Economic Systems 43 (2019) 100716

Contents lists available at ScienceDirect

Economic Systems

journal homepage: www.elsevier.com/locate/ecosys

The impact of oil prices and the financial market on cost efficiency in the insurance and Takaful sectors: Evidence from a stochastic frontier analysis

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ARTICLE INFO

Keywords:
Cost efficiency
Financial capital development
Islamic Finance
GCC
Insurance
Oil price
Takaful

ABSTRACT

The Gulf Cooperation Council's (GCC) insurance industry, including conventional insurance and *Takaful*, has witnessed remarkable growth during the last decade. However, the economies of this region rely on oil as the primary stream of revenue and lack development in financial markets. This could affect the insurance industry. For this reason, this paper examines the impact of oil prices and the financial market on the cost efficiency of the insurance and *Takaful* sectors in GCC countries using a stochastic frontier cost function with data from 2009–2016. The results show that the relationship between oil prices and efficiency changes from positive to negative when the prices increase, whereas the relationship between the financial market and efficiency is negative. No clear evidence of the impact of oil prices on efficiency arises from the differences between conventional insurance and *Takaful*. However, there are differences regarding the financial market, with a negative impact on conventional insurance and a positive one on the *Takaful* business. The results of this study have implications for regulators and management. The *Takaful* industry is rapidly growing compared to conventional insurance in the GCC and, therefore, the financial market may have added benefits for the GCC region. However, caution is required in relation to the impact of the financial market on conventional insurance. Furthermore, management may require the development of strategies to deal with the nature of GCC economies to avoid shocks to oil prices.

1. Introduction

Since its establishment, the insurance industry in the member countries of the Gulf Cooperation Council (GCC) has grown substantially in various respects, such as premiums/contributions, market penetration and market density; however, its profitability is still relatively low (Alpen Capital, 2017; EY, 2014; IFSB, 2018). Middle East Global Advisors (2016) and Finance Forward state that the drop in oil prices and the lack of development in financial markets may adversely affect the sector's performance.

The literature has shown limited interest in the connection between oil prices and efficiency at financial firms, with only one study examining it. Said (2015) analyses the effect of oil prices on efficiency scores in Islamic banking during the financial crisis of 2008–2009. The current literature lacks sufficiently comprehensive empirical studies on the impact of the stock market performance and efficiency on insurance firms. Few studies examine the connection between firm efficiency and stock price performance in

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https://doi.org/10.1016/j.ecosys.2019.100716
Received 19 April 2018; Received in revised form 26 November 2018; Accepted 3 December 2018
Available online 31 August 2019
0939-3625/

insurance (Ajlouni and Tobaishat, 2010; Aktaş and Seyfettin, 2015; Gaganis et al., 2013).

First, global oil prices might influence the profitability of insurers and *Takaful* (Islamic insurance) providers. Gulf countries rely heavily on oil as their primary source of revenue, hurting other sectors (Khamis and Hamdan, 2016). The current drop in the price of oil has shrunk government revenue. Gulf members lost $380 billion in revenue, reducing government expenditure and investment in construction and other sectors. Saudi Arabia cancelled $20 billion in projects in 2016 (PWC, 2016). Therefore, insurance and *Takaful* firms have to compete for limited opportunities.

Second, the financial market is a crucial factor that affects profitability (Naceur et al., 2014). Insurers and *Takaful* providers allocate their investment heavily towards equity and real estate, because of the lack of development in financial markets. These asset classes can be profitable when the economic conditions are sound. However, when an economic slowdown occurs, the greater economic risk affects investment (Mensi, 2017). This high allocation of assets to equity and real estate is an area of weakness for sharia-compliant fixed-income instruments. Hence, having an appropriate capital market—including an Islamic capital market—with sufficient instruments in fixed income is a solid platform for firms to diversify their investment. Diversification reduces risk by allocating investments to different financial instruments with different characteristics. It seeks to maximize returns by utilizing different investment opportunities, which react differently to the same event. Middle East Global Advisors (2016) and Finance Forward state that *Takaful* firms in the GCC have limited investment options and rely on real estate investment and unit trusts. Interestingly, *Takaful* firms keep a high percentage of their assets in cash, as much as 17%. This lack of instruments affects profitability.

Given the volatility of the current environment, it is necessary to examine the industry's performance by measuring its cost efficiency in a dual system, in which *Takaful* providers operate alongside conventional insurance companies. To this end, the paper seeks to measure the impact of oil prices and financial markets on cost efficiency in the insurance industry in the GCC from 2009 to 2016 and investigate whether their impact on cost efficiency in the GCC differs between *Takaful* providers and insurance companies.

1.1. Insurance and Takaful in the GCC

Since its introduction, the insurance industry in the GCC has recorded significant growth, in parallel with the region's overall economic growth, population growth, greater awareness and supportive legal environment. Alpen Capital (2017) states that in 2016 the insurance industry in this region experienced a compound annual growth rate (CAGR) of 12.1% in gross written premiums (GWP), valued at $26.2 billion. Furthermore, it forecasts that by 2021 the insurance industry in the GCC will achieve 10.9% in CAGR, reaching $44.0 billion. Market penetration is expected to improve from 1.9% in 2016 to 2.5% in 2021, and insurance destiny is expected to increase at a CAGR of 8.4% to $729.6.

This region has the largest share of the global *Takaful* market and, according to the IFSB (2018), as of 2016 its gross written premiums comprise 48% of this market. That year, the market grew 7.4%, after growth of 21% in 2015 and 18% in 2014, compared to an average increase of 10% in conventional insurance premiums over that period.

The research finds that when the price of oil increases, the relationship between oil prices and efficiency switches from positive to negative. A negative relationship between financial markets and efficiency is also found. Furthermore, the impact of oil prices on efficiency shows no clear differences between conventional insurance and *Takaful*; however, the results regarding financial markets are negative in conventional insurance and positive in the *Takaful* business.

The results of this study have implications for regulators and management. Where regulators should develop a robust financial market consisting of different instruments for conventional insurance and *Takaful*, at the same time it is required of them to formulate a comprehensive governance framework, including remuneration, to ensure all stakeholders' interests are protected. Furthermore, management may require developing inclusive strategies to deal with the nature of the GCC economies during fluctuations of oil prices, especially as we found that insurance and *Takaful* players become less efficient when oil prices increase. In particular, this situation is very critical to *Takaful* operators, who, as an agent of participants/policyholders, are responsible for managing the funds in line with the participants' objectives.

The paper is organized as follows. Section 2 discusses the increase in the connection between oil prices and efficiency and highlights its impact on corporations and individuals. Furthermore, the relationship between financial markets and efficiency is addressed. In Section 3, we deliberate on the methodology to achieve our research objectives. The dataset and empirical findings are discussed in Section 4. Section 5 concludes the study.

2. Literature review

2.1. Oil prices and efficiency

Because of its geographic location, the GCC is well endowed with natural resources, particularly oil, which is a major revenue source for the countries in the region. Therefore, fluctuations in oil prices are reflected in the entire economy. After a period in which oil prices rose above $100 a barrel, they fell below $30 in 2016 (Hiscox, 2016). According to the International Monetary Fund (IMF), Gulf members lost $380 billion in revenue in 2015.

Since the plunge in global oil prices, analysts and researchers have tried to identify the factors that affect demand for oil produced in the region, such as slowdowns in China, India and Europe, and the factors that affect supply, including increased production of shale oil in the United States and elsewhere. In sum, the supply of oil has increased overall, though a significant portion is from outside the GCC, while at the same time demand has severely declined (Rodger, 2016).

The literature on the connection between oil prices and efficiency at financial firms is limited. In the one study looking at this connection, Said (2015) examines the effect of oil prices on efficiency scores in Islamic banking throughout the financial crisis of 2008–2009, finding no direct relationship between them. However, this relationship may lead us to highlight a common concept in economics: the resource curse, or the paradox of plenty. Humphreys et al. (2007) state that the resource curse indicates the failure of many resource-rich countries to utilize their natural resources effectively. The governments in these countries overspend on salaries and inefficient fuel subsidies and underspend on health, education and other social services (Ross, 2015). If the government does not spend the revenue efficiently, it creates economic burdens. Hartwell (2016) studies 130 countries with abundant and scarce resources from 1970 to 2011. He found that, on average, the countries with abundant resources use their resources less efficiently. Furthermore, Polterovich et al. (2010) find that the accumulation of human capital is slower and institutions are worse in resource-rich countries. Our study tries to fill the gap in the literature by examining the following research question:

RQ1. What is the impact of oil prices on cost efficiency in the insurance sector in the GCC?

2.2. Impact of oil prices on corporations and individuals

The GCC oil market consists of several large energy firms, such as Aramco, Qatar Petroleum and the Kuwait Oil Company. The reduction in oil prices led oil companies to reduce their activities in exploration and production because cash flow and profitability were affected. Consequently, companies that service the oil industry are expected to undergo a downturn (Rodger, 2016). The volatility of global oil prices indirectly requires corporations to review their exploration and production strategies by closing rigs and stopping drilling, leading to cancellations of plans for large and costly projects.

According to Hiscox (2016), the reduction in activities may lead to decreased liability exposure, and the pricing of insurance policies reflects the risk exposure, so the premium payable will decrease. This is a direct consequence of corporate-level decisions. Whenever the economy slows down, activities at the individual level (consumption) decrease, hence profitability is affected. Instead, firms restructure their costs by laying off some employees. Because of this reduced workforce, insurers receive fewer premiums from corporate customers, as the value of premiums payable depends on the size of the workforce covered. Another point that must be considered is moral hazard. Whenever a global crisis or economic downturn occurs, many fake claims will be made, thus affecting the insurance market.

2.3. Oil prices, fiscal policy and the insurance sector

In the GCC, oil receipts account for more than 80% of government revenue, so fiscal policy is significantly affected by oil prices (Rahman, 2015). For this reason, fiscal policy works by transferring oil revenue into decisions to spend on social and economic needs. However, the unpredictability of oil prices is causing chaos for governments regarding revenue and expenditures that affect the economy. Spending moves positively with oil prices, so that governments increase spending when oil prices are high and vice versa. Although economic growth in the Gulf is slowing down because of the sharp decline in their main source of revenue since mid-2014, the governments are expected to tighten their fiscal policy, which requires significant adjustments in regional spending (budget) and revenue policies (Qatar Financial Centre, 2016).

Many projects related to infrastructure and public construction will need to be reassessed as part of a tighter fiscal policy. Governments have trimmed their spending and rescheduled capital expenditure plans. The countries will focus on key projects, ensuring the completion of existing contracts, and other projects will either be pushed back or reviewed after oil prices recover (Qatar Financial Centre, 2016). For example, in the first quarter of 2015, projects worth around $200 billion were cancelled by national oil companies such as Qatar Petroleum and Aramco, and some major petrochemical projects were cancelled to cut capital expenditure programs (Rahman, 2015).

Thus, less government spending leads to fewer projects, which means fewer opportunities for insurance coverage in commercial lines. The reforms conducted by governments might reduce disposable incomes, which will affect personal lines of insurance. However, the upside for insurance of declining oil prices is that the adjustment in fiscal policy might cut medical subsidies and replace current systems with compulsory insurance schemes run by the private sector. This would boost growth in medical insurance.

2.4. Financial market and efficiency

The current literature lacks sufficiently comprehensive empirical studies on the impact of stock market performance and the efficiency of insurance firms. Few studies examine the connection between firm efficiency and stock price performance in insurance (Ajlouni and Tobaishat, 2010; Aktaş and Seyfettin, 2015; Gaganis et al., 2013), while various studies have been conducted on the banking industry (Beccalli et al., 2006; Eltivia et al., 2014; Liadaki and Gaganis, 2010; Vardar, 2013; Shawtari et al., 2015; Al-Khouri and Arouri, 2016; Seven and Yetkiner, 2016; Le et al., 2016; Luo et al., 2016; Cojocaru et al., 2016; Bitar et al., 2017; Park and Shin, 2017; Fu and Liu, 2018; Kutan et al., 2018; Tayssir and Feryel, 2018; Alqahtani and Mayes, 2018; Aluko and Ajayi, 2018, among others).

Gaganis et al. (2013) examine the relationship between efficiency and stock returns in the insurance sector from 2002 to 2008. They record a positive and statistically significant relationship in profit efficiency but find no clear relationship in terms of cost efficiency. In addition, Aktaş and Seyfettin (2015) investigate the link between financial efficiency ratios and stock prices of Turkish insurance firms listed on the Istanbul Stock Exchange. The financial efficiency ratios represent cost, revenue and profit efficiency, which they all found to be statistically significant, with profit efficiency having the highest significance. Ajlouni and Tobaishat (2010) examine the same relationship in Jordan from 2000 to 2006 and find a significant positive connection.

In the banking sector, Eltivia et al. (2014) study whether firm cost efficiency influences stock performance on the Indonesia Stock Exchange. They found no impact, which suggests that shareholders focus more on profits than on cost. Furthermore, Ioannidis et al. (2008) investigate the correlation between changes in bank efficiency and stock price returns at Asian and Latin American listed banks from 2000 to 2006. Their findings on profit efficiency reveal a positive relationship with stock returns but no evidence on cost efficiency. Vardar (2013) examines the connection between cost and profit efficiency at European banks and their stock price performance using the SFA model. His findings show that the relationship is significant and positive in terms of profit efficiency with stock performance while it is significant and negative between cost efficiency and stock returns. Liadaki and Gaganis (2010) test the impact of the stock performance of 15 banks in Europe with respect to their profit efficiency. They conclude that a significant positive relationship exists between them, while cost efficiency remains undetermined. Nguyen (2018) examines the impact of diversification on cost and profit efficiency in the banking sector in six Asian countries over the period 2007–2014. She finds that banks with more diversified incomes have lower cost efficiency, while banks with more diversified assets have lower persistent cost efficiency. Moreover, Doan et al. (2018) examine the connection between income diversification and bank efficiency in 83 countries and find that increased diversification tends to improve bank efficiency. However, studying five European countries, Beccalli et al. (2006) find a positive correlation between cost efficiency and bank stock performance.

This study contributes to the literature by examining the following research question:

RQ2. What is the impact of financial market on cost efficiency in the insurance sector in the GCC?

2.5. *Comparing efficiency in Takaful and conventional insurance*

Few empirical studies have compared efficiency at *Takaful* providers and conventional insurance firms, and the majority of them concentrate on the Malaysian insurance industry, which is not surprising given the market's maturity. Moreover, the research collectively concludes that, in Malaysia, *Takaful* has lower cost efficiency than conventional insurance (Antonio et al., 2013; Bahrain and Isa, 2013; Ismail et al., 2011; Saad, 2012; Saad et al., 2006).

Saad et al. (2006) examined efficiency in Malaysia at 12 firms, including only one *Takaful* provider, from 2002 to 2005. They found that the pure efficiency of *Takaful* providers is below the industry average, while the change of scale efficiency moves is equivalent to the industry average. However, the sample they used may not provide an accurate result because it includes only one *Takaful* provider. Ismail et al. (2011) expanded on this research using a larger sample that includes seven *Takaful* providers and find that *Takaful* has lower cost efficiency than conventional insurance in Malaysia over the period 2004 to 2009. Later, Saad (2012) overcame the limitations in Saad et al. (2006), analyzing 28 firms from 2007 to 2009 and finding that conventional insurance firms perform better than *Takaful* firms.

Antonio et al. (2013) researched the same issue with an updated sample from 2009–2011. They also found that *Takaful* providers were less efficient than conventional insurance firms. Bahrain and Isa (2013), examining 19 firms including both life insurance and family *Takaful* providers in Malaysia from 2002 to 2010, also found that *Takaful* has lower cost efficiency than conventional insurance. This result indicates that the organizational form has an impact on efficiency.

Globally, Singh and Zahran (2013) showed no significant difference between *Takaful* and conventional insurance in terms of efficiency after analyzing 32 firms operating in eight countries. Karbhari et al. (2018) studied the global *Takaful* industry by examining the connection between corporate governance and both technical and scale efficiency. They found that *Takaful* firms are inefficient, possibly due to managerial and operational apathy. Their paper has sufficient data only on *Takaful*, but did not compare it to conventional insurance and failed to conduct any analysis across countries. Khan and Noreen (2014) examined 17 firms in Pakistan including five *Takaful* from 2006 to 2010, and found that *Takaful* providers are more cost efficient than conventional insurance firms.

Studies on the GCC (Al-Amri, 2015; Miniaoui and Chaibi, 2014) did not compare *Takaful* with conventional insurance. Al-Amri (2015) examined *Takaful* efficiency using panel data with 115 firm-year observations from 2004 to 2009. He found that *Takaful* providers are moderately efficient, with many opportunities for development. In addition, Miniaoui and Chaibi (2014) compared technical efficiency in the *Takaful* sector between Malaysia and the Gulf region with 12 firms from 2006 to 2009. They found that *Takaful* firms in the Gulf are more efficient than those in Malaysia.

Extensive research is available on other financial markets or financial institutions in GCC countries; see, for example, Hassan et al. (2003); Al Janabi et al. (2010); Louis and Balli (2014); Dewandaru et al. (2014); Mansour et al. (2017); Saiti et al. (2016); Tanha and Dempsey (2017) and Akguc and Al Rahahleh (2018), among others. However, no research has discussed the impact of oil prices and financial markets on cost efficiency in the insurance and *Takaful* sector in GCC countries. Furthermore, the existing research uses data envelopment analysis to measure efficiency, whereas we use SFA. Additionally, this research expands the dataset to ensure the results cover a larger scope. The limitations in the current literature motivate us to examine the following research question:

RQ3. Is there a difference between Takaful providers and insurance companies in terms of the impact of oil prices and financial markets on cost efficiency in the GCC?

3. Data and research methodology

3.1. Data

The main source of data used in this research is the DataStream database and annual reports of insurance companies and *Takaful* providers in the Gulf countries Kuwait, Bahrain, Saudi Arabia, the United Arab Emirates (UAE), Qatar and Oman, from 2009 to 2016. Our dataset includes 94 direct players with 48 companies that operate in line with sharia principles (see Ardo and Saiti, 2017; Alshammri et al., 2018).

3.2. Selection and measurement of variables

3.2.1. Variable selection

The variables in our research can be divided into firm-specific variables and non-firm variables. The first category includes inputs and outputs that are under management control while the second category focuses on oil prices and the financial market.

3.2.2. Operating costs

Fenn et al. (2008) state that operating costs for each company can be measured as total administrative costs and expenses before deductions for deferred acquisition costs and including investment management expenses and claims management costs. It is important to state that payment loss adjusters are the insurances' internal claims adjusters for administrative costs. Additionally, legal costs are under claims costs. This variable represents the cost efficiency of the firms. To avoid confusion, claims incurred and settled are not included in claims management costs, which refer to the insurer's internal administrative claims costs, such as payments to loss adjusters.

3.2.3. Output factors

The value-added approach is used in the research for measuring output factors in insurance and *Takaful* businesses. This approach considers outputs important when they add value to operating cost allocations (Cummins and Weiss, 1993). Eling and Luhnen (2010) state that this approach assumes that the insurer/*Takaful* provider offers three main services, for which the volume of output proxies must be defined.

1 Risk-pooling and risk bearing, in which the provider tries to reduce the risks consumers and businesses are exposed to by pooling their homogeneous risks. When measuring this service, it is important to state that the number of applications processed, the number of policies issued, the number of claims settled, and other detailed information are not publicly available. Therefore, we use a proxy for this service, incurred claims and additional reserves (Yuengert, 1993).
2 Financial services relating to insured losses, in which a variety of services provided to policyholders by insurers, such as financial planning, risk management and the provision of legal defence in liability disputes. The policyholder will take advantage to reduce costs. Hence, net incurred claims can be used to measure this service, because the amount of claims settlement and risk management services are highly correlated with loss aggregates. According to Yuengert (1993), a good proxy for the amount of risk-pooling/bearing and financial services is the net incurred claims, defined as current claims paid, plus additions to reserves.
3 Intermediation, in which the insurer invests funds until they are used for claim settlement or withdrawn by policyholders. This transaction can create the net interest (profit) margin, which is the difference between the rate of return on invested assets and the rate credited to policyholders. Hence, we can see the value-added from the intermediation function and choose total invested assets as an output (Eling and Luhnen, 2010).

3.2.4. Input factors

Studies of cost efficiency in insurance employ labour and capital as inputs (Boonyasai et al., 1999; Cummins and Weiss, 1993; Cummins and Zi, 1997; Eling and Luhnen, 2010). Considering the availability of data, we use the staff salary as a proxy for labour, which comprises both the average number of employees per company and the average monthly earnings of workers in the insurance sector (Hardwick, 1997). The second input is capital, which is divided into equity capital and debt capital (Alhassan et al., 2015). Total capital is used for measuring equity capital input while long-term average stock market return indexes are a proxy for the price of equity capital (Al-Amri, 2015; Ismail et al., 2011). Regarding debt capital, technical provision is used as a proxy for the quantity side while the rate of return on debt or the Treasury bill (TB) yield is employed to measure the price of debt capital (Al-Amri, 2015; Cummins and Rubio-Misas, 2006). However, in some countries, i.e., the UAE (Central Bank of UAE, 2014), the domestic bond markets are not well developed, meaning that the risk-free rate is difficult to obtain where financial intermediation is mostly done by commercial banks. Hence, their bond yield is used as a proxy.

Many studies compare *Takaful* with conventional insurance and don't differentiate between *Takaful* and conventional insurance in terms of choosing inputs and outputs (Ismail et al., 2011; Yakob et al., 2014).

3.2.5. Non-firm-specific variables

Non-firm-specific variables can be divided into main and control variables, where the two main determinants are oil prices and financial market, while the two control variables are inflation and fiscal stance.

Crude oil is considered a major benchmark price for purchases of oil worldwide. This variable is crucial in our study because the

GCC relies heavily on oil, which is considered the engine of other sectors (Khamis and Hamdan, 2016). The crude oil spot price has fluctuated over time, which has an impact on revenue for GCC governments and may affect insurance indirectly. Higher oil prices may lead to economic growth, which has a positive effect on the insurance sector. This research uses the average annual Organization of the Petroleum Exporting Countries (OPEC) crude oil price (Abduh and Baharoon, 2016).

Financial market is also an important variable in our study because of the nature of the insurance industry. Insurers and *Takaful* providers always invest a portion of premiums and contributions in the capital market. Hence, examining the performance of this variable in the insurance industry is a core element. The variable can be measured by various proxies: the ratio of stock market capitalization to GDP, the average total index return, bond yield and *sukuk* (Islamic Bond) returns, in which these measurements cover both the stock market and the debt market. However, the availability of data limits our focus to the stock market, where the ratio of stock market capitalization to GDP is calculated as the total value of all listed shares on the stock market as a percentage of GDP (Dima et al., 2014). Additionally, it is important to add total index returns to measure the capital gains of equity over time or average stock market returns.

In addition, we use various control variables; they are not the variables of interest, but we add them to remove their effects from the equation. The first is inflation, which is an important macroeconomic variable and usually has an impact on the insurance industry. Haley (1993) and Alhassan et al. (2015) find a negative significant impact, while Karbhari et al. (2018) find that the impact is significantly positive. During inflationary periods, returns on investments may increase, indicating the positive side of inflation. However, claims generally increase, together with prices. This may influence input prices and consequently may be reflected in firm efficiency. Hence, we predict a negative effect of inflation on efficiency. The study uses the consumer price index (CPI) to measure inflation. The second variable is fiscal stance, which is crucial for oil-exporting countries, as it represents the ratio of the budget surplus to GDP, in which its impact is generally positive (Hesse and Poghosyan, 2009). Therefore, we predict a positive influence of fiscal stance on the insurance industry. The variables are summarised in Table 1.

3.3. Estimation methods

This research uses stochastic frontier analysis (SFA) to estimate efficiency.[1] Barros et al. (2005) regarded SFA as a parametric approach, which has several advantages: (1) the availability of appropriate statistical tests to investigate the validity of the model specification by testing the significance of inclusion or exclusion of factors, or for the functional form; (2) when including a variable that is not required, it will have low, or even zero, weighting in the calculation of the efficiency scores; and (3) it allows the decomposition of deviations from efficient levels between random noise (v_i) and an inefficiency component (u_i). This helps weaken the influence of errors on the estimated results.

3.3.1. Cost function

This approach is built on the assumption of a cost minimization objective function, whose measurement is based on the estimation of efficient frontiers that denote the optimal cost level for a given use of inputs in the creation of output (Hussels and Ward, 2007). Eq. (1) is the minimum cost (C) of generating a specific output vector (y) with given input prices (p):

$$C = C(p, y) \tag{1}$$

3.3.2. Translog cost function (TCF)

The TCF is the most common model in the literature and is located under flexible functional forms. It was presented by Christensen et al. (1973) and used to describe costs. Translog is a local, second-order approximation to an arbitrary cost function. It places no a priori restriction on the elasticity of substitution and allows the economies of scale estimate to vary with the output level. It is a flexible functional form that has proven to be an effective tool for the empirical assessment of efficiency (Bikker and van Leuvensteijn, 2008). This functional form is mostly written as $C = f(y,p,t)$, where C is the total cost, y is total output quantity, p is the input price and t is time. Eq. (2) represents TCF in a detailed form (Huang, 2007):

$$\ln C = \left[\alpha_0 + \sum_{i=1}^{N}\beta_i \ln y_i + \frac{1}{2}\sum_{i=1}^{N}\sum_{k=1}^{N}\gamma_{ik}\ln y_i \ln y_k + \sum_{j=1}^{M}\vartheta_j \ln p_j + \frac{1}{2}\sum_{j=1}^{M}\sum_{f=1}^{M}\mu_{jf}\ln p_j \ln p_f + \sum_{i=1}^{N}\sum_{j=1}^{M}\delta_{ij}\ln y_i \ln p_j\right] + v + u \tag{2}$$

In Eq. (2), the y variables combine outputs and fixed inputs (N in total), while the p variables are the prices of the variable inputs (M in total). Additionally, the random error, as ε, consists of error term v and inefficiency u.

3.3.3. Estimation of the determinants of efficiency

Rather than a two-step procedure, this research uses a one-step model, which consists of the stochastic frontier, with efficiency u

[1] Efficiency estimation in the insurance industry can be done through parametric or non-parametric methods. Stochastic frontier analysis (SFA), the thick frontier approach (TFA) and the distribution-free approach (DFA) are parametric approaches, while data envelopment analysis (DEA) and free disposable hull analysis (FDA) are non-parametric. The non-parametric approach has the following limitations: (1) sensitivity to the number of constraints specified; (2) results can be influenced by outliers; and (3) it does not require an error term with no accommodation for bias arising from environmental heterogeneity, external shocks, measurement error and missing variables. Hence, any deviation from the frontier is considered inefficient (Hao, 2008; Mahlberg and Url, 2003).

Table 1
Summary of key variables.

Variables	Proxy
Outputs and Prices of Inputs	
Price of labor	Salary of all staff
Price of debt capital	Rate of return on debt * technical provision
Price of equity capital	Average stock market return indexes * total capital
Net claims incurred	Incurred claims and additional reserves
Investments	Total assets invested
Non-Firm-Specific Variables	
Oil price	Average annual OPEC crude oil price
Financial market	Average total index returns
	Ratio of stock market capitalization to GDP
Control Variables	
Inflation	Consumer Price Index (CPI)
Fiscal stance	Ratio of budget surplus to GDP

depending on z_i. The estimation is conducted in a single step by maximum likelihood. Adopting the one-step model makes it easier to obtain reliable results, especially when we know that the two-step procedure has been criticized by many researchers (Caudill and Ford, 1993; Caudill et al., 1995) (see Appendix 1). Specifically, this research adopts Wang's (2002) model, as follows:

$$C_{it} = x_{it}\,\beta + (v_{it} + u_{it}) \tag{3}$$

$$v_{it} \sim N\,(0,\ \sigma_{it}^2) \tag{4}$$

$$u_{it} \sim N^+\,(\mu_{it},\ \sigma_{it}^2) \tag{5}$$

$$\mu_{it} = z_{it}\delta \tag{6}$$

$$\sigma_{it}^2 = exp\,(z_{it}\,\gamma) \tag{7}$$

where u_{it} is the inefficiency effect, which is a non-negative truncation of a normal random variable, while the variable vector z_{it} includes a constant of 1 and some other exogenous variables associated with inefficiency. Lastly, δ and γ are the corresponding coefficient vectors.

This model allows exogenous variables to affect inefficiency through two different channels: mean and variance. The result of this flexibility is the ability to accommodate non-monotonic efficiency effects. The model has the ability to accommodate $z[k]$'s non-monotonic effects on the mean and the variances of *uit* measured by the unconditional statistics of $E(uit)$ and $V(u_{it})$, respectively. The marginal effect of $z[k]$ on $E(u_{it})$, and $V(u_{it})$ can be both positive and negative in the sample. Eqs. (8) and (9) represent the two moments "after truncation" (i.e., the mean and the variance) of u_{it}

$$m_1 = f(\mu_{it,},\ \sigma_{it}) = \sigma_{it}\left[\Lambda + \frac{\phi(\Lambda)}{\Phi(\Lambda)}\right] \tag{8}$$

$$m_2 = g(\mu_{it,},\ \sigma_{it}) = \sigma_{it}^2\left[1 - \Lambda\left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right] - \left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right]^2\right] \tag{9}$$

where $\Lambda = \mu_{it}/\sigma_{it}$,and ∅ and Φ are the probability and cumulative density functions of a standard normal distribution, respectively.

3.3.4. Marginal effects

Marginal effects express how the dependent variable changes when the explanatory variable changes. It is commonly constant in linear regression, while this is not the case in non-linear regression (Wang, 2002), meaning the marginal effect is a coefficient in any linear regression and does not depend on anything else. However, the marginal effect is not represented directly and straightforwardly as a coefficient, where the coefficient depends on another value.

In our research, the marginal effects are related to the relationship between efficiency and determinants (z_{it}). Hence, it is necessary to calculate marginal effects. The calculation will consider Eqs. (6) and (7), where the marginal effects of $z[k]$ on $E(u_{it})$ are represented by Eq. (10):

$$\frac{\partial E\,(u_{it})}{\partial z(k)} = \delta[k]\left[1 - \Lambda\left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right] - \left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right]^2\right] + \gamma[k]\frac{\sigma_{it}}{2}\left[1 + \Lambda^2\left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right] + \left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right]^2\right] \tag{10}$$

where δ[k] and γ[k] are corresponding coefficients in Eqs. (6) and (7), respectively. Eq. (10) shows that the marginal effect is the sum of the adjusted slope coefficients from the mean and the variance functions.

Additionally, the marginal effects of z[k] on $V(u_{it})$ are represented by Eq. (11):

Table 2
Number of insurance firms and Takaful providers.2009–2016.

Country	2009	2010	2011	2012	2013	2014	2015	2016
Bahrain	16 (4)	17 (4)	18 (4)	19 (4)	19 (4)	19 (4)	19 (4)	19 (4)
Kuwait	5 (1)	6 (2)	6 (2)	6 (2)	6 (2)	6 (2)	6 (2)	6 (2)
Oman	3 (0)	3 (0)	3 (0)	3 (0)	3 (0)	5 (2)	5 (2)	5 (2)
Qatar	5 (2)	5 (2)	5 (2)	5 (2)	5 (2)	5 (2)	5 (2)	5 (2)
Saudi Arabia	15 (15)	27 (27)	28 (28)	29 (29)	30 (30)	32 (32)	32 (32)	32 (32)
UAE	25 (5)	25 (5)	27 (6)	27 (6)	27 (6)	27 (6)	27 (6)	27 (6)
Total	69 (27)	83 (40)	87 (42)	89 (43)	90 (44)	94 (48)	94 (48)	94 (48)

Note: The number is the combined total of insurance and *Takaful* firms, with the number of *Takaful* providers in parentheses.

$$\frac{\partial V(u_{it})}{\partial z(k)} = \frac{\delta[k]}{\sigma_{it}}\left[\frac{\phi(\Lambda)}{\Phi(\Lambda)}\right](m_1^2 - m_2) + \gamma[k]\sigma_{it}^2\left\{1 - \frac{1}{2}\left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right]\left(\Lambda+\Lambda^3 + (2 + 3\Lambda^2)\left[\frac{\phi(\Lambda)}{\Phi(\Lambda)}\right] + 2\Lambda\left[\frac{\phi(\Lambda}{\Phi(\Lambda)}\right]^2\right)\right\} \tag{11}$$

As in Eq. (10), the marginal effect is the sum of the adjusted slope coefficients from the mean and the variance functions.

4. Results and findings

4.1. Descriptive analysis

Table 2 shows that the number of players increased by 36%, from 69 to 94 firms. The Saudi, UAE and Bahraini markets constitute the majority of our sample data due to availability. For the same reason, data for Kuwait, Oman and Qatar are limited. In terms of *Takaful* business, Saudi Arabia is the only market where all players operate based on sharia principles, while Oman was the last market to offer *Takaful* business starting in 2014. The number of *Takaful* operators increased from 27 to 48 during the period.

The summary statistics for the variables used in the analysis are presented in Table 3, which indicates that the average oil price throughout the period is $81.13 per barrel, with a minimum of $40.68 and a maximum as high as $109.45. Fig. 1 illustrates oil prices from 2009 to 2016, showing that prices increased dramatically from 2009 to 2012, then dropped, until reaching $40.68 in 2016. The drop in global oil prices occurred on both the demand and supply sides. Analysts and researchers identify the underlying factors, such as a slowdown in China, India and Europe affecting demand and an increased production of shale oil affecting supply. The outcome is that the supply of oil increased while demand declined severely (Rodger, 2016).

Another aspect discussed in this paper is the financial market, which we planned to view through four variables: average total index return, the ratio of stock market capitalization to GDP, bond yields and *sukuk* returns. However, a lack of data and poor development in the debt market led us to concentrate on the first two measurements. Table 3 shows that the average total index returns in GCC stock markets equal 0.197 through our period of study. We break down the analysis on a country basis in Table 4.

The GCC has a total of 786 firms listed on stock markets. Table 4 and Fig. 2 illustrate the average total index returns in the GCC over the sample period, showing high fluctuation over the period in all countries. The worst year for the majority of markets was 2011 because of the global subprime crisis, and the best index returns for the majority of markets was 2013 because of the high oil prices.

The Qatari market recorded the highest ratio of market capitalization to GDP over the period, while the Omani and UAE markets had the lowest. The ratio in the other markets ranged between 0.50 and 0.79, as shown in Table 5.

Table 6 lists a summary of the statistics, including efficiency scores and a breakdown by type of firm. In addition, it shows the significance of the difference of efficiency scores across firm type. The efficiency score varies from 0.75 to 0.99 in our sample, with an average of 0.93. In our smaller sample, *Takaful* companies have a significantly higher efficiency score, suggesting that they are more efficient than conventional insurance.

Table 7 shows a comparison of efficiency scores across GCC countries. Saudi Arabia has the highest average (0.938) and the UAE the lowest (0.917).

In examining the possibility of high correlation among the independent variables, the Pearson correlation coefficient was estimated. The results are in Table 8 and show low correlation among the independent variables. Regarding the correlation between the dependent variable and independent variables, the results show a strong correlation between both oil prices and financial market

Table 3
Summary statistics on key variables.

	Number of observations	Mean	Standard deviation	Min	Max
Oil price	689	81.1343	26.4022	40.68	109.45
Average total index rate	689	.1979	.2036	.0025	1.0039
Ratio of stock market capitalization to GDP	689	.5863	.1472	.27	1.0155
Inflation	689	.0259	.0163	−.04863	.0582
Fiscal stance	689	−.2664	12.1494	−19	34.37

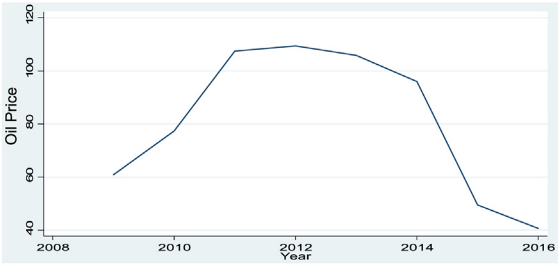

Fig. 1. Average annual OPEC crude oil price in US dollars per barrel.2009–2016.
Source: Bloomberg.

Table 4
Average total index returns in GCC stock markets, 2009–2016.
Source: Bloomberg, stock market of each country.

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
2009	0.0183	0.1582	0.3305	0.1706	0.3146	0.2751
2010	0.1922	0.6197	0.2206	0.4075	0.1215	0.0976
2011	0.0085	0.0025	0.0031	0.1712	0.0094	0.0066
2012	0.1417	0.2083	0.1715	0.1121	0.0997	0.2971
2013	0.382	0.286	0.3464	0.4017	0.295	1.0039
2014	0.3523	0.1893	0.0881	0.3436	0.0163	0.2378
2015	0.0623	0.0581	0.0123	0.0089	0.2106	0.043
2016	0.2138	0.2266	0.2296	0.1607	0.0832	0.2381

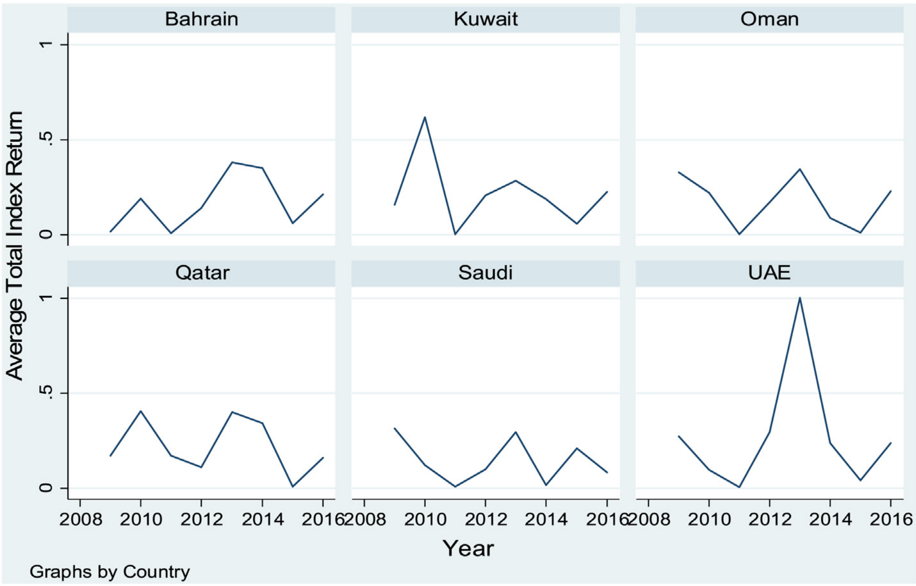

Fig. 2. Average total index returns.

measures and efficiency scores for the sample dataset.

4.2. The impact of oil prices on inefficiency in the insurance and Takaful industry in the GCC

4.2.1. Basic results

In order to assess the impact of oil prices and the financial market on cost inefficiency, we estimate the cost function in Eqs (4)–(8). Then, we analyze the estimation results. Tables 9–11 show the estimated effects of the three determinants and other control variables on inefficiency. In each table, the estimated effects of the determinants of inefficiency are divided into two parts. The first part concerns the impact of determinants on the level of inefficiency (u_{it}), whereas the second observes the effect of determinants on the variance in inefficiency ($\sigma^2_{u,\,it}$).

Table 5
The ratio of stock market capitalization to GDP in the GCC, 2009–2016.
Source: World Bank

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
2009	0.709	0.883	0.464	0.899	0.743	0.550
2010	0.780	0.968	0.483	0.989	0.669	0.460
2011	0.569	0.591	0.395	0.749	0.505	0.270
2012	0.545	0.603	0.395	0.676	0.507	0.270
2013	0.561	0.619	0.466	0.768	0.626	0.460
2014	0.661	0.635	0.467	0.901	0.639	0.500
2015	0.618	0.773	0.589	0.866	0.644	0.530
2016	0.609	0.797	0.351	1.015	0.694	0.560

Table 6
The efficiency scores of insurance and *Takaful* providers.

Group	Number of observations	Mean	Standard deviation	Min	Max
Overall	689	.9289	.0497	.7534	.9897
insurance	349	.9246	.0544	.7663	.9879
Takaful	340	.9333	.0439	.7535	.9897
Difference in mean		−.0087**			

Table 7
Comparison of efficiency scores across the GCC countries.

Country	Number of observations	Mean	Standard deviation	Min	Max
Bahrain	145	.9325	.0395	.8703	.9837
Kuwait	47	.9262	.0362	.8730	.9728
Oman	21	.9332	.0453	.8778	.9859
Qatar	40	.9282	.0378	.8661	.9768
Saudi Arabia	225	.9380	.0362	.8848	.9897
UAE	211	.9170	.0681	.7534	.9879
Overall	689	.9289	.0497	.7535	.9897

Table 8
Correlation matrix.

	Efficiency	Oil price	Average total index rate	Ratio of stock market capitalization to GDP	Inflation	Fiscal stance
Efficiency	1.0000					
Oil price	−0.4185	1.0000				
Average total index rate	−0.7018	0.1732	1.0000			
Ratio of stock market capitalization to GDP	0.3473	−0.4119	−0.0205	1.0000		
Inflation	0.1308	−0.1033	−0.1638	0.2169	1.0000	
Fiscal stance	−0.3429	0.6633	0.1889	−0.1252	0.1283	1.0000

In addition, each table includes regressions in which each model consists of different variables to explain inefficiency. Furthermore, estimations have been done according to different outputs (net claims incurred and investment). However, the findings in the tables in this section are difficult to interpret given the non-linearity, and therefore marginal analysis has been conducted for easy interpretation. Marginal effects show the effect of oil prices, the average total index rate and the ratio of stock market capitalization to GDP on the level and variability of inefficiency (Fig. 3).

Table 9 consists of four models, all of which include oil price variables, while the other variables change. A positive coefficient indicates that oil prices have a negative effect on efficiency, whereas a negative coefficient has a positive influence on efficiency. The results show that oil prices are insignificant with respect to efficiency in the majority of the models, which is consistent with Said (2015). Model 3 is the only significant model with a positive coefficient in u_{it}. This means that the increase in oil prices may make firms become inefficient. The results support the resource curse hypothesis. This finding is similar to Hartwell (2016) and Ross (2015).

Table 10 consists of four models, with an average total index rate variable as a proxy for financial market. A positive coefficient indicates that the average total index rate has a negative effect on efficiency, while a negative coefficient shows a positive influence with respect to efficiency. The main focus of Table 10 is the average total index rate, in which the majority of coefficients are positive.

Table 9
Cost function estimation (oil price on inefficiency).

Models	Model 1	Model 2	Model 3	Model 4
Output	1	1	2	2
Effects on u_{it}				
Oil Price	**0.00905**	**0.0125***	**−0.114**	**−0.000696**
	(0.92)	**(1.88)**	**(-0.30)**	**(-0.36)**
Average total index return	0.202			
	(1.12)			
Ratio of stock market capitalization to GDP		0.707***		
		(2.69)		
Fiscal stance				0.0187***
				(4.39)
Constant	−0.897	−1.389*	4.997	0.215
	(-0.85)	(-1.91)	(0.32)	(1.25)
Effects on $\sigma^2_{u,it}$				
Oil price	**−0.0751**	**−0.0529*****	**0.0839***	**−0.302***
	(-1.53)	**(-3.00)**	**(1.77)**	**(-1.80)**
Average total index return	3.778			
	(0.70)			
Ratio of stock market capitalization to GDP		6.500***		
		(3.02)		
Fiscal stance				−0.101
				(-1.52)
Constant	−0.519	−3.474**	−9.384	9.802
	(-0.18)	(-2.05)	(-1.41)	(1.38)
$\sigma^2_{v,it}$				
Constant	−0.981***	−1.048***	−0.371***	−0.369***
	(-17.91)	(-17.75)	(-6.70)	(-6.66)
Observations	689	689	689	689

t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
u_{it} and v_{it} are the level and variance of inefficiency, respectively. $\sigma^2_{v,it}$ is the variance in the error term.

Table 10
Cost function estimation (average total index rate on inefficiency).

	Model 5	Model 6	Model 7	Model 8
Output	1	1	1	2
Effects on u_{it}				
Average total index return	**0.202**	**0.736**	**0.304***	**1.260*****
	(1.12)	**(0.35)**	**(1.70)**	**(7.21)**
Oil price	0.00905	−0.0321		
	(0.92)	(-0.42)		
Ratio of stock market capitalization to GDP		1.315*		0.839***
		(1.79)		(4.10)
Fiscal stance			0.0149***	
			(3.67)	
Constant	−0.897	−0.553	0.0205	5.144
	(-0.85)	(-0.44)	(0.18)	(0.04)
Effects on $\sigma^2_{u,it}$				
Average total index return	**3.778**	**1.013**	**3.598**	**−5.070*****
	(0.70)	**(0.66)**	**(0.38)**	**(-2.69)**
Oil price	−0.0751	0.0695**		
	(-1.53)	(2.23)		
Ratio of stock market capitalization to GDP		3.676		1.828**
		(1.52)		(2.20)
Fiscal stance			−0.151	
			(-0.78)	
Constant	−0.519	−11.81**	−7.704	−1.190**
	(-0.18)	(-2.06)	(-1.20)	(-2.19)
$\sigma^2_{v,it}$				
Constant	−0.981***	−1.040***	−1.125***	−1.394***
	(-17.91)	(-18.37)	(-16.89)	(-3.44)
Observations	689	689	689	689

t-statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
u_{it} and v_{it} are the level and variance of inefficiency, respectively. $\sigma^2_{v,it}$ is the variance in the error term.

Table 11
Cost function estimation (ratio of stock market capitalization to GDP on inefficiency).

Models	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Output	1	1	1	1	2	2
Effects on u_{it}						
Ratio of stock market capitalization to GDP	**0.164**	**1.178****	**1.315***	**1.615***	**0.839*****	**1.001**
	(0.70)	**(2.35)**	**(1.79)**	**(1.79)**	**(4.10)**	**(0.87)**
Average total index return		0.239	0.736		1.260***	
		(0.53)	(0.35)		(7.21)	
Oil price		−0.0102**	−0.0321			
		(-2.32)	(-0.42)			
Fiscal stance	0.0148***					−0.0688*
	(4.18)					(-1.76)
Inflation		19.49***		25.56		58.68**
		(3.47)		(1.61)		(2.33)
Constant	0.186	−1.790***	−0.553	−2.024**	5.144	−3.156*
	(0.48)	(-3.15)	(-0.44)	(-2.09)	(0.04)	(-1.93)
Effects on $\sigma^2_{u,it}$						
Ratio of stock market capitalization to GDP	**2.267**	**3.135**	**3.676**	**−4.088**	**1.828****	**−0.0249**
	(0.40)	**(1.03)**	**(1.52)**	**(-0.36)**	**(2.20)**	**(-0.01)**
Average total index return		1.131	1.013		−5.070***	
		(0.91)	(0.66)		(-2.69)	
Oil price		0.110**	0.0695**			
		(2.00)	(2.23)			
Fiscal stance	−0.0690					0.0831***
	(-1.01)					(4.36)
Inflation		−16.60		−182.2		−1.149
		(-0.39)		(-0.53)		(-0.06)
Constant	−5.172	−15.84**	−11.81**	0.882	−1.190**	−2.170*
	(-1.11)	(-2.06)	(-2.06)	(0.17)	(-2.19)	(-1.65)
$\sigma^2_{v,it}$						
Constant	−1.155***	−1.067***	−1.040***	−1.155***	−1.394***	−0.397***
	(-13.40)	(-19.03)	(-18.37)	(-16.06)	(-3.44)	(-6.90)
Observations	689	689	689	689	689	689

t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
u_{it} and v_{it} are the level and variance of inefficiency, respectively. $\sigma^2_{v,it}$ is the variance in the error term.

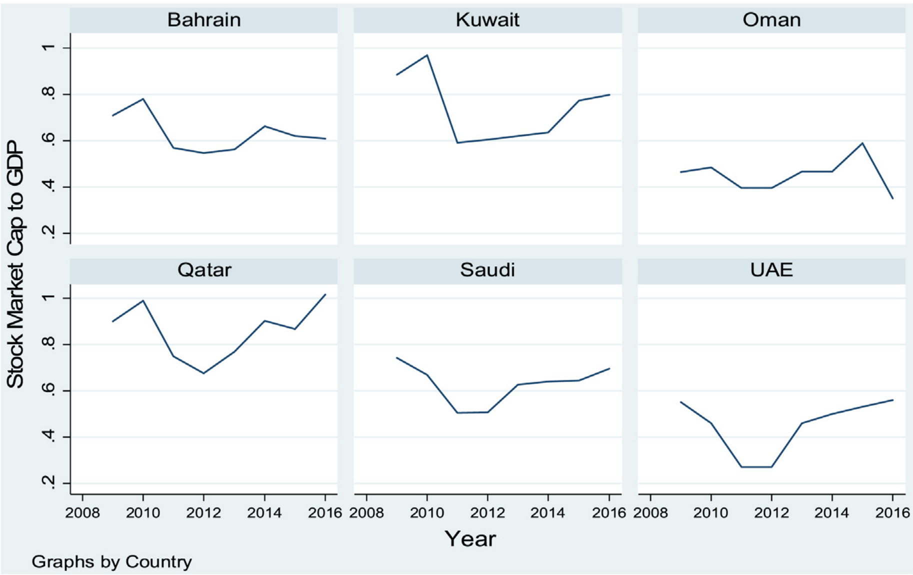

Fig. 3. The ratio of stock market capitalization to GDP.

Models 5, 6 and 7 are significantly positive in u_{it}, which means that when the average total index rate increases, this may cause insurers and *Takaful* providers to become inefficient (negative with efficiency), supporting the resource curse hypothesis. This finding is similar to Hartwell (2016) and Ross (2015).

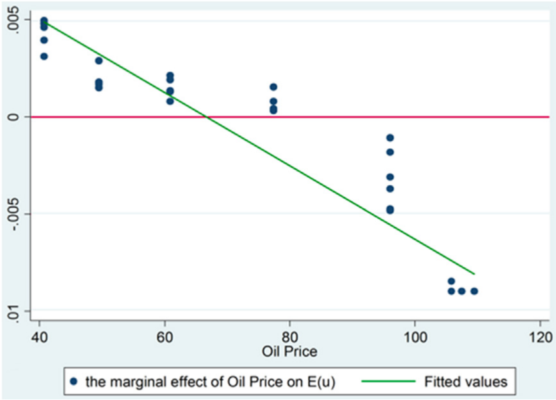

Fig. 4. Marginal effect of oil prices on efficiency.

Table 11 consists of six models, all of which include the ratio of stock market capitalization to GDP variable as a proxy for financial market, while changing the other variables. A positive coefficient indicates that the ratio of stock market capitalization to GDP has a negative effect on efficiency, while a negative coefficient shows a positive influence. The results show that the impact of stock market capitalization to GDP on inefficiency is positive in all models regarding u_{it}. This indicates that the increase in the ratio of stock market capitalization to GDP may tend towards firm inefficiency (negative with efficiency), which supports the resource curse hypothesis. Again, this finding is similar to Hartwell (2016) and Ross (2015).

4.2.2. The non-linear impact of oil prices on efficiency

For the comprehensiveness of the analysis and because of the non-linearity of the model, we need to derive and investigate the marginal effect of the variables on efficiency. The marginal effect tells us how efficiency will change when a determinant changes. The following figures provide more accurate results than the previous tables.

Fig. 4 displays the marginal effect of oil prices on efficiency, where marginal effects are plotted against oil prices. The figure illustrates that the relationship between oil prices and efficiency is mixed: it starts out positive and at a certain point becomes negative. This relationship makes sense in this region, where oil is the engine of the entire economy and leads growth in the market. When the market grows, more projects deemed to be risky need to be covered, which is consequently reflected in premiums/ contributions. When the oil price is high, the capital market grows, and insurers and *Takaful* providers invest their funds, leading to high returns.

All these elements indicate one key observation: insurers and *Takaful* providers do not struggle to find business, which makes managers spend less effort or/and more in expenses. Hence, the resource curse might be a suitable justification for this result. Governments rich in resources are usually inefficient because they run their countries through overspending. This finding is similar to Hartwell (2016) and Ross (2015).

Fig. 5 displays the marginal effect of the average total index rate on efficiency, where the marginal effects are plotted against the average total index rate, showing a negative relationship between the average total index rate and efficiency. The increase in the average total index rate leads to a decrease in efficiency. This result supports the previous analysis and is in line with the resource curse hypothesis. This finding is similar to Hartwell (2016) and Ross (2015).

Fig. 6 illustrates the marginal effect of the ratio of stock market capitalization to GDP on efficiency, where the marginal effects are

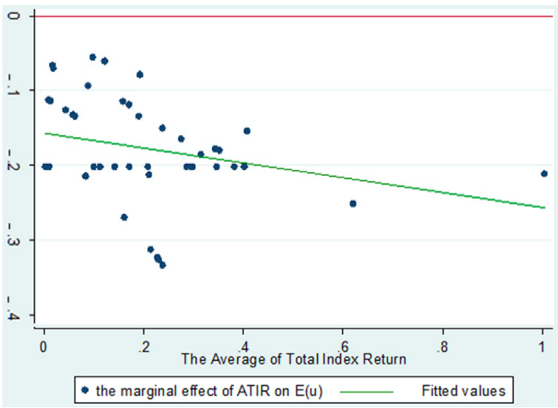

Fig. 5. Marginal effect of average total index rate on efficiency.

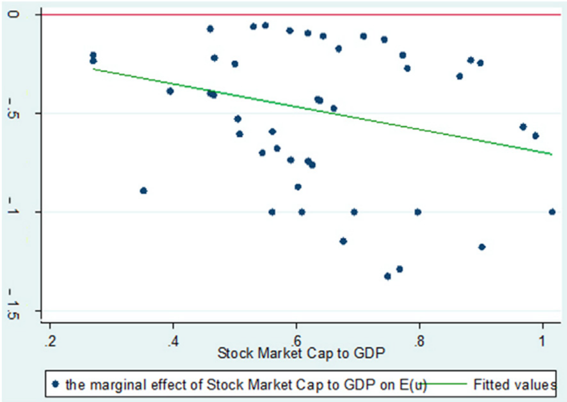

Fig. 6. Marginal effect of the ratio of stock market capitalization to GDP on efficiency.

plotted against the ratio of stock market capitalization to GDP. This figure supports the previous analysis. The relationship between the ratio of stock market capitalization to GDP and efficiency is negative. Insurers invest their funds in stock markets, so the GCC stock market flourishes when oil prices are high. When the ratio of stock market capitalization to GDP increases, efficiency decreases. Furthermore, the marginal effect shows a negative impact through all observations. The magnitude of this negative impact increases as the market share rises. The resource curse hypothesis may justify this result. This finding is similar to Hartwell (2016) and Ross (2015).

4.3. The impact of oil prices on inefficiency, comparing Takaful providers with insurance companies in the GCC

4.3.1. Basic results

This section explores whether the impact of a determinant on inefficiency differs between *Takaful* providers and insurance companies. The findings in the following tables are difficult to interpret given the non-linearity, and therefore marginal analysis has been conducted for easy interpretation.

Table 12 shows that all coefficients are positive for inefficiency with respect to u_{it}, including the significant models. Therefore, in terms of efficiency, *Takaful* providers are no better than insurance companies. Furthermore, some *Takaful* providers are less efficient than insurance firms, as in models 19–20 and 22–23. The result supports previous studies (Antonio et al., 2013; Bahrain and Isa, 2013; Ismail et al., 2011; Saad, 2012; Saad et al., 2006).

Another area we explore through estimations conducted in Tables 9–12 is the impact of the control variables inflation and fiscal stance on inefficiency. We observe that all significant coefficients of inflation are positive in terms of affecting inefficiency, which means that the relationship between inflation and efficiency is negative, where increases in inflation may cause efficiency to drop. However, fiscal stance has mixed results, both positive and negative, although the majority of significant coefficients are positive, while an increase in fiscal stance may adversely affect efficiency.

4.3.2. The non-linear impact of oil prices on efficiency

The previous tables do not have conclusive results because of the non-linearity of the models. The following figures show the marginal effect of the determinants on cost efficiency by comparing *Takaful* providers to insurance companies.

Fig. 7 does not show clear evidence of a difference between *Takaful* and conventional insurance in terms of the impact of oil prices on efficiency. Similarly, Fig. 8 shows no difference between conventional insurance and *Takaful* providers in terms of the impact of the average total index rate on efficiency. However, Fig. 9 shows differences between *Takaful* providers and conventional insurers regarding the impact of the ratio of stock market capitalization to GDP on efficiency. In conventional insurance, the relationship between this variable and efficiency is negative, whereas among *Takaful* operators the relationship is positive, where the increase in the ratio of stock market capitalization to GDP pushes firms to improve efficiency.

4.4. Robustness check

To support the previous results, we conducted a robustness check consisting of five models (26–30) with a country dummy as a control variable to see whether the impact of determinants against inefficiency changed compared to the previous tables; another aim of this test is to capture the country effects and differences among them (see Appendix 2). All countries are compared to the UAE, which is deemed a benchmark. The UAE is the only country with an independent authority to govern the insurance sector and has the biggest sector in the GCC in terms of premiums and number of players.

Table A.1 in Appendix 3 and u_{it} show that the results for oil prices are significant only for the positive coefficient, which enhances the results of Table 9. Additionally, the findings of the average total index in this table strongly support the results in Table 10 (Table A.2 in Appendix 3), where the relationship between this variable and inefficiency is positively significant. Finally, the variable for the

Table 12
Cost function estimation (determinants of inefficiency including the dummy variable for Takaful providers).

Output	Model 19 1	Model 20 2	Model 21 2	Model 22 1	Model 23 2	Model 24 1	Model 25 1
Effects on u_{it}							
Takaful	**0.342*****	**0.365*****	**1.901**	**0.366*****	**0.623*****	**4.025**	**2.086**
	(5.08)	**(7.73)**	**(0.39)**	**(7.74)**	**(9.75)**	**(0.20)**	**(0.38)**
Oil price	0.00313*	0.000527	−0.00105				
	(1.71)	(0.62)	(-0.32)				
Average total index return		0.319**		0.335**	1.153***		
		(2.31)		(2.48)	(6.56)		
Ratio of stock market capitalization to GDP	0.0502				0.376*	−0.176	−0.426
	(0.18)				(1.92)	(-0.42)	(-1.09)
Fiscal stance			0.00214			−0.000692	
			(0.27)			(-0.16)	
Constant	−0.209	4.090	−1.019	4.508	4.616	−3.117	−0.884
	(-0.80)	(0.23)	(-0.20)	(0.04)	(0.17)	(-0.15)	(-0.16)
Effects on $\sigma^2_{u,\,it}$							
Takaful	**1.305***	**1.849*****	**−0.838**	**1.778*****	**0.748****	**−1.972**	**−1.491**
	(1.80)	**(3.72)**	**(-0.26)**	**(3.64)**	**(2.00)**	**(-0.37)**	**(-0.45)**
Oil price	−0.0569*	−0.00772	−0.0273				
	(-1.93)	(-1.51)	(-1.41)				
Average total index return		−7.339***		−7.353***	−6.468**		
		(-3.57)		(-3.25)	(-2.41)		
Ratio of stock market capitalization to GDP	13.18***				2.335**	1.831	2.844
	(3.16)				(2.22)	(1.05)	(1.40)
Fiscal stance			0.0692			0.0380	
			(1.63)			(1.07)	
Constant	−9.427***	0.286	−0.0565	−0.187	−2.067**	−2.192	−2.897
	(-3.28)	(0.33)	(-0.02)	(-0.22)	(-2.56)	(-0.35)	(-0.68)
$\sigma^2_{v,\,it}$							
Constant	−1.138***	−1.702***	−0.507***	−1.673***	−1.327***	−0.506***	−0.628***
	(-18.83)	(-12.73)	(-7.42)	(-11.98)	(-4.43)	(-6.93)	(-7.16)
Observations	689	689	689	689	689	689	689

t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
u_{it} and v_{it} are the level and variance of inefficiency, respectively. $\sigma^2_{v,\,it}$ is the variance in the error term.

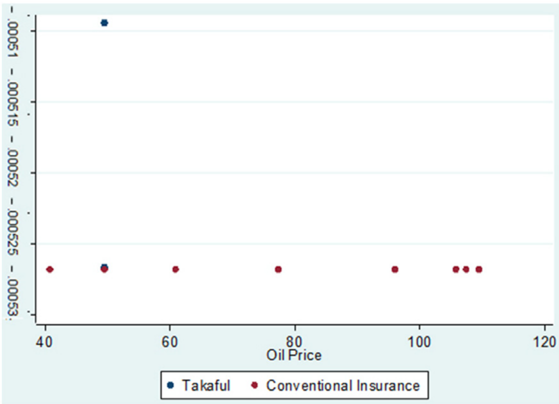

Fig. 7. The ratio of stock market capitalization to GDP.

ratio of stock market capitalization to GDP is positive in all models and significant in the majority of them, and this result supports the accuracy of our results in Table 11 (Table A.3 in Appendix 3). Overall, our robustness check supports the results from the previous analysis.

Regarding country effects, the results for Kuwait and Saudi Arabia are positively significant, which means that they are less cost efficient than the UAE. However, Bahrain is the only country that is more efficient than the UAE. In addition, Oman and Qatar are insignificant in models 50 and 51, where they are less cost efficient than the UAE. The table also shows that the results for Qatar are insignificant in all models.

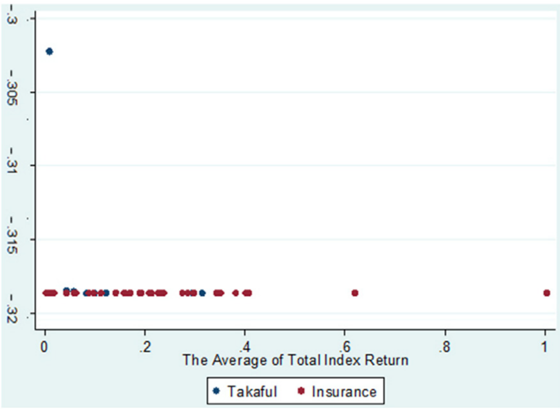

Fig. 8. The average of total index returns.

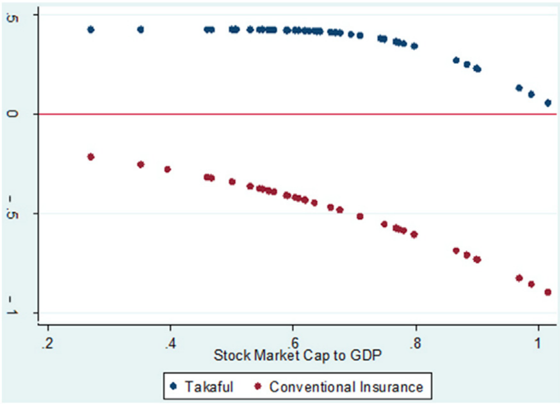

Fig. 9. The ratio of stock market capitalization to GDP.

5. Conclusion

This paper examines the impact of oil prices and the financial market on cost efficiency in the GCC insurance sector, using the stochastic frontier cost function from 2009 to 2016 by adopting Wang's (2002) model.

The results of the relationship between oil prices and efficiency are negatively insignificant. However, the marginal effect of oil prices on efficiency, illustrating the relationship between oil prices and efficiency, is positive at a certain point and then becomes negative. The price of oil may influence the entire economy to the extent that insurers and *Takaful* providers do not struggle to find business, which leads managers to make less efforts or/and spend more on expenses. Hence, the resource curse might be a suitable justification for this result. This is in line with Hartwell (2016) and Ross (2015).

In addition, the average total index rate and the ratio of stock market capitalization to GDP are proxies for the financial market, and the results show a negative relationship with efficiency. This may support the resource curse hypothesis and is similar to other findings (Hartwell, 2016; Ross, 2015).

In terms of differences between *Takaful* providers and conventional insurers concerning the impact of oil prices and the financial market on cost efficiency, we found no clear evidence of the impact that oil prices have on efficiency. However, there are differences regarding the financial market, with a negative impact on conventional insurance and a positive one on *Takaful* business. The *Takaful* industry is rapidly growing as compared to conventional insurance in the GCC and therefore the financial market can have added benefits for the GCC region. However, caution is required in relation to the impact of financial markets on conventional insurance

The results of this study have implications for regulators. The relationship between the financial capital market and efficiency encourages regulators to build capital markets that involve numerous instruments to boost the sustainability of the insurance industry. Management could enhance cost efficiency by developing human resources to create new and effective products. They should invest in new technology for robust delivery systems to maximize resource usage. Also, underwriting and claims practices have an essential role in strengthening firm performance, and any shortcomings and leakage affect the operational cycle. Furthermore, management may require the development of strategies to deal with the nature of GCC economies to avoid any shocks to the oil price. Regarding limitations, data availability is a common dilemma in academia. The research uses a reasonably sized sample for the UAE, Saudi Arabia and Bahrain, but the sample for the Kuwaiti, Omani and Qatari markets is limited because of the lack of disclosure and publications. Furthermore, the data could contain variables that affect the insurance sector in the GCC, i.e. debt market variables.

Acknowledgements

The authors are deeply grateful to Professor Richard Frensch (the Managing Editor), the Co-editor Professor Ali Kutan and the anonymous reviewers for their helpful comments, which improved the quality of the paper greatly. We also thank Kinan Salim for technical assistance. The authors acknowledge and assume responsibility for any remaining mistakes or errors within the manuscript.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ecosys.2019.100716.

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