607.52	13.086	2,292.40
Price of debt capital	%	10	4	3	23
Price of equity capital	%	14.16	3.37	5.06	16.91
Motor premium	Thousand $	163.917	732.27	0	590.69
Fire premium	Thousand $	54.035	341.42	0	3649.3
Accident premium	Thousand $	18.608	88.84	0	813.93
Marine and aviation premium	Thousand $	71.833	423.75	0	5,532.40
Family premium	Thousand $	60.329	422.06	0	5,330.42
Other Premium	Thousand $	64.768	291.18	0	2,845.05
Investments	Million $	519.841	4.7	2.91	74,500

Note: The values are winsorized at the 5% and 95% level.

The CRS efficiency score of each insurance firm measures its technical efficiency (TE), which takes into account the input/output configuration and the size of operations. On the other hand, the VRS efficiency score represents pure technical efficiency (PTE); that is it is the measure of efficiency after eliminating the scale inefficiency. Therefore, the scale efficiency score is calculated by dividing the technical efficiency score by the pure technical efficiency score (SE=TE/PTE).

The average cost efficiency score for the period from 2004 to 2009 of 53.63% suggests that Takaful insurers are moderately efficient overall, but there is large room for improvement. The low number of fully efficient insurance firms confirms the belief that the Takaful insurance industry still has a long way to go. Moreover, the Takaful insurance firms present a high dispersion in terms of efficiency. The average scale efficiency score is 80.06% for the period from 2004 to 2009. The efficiency scores show a large range of scores and high standard deviations as can be seen in *Table 3*.

2.4.2 Multiple Regression Analysis and Hypotheses Test

The summary statistics for variables used in the regression are presented in *Table 3* and the correlation matrix is presented in *Table 4*. To provide evidence on the effects of focus versus diversification while controlling for other firm characteristics that may influence efficiency, I conduct multiple regression analysis with efficiency scores, return on equity (ROE), and return on assets (ROA) as dependent variables. I used ROE and ROA as alternative measurement for firms' performance. The regression model with insurer i in year t is:

Table 3: Regression Variables Summary for Sample Period of 2004-2009

Variable	Mean	Std. Dev.	Min	Max
LogAsset	10.5136	2.4775	2.0553	18.1841
Focused	0.6022	0.4903	0	1
ProfitShar	0.2714	0.4455	0	1
HHI_Country	0.0693	0.1274	0.003	1
Age^2	236.901	406.839	0	2025
%Sukkuk	0.1799	0.2967	0	1
%Stocks	0.2271	0.3099	0	1
%Real_Estate	0.0735	0.1761	0	0.9277
%Motor	0.3952	0.2765	0	1
%Fire	0.1202	0.1207	0	0.8025
%Accident	0.0652	0.0926	0	0.7739
%Marine_Aviation	0.0961	0.1103	0	0.5855
%Family	0.1208	0.2665	0	1
CE	0.5363	0.3436	0.017	1
SE	0.8006	0.2636	0.2094	1
ROA	0.171	2.4282	-0.2674	1.0531
ROE	0.1308	0.5518	-0.4109	2.37172

Note: LogAsset: log of total assets; HHI_Country: Herfindahl index based on percentages of premiums written within countries; Focused: 1 for specialized firm (either property-liability or family), 0 otherwise; ProfitShar: 1 if a firm operates in a profit sharing (Mudharaba model) model, 0 otherwise; Age^2: square of the age of the firm; %Sukkuk: percentage of the investment in Islamic Bonds; %Stock: percentage of the investment in stock; %Real Estate: percentage of the investment in real estate; %Motor: percentage of motor insurance premium out of the total premium; %Fire: percentage of fire insurance premium out of the total premium; %Marine_Aviation: percentage of marine and aviation insurance premium out of the total premium; %Family: percentage of family insurance (life) premium out of the total premium; CE: Cost Efficiency; SE: scale efficiency; ROA: Return on Assets; ROE: Return on Equity.
The values are winsorized at the 5% and 95% level.

$$CE/SE_{i,t} = \beta_0 + \beta_1 . Focused_{i,t} + \beta_2 . ProfitShar_{i,t} + \beta_3 . TotalAssets_{i,t} + \beta_4 . HHI\_Country_{i,t} + \beta_5 . Age^2{}_{i,t} + \beta_6 . \%Stock_{i,t} + \beta_7 . \%Sukkuk_{i,t} + \beta_8 . \%RealEstate_{i,t} + \beta_9 . \%Motor_{i,t} + \beta_{10} . \%Fire_{i,t} + \beta_{11} . \%MarineAvia_{i,t} + \beta_{12} . \%Famil_{i,t} + \gamma_j + \mu_t + \varepsilon_{i,t} \quad (1)$$

$CE/SE_{i,t}$ is cost efficiency divided by scale efficiency for insurer i in year t. To separate the effects of scale and scope economies, the dependent variable is purged of the effects of scale efficiency. $Focused_{i,t}$ is dummy variable equal to 1 for specialized (either property-liability or life) firms and zero for diversified firms. $ProfitShar_{i,t}$ is a dummy variable equal to 1 for *Mudharaba* (profit sharing) Takafuls and, zero otherwise. $TotalAssets_{i,t}$ is the natural logarithm of total assets and serves as a proxy for the Takaful insurer size. $HHI\_Country$ is the Herfindahl index based on percentages of premiums written within countries. Age^2 is the squared value of the age of firms. $\%Stock_{i,t}$, $\%Sukkuk_{i,t}$, $\%RealEstate_{i,t}$, are the percentages of investment held in stock, sukkuk, and real estate. $\%Motor_{i,t}$, $\%Fire_{i,t}$, $\%MarineAvia_{i,t}$, $\%Famil_{i,t}$ are the percentage of insurance premiums written in motor, fire, marine and aviation, and family (life) respectively. γ_j, μ_t are country and year dummies respectively. $\varepsilon_{i,t}$ is the error term. Follow Berger, Cummins and Weiss (2000), I distinguish between life and property-liability generally.

Table 4: Correlation Matrix for Regression Variables Relating Scope Economies to Agency Problems

	CE/SE	ROA	ROE	Focused	ProfShar	LAsset	HHI	Age2	%Sukuk	%Stocks	%RealEst	%Motor	%Fire	%Accidt	%MarAv	%Family
CE/SE	1															
ROA	0.07	1														
ROE	0.00	0.08	1													
Focused	0.07	0.08	0.06	1												
ProfShar	-0.15	0.00	0.10	0.03	1											
LAsset	-0.01	-0.14	-0.04	0.01	-0.04	1										
HHI	0.11	-0.03	-0.02	-0.05	-0.07	0.18	1									
Age^2	0.09	0.11	0.00	0.20	-0.06	0.24	-0.12	1								
%Sukuk	0.04	0.03	0.07	-0.02	-0.13	-0.02	-0.01	-0.02	1							
%Stocks	-0.07	-0.04	-0.04	-0.09	0.01	0.14	-0.02	-0.01	-0.24	1						
%RealEst	0.14	0.15	0.02	0.02	-0.15	-0.06	-0.03	0.22	-0.14	-0.03	1					
%Motor	-0.06	-0.01	0.06	0.04	0.09	-0.14	-0.04	0.06	0.05	-0.15	0.1	1				
%Fire	0.01	0.09	0.04	0.04	-0.04	0.01	0.00	0.26	-0.07	-0.07	0.2	-0.11	1			
%Accidt	0.04	0.01	-0.01	-0.01	0.31	-0.07	0.05	-0.01	-0.07	-0.06	-0.1	-0.06	0.07	1		
%MarAv	0.05	-0.02	-0.04	-0.01	-0.13	-0.02	0.01	0.25	0.13	0.06	0.1	-0.03	0.18	0.02	1	
%Family	0.07	-0.01	0.01	-0.05	-0.05	0.04	0.06	-0.17	-0.03	0.06	-0.1	-0.45	-0.28	-0.20	-0.3	1

Note: CE/SE: cost efficiency divided by scale efficiency; ROA: Return on Assets; ROE: Return on Equity; Focused: 1 for specialized firm (either property-liability or family), 0 otherwise; ProfitShar: 1 if a firm operates in a profit sharing (Mudharaba model) model, 0 otherwise; LAsset: log of total assets; HHI: Herfindahl index based on percentages of premiums written within countries; Age^2: square of the age of the firm; %Sukuk: percentage of the investment in Islamic Bonds; %Stock: percentage of the investment in stock; %RealEst: percentage of the investment in real estate; %Motor: percentage of motor insurance premium out of the total premium; %Fire: percentage of fire insurance premium out of the total premium; %Accidt: percentage of Accident insurance premium out of the total premium;%MarAv: percentage of marine and aviation insurance premium out of the total premium; %Family: percentage of family insurance (life) premium out of the total premium.

The principal regressor to measure the effects of strategic focus versus diversification is an indicator variable set equal to 1 for focused firms (either property liability or family insurance) and 0 for diversified firms (both property-liability and family insurance). A positive (negative) coefficient on this variable would imply that focused firms are more (less) efficient than diversified firms. The main variable to quantity the effects of agency problems is an indicator variable (ProfitShar) set equal to 1 for the *Mudharaba* (profit sharing) model and 0 for the *Wakala* (fee based) model. A positive (negative) coefficient on this variable would imply that firms operating under the *Mudharaba* (profit sharing) model are more (less) efficient than firms operating under the *Wakala* (fee based) model.

The control variables in the regressions include important firm characteristics such as size, type of investment, and percentage of premiums by line. Year and country dummy variables are also included in the regressions but are not shown in the regression table to save space[5].

The percentage of investments in stock, real estate, *sukkuk*[6] are included in the regression to control for type of investment, with cash and short term investments as the excluded category. The proportion of premiums in four lines of insurance including automobile, fire, accident, marine and aviation, and family are included in the regressions to control for business mix, with other premiums as the excluded category.

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[5]There is a tradeoff between selecting a homogenous sample of countries and the number of observations. That is, by selecting a homogenous sample I will reduce the sample size which would make the subsequent results have low statistical power. I control for the heterogeneity between countries by including country dummies. The downside of the country dummies is that they might not fully capture the heterogeneity across countries.

2.4.3 Empirical Results

The Takaful firms' efficiency regressions are presented in *Table 5*. I first discuss the results with the focus indicator variable, then the agency problem indicator variable. The focus strategy indicator variables are significant and positively related for cost scope economies, ROE, and ROA in the OLS regressions. As robustness check, I run a Tobit regression and the results still hold. Therefore, there is strong and consistent evidence that the focused firms are more efficient than diversified firms, which supports the hypothesis.

The effects of agency problems on Takaful firms' performance are shown in the cost scope economies OLS regressions in *Table 5*. Also, as a robustness check I run a Tobit regression, and the results still hold for scope economies. Because the dependent variables is cost scope economies, the significant positive coefficient on the profit sharing indicator variable reveals that insurers operating under the *Mudharaba* (profit sharing) model are more cost efficient than Takaful firms that operate under the *Wakala* (fee based) model. However, there is no evidence for this when I have ROE and ROA as the dependent variables.

Thus, the results only hold for scope economies in the OLS and Tobit regression. Therefore, there is evidence that firms operating under the *Mudharaba* (profit sharing) model are more efficient than those who operate with a *Wakala* (fee based) model. This is consistent with the hypothesis that the *Mudharaba* (profit sharing) model minimizes agency problems and motivates the agent to act in compliance with policyholders' wealth maximization objectives.

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[5]Sukkuk refers to the Islamic equivalent of bonds.

Table 5: Regression Relating Scope Economies to Agency Problems

	OLS Regression			Tobit Regression
	(1)	(2)	(3)	(1)
	CE/SE	ROA	ROE	CE/SE
Focused	0.125**	0.472**	0.0430	0.124**
	(0.040)	(0.015)	(0.391)	(0.025)
ProfitShar	0.116**	0.184	0.118	0.115***
	(0.014)	(0.133)	(0.343)	(0.006)
LogAsset	0.0275**	0.0933*	0.0150*	0.0272**
	(0.023)	(0.072)	(0.050)	(0.012)
HHI_ Country	-0.0125	0.188	-0.0161	-0.00851
	(0.969)	(0.823)	(0.831)	(0.978)
Age2	-0.000	0.0006***	0.000	-0.000
	(0.902)	(0.000)	(0.699)	(0.916)
%Sukkuk	0.106	0.902***	0.0149	0.107
	(0.284)	(0.001)	(0.781)	(0.254)
%Stocks	-0.0231	0.306	-0.00604	-0.0237
	(0.840)	(0.380)	(0.929)	(0.830)
%Real_Estate	0.267**	2.318	0.175	0.268**
	(0.047)	(0.338)	(0.262)	(0.029)
%Motor	0.172	0.0133	-0.0168	0.172
	(0.315)	(0.959)	(0.826)	(0.291)
%Fire	0.289	2.142	0.298	0.293
	(0.316)	(0.110)	(0.395)	(0.285)
%Accident	0.722**	0.576*	-0.145*	0.724**
	(0.034)	(0.092)	(0.069)	(0.019)
Marine_Aviation	0.446	-1.560	-0.196*	0.450
	(0.148)	(0.188)	(0.070)	(0.119)
%Family	0.361**	0.460	0.111*	0.364***
	(0.020)	(0.216)	(0.059)	(0.009)
N	268	268	268	268
R-sq	0.771	0.071	0.026	

Note: ROA: Return on Assets; ROE: Return on Equity; CE/SE: Cost Efficiency divided by scale efficiency; ProfitShar: 1 if a firm operates in a profit sharing (*Mudharaba*) model, 0 otherwise; HHI_Country: Herfindahl index based on percentages of premiums written within countries; Age^2: square of the age of the firm; LogAsset: log of total assets; %Stock: percentage of the investment in stock; %Sukkuk: percentage of the investment in Islamic Bonds; %Real Estate: percentage of the investment in real estate; %Motor: percentage of motor insurance premium out of the total premium; %Fire: percentage of fire insurance premium out of the total premium; %Marine_Aviation: percentage of marine and aviation insurance premium out of the total premium; %Family: percentage of family insurance (life) premium out of the total premium.

P-value in parentheses * $p < .1$, ** $p < .05$, *** $p < .01$.

The coefficient of log assets is positively related to cost efficiency. Thus, the large Takaful insurers are more cost efficient. This would be consistent with larger firms having lower costs of capital than smaller firms. Large firms are more likely to enjoy higher negotiation power over their clients and suppliers. Also, larger firms may achieve better diversification of risk. The cost scope economies is positively related to the percentage investment in real estate and the percentage premium written in accident and family insurance.

The coefficient of percentage investment in *sukkuk* and age are positively related to ROA suggesting that investment in *sukkuk* and age enhances the performance of a firm. The year and country dummy variables (not shown) are generally statistically significant indicating that it is important to control for differences in intercepts across years and countries. There is no trend over time in the magnitude of the year-effect coefficients[7].

2.5 Conclusion

This study investigates economies of scope and agency problems for an unbalanced sample of 89 Takaful insurance companies operating in 19 countries from 2004 to 2009. The tests seek to determine whether diversified firms, which offer both family Takaful (life insurance) and property liability insurance, are more or less efficient in producing family Takaful (respectively, property liability) insurance than firms that specialize in family Takaful (respectively, property liability) insurance, i.e., to determine whether diversified insurance firms associated with economies of scope.

[7]I did not include other variables such as insurance penetration, insurance density, and legal system in the regression equations. Most of those variables were not significant under many specifications. There is a tradeoff between variables included in the regression and the degrees of freedom. That is, the more variables you add, the more you erode the ability to test the model (e.g., the statistical power goes down).

Cost economies of scope arise due to production complementarities, such as efficiencies in the use of shared inputs. Also, the tests seek to determine whether firms who operate under a *Mudharaba* (profit sharing) model are more or less efficient than firms that operate under a *Wakala* (fee based) model. Agency problems may arise due to lack of incentive, such as a bonus or profit share percentage to shareholders (agent) to work in the best interest of the policyholder (principal) in the *Wakala* model.

I estimate cost efficiency utilizing data envelopment analysis (DEA) and test for scope economies and agency problems by regressing efficiency scores on control variables and on an indicator variable for strategic focus and type of operating model. There is a positive relationship between focused Takaful firms and cost scope economies. Therefore, strategic focus is generally superior to conglomeration in the Takaful industry.

The regression results provide evidence of agency problems in the Takaful industry as well. The *Mudharaba* (profit sharing) operating model is positively related to cost efficiency. Therefore, the *Mudharaba* (profit sharing) model is generally superior to the *Wakala* (fee based) model in the Takaful industry over the sample period.

The results of the research imply that managers of Takaful firms should focus on core competencies rather than pursuing conglomeration strategies. Thus, property liability or family specialists should exercise caution when considering expansion across industry segments. Insurers operating in both segments might consider divestitures as a way of improving performance. Regulators should be skeptical of scope economies as justifications for mergers and acquisitions. Moreover, the results of the research imply that managers of Takaful firms should focus on the *Mudharaba* (profit sharing) model rather than the *Wakala* (fee based) model to minimize agency problems. Thus, Takaful entrepreneurs should use caution when they are considering establishing a Takaful company.

CHAPTER 3

ARE MORE EFFICIENT INSURERS LESS LIKELY TO DEFAULT? EVIDENCE FROM THE TAKAFUL INSURANCE INDUSTRY

3.1 Introduction

Insolvency risk in the insurance industry is a major concern for policyholders, investors, and regulators. Insurance solvency is important because of potential contagion across the financial sector and the consequent meltdown of the financial system, clearly manifested in the financial crisis of 2007-2009. To mitigate excessive risk taking by the insurer, the insurance industry is subjected to strict regulatory restrictions in terms of capital requirements. In particular, in the aftermath of the recent financial crisis, regulation of insurance capital structure has received a great deal of attention because capital structure is an important factor in maintaining solvency.

Many researchers have examined insolvency in the insurance industry in the US and other developed countries. Few studies have investigated the insolvency risk in developing countries and in particular for the Takaful insurance industry. Takaful insurance is a type of mutual insurance based on Islamic principles. The rapid growth of Takaful insurers in many countries around the world and their long existence (for 30 years) make it important to examine them.

Further, few studies have examined the association between efficiency and risk for insurance firms (Brockett et al., 2004). Even so, the results based on U.S insurance firms cannot be generalized to Takaful insurance firms because they are fundamentally different in the way they operate, in their regulation (e.g. they have to meet Shari'a law and other laws), and in the market in which they operate (most Takaful firms operate in developing countries where the regulation and market are not mature or saturated).

The purpose of this study is to measure insolvency propensity for Takaful firms using the z-score and to determine if insolvency propensity and efficiency interact. Following Laeven and Levine (2009), I mainly measure insurer risk using the z-score of each insurer, which is equal to the return on assets plus the capital asset ratio divided by the standard deviation of asset returns. The z-score measures the distance to default (Roy, 1952).

A question of interest is whether solvency and efficiency interact. In particular, an issue I address is whether solvency requirements interfere substantially with efficiency and, if so, what are the magnitudes in the reduction in efficiency. Further, I try to determine whether there is any diversification penalty due to operating in multiple lines of businesses (e.g., property-liability vs. life and health insurance) versus operating in one main line of business. I also examine which types of investments (sukkuk, real estate, and stock) are associated with insolvency.

In an attempt to better understand and clarify these results, I go further to dichotomize the results by organizational form into the *Mudharaba* (profit sharing) and *Wakala* (fee based) model. This allows for the possibility that the two organization types might be differentially affected by solvency constraints. Rationales for potential differences in the efficiency and solvency relationship in the *Mudharaba* (profit sharing) and *Wakala* (fee based) models can be derived from the different incentive structures inherent in the two types of organizational forms. In the *Mudharaba* (profit sharing) model both the policyholder and the insurer share profits from Takaful operations. While in the *Wakala* model, there is a complete separation between the insurer's capital and the policyholders' fund. Also, the insurer under the *Wakala* model receives a fixed fee for managing/investing the fund on the policyholders' behalf; that is, all profits from Takaful operations, less fixed fees for underwriting and investment services, belong exclusively to policyholders.

My contributions include the following. First, I explicitly estimate firm performance by computing the cost efficiency of individual Takaful firms over the time period 2004 to 2009 using data envelopment analysis (DEA). DEA measures efficiency by comparing each firm in an industry to a ‘‘best practice” frontier formed by the most efficient firms in the industry. Second, I examine the effect of organizational form on insurer solvency propensity. Insolvency is related to organizational form because different organizational forms vary on the process to incentivize their employees and differently mitigate agency problems through different compensation schemes. Third, it is the first study that analyzes Takaful insolvency for Takaful firms in 19 countries[1] for a long time period (2004 to 2009). I also use a different measure for measuring insolvency than the traditional measure used in previous studies both for insurance in general and Takaful insurance in particular. I use z-score as a proxy for distance to default (Laeven and Levine, 2009). The remainder of this article is organized as follows: the "Literature Review" reviews previous studies on insurers' insolvency. “Hypotheses Developments" and “Data and Methodology” presents data and methods employed for testing the hypotheses developed, followed by "Empirical Results." The article concludes with a discussion of regulatory implications.

[1]Bahrain, Bangladesh, Brunei, Egypt, Indonesia, Iran, Jordan, Kuwait, Malaysia, Pakistan, Qatar, Saudi, Senegal, Sri Lanka, Sudan, Syria, Tunisia, UAE, Yemen.

3.2 Literature Review

The literature on insolvency can be categorized as techniques used previous research on insolvency, insolvency techniques: RBC and FAST, and insolvency in the Takaful industry. The rest of this section discusses these categories.

3.2.1 Techniques Used in Prior Research on Insolvency

Many previous researchers have studied the propensity for insolvency of property- liability insurers as well as life/health insurers. Researchers have used different techniques and methodologies, such as linear discriminant analysis (LDA), genetic algorithm (GA), and multivariate discriminant analysis (MDA) (Trieschmann and Pinches, 1973; Ambrose and Seward, 1988; Hershbarger and Miller, 1986; Carson and Hoyt, 1995). Other techniques have been used such as logit and probit analyses (BarNiv and Hershbarger, 1990; Carson and Hoyt, 1995; Cummins, Harrington, and Klein, 1995; Cheng and Weiss, 2012), univariate analysis (Beaver, 1966; Pinches and Trieschmann, 1974; BarNiv and Smith, 1987) and cash flow simulation (Cummins, Grace, and Phillips, 1999).

Other studies focus on nonparametric discriminant analysis (BarNiv and Raveh, 1989) and an exponential generalized beta model (BarNiv and McDonald, 1992). In addition, multivariate regression models (MRMs), and fixed or random effects regression, are used to predict insolvency, determine the bankruptcy classification, or identify the determinants of insurance solvency (Baranoff et al., 1999; Carson and Hoyt, 2000; Browne et al., 2001; Zou, Adams, and Buckle, 2003; Shiu, 2005; Hsiao and Whang, 2009). More recently, the artificial neural network (ANN) approach and rough set approach (RS), have been used to determine the probability of insurance firm insolvency (Brockett et al., 1994, 1997, 2006; Sanchis et al., 2007; Chiet et al., 2009).

3.2.2 Insolvency Techniques: RBC and FAST

Regulators strive to prevent/mitigate the insolvency risk by imposing rules to make sure the insurer has adequate capital to survive an economic downturn. The National Association of Insurance Commissioners (NAIC) uses several mechanisms/tools for this purpose. Two well-known solvency monitoring mechanisms/tools are risk-based capital (RBC) requirements and the financial analysis solvency test (FAST). These were developed partly as a response to a rash of insolvencies during the 1980s and went into effect in the 1990s (Cheng and Weiss, 2012).

Several studies have investigated the accuracy of RBC and FAST in predicting insolvency. For example, Grace, Harrington, and Klein (1998) (GHK) find that, while the ratio of actual capital to RBC is negatively and significantly associated with the propensity of subsequent failure, relatively few companies that later failed had ratios of actual capital to RBC within the NAIC's ranges for regulatory action. Cummins, Harrington, and Klein (1995) (CHK) confirm that the predictive accuracy of the RBC ratio is very low, even when the components of the ratio, rather than the overall ratio, are used as predictors. Cummins, Grace, and Phillips (1999) compare the accuracy of RBC, FAST, and a cash flow simulation model developed by the authors. They find that the cash flow simulation variables lead to more accurate solvency prediction than the ratio-based models taken alone.

In GHK tests, the overall FAST score performs considerably better than RBC in predicting insolvencies, and the addition of the RBC ratio to the FAST-ratio prediction models leads to some improvements in predictive accuracy. Cummins, Grace, and

Phillips (1999) find that a core set of financial ratios used in the FAST system were superior to the RBC ratio in predicting insurer insolvencies in the period 1990–1992.

A more recent study by Cheng and Weiss (2012) analyze the performance of the risk-based capital (RBC) ratio and other variables in predicting insolvencies in the property–liability insurance industry during the period 1994–2008. The results indicate that the accuracy of the RBC ratio in predicting insolvencies is inconsistent over time and that some previously tested financial ratios that are part of the FAST system do not always reliably predict insurer insolvency. They found that the insolvency propensity is significantly related to an insurer's hurricane prone area exposure, changes in interest rates, the industry wide combined ratio, and the industry-wide Herfindahl index of premiums written. A drawback of both the RBC and FAST systems is that they are grounded on a "snap-shot" view of the firm at a specified point in time, i.e., they are static rather than dynamic approaches to solvency testing (Cummins, Harrington, and Niehaus, 1993,).

Another stream of research focuses on macroeconomic variables such as interest rates and the inflation rate (Browne and Hoyt, 1995; Chen and Wong, 2004; Cheng and Weiss, 2012) in predicting insolvency. Browne, Carson, and Hoyt (1999) find support for the argument that economic and market factors are important in the prediction of life/health insurers' financial health. However, Chen and Wong (2004) did not find any support for the effects of market/economic factors on general insurers' financial strength.

3.2.3 Insolvency in The Takaful industry

Unlike conventional insurance, Takaful research is very limited, especially the research on insolvency. This is partially due to the limited availability of data, the relatively recent existence of Takaful insurers in many countries, and limited experts in the field. The two main studies on insolvency in Takaful insurance are Yakob et al. (2012) and Onagun (2011).

Onagun (2011) focuses on the nature of Qard and its basis in *Sharia'* (Islamic law) [2]. He examine the various analyses to the nature of Qard in Takaful and the resulting legal effects from each analysis to the issue of solvency of Takaful fund. He focuses on specific part of the Takaful funds which is allocated for coverage of risks and claims (risk funds).

Yakob et al. (2012) identifies factors that affect the solvency of insurers/Takaful operators in Malaysia. It is determined that investment income, the total benefit paid to capital, the surplus ratio, financial leverage, and liquidity are significantly related to solvency. Investment income has a positive relationship with solvency, while the total benefit paid to capital, the surplus ratio, and financial leverage are negatively related with solvency.

3.3 Hypotheses Developments

7 hypotheses are tested in this research. The hypotheses center on efficiency, conglomeration vs. strategic focus, organizational form, operating risk, and family Takaful. The remainder of this section discusses the hypotheses in more detail.

3.3.1 Firms' Efficiency and The Insolvency Risk

The association between firm efficiency and insolvency risk has been studied by a limited number of academics in the insurance industry (e.g., Leverty and Grace, 2012).

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[2] According to the *Sharia'* principles, the Takaful Operator is commonly expected to provide a Qard facility (interest free loan) in case of a deficit in the Takaful fund and the repayment of Qard should be from future surplus arising from the Takaful funds.

Several reasons exist to associate firm performance with solvency. First, since firm performance provides an indication of how well the firm is doing, it should have a direct link to its solvency. That is, a firm's relative performance can tell us how well the firm is doing and that should be directly related to the firm's solvency condition.

Second, corporate failure is generally not a sudden event; it is rare that firms with good profitability and strong balance sheets file for bankruptcy because of a sudden change in the economic environment. Usually, corporate failure is the culmination of several years of adverse performance and, hence, will be largely captured by the firm's accounting statements (Agarwal and Taffler, 2008).

Third, inefficient corporate governance is likely to be at the root of financial difficulties, which ultimately might be followed by an acquisition or bankruptcy (Heiss and Koke, 2004). The empirical evidence for market-based economies suggests that target firm tend to be associated with poor performance. Altman (1971) shows that some accounting ratios (profitability and efficiency) are negatively correlated with bankruptcy.

Further, Altman (1984) examined a sample of firms that later went bankrupt and used two methods of estimating financial distress costs. The first method measured the decline in sales relative to others in the industry, and the second method measured the deviation between firms' actual earnings and forecasts of their earnings over the three years prior to filing for bankruptcy. An insurer's operating performance is frequently measured using accounting ratios such as return on assets and return on investment. These ratios provide a great deal of information about an insurer's financial performance compared with prior periods and compared with other insurers' performance.

[3]For the USA, see Bethel et al. (1998) and Denis and Sarin (1999); for the UK, see Franks et al. (2001).

Nevertheless, there are limitations to the use of these ratios. One is that financial ratios fail to consider the value of management's actions and investment decisions that will affect future as opposed to current performance. For example, a firm that defers marketing and new product development costs can appear to be performing well based on accounting ratios even though these actions may impair future performance. Another limitation is that accounting ratios aggregate many aspects of performance such as financing, marketing and operations. An insurer may appear to be performing well even if it is poorly managed on certain of these dimensions, as long as it compensates by performing particularly well on other dimensions (Sherman and Gold, 1985)[4]. Given the above argument I test the following hypothesis:

H1*: Efficient Takaful firms have lower insolvency risk.*

3.3.2 Focused VS. Diversified Firms

Diversified firms are more prone to different types of risks since they are operating in multiple lines of business (e.g., property-liability and life insurance). Meanwhile focused firms that operate in one specialized line of business can develop expertise in that area and accumulate experience. If a firm is operating in multiple lines of business they may be less efficient in managing risks that are not related to all business lines. Also being a conglomerate (operating in different types of business) may exacerbate agency problems by funneling extra cash flow to weak subsidiaries and reducing the market control that would otherwise block negative net present value investments (Jensen, 1986; Meyer, Milgrom, and Roberts, 1992). Moreover, conglomeration may result in agency problems in which managers may add businesses to shield the value of their human capital (Amihud and Lev, 1981) or to increase their

[4]For details in disadvantages of using accounting ratios see (Agaral and Taffler, 2008).

personal benefits (Jensen, 1986).Thus, conglomerate firms are prone to a diversification penalty.

Hoyt and Trieschmann (1991) compare the risk-return tradeoff for life-health, property-liability, and diversified insurers. They found that investment in individual life-health and property-liability insurance was better than investment in a diversified insurer. They argue that larger diversified insurers may simply be unable to efficiently manage combined life-health and property-liability insurance operations.

One might argue that a firm operating in multiple lines will be less prone to risk or a financial/economic downturn due to a diversification effect. While this might be true, it would most likely be hard or less efficient for a firm to deal with different types of risk at the same time especially if each special type of risk requires specific knowledge and experience. Previous studies have shown that focused firms are more efficient than diversified firms (e.g., Cummins et al. 2010). Given the above arguments, I test the following hypothesis:

H2*: Focused Takaful firms have lower insolvency risk than diversified firms.*

3.3.3 Organizational Form and The Insolvency Risk

The potential agency problems discussed above exists in all types of Takaful insurance (*Mudharaba* and *Wakala*). However, I assume that the problem will be even more severe in the case of the Wakala model. This is because the structure of the Wakala model represents a complete separation between the insurer's capital and the policyholders' fund. The insurer receives a fixed fee for managing/investing the fund on the policyholders' behalf; that is, all profits from Takaful operations less fixed fees for underwriting and investment services belong exclusively to the policyholder (Kwon, 2007). Since the agents (managers) are not properly incentivized, they may take actions such as investing in low return investments. Hence, under the *Wakala* model the return may be less than under the *Mudharaba* model and will be more prone/affected by any financial and economic crisis/downturns. The *Mudharaba* model, on the other hand, eliminates or reduces the principal-agent conflict by aligning the interests of both policyholders and agents through profit sharing. Weitzman (1984) argues that profit-sharing policies have desirable macroeconomic characteristics (e.g., increase employment). Given the above argument I test the following hypothesis:

H3*: The Mudharaba Takaful model has lower insolvency risk.*

3.3.4 Operating Risk and Insolvency

The indicator of (operating risk) is the portion of the firm's investments held in stocks, *sukkuk* (Islamic bond), and real estate. Vaughan (1992) states that "the investment income of a property and liability insurer is composed basically of interest on bonds, dividends on stocks, and interest on collateral loans and bank deposits" (p. 134). Thus, the decision on how to allocate funds across financial assets for investment purposes can affect operating risk (Borde, Chambliss, and Madura, 1994). Insurers' operations typically focus on two primary activities, insurance underwriting and investments.

According to A.M. Best (2012), 57% of assets held by Takaful operators are in higher risk investments such as shares (which include private equity), loans, and real estate. *Sharia'* compliance refers not only to the operational structure of the company, but also to its investment policy. Takaful companies must avoid investing in traditional fixed income securities due to the coupon interest payment attached. Instead, they are allowed to invest in *sukkuk*, Islamic bonds, where coupon payments take the form of a profit share on a particular enterprise. Thus, a large portion of investments is held in stock form which is considered risky due to the volatility of the stock market. Given the above argument, I test the following hypothesis:

***H4**: The percentage of a Takaful's investment held in stock is positively related to insolvency risk.*

The second indicator of operating risk is the portion of the firm's investments held in the form of the investment *Sukkuk*. According to A.M Best (2012)[5], traditional life insurers outperformed their Takaful competitors during 2009 when return on life premium was 7.3% for Takaful operators, compared to 9.4% for their counterparts. This was not a consequence of Takaful operators' risk selection, rather a result of their asset composition with their investments being concentrated in *sukkuk* (*Sharia'* compliant bonds) and private equity investments, which were among the hardest hit by the global downturn. Also, some of the *sukkuk* are non-tradable which make them even more risky. Thus, I test the following hypothesis:

***H5**: The percentage of a Takaful's investment held in sukkuk is positively related to insolvency risk.*

A third indicator of operating risk is company exposure to real estate holdings. Real estate holdings offer diversification from fixed-income assets. Yet, real estate holdings are commonly viewed as risky because of their sensitivity to volatile real estate market trends (Borde, Chambliss, and Madaura, 1994). Thus, I test the following hypothesis:

***H6**: The percentage of a Takaful's investment held in real estate is positively related to insolvency risk.*

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[5]A.M Best's MENA review 2012.

3.3.5 Family (life) and insolvency risk

The hypothesis is that life/health insurance companies exhibit less risk, because their future payouts resulting from claims are subject to less uncertainty which improve the cash outflow prediction (Borde, Chambliss and Madaura, 1994)[5]. While property-liability insurers face some of the same risk as life insurers, they are also subject to volatile cash outflows due to liability lawsuits, property catastrophes, and other contingent events affecting claim costs (Cummins, Phillips, and Smith, 2001). Therefore, given the above argument, I test the following hypothesis:

H7*: Family Takaful insurance exhibits lower insolvency risk than property-liability Takaful insurers.*

3.4 Methodology

In this section the OLS regression model used to test the hypotheses is presented. Variables to test the hypotheses are discussed as well as control variables.

3.4.1 Model

If a firm's performance has an impact on its solvency, I would expect an association between the efficiency score and insolvency risk (z-score). Along the same lines, I would expect an association between focused Takaful insurers, organizational form, operating risk (proxied by investments in stock, sukkuk, and real estate), family insurance, and insolvency risk. The model is specified as follows:

[5]Kim et al. (1995) found that the correlation coefficients of identified variables in life insurers' insolvency are not highly correlated with insolvencies of property-liability insurers.

$$\text{Risk}_{i,t} =$$

$$\beta_0 + \beta_1 . \text{Efficiency}_{i,t} + \beta_2 . \text{Focused}_{i,t} + \beta_3 . \text{OrganizationalForm}_{i,t} + \beta_4 . \text{OperatingRisk}_{i,t} + \beta_5 . \text{Family}_{i,t} + \beta_6 . \text{ControlVariables}_{i,t} + \gamma_j + \mu_t + \varepsilon_{i,t} \quad (1)$$

Where $\text{Risk}_{i,t}$ is proxied by the z-score of insurer *i* in year *t*. $\text{Efficiency}_{i,t}$ is the cost efficiency, and it is used as a proxy for insurer performance. $Focused_{i,t}$ is a dummy variable equal to 1 if a firm is either property-liability or family, and 0 otherwise. $\text{OrganizationalForm}_{i,t}$ is a dummy variable equal to 1 for *Mudharaba* (profit sharing) models and 0 for *Wakala* models. $\text{OperatingRisk}_{i,t}$ is proxied by the proportion of investments in stocks, *sukkuk*, and real estate, with cash and short term investments as the excluded category. $\text{Family}_{i,t}$ is proportion of life insurance premium. γ_j is a country dummy and μ_t is a year dummy. $\varepsilon_{i,t}$ is the error term

3.4.2 Variable Construction

For management to identify and develop ways to assess insurer performance, other management tools that compensate for the weaknesses in accounting ratios are needed. This paper uses Data Envelopment Analysis (DEA) as one approach to measure insurers' performance. The results suggest that DEA provide insights into insurer operating efficiency beyond that available from accounting ratios and help improve insurer efficiency. DEA results were analyzed in conjunction with other analytic techniques and were found to suggest areas where operating efficiency can be improved (Sherman and Gold, 1985).

To measure Takaful performance, I calculate cost efficiency using Data Envelopment Analysis (DEA). DEA has been widely used to measure the efficiency of property-liability and life insurers (see Cummins and Weiss, 2012). Cost efficiency is the ratio of the minimum required costs to the actual costs utilized to produce a given level of output. A firm is considered fully efficient if its actual input usage equals optimal input usage for given output quantities and input prices.

A firm is inefficient if actual input usage exceeds optimal input usage. For a given Takaful insurer, an overall cost efficiency score reflects both ‘‘technical’’ and ‘‘allocative’’ efficiency. Technical efficiency (TE) measures how efficiently technology is employed in the use of inputs to achieve a given level of output. Allocative efficiency (AE) refers to how efficiently management chooses the mix of inputs at given input prices. A cost frontier shows the minimum cost of producing any given quantity of output for a perfectly efficient firm. Takaful insurance firms may fail to reach the cost frontier because of technical and/or allocative inefficiencies— that is, because they fail to get the best out of their inputs and/or they fail to employ the cost-minimizing combination of inputs.

Following Laeven and Levine (2009), I mainly measure insurer risk using the z-score of each insurer, which equals the return on assets plus the capital asset ratio divided by the standard deviation of asset returns. The z-score measures the distance from insolvency (Roy, 1952). Insolvency is defined as a state in which losses surmount equity ($E<-\pi$) (where E is equity and π is profits). The probability of insolvency, therefore, can be expressed as prob ($-ROA<CAR$), where ROA ($=\pi/A$) is the return on assets and CAR ($=E/A$) is the capital assets ratio. If profits are normally distributed, then the inverse of the probability of insolvency equals $(ROA+CAR)/\sigma(ROA)$, where $\sigma(ROA)$ is the rolling standard deviation of ROA. Following the literature, I define the inverse of the probability

of insolvency as the *z*-score. A higher *z*-score indicates that the insurer is less likely to become insolvent.

3.4.3 Control Variables

Natural logarithm of total assets are used as a control variable for the size of a firm. Previous studies of insurer failures provide evidence of higher insolvency rates for small firms (Cummins, Harrington, and Klein (1995); Cummins, Grace, and Phillips (1999); and Cheng and Weiss (2012)).

Other indicator variables are the portion of premiums in four lines of insurance including automobile, fire, accident, and marine and aviation. The proportions of business in these lines are included in the regressions to control for business mix, with other premiums as the excluded category. I interact the Natural logarithm of total assets with the percentage of premium in Motor. The rationale is that the motor insurance market is dominated by a few large motor insurance companies. A negative value for the effect of the interaction term would imply that the larger the insurer, the less effect that motor premium has on insurer solvency. I control for competition by including the proportion of business written by top 5 writers. Year and country dummy variables are also included in the regressions but are not shown in the regression table to save space[6].

3.5 Data and Sample

I obtained the data from the *World Islamic Insurance Directory*, Takaful Re/Insurance Communications, UAE. This directory provides accounting data at the firm-level on major Takaful insurance companies in different countries.

[6]There is a tradeoff between selecting a homogenous sample of countries and the number of observations. That is, by selecting a homogenous sample I will reduce the sample size which would make the subsequent results have low statistical power. I control for the heterogeneity between countries by including country dummies. The downside of the country dummies is that they might not fully capture the heterogeneity across countries.

I have a total of 213 firm-year observations of Takaful insurers across 19 countries. The accounting data on Takaful insurers are from 2004 to 2009. The data contain a sample of Takaful insurers of varying size and premiums by lines in each year. To allow for standardization of the financial data, all monetary amounts were converted to U.S. dollars at the end-of-year exchange rates reported by the World Bank and deflated by the Consumer Price index (CPI) to year 2005.

3.5.1 Descriptive Statistics

Table 6 reports the annual statistics for Takaful insurers in the sample for the period 2004-2009.The asset size is highly skewed to the right as Takaful insurers in the top quartile are several times bigger than median size Takaful insurers[7]. The average of the z-score is 5.22, which indicates that, on average, profits have to fall by almost 5 times their standard deviation to deplete Takaful insurers' equity.

The correlation matrix is reported in *Table 7* for the primary variables. There are no signs of multicollinearity. However, the pair-wise correlation measures may be highly unreliable indicators of the relationships among the variables of interest because Takaful size, premium by line, investments by line and other attributes are likely to affect Takaful

solvency. Hence, I carry out tests of the main hypotheses using a multiple regression framework.

3.6 Empirical Results

The empirical results are presented in *Table 8*. This section discusses the results of the hypothesis tests in terms of variable coefficients in *Table 8*.

[7]I use the natural logarithm of total assets to measure Takaful insurers' size to reduce the effect of skewness on the results.

Table 6: Sample Statistics of Takaful Insurers, Efficiency, and Insolvency

Variable	Mean	Std. Dev.	Min	Max
Focused	0.5875	0.4931	0	1
ProfitShar	0.3102	0.4634	0	1
LogAsset	10.5136	2.4775	2.0553	18.1841
%Sukkuk	0.1799	0.2967	0	1
%Stocks	0.2271	0.3099	0	1
%Real_Estate	0.0735	0.1761	0	0.9277
%Motor	0.3952	0.2765	0	1
%Fire	0.1202	0.1207	0	0.8025
%Accident	0.0652	0.0926	0	0.7739
%Marine_Aviation	0.0961	0.1103	0	0.5855
%Family	0.1208	0.2665	0	1
Top_5	0.0112	0.1052	0	1
Z_Score	5.2208	2.85148	0.0527	7.9447
CE	0.5363	0.3436	0.0170	1
Std_ROE	0.124222	0.330223	0.0027	3.9504
Std_ROA	0.633082	2.104106	0.0087	2.6482

The dependent variable is insolvency risk (Z-Score) ((ROA+CAR)/σ(ROA)), in which ROA is the return on assets and CAR is the capital-asset ratio, Std_ROA: standard deviation of return on asset, Std_ROE: standard deviation of return on equity, CE: cost efficiency, Focused: 1 for specialized firms, 0 for diversified firms, ProfitShar: 1 for Mudharaba model and 0 for Wakala model, Top_5: Percentage of premium of top 5 firms. LogAsset: log of total assets, %Stock, %Sukkuk, %Real_Estate: percent of investments in stock, sukkuk, and real estate, respectively. %Motor, %Fire, %Accident, %Marine_Aviation, %Family: percent of insurance premium written in Motor, Fire, Accident, Marine and Aviation, and life insurance, respectively.

Table 7: Correlation Matrix Regression Variables Relating Takaful Insurers Efficiency and Insolvency Risk

	z-score	std_ROA	std_ROE	CE	ProfShar	Focused	LAsset	%Motor	%Fire	%Accidt	%MarAv	%Family	%Sukuk	%Stocks	%RealEst	Top_5
z-score	1															
std_ROA	-0.431	1														
std_ROE	-0.194	0.013	1													
CE	0.077	-0.025	-0.021	1												
ProfShar	0.035	0.136	-0.113	0.068	1											
Focused	-0.17	0.03	0.151	0.098	-0.01	1										
LAsset	-0.183	-0.041	-0.088	-0.323	0.034	-0.057	1									
%Motor	-0.211	0.212	0.141	0.04	-0.124	0.232	-0.187	1								
%Fire	0.116	0.014	-0.029	-0.018	0.038	0.202	0.006	-0.079	1							
%Accidt	0.127	-0.073	-0.022	-0.063	-0.319	0.033	-0.088	-0.07	0.099	1						
%MarAv	-0.161	0.129	-0.05	-0.042	0.136	0.106	0.019	0.006	0.154	0.043	1					
%Family	0.014	-0.091	-0.023	-0.044	0.057	-0.466	0.065	-0.466	-0.294	-0.204	-0.273	1				
%Sukuk	0.105	-0.077	0.118	-0.058	0.133	-0.052	-0.058	0.037	-0.097	-0.115	0.123	-0.003	1			
%Stocks	-0.143	-0.057	-0.106	-0.04	-0.03	-0.118	0.168	-0.135	-0.078	-0.028	0.053	0.04	-0.245	1		
%RealEst	-0.311	0.418	0.101	0.217	0.164	0.102	-0.097	0.175	0.108	-0.042	0.147	-0.116	-0.144	-0.047	1	
Top_5	0.022	-0.038	-0.028	-0.01	0.022	-0.069	0.111	-0.036	-0.075	0.105	0.208	-0.039	0.035	-0.052	-0.061	1

Insolvency risk (Z-Score)= ((ROA+CAR)/σ(ROA)), in which ROA is the return on assets and CAR is the capital-asset ratio, Std_ROA: standard deviation of return on asset, Std_ROE: standard deviation of return on equity, CE: cost efficiency, ProfitShar: 1 for Mudharaba model and 0 for Wakala model, Focused: 1 for specialized firms, 0 for diversified firms, LAsset: log of total asset, %Motor, %Fire, %Accident, %MarAv, %Family: percent of insurance premium written in Motor, Fire, Accident, Marine and Aviation, and life insurance, respectively, %Stock, %Sukkuk, %RealEst: percent of investments in stock, sukkuk, and real estate, respectively. Top_5: Percentage of premium of top 5 firms.

3.6.1 Efficiency and Takaful Insurer Stability

The association between Takaful stability and cost efficiency is described by equation (1) presented earlier. *Table 2* displays the multivariate regression results for the models, where the variable Risk is proxied by the z-score (model 1). As robustness test, I utilize standard deviation of ROA (model 2), and standard deviation of ROE (model 3) as measures for risk. The models are estimated using the Ordinary Least Squares (OLS) technique.

One parameter of interest are the coefficients of cost efficiency (CE). The coefficient estimates of CE are positive and significant at the 5% level in Model (1). CE is negatively related to volatility of ROA and ROE and significant at the 1% level in models (2) and (3). The results suggest that an increase in cost efficiency reduces the Takaful insurance insolvency risk (increases the z-score). A reduction in cost efficiency is associated with an increase in volatility of ROA and ROE (models 2 and 3). These results are consistent with Hypothesis H1, which states that as firms' efficiency increases, insolvency risk decreases. Thus, efficiency is an influential factor in determining Takaful insurer stability.

3.6.2 Focus Strategy Versus Conglomeration Strategy and Takaful Insurer Solvency

In this section, I investigate the relationship between the strategy adopted (focus vs. conglomeration) and Takaful insurers' solvency to determine which strategy mitigates the insolvency risk. The coefficient estimates of the focused variable are positively related to the z-score and significant at the 5% level in model (1). Also, the coefficient of focused is negative related to volatility of ROE and significant at the 1% level in model

(3). The results suggest that by adopting a focused strategy, Takaful firms will be less likely to default (i.e., the z-score increases). This is consistent with hypothesis H2.

3.6.3 Organizational Form and Takaful Insurer Stability

The association between organizational form and Takaful insurer insolvency risk is particularly important because of the existence of agency problems inherent in the Wakala (fee based) model. The parameters of interest are the coefficients of organizational form (Profitshar). The coefficient estimate of ProfitShar is positively related to the z-score and significant at the 10% level in model (1). The coefficient of profitshar is negatively related to volatility in ROA and ROE, and significant at the 5% and 1% level in models (2) and (3) , respectively. The results suggest that by adopting the *Mudharaba* (profit sharing) model, Takaful firms will be less likely to default (i.e., the z-score increase). The result is consistent with hypothesis H3.

3.6.4 Operating Risk and Takaful Insurer Stability

The indicators of operating risk are the coefficients of the percentage of the firm's investments held in stocks, *sukkuk* (Islamic bond), and real estate. The coefficient estimate of Stocks is negatively related to the z-score as expected, but not significant in models (2) and (3). The coefficient estimates for *sukkuk* are positive and significant at the 10% and 5% level in models (2) and (3), respectively. The result is consistent with hypothesis H5 which states that the percentage of a Takaful's investment held in *sukkuk* is positively related to insolvency risk.

Table 8: Regression Relating Takaful Insurers Efficiency and Insolvency Risk

	(1) Z_Score	(2) Std_ROA	(3) Std_ROE
CE	0.0186**	-0.0087***	-0.000788***
	(0.031)	(0.001)	(0.003)
ProfitShar	1.133*	-0.371**	-0.107***
	(0.055)	(0.011)	(0.001)
Focused	1.128**	-0.130	-0.128***
	(0.045)	(0.691)	(0.000)
LogAsset	0.139	-0.00173	-0.00594***
	(0.294)	(0.947)	(0.001)
%Motor	-0.167	1.378**	0.120*
	(0.883)	(0.016)	(0.083)
%Fire	3.237*	-0.358	-0.00687
	(0.093)	(0.712)	(0.956)
%Accident	3.245	-0.531	-0.0950
	(0.257)	(0.199)	(0.381)
%Marine_Aviation	-2.585	1.444	-0.211
	(0.314)	(0.228)	(0.110)
%Family	-0.994	0.198	0.149***
	(0.412)	(0.551)	(0.000)
%Sukkuk	-0.465	0.468*	0.189**
	(0.611)	(0.054)	(0.019)
%Stocks	-1.767*	-0.261	-0.0195
	(0.062)	(0.155)	(0.439)
%Real_Estate	-5.611***	4.543***	0.275***
	(0.004)	(0.000)	(0.000)
Motor X Asset	-0.000***	0.000	0.000
	(0.005)	(0.568)	(0.701)
Top_5	0.721	-0.440	0.0506
	(0.690)	(0.163)	(0.607)
N	212	213	213
R-sq	0.417	0.472	0.326

This table reports the OLS regression results explaining Takaful insurer distance to default (Z-Score) using Eq. (1). The dependent variable is insolvency risk (Z-Score) ((ROA+CAR)/σ(ROA)), in which ROA is the return on assets and CAR is the capital-asset ratio, Std_ROA: standard deviation of return on asset, Std_ROE: standard deviation of return on equity, CE: cost efficiency, Focused: 1 for specialized firms, 0 for diversified firms, ProfitShar: 1 for Mudharaba model and 0 for Wakala model, Top_5: Percentage of premium of top 5 firms, LogAsset: log of total asset, %Stock, %Sukkuk, %Real_Estate: percent of investments in stock, sukkuk, and real estate, respectively. %Motor, %Fire, %Accident, %Marine_Aviation, %Family: percent of insurance premium written in Motor, Fire, Accident, Marine and Aviation, and life insurance, respectively.
P-value in parentheses * $p < .1$, ** $p < .05$, *** $p < .01$.

The coefficient estimates on real estate are negatively related to the z-score and significant at the 1% level in model (1). The coefficient is positively related to volatility in ROA and ROE and significant at 1% level in models (2) and (3). The result is in line with hypothesis H6 which states that the percentage of a Takaful's investment held in real estate is positively related to insolvency risk.

3.6.5 Family (life) and Takaful Insurer Solvency

The indicator for type of insurance is the percentage of premium written in family (life) insurance (%Family). This variable serves as an indicator for which type of insurance is more vulnerable to risk; that is, the life/health insurance companies exhibit less risk because their future payouts resulting from claims are subject to less uncertainty (Borde, Chambliss and Madaura, 1994). The coefficient estimates for %Family are not significant in model (1) and model (2). However, it is positively related to volatility in ROE which is the opposite sign expected for hypothesis H7. Thus, the result is not consistent with hypothesis H7 which states that family Takaful insurance exhibits lower insolvency risk than property-liability Takaful insurers.

3.6.6 Control Risk to Takaful Insurer Solvency

The additional control variables included in equation (1) are the natural logarithm of total assets (LogAsset) which proxies for size of the Takaful insurers and the percentage of premiums written in motor, fire, accident, and marine and aviation (%Motor, %Fire, %Accident, %MarineAviation, respectively). The size is inversely related to the volatility of ROE. The motor insurance premium has a positive impact volatility of ROE. There is no evidence of the effect of competition (Top_5) on the Takaful insurers' stability. The year and country dummy variables (not shown) are generally statistically significant indicating that it is important to control for differences in intercepts across years and countries. There is no trend over time in the magnitude of the year-effect coefficients[8].

3.7 Conclusion

In this study, I assess the association between efficiency and Takaful insurers' solvency (risk). Also, I assess the association between Takaful insurance firms' characteristics and its solvency. I find that efficient firms are less likely to default. Moreover, Takaful insurers that are diversified are more prone to insolvency risk than specialized Takaful insurers. Takaful insurers that adopted the *Mudharaba* (profit sharing) model have higher distance to default than insurers that use the *Wakala* model.

There is some evidence of the impact of operating risk on Takaful insurers' solvency. Investments in stock and real estate are associated with higher insolvency risk for Takaful insurers. Investments in *sukkuk* are associated with higher volatility of ROA and ROE. Also, some lines of insurance business are risker than other lines of insurance business. Specifically, motor decreases the stability of Takaful insurers.

To the best of my knowledge, this study is the first research that analyzes the solvency of Takaful insurers using z-score as a measure of risk. The implication of this research will promote understanding of Takaful insurance and its solvency. Managers in the Takaful insurance industry should focus on enhancing the efficiency of their firms.

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[8] I did not include other variables such as insurance penetration, insurance density, age, and legal system in the regression equations. However most of these variables were not significant under many specifications. There is a tradeoff between variables included in the regression and the degrees of freedom. The more variables you add, the more you erode the ability to test the model (e.g., the statistical power goes down).

They should exercise caution when they want to expand their business or start new lines of business.

CHAPTER 4

ORGANIZATIONAL FORM AND EFFICIENCY: THE COEXISTENCE AND CONVENTIONAL INSURERS

4.1 Introduction

Agency costs, in the modern theory of the firm, have been used to explain the structure of organizations with the organizations that last in any economic activity being the ones that deliver the preferred product at the lowest possible price while covering agency costs and the costs of production (e.g., Jensen and Meckling 1976). The insurance industry provides a particularly interesting environment for studying agency-theoretic hypotheses as two types of organizational forms coexist in the industry: stock insurers, owned by stockholders, and mutual insurers, owned by policyholders (Cummins, Misas and Zi, 2004). Several hypotheses have been developed that address the coexistence of these two types of organizations, the two most prominent being the expense preference hypothesis (Mester, 1991) and the efficient structure hypothesis (see Cummins, Misas and Zi 2004). The expense preference hypothesis states that mutual insurers are less cost efficient than stock insurers due to unresolved agency conflicts (e.g., higher bonus consumption by mutual managers). The efficient structure hypothesis claims that the two organizational forms serve different market segments due to differences in managerial discretion and access to capital.

Two types of organizational forms exist in Muslim countries as well as some western countries which have large Muslims populations, namely conventional and Takaful insurers. Globally, Takaful contributions grew by 19% in 2010, to US$ 8.3b and they are expected to reach US$ 12 billion by 2012. Conventional insurance has penetrated a small percentage of the 1.6B Muslims market globally. Whether this is due to religious inclinations, inadequate insurance distribution or lack of education about insurance products, the untapped segment provides a huge potential for Takaful (The World Takaful Report, 2012).

The birth of Takaful was due to the prevailing need of the Muslim population for an Islamic alternative to conventional insurance. It was also aimed to complement the operation of the Islamic banking system (Saad, 2012). While the first Takaful insurance company was set up in 1979, it has only been in the last few years that the industry has experienced rapid growth. Increasing awareness and globalization will lead to Takaful becoming a real and identifiable sector of the world insurance market in the next decade (ICMIF, 2009).Takaful has grown hand-in-hand in the same market as conventional insurance.

This paper focuses on the two organizational forms: conventional and Takaful insurers. The Takaful firms are similar to the mutual form which is owned by policyholders whereas the conventional insurance firms refer to the stock form owned by stockholders (See Saad, 2012). I use cross-frontier analysis, based on data envelopment analysis (DEA), to provide new evidence about the relationship between organization and efficiency in insurance markets where conventional and Takaful firms coexist. This is the first study to empirically test the expense preference hypothesis and the efficient structure hypothesis in a large international study in the context of Takaful and conventional insurers. I consider 666 firm-years covering 13 countries from 2007-2011[1].

[1]Bahrain, Bangladesh, Jordan, Kuwait, Malaysia, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Tunisia, Turkey, United Arab Emirates.

In addition to increasing public awareness of Takaful insurance, my contributions include the following. First, it is the first study that explicitly estimates firm performance by computing the revenue efficiency of individual Takaful and conventional firms over the time period 2007 to 2011 using data envelopment analysis (DEA). DEA measures efficiency by comparing each firm in an industry to a ‘‘best practice” frontier formed by the most efficient firms in the industry. Second, it is the first study that analyses organizational form in the context of the coexistence of Takaful firms and conventional insurers in 13 countries. I consider different types of insurance in this study: life, non-life, and multi-line insurance firms.

This study shows the operating status of the Takaful industry in the presence of conventional insurers in terms of efficiency. Hence, it would be useful for managers and regulators in taking steps to improve the overall insurance industry market. For example, conventional and Takaful insurers can be ranked by their efficiency to determine the most efficient suppliers of insurers. Managers of insurers with low efficiency rankings can use this knowledge to develop ways to improve performance.

The paper is organized as follows. Section 2 presents the literature review followed by the efficiency concepts in section 3. The hypotheses are presented in section 4. Section 5 presents the discussion of the DEA methodology, and data are discussed in Section 6. Section 7 presents the empirical results and analysis, and finally, Section 8 concludes.

4.2 Literature Review

Prior literature can be categorized as focusing on organizational form in the insurance industry and organizational form in the Takaful industry. The rest of this section discusses these categories.

4.2.1 Prior Literature on Organizational Form in Insurance Industry

Organizational form and efficiency has been extensively studied in the insurance literature. It is examined by Fecher et al. (1993; French life and non-life insurers), Gardner and Grace (1993; US life), Fukuyama (1997; Japanese life), and Cummins and Zi (1998; US life). These studies did not find significant efficiency differences between stocks and mutuals.

More recent studies include Cummins, Weiss and Zi (1999; US non-life), Cummins, Misas and Zi (2004; Spanish life and non-life), Greene and Segal (2004; US life), Brockett et al. (2005; US non-life), Jeng and Lai (2005; Japanese non-life), Erhemjamts and Leverty (2010; US life), Diboky and Ubl (2007; German life), Wende, Berry-Stölzle and Lai (2008; German non-life), Eling and Luhnen (2010; international life and non-life), and Biener and Eling (2012; northern America and the European Union life and non-life). Recent research has shown mixed evidence for the expense preference hypothesis for the United States, Europe, and other insurance markets. For example, Cummins, Weiss and Zi (1999) find evidence for the expense preference hypothesis for the US property-liability insurance industry. However, Greene and Segal (2004) find that both US life mutual companies and stock companies are operating on the same cost efficiency frontier, which is inconsistent with the expense preference hypothesis. Cummins, Misas and Zi (2004) conclude that the expense preference hypothesis does not hold for the Spanish insurance industry. Diboky and Ubl (2007) and Wende, Berry-

Stölzle and Lai (2008) findings are mixed for the German insurance market. Wende, Berry-Stölzle and Lai (2008) find evidence both for expense preference and managerial discretion in non-life whereas Diboky and Ubl (2007) reject the expense preference hypothesis for German life insurers. Eling and Luhnen (2010) conducted a broad efficiency comparison of 6462 insurers from 36 countries. They compared different methodologies, countries, organizational forms, and company sizes considering life and non-life insurers. They did not find any support for the expense preference hypothesis.

The first study that empirically tests the expense preference hypothesis and the efficient structure hypothesis in a large cross-country sample was conducted by Biener and Eling (2012). They provide new insight into the relationship between organizational form and efficiency in international insurance markets. The study covers 23,807 firm-years for 21 countries from North America and the European Union. They find evidence for the efficient structure hypothesis in selected market segments, but they find no evidence for the expense preference hypothesis.

4.2.2 Prior Literature on Organizational Form in Takaful Industry

Unlike conventional insurance, Takaful research is very limited in scope, especially research on organizational form. This is partially due to the limited availability of data, the recent existence of Takaful insurers in many countries, and limited experts in the field. Most of the Takaful organizational form research has been conducted in the Malaysia market. The 3 main studies on organizational form in the Takaful insurance context are Saad (2012), Ismail et al. (2011), and Saad et al. (2006).

Saad et. al. (2006) investigates the efficiency of eleven life insurers and one Takaful firm, Takaful Nasional, over the period 2002 to 2005. They found that pure efficiency for Takaful Nasional is below the industry average whereas scale efficiency change is equivalent to the industry average. This study is not the final word on evaluating Takaful efficiency because only one Takaful operator is studied compared to eleven life insurers. Ismail et al. (2011) provides an empirical study of the relationship between efficiency and organizational structure for Takaful operators in the Malaysian market over the period 2004-2009.The findings indicate that there is a significant difference in technical efficiency between the Takaful industry and the conventional insurance industry. It is found that Takaful insurers have lower technical efficiency than conventional insurers. The study found that conventional insurers have higher scale efficiency than Takaful insurers.

Saad (2012) examines the efficiency of general or non-life Takaful and the conventional insurance industry in Malaysia during the period 2007 to 2009. The author use Data Envelopment Analysis (DEA) and the Malmquist index. A significant difference in efficiency is found between the Takaful industry and the conventional insurance industry. The Takaful insurance industry is less efficient than the conventional insurance industry under both a constant returns to scale (CRS) and variable returns to scale (VRS) assumption. In addition, the Takaful industry has lower pure technical efficiency (PTE) and scale efficiency (SE) than the conventional insurance industry. Therefore, it seems that the organizational form has direct implications for efficiency. This is consistent with the managerial discretion hypothesis and the expense preference hypothesis as stated by Cummins, Weiss and Zi (1999).

In summary, the literature review shows that that mutual and stock ownership forms coexist in most developed and emerging economies worldwide. Takaful and conventional insurers coexist also, but this coexistence has never been analyzed in an international context.

4.3. Efficiency Concepts

This section first discusses cross-frontier analysis, frontier efficiency concepts, and provides an overview of the estimation strategy.

Frontier efficiency techniques measure a company's performance relative to the ‘‘best practices’’ of the most efficient companies in the same industry and integrate inputs and outputs into a single performance measure that differentiates between companies based on a multidimensional framework (Cummins and Weiss, 2012). I use DEA to estimate ‘‘best practice’’ technical, cost, revenue, and allocative frontiers. Efficiency scores can be used in different ways to provide managerial insight, e.g., at the firm level as well as at the industry level. One significant application of DEA at the industry level is the efficiency analysis of different organizational forms (Biener and Luhnen, 2012). In this framework, Cummins, Weiss and Zi (1999) introduced *cross-frontier analysis* (CFA), an innovative technique that allows direct tests of hypotheses with regard to organizational form in insurance markets such as the efficient structure and the expense preference hypotheses. In my work, I follow Cummins, Weiss and Zi (1999), and Cummins et al. (2004) by estimating technical, cost, revenue, and allocative efficiencies with respect to different frontiers for Takaful and conventional insurers from the life, non-life, and the multi-line insurance industry.

I modified the simple example used by Biener and Eling (2012) to illustrate CFA in the context of conventional and Takaful insurers. The example contained just one input and one output. In *Table 9*, I consider 10 firms; the first five are conventional, the second five are Takaful insurers. The efficiency score of insurer *i* on the pooled frontier, i.e., consisting of both conventional and Takaful insurers, is calculated as the output/input ratio for insurer *i* divided by the maximum output/input ratio of all insurers in the sample. The efficiency of insurer *i* on its own frontier, i.e., only insurers belonging to its own group, is obtained as the output/input ratio of insurer *i* in relation to the maximum output/input ratio of all conventional insurers (if insurer *i* is a conventional insurer) or Takaful insurers (if insurer *i* is a Takaful insurer) in the sample. The cross-frontier efficiency scores are calculated as the output/input ratio of insurer *i* in relation to the maximum output/input ratio of all conventional insurers (if insurer *i* is a Takaful insurer) or Takaful insurers (if insurer *i* is a conventional insurer). Based on these results, cross-to-own efficiency scores can be obtained by dividing the cross-frontier efficiency score of insurer *i* by its own frontier efficiency score.

In Example 1 (*Table 9*, Panel A), the cross-to-own efficiency scores are consistently larger than 1 for the conventional insurers and consistently lower than 1 for the Takaful insurers. This can be interpreted as meaning that the conventional production technology dominates the Takaful production technology. In the single input/single output example, the company with the best output/input ratio will obtain the maximum efficiency score of 1 and thus will always constitute the pooled frontier, the own frontier of the dominating technology, and the cross-frontier of the technology that is dominated. If, e.g., Company 10 needs only five (instead of seven) input units to produce its output, it would obtain the maximum output/input ratio (1.20) and the maximum efficiency score of 1, and thus constitute the pooled frontier and its own frontier (see *Table 9*, Panel B).

Computing CFA for a single input/single output situation is simple. However, real life is seldom that simple and calculating CFA when there is more than one input and output is more complex.

Table 9: Calculation of pooled, own, and cross-frontiers

Firm i	Type	Input	Output	Output/input	Technical efficiency			
					Pooled	Own	Cross	Cross/own
Panel A: Example 1								
1	Conventional	1.00	1.00	1.00	1.00	1.00	1.17	1.17
2	Conventional	2.00	2.00	1.00	1.00	1.00	1.17	1.17
3	Conventional	3.00	3.00	1.00	1.00	1.00	1.17	1.17
4	Conventional	4.00	4.00	1.00	1.00	1.00	1.17	1.17
5	Conventional	5.00	5.00	1.00	1.00	1.00	1.17	1.17
6	Takaful	3.00	2.00	0.67	0.67	0.78	0.67	0.86
7	Takaful	4.00	3.00	0.75	0.75	0.88	0.75	0.86
8	Takaful	5.00	4.00	0.80	0.80	0.93	0.80	0.86
9	Takaful	6.00	5.00	0.83	0.83	0.97	0.83	0.86
10	Takaful	7.00	6.00	0.86	0.86	1.00	0.86	0.86
Panel B: Example 2								
1	Conventional	1.00	1.00	1.00	0.83	1.00	0.83	0.83
2	Conventional	2.00	2.00	1.00	0.83	1.00	0.83	0.83
3	Conventional	3.00	3.00	1.00	0.83	1.00	0.83	0.83
4	Conventional	4.00	4.00	1.00	0.83	1.00	0.83	0.83
5	Conventional	5.00	5.00	1.00	0.83	1.00	0.83	0.83
6	Takaful	3.00	2.00	0.67	0.56	0.56	0.67	1.20
7	Takaful	4.00	3.00	0.75	0.63	0.63	0.75	1.20
8	Takaful	5.00	4.00	0.80	0.67	0.67	0.80	1.20
9	Takaful	6.00	5.00	0.83	0.69	0.69	0.83	1.20
10	Takaful	5.00	6.00	1.20	1.00	1.00	1.20	1.20

Adapted from Biener and Eling (2012).

An example of cross-frontier analysis with two input units and one output is presented in *Fig. 3*. It shows the production isoquants subject to inputs x_1 and x_2, i.e., the combinations of x_1 and x_2 that could be used to produce the same output quantity. The isoquants represent the best available technology for producing a fixed output quantity.

The isoquants for the conventional and for the Takaful are given by $L^C(y)$ and $L^K(y)$, respectively. The own frontier efficiency of the conventional company represented by point B can be obtained as 0A/0B. The own frontier efficiency of the Takaful company represented in F can be obtained as 0E/0F. The cross-frontier efficiency of the conventional (Takaful) company represented in B (F) can be obtained as 0G/0B (0D/0F). The cross-frontier efficiency for the conventional insurer is larger than 1, for the Takaful it is lower than 1. In this example, the conventional technology again dominates the Takaful technology.

Note that the isoquants might intersect, meaning that the conventional technology is optimal for some operating points and the Takaful technology is best for other operating points (for an example involving stocks and mutuals, see Cummins Weiss and Zi, 1999). Under such conditions, I cannot conclude that one technology is strictly dominant in producing the other technology. Under the efficient structure hypothesis, I would expect that conventional firms dominate Takaful firms in some areas (where conventional firms have advantages) and that Takaful firms dominate conventional firms in other areas (where Takaful firms have advantages). Such an example is illustrated in the right part of *Fig. 3*. Left of points D and E, the conventional firms' technology dominates the Takaful firms' technology; to the right of points D and E, the Takaful technology dominates the conventional technology.

4.4 Hypotheses

To examine the efficient structure and the expense preference hypotheses, I depend on the cross-to-own efficiency ratios. The Takaful firms are similar to the mutual form which is owned by policyholders whereas the conventional insurance firms are akin to the stock form owned by stockholders. The efficient structure hypothesis predicts that conventional and Takaful insurers produce different insurance outputs and each will be relatively successful in producing its own insurance outputs efficiently.

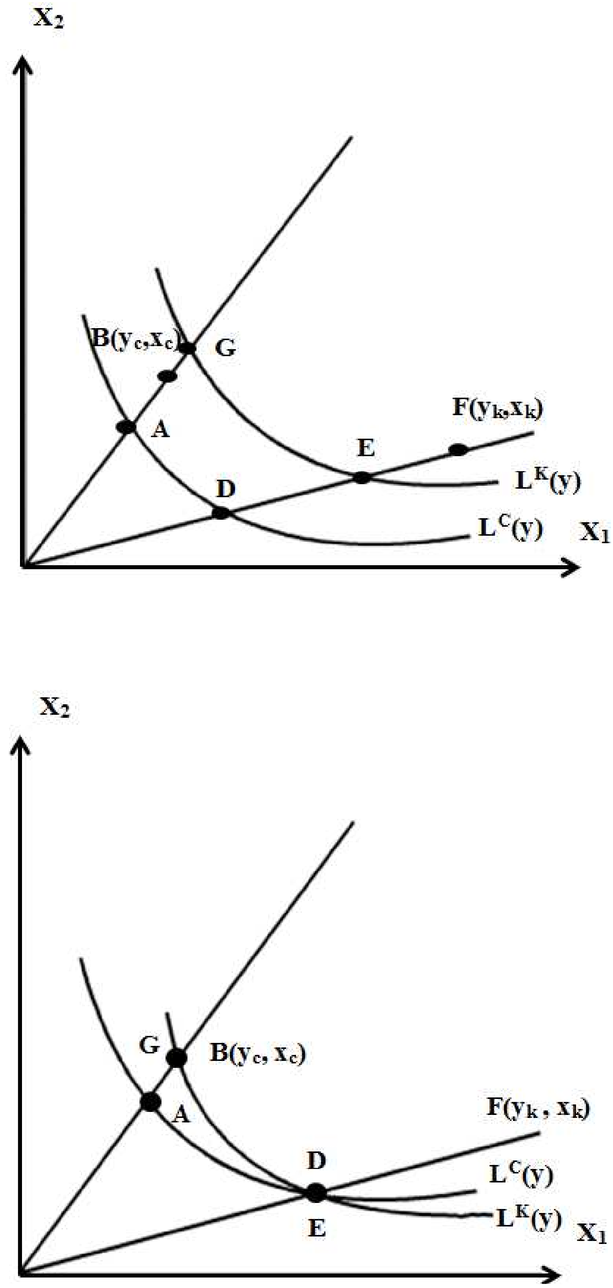
This suggests that input usage or production costs are on average less than would be incurred if the same insurance outputs were produced by the other type of insurer (Cummins, Misas and Zi, 2004).

In the first step of the analysis, I test the hypothesis that conventional and Takaful insurers operate on the same frontier. Rejection of this hypothesis would provide the grounds for estimating efficient with separate frontiers. To this end, I estimate efficiency for conventional and Takaful insurers based on the pooled and the individual own frontiers. Rejection of this hypothesis would also be consistent with the efficient structure hypothesis in that it indicates that conventional and Takaful insurers employ different technologies and that measuring efficiency based on the pooled frontier leads to biased conclusions.

To gain more perception into whether conventional and Takaful are arranged into market segments where they have a comparative advantage, I use size-ownership interaction terms resulting from the frontier distance regressions. The size-ownership interaction terms can be interpreted as the cross-to-own efficiency ratios of firms in the respective group, i.e., small, medium, and large conventional and Takaful insurers, while controlling for other important variables.

To validate the efficient structure hypothesis, I test whether each group's output vectors could be produced with equal efficiency using the other group's production technology.

Fig. 3. Own efficiency isoquants for conventional and Takaful insurers.



Note: The isoquants LC(y) and LK(y) constitute the own production frontier for a fixed output level y with respect to different levels of inputs x1 and x2 of conventional (C) and Takaful (K) insurers.

Adapted from Biener and Eling (2012).

For values of a cross-to-own efficiency ratio significantly greater than 1, I can reject the hypothesis and conclude that insurers in the respective group have a comparative efficiency advantage (technical, cost, revenue, allocative) in producing their own outputs. Such a result would support the efficient structure hypothesis for this group of insurers.

Even if conventional and Takaful insurers have comparative technical efficiency advantages in producing their own outputs, i.e., the efficient structure hypothesis holds, these advantages may be corroded by failing to choose cost minimizing input combinations, which would be consistent with expense preference behavior. The expense preference hypothesis suggests that Takaful insurers are less cost efficient than conventional insurers due to unresolved agency conflicts (e.g., higher perquisite consumption by Takaful insurer managers). Also, service charges are very high because an Islamic investment portfolio is not adequately well diversified to reduce investment risk (Choudhury, 2013). For the expense preference hypothesis to hold, I would have to observe comparative technical efficiency advantages, i.e., size-ownership interaction terms for Takaful significantly larger than 1, and comparative cost efficiency disadvantages, i.e., cost and allocative size-ownership interaction terms for Takaful significantly less than 1.

4.5 Methodology

4.5.1 Cross Frontiers Analysis

CFA can be modified to multiple inputs and outputs utilizing the concept of distance functions introduced by Shephard (1970). For analyzing production frontiers, I use input-oriented distance functions assuming constant returns to scale (CRS). Following Cummins, Misas and Zi (2004), an input-oriented distance function D(y,x) for an insurer producing outputs $\mathrm{y} = (\mathrm{y}_1, \dots, \mathrm{y}_\mathrm{n})^\mathrm{T} \in \mathbb{R}_+^\mathrm{n}$ with inputs $\mathrm{x} = (\mathrm{x}_1, \dots, \mathrm{x}_\mathrm{k})^\mathrm{T} \in \mathbb{R}_+^\mathrm{k}$ is defined as:

$$D_p(y, x) = \sup\left\{\theta: \left(y, \frac{x}{\theta}\right) \in V(y)\right\}, \tag{1}$$

With subscript P indicating the measurement of the output/input set (y,x) for the pooled frontier consisting of conventional and Takaful insurers. The distance function estimates the largest θ for which $\left(y, \frac{x}{\theta}\right)$ is attainable in set V(y), where V(y) denotes the subset of all input vectors $x \in \mathbb{R}_+^k$. The resulting θ can be interpreted as the distance between the operation point (y,x) and the efficient frontier. By applying this definition, I assume a production technology that transforms inputs into outputs. The relation $y \to V(y) \subseteq \mathbb{R}_+^k$ models this transformation in that V(y) constitutes the subset of all input vectors $x \in \mathbb{R}_+^k$ yielding at least y for any $y \in \mathbb{R}_+^n$. From the definition of the distance function, I can derive Farrell's (1957) measure of input technical efficiency. The input technical efficiency is$T_P(y, x) = 1/D_P(y, x)$ where $D_P(y, x)$ is defined on the interval [0;∞[, the Farrell measure $T_P(y, x)$is defined on [0;1]. This input-oriented distance function can be applied to different reference sets, e.g., production frontiers. To test the efficient structure and expense preference hypotheses, I need an estimate of the dominance of one specific technology (conventional, Takaful) over another. For this purpose, I estimate the distance of insurers belonging to a specific group (conventional, Takaful) to the production frontier of their own and the opposing group.

The own-frontier distance functions measure the distance of a firm to the own technologies' efficient frontier, e.g., a conventional firm is evaluated against all efficient conventional firms. For conventional insurers $D_C(y_c, x_c)$ and Takaful insurers $D_K(y_k, x_k)$, the respective own-frontier distance functions are defined as:

$$D_C(y_c, x_c) = Sup\left\{\theta: \left(y_c, \frac{x_c}{\theta}\right) \in V^C(y_c)\right\}, c = 1, 2, \dots, C, \text{ and}$$
$$D_K(y_k, x_k) = Sup\left\{\theta: \left(y_k, \frac{x_k}{\theta}\right) \in V^K(y_k)\right\}, k = 1, 2, \dots, K, \quad (2)$$

$D_c(y_c, x_c)$ measures the distance of conventional firms $c = 1, 2, \dots, C$ to the conventional frontier. $V^C(y_c)$ is the conventional firms' input correspondence for the output vector y_c and C is the total number of conventional firms. $D_K(y_k, x_k)$ is defined accordingly for $k = 1, 2, \dots, K$ with $V^K(y_k)$ being the Takaful firms' input correspondence and K is the total number of Takaful firms.

The cross-frontier distance functions were introduced by Cummins, Weiss and Zi (1999) and measure the distance of a firm from the opposing technologies' efficient frontier. For conventional $D_K(y_c, x_c)$ and Takaful $D_C(y_k, x_k)$, the respective cross-frontier distance functions are defined as:

$$D_K(y_c, x_c) = Sup\left\{\theta: \left(y_c, \frac{x_c}{\theta}\right) \in V^K(y_c)\right\}, c = 1, 2, \dots, C, \text{ and}$$
$$D_C(y_k, x_k) = Sup\left\{\theta: \left(y_k, \frac{x_k}{\theta}\right) \in V^C(y_k)\right\}, k = 1, 2, \dots, K \quad (3)$$

$D_K(y_c, x_c)$ measures the distance of a conventional firm $c = 1, 2, \dots, C$ to the Takaful frontier where $V^K(y_c)$ is the Takaful firms' input correspondence for the output vector y_c and K is the total number of Takaful firms. $D_C(y_k, x_k)$ is defined accordingly for $k = 1, 2, \dots, K$ where $V^C(y_k)$ is the conventional firms' input correspondence and C is the total number of conventional firms.

I estimate DEA efficiency with linear optimization procedures described in Cummins Weiss and Zi (1999) and in Cummins and Weiss (2012). Estimation of cross-frontier distance functions allows me to measure the performance of firms belonging to a specific group (conventional, Takaful) against the technology of the other group, which also implies that values of cross-frontier efficiencies are not bounded by 1. Since firms are not included in the subset of $V(y)$ (the subset of all input vectors $x \in \mathbb{R}_{+}^{k}$), they can perform better than the efficient frontier firms of the opposing technology, and thus their cross-frontier distance functions and efficiency values can range between 0 and infinity.

To test the hypotheses with respect to the superiority of one technology over the other, I need a ratio that constitutes the distance between two opposing frontiers. Following Cummins, Misas and Zi (2004), I use cross-to-own efficiency ratios, $D_{T\{C:K\}}(y_c, x_c)$ and $D_{T\{K:C\}}(y_k, x_k)$, which measure the distance between the conventional and Takaful frontiers at each operation point. T characterizes the distance measure as related to the production frontier (technical) and the terms $\{C: K\}$ and $\{K: C\}$ describe which frontiers are measured against each other, i.e. the conventional frontier against the Takaful frontier with $\{C: K\}$, and the Takaful frontier against the conventional frontier with $\{K: C\}$. The cross-to-own efficiency ratios are defined as:

$D_{T\{C:K\}}(y_c, x_c) = \frac{D_C(y_c, x_c)}{D_K(y_c, x_c)} = \frac{T_K(y_c, x_c)}{T_C(y_c, x_c)}$, and

$$D_{T\{K:C\}}(y_k, x_k) = \frac{D_K(y_k, x_k)}{D_C(y_k, x_k)} = \frac{T_C(y_k, x_k)}{T_K(y_k, x_k)}, \quad (4)$$

Cross-to-own efficiency ratios larger than 1 indicate that the own production technology dominates the opposing technology at the considered operating point. If I perform this calculation for all insurers in the sample, I can determine whether the own technology dominates the opposing technology. Finding average values of cross-to-own efficiency ratios larger than 1 for each type of insurer (conventional, Takaful) would provide evidence in support of the efficient structure hypothesis; i.e., the respective type of insurer (conventional, Takaful) has a comparative advantage in producing its own output. If the own production technology is dominated by the opposing technology, average cross-to-own efficiency ratios are smaller than 1; such a finding would not support the efficient structure hypothesis. The cross-to-own efficiency ratios are thus the basis of deriving conclusions as to the competition between conventional and Takaful insurers in insurance markets. The DEA estimation methodology for cost, revenue, and allocative efficiency are specified in the *Appendix A*.

4.5.2 Frontier Distance Regressions

As a robustness check for the CFA results of the distances between the production frontiers, I conduct multiple regression analyses with cross-to-own efficiency ratios as dependent variables and firm-specific characteristics as independent variables (frontier distance regressions). I follow Cummins, Misas and Zi (2004) and Biener and Eling (2012) by applying a Tobit regression model with omitted intercept and the dependent variable censored at 0. I calculate different regression models for technical, cost, revenue, and allocative cross-to-own efficiency ratios, for life, non-life, and multiple lines insurers, separately.

The regression model for technical cross-to-own efficiency ratios D_{Tit} with insurer i in year t is:

$$D_{Tit} = \beta_{\alpha}\mathrm{INTERACT}_{i\alpha} + \beta_{Den}\mathrm{DENSITY}_{it} + \beta_{Pen}\mathrm{PENETRATION}_{it} + \beta_{\gamma}\mathrm{LAW}_{i\gamma} + \beta_{Cor}\mathrm{CORRUPTION}_{it} + \beta_{HII}\mathrm{HII\_Country}_{it} + \beta_{\delta}\mathrm{YEAR}_{i\delta} + \beta_{\varepsilon}\mathrm{COUNTRY}_{i\varepsilon} + u_{it}, \quad (5)$$

where $INTERACT_{i\alpha}$ are six size-ownership interaction terms used to control for firm size with α = Q1*K, Q2* K, Q3*K, Q1* C, Q2*C, Q3*C. I interact three size quartile dummy variables (Q1 = small, Q2 = medium, Q3 = large) with two dummy variables K (1 for Takaful, 0 otherwise) and C (1 for conventional, 0 otherwise). Consequently, a large conventional insurer i would receive the value 1 for the interaction term $INTERACT_{iQ3*C}$ and 0 for the other five interaction terms. $DENSITY_{it}$ indicates the density of the insurance market (premiums in US dollar per capita) for firm i in year t. Insurance density represents the average spent on insurance by each person and shows the depth of insurance coverage in an economy. A high insurance density implies that insurance market is highly developed. $PENETRATION_{it}$ measures the degree of market penetration (premiums in US dollar/ GDP) in the market in which firm i is operating in year t. Insurance penetration is a rough indicator of growth potential. $LAW_{i\gamma}$ are two dummy variables reflecting legal systems: γ = Islamic, MIXED represent Islamic law or mixed legal systems, respectively. A third legal system variable (civil law) is excluded to avoid singularity. $CORRUPTION_{it}$ indicates the degree of corruption in year t and country of firm i. $HHI\_Country$ is the Herfindahl index based on percentages of premiums written within countries. It serve as a measure for competition within countries. $YEAR_{i\delta}$ are dummy variables for each year with one year excluded to avoid singularity. $COUNTRY_{i\varepsilon}$ are country dummies, again with one country excluded. Country dummy variables are not shown in the regression tables to conserve space[2]. u_{it} is the error term in the regression, with $u \sim N(0, \sigma^2)$.The model is identical for technical, cost, revenue, and allocative cross-to-own efficiency ratios, the only difference being that the dependent variable is D_{Cit} or D_{Rit} or D_{Ait} instead of D_{Tit}.

I analyze technical, cost, revenue and allocative efficiency using CFA for insurers from 13 countries, two organizational forms (conventional, Takaful), three branches (life, non-life, multi-line), and three company sizes (large, medium, small). I consider total assets as a measure of insurer size (see, e.g., Cummins and Zi, 1998; Diacon et al., 2002) and thus subdivide all companies by their total assets into large, medium, and small insurers. For DEA, I calculate technical, cost, revenue, and allocative efficiency values assuming input orientation and constant returns to scale. I perform a cross-frontier analysis as presented in Cummins, Weiss and Zi (1999), and Cummins, Misas and Zi (2004).

4.6 Data, Inputs and Outputs

Data on organization type for conventional and Takaful insurers, and lines of business are taken from the Capital IQ database for the period 2007-2011. Company-specific information on domiciliary country is taken from World Bank and Bloomberg. Specifically, interest rate, CPI, GDP, and GDP per capita are obtained from world bank. Rate of return on stock market index for each country is obtained from Bloomberg. Information on the legal systems is taken from the University of Ottawa (see http://www.juriglobe.ca/eng/index.php). Corruption index is obtained from corruption perceptions index provided by Transparency International (available at http://www.transparency.org). The calculations include all companies from 13 countries that have positive values for the inputs and outputs described in *Table 10*.

[2]There is a tradeoff between selecting a homogenous sample of countries and the number of observations. That is, by selecting a homogenous sample I will reduce the sample size which would make the subsequent results have low statistical power. I control for the heterogeneity between countries by including country dummies. The downside of the country dummies is that they might not fully capture the heterogeneity across countries.

I have an unbalanced panel, i.e., I do not require that each company has data for all years. The dataset consists of 666 firm-years from 13 countries. There is widespread agreement in the literature with regard to the choice of inputs (Eling and Luhnen, 2010a). Following this literature, I use labor, business services and materials, and equity capital as inputs.

A major fraction of operating expenses in insurance is labor related (Cummins and Weiss, 2012, show that the largest share of operating expenses are employee salaries and commissions for the U.S.). I thus concentrate on labor to determine the price of the operating- expenses-related input factor. For the price of labor I use the selling, general, and administrative expenses divided by the number of employees. I proxy for business services by policy acquisition costs which include commission and other underwriting expenses. The price for policy acquisition is proxied by the consumer price index (CPI) which I obtained from the World Bank for each country. The price of equity capital is proxied by a long-term average of the yearly rates of total return of the country-specific stock market indices which are obtained from Bloomberg. After converting all numbers into US dollars, I deflate each year's value by the consumer price index to the base year 2005 so that all monetary values are directly comparable (Weiss, 1991; Cummins and Zi, 1998). The country-specific consumer price indices and exchange rates were obtained from the World Bank.

As done in many studies on efficiency in the insurance industry, I use the value-added approach, also known as the ‘‘production approach’’ (see Grace and Timme, 1992), to determine the outputs. I distinguish between three main services provided by insurance companies—risk-pooling/bearing, financial services, and intermediation. A proxy for the amount of risk-pooling/bearing and financial services frequently used in the literature is the value of real incurred losses. I proxied the incurred losses by the policy benefits paid. The intermediation function is proxied by the real value of investments. All monetary values are deflated to obtain constant values[3].

Table 10 presents inputs, outputs, and prices (all in US dollars). The total number of observations for the pooled sample is 666 firm-years. The total number of observations for the conventional insurers is 485 firm-years. This is almost 3 times the total number of the observations of Takaful insurers, which is 181 firm-years. Most of the firms (conventional and Takaful) write both life and non-life insurance. 81 firm-years write only life and health insurance, 364 firm-years write insurance for multi-lines, and 221 firm-years write only non-life insurance. I exclude reinsurers and insurance brokers in the study.

4.7 Empirical Results

In this section, I present results based on the assumption that conventional and Takaful insurers from the 13 countries compete with each other, i.e., they operate on the same efficient frontier.

In *Table* 11, I provide aggregate results for the different organizational forms—conventional and Takaful—in the 13 countries' insurance markets. I conduct two different statistical tests. In *Table* 11, the insurers are grouped by type of organizational form (conventional and Takaful) in order to test whether conventional and Takaful insurers operate on the same pooled frontier or on their own frontier.

[3]I use CPI as a price for input variable business services. Thus, the business services was not deflated by CPI.

Table 10: Inputs and Outputs for Efficiency Calculation

Inputs and outputs

Panel A: Definition of input, input prices, outputs, and output prices	
Inputs	**Proxy**
Labor	Number of employees
Business services	Policy acquisition cost
Equity capital	Capital & surplus
Input prices	
Price of labor	Selling, general, & admin. expenses/ number of employees
Price of business services	CPI
Price of equity capital	Long-term average stock market return indices
Outputs	
Benefits Paid	Policy benefits paid
Investments	Total investment
Output prices	
Price of benefits paid	(Net premiums earned - policy benefits paid)/ policy benefits paid
Price of investment	[(Expected return on stock * investment in equity) + (total investment –investment in equity) * rate of return on debt] / total investment

Panel B: Summary statistics for variables used

variable	Unit	Pooled		Conventional		Takaful	
		Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Number of employees	Quantity	379.265	449.402	416.101	504.417	282.911	228.953
Acquisition cost	Million $	33.825	13.928	34.017	14.275	33.324	13.002
Capital & surplus	Million $	97.895	100.182	96.830	100.525	100.679	99.487
Selling & Admin expenses/number of employees	Million $	0.125	0.138	0.122	0.126	0.132	0.166
Long-term average stock market return indices	%	0.126	0.509	0.126	0.509	0.126	0.509
Policy benefits paid	Million $	49.814	84.807	53.864	88.236	39.218	74.279
Total investment	Million $	84.807	192.264	139.301	195.379	141.824	184.340
(Net premiums earned - policy benefits paid)/ policy benefits paid	%	0.318	0.275	0.314	0.277	0.329	0.271
(Expected return on stock * investment in equity) + (total investment - investment in equity) * rate of return on debt / total investment	%	0.138	0.113	0.146	0.108	0.117	0.124
CPI	%	1.187	0.222	1.187	0.222	1.187	0.222

Note: The values are winsorized at the 5% and 95% level.

The first test is to determine whether conventional and Takaful insurers are operating on the same frontier. Therefore, I compare the efficiency results for conventional and Takaful insurers on the pooled frontier ($T_P(y_c;x_c)$ and $T_P(y_k;x_k)$) with the efficiency results for the group specific frontiers ($T_C(y_c;x_c)$ and $T_K(y_k;x_k)$) in *Table 11*. I use both a parametric t-test as well as a non-parametric Wilcoxon test as significance tests (in *Table 11* I present the results of the Wilcoxon test). Both tests clearly reject the hypothesis that the Takaful production frontier is identical to the pooled frontier for life, non-life, and multi-line insurers at the 1% level (T_P : T_K***). The same results are obtained for cost (panel B), revenue (panel C), and allocative efficiency (panel D). Also, both tests reject the hypothesis that the conventional production frontier is identical to the pooled frontier for life, non-life, and multi-line insurers at the 1% level (T_P : T_C***) (with one exception for life technical conventional efficiency rejected at which is the 10% level). This finding is in line with Cummins, Weiss and Zi (1999), who also reject the hypothesis of identical frontiers for mutual and stocks. However, those authors find no significant differences between the stock own and pooled frontiers, which is in contrast to the empirical result. That is, I also reject the hypothesis of identical frontiers for conventional (T_P: T_C***). I follow Cummins, Weiss and Zi (1999) in concluding that the rejection of identical frontiers implies that efficiency analysis of conventional and Takaful insurers should be based on separate frontiers rather than on the pooled frontier. The economic interpretation of this finding is that Takaful and conventional insurers use different technologies for producing their respective outputs.

Table 11: Results of the cross-frontier analysis.
Comparison of different types of frontiers for conventional and Takaful insurers

		Non-life		Life		Multi	
Panel A:	**Technical efficiency**						
		Mean	Wilcoxon	Mean	Wilcoxon	Mean	Wilcoxon
Conventional	$T_P(y_c;X_c)$	0.8618	T_p:T_c***	0.9120	T_p:T_c*	0.8186	T_p:T_c***
	$T_C(y_c;X_c)$	0.8802	T_c:T_k***	0.9137	T_c:T_k***	0.8206	T_c:T_k***
	$T_K(y_c;X_c)$	1.0264	T_p:T_k***	1.1065	T_p:T_k***	0.9909	T_p:T_k***
	$D_{T(C:K)}(y_c;X_c)$	1.1652		1.2118		1.2196	
Takaful	$T_P(y_k;X_k)$	0.8731	T_p:T_k***	0.8172	T_p:T_k***	0.7892	T_p:T_k***
	$T_K(y_k;X_k)$	0.9027	T_k:T_c***	0.9245	T_k:T_c***	0.9587	T_k:T_c***
	$T_C(y_k;X_k)$	1.0473	T_p:T_c***	1.0215	T_p:T_c***	1.1698	T_p:T_c***
	$D_{T(K;C)}(y_k;X_k)$	1.1592		1.1048		1.2077	
Panel B:	**Cost efficiency**						
		Non-life		Life		Multi	
		Mean	Wilcoxon	Mean	Wilcoxon	Mean	Wilcoxon
Conventional	$C_P(y_c;X_c)$	0.5381	C_p:C_c***	0.6980	C_p:C_c ***	0.4392	C_p:C_c***
	$C_C(y_c;X_c)$	0.5724	C_c:C_k***	0.6338	C_c:C_k***	0.4923	C_c:C_k***
	$C_K(y_c;X_c)$	2.0426	C_p:C_k***	0.9930	C_p:C_k***	1.6855	C_p:C_k***
	$D_{C(C:K)}(y_c;X_c)$	3.4051		1.5712		3.7400	
Takaful	$C_P(y_k;X_k)$	0.6058	C_p:C_k***	0.6503	C_p:C_k***	0.3674	C_p:C_k***
	$C_K(y_k;X_k)$	0.7028	C_k:C_c***	0.8305	C_k:C_c***	0.6422	C_k:C_c***
	$C_C(y_k;X_k)$	1.9332	C_p:C_c***	1.2528	C_p:C_c***	1.9497	C_p:C_c***
	$D_{C(K;C)}(y_k;X_k)$	2.9578		1.4955		2.9669	

Panel C:	**Revenue efficiency**						
		Non-life		Life		Multi	
		Mean	Wilcoxon	Mean	Wilcoxon	Mean	Wilcoxon
Conventional	$R_P(y_c; X_c)$	0.3734	R_p:R_c***	0.6423	R_p:R_c***	0.4468	R_p:R_c***
	$R_C(y_c; X_c)$	0.4380	R_c:R_k***	0.6486	R_c:R_k***	0.4523	R_c:R_k***
	$R_K(y_c; X_c)$	0.9774	R_p:R_k***	1.0431	R_p:R_k***	1.3800	R_p:R_k***
	$D_{R(C:K)}(y_c; X_c)$	2.2499		1.6172		3.3644	
Takaful	$R_P(y_c; X_c)$	0.4446	R_p:R_k***	0.6271	R_p:R_k***	0.3570	R_p:R_k***
	$R_C(y_c; X_c)$	0.7107	R_k:R_c***	0.8914	R_k:R_c***	0.7852	R_k:R_c***
	$R_K(y_c; X_c)$	1.9718	C_p:R_c***	1.4078	C_p:R_c***	1.8388	C_p:R_c***
	$D_{R(C:K)}(y_c; X_c)$	2.7631		1.5881		2.3113	

Panel D:	**Allocative efficiency**						
		Non-life		Life		Multi	
		Mean	Wilcoxon	Mean	Wilcoxon	Mean	Wilcoxon
Conventional	$A_P(y_c; X_c)$	0.6485	A_p:A_c***	0.7671	A_p:A_c***	0.5758	A_p:A_c***
	$A_C(y_c; X_c)$	0.6670	A_c:A_k***	0.6945	A_c:A_k***	0.6403	A_c:A_k***
	$A_K(y_c; X_c)$	1.0081	A_p:A_k***	0.7365	A_p:A_k**	2.3638	A_p:A_k***
	$D_{A(C:K)}(y_c; X_c)$	1.5058		1.0564		3.9743	
Takaful	$A_P(y_c; X_c)$	0.7027	A_p:A_k***	0.7994	A_p:A_k***	0.5342	A_p:A_k***
	$A_C(y_c; X_c)$	0.7752	A_k:A_c***	0.9003	A_k:A_c***	0.6775	A_k:A_c***
	$A_K(y_c; X_c)$	1.2552	A_p:A_c***	1.0591	A_p:A_c***	2.2044	A_p:A_c***
	$D_{A(C:K)}(y_c; X_c)$	1.5946		1.1724		3.1824	

Note: *** indicates a significance level at 1%. The test is defined by the abbreviations T_i, C_i, R_i, and A_i with i= P, C, K. T_P:T_C with conventional indicates,for example, a Wilcoxon test for the difference in mean technical efficiency between the conventional pooled and own frontier. Takaful, T_P:T_K would indicatea Wilcoxon test for the difference in mean technical efficiency between the Takaful pooled and cross frontier.

In the second test, I now consider the results shown in *Table 12* and analyze the efficiency scores based on separate Takaful and conventional frontiers in the rows $T_K(y_k;x_k)$ and $T_C(y_c;x_c)$. Takaful insurers are significantly more efficient with respect to their own Takaful frontier compared with the efficiency of conventional insurers relative to their own conventional frontier (e.g., 0.96 vs. 0.82 for technical efficiency in multi-line). This result may indicate that there are more degrees of freedom for conventional firms to make mistakes that degrade efficiency when operating in more complex lines of business (see Cummins, Misas and Zi; 2004).

The third test is to consider the cross-frontier efficiencies in *Table 12*, i.e., the efficiency of Takaful (conventional) relative to the conventional (Takaful) frontier ($T_C(y_k;x_k)$ and $T_K(y_c;x_c)$) and the resulting cross-to-own efficiency ratios. I find that, on average, conventional insurers are more efficient relative to the Takaful frontier in technical efficiency for life firms, cost efficiency for life and multi-line firms, revenue and allocative for multi-line insurance. That is the cross-to own efficiency ratios for conventional ($D_{T\{C:K\}(}y_c;x_c)$) are consistently larger than cross-to-own efficiency ratios for Takaful ($D_{T\{K:C\}(}y_k;x_k)$). The economic interpretation of this result is that conventional firms are dominant for producing conventional output vectors. These differences in technical, cost, revenue, and allocative efficiency are important since they might be an indication of expense preference behavior by life and multi-line Takaful insurers.

To provide evidence on whether the differences in cross-to-own frontier efficiencies are robust when controlling for firm and country characteristics, I conduct a

Table 12: Results of the cross-frontier analysis (2007-2011, full sample). Comparison of conventional and Takaful on different types of frontiers

Panel A: Technical efficiency

		Non-life				**Life**				**Multi**			
		Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox
Pooled	$T_P(y_c;X_c)$	0.8618				0.9120	**	**	***	0.8186			
	$T_P(y_k;X_k)$	0.8731				0.8172				0.7892			
Own	$T_C(y_c;X_c)$	0.8802				0.9137				0.8206	***	***	***
	$T_K(y_k;X_k)$	0.9027				0.9245				0.9587			
Cross	$T_K(y_c;X_c)$	1.0264				1.1065		*	**	0.9909	***	***	***
	$T_C(y_k;X_k)$	1.0473				1.0215				1.1698			
Cross/Own	$D_{T(C:K)}(y_c;X_c)$	1.1652				1.2118	***	***	***	1.2077			
	$D_{T(K;C)}(y_k;X_k)$	1.1592				1.1048				1.2196			

Panel B: Cost efficiency

		Non-life				**Life**				**Multi**			
		Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox
Pooled	$T_P(y_c;X_c)$	0.5381	*	**	*	0.6980				0.4392	*	***	*
	$T_P(y_k;X_k)$	0.6058				0.6503				0.3674			
Own	$T_C(y_c;X_c)$	0.5724	***	***	***	0.6338	***	***	***	0.4923	***	***	***
	$T_K(y_k;X_k)$	0.7028				0.8305				0.6422			
Cross	$T_K(y_c;X_c)$	2.0426			**	0.9930	**	**	**	1.6855			
	$T_C(y_k;X_k)$	1.9332				1.2528				1.9497			
Cross/Own	$D_{T(C:K)}(y_c;X_c)$	3.4051				1.5712			**	3.7400	***	***	***
	$D_{T(K;C)}(y_k;X_k)$	2.9578				1.4955				2.9669			

Panel C: Revenue efficiency

		Non-life				Life				Multi			
		Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox
Pooled	$T_P(y_c;X_c)$	0.3734		*	*	0.6423				0.4468	***	***	***
	$T_P(y_k;X_k)$	0.4446				0.6271				0.3570			
Own	$T_C(y_c;X_c)$	0.4380	***	***	***	0.6486	***	***	***	0.4523	***	***	***
	$T_K(y_k;X_k)$	0.7107				0.8914				0.7852			
Cross	$T_K(y_c;X_c)$	0.9774	***	***	***	1.0431	***	***	***	1.3800	***	***	***
	$T_C(y_k;X_k)$	1.9718				1.4078				1.8388			
Cross/Own	$D_{T(C:K)}(y_c;X_c)$	2.2499	***	***	***	1.6172				3.3644	***	***	***
	$D_{T(K;C)}(y_k;X_k)$	1.9718				1.5881				2.3113			

Panel D: Allocative efficiency

		Non-life				Life				Multi			
		Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox	Mean	t_a	t_b	Wilcox
Pooled	$T_P(y_c;X_c)$	0.6485		*		0.7671				0.5758			
	$T_P(y_k;X_k)$	0.7027				0.7994				0.5342			
Own	$T_C(y_c;X_c)$	0.6670	*	**	***	0.6945	***	***	***	0.6403			
	$T_K(y_k;X_k)$	0.7752				0.9003				0.6775			
Cross	$T_K(y_c;X_c)$	1.0081	***	***	***	0.8287	***	***	***	2.3638			**
	$T_C(y_k;X_k)$	1.2552				1.2552				2.2044			
Cross/Own	$D_{T(C:K)}(y_c;X_c)$	1.5058	**	***	**	1.1861				3.9743	*	**	***
	$D_{T(K;C)}(y_k;X_k)$	1.5946				1.1724				3.1824			

Note:*, **, *** indicate significance levels of 10%, 5%, and 1%, respectively, of t-test and Wilcoxon test for difference between conventional and Takaful insurer means for the pooled, and cross frontiers and the cross/own ratios. t_a-Test for difference between conventional and Takaful insurers. t_b-Test for whether the difference between conventional and Takaful are > or <0. Wilcox: is Wilcoxon test.

frontier distance regression following Cummins, Misas and Zi (2004) with cross-to-own frontier ratios (distances between frontiers) as dependent variables and selected characteristics as independent variables (equation 5). The idea is to regress various company-specific and country factors on the distance of Takaful to conventional production (and the distance of conventional to Takaful), cost, revenue, and allocative frontiers. I run the regression separately for the three main branches: non-life (panel A of *Table 13*), life (panel B of *Table 13*) and multi-line insurers (panel C of *Table* 13). I apply a Tobit regression model with omitted intercept, and the dependent variable is censored at 0. Omitting the intercept allows us to interpret the regression coefficients of the interaction terms as an intercept for insurers in that specific group.

In the production frontier regression, all size-ownership interaction terms are significantly larger than 1(z_2 is significant at 1% level) in non-life, life, and multi-line insurance (with one exception for life medium-size Takaful), implying that they are dominant for producing their specific output vectors. Coefficients of all conventional insurer interaction terms are significantly greater than the corresponding coefficient of the Takaful interaction terms for each size quartile in non-life and life. The production frontier regression thus supports the efficient structure hypothesis for non-life, life as well as for multi-line conventional and Takaful insurers.

Concerning the cost frontier regression, all size-ownership interaction terms are significantly larger than 1 in life and multi-line insurance. The regression results for the cost frontier thus provide additional support for the efficient structure hypothesis for life and multi-line insurance. The coefficient of conventional insurers is larger than the coefficient of Takaful insurers in multi-line insurance. That is, the dominance of conventional insurers is higher than the dominance of Takaful insurers in multi-line insurance. With respect to the expense preference hypothesis, I find evidence of cost deficiencies for non-life insurers in all size quantiles since the test statistic z_2 is insignificant for Takaful insurers. This finding implies that Takaful insurers waste more resources than conventional insurers in non-life insurance, which is in line with the expense preference hypothesis.

In the revenue frontier regression, the interaction terms of all size-ownership variables are significantly larger than 1 in life and multi-line insurance. The regression results for the revenue frontier confirm the efficient structure hypothesis for life and multi-line insurance. The coefficient of the interaction term of conventional insurers for medium-size in life, and in all size quantiles in multi-line insurance is higher than the coefficient of the interaction term for the Takaful insurers. Thus, the dominance of conventional is higher than the dominance of Takaful only for medium-size in life, and all size quantiles in multi-line insurance. For the expense preference hypothesis, I find evidence of revenue deficiencies for non-life insurers in medium-size quantile since the test statistic z_2 is insignificant for Takaful insurers. This finding implies that Takaful insurers waste more resources than conventional insurers in non-life insurance for only medium-size, which is in line with the expense preference hypothesis.

Regarding the allocative cross-to-own efficiency regressions, I find values for all size-ownership interaction terms to be significantly larger than 1 in non-life and life insurance, indicating that conventional and Takaful insurers of all sizes are dominant in choosing the cost minimizing combination of inputs for producing their own outputs.

Table 13: Frontier Distance Regression

Panel A

Independent variables	Non-Life											
	Production frontier			Cost frontier			Revenue frontier			Allocative frontier		
	Coeff.	z1	z2	Coeff.	z1	z2	Coeff.	z1	z2	Coeff.	z1	z2
Q1*Conventional	1.223	77.11***	***	1.146	15.14***	**	2.999	2.31**	**	1.316	11.49***	***
Q2*Conventional	1.228	90.25***	***	1.154	12.76***	**	3.106	2.20**	**	1.310	11.41***	***
Q3*Conventional	1.240	58.10***	***	1.182	8.76***	**	2.695	1.92*		1.261	9.73***	**
Q1*Takaful	1.217	56.42***	***	0.830	6.20***		3.495	2.37**	**	1.406	10.25***	***
Q2*Takaful	1.253	39.77***	***	0.920	10.14***		2.892	1.94*		1.285	7.92***	**
Q3*Takaful	1.225	57.57***	***	0.809	6.95***		2.922	1.63		1.353	8.64***	**
Islamic	-0.011	-0.66		-0.049	-0.69		0.146	0.27		0.0337	0.48	
Density	-0.000	-1.14		-0.000	-0.57		0.000	0.57		0.000	0.79	
Penetration	7.275	0.93		26.00	1.85*		-177.6	-0.61		-27.28	-0.79	
Corruption	-0.005*	-1.92		-0.018	-1.18		0.0980	1.06		0.018	1.54	
HHI_Country	0.000	0.77		-0.000	-0.11		0.0005	0.61		0.000	0.70	
2007	-0.027	-2.10**		-0.003	-0.39		9.869	6.50***		0.072	0.77	
2008	-0.093	-4.51***		-0.028	-1.22		-2.469	-2.03**		-0.007	(-0.07)	
2009	-0.063	-4.30***		-0.015	-0.74		9.569	6.67***		0.355	2.58**	
2010	0.017	10.88***		10.83	65.41***		9.948	6.94***		0.126	1.03	
N	221			221			221			221		

Panel B

Independent variables	Life											
	Production frontier			Cost frontier			Revenue frontier			Allocative frontier		
	Coeff	z1	z2	Coeff	z1	z2	Coeff	z1	z2	Coeff	z1	z2
Q1*Conventional	1.141	27.22***	***	1.652	188.09***	***	1.766	14.21***	***	1.452***	33.57	***
Q2*Conventional	1.147	45.38***	***	1.652	136.41***	***	1.784	17.40***	***	1.445***	63.97	***
Q3*Conventional	1.142	41.49***	***	1.653	139.62***	***	1.769	17.43***	***	1.452***	53.41	***
Q1*Takaful	1.061	55.47***	***	1.571	120.50***	***	1.806	20.81***	***	1.474***	71.06	***
Q2*Takaful	1.018	19.29***		1.567	134.11***	***	1.711	11.44***	***	1.520***	27.93	***
Q3*Takaful	1.108	56.94***	***	1.562	111.17***	***	1.866	20.18***	***	1.409***	88.65	***
Islamic	-0.110	-1.63		0.000	0.09		-0.227	-2.02**		0.134	1.50	
Density	0.000	0.41		-0.000	-1.68*		-0.000	-0.73		-0.000	-0.73	
Penetration	-106.6	-4.87***		37.80	5.24***		-83.42	-2.30**		161.6	5.23***	
corruption	0.008	4.98		-0.003	-4.36***		0.005	0.84		-0.012	-7.76***	
HHI_Country	-0.000	-2.46**		0.000	3.56***		-0.000	-2.07**		0.000	2.60**	
2007	0.068	2.78***		-0.180	-31.17***		-0.012	-0.15		-0.236	-9.17***	
2008	0.289	4.88***		0.379	41.42***		0.240	1.47		-0.008	-0.12	
2009	0.032	3.70***		-0.331	-19.58***		-0.651	-8.43***		-0.333	-34.85***	
2010	-0.046	-3.39***		-0.308	-11.75***		-0.255	-2.50**		-0.224	-5.62***	
N	81			81			81			81		

Panel C

Independent variables	Multi											
	Production frontier			Cost frontier			Revenue frontier			Allocative frontier		
	Coeff	z1	z2	Coeff	z1	z2	Coeff	z1	z2	Coeff	z1	z2
Q1*Conventional	1.121	94.31***	***	1.973	37.28***	***	2.757	200.09***	***	1.716	27.87***	***
Q2*Conventional	1.127	75.39***	***	1.933	39.52***	***	2.782	181.62***	***	1.661	29.41***	***
Q3*Conventional	1.124	79.37***	***	1.958	38.46***	***	2.771	173.05***	***	1.692	28.98***	***
Q1*Takaful	1.157	70.05***	***	1.270	14.48***	***	2.118	85.34***	***	1.058	8.37***	
Q2*Takaful	1.129	75.09***	***	1.230	18.73***	***	2.170	96.72***	***	0.948	12.37***	
Q3*Takaful	1.137	87.92***	***	1.201	17.79***	***	2.165	133.65***	***	0.932	12.64***	
Islamic	-0.021	-1.34		0.109	1.56		-0.039	-1.63		0.149	1.69*	
Density	0.000	1.76*		-0.000	-2.14**		0.000*	1.71		-0.000	-1.79*	
Penetration	-0.069	-0.30		5.092	1.91*		-1.272	-2.31**		4.380	1.44	
Corruption	-0.005	-1.26		0.022	1.64		-0.011	-2.68***		0.033	1.95*	
HHI_Country	0.000	1.17		-0.000	-1.58		0.000	1.69*		-0.000	-1.81*	
2007	0.051	1.84*		0.536	24.70***		4.428	133.38***		-0.085	-2.46**	
2008	0.192	42.20***		6.418	37.09***		0.806	32.02***		9.588	47.49***	
2009	0.144	14.42***		0.457	25.07***		-0.363	-9.72***		0.253	8.63***	
2010	0.099	20.05***		0.559	10.33***		0.386	254.12***		0.270	10.62***	
N	364			364			364			364		

Z1 significantly different from 0, based on a two-tail test. Z2 significantly greater or less than 1 based on a one-tail test. Note: The dependent variable is the ratio of the efficiency of each conventional (Takaful) firm relative to the Takaful (conventional) frontier to the efficiency of each conventional (Takaful) firm relative to its own frontier. This is a measure of the distance between the conventional and Takaful frontiers for the ith firm's input-output vector.
*, **, *** indicate significance levels of 10%, 5%, and 1% respectively.

However, conventional insurers are significantly more successful in choosing the cost minimizing input combination compared to Takaful insurers in multi-line insurance. That is, the Takaful size-ownership interaction terms are not significantly greater than 1 (z_2 is not significant). The allocative frontier distance regression thus supports the efficient structure hypothesis and provides evidence for the expense preference hypothesis in multi-line insurance since the coefficient terms for Takaful insurers are not significantly greater than 1 for all sizes. In conclusion, the results show that the efficient structure and expense preference hypotheses hold for the international dataset.

In inferring the residual regression variables, recall that the dependent variable is larger than 1 in case of dominance of the own group-specific frontier for producing their own output. Coefficients of the remaining variables greater (less) than 0 are thus associated with wider (smaller) distances between the own-group frontier and the opposing group's frontier. Smaller distances between the conventional and Takaful frontiers are likely associated with a higher degree of competition between conventional and Takaful insurers, since the comparative advantage of producing the own-group outputs will be smaller (see Cummins, Misas and Zi, 2004). For the sake of brevity, I restrict the discussion to the most relevant results.

The coefficients for market density for multi-line insurance are significantly less than 0 for the cost frontier and allocative frontier. It thus seems that the higher the market density, the lower the distances between the conventional and Takaful frontiers. Thus, there is likely to be a higher degree of competition between Takaful and conventional insurers in high-density multi-line insurance markets. The coefficients for insurance market penetration are opposite to the density coefficients for multi-line insurers.

I find that the Islamic legal system coefficient is negative and significant for revenue frontiers in life insurance, implying that in countries with legislation based on Islamic law the differences between conventional and Takaful frontiers are reduced; i.e., there likely exists a higher degree of competition between conventional and Takaful in life insurers. The corruption coefficient is negative and significant for the non-life production frontier, the life cost and allocative frontiers, and the multi-line revenue frontier. This might be due to the fact that some of countries which have an Islamic legal system tend to have a developing insurance market. Thus, many of the international conventional insurers see those markets as an opportunity to expand. This implies that there is strong competition between conventional and Takaful insurers in countries that have a higher degree of corruption. The coefficient of HHI_Country is positive and significant for life cost and allocative frontiers, and multi-line revenue and allocative efficiency[4].

4.8 Conclusion

An economically interesting feature of emerging/developing insurance markets is the coexistence of two organizational forms: conventional insurers and Takaful insurers. I apply cross-frontier analysis to study the efficiency of these two organizational forms and derive conclusions regarding the competition between them. A few authors assess the performance difference between these two organizational forms in Malaysia only, but I are the first to analyze this issue in a cross country study. I consider a pooled sample of 13 countries. The research design has the advantage of allowing us to separate the effects

[4] I include age variable, but it is not significant under all specifications.

of different countries and organization types on efficiency, thus providing insight into the performance of different organizational forms. Thus, the results are valid not only for one country, but can also aid in comparing conventional and Takaful insurers under different market environments. The efficient structure hypothesis holds for the most frontiers (i.e., conventional and Takaful insurers are dominant in producing their own outputs). I also find indication of the expense preference hypothesis (Takaful insurers are less cost efficient than conventional insurers).

CHAPTER 5

CONCLUSION

In this study I address different aspects of Takaful Insurance. First, I summarized the history of Takaful and the development of Takaful in different periods. Second, I examine scope economies and agency problems of Takaful insurance companies. Third, I investigate the insolvency risk for Takaful insurers and different characteristics of Takaful insurers that are associated with insolvency risk. Finally, I examine the Takaful insurers and conventional insurers in the market where both coexist.

It is hard to determine the origin of Takaful in history. I divide the history of Takaful into five main periods. The first period is the development of the doctrine of *Aqila* among the ancient Arab tribes. *Aqila* is blood money that the relative of the killer has to pay to the heir of the deceased victim in order to save the killer from the legal consequences. The second period is the conduct of the Holy Prophet Muhammed. He recognized the practice of *Aqila*. He also endorsed the practice of *Fidya* (ransom) which is money paid to free a prisoner. Between the fourteenth and the seventeenth centuries, a Sufi Order of the *Kazeruniyya* was very active in port cities in India and China. This order facilitated the development of organizations that served as a kind of marine travel insurance companies. In the nineteenth century, a famous scholar, Ibn Abidin, spread the awareness of insurance and its legal existence. During the twentieth century, renowned Islamic jurist, Muhammed Abduh issued two fatwas allowing insurance practice. One of those fatwas states that insurance transactions are similar to the contract of the

Mudharaba financing of a project. The second fatwa states that a transaction which is akin to endowment or life insurance is legal.

I address different questions related to Takaful insurers. First, I examine the agency problem and scope economies. I test whether diversified firms, which offer both family Takaful (life insurance) and property-liability insurance, are more or less efficient in producing family Takaful (property-liability) insurance than firms that specialize in family Takaful (property-liability) insurance. Also, I test whether firms that operate under a *Mudharaba* (profit sharing) model are more or less efficient than firms that operate under a *Wakala* (fee based) model. Agency problems may arise due to lack of incentive, such as a lack of bonus or profit share percentage to shareholders (agent), to work in the best interest of the policyholder (principal) in the *Wakala* model.

I estimate cost efficiency utilizing data envelopment analysis (DEA) and test for scope economies and agency problems by regressing efficiency scores on control variables and on an indicator variable for strategic focus and type of operating model. There is a positive relationship between focused Takaful firms and cost efficiency. Therefore, strategic focus is generally superior to conglomeration in the Takaful industry. The findings offer evidence of agency problems in the Takaful industry as well. The *Mudharaba* (profit sharing) operating model is positively related to cost efficiency. Thus, the *Mudharaba* (profit sharing) model is generally superior to the *Wakala* (fee based) model in the Takaful industry.

Second, I evaluate the association between efficiency and Takaful insurers' solvency (risk). I also evaluate the association between Takaful insurers' characteristics and its solvency. I find that efficient firms are less likely to default. Moreover, Takaful insurers that are diversified are more prone to insolvency risk than specialized Takaful insurers. Takaful insurers that adopted the Mudharaba (profit sharing) model have higher distance to default than insurers that use the Wakala model. There is some evidence of the effect of investment risk on Takaful insurers' solvency. Investments in stock and real estate are associated with higher insolvency risk.

Third, I examine an interesting phenomenon in developing insurance markets where two organizational forms coexist: conventional insurers and Takaful insurers. I utilize cross frontier analysis to test the efficient structure hypothesis and expense preference hypothesis. The efficient structure hypothesis states that the two organizational forms serve different market segments due to differences in managerial discretion and access to capital. The expense preference hypothesis states that mutual insurers are less cost efficient than stock insurers due to unresolved agency conflicts. Takaful insurers incur high cost due to limited investment options and the high cost of investment transactions. In Takaful, the service charges are very high because an Islamic portfolio is not adequately diversified to reduce the unit risk of investment. I found that the efficient structure hypothesis holds for most of the frontiers estimated. I also find an indication of the existence of the expense preference hypothesis.

This dissertation show the operating status of the Takaful industry in the presence of conventional insurers and in terms of efficiency. Hence, it would be useful for managers and regulators in taking steps to improve the overall insurance market.

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APPENDICES

APPENDIX A

The DEA METHPDOLOGY*

Distance Functions and Efficiency

To analyze production frontiers, I employ both input and output-oriented distance functions (Fare et al., 1985). Suppose a firm uses input vector $x = (x_1, x_2, \dots, x_m)^T \in R_+^m$ to produce output vector $y = (y_1, y_2, \dots, y_n)^T \in R_+^m$, where T denotes the vector transpose. A production technology which transforms inputs into outputs can be modeled by an input correspondence $y \rightarrow V(y) \subseteq R_+^m$, such that for any $y \in R_+^m, V(y)$ denotes the subset of all input vectors for a given decision making unit (DMU) that minimizes input consumption conditional on outputs:

$$D_1(y, x) = \sup\left\{\theta: \frac{x}{y} \in V(y)\right\}, \quad (1)$$

Where θ is a scalar, i.e., a radial distance. In the output-oriented case, technology is modeled by an output correspondence $x \rightarrow P(x) \subseteq R_+^n$, such that $P(x)$ denotes the subset of all output vectors obtainable from input vector $x \in R_+^m$. The output distance function for a DMU maximizes output conditional on inputs:

$$D_0(y, x) = \inf\left\{\theta: \frac{y}{\theta} \in P(x)\right\}. \quad (2)$$

The input distance function is the reciprocal of the minimum equi-proportional contraction of the input vector x, given output y, i.e., input-oriented technical efficiency $TE_1(y, x) = 1/D_1(y, x)$, and a similar interpretation applies for output-oriented

* This is a modified appendix of Cummins et al. (2010).

efficiency.

The choice of input versus output orientation is based on the microeconomic theory of the firm. In microeconomic theory, the objective of the firm is to maximize profits by minimizing costs and maximizing revenues. Cost minimization involves choosing the optimal amounts and mix of inputs to produce a given output vector, and revenue maximization involves choosing the optimal amounts and combination of outputs conditional on the input vector. Hence, the input orientation is adopted to estimate technical efficiency in the cost minimization problem, and the output orientation is adopted for the revenue maximization problem.

The minimum cost function or cost frontier is defined using the distance function approach (e.g., Cooper et al., 2004). Let $x_j = (x_{1j}, x_{2j}, \dots ,x_{mj})^T \in \Re_+^m$ denote the input vector from firm j, $\mathrm{y_j} = (\mathrm{y_{1j}}, \mathrm{y_{2j}}, \dots ,\mathrm{y_{nj}})^{\mathrm{T}} \in \Re_+^{\mathrm{m}}$ denote the output vector from firm j, and $\mathrm{w_j} = (\mathrm{w_{1j}}, \mathrm{w_{2j}}, \dots ,\mathrm{w_{mj}})^{\mathrm{T}} \in \Re_+^{\mathrm{m}}$ denote the input price vector from firm j. Then the cost frontier is:

$$\mathrm{C}(\mathrm{y_j}, \mathrm{w_j}) = \mathrm{Min}_{\mathrm{xj}}\{\mathrm{w_j^T}\, \mathrm{x_j} : \mathrm{x_j} \in \mathrm{V}(\mathrm{y_j})\}, \tag{3}$$

Where $C(y_j, w_j)$ = the cost frontier for firm j with output-input vector (y_j, x_j). The optimal vector x_j^* minimizes the costs of producing y_j given the input prices w_j. Cost efficiency for firm j is calculated as $\eta_j = w_j^T x_j^* / w_j^T x_j$, where x_j represents actual input usage and $0 < \eta_j \leq 1$.

The maximum revenue function or revenue frontier is defined analogously to the cost function, also using the distance function approach. Let $p_j = (p_{1j}, p_{2j}, \dots, p_{nj})^T \in$

$\Re^n_{++}$ denote the output price vector corresponding to the output vector y_j. Then the revenue frontier is defined as:

$$R\left(x_j, p_j\right) = \underset{y_j}{Max} \{p_j^T\, y_j : y_j \in P\left(x_j\right)\}, \quad (4)$$

Where $R\left(x_j, p_j\right)$ = the revenue function for firm j. The optimal output vector y_j^* maximizes revenue conditional on inputs x_j and output prices p_j. Revenue efficiency is calculated as the ratio $C = p_j^T y_j / p_j^T y_j^*$, where y_j is the actual output vector. Therefore, $0 < y_j \leq 1$.

Estimating Efficiency

DEA efficiency is estimated by solving linear programming problems. For example, the technical efficiency with respect to the pooled frontier is estimated by solving the following problem, for each firm, j= 1, 2, …, Q in each year of the sample period:

$$\left[D\left(y_j, x_j\right)\right]^{-1} = TE\left(y_i, x_j\right) = \min \theta_j \quad (5)$$

Subject to: $Y\lambda_j \geq y_j$,

$X\lambda_j \leq \theta_j x_j$,

$\lambda_j \geq 0$,

Where Q=total number of insurers, Y is an n ×Q output matrix for all firms in the sample, and X an m × Q input matrix for all firms in the sample; y_j is an n × 1 output vector and x_j an m × 1 input vector for firm j, and $\lambda_j$is a Q × 1intensity vector. Constraining the λ_j only to be non-negative imposes constant returns to scale. Imposing the additional constraint, $\sum_{i=1}^{Q} \lambda_{ji} = 1$ allows for VRS, and changing he constraint to

$\sum_{i=1}^{Q} \lambda_{ji} \leq 1$ estimates the frontier under NIRS, where λ_{ji} is the ith element of the vector λ_j.

The following problem is solved as the first step to obtain cost efficiency of firm j:

$$\underset{x}{\text{Min}} \; w_j^T x_j \tag{6}$$

Subject to: $Y\lambda_j \geq y_j$,

$X\lambda_j \leq \theta_j x_j$,

$\lambda_j \geq 0$,

Where w_j is an $m \times 1$ vector of input prices, and x_j is an $m \times 1$ vector of input quantities. As in the case of technical efficiency, constraining λ_j only to be non-negative imposes CRS. Imposing the additional constraint $\sum_{i=1}^{Q} \lambda_{ji} = 1$ imposes VRS and imposing the constraint $\sum_{i=1}^{Q} \lambda_{ji} \leq 1$ imposes NIRS. The solution of (7) is the cost-minimizing input vector for firm $j(x_j^*)$. Cost efficiency is then calculated as explained above.

Revenue efficiency is obtained by solving the following problem:

$$\underset{y}{\text{Min}} \; p_j^T y_j \tag{7}$$

Subject to: $Y\lambda_j \geq y_j$,

$X\lambda_j \leq \theta_j x_j$,

$\lambda_j \geq 0$,

The solution is the revenue maximizing output vector y_j^*.