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IMPACT OF CAPITAL STRUCTURE AND FREE CASH FLOW ON THE EFFICIENCY OF ENERGY FIRMS IN SAUDI ARABIA

Abstract

The components of free cash flow and a firm's capital structure affect the value of the firm. A firm with efficient cash management and optimum capital structure tends to have a better firm value. The current study examines the effect of capital structure and free cash flow on energy firms' efficiency in Saudi Arabia. The data required for analysis were collected from a sample of seven energy companies from 2014 through 2022. The study used Data Envelopment Analysis to measure the efficiency of energy firms. Further, the simple regression and Generalized Linear Model were used to estimate the results. The study reports an average efficiency score of 1.13 for the energy companies, showing an efficiency increase. The results of simple regression are consistent with the results of the Generalized Linear Model. The study findings demonstrate that the association of firms' capital structure is positive and significant (with a coefficient of 41.60, significant at a p-value of 0.01) to the efficiency of Saudi Arabian energy firms. Further, current research results indicate that firms' free cash flows negatively affect the efficiency (with a coefficient of -0.79 and insignificant) of Saudi Arabian energy firms with no evidence. Therefore, the study accepts the association of free cash flow and firms' efficiency as positive and rejects the alternative hypothesis that there is a negative association between free cash flow and efficiency in Saudi Arabian energy firms.

Keywords

capital structure, cash flow, pecking order theory, agency theory, firm efficiency, energy sector, firm value

JEL Classification

G32, M41, L71, L95

INTRODUCTION

The main objective of financial management is to maximize firms' profits and shareholders' wealth. To achieve the desired purpose, financial officers efficiently make different decisions regarding financing, investing, and profit. Therefore, to achieve these objectives and draft suitable financial policies, the financial officers consider the firms' capital structure and cash management. The efficiency of cash management in a firm increases its efficiency, which in turn leads to an increase in the value of a firm. Cash is considered significant in terms of its use in day-to-day operations and investment in future projects.

The components such as free cash flow and capital structure significantly affect the value of a firm. A firm with an optimum capital structure and efficient cash management shall have excellent firm value, retaining the existing investors and attracting new investors to invest in the company's assets. As per the free cash flow hypothesis, free cash flows help financial officers to achieve different objectives, such as investment in existing assets and new assets (Richardson, 2006). Free cash flow has pros and cons. If financial officers invest the excess free cash flows in those projects that anticipate a negative return, this would decrease the value of a firm (Jensen, 1993; Jensen & Meckling, 1976). Moreover, if firms retain free cash flows to a large extent, this



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shall decrease the value of a firm (Dechow et al., 2008). Hence, the free cash flow is a significant component of a firm's efficacy, leading to a more considerable firm value.

The concept of optimum capital structure is significant to the firms' financial officers as it affects the value of a firm. In addition, it is essential to determine the elements of economic growth, such as firms' profitability, efficiency, and competitiveness. Capital structure is a mix of financial sources such as equity and debt. The association between firms' capital structure and its different related elements became significant in drafting capital structure theories. In a perfect market, the value of a firm is not associated with the capital structure (Modigliani & Miller, 1958). The remarkable capital structure theories argue that debt financing is preferred over equity financing since the former is less costly. A firm's capital mix decision is a significant decision of firm financing, which becomes an integral part of value maximization.

The Kingdom of Saudi Arabia is the world's largest exporter of fossil fuels (Investopedia, 2022). The Kingdom's energy sector contributes 46 percent to its GDP (Trading Economics, 2022). Nevertheless, the Kingdom's primary source is the export of fossil fuels; it intends to invest in the research and development of new energy-producing technologies. Moreover, the Kingdom's transition in energy might encourage and improve efficiency in the energy sector (World Economic Forum Report, 2023).

Therefore, cash that remains after spending for operating activities and capital investments is the firms' free cash flow. On the other hand, firms need investments from external sources like equity and debt. Firms consider a balance between these two components to be significant. Therefore, the firms intend to have an optimum capital structure that ultimately leads to profits. Further, as discussed, the Kingdoms' motive towards investment in research and development of the energy sector requires investment in terms of equity, debt, and cash flow. In this regard, examining the impact of capital structure (debt-equity mix) and free cash flows on the efficiency of energy-producing firms in Saudi Arabia becomes significant.

1. LITERATURE REVIEW AND HYPOTHESIS

Trade-off theory recommends maintaining debt along with equity to attain optimal capital structure. The lower the debt level, the greater the equity focus. Therefore, past researchers worked on free cash flow theory to correct this exception. The current section explains the prior research regarding capital structure and free cash flow.

In this regard, Honjo (2021) studied the method used by start-up companies to find initial capital in the Japanese industrial sector. They discovered that start-up companies maintained by founder investors use equity financing compared to debt financing. He also found that start-up companies managed by educated founders successfully raise debt capital, and these companies tend to grow at a pace. Duran and Stephen (2020) examined the impact of globalization on the capital structure of emerging nation companies after the 2008 financial crisis. They found that multinational firms

had lower debt levels before the financial crisis, while the debt levels increased after the crisis. This shows that the multinational firms' capital structure found borrowing more debt at lower interest rates globally beneficial. Similarly, Sardo et al. (2022) studied the financing behavior of different kinds of firms (new and old) by establishing a relationship between equity and debt financing. They found that the results of new and old firms are close to the pecking order theory. The new firms can acquire debt for an optimum capital structure, while the old firms adjust slowly due to transaction costs. Nguyen et al. (2023) studied the role of firms' capital structure in administering financial soundness and found that hotel firms with lower debt levels can be financially sound and flexible. This benefit is related to more unstable hotels. Further, hotels with minimum long-term debt are also economically sound and flexible. Cuevas-Vargas et al. (2022) examined the joint impact of capital structure on the performance of small and medium-sized Mexican firms mediating with technology using the PLS-SEM model. They found

a collateral effect of capital structure on firm performance, while capital structure and technology are significantly related. They concluded that introducing new technologies can increase the performance level of SMEs to a whole level. Bredea (2012) investigated the impact of market timing on capital structure, and the results showed a positive association between capital structure and Romanian firms' P/E ratio. The later panel data results showed a fluctuating impact between capital structure and market timing. Further, Vatavu (2015) reveals that Romanian-listed companies' performance increases when operated on an equity basis. Further, incorporating debt into the capital structure is beneficial when these firms face difficulties procuring equity capital. Shoaib and Siddiqui (2022) studied the influence of earnings in explaining the association between capital structure and firm growth of companies belonging to APTA nations. Following the agency theory, they found an association between capital structure and firm growth, where the financial managers control the firms' earnings. Further, they observed a significant self-centered behavior in terms of discretionary earnings. Ulbert et al. (2022) found a positive association between golden ratio-based capital structure deviations and vice-versa. They reported that the golden ratio-based capital structure is a significant tool to enhance the performance and acceptance of firms in the market. Rehan et al. (2023) explored the components that determine the capital structure of firms listed on the Malaysian stock exchange and reported that the Malaysian market consists of all the determinants of capital structure included in the study. They also noted that the Malaysian industrial sectors comprise a dynamic capital structure and follow a dynamic trade-off theory of capital structure. Su (2010) used multivariate analysis to investigate the extent to which corporate diversification impacts firms' capital structures and whether ownership has any association with these strategies and capital structures. The study found contrasting effects of diversification strategies on capital structures when controlled by ownership structure. The study also evidenced that government firms use less debt financing. Shyu (2013) examined the influence of ownership, capital structure, and firm performance on agency problems in group-affiliated firms using the panel two-stage least square regression method. The study found contrast-

ing results between internal ownership and firm growth. Further, the decisions on capital structure are group-centric and not individual-based.

Furthermore, Sheikh and Wang (2012) investigated the influence of different elements of CG on firms' capital structure and found that the aspects of corporate governance are negatively associated with the capital structure, except CEO duality, which is insignificant. Further, the control variables were also negatively associated with the capital structure, except for the firm size. Similarly, Perfect et al. (1995) studied the reasons for Howe et al.'s (1992) rejection of the free cash flow hypothesis. They reported that accepting or rejecting the theory based on q measures is sensitive while supporting cash flow signaling. Park and Jang (2013) studied the association of free cash flow with different financial elements, such as capital structure, financial performance, and diversification. They found that diversification disorders associated with free cash flow and financing in debt reduce free cash flow, which leads to an increase in firm growth. Chung et al. (2005) examined the association of earnings with free cash flow and external audit and found that low-profile firms having sizeable free cash flows use discretionary accruals to cover the low-profile earnings. External auditors and institutional investors have moderation between free cash flows and discretionary accruals, which can deter the opportunistic earnings of managers. Jaroszewicz (2022) analyzed the effect of different cash flows on the firms' total cash flow and reported a positive cash flow from operations, while the investing and financing cash flows were low. The study found considerable flexibility in firm financing. Pierru and Babusiaux (2010) examine the valuation of project investments where interest costs are involved using the weighted average cost of capital methodology. They report that the violation of using the after-tax weighted average cost of capital could be indemnified by adjusting the projects' free cash flows. Chiou et al. (2010) examined the behavior of cash dividends on asset takeovers to resolve the conflict between the tunnel hypothesis and free cash flow and found that cash holdings with ownership control are associated with the tunneling hypothesis, while in terms of investment, the free cash flow hypothesis better explains the firms' dividend policy. Xie et al. (2023) investigated the

different components of free cash flow growth in China's government and non-government firms. They found that government firms have marginally weak free cash flow growth but are more potent than non-government firms. Further, some control variables, such as firm size, age, etc., cannot explain the concept of free cash flow growth. Bukit and Nasution (2015) studied motivation provided by free cash flows and employee differences in practicing earnings management by the firms' financial officers. They associated the managers' manipulation of earnings with the firms' monitoring system and suggested an intensified monitoring system. Evdokimov et al. (2023) investigated the performance of machine learning models in forecasting financial time series benchmarking with traditional ARIMA models. They found the machine learning models to be less error-free than the conventional models. Yeo (2018) investigated the influence of free cash flow on investment and dividend levels in the shipping industry using GLS regression. They found free cash flow significant in explaining the industry's investments and dividends. They reported that more substantial amounts of free cash flow increase the level of investments and reduce the payment of dividends. Moreover, Kadioglu and Yilmaz (2017) examined the credibility of the free cash flow hypothesis in the context of the firms listed on the Borsa Istanbul Exchange. They found that the free cash flow hypothesis negatively influences dividends per share and leverage. In addition, Ur Rehman (2022) studied the influence of investor perception on different business and economic elements in Pakistan's emerging market. He found a significant effect of investor behavior on financial and business activities. Kolmakov and Polyakova (2019) studied regional performance evaluation through the regional free cash flow dataset. Economic indicators such as GDP, industrial output, etc., were criticized mainly due to their negative impact. Regional free cash flow data can discount this obstacle. Ameer (2012) investigated the effect of firms' ownership attention and cash holdings on their growth using data from non-financial firms listed in Australia using a GMM panel regression method. He found a positive association between firm growth (q) and cash holdings. At the same time, there is a change in the relationship between broadly held and closely held firms when moderated with ownership. Mohammad et al. (2018) used

panel regression to investigate the association between firms' cash holdings, audit fees, and investment alternatives and found a significant association between firm cash holdings and audit fees, while the association between firms' cash holdings, audit fees, and investment alternatives was insignificant. Rusmin et al. (2014) examined the influence of free cash flow (surplus) and audit quality on earnings management in firms listed on stock exchanges in Indonesia, Malaysia, and Singapore. They found that the financial officers of firms with significant free cash flows and low-growth aspects exploit the firms' earnings according to their personal choices. Rahman and Sharma (2020) examined the influence of cash flow from operations on the financial growth of the Saudi Arabian industrial sector. They used cross-sectional regression to analyze the results. They found a positive association between the firm performance variables and firm cash flow from operations.

The present study conducted a detailed review of the literature, in which different authors studied the association of capital structure and free cash flow with the efficiency of firms. The research papers reviewed reported contradictory results, with some authors reporting a positive association between capital structure and free cash flow on firms' efficiency and some reporting vice-versa. The results reported by different researchers on the association of capital structure and free cash flow on firms' efficiency could have been more consistent. Therefore, this becomes significant for the present research to study further. Moreover, studies have been found in past literature explaining the association between capital structure and firm value, free cash flow, and firm value of Saudi Arabian companies. Still, past research has yet to establish the combined association of capital structure and free cash flow with the efficiency of firms. Therefore, considering the above discussion, it becomes significant for the present study to examine the combined association of capital structure and free cash flow on the efficiency of Saudi Arabian energy firms. In this regard, the present research establishes the following hypothesis.

H1: There is a positive association between firms' capital structure, free cash flows, and efficiency.

2. METHODOLOGY

The present study investigates the effect of free cash flow and capital structure on the efficiency of Saudi Arabian energy companies in two stages. First, it examines the efficiency of sample firms and produces efficiency scores through the DEA model. Second, it investigates the effect of free cash flow and capital structure on these efficiency scores through regression models.

The study collects data from a sample of 7 energy companies listed on Tadawul from 2014 to 2022 to examine the abovementioned effect. The study is based on secondary data and obtains the required data for the analysis from the Koyfin financial database. As discussed hitherto, the primary source of Saudi Arabia is the export of fossil fuels, and it intends to invest in the research and development of new energy-producing technologies. Hence, the study finds it significant to select the energy sector. The study uses the DEA approach to calculate the efficiency of Decision-Making Units (DMUs). The DMUs are given in Table 1.

Table 1. Decision-making units

S.No.	Decision-Making Unit (DMU)	Company Name
1	DMU-1	Rabigh Refining and Petrochemical Company (2380)
2	DMU-2	Aldrees Petroleum and Transport Services Co. (4200)
3	DMU-3	Arabian Drilling Co. (2381)
4	DMU-4	Saudi Arabian Oil Company (2222)
5	DMU-5	ADES Holding Co. (2382)
6	DMU-6	Saudi Arabia Refineries Co. (2030)
7	DMU-7	National Shipping Company of Saudi Arabia (4030)

The present study uses the DEA model that Charnes et al. (1978) suggested, which is relevant to the Constant Returns to Scale (CRS) model. The Data Envelopment Analysis (DEA) approach (Farrell, 1957; Charnes et al., 1978) is assumed to be a remarkable approach among different efficiency methods as it deals with the complex nature of inputs and outputs (Thanassoulis et al., 2012). This model measures the relative efficiency of firms by estimating an efficiency score with the help of input and output ratios. The DEA model, as given by Tikto et al. (2014), is calculated as follows:

$$\max k_0 = \frac{\sum_{s=1}^t v_s x_{s0}}{\sum_{q=1}^p u_q y_{q0}}, \tag{1}$$

Subject to:

$$\frac{\sum_{s=1}^t v_s x_{sj}}{\sum_{q=1}^p u_q y_{qj}} \leq 1, \tag{2}$$

$$v_s, u_q \geq 0, \quad j = 1, \dots, n,$$

When Eq. (3) is transformed into a Linear Programming model (LP), then the efficiency model looks as follows:

$$\max k_0 = \sum_{s=1}^t v_s x_{s0},$$

Subject to:

$$\sum_{s=1}^t v_s x_{sj} - \sum_{q=1}^p u_q y_{qj} \leq 0, \tag{3}$$

$$\sum_{q=1}^p u_q y_{q0} = 1, \quad v_s, u_q \geq 0, \quad j = 1, \dots, n.$$

Certain specifications determine the DEA model, such as optimization goal, returns to scale [constant returns (CR) or variable returns (VR)], etc. There are different opinions among researchers regarding the use of DEA models. However, the current study is interested in using the Malmquist DEA model with constant returns to scale (CRS) assumption given by Caves et al. (1982). Moreover, the objective of the current study is to examine the effect of capital structure and, according to Caves et al. (1982), is effective in measuring different firms spread over several periods. This model measures the different types of efficiencies. The efficiency of different periods using the Malmquist Productivity Index is calculated as:

$$MPI^s = \frac{PI_o^s(x^{s+1}, y^{s+1})}{PI_o^s(x^s, y^s)}, \tag{4}$$

$$MPI^{s+1} = \frac{PI_o^{s+1}(x^{s+1}, y^{s+1})}{PI_o^{s+1}(x^s, y^s)}, \tag{5}$$

where MPI is the Malmquist Productivity Index, s and $s+1$ is the time period, PI is the change in efficiency, x and y are observed variables, and o is the model alignment. The combination of Eqs. (4) and (5) yield the following geometric mean equation.

$$MPI^{gm} = \sqrt{\frac{PI_o^s(x^{s+1}, y^{s+1}) \cdot PI_o^{s+1}(x^{s+1}, y^{s+1})}{PI_o^s(x^s, y^s) \cdot PI_o^{s+1}(x^s, y^s)}}. \quad (6)$$

The scale efficiency and pure efficiency are measured as given in Eq. (7).

$$MPI^{gm} = (PEFCH) \cdot (TCCH). \quad (7)$$

The present study calculates the efficiency scores, which is the dependent variable. The criteria for measuring efficiency are as follows:

If Efficiency score >1 = Increase in efficiency.

If Efficiency score <1 = Decrease in efficiency.

If Efficiency score $=1$ = Constant.

The study determines the following input and output variables for the DEA-MPI model to calculate the efficiency scores.

Table 2. Input and output variables

Input Variables	Output Variables
1. Capital structure (CS)	1. Return on Investment
2. Free Cash Flow (FCF)	2. Earnings per Share (Rimaz and Ayanoglu, 2021)
3. Size	
4. Growth	
5. Operating Cash Flow	

The theories that explain the core concept of firms' capital structure are the agency, pecking order, and trade-off theories. The agency theory investigates the cost-related issues of firms and shareholders on firms' capital structure. The free cash flow theory is one of the forms of agency theory. The pecking-order theory has asymmetric views regarding the selection of finances (internal or external) by the firm, inclining towards debt in the case of external financing. The trade-off theory intends to balance the benefits and costs of financing (Ghosh & Chatterjee, 2018).

The agency theory explains the significance of capital structure in increasing the firms' efficiency. Since there is always a conflict between the

financial managers and shareholders of a firm in terms of firm value, debt financing is a tool to decrease the excess involvement of financial managers in making over-investments by using free cash flows. Using leverage shall put the managers at risk, motivating them to work efficiently and protect the firm from bankruptcy. Further, free cash flow is a good measure of a firm's growth. It allows firms to benefit from opportunities that increase shareholder value, leading to a firm's sustainability. Therefore, free cash flow is good evidence of a firm's growth, but financial managers can invest the excess cash to achieve their personal objectives.

Free cash flow is calculated as operating income minus (Income tax, interest expense, and dividend paid to shareholders) and is scaled by the value of total assets.

$$FCF_{i,t} = \frac{OI_{i,t} - (IntExp_{i,t} + IncTax_{i,t} + Div_{i,t})}{TA_{i,t}}, \quad (8)$$

where FCF = Free Cash Flow, OI = Operating Income, $IntExp$ = Interest Expense, $IncTax$ = Income Tax, Div = Dividend, TA = Total Assets.

Further, the effect of capital structure and free cash flow on the efficiency scores shall be estimated using linear regression and GLM models. The study incorporates capital structure and free cash flow as explanatory variables and firm size as control variables, as defined in Table 3. The reason behind the selection of explanatory variables, such as capital structure and free cash flow, is that the firms in the energy sector are involved in research and development activities and, hence, require cash, debt, and equity that ultimately lead to profits.

Table 3. Definition of dependent and independent variables

Model Variables	Definition
1. Efficiency	Calculated as per Eq. (7)
2. Capital structure (CS)	Total Debt scaled by Total Assets.
3. Free Cash Flow (FCF)	Calculated as per Eq. (8)
4. Firm Size	Log of Total Assets

$$Eff_{i,t} = \alpha_0 + \beta_1 CS_{i,t} + \beta_2 CS_{i,t}^2 + \beta_3 FCF_{i,t} + \beta_4 FS_{i,t} + \varepsilon_{i,t}, \quad (9)$$

where α_0 – Constant, β_1 to β_4 – Coefficients of explanatory variables, ε – error term, *Eff* – Firms' Efficiency, *CS* – Firms' Capital structure, *FCF* – Firms' Free Cash Flow, *FS* – Firm Size.

As discussed earlier, the study estimates the data using a linear regression model. To check the robustness of the results, the study uses a generalized linear model (GLM). The GLM model shall be estimated using different distributions, such as Gaussian, Poisson, and Gamma, with identity links. The fitness of these models shall be tested using the F test statistic. The Log Likelihood ratio, AIC, and BIC criterion shall be used to compare the GLM models.

3. RESULTS AND DISCUSSION

The current section reports descriptive statistics, correlation analysis, Data Envelopment Analysis (DEA) results, and regression analysis. Further, the study used the GLM model to test the robustness of the results. The results section is divided into sub-sections that separately report the above results.

3.1. Descriptive statistics and correlation analysis

The descriptive statistics and correlation analysis results are reported in Tables 3 and 4.

Table 4. Descriptive statistics

Variables	Observations	Mean	SD	Min	Max
<i>Effscore</i>	63	1.13	1.12	0.01	5.29
<i>CS</i>	63	0.47	0.29	0.01	0.91
<i>CS²</i>	63	0.30	0.26	0.01	0.83
<i>FCF</i>	63	0.06	0.08	-0.05	0.34
<i>FS</i>	63	8.87	3.42	0.01	14.73

The results reported in Table 4 show that the efficiency score (*Effscore*) has a mean of 1.13 with an SD of 1.12. Since this is an efficiency score calculated by DEA analysis, the variance between the scores will be more significant; hence, the SD will be more than one. The capital structure (*CS*) has a mean of 0.47 with an SD of 0.29. The descriptive result of the capital structure shows that Saudi Arabian energy firms are maintaining an opti-

imum level of debt and equity. The square of capital structure has a mean of 0.30 with an SD of 0.26. The free cash flow (*FCF*) has a mean of 0.06 with an SD of 0.08. The descriptive free cash flow result shows that the Saudi Arabian energy firms hold negative and positive cash balances. Further, the firm size (*FS*) has a mean of 8.87 with an SD of 3.42. The descriptive results of *FS* show that the Saudi Arabian energy firms are, to a large extent, large-scale firms.

Table 5. Results of correlation

Variables	<i>Effscore</i>	<i>CS</i>	<i>CS²</i>	<i>FCF</i>	<i>FS</i>
<i>Effscore</i>	1.000				
<i>CS</i>	0.22	1.000			
<i>CS²</i>	0.16	0.95	1.000		
<i>FCF</i>	0.04	-0.08	-0.23	1.000	
<i>FS</i>	-0.03	0.42	0.28	0.17	1.000

The correlation result shows that the capital structure (*CS*), *CS²*, and free cash flow (*FCF*) positively affect the efficiency score, which indicates that these components increase the performance of Saudi Arabian energy firms. Moreover, the control variable firm size (*FS*) negatively affects the firms' efficiency. Furthermore, the correlation between capital structure and free cash flow is negative.

3.2. Results of regression

This subsection reports the results of regression analysis and GLM models. Tables 6 to 9 report the results of both models.

Table 6. Regression analysis results

Variable	Constant (α)	β	t	p-value
<i>Effscore</i>	10.53		3.29	0.002***
<i>CS</i>		41.60	2.51	0.01***
<i>CS²</i>		-36.76	-2.03	0.05**
<i>FCF</i>		-0.79	-0.29	0.77
<i>FS</i>		-0.75	-1.89	0.06*
<i>No. of Obs.</i>	63			
<i>R²</i>		0.13		
<i>F-statistic</i>		2.23 (0.07*)		

Note: *** Significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.10 level.

Table 6 reports the results of the regression analysis. The results show that a firm's capital structure is positive and significant at the one percent significance level, which shows the positive association between capital structure and firms' efficiency. On

the other hand, free cash flow is negative and insignificant. Further, the firm size is negative and significant at the 10 percent significance level. The R^2 of the regression model is 13 percent, and the F-statistic is significant at the 10 percent significance level.

3.3. Results of the GLM model

Table 7. Results of GLM model (Gaussian distribution)

Variable	Constant (α)	β	t	p-value
<i>Effiscore</i>	10.53		3.29	0.001***
<i>CS</i>		41.60	2.51	0.01***
<i>CS</i> ²		-36.76	-2.03	0.04**
<i>FCF</i>		-0.79	-0.29	0.77
<i>FS</i>		-0.75	-1.89	0.06*
<i>No. of Obs.</i>	63			
<i>Log-likelihood</i>		-222.84		
<i>AIC</i>		7.23		
<i>BIC</i>		4116.41		

Note: *** Significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.10 level.

The results of the GLM model with Gaussian distribution are reported in Table 7. The results show that a firm's capital structure is positive and significant at the one percent significance level, which shows the positive association between capital structure and firms' efficiency. On the other hand, free cash flow is negative and insignificant. Further, the firm size is negative and significant at the 10 percent significance level. The results of the GLM model with Gaussian distribution are similar to the linear regression model.

Table 8. Results of GLM model (Poisson distribution)

Variable	Constant (α)	β	t	p-value
<i>Effiscore</i>	10.74		8.89	0.000***
<i>CS</i>		37.37	5.93	0.000***
<i>CS</i> ²		-33.62	-4.67	0.000***
<i>FCF</i>		-0.48	-0.45	0.65
<i>FS</i>		-0.68	-4.32	0.000***
<i>No. of Obs.</i>	63			
<i>Log-likelihood</i>		-263.20		
<i>AIC</i>		8.51		
<i>BIC</i>		25.65		

Note: *** Significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.10 level.

The results of the GLM model with Poisson distribution are reported in Table 8. The results show

that a firm's capital structure is positive and significant at the one percent significance level, which shows the positive association between capital structure and firms' efficiency. On the other hand, free cash flow is negative and insignificant. Further, the firm size is negative and significant at the 1 percent significance level. The results of the GLM model with Poisson distribution are similar to those of the linear regression model and GLM model with Gaussian distribution.

Table 9. Results of GLM model (Gamma distribution)

Variable	Constant (α)	β	t	p-value
<i>Effiscore</i>	10.85		4.07	0.000***
<i>CS</i>		34.38	2.50	0.012***
<i>CS</i> ²		-31.33	-1.96	0.050**
<i>FCF</i>		-0.26	-0.11	0.91
<i>FS</i>		-0.63	-1.78	0.075*
<i>No. of Obs.</i>	63			
<i>Log-likelihood</i>		-216.79		
<i>AIC</i>		7.04		
<i>BIC</i>		-219.39		

Note: *** Significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.10 level.

The results of the GLM model with Poisson distribution are reported in Table 9. The results show that a firm's capital structure is positive and significant at the one percent significance level, which shows the positive association between capital structure and firms' efficiency. On the other hand, free cash flow is negative and insignificant. Further, the firm size is negative and significant at the 10 percent significance level. The results of the GLM model with Gamma distribution are similar to the linear regression model. The fitness statistics of the GLM model, such as Log Likelihood, AIC, and BIC, show that the GLM model with Gamma distribution is a better fit and appears to be parsimonious.

4. DISCUSSION

The current study examines the effect of capital structure and free cash flow on firms' efficiency. The association of explanatory variables on firms' efficiency is different. The positive association of free cash flow with firms' efficiency shows a reduction of agency costs by the managers by using free cash flows and generating satisfactory re-

turns for shareholders. The negative association of capital structure on firms' efficiency shows the more extensive usage of external finance, which leads to the higher cost of capital that ultimately leads to lower efficiency of firms. In contrast, the positive association leads to vice-versa results.

Current research results show that firms' capital structure positively affects the efficiency of Saudi Arabian energy firms. The capital structure results reported by the past studies were inconsistent; some studies reported positive effects on firms' efficiency, and some reported the opposite. The positive effect of capital structure shows that financial managers maintain an optimum capital structure, where the acceptable benefits equal the acceptable costs, increasing firms' efficiency. The results of the current study, where capital structure positively affects the firms' efficiency, follow those studies that reported a positive effect of capital structure on firms' efficiency, such as Margaritis and Pisillaki (2007), where they found evidence confirming the agency cost theory proposed by Jensen and Meckling (1976). They found a positive association between firms' efficiency and leverage.

Similarly, the results support the findings of Rimaz and Ayanoglu (2021) and Rahim and Shah (2019), where they found a positive relationship between capital structure and firms' efficiency. Generally, financial managers intend to increase firms' debts to invest in profitable projects, ultimately improving efficiency. However, negligence in terms of an increase in the level of firms' debt might lead to bankruptcy.

Nevertheless, the increase of debt in firms' capital structure may lead to financial risk, which leads to a decrease in creditors' financing. In contrast, a positive association is possible because the firm's profitability demands more debt, and the interest paid on these debts is deducted from the taxes (Ponce et al. 2019). The current positive results show that the Saudi Arabian energy firms hold the tradeoff theory where the firms follow optimal capital structure. Further, the results of the current study are in contrast to past studies, such as Karadeniz et al. (2016) and Muhammad et al. (2021), where their results of the relationship between capital structure and

firm performance show a negative impact supporting the pecking order theory proposed by Myers and Majluf (1984). Similarly, past studies by Shaik and Ali (2022) and Ali and Shaik (2022) found a negative relationship between leverage and firms' financial performance. Therefore, the present research results support the null hypothesis that a positive association exists between firms' capital structure and efficiency.

Further, the results of the current study show that firms' free cash flows negatively affect the efficiency of Saudi Arabian energy firms, with no evidence, as the p-value of this coefficient is found to be insignificant. The study can also take the insignificant negative coefficient as of no effect, but it assumes the association to be negative. Therefore, the null hypothesis is rejected that the association of free cash flow and firms' efficiency is positive, accepting the alternative hypothesis that the association is negative. The reason is that the excessive free cash flows with the energy firms motivate managers to invest surplus cash in long-term projects. Nevertheless, they have a negative net present value. This spirit might decrease the firms' efficiency. This can be mitigated by increasing the share of debt financing in the firms' capital structure as proposed by the agency cost theory. The increase in the share of debt financing forces financial managers to pay interest, hence minimizing the free cash flow and increasing the firms' efficiency. Therefore, Saudi Arabian firms should increase their share in debt financing to regulate over-investment, which controls free cash flows and enhances efficiency.

The result of the negative impact of free cash flows on firms' efficiency follows the past research of Rimaz and Ayanoglu (2021) and Park and Jang (2013), where they reported the negative effect of free cash flow on firms' efficiency and that the results went beyond the free cash flow theory proposed by Jensen. Moreover, the results of free cash flow contradict the past studies by Ali et al. (2018), Wang (2010), Bukit and Nasution (2015), Rusmin et al. (2014), and Cheung and Jiang (2016), which reported a positive relationship between free cash flow and firms' efficiency, by observing that the free cash flows increase firm value when it is under control.

CONCLUSION

This study examined the effect of capital structure and free cash flow on the efficiency of Saudi Arabian energy firms from 2014 to 2022. The study extracted the data with 63 observations from seven energy firms listed on the Saudi Arabian Stock Exchange (Tadawul). The study employed linear regression and GLM models using firms' efficiency as an outcome variable, capital structure and free cash flow as explanatory variables, and firm size as a control variable.

Current research results report a positive impact of capital structure on firms' efficiency. Usually, the negative association of capital structure on firms' efficiency shows the more extensive usage of external finance, which leads to the higher cost of capital, ultimately leading to lower efficiency. In contrast, the positive association leads to the opposite results. The positive effect of capital structure shows that financial managers maintain an optimum capital structure. Therefore, the current capital structure results are positive, which indicates that the Saudi Arabian energy firms hold the tradeoff theory where the firms follow optimal capital structure.

Moreover, the current study results show that firms' free cash flows negatively affect the efficiency of Saudi Arabian energy firms with no evidence, as the p-value was found to be insignificant. The study can also take the insignificant negative coefficient as of no effect, but it assumes the association to be negative. Therefore, the null hypothesis is rejected that the association of free cash flow and firms' efficiency is positive, accepting the alternative hypothesis that the association is negative. The results of free cash flow on firms' efficiency might be due to a small sample. Therefore, the results show that the energy firms of Saudi Arabia are operating efficiently in terms of capital structure and free cash flow.

The present study results might be helpful to the financial managers of Saudi Arabian energy firms and policymakers. The results are also beneficial to academicians in establishing diverse relationships between the study variables, further examining the association of free cash flow on firm efficiency. Therefore, the same model can be applied to firms in other sectors and include different explanatory and control variables in future research. Moreover, the share of debt financing in capital structure can be divided into short-term and long-term debt, and their impact on firms' efficiency can be examined.

AUTHOR CONTRIBUTIONS

Conceptualization: Abdul Rahman Shaik.
Data curation: Abdul Rahman Shaik.
Formal analysis: Abdul Rahman Shaik.
Funding acquisition: Abdul Rahman Shaik.
Investigation: Abdul Rahman Shaik.
Methodology: Abdul Rahman Shaik.
Project administration: Abdul Rahman Shaik.
Resources: Abdul Rahman Shaik.
Software: Abdul Rahman Shaik.
Supervision: Abdul Rahman Shaik.
Validation: Abdul Rahman Shaik.
Visualization: Abdul Rahman Shaik.
Writing – original draft: Abdul Rahman Shaik.
Writing – review & editing: Abdul Rahman Shaik.

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