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Investment Decisions in the Energy Industry: The Role of Industrial Competition and Size

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Abstract

Investment decisions are one of the most fundamental issues in financial management. This study aims to determine the factors that affect investment decisions in the energy industry and to contribute to the companies in this industry to develop strategic policies. The System GMM analyzes were carried out using the data of companies registered on the stock exchange for the period 2000–2015. The findings showed that industrial competition and firm size were important factors influencing the investment decisions of firms in the energy industry. The findings indicated a nonlinear relationship between industrial competition and the rate of investment in the energy sector. Depending on the firm's size, the effect of industrial competitiveness on investment varies. Smaller businesses are more impacted by the level of competition than larger ones. The investment rate decreases depending on the increase in cash holding level and firm risk. When the sub-groups in the energy industry are examined, it is determined that they reveal some differences in terms of financial structure. A higher investment rate results from a higher retained earnings ratio. The investment rate of firms falls as a company's risk level and sales revenue variability increase.

Keywords: Investment Decisions, Energy, Competition, Nonlinear Relationship

JEL Classification Code: G32, Q4, D4

1. Introduction

The management style of investment decisions in the energy industry is important for the successful execution of the investment project. Investment decisions should be optimal in terms of increasing the value of the firm and ensuring sustainable growth, especially for the purpose of continuing its activities. In this process, the attitudes of competitors in the industry and the performance of company managers are particularly important. Managers' performance is a factor that affects the risk and return of the investment project. The ability of firms to convert their cash flows into investments is essential for firm growth. Especially in a competitive environment, how managers use cash flows affects the implementation or rejection of investment projects.

Energy investments can vary depending on the opportunities offered by the market in which the market operates. When it comes to financing the investment with debt, there should be segments in the market that can offer many funds. Investment decisions in businesses can change according to the economy in which they operate, macroeconomic variables, and firm-specific factors. Even if companies have similar investment opportunities, their investment rates may differ from each other. Investment decisions are of strategic importance for companies and are among the controversial issues in the financial literature. It is seen that studies focusing on investments in the energy industry frequently examine the effects of market-specific factors and macroeconomic factors such as the structure of the market in which they operate, the impact of foreign direct investments, and gross domestic product. However, very few studies use firm-level data in the energy industry. In this study, investment decisions in the energy industry

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are investigated based on the competitive environment in the industry and firm-specific factors. To achieve this goal, changes in investment rate are analyzed through the variables of industrial competition, firm size, cash holding, retained earnings, risk, efficiency, cash flow margin, leverage, growth of sales, and growth of gross domestic products.

This study makes direct contributions to the literature in three aspects. The first is to examine the factors affecting investments in the energy industry based on industrial competition. Secondly, analyzing firm data from many countries with the System Generalized Methods of Moment (GMM), which considers the dynamic relationships between variables. Finally, investment decisions are examined by considering the impact of the firm size and competition in the industry together. The findings show that the level of competition in the industry and firm size affect investments in the energy industry. It was found that there is a nonlinear relationship between these variables. It is concluded that the effect of competition on investment differs by firm size.

2. Theoretical Framework and Literature Review

Many of the economic theories are based on perfect competition in the market and offer some predictions in explaining the causes and consequences of the activities in the economy. According to Modigliani and Miller (1958), real investment decisions and financing decisions of firms are unrelated to each other under perfect competition market conditions. Capital structure decisions can influence investment decisions of firms in inefficient markets. The reason for this effect is that the cost of external financing in inefficient markets is higher than the cost of internal funding sources. Under inefficient markets, according to the financial hierarchy theory, it is less costly to obtain financing from internal funding sources relative from external sources of finance. Factors such as the firm's level of competition and the structure of the market can affect investment decisions. Fazzari et al. (1988) examined the relationship between firms' investment decisions and cash flows. In firms with high financial constraints, the difference between internal financing and external financing costs is greater. The sensitivity of the investment to cash flow is higher in these companies. Firms with financial constraints have higher external financing costs. Kaplan and Zingales (1997) emphasized that there is no uniform relationship between firms' investment decisions and financial constraints.

Aghion et al. (2005) revealed that competition at the industry level can affect the investment decisions of firms. Schmidt (1997) pointed out that managers' behavior may be influenced by different levels of competition. It is stated that effectiveness in management may increase initially with the introduction of new competitors to the market, but if competition increases further, the managerial effort will no longer be beneficial. In case of intense competition in the industry, managers who want to reach better performance levels and continue the activities of the company need to work more. Otherwise, they may face financial distress and bankruptcy process. This process leads to an increase in the level of activity in the market, as the managers in a market with a high level of competition must work more effectively to cope with the competition. Leibenstein (1973) explained that the decrease in the motivation of the owners of the production factors could affect production and cause a decrease in the production amount. Considering the contracts between people and economic resources, the structure of the contracts made with managers can affect production efficiency.

Jensen and Meckling (1976) highlighted the problems that may occur between the represented and the representative and explained the agency costs. These approaches, which also form the basis of the agency theory, are based on the presence of asymmetric information in the market in the study by Hart (1983) and are explained within the framework of asymmetric information costs. Asymmetric information costs in a market can affect the performance and decisions of the manager. Zaludin et al. (2021) found that managerial overconfidence has a positive effect on internal financing and investment decisions. Hala et al. (2020) found that investment decisions effect by financial decision-making perspective and emotional factors. Studies find that competition negatively affects firm performance (Becerra & Markarian, 2013).

On the other hand, studies suggesting that the relationship is not linear are found in the literature (Aghion et al., 2001). Wang et al. (2014) found that firms with high free cash flows achieved a better performance level if they worked under intense competition. Companies operating in a highly competitive environment have increased their product and service quality and increased performance (Chong & Rundus, 2004). Aguilar and Cai (2010) examined the investments of private companies operating in the renewable energy industry in America. They found that among the renewable energy investments, solar and wind energy investments ranked highest, and grass and wood-based technologies ranked lowest. This ranking reflects the investments made worldwide. Dögl et al. (2012) investigated the competitive advantage of German renewable energy companies operating in India and China. It was determined that German renewable energy companies have a competitive advantage in the fields of solar, wind, and biomass energy.

Kaloud (2017) analyzed the factors affecting investments in energy transmission lines with the GMM estimation method, using data from European Union countries. He stated that in case of an increase in cash flows, energy transmission lines also increase. Also, as the fixed asset ratio and the inflation rate increase, the investments decrease. Thu and Khuong (2018) investigated the factors that affect the level of cash holding in energy companies in Vietnam. They found that cash holding decreased as leverage, return on assets, and operating cash flows increased. Phan and Nguyen (2020) analyzed the factors affecting corporate investment decisions in firms using data from the Vietnam stock market. They found that cash flow and sales growth have a positive impact on investment decisions.

Zhang et al. (2016) stated that the investments made in China are more than those made in the USA and the European Union. As a result of the GMM estimates, the leverage has a negative effect on the investments of the firm. They found that there is over-investment in the renewable energy industry in China. Chang et al. (2019) made GMM estimates using data from companies in the renewable energy industry in China. They stated that financial constraints and credit policy affect fixed assets and R&D investments. The fixed asset investments in the renewable energy industry increase depending on bank credit, liquid assets, the rate of return on investment, and investment opportunities. However, as the dependency on long-term debt ratio and bank credits increases, fixed asset investments in the industry are negatively affected. Angelopoulos et al. (2017) stated that the investment and financing costs of projects in the renewable energy industry are high. Using data from small and medium-sized businesses in Vietnam, Xuan (2020) demonstrated that the factors affecting investment capital size include business lines and geographic areas.

3. Data and Methodology

The analyses were carried out for 2000–2015 using a large data set of developed and developing countries. The countries involved in the study are the United States of America, United Kingdom, France, Germany, Italy, Japan, Canada, Turkey, India, Brazil, Russia, Indonesia, China, Australia, Hong Kong, New Zealand, Singapore, Malaysia, Thailand, Taiwan, South Korea, South Africa, Netherland, and Austria. Data on companies were obtained from Woldscope Database via Datastream. Industry Classification Benchmark codes (ICB Codes) are considered in the classification of the energy industry. Energy companies listed on the stock exchange are included in the analysis (ICB codes: 0533–0587).

3.1. Research Model and Definitions of Variables

The research questions of the study are gathered under two topics. The first is to determine how firm-specific factors affect investment decisions. Firm-specific factors are considered as firm size, cash holding, retained earnings, strong risk, efficiency, cash flow margin, leverage, and changes in sales. The second question of the research is to determine the effect of competition in the industry on firm investments. For this purpose, it was investigated whether there is a relationship between industrial competition and investment rate, and the structure of the relationship was examined. The Gross Domestic Product (GDP) variable was used to include the developments in the operating economy in the model. The research model is presented below:

$$\begin{aligned} \text{Investment}_{it} = {} & \alpha_0 + \beta_1 \text{Investment}_{it-1} + \beta_2 \text{Competition}_{it} + \\ & \beta_3 \text{Size}_{it} + \beta_4 \text{Cash Holding}_{it} + \beta_5 \text{Retanied} \\ & \text{Earnings}_{it} + \beta_6 \text{Risk}_{it} + \beta_7 \text{Efficiency}_{it} + \\ & \beta_8 \text{Cash Flow Margin}_{it} + \beta_9 \text{Leverage}_{it} + \\ & \beta_{10} \text{Sales Growth}_{it} + \beta_{11} \text{GDP}_{it} + \varepsilon_{it}, \end{aligned} \tag{1}$$

In the equation, i indicates the firms (i = 1, ..., N) and t indicates the analysis period (t = 1, ..., T). The investment rate, which is a dependent variable in the research model, is calculated using the firm's capital expenditures, depreciation, and net fixed assets. Accordingly, the investment rate is obtained by dividing the net investments of the firm in the current period by the net fixed assets value of the previous year (Aivazian et al., 2005; Lang et al., 1996). The industrial competition variable is calculated through the Lerner Index. The Lerner index shows the market power of the firm. The firm's market power arises relative to the market power of other firms in that industry. The firm's level of competition is expressed as the "1-Lerner Index". It is understood that the less the market power of a firm in an industry, the higher the level of competition in that industry. High competition can force firms to show higher performance and prepare an environment for them to develop better investment and financing policies against strong competitors. To calculate the degree of competition at the firm level, it is necessary to know the Lerner index value at the firm level. The company's Lerner index is obtained by subtracting the financial cost from the operating income divided by net sales. While calculating the Lerner index, the method in Aghion et al. (2005) was used.

Size is calculated as the natural logarithm of the firm's market capitalization value. Market capitalization (U.S. $) represents the total market value of the company. Market capitalization is calculated based on year-end price, and the number of shares outstanding converted to U.S. dollars using the year-end exchange rate. Since large-scale companies have high credibility, they can obtain more funds from the capital markets more easily compared to small-scale companies. Chang et al. (2019) found that there is a positive relationship between size and the investment rate. In this study, the direction and structure of the relationship between firm size and investment rate are examined. A nonlinear relationship is expected between this variable. The cash holding ratio is calculated as the ratio of cash and equivalents in total current assets. Financial hierarchy theory states that firms with high cash flow generation capacity can accumulate more cash (Opler et al., 1999).

There are studies in the literature showing that as firms' cash holding level increases, their investment rate decreases (Thu & Khuong, 2018). The ratio of retained earnings is calculated as the ratio of retained earnings to equity. If some or all of the profit obtained by the firm is not distributed and remains in the company, retained earnings occur and can be used for auto-financing. Retained earnings can be used for financing the company's existing activities as well as for new investments. Risk is calculated through the standard deviation of stock returns. The increase in firm risk is not desirable and causes investors to have negative expectations about the firm's future. The increase in the possibility of financial distress is a risk factor in terms of the sustainability of the company's activities. There is expected to be a negative relationship between risk and investments.

The efficiency ratio is calculated as the ratio of net sales to total assets. It shows whether the assets of the firm as a whole are used effectively. The high ratio indicates that high sales income can be achieved with current assets. The ratio is also an indicator of the performance of the company manager. The cash flow margin has been calculated as funds from operation to net sales. The high capacity of the firm to generate cash flow with its activities indicates that a significant amount of income is obtained from the activity. It shows that the firm has carried out productive activities. A negative ratio indicates that the company loses cash even while generating sales revenue. In this case, there will be a need to borrow money to finance existing activities. Leverage is calculated as a ratio of total debt to total assets. If the ratio is too high, there is a high probability of financial distress. Sales growth is calculated through the annual growth of net sales. If the company's sales revenues are very variable, it may be risky in terms of regular income. The economic development in the country is important for companies to implement their investment decisions. The growth of the GDP variable is calculated as the annual growth in the value of Real Gross Domestic Products. The calculation methods and Datastream codes of variables are presented in Table 1.

3.2. Analysis Method

The data set consists of variables that vary based on economic relations. The data of the companies have a panel data structure. In panel data, problems such as the short analysis period or the small number of units included in the sample cause some problems in the analysis process (Gujarati, 2004). The analysis method in the study was determined based on the factors affecting the investment decision. Companies' investment decisions are affected by other managerial and financial decisions taken in the company. In addition, the firm's policies on investment can also affect other financial decisions. The endogeneity problem is emphasized in studies dealing with investment in the literature (Cambini & Rondi, 2010; Cullmann & Nieswand, 2016). Considering that the investment variable may cause an endogeneity problem, the GMM estimation method, which allows this problem to be dealt with, was used in the analysis. If the Least Squares estimation method is applied, biased and inconsistent findings can be obtained (Baltagi, 2013: 155). The application of dynamic panel data estimation methods is recommended to overcome the

Table 1: Calculation Methods of Variables

Variables	Datastream Codes	Calculation Methods
Investment	(WC04601-WC01148)/ $WC02501_{t-1}$	(Capital Expenditure-Depreciation)/Lagged Net Fixed Assets
Competition	-	1-Lerner Index
Size	Ln(WC07210)	Ln(Market Capitalization US$)
Cash Holding	WC08111	Cash and Short Term Investments/Total Current Assets
Retained Earnings	WC08911	Retained Earnings/Equity
Risk	-	Standard Deviation of Stock Returns
Efficiency	WC01001/WC02999	Net Sales/Total Assets
Cash Flow Mar.	WC08311	Funds from Operation/Net Sales
Leverage	WC03255/WC02999	Total Debt/Total Assets
Sales growth	WC08631	1 Year Annual Growth in Net Sales
GDP	-	Growth Rate of Real GDP

endogeneity problem (Windmeijer, 2005). Considering that the rate of the investment may have indirect relationships with firm-specific factors, it is likely that the variables are correlated with the error term. In this case, the validity and reliability of the findings obtained are not reliable. Dynamic estimation methods are used to eliminate this problem. The dynamic estimation method applied to panel data is presented below;

$$y_{it} = \gamma \,.\, y_{i,t-1} + x'_{it} \,.\, \beta + \alpha_i + \varepsilon_{it} \quad (2)$$

In the equation, $y_{i,t-1}$ is a lagged value of the dependent variable. γ represents the coefficient for the lagged value of the dependent variable. i represents each firm in the data set and t represents the relevant year. The x'_{it} in the model is the independent variable vector of 1 * K dimension. β denotes the matrix of coefficients. $u_{it} = \alpha_i + \varepsilon_{it}$, u_{it} is compatible with the one-way error component model. The model can be estimated with the Generalized Moments Method (Verbeek, 2004). The ability of companies to have an optimal investment rate can also be determined by this method. Two methods stand out in the prediction of models that may include dynamic relationships. The first of the generalized moments estimation methods is known as Difference GMM (Difference GMM). The method was introduced in Arellano and Bond (1991) and the lagged values of the variable are taken into account in the analysis. The difference GMM method is a method that can be applied when the analysis period is short and the number of units in the panel data is large. This method cannot provide reliable estimates if the autoregressive parameters are high. Arellano and Bover (1995) / Blundell and Bond (1998) developed the System GMM estimator. In unbalanced panel data, the Difference GMM method causes data loss. In the system GMM method, data loss occurs at the lowest level. In this study, regression estimates were applied using the System GMM method developed by Arellano and Bover (1995) and Blundell and Bond (1998). System-GMM method provides effective results in autocorrelation and heteroscedasticity problems (Roodman, 2009; Mileva, 2007). When this method is applied, estimates resistant to heteroscedasticity and autocorrelation can be obtained (Tatoğlu, 2013: 92–103). The system-GMM method is especially preferred because it causes less data loss compared to the Difference-GMM method. (Arellano & Bover, 1995; Blundel & Bond, 1998).

Whether the findings obtained as a result of GMM estimates are valid and reliable results should be investigated. It should also be tested whether the instrument variables used are valid or not. At this stage, Hansen Test statistics were used. Also, there should be no second-order autocorrelation between the error terms of the first difference equation. For this purpose, AR(1) and AR(2) autocorrelation tests were used. The multicollinearity problem between variables was determined with the Variance Inflation Factor (V.I.F). In the determination of the heteroskedasticity problem, Breush-Pagan Test was used. As a result of the test, robust predictions were applied in the analysis.

4. Results

4.1. Descriptive Statistics

In the first stage, descriptive statistics were calculated, and the general characteristics of the energy industry were revealed. The correlation relations between variables were analyzed. In the second stage, the system GMM regression estimates were obtained, and the factors affecting investment decisions in energy companies were analyzed. Descriptive statistics are presented in Table 2.

Table 2: Descriptive Statistics

	Observations	Mean	Median	Minimum	Maximum	Std. Dev.
Investment	10244	0.341	0.085	–2.830	30.372	1.506
Competition	10244	0.989	1	0.184	1	0.048
Size	9737	12.234	12.208	2.079	20.412	2.733
Cash Holding	10144	0.398	0.336	0	1	0.301
Retained Earnings	10244	–0.483	0.147	–59.558	54.590	5.871
Risk	9599	0.210	0.138	0	42.870	0.891
Efficiency	10244	0.641	0.391	0.0002	5.008	0.730
Cash Flow Margin	10244	–1.189	0.121	–82.069	0.948	6.249
Leverage	10244	0.233	0.182	0	2.818	0.276
Sales growth	10244	0.491	0.136	–0.997	21.384	1.727
GDP	9534	0.083	0.069	–16	0.825	0.421

In Table 2, the median investment rate in energy companies is around 0.08. The average level of competition in the energy industry is 0.98. This value indicates that there is intense competition in the industry. The firm size is between 2.08 and 20.41. It is understood that the scale of the firm in the industry varies. The median cash holding ratio of firms is 0.34, and the retained earnings ratio in the industry is 0.15. The standard deviation of the undistributed profits ratio is calculated to be quite high. The median value of firm risk was set at around 0.14. The efficiency level of companies in the energy industry was determined as 0.39. The ratio of cash flows from operations to sales is 0.12. The leverage level of the firms was determined as 0.18. The median annual growth level in sales is around 0.13. The GDP growth rate is on average around 0.08. Descriptive statistics regarding subgroups of the energy industry are included in Table 3.

In Table 3, the median values of the exploration and production sub-sector have been examined, and it has been determined that the investment rate and cash holdings level are at the highest level compared to other sub-sectors. In the integrated oil and gas sector, firm size, efficiency, and retained earnings are relatively higher than in other sectors. The competition level is generally high and similar between sectors. The pipeline sub-sector has been determined as the sector with the highest cash flow margin and leverage levels. The growth rate of sales in the renewable energy and equipment sector is higher than in others. The sector with the highest company risk has been determined as the alternative fuels sector. Pearson correlation coefficients are included in Table 4.

In Table 4, there is a statistically positive correlation between investment rate and competition variables in the energy industry. A negative correlation was obtained between the variables retained earnings, efficiency, cash flow margin, leverage, and the investment rate. On the other hand, a positive correlation was found between cash holdings, risk, sales growth variables, and investment rate.

4.2. System GMM Regression Results

Regression analysis is reported in three stages. First, the changes in the investment rate are analyzed. In the second stage, industrial competition and size factors are focused on. It has been investigated whether the effects of industrial competition and size variables y rate are linear. Finally, the interaction effect of industrial competition and firm size on the investment rate is analyzed. The results are given in Table 5.

In Table 5, the Wald Chi^2 test statistic shows that the relevant models are statistically significant. Evidence that there was no first-order autocorrelation problem in all of

Table 3: Descriptive Statistics of Energy Sub-Sectors

	Oil and Gas Producers				Oil Equipment, Services and Distribution				Alternative Energy			
	Exploration and Production		Integrated Oil and Gas		Oil Equipment and Services		Pipelines		Renewable Energy Equipment		Alternative Fuels	
	Mean	**Medan**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Investment	0.427	0.104	0.108	0.070	0.157	0.071	0.194	0.074	0.489	0.085	0.293	–0.001
Competition	0.990	1	0.989	0.999	0.988	1	0.980	0.999	0.986	0.999	0.989	0.999
Size	11.633	11.491	16.024	16.289	12.794	12.961	13.833	14.049	11.999	12.001	10.751	10.838
Cash Hold.	0.473	0.465	0.236	0.204	0.270	0.218	0.340	0.299	0.378	0.342	0.443	0.409
Retain. Earn.	–0.872	–0.058	0.497	0.655	0.146	0.372	0.308	0.088	–0.704	0.093	–0.252	–0.235
Risk	0.219	0.152	0.102	0.078	0.189	0.119	0.125	0.078	0.233	0.161	0.374	0.183
Efficiency	0.487	0.252	1.260	1.026	0.779	0.693	0.566	0.446	0.754	0.607	0.761	0.489
Cash Fl. Mr.	–1.851	0.165	0.093	0.115	–0.037	0.146	0.186	0.178	–0.998	0.046	–2.014	–0.087
Leverage	0.215	0.148	0.208	0.178	0.233	0.205	0.404	0.434	0.263	0.226	0.314	0.190
Sales growth	0.568	0.131	0.226	0.129	0.286	0.136	0.313	0.121	0.638	0.190	0.736	0.139
GDP	0.081	0.071	0.106	0.0925	0.0887	0.067	0.099	0.072	0.065	0.064	0.074	0.058
Observations	5562		645		2261		301		1036		439	

Notes: ICB Industry Codes: Oil and Gas Producers (0530), Exploration and Production (0533), Integrated Oil and Gas (0537). Oil Equipment, Services, and Distribution (0570), Oil Equipment and Services (0573), Pipelines (0577). Alternative Energy (0580), Renewable Energy Equipment (0583), Alternative Fuels (0587).

Table 4: Pearson Correlation Coefficients

	Invest.	Compet.	Size	Cash Holding	Ret. Earn.	Risk	Efficiency	Cash Flow Mar.	Leverage	Sales Growth
Competition	0.020**	1								
	(0.042)									
Size	–0.038***	0.039***	1							
	(0.000)	(0.000)								
Cash Holding	0.100***	0.019*	–0.263***	1						
	(0.000)	(0.061)	(0.000)							
Retained Earn.	–0.018*	–0.013	0.156***	–0.098***	1					
	(0.063)	(0.187)	(0.000)	(0.000)						
Risk	0.063***	–0.003	–0.108***	0.032***	–0.009					
	(0.000)	(0.760)	(0.000)	(0.002)	(0.367)					
Efficiency	–0.079***	–0.046***	0.178***	–0.364***	0.099***	–0.030***	1			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)				
Cash Flow Mar.	–0.102***	–0.020**	0.229***	–0.250***	0.097***	–0.038***	0.171***	1		
	(0.000)	(0.044)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
Leverage	–0.044***	0.003	–0.008	–0.192***	0.211***	0.041***	0.029***	0.040***	1	
	(0.000)	(0.745)	(0.420)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)		
Sales Growth	0.154***	–0.012	–0.066***	0.073***	–0.005	0.032***	–0.068***	0.007	–0.043***	1
	(0.000)	(0.228)	(0.000)	(0.000)	(0.645)	(0.002)	(0.000)	(0.493)	(0.000)	
GDP	0.015	0.005	0.019*	0.011	–0.003	–0.002	–0.021**	–0.009	–0.020**	0.017
	(0.141)	(0.655)	(0.066)	(0.290)	(0.769)	(0.852)	(0.040)	(0.366)	(0.048)	(0.108)

Note: *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

the created models was obtained as a result of the Arellano / Bond AR (1) test statistics. Evidence that the instrument variables are used adequately is seen in the Hansen Test statistics results. Accordingly, it is seen that the investment rate does not have a statistically significant relationship with the previous period investment rate. There is a negative relationship between industrial competition and investment rate. The finding can be interpreted as if the competition in the energy industry increases, the investment rate of firms decreases. As the firm increases in size, the investment rate of the firm increases. This finding was obtained in accordance with the study conducted by Chang et al. (2019) in the literature. Large-scale companies have a higher capacity to access funding sources relative to small-scale companies. These companies have the opportunity to invest more. It has been determined that there is a negative relationship between the increase in cash holding levels of firms in the energy industry and their investment rate. On the other hand, it has been determined that the increase in the ratio of undistributed profits in firms leads to an increase in the investment rate. If the risk level of the company and the variability in sales revenues increase, the investment rate of companies in the energy industry decreases. There is no relationship between the effect of leverage and efficiency factors on the investment rate. A positive relationship has been found between growth in GDP, which is the macroeconomic factor, and the rate of investment. It is seen that the growth in the economy of operation positively affects firm investments.

It has been investigated whether the effect of industrial competition and firm size variables on the investment rate is linear. The findings are presented in Table 6.

In Table 6, the squared term of industrial competition and squared term of size are added to the research model. First, it is seen that as industrial competition increases, the rate of investment decreases. However, when the squared term of industrial competition is included in the model, a positive relationship is obtained between this variable and the investment rate. Accordingly, if the competition in the industry is very high, the investment rate of companies in the energy industry also increases. The finding indicates that there is a nonlinear relationship between industrial competition and investment rate in the energy industry.

Table 5: System GMM Estimates of Factors Affecting Investment Rate

	INV	INV	INV	INV	INV	INV	INV	INV
Investment$_{(t-1)}$	0.001	0.001	0.000	–0.000	–0.000	0.001	0.002	–0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Competition	–4.674***	–5.925***	–4.702***	–4.527**			–0.146	
	(1.427)	(2.042)	(1.270)	(1.812)			(0.494)	
Size	0.445***	0.492***	0.414***	0.440***	0.068	0.111***		
	(0.119)	(0.143)	(0.092)	(0.134)	(0.045)	(0.017)		
Cash Holding	–1.549			–1.582**	0.137		1.271	
	(1.454)			(0.680)	(1.476)		(1.104)	
Retained Earn.	–0.016	–0.070	–0.013	0.030*	0.017	–0.023	–0.040	0.001
	(0.060)	(0.061)	(0.053)	(0.017)	(0.057)	(0.044)	(0.067)	(0.041)
Risk	0.129	0.595	–0.185	–0.206	–2.957**	–0.511	0.506	0.153
	(0.828)	(1.362)	(0.654)	(1.020)	(1.446)	(0.643)	(0.549)	(0.608)
Efficiency	0.136	0.108					–0.149	–0.243
	(0.134)	(0.067)					(0.196)	(0.225)
Cash Flow Mar.	–0.038	–0.043	–0.029	–0.007	–0.017	–0.061	–0.060	–0.014
	(0.038)	(0.035)	(0.029)	(0.024)	(0.040)	(0.044)	(0.046)	(0.013)
Leverage	0.153	0.082	0.038	0.083	–0.066		0.122	
	(0.275)	(0.160)	(0.124)	(0.148)	(0.156)		(0.288)	
Sales growth	–0.369***	–0.367***	–0.369***	–0.370***	–0.369***	–0.369***	–0.364***	–0.367***
	(0.002)	(0.003)	(0.003)	(0.005)	(0.004)	(0.003)	(0.002)	(0.005)
GDP	–0.020	–0.047	–0.034	0.006	0.023	–0.166	0.043*	0.160**
	(0.037)	(0.036)	(0.030)	(0.060)	(0.105)	(0.138)	(0.023)	(0.063)
Num. of Obs.	8317	8401	8440	8356	8400	8401	8370	8416
Wald Chi^2 Test	54081.95	36156.81	74334.66	8807.14	19594.04	184710.07	59635.69	17841.40
P Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(1)	–1.953	–2.126	–1.987	–2.023	–2.024	–1.914	–1.944	–1.996
P Value	0.051	0.033	0.047	0.043	0.043	0.056	0.052	0.046
AR(2)	–0.931	–0.950	–0.910	–0.854	–0.878	–0.980	–0.987	–0.872
P Value	0.352	0.342	0.363	0.393	0.380	0.327	0.324	0.383
Hansen J Statistics	25.857	20.525	18.760	41.522	30.549	33.994	21.895	28.547
P Value	0.633	0.766	0.715	0.320	0.134	0.166	0.527	0.196

Notes: Standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. INV stands for the abbreviation for the investment ratio.

Table 6: The Nonlinear Effects of Industrial Competition and Firm Size on the Investment Rate

	INV	INV	INV	INV	INV	INV	INV	INV
$Investment_{(t-1)}$	0.001	0.001	0.001	0.001	–0.000	–0.000	–0.000	–0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Competition	–8.877***	–10.000***	–8.768***	–13.027***	–13.763***	–11.291***	–11.571***	–11.994***
	(3.171)	(3.379)	(2.831)	(2.838)	(3.127)	(2.509)	(1.942)	(2.046)
Competition_Sq	4.785*	5.238**	4.361*	8.129***				
	(2.446)	(2.653)	(2.369)	(2.310)				
Size	0.395***	0.450***	0.416***	0.429***	2.132***	1.710***	1.747***	1.795***
	(0.099)	(0.098)	(0.079)	(0.064)	(0.451)	(0.365)	(0.316)	(0.323)
Size_Sq					–0.077***	–0.060***	–0.061***	–0.063***
					(0.017)	(0.014)	(0.013)	(0.013)
Cash Holding	–1.132	–1.176	–0.940		–0.212			0.441
	(1.469)	(1.293)	(1.266)		(0.876)			(0.785)
Retained Earn.	0.014	0.032	0.021	–0.036	–0.068	–0.068	–0.091	–0.072
	(0.047)	(0.078)	(0.079)	(0.051)	(0.058)	(0.057)	(0.057)	(0.054)
Risk	–0.046	0.550			0.074	–0.014		
	(0.822)	(0.627)			(1.093)	(0.960)		
Efficiency	0.106	–0.052	0.053	0.046	0.114	0.029	0.032	
	(0.119)	(0.193)	(0.127)	(0.082)	(0.184)	(0.127)	(0.127)	
Cash Flow Mar.	–0.038	–0.054	–0.055	–0.057	–0.041	–0.065*	–0.063	–0.059
	(0.039)	(0.048)	(0.056)	(0.043)	(0.034)	(0.039)	(0.043)	(0.041)
Leverage	0.087				0.313			
	(0.198)				(0.513)			
Sales growth	–0.370***	–0.368***	–0.369***	–0.367***	–0.369***	–0.368***	–0.367***	–0.366***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)
GDP	–0.021	–0.021	–0.016	–0.047	0.030	0.002	–0.007	0.007
	(0.035)	(0.036)	(0.032)	(0.031)	(0.033)	(0.028)	(0.029)	(0.030)
Num. of Obs.	8317	8355	8480	8564	8317	8439	8564	8532
Wald Chi^2 Test	33638.05	21103.20	57209.46	67931.04	30214.24	23756.15	15557.84	38244.44
P Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(1)	–1.966	–1.965	–1.928	–1.921	–2.106	–2.049	–2.129	–2.084
P Value	0.049	0.049	0.054	0.055	0.035	0.040	0.033	0.037
AR(2)	–0.927	–0.948	–0.959	–0.977	–0.941	–0.995	–0.996	–0.990
P Value	0.354	0.343	0.338	0.328	0.347	0.320	0.319	0.322
Hansen J Statistics	29.851	28.049	26.558	17.313	29.340	22.440	19.074	24.015
P Value	0.421	0.356	0.275	0.633	0.602	0.664	0.697	0.403

Notes: Standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. INV stands for the abbreviation for the investment ratio.

Table 7: The Interaction Effects of Industrial Competition and Firm Size on the Investment Rate

	INV	INV	INV	INV	INV	INV
$Investment_{(t-1)}$	0.000	0.000	0.000	–0.001	–0.000	–0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Investment_{(t-2)}$	0.000	0.000	0.000			
	(0.000)	(0.000)	(0.000)			
Competition	–4.109**	–3.785*	–3.460**	–3.662*	–5.455***	–5.320***
	(1.831)	(2.187)	(1.582)	(1.910)	(1.499)	(1.323)
Size	1.075***	1.026***	0.864***	0.978**	1.134***	1.109***
	(0.341)	(0.336)	(0.267)	(0.411)	(0.394)	(0.339)
Competition * Size	–0.678**	–0.665*	–0.506*	–0.623*	–0.645*	–0.624**
	(0.340)	(0.370)	(0.269)	(0.368)	(0.364)	(0.317)
Cash Holding	–1.742**	–1.665*	–1.882	–1.394*	–1.805*	–1.913*
	(0.873)	(0.880)	(1.235)	(0.810)	(1.005)	(1.049)
Retained Earn.	–0.003	–0.001	0.019	0.030***	0.019	0.010
	(0.016)	(0.019)	(0.014)	(0.012)	(0.018)	(0.017)
Risk	0.279	0.103	0.089	–0.566		
	(0.830)	(0.901)	(0.803)	(1.060)		
Efficiency	–0.227		–0.103			–0.082
	(0.478)		(0.470)			(0.092)
Cash Flow Mar.	–0.014	–0.014	–0.011	–0.006	–0.014	–0.015
	(0.021)	(0.023)	(0.013)	(0.020)	(0.027)	(0.025)
Leverage	0.374	0.331		0.066	0.103	0.086
	(0.242)	(0.261)		(0.139)	(0.155)	(0.135)
Sales growth	–0.368***	–0.369***	–0.370***	–0.370***	–0.369***	–0.370***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
GDP	–0.019	–0.010	–0.011	0.048	0.087	0.081
	(0.078)	(0.083)	(0.102)	(0.078)	(0.103)	(0.083)
Num. of Obs.	7665	7703	7699	8356	8486	8440
Wald Chi^2 Test	49242.80	40813.62	29095.34	12264.06	11426.70	12667.02
P Value	0.000	0.000	0.000	0.000	0.000	0.000
AR(1)	–1.898*	–1.897*	–1.906*	–2.021**	–1.984**	–1.971**
P Value	0.058	0.058	0.057	0.043	0.047	0.049
AR(2)	–0.969	–0.968	–0.965	–0.853	–0.875	–0.880
P Value	0.333	0.333	0.335	0.393	0.382	0.379
Hansen J Statistics	46.445	44.773	44.068	46.313	40.389	50.811
P Value	0.495	0.397	0.426	0.299	0.365	0.165

Notes: Standard errors in parentheses. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. INV stands for the abbreviation for the investment ratio.

Schmidt (1997) points out that executive behavior can be affected by different levels of competition. Management efficiency may increase initially with the entry of new competitors into the market, but the managerial effort will no longer benefit at high levels of competition. In case of intense industrial competition, managers must work harder to cope with competitors and avoid financial difficulties. This leads to an increase in the level of efficiency in the market. The findings of this study show that the investment rate of firms in the energy industry is affected by very high or very low industrial competition. It has been determined that the investment rate has decreased in average competition levels.

As a result, there is a positive relationship between firm size and investment rate. When the squared term of firm size is added to the research model, a negative relationship is obtained between this variable and the investment rate. Findings show that there is a nonlinear relationship between firm size and investment rate. When the firm size in the energy industry increases, the investment rate increases. However, when the size becomes too high, the investment rate is negatively affected. It appears that there is an optimal point between the size and the investment rate. Leibenstein (1973) explained that the decrease in the motivation of the owners of the production factors can cause a decrease in production. The findings indicate that firms in the energy industry reduce their investment rate after reaching a certain level in terms of firm size.

System-GMM regression estimates were made by considering the interaction between the industrial competition and the firm size.

In Table 7, the interaction term of industrial competition and size has been added to the research model. A statistically significant negative relationship was found between the interaction term and investment rate. The finding means that the impact of industrial competition on investment varies according to the size of the firm. Accordingly, small-scale companies can invest more while industrial competition is less. Where competition is low, the rate of investment in large-scale companies is more positively affected.

5. Conclusion and Policy Implications

In this study, factors affecting investments in the energy industry are investigated on the axis of firm-specific factors and industrial competition. The changes in the investment rate have been tested using the System GMM regression method. When the sub-sectors in the energy industry are examined, it is determined that they differ in terms of financial structure. The level of competition in sub-sectors is generally high, showing similarities between sub-sectors. The investment rate is highest in the exploration and production sub-sector. The level of cash holdings in this sector is at the top level compared to other sub-sectors. In the integrated oil and gas sector, firm size, efficiency, and retained earnings values are relatively higher than in other sectors. The pipeline sub-sector is the sector with the highest cash flow margin and leverage levels. The growth in sales in the renewable energy and equipment sector is higher than in other sectors. The sector with the highest company risk has been determined as the alternative fuels sector.

The results show that the investment rate is not related to the previous period investment rate. As industrial competition increases, the rate of investment decreases. However, it is concluded that the investment rate of companies in the energy industry increases at levels where competition within the industry is high. The findings showed that there was a nonlinear relationship between industrial competition and investment rate in the energy industry. In case of intense industrial competition, managers should have higher performance. It was determined that companies in the energy industry increased their investment rate if the industrial competition is too high or too low. Firms' investment rate is adversely affected at average levels of competition.

According to the findings, there is a nonlinear relationship between firm size and investment rate. In terms of companies operating in the energy industry, as the scale of the company increases, the investment rate initially increases, but when the scale increases too much, the investment rate begins to decrease. It appears that there is an optimal point between the firm size and the investment rate. The findings indicate that firms in the energy industry reduce their investment rate after reaching a certain level in terms of market value. The increase in firm size provides an advantage up to a certain point. After this point is exceeded, the investment rate is negatively affected. The importance of operating at the optimal company scale for companies in the energy industry has emerged. It has been determined that there is a negative relationship between the interaction term and investment rate. The impact of industrial competition on investment differs according to the size of the firm. Accordingly, small-scale companies can invest more while industrial competition is less. Where competition is low, the rate of investment increases more in large-scale companies. It has been determined that the increase in the cash holding level of companies in the energy industry negatively affects the investment rate.

On the other hand, the increase in the retained earnings ratio in companies causes an increase in the investment rate. If the risk level of the company and the variability in sales revenues increase, the investment rate of companies in the energy industry decreases. The association between the investment rate and leverage and efficiency variables could not be proven to be statistically significant. It has been determined that there is a positive relationship between growth in GDP and investment rate. It is seen that the growth in the economy of operation positively affects firm investments. The efficiency of investments in an economy is a factor that will ensure economic growth. The results of the study are expected to be guiding for policymakers and implementers, parties to the firm, market funders, and investors.

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