Testing the production efficiency of the investment sector in Kuwait using two-stage approach

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Abstract

Purpose – Testing the efficiency in the economy has been highly pronounced since the financial crisis in 2008, as many countries have started to deregulate their economic sectors. The potential impact of testing efficiency is thus the key driver of world output and welfare. For this purpose, the main objective of the Capital Market Authority consists of more regulation of securities trading to boost economic efficiency. In particular, the purpose of this paper, is to examine the efficiency of 40 investment companies in Kuwait. In this study, the authors investigate the efficiency in the investment sector in Kuwait. Studying such a case is important for several reasons. First, the investment sector in Kuwait is affected by the World Trade Organization (WTO) conditions and regulations for more market liberalization. Second, most studies on efficiency have focussed on developed countries, such as those of Europe and the USA, with very few studies examining developing countries, such as Kuwait. Third, the study efficiency features is important in helping policy makers evaluate how the investment sector will be affected by increasing competition and then formulate policies that affect that sector and the economy as a whole.

Design/methodology/approach – In this study, we use non-parametric data envelopment analysis (DEA) to estimate investment companies' efficiency in Kuwait. The authors test predictions of the model using yearly data for 2006-2010. In the analysis, the authors follow the two-stage approach suggested by Coelli *et al.* (1998). In the literature on DEA efficiency score measurement, this two-stage approach is the most prominent. This approach uses the efficiency score, measured by the DEA model, as the dependent variable in a regression model with explanatory variables that are supposed to capture the impact of external factors (Hahn, 2007). In the second stage, the authors used a Tobit model to investigate factors affecting the efficiency in the Kuwaiti investment sector.

Findings – The findings of the second stage suggest that 2008-2010 had a negative impact on firms' efficiency in Kuwait. The results confirm the substantial influence of the 2008 global financial crisis on the investment sector in Kuwait. In addition, the results show that factors affecting production efficiency in the investment sector in Kuwait include the total revenues, total assets, government participation, and Islamic firm dummy. These second-stage results are confirmed using different specifications of a fixed effect model, a random effects model, and a logit model.

Originality/value – The results may be utilized by both monetary authorities and policy makers in establishing the general economic policy in the country. A number of policy implications may be derived from the estimates obtained in the current paper. First, the results show that the investment

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sector in Kuwait faced a sharp drop in its efficiency in 2008 due to the global financial crisis. This result tells us that there was a spillover effect of the global financial crisis in the Kuwaiti investment market, as companies in this market are highly vulnerable to global shocks. As a result, the investment sector needs to be regulated by, for example, encouraging more company mergers and acquisitions. Second, to meet the appropriate regulations in the investment sector in Kuwait, monetary authority in Kuwait should take into consideration the WTO conditions for more openness in the economic sector. Therefore, companies in the investment sector should be more efficient to compete with foreign investment companies that decide to enter into Kuwaiti market. Therefore, the need for regulations in the Kuwaiti investment sector is more necessary than before. Third, the study of efficiency features is important to help policy makers evaluate how the investment sector will be affected by increasing competition and then formulate policies that affect that sector and the economy as a whole. Furthermore, monetary policy can play an important role in influencing the efficiency in the investment sector. Therefore, the Central Bank of Kuwait should take a leading role in regulating abnormal financial activity in the Kuwaiti market.

Keywords Economics, Empirical research

Paper type Research paper

1. Introduction

Efficiency is a basic rule to achieve the economic development objectives of strategic plans in most economies. Market efficiency, however, leads to an increased rate of consumption of the resources used. Therefore, it may lead to more economic growth by increasing the demand for resources. Recently, many developing countries have gradually implemented procedures to develop more regulated sectors through achieving the efficiency objectives in these sectors.

Testing the efficiency in the economy has been highly pronounced since the financial crisis in 2008, as many countries have started to deregulate their economic sectors. The potential impact of testing efficiency is thus the key driver of world output and welfare. For this purpose, the main objective of the Capital Market Authority (CMA) consists of more regulation of securities trading to boost economic efficiency. In particular, in this paper, we examine the production efficiency of 40 investment companies in Kuwait.

In this study, we investigate the efficiency in the investment sector in Kuwait. Studying such a case is important for several reasons. First, the investment sector in Kuwait is affected by the World Trade Organization (WTO) conditions and regulations for more market liberalization. This is because inefficient investment companies are forced out of the market as increased competition keeps only efficient companies in the market. To meet these challenges, company managers and regulators must determine the level and sources of efficiency in the investment sector as an indicator of performance of both the individual company and the industry as a whole. Second, most studies on efficiency have focussed on developed countries, such as those of Europe and the USA, with very few studies examining developing countries, such as Kuwait. Third, studying the efficiency is important in helping policy makers evaluating how the investment sector is be affected by increasing competition and then formulate policies that affect that sector and the economy as a whole.

In this study, we use non-parametric data envelopment analysis (DEA) to estimate investment companies' efficiency in Kuwait. We test predictions of the model using yearly data for 2006-2010. In our analysis, we follow the two-stage approach suggested by Coelli *et al.* (1998). In the literature on DEA efficiency score measurement, this two-stage approach is the most prominent. This approach uses the efficiency score, measured by the DEA model, as the dependent variable in a regression model with

explanatory variables that are supposed to capture the impact of external factors (Hahn, 2007). In the second stage, we use a Tobit model to investigate factors affecting the efficiency in the Kuwaiti investment sector. The findings of the second stage suggest that years of 2008-2010 had a negative impact on firms' efficiency in Kuwait. The results confirm the substantial influence of the 2008 global financial crisis on the investment sector in Kuwait. In addition, the results show that factors affecting production efficiency in the investment sector in Kuwait include the total revenues, total assets, government participation, and Islamic firm dummy. These second-stage results are confirmed using different specifications of a fixed effect model, a random effects model, and a logit model.

This paper is organized as follows. Section 2 contains a brief survey of the relevant literature. Section 3 shows an overview of the investment sector in Kuwait. In Section 4, the methodology and model specification used in the study are explained, as well as data selection and descriptions. The empirical results are explained in Section 5. In Section 6, the conclusion and policy implications are provided.

2. Literature review

Studying the efficiency of the investment sector is important because it may affect the stability of the financial industry and then the effectiveness of the whole economy. In financial research, a huge body of literature focusses on efficiency, including both scale and scope economies, with an increasing focus on *X*-efficiency.

Efficiency is measured by various methods that estimate the production/cost frontier. These methods include non-parametric DEA, the free disposal hull (FDH) and parametric frontier models, the stochastic frontier approach (SFA), the distribution free approach (DFA), and the thick frontier approach (TFA).

Berger and Humphrey (1997) reviewed 130 studies that related the analysis of frontier efficiency to financial institutions in 21 countries. They determined that the efficiency estimates from non-parametric (DEA and FDH) studies are mostly the same as those from parametric frontier models (SFA, DFA, and TFA). The exception of that is the non-parametric methods which generally yield slightly lower mean efficiency estimates and seem to have a larger spread than the results of the parametric models (Berger and Humphrey, 1997). This supports the findings of using either approach; the non-parametric approach or parametric approach.

Yener Altunbas *et al.* (2000) used the stochastic cost frontier methodology to evaluate scale and *X*-inefficiencies to examine the impact of risk and quality factors on banks' cost in Japanese commercial banks between 1993 and 1996. They found strong evidence of scale economies across a wide range of bank sizes, even for the largest firms. They also concluded that the *X*-inefficiency estimates vary between 5 and 7 percent and are less responsive to risk and quality factors. Finally, they suggested that the largest banks can be more efficient in reducing costs by decreasing output rather than improving *X*-efficiency. However, their findings reveal very interesting conclusions about the Japanese case, they are not consistent with what previous studies found. This might be an incentive for policy makers in Japan to find an alternative policy toward enhancing the scale efficiency within the banking system in Japan.

Michael (2006) used DEA in his study to measure the *X*-efficiency to see if less productive banks were catching up to more productive ones in the USA by examining the convergence of productivity among bank holding companies (BHCs). He found that each BHC possesses its own steady-state productivity to which it converges. In other words, differences in *X*-efficiency between BHCs can create permanent differences in

productivity between them. He also concluded that all BHCs are converging to a minimum efficient scale; however, this scale is conditional on the level of *X*-efficiency. As such, an upper rank of *X*-efficiency caused by technological improvements, higher management incentives, and further specialized banking activities may enlarge the minimum efficient scale. Although findings of Michael (2006) do not support the hypothesis of absolute convergence, his results draw interesting conclusions for the conditional convergence.

Bikker (1999) applied the stochastic cost frontier approach and production approach to some of European banks to measure their *X*-efficiency. He measured the cost efficiency of banks in nine European countries by using the data for these banks from 1989 to 1997. He found that the least efficient banks are Spanish banks, followed by French and Italian banks. Banks in Germany, the Netherlands, and the UK have a mid-range level of efficiency. However, the most efficient banks are in Luxemburg, followed by banks in Belgium and Switzerland.

Allen and Liu (2005) measured the cost efficiency and economies of scale of the six largest banks in Canada using quarterly data from 1983 to 2003. They estimated four econometric models: a time-varying fixed-effects panel model, a stochastic cost efficiency frontier model, a system of seemingly unrelated regressions model, and a time-varying fixed-effects model. Allen and Liu concluded that changes in regulatory policies aided in reducing the banks' production cost. They also found that the inefficiency of Canadian banks is approximately 10 percent, and the ranking of efficiency suggests that larger banks are more cost efficient than smaller banks.

Shanmugam and Das (2004) measured the technical efficiency of 94 banks in India. They applied the stochastic frontier function methodology using panel data for the period between 1992 and 1999. They stated that there are variations in the efficiency among sample banks for four outputs: interest margin, non-interest income, investment, and credit. Shanmugam and Das concluded that 50 percent of the banks have technical efficiency and that the state bank group and private-foreign group banks are more efficient than other Indian banks. While findings support the efficiency across all banks specially private banks, these results are in line with the objectives of reform measures toward increasing economic growth.

Yildirim (2002) used non-parametric DEA to analyze the efficiency performance of the Turkish banking sector from 1988 to 1999. He chose this period because the unstable macroeconomic environment is at a high level. Yildirim stated that the technical efficiency measure showed large variation with the absence of sustained efficiency gains. He also found that efficient banks are more profitable than inefficient banks. For the period under study, he reported that the instability of the macroeconomic environment had a profound influence on the efficiency measures.

3. Overview on the Kuwaiti investment sector

The investment sector in Kuwait is one of the largest sectors after oil production. It contributes significantly on the overall Kuwaiti economy. Investment companies undertake various activities, most importantly asset management activities. Since 2004, the financial sector in Kuwait has developed significantly. The number of investment companies has more than doubled. This reflects the expansion of the investment sector due to the global trend toward a larger role for non-banks in the economy. The Kuwaiti investment sector consists of 100 investment companies. While a total of 54 investment companies operate under Islamic Sharia provisions, the other 46 investment companies operate under the conventional rules.

It is noteworthy that the investment sector is regulated by the Central Bank of Kuwait. The development in the Islamic finance has helped the local market to use proper instruments for risk management and cash flow management.

The creation of the CMA in 2010 helped in establishing regulatory instructions for the investment sector in Kuwait. These regulations have brought a new financial environment with international standards. The establishment of the CMA has increased investors' confidence in the economy. This also helps in the development of a more dynamic capital market that supports the private sector to increase their contributions in different funds operating effectively. The main objective of the CMA is to regulate securities trading to boost economic efficiency.

In addition, the Central Bank of Kuwait has recently announced some instructions to the investment companies to promote financial stability and increase the degree of interaction between the investment companies and various real sectors in the Kuwaiti economy. The instructions consist of three regulatory ratios that investment companies in the sector must fulfill by 2013: a maximum debt to equity ratio, a minimum cash and cash equivalents to current liabilities ratio, and a maximum external liabilities to equity ratio.

As a result of the global financial crisis in 2008, the economy of Kuwait has suffered, especially in the financial sector. Due to the economic crisis and depressed oil prices, the economy dropped by 21 percent in nominal terms in 2009. Specifically, the investment sector – consisting of listed companies – lost a total of approximately 864 million KD in 2009, which followed losses of 927 million KD in 2008, compared to profits of 903 million KD in 2007. In addition, some investment companies were suspended from trading on the Kuwait Stock Market due to non-compliance related to late submission of financial statements. At the same time, other investment companies, such as Dar Investment and Global Investment House, faced major debt repayment problems.

The reaction was followed by government intervention with a stimulus package of 1.5 billion KD to stabilize the financial sector. The economy of Kuwait has recovered, but at a slower pace. Some difficulties persist for the investment sector in Kuwait. Currently, the investment sector is undergoing a major reregulating in agencies as a result of numerous defaults and regulatory breaches by the various companies that were influenced by the global financial crisis. This may improve transparency and prevent excessive leverage in the system, reducing the overall systematic risk.

4. Methodology and model specification

The level of efficiency is measured by various techniques that estimate the production cost frontier. Pastor *et al.* (1997) stated that the techniques used in estimating the frontier are based on parametric methods when some hypotheses are introduced on the frontier functional form based on their properties, and non-parametric methods are used when observational criteria based on programming techniques are used to construct the frontier. Hence, there are two main techniques used in estimating a frontier: non-parametric DEA and parametric stochastic frontier analysis (SFA).

4.1 DEA

DEA is a non-parametric method that measures efficiency using linear programming techniques, occasionally called frontier analysis. DEA is a performance measurement technique, first used by Charnes *et al.* (1978). According to Berger and Humphrey (1997),

DEA is a linear programming technique in which the set of frontier observations are decision-making units (DMUs) for which no other DMU produces as much or more of every output (given input) or uses as little as or less than every input (given output). In other words, DEA is commonly used to evaluate the efficiency of a number of producers or DMUs. The production process for each producer involves using a set of inputs to produce a set of outputs. Each producer has a varying level of inputs and gives a varying level of outputs. The ratio of outputs to inputs is a commonly used measure of efficiency:

$$\text{Efficiency} = \text{output}/\text{input}$$

Figure A1 shows a set of DMUs, a, b, c, d, e, f, and g, with each unit consuming a single input x to produce a single output y. We may identify b and e as the most efficient DMUs since they are located on the efficient frontier line, while the DMUs a, c, d, f, and g are inefficient because they appear below the efficient frontier line.

Now let us present a case of one input and two inputs. Figure A2 shows a set of DMUs, a, b, c, d, e, f, and g, with each consuming the same amount of a single input and producing a different amount of two outputs ($y1$ and $y2$). Applying the DEA approach to this set of DMUs will identify a, e, g, and f as efficient DMUs because they are on the efficient frontier line. In addition, these DMUs provide an envelope around the entire data set. The DMUs b, d, and c are below the efficient frontier line (within the envelope); hence, they are inefficient.

Charnes *et al.* (1978) proposed a DEA model (CCR model) with the assumption of constant return to scale (CRS). Later, Banker *et al.* (1984) used an alternative assumption in their DEA model (BCC model), which is a variable return to scale (VRS) (Casu and Molyneux, 2003).

4.2 SFA

SFA has its starting point in the stochastic production frontier models simultaneously introduced by Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977). "SFA posits a composed error model where inefficiencies are assumed to follow an asymmetric distribution, usually the half-normal, while random errors follow a symmetric distribution, usually the standard normal. The logic is that the inefficiencies must have a truncated distribution because inefficiencies cannot be negative. Both the inefficiencies and the errors are assumed to be orthogonal to the input, output, or environmental variables specified in the estimating equation. The estimated inefficiency for any firm is taken as the conditional mean or mode of the distribution of the inefficiency term, given the observation of the composed error term" (Berger and Humphrey, 1997)

Aigner *et al.* (1977), Battese and Corra (1977), and Meeusen and Van den Broeck (1977) independently developed a model to estimate an SFA. The model is denoted in logs as:

$$\ln(yj) = \ln xj\,\beta + vj - uj$$

where yj is an output vector for firm j; xj is an input vector for firm j; vj is a random error added to the non-negative inefficiency term; uj is an inefficiency term; and β is a vector of coefficients that need to be estimated.

The random error term vj measures error and other random factors affecting the value of the output variable, together with the combined effects of unspecified input variables in

the production function. We call the model stochastic because the right-hand side is determined by the stochastic variable:

$$\exp(xj\,\beta + vj)$$

The random error term vj can be negative or positive, so the stochastic frontier outputs vary relative to the deterministic part of the frontier model:

$$\exp(xj\,\beta)$$

The functional form is needed to estimate the stochastic frontier model, but the specification of a functional form is not practical since the banking industry is a multi-output industry. Thus, a cost frontier can be specified.

The stochastic cost frontier has the following form:

$$\ln cj = \mathrm{f}(\ln yr, j, \ln cij) + \varepsilon j$$

where cj is the total cost for firm j; yr,j is the rth output of firm j; ci,j is the price of the ith input of firm j; and εj is the error term. The error term εj consists of two elements, random error term vj and inefficiency term uj. The random error term vj is assumed to have non-negative distribution $vj \sim N(0, \sigma 2v)$ and to be independent of the explanatory variables. The inefficiency term uj is also assumed to have the non-negative distribution $uj \sim N(0, \sigma 2v)$ and to be independent of the vj (Fiorentino *et al.*, 2006).

In this study, we use non-parametric DEA to estimate investment companies' efficiency in Kuwait with the assumption of a VRS. The reason for choosing DEA is because the SFA requires a large sample size to make reliable estimates (Havrylchyk, 2006). On the other hand, DEA works well with a small sample size and does not necessitate knowledge of any functional form of the frontier. This will help us in our analysis due to the small number of investment companies with available data. In addition, DEA does not require a cost minimizing or profit maximization condition, and it does not require any data on prices. This is convenient for those cases in which there are data problems, as in the situation of Kuwait.

4.3 Two-stage approach

In our analysis, we follow the two-stage approach suggested by Coelli *et al.* (1998). In the literature on DEA efficiency score measurement, the two-stage approach is the most prominent. This approach uses the efficiency score measured by the DEA model as the dependent variable in a regression model, with explanatory variables employed to capture the impact of the external factors (Hahn, 2007). This approach involves solving a DEA problem in the first-stage analysis. In the second stage, the efficiency score measures derived from the DEA estimations (first stage) is to be used as the dependent variable and then regressed upon environmental variables. The coefficients of the environmental variables will be evaluated to investigate how they will affect the efficiency score.

4.3.1 Data selection. It is not easy to select output and input variables that must be addressed by any study on financial institution efficiency. The choice is influenced by the selected concept of institutions and by the availability of reliable information. According to Berger and Humphrey (1997), there are two main methods to defining inputs and outputs, the production approach and the intermediation approach.

Production approach views company as primarily services producing for customers, it generates transactions and process documents for customers as an output, while the input includes only the physical variables. Under this approach, inputs are best measured by physical units, and outputs are best measured by the number and type of transactions or documents processed over a given time period.

Intermediation approach treats the work of company as primarily intermediating. The companies use operating and interest expenses to produce major assets. For instance, they use labor and capital as inputs to produce investments, and other means of financing as outputs. Accordingly, this study follows the intermediation approach to determine outputs and inputs because the data used in the production approach is not available for most companies.

With regards to input variables, capital is used to generate wealth through investment and it represents the value of shares as authorized in articles of association (issued and subscribed). On the other hand, general administration expenses is the set of expenses required to administer a business or we can say it represents the costs of operating a business and costs incurred to generate revenues.

With respect to output variables, earnings per share is the portion of a company's profit allocated to each outstanding share of common stock and it is represented as an indicator of a company's profitability. Return on assets (ROA) tells us how efficient management is using assets to generate earnings and it used as indicator of how profitable a company is relative to its total assets.

4.3.2 Data description. The data we apply in analysis are annual panel data for investment companies listed in the stock markets of Kuwait for 2006-2010. We have excluded companies established after 2010 and companies for which some data were missing. The annual data for all variables are obtained from the Kuwait Stock Exchange Market database (official web site). All data are measured in thousands of US dollars. In particular, data for the variables of total revenue, total assets, and net cash flows are constructed from the balance sheets of each firm in the data sample. Information on the government participation with each firm is obtained from the firm's profile on the official web site of the Kuwait Stock Exchange Market. Data for leverage ratios are obtained from the yearly financial ratio statement for each firm at the official web site of the Kuwait Stock Exchange Market. Information on Islamic and non-Islamic investment firms is obtained from the firms' profiles on the official web site of the Kuwait Stock Exchange Market.

5. Empirical results

We present an analysis employing the first-stage method for investment sector efficiency in Kuwait. In the first stage, we estimate the efficiency level of 40 investment companies listed in the Kuwait Stock Market using the DEA approach to investigate whether the technical efficiency of these companies improved between 2006 and 2010. We also try to determine how trends involving the number of efficient companies and companies with low-efficiency scores changed during the period of study.

In the second stage, we regress the efficiency level obtained from the first stage on factors that could influence the efficiency of investment companies by using a Tobit regression model for each year during the period of study. In addition, we apply data as panel data for four years and use the same Tobit regression model to estimate the coefficients for variables that could influence the efficiency score.

5.1 Stage one

To estimate the efficiency levels for investment companies, we used an input-output DEA approach for each year as follows:

$$\text{Max}\,\theta = \frac{Y1+Y2}{X1+X2}, \quad \text{subject to}$$

$$\text{Company1}\frac{Y1+Y2}{X1+X2} \leqslant 1 \quad \text{Company2}\frac{Y1+Y2}{X1+X2} \leqslant 1 — \quad —\text{Company40}\frac{Y1+Y2}{X1+X2} \leqslant 1$$

where $Y1$ is the earnings per share (EPS), OUTPUT; $Y2$ is the ROA, OUTPUT; $X1$ is the capital, INPUT; $X2$ is the general administration expenses, INPUT.

Table AI in Appendix 2 presents yearly summary statistics of technical efficiency scores for Kuwait investment companies listed in the Kuwait Stock Exchange. We find that the movement trend of the mean of technical efficiency was quite different during the period of study. However, all the sample companies in each year appeared to be performing reasonably well, with the annual mean of technical efficiency scores for the investment sector ranging between 0.89 in 2006 and 0.43 in 2008. As the table shows, the technical efficiency appeared almost the same in the first two years, 0.89 to 0.88 (2006-2007), and then the efficiency score mean moved in the opposite direction by 50 percent, reaching 0.43 because of the 2008 global financial crisis happened. The mean of efficiency score increased, however, in 2009, reaching 0.65. In the final year of the sample period (2010), the efficiency score improved to 0.78, which led to a cumulative
12 percent drop in the mean score in the investment sector during the sample period.

5.2 Stage two

In the second stage, the efficiency score measures derived from the DEA estimations (first stage) will be used as the dependent variable and then regressed upon environmental variables. The coefficients of the environmental variables are to be evaluated to investigate how they will affect the efficiency score. After that, the hypothesis will be tested to investigate the strength of the relationship between the efficiency score and environmental variables. To investigate the progress of the efficiency score in the period of study, we compare the average efficiency score for all companies in the sample for each year. Then we estimate the Tobit regression in the following model:

$$\Theta = \beta 1\, R + \beta 2\, \text{TA} + \beta 3\, \text{NCF} + \beta 4\, \text{GP} + \beta 5\, \text{LR} + \beta 6\, \text{IF} + \epsilon i$$

where Θ is the efficiency score; R the revenue; TA the total assets; NCF the net cash flow; GP the government participation; LV the leverage ratio; and IF the a dummy variable (1 if the firm is Islamic and 0 otherwise).

5.2.1 Benchmark results. Table AII in Appendix 2 shows the results for the benchmark model using a pooled ordinary least square (OLS) regression. The table represents the estimation across all firms used in the data sample. According to Table AII, the estimated coefficients for variables of revenues, total assets, and Islamic firm dummy are significant and show the expected sign. Based on Table AII, the coefficient of total revenues is statistically significant at the one percent level with a positive sign. This indicates that, across the data sample, the higher the total revenue

a firm generates, the higher the rate of efficiency the firm can achieve. The relationship is expected, as sales reflect the accelerator effect; therefore, any increase in sales means higher demand for a firm's output, which may lead to an increase in investment and its firm efficiency in production.

The coefficient of the total assets turns out to be statistically significant at the 1 percent level with a negative sign. Such a coefficient indicates that the higher the total assets the firm can generate, the lower the rate of efficiency the firm can achieve. It is noteworthy that the use of firm size, which is represented by the firm's total assets, can be explained as controlling for other firm characteristics that typically can be important for production. This result is not consistent with Yildirim (2002) who reported that a higher value of total assets, which means a larger size of a financial institution was positively related to technical efficiency. Jemric and Vujcic (2002) as well found in their study that large banks appeared to be locally more efficient than smaller ones. Therefore, we can say that a larger firm size in Kuwait has a different case, because it may lead to difficulty in efficiently controlling and coordinating a firm's operation when it becomes large. Such a case is achieved under diseconomies of scale.

The coefficient of the Islamic firm dummy is statistically significant at the 5 percent level with a negative sign. Hussein (2004) reported a different result and he found that Islamic financial institutions are more efficient than their traditional counterparts. This means that financial institutions in Kuwait operate under sharia compliant are more likely to achieve less efficiency in production. This suggests that policy makers of Islamic institutional operations are relatively less efficient in utilizing the factors of inputs over the study period.

5.2.2 Extended results. In Table AII in Appendix 2, the estimated model in column 3 is tested using only the time fixed effect. According to Table AII, the findings of the time fixed-effect technique are robust to the findings of the pooled OLS. This indicates that the main influential factors on production efficiency in the investment sector in Kuwait include the firm's sales, the firm's size, and the operational structure for the firm, whether Islamic or non-Islamic. Aside from these main variables and unlike the findings shown of the pooled OLS, the estimated coefficient of the government participation variable turns out to be statistically significant at the 5 percent level with a negative sign. The interpretation of the government participation variable can be seen as indicating that the higher government participation or government control over the firm's management is, the lower the firm's efficiency will be. The finding is confirmed by the relationship between the efficiency score and the government participation percentage. Looking at the data, we can see that firms with a high level of government participation in Kuwait achieved low-efficiency scores in 2008. For example, the Kuwait Investment Company, with 76 percent government participation, had an efficiency score of 92 percent in 2006, and its efficiency score decreased to 25 and 55 percent in 2008 and 2009, respectively. Another example, Global Investment House, with around 10 percent government participation, had an efficiency score of 90 percent in 2006, and its efficiency score decreased to 5 and 25 percent in 2008 and 2009, respectively.

Interestingly, based on the time fixed effect results shown in Table AII, the coefficients of the time dummy for 2008-2010 are statistically significant with negative signs. However, the coefficient of the 2007 year dummy turns out to be statistically insignificant. This suggests that 2008-2010 had a negative impact on firms' efficiency in Kuwait. This result confirms the substantial influence of the 2008 global financial crisis on the investment sector in Kuwait.

Using different specifications, the results shown in column 4 (in Table AII – Appendix 2), the estimated model is tested using only the random effect. According to Table AII, the findings of the random effect technique are robust to the findings of pooled OLS, with the exception of the government participation variable. This indicates that factors affecting the production efficiency in the investment sector in Kuwait include the firm's sales, the firm's size, and the operational structure for the firm, whether Islamic or non-Islamic.

On the other hand, as the dependent variable (efficiency score) consists of ratios varying from 0 to 1, and then constructing a model to explain the dependent variable better is important. The results shown in Table AIII in Appendix 2 use the generalized linear model with a logit link and binomial family regression. Based on Table AIII, the results of the logit technique are found to be statistically significant and consistent with findings shown in Table AII.

According to the findings shown in Table AIII, the production efficiency in the investment sector in Kuwait can be affected by variables such as the firm's sales, indicated by total revenue, the firm's size, indicated by the total amount of assets, the operational structure of the firm, whether Islamic or non-Islamic, and government participation. It is noteworthy that the estimated coefficient of the government participation variable turns out to be statistically significant at the 10 percent level with a negative sign. This finding is consistent with findings shown in Table AIII.

6. Concluding remarks

The study investigates the efficiency of the investment sector in Kuwait. In particular, in this paper, we examine the efficiency of 40 investment companies in Kuwait. We test predictions of the model using yearly data for 2006-2010. In our analysis, we follow the two-stage approach suggested by Coelli *et al.* (1998). The findings of the first stage show that the investment sector's efficiency has been improved throughout the period of the study with the exception of 2008 due to the global financial crisis. Using different specifications, the findings of the second stage suggest that years of 2008-2010 had a negative impact on the firms' efficiency in Kuwait. The result confirms the substantial influence of the 2008 global financial crisis on the investment sector in Kuwait. In addition, the results show that factors affecting production efficiency in the investment sector in Kuwait include total revenues, total assets, government participation, and the Islamic firm dummy. The results are robust for different specifications using a fixed-effect model, a random-effect model, and the Tobit model.

In addition to the empirical findings of the model tested, the results may be utilized by both monetary authorities and policy makers in establishing the general economic policy in the country. A number of policy implications may be derived from the estimates obtained in the current paper. First, the results show that the investment sector in Kuwait faced a sharp drop in its efficiency in 2008 due to the global financial crisis. This result tells us that there was a spillover effect of the global financial crisis in the Kuwaiti investment market, as companies in this market are highly vulnerable to global shocks. As a result, the investment sector needs to be regulated by, for example, encouraging more company mergers and acquisitions.

Second, to meet the appropriate regulations in the investment sector in Kuwait, monetary authority in Kuwait should take into consideration the WTO conditions for more openness in the economic sector. Therefore, companies in the investment sector should be more efficient to compete with foreign investment companies that decide to

enter into Kuwaiti market. Therefore, the need for regulations in the Kuwaiti investment sector is more necessary than before. Third, this study of efficiency features is important to help policy makers evaluating how the investment sector will be affected by increasing competition and then formulating policies that affect that sector and the economy as a whole. Furthermore, monetary policy can play an important role in influencing the efficiency in the investment sector. Therefore, the Central Bank of Kuwait should take a leading role in regulating abnormal financial activity in the Kuwaiti market.

Although the study tests predictions for the efficiency in the investment sector in Kuwait, the data sample covered in the study includes only firms listed at the Kuwaiti stock market. It may therefore help to shed new light on other investment firms that are not listed at the stock market and have available data in order to make a comprehensive view at the investment sector as whole.

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(The Appendix follows overleaf.)

Appendix 1. Graphs

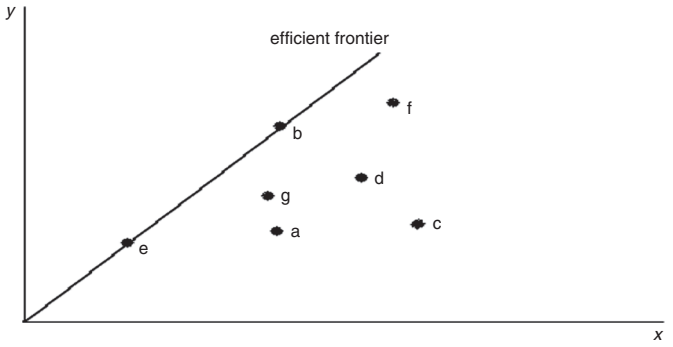

Figure A1.
DEA model with single input and single output

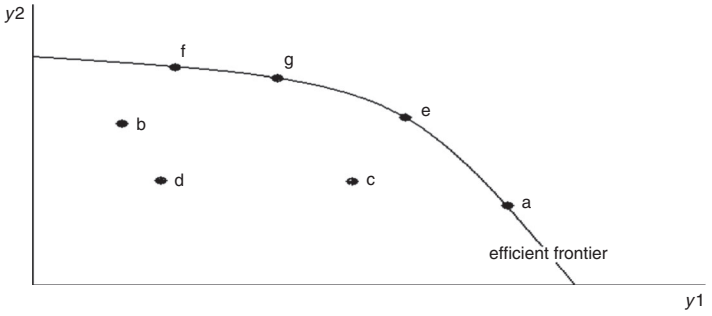

Figure A2.
DEA model with single input and two outputs

Appendix 2. Results

	2006	2007	2008	2009	2010
Mean	0.893906	0.883537	0.434545	0.652674	0.784087
Median	0.8915	0.871	0.3905	0.608	0.7675
Maximum	1	1	1	1	1
Minimum	0.777	0.739	0.049	0.268	0.529
SD	0.060288	0.084251	0.211574	0.17552	0.095782
Skewness	0.31397	0.139985	1.140949	0.613305	0.08191
Kurtosis	2.211145	1.723797	4.325367	3.003407	4.108681
Observations	32	41	44	46	46

Table AI.
Summary statistics of efficiency scores for investment companies

Dependent variable: efficiency score	Pooled OLS	Time fixed effect	Random effect
Revenue	4.23e-07 (4.46)***	2.22e-07 (3.61)***	4.23e-07 (4.46)***
Total assets	−5.37e-08 (−5.01)***	−3.17e-08 (−4.60)***	−5.37e-08 (−5.01)***
Net cash flow	1.40e-07 (0.60)	8.99e-08 (0.62)	1.40e-07 (0.60)
Government participation	−0.0016891 (−1.42)	−0.0017534 (−2.38)**	−0.0016891 (−1.42)
Leverage ratio	−0.000023 (−0.68)	−0.0000288 (−1.33)	−0.0000236 (−0.68)
Islamic firm dummy	−0.073246 (−2.30)**	−0.0750493 (−3.78)***	−0.073246 (−2.30)**
Year 2007 dummy		−0.0390361 (−1.29)	
Year 2008 dummy		−0.4486125 (−15.34)***	
Year 2009 dummy		−0.2348029 (−8.06)***	
Year 2010 dummy		−0.091468 (−3.07)***	
Observations	203	203	203
R^2/adjusted R^2	0.1577	0.6659	0.1306

Notes: The table reports the *t*-statistic in parentheses. Robust standard errors (white test). *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table AII.
Benchmark results: pooled sample, time fixed effect, random effect

Dependent variable: efficiency score	GLM
Revenue	4.78e-06 (3.30)***
Total assets	−4.22e-07 (−4.05)***
Net cash flow	−1.89e-06 (−0.94)
Government participation	−0.0079412 (−1.73)*
Leverage ratio	−0.0000497 (−0.44)
Islamic firm dummy	−0.4610045 (−3.16)***
Observations	203
AIC	0.909301

Notes: The table reports the *Z*-score in parentheses. Robust standard errors (white test). *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table AIII.
Extended results: generalized linear model (GLM) with a logit link and binomial family regression

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