FACTORS AFFECTING ENERGY ENTERPRISE INVESTMENT DEMAND FOR MACHINERY AND EQUIPMENT

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ABSTRACT

This study analyzes the impact of factors affecting capital investment in machinery and equipment using a Nerlove-type partial adjustment demand function. The study was conducted on data from 150 energy enterprises listed on the Vietnam Stock Exchange in the period 2019-2023. The estimated results of the model obtained the output variable with the value of the adjustment coefficient of 0.7113. This shows that the information has not been updated by enterprises in time to form their machinery and equipment investment plans, thereby affecting the demand for machinery and equipment investment. In the short term, the output factor affects the decision to invest in machinery and equipment less than in the long term. After 2.5 years, the impact of output on capital investment in machinery and equipment will be clearly seen. In addition, the revenue and number of years of operation of the enterprise positively affect capital investment in machinery and equipment. Meanwhile, the debt ratio of the previous year and the profit of the previous year have a negative impact on capital investment in machinery and equipment.

Keywords*:* Elasticity; Investment; Machinery and Equipment; Nerlove demand function

INTRODUCTION

The energy sector is one of the important and fundamental economic sectors of a country. Modern production can only develop strongly when there is an energy sector. As the driving force for economic sectors, the energy sector is considered the most important part of the production infrastructure system. The development of this sector entails a series of other sectors such as mechanical industry, construction materials industry. The energy sector also attracts electricity-intensive industries such as non-ferrous metallurgy, metal processing, food processing, chemicals, textiles.

Vietnam, with GDP growth in the past 5 years, from 2019-2023 reaching the lowest of 5.05%, which means that Vietnam's energy demand will also increase by 8-10% per year. Every year, the energy sector contributes to the state budget, accounting for 9-11% of total budget revenue and 16.5-17% of total central budget revenue. The contribution to the state budget from crude oil alone accounts for 5 - 6% of the total state budget revenue and 7 - 9% of the total central budget revenue; the annual average contribution to national GDP is from 10 - 13%;

In Vietnam and many other countries, most of the energy sources for work are non-renewable energy sources: Petroleum; Liquid hydrocarbons; Natural gas; Coal; Nuclear energy.

These energy sources are called non-renewable because their supply is limited to the amount that we can mine or extract from the ground. Coal, natural gas and oil are formed over thousands of years from the buried remains of ancient plants and marine animals that lived millions of years ago. That is why we also call those energy sources fossil fuels.Besides that finite fossil fuel source, we have five main renewable energy sources, which are: Solar energy from the sun; Geothermal energy from the heat inside the ground; Wind energy; Biomass from plants; Hydroelectricity from flowing water.

They are called renewable energy sources because they are naturally replenished. Day after day, the sun shines, trees grow, the wind blows and rivers flow. Renewable energy has been the primary source of energy for most of human history.
In fact, the demand for investment in machinery and equipment for the renewable energy industry to serve sustainable growth in Vietnam is very large. The chart 1 below shows the role of Vietnam energy sector, their major uses, and their percentage shares of total Vietnam energy consumption in 2010-2030.

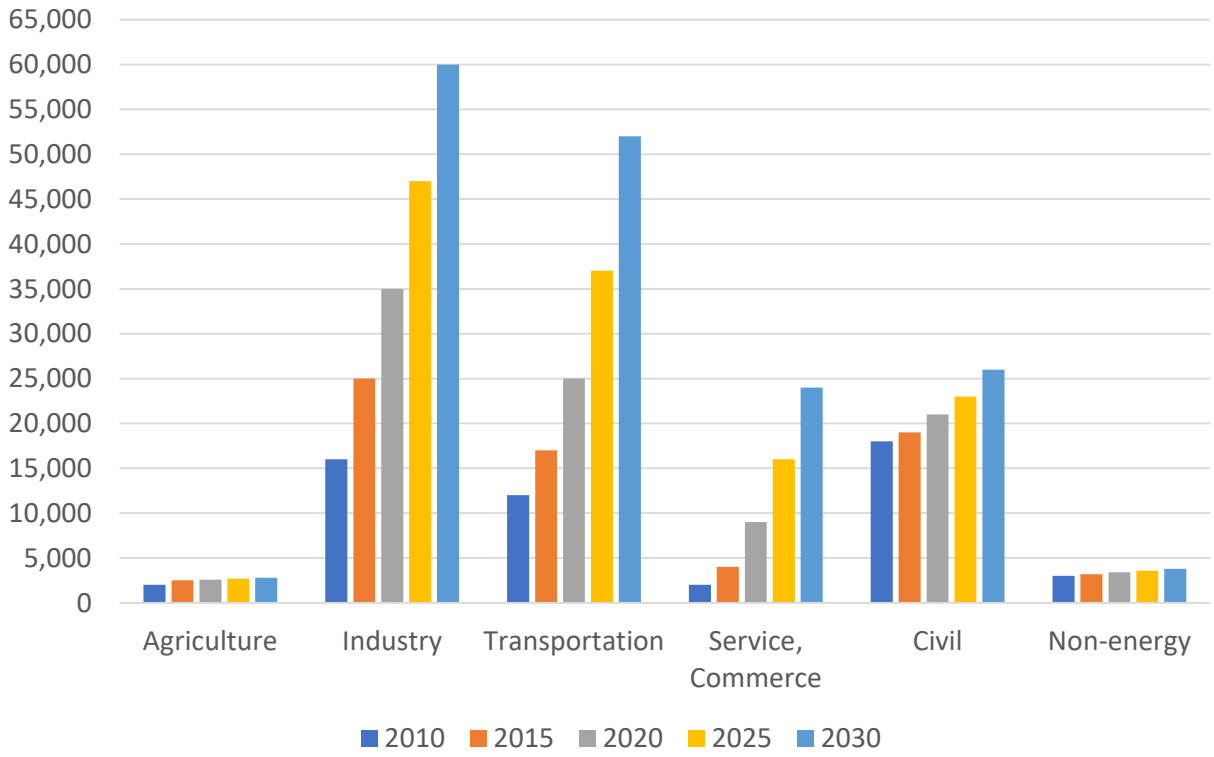

Chart 1 : Energy-using in Vietnam 2010-2030

Source: Ministry of Planning and Investment of Vietnam and United Nations Development Program.

Currently, the assessment of investment demand for machinery and equipment in energy enterprises based on output (measured by net revenue) as a basis for determining the necessary investment capital for new machinery and equipment when wanting to increase output value has almost not been studied in Vietnam.

Therefore, the main objective of this study is to analyze the current investment status and investment demand for machinery and equipment of energy enterprises listed on the Vietnamese stock exchange. Based on the research results, the authors propose solutions to improve the investment capacity of energy enterprises in machinery and equipment.

This research is structured as follows. Section 2 reviews the theoretical frameworks. Section 3 describes details of research methodology. Section 4 sets out of key results, while Section 5 shows some key conclusions and recommendations of the study.

THEORETICAL FRAMEWORKS

Investment measurement is carried out by various methods, empirically using diagnostic survey methods or econometric methods. Investment variables are measured by total investment (short-term and long-term) on the balance sheet, sometimes some studies only use investment in fixed assets or investment in research and development. The measurement of investment variables depends on the characteristics of the market and the general trend of enterprises in the countries.

On a national scale, appropriate investment policies help promote economic growth and expand the labor market. For enterprises, investment policies, if implemented effectively, help contribute to the goal of maximizing business profits. Increased business investment is accompanied by expanding production lines, replacing old machines with new ones, and applying technology (Arora et al., 2012). Investment in research and development (R&D) is also accompanied by increased productivity and business profits. Campello & Graham (2013) divided total investment into operating investment and investment in new assets. Investment in new assets is divided into expected and unexpected investment. In addition, firm-specific factors are added to the model to minimize measurement error.

Nerlove's (1968) study of the factors affecting the earnings per share of US firms from 1950 to 1964 showed that financial leverage is related to how much debt and how much equity a firm will finance its capital structure. It is the division of debt and equity in its capital structure that allows a firm to achieve efficiency through investment activities as well as save costs and resources of the firm.

According to Brigham & Ehrhardt (2009), investment has 3 forms: (i) investment in current assets (short-term investment to ensure the production and business activities of the enterprise), (ii) investment in fixed assets (long-term investment to construct and purchase machinery and equipment), and (iii) investment in financial assets (financial investment through the purchase of stocks, bonds, and capital contribution to joint ventures with other enterprises). At the same time, that study measured overinvestment based on the investment variable in the category of investment in current assets (short-term investment to ensure the production and business activities of the enterprise), or investment in fixed assets (long-term investment to construct and purchase machinery and equipment), or investment in financial assets (financial investment through the purchase of stocks, bonds, and capital contribution to joint ventures with other enterprises).

According to Nilsen et al. (2009), Increased investment means applying new technology, replacing old machines with new ones, and expanding production lines which help to improve the productivity of the enterprise.

Balestra & Nerlove (1966) consider two basic aspects of demand analysis, with applications to the demand for natural gas in residential and commercial markets. The more basic gas involves constructing a demand function for a commodity - such as natural gas - whose consumption is technologically related to the amount of household appliances. Thus in this work the authors have constructed a demand function for the commodity, which serves as a basis for detailed industry-specific studies later.

Nerlove (1955) built a model to study meat demand. Nerlove (1958) introduced the Partial Adjustment Model (PAM) estimation method to estimate the investment demand function of enterprises. Thus, to calculate the demand for investment in machinery and equipment, the author relied on the above studies of Nerlove.

Abel (2018) studied the variable revenue growth on the investment demand of enterprises. The difference between revenue in year t and year t – 1 divided by (/) revenue in year t – 1 will give us the revenue growth index (Wang et al., 2019; Putri & Rahyuda, 2020). Therefore, this hypothesis is designed as:

Hypothesis 1: Net Sales has a positive impact on demand for machinery and equipment investment

Arora and Chakraborty (2012) studied the factors affecting the investment decisions of enterprises. The results showed that investment of enterprises depends on factors such as: equity capital, profits of previous years, amount of money borrowed from banks, growth of revenue in the past, internal capacity, business environment. Larger enterprises have a slower rate of investment and expansion. Nerlove (1968) studied the impact of profit after tax on investment demand. Therefore, this research hypothesis is given as below:

Hypothesis 2: Net Income has a positive impact on demand for machinery and equipment investment

Danh (2011) used the supply response function of piecewise adjustment to study the sugarcane supply function. This is an autoregressive model and the author applied the OLS regression model to determine the influencing coefficients. The results of the study showed that price does not affect the decision to allocate sugarcane planting area in the short term, but in the long term it affects the change in sugarcane planting area. In particular, world sugar price becomes an important factor and has a great influence on the allocation of sugarcane planting area in the Mekong Delta in both the short term and the long term. In the long term, this influence is greater. The elasticity of world sugar price in the short term and the long term is 1.2 and 5.0.

The variable ROE is used as a proxy for the operating efficiency affecting the investment demand of enterprises in the studies of Chan et al. (1989); Mansoori & Muhammad (2012). So, we design the 3rd hypothesis as:

Hypothesis 3: Return on equity has a positive impact on demand for machinery and equipment investment

When observing the operating dynamics of enterprises, it is shown that enterprises are quite interested in choosing their capital structure because the capital structure will affect the level of debt that the enterprise uses, the level of tax that the enterprise must pay, and the risk that the enterprise must bear. Enterprises often consider these factors with the aim of optimizing the value of the company and minimizing the cost of capital that must be used, thereby helping the enterprise operate more effectively. This shows that the debt ratio must have a certain influence on the efficiency of the enterprise's operations, affecting the investment decision, so that enterprises pay much attention to this factor (Biddle et al., 2009).

According to Jiang & Yang (2019), the impact of debt structure on investment varies by ownership, industry, and debt restructuring method. The authors studied the factors affecting the business performance of small scale enterprises. The results showed that the factors affecting the business performance of female-owned small enterprises are different from the factors affecting the business performance of male-owned small enterprises. The age of the enterprise, the human resources of the enterprises have a positive impact on the business performance of small scale enterprises. Another factor that also affects the business performance is the ability to fully access financial resources of the enterprise. Therefore, the 4th hypothesis is given as:

Hypothesis 4: Debt ratio has a positive impact on demand for machinery and equipment investment

Danh & Lam (2013) used the partially adjusted demand model and the firm identification theory to analyze the investment demand of enterprises. The results showed that the factors: business efficiency, business growth and business size are the main factors affecting the choice of capital structure of small and medium enterprises. Due to capital constraints, most of the machinery and

equipment of small and medium enterprises are of high age. The investment demand of small and medium enterprises depends more on revenue growth than on the investment scale of previous years (Dung, 2019).

Chi & Choi (2017) examined the impact of the variable Enterprise Size based on the number of employees on the investment demand of enterprises. The study showed that there is a positive relationship between these two indicators.Therefore, this hypothesis is designed as:

Hypothesis 5: The number of employees has a positive impact on demand for machinery and equipment investment

There are a number of related studies on the content of factors affecting investment in many type of businesses found that factors affecting investment include the number of operation, type of business, total assets (Olabisi, 2014). This paper uses the lag regression model according to Marc Nerlove's approach to find out the elasticity of investment demand for machinery and equipment in the short and long run and calculate the average time leading to the lag. Therefore, this hypothesis is designed as:

Hypothesis 6: Years of operation has a positive impact on demand for machinery and equipment investment

Chart 2 : Research Model

Source: Compiled from the authors

DATA COLLECTION METHODOLOGY

Primary data: This study uses data from 150 energy enterprises listed on the Vietnam Stock Exchange. The data are audited financial statements of enterprises for the period 2019-2023 (5 years).

Secondary data: Secondary data is collected from the Vietnam Statistical Yearbook 2023, reports, and studies related to the investment situation, investment efficiency, factors affecting business investment, solutions to improve investment efficiency.

ANALYSIS METHODOLOGY

The study uses the following analytical methods:

Method of comparing data and descriptive statistics to describe and evaluate the current status of investment in machinery and equipment of enterprises, production and business efficiency, investment needs in machinery and equipment, etc. of enterprises to see the current investment status of enterprises listed on the Hanoi Stock Exchange, Hochiminh city Stock Exchange.

Analysis of financial ratios to evaluate the business performance of enterprises in the period 2019-2023. The following financial ratios are used in the study:

Return on equity (ROE) to evaluate the efficiency of using equity of enterprises.

Return on fixed assets (ROF) to evaluate the efficiency of using fixed assets of enterprises.

Marc Nerlove's Partial Adjustment Model (PAM) estimation method to estimate the investment demand function of enterprises.

Marc Nerlove's Partial Adjustment Model (PAM) estimation method is used to estimate the investment demand function of enterprises. Marc Nerlove's Partial Adjustment Model is used to estimate the impact of output on capital investment in machinery and equipment. The capital investment in production of enterprises includes capital investment in fixed assets and capital investment in current assets. The capital investment object in this study is capital investment in fixed assets, mainly capital investment in three groups of assets:

(i) Capital investment in machinery, equipment, and technology through basic construction;

(ii) Capital investment in fixed assets without basic construction; and

(iii) Cost of repairing and upgrading fixed assets.

Assume that the desired level of investment by a business in new technology and machinery (Y *) is a linear function of net revenue (X) as follows:

$$Y^* = \beta_0 + \beta_1 X_t + u_t \quad (1)$$

Since the desired level cannot be directly observed, Marc Nerlove proposed the partial adjustment hypothesis written as the following equation:

$$Y_t - Y_{t-1} = \delta(Y_t^* - Y_{t-1}) \quad (2)$$

In which:

δ: Adjustment coefficient ($0 < \delta \leq 1$)

$Y_t - Y_{t-1}$: Actual change in investment

Equation (2) shows that the actual change in the enterprise's investment capital in period t is a part δ of the desired change for that period.

If $\delta = 1$, the actual investment capital is equal to the desired investment capital, or in other words, the actual investment capital is adjusted to the desired investment capital immediately (in the same period).

If $\delta = 0$, it means that there is no change because the actual investment capital at time t is equal to the previous period.

Equation (2) can be written in another way as follows:

$$Y_t = \delta Y_t^* + (1 - \delta)Y_{t-1} \quad (3)$$

Equation (3) shows that the investment of the enterprise at time t is the average of the desired investment at that time and the investment existing in the previous period, δ and $(1-\delta)$ are the influence indexes.

Substituting (1) into (3) we get the econometric model below:

$$Y_t = \delta\beta_0 + \delta\beta_1 X_t + (1 - \delta)Y_{t-1} + \delta u_t \quad (4)$$

Equation (4) is a linear regression equation and this model is called the partial adjustment model (PAM) or the short-term demand function for investment. Where:

β_1: Elasticity of investment demand with respect to revenue

$\delta\beta_1$: Short-run elasticity of investment demand

Equation (4) can be transformed into a logarithmic linear model (the logarithm of the dependent regressor is a function of the logarithms of the independent regressors) as follows:

$$LnY_t = \alpha_0 + \alpha\, LnX_t + \beta\, LnY_{t-1} + eu_t \quad (5)$$

We will use the logarithmic linear model (5) to estimate the short-run demand function for machinery and equipment investment.

Model (1) represents the long-run or equilibrium, demand for investment so model (4) can be viewed as the short-run demand for investment because in the short run the current investment may not necessarily be equal to its value in the long run.

Once we estimate the short-run function of model (4) and obtain an estimate of the adjustment coefficient δ (from the coefficient Y), we can easily derive the long-run demand function for investment by dividing $\delta\beta_0$ and $\delta\beta_1$ by δ and ignoring the lag term Yt-1.

This study uses a multivariate regression model using the ordinary least squares (OLS) method to estimate the demand model for machinery and equipment investment with the variables taken logarithmically before processing the OLS regression. Test for autocorrelation using the BG – Breush & Godfrey test (test for serial correlation of order p, with $p \geq 1$). If LM = obs*R-Squared > α * or P-Value < α to be tested, reject the hypothesis H_0, which means the model has autocorrelation.

Multivariate regression analysis to determine factors affecting investment in machinery and equipment.

Before applying the multivariate regression model used to determine factors affecting investment in machinery and equipment, we check for multicollinearity by

(i) correlation matrix to determine the relationship between independent variables to select variables to include in the model;

(ii) variance inflation factor (VIF) to detect multicollinearity to assess the suitability of the model. Durbin-Watson test is used to detect autocorrelation.

The study uses a multivariate regression model using the ordinary least squares (OLS) method with the following equation:

$$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \epsilon_i$$

In which:

Y: Additional investment capital for machinery and equipment investment (million VND),

ϵ_i is the error.

X_1: Net Sales (million VND)

X_2: Net Income of the previous year (million VND)

X_3: Return on Equity of the previous year (million VND)

X_4: Debt ratio of the previous year (times)

X_5: Number of employees (person)

X_6: Number of years of operation (years)

RESEARCH RESULTS

The study surveyed the audited financial statements of 150 energy enterprises listed on the Vietnam Stock Exchange. Most enterprises did not change their main business lines during the period 2019-2023. Table 1 reports the list of surveyed energy enterprises that the author collected financial reportings by internet at the time of study, April 30, 2024.

Table 1: The list of surveyed enterprises

Industry group	Number of enterprises	Percentage
Oil and Gas	51	34%
Solar power	27	18%
Coal	25	17%
Recycled energy	26	17%
Activities supporting services for mining,gas…	21	14%
Total	150	100%

Source: Compiled from the authors

The average total regular employees of each enterprise in 2019 was 2,137 people (512 people), in 2020 it increased by 4.4% compared to 2019 but then tended to decrease gradually (in 2021 it decreased by 2.2% compared to 2020, in 2022 it decreased by 10.8% compared to 2021).

Asset structure and capital sources of the enterprise: The total assets of the enterprise in 2020 averaged 70,743 million VND and increased continuously over the years (average 18.7%/year). The enterprise's short-term assets accounted for a large proportion of the asset structure (48% to 63%). In 2021, there was a major shift in the enterprise's equity, the equity structure decreased from 42% (2019) to 39% (2020) and from 2021 to 2023, energy enterprises maintained an average debt financing structure of 61% and equity of 39%. The capital structure of the enterprise shows that the enterprise has taken advantage of debt financing instead of increasing equity, which will reduce the financial efficiency of the enterprise.

Business performance of enterprises in the period 2019-2023: Chart 3 shows that 2019 is the year when energy enterprises operate most effectively in the period 2019-2023, reflected in financial ratios such as return on total assets (ROA), fixed asset utilization efficiency (ROF), return on equity (ROE), all of which are higher than in other years.

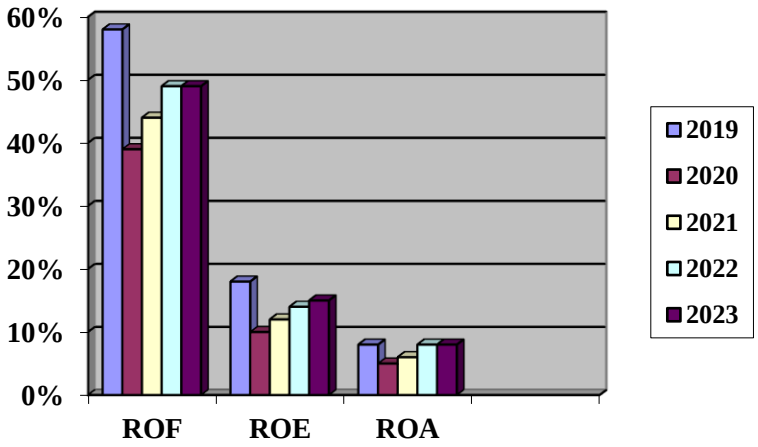

Chart 3 Business performance of energy enterprises in 2019-2023

Source: Compiled from the authors

The business performance of energy enterprises in the period 2019-2023 gradually decreased, ROE is still low (10% to 16%) and during this period, many energy enterprises suffered losses, leading to a deficit in equity. Reduced business performance is one of the factors that reduces the investment motivation of energy enterprises in the following years and therefore there is a risk of falling into a vicious cycle: reduced investment leads to low efficiency - low efficiency makes low accumulated profits, leading to reduced investment.

The survey results show that the number of energy enterprises increasing their investment capital annually in the period of 2019-2023 is still low, with the proportion of enterprises increasing their investment capital being 40%, 36%, 29%, 30%, and 20%, respectively. Most of the investment capital is allocated to supplement working capital, accounting for 63% of the total additional investment capital in 2023, accounting for 42%-43% in the years 2019-2023. The additional investment capital allocated to the purchase of fixed assets and basic construction is unstable. In the capital for basic construction, enterprises allocate a portion (31%-51%) of capital to purchase machinery and equipment. In addition, enterprises also allocate investment capital annually to repair fixed assets or other investments. Enterprises' investment capital is invested in many activities, but the annual allocation rate of investment capital for machinery and equipment is still low. Meanwhile, new investment and additional investment in machinery and equipment play an important role in increasing productivity and output, helping energy enterprises develop in breadth and depth. Therefore, enterprises need to consider balancing investment capital and the role of investment capital in machinery and equipment in contributing to changing the income of enterprises.

The short-run investment demand model is measured by the elasticity of output (measured by net revenue: X) with capital investment in machinery and equipment (Y). In the model estimation, equation (5) is adjusted by adding a time variable T to eliminate the influence of technical factors on the demand for capital investment in machinery and equipment. The short-run investment demand function according to equation (5) is estimated by OLS regression and the results are shown in Table 2: Regression results of the demand model for machinery and equipment investment of energy enterprises according to the Nerlove model

Table 2: Regression results of the model

Indicator	Symbol	Coefficient	t-value
Constant		0,904	0,882
Net revenue	X_t	0,456*	3,54
Previous Year's Investment in Machinery and Equipment	Y_{t-1}	0,289**	1,995
Prob (F-statistic) = 0,000			
F= 17,794			
R^2 = 0,554			
Durbin-Watson = 1,809			

*, ** are statistically significant at the 1% and 10% levels, respectively.
Source: Compiled from the authors

The analysis results in Table 2 show that the demand for investment in machinery and equipment of energy enterprises depends on revenue. Therefore, good revenue growth is the driving force for energy enterprises to increase investment. In addition, the investment scale of previous years also has an impact on increasing investment capital in machinery and equipment in the following year. The results of regression analysis show that the demand for investment in machinery and equipment is inelastic to revenue. The investment elasticity in the long term and short term is 0.641 and 0.456, respectively, corresponding to the adjustment coefficient $\delta = 0.711$. Therefore, when output increases steadily in the long term, the demand for investment capital in machinery and equipment increases compared to the short term.

In the long run, capital investment in machinery and equipment will gradually be adjusted to the desired amount of capital investment in machinery and equipment. However, it is necessary to determine how long it takes for the demand for machinery and equipment investment (Y) to begin to respond to changes in the independent variables (X). The median lag is 2 (median lag = - log2/logδ) which means that 50% of the change in demand for machinery and equipment investment occurs within 2 years. The average lag (median lag = - $\delta/(1-\delta)$) is determined to be 2.5 which means that on average it takes 2.5 years for the change in investment demand to be clearly seen due to the impact of output changes.

In the short term, the output and capital investment in machinery and equipment in the previous year have a positive impact on increasing capital investment in machinery and equipment, the change in output is of a long-term nature, then the investment capital will be adjusted in the long run to be close to the desired investment capital. The time for the amount of investment to adjust to changes in average output is 2.5 years. The long-term elasticity and average lag provide information for businesses so that when businesses determine the amount of additional investment in machinery and equipment, they can also predict future output or vice versa, if businesses set a target for future output, they can estimate the necessary investment capital for machinery and equipment at the present time.

FACTORS AFFECTING INVESTMENT IN MACHINERY AND EQUIPMENT OF ENERGY ENTERPRISES

Table 3 presents the results of the analysis of factors affecting investment capital in machinery and equipment. There is indeed a linear relationship between investment capital in machinery and equipment and at least one of the factors that are independent variables included in the model, and the independent variables selected in the model have a fairly high ability to explain changes in investment capital for machinery and equipment ($R^2 = 0.667$). The model does not have autocorrelation (Durbin-Watson is 1.174) and does not have multicollinearity (VIF > 5).

Table 3: Factors affecting demand for machinery and equitpment investment of energy enterprises

Indicator	Symbol	Coefficient	t-value	VIF
Constant		-692,351	-0,314	
Net Sales	X_1	0,378*	14,678	2,651
Net income (last year)	X_2	0,264*	-4,070	1,954
ROE (last year)	X_3	-199,620	-0,068	1,405
Debt ratio (last year)	X_4	-157,253	-1,477	1,065
Number of employees	X_5	-209,82	-6,396	2,140
Number of years in operation	X_6	30258,7**	1,923	1,372
Sig.F = 0,000				
R^2 = 0,767				
Durbin-Watson = 1,174				

*, ** are statistically significant at the 1% and 10% levels, respectively.
Source: Compiled from the authors

Two factors that positively affect capital investment in machinery and equipment are net revenue and the number of years of operation of the enterprise. The level of influence of net revenue on capital investment in machinery and equipment of the enterprise is low (1% change in net revenue leads to 0.378% change in capital investment in machinery and equipment) possibly due to the time lag factor in investment and on average about 2.5 years after revenue increases, the enterprise begins to increase investment in machinery and equipment, while the additional investment in machinery and equipment at the present time when revenue increases is only a small number.

The longer the enterprise operates, the higher the need to invest in machinery and equipment to increase productivity, output, and product quality, and this is a factor that has a very positive impact on increasing capital investment in machinery and equipment of the enterprise. For each additional year of production and business, the enterprise needs to invest about 30,258 million VND more in machinery and equipment (significance level 10%).

Three factors that have an opposite effect on capital investment in machinery and equipment are the previous year's after-tax profit, the previous year's debt ratio, and the number of employees of the enterprise. The previous year's after-tax profit increases, the following year's capital investment in machinery and equipment tends to decrease (-0.264).

The higher the debt/equity ratio of the enterprise in the previous year, the more sharply the amount of capital investment in machinery and equipment of the enterprise decreases (debt/equity increases by 1%, capital investment in machinery and equipment decreases by more than 157 times). Therefore, if the enterprise has previously borrowed capital, causing the debt/equity ratio to increase, the following year the enterprise no longer needs to invest in more machinery and equipment, or the enterprise has a need but the debt ratio is already high, making it difficult to access official capital sources.

The research results show that there is a trade-off between capital and labor. If an enterprise reduces one employee in a year, the capital investment in machinery and equipment needs to increase by about 209 million VND (significance level 1%). When investing in machinery and equipment, labor costs will be reduced, but capital costs tend to increase, so businesses must evaluate to make investment decisions.

Furthermore, in the conditions of urbanization and economic restructuring, labor resources, especially manual labor and skilled labor, are increasingly scarce, so businesses can analyze economic efficiency to have the best choice for capital use to mechanize and modernize production.

CONCLUSIONS AND RECOMMENDATIONS

Quantitative research results show that in the period of 2019-2023, energy enterprises listed on the Vietnamese stock market have allocated a portion of their capital to invest in machinery and equipment, fixed assets and repair and upgrade of fixed assets, but the proportion is still low compared to the total annual investment capital.

In the long term, capital investment in machinery and equipment is more elastic than in the short term. In the long term, capital investment will gradually reach the desired investment level. With an average time of about 2.5 years, changes in output will affect the change in capital investment in machinery and equipment of energy enterprises listed on the Vietnamese stock market.
Two factors that positively affect capital investment in machinery and equipment are the number of years of operation and net revenue of energy enterprises;

Meanwhile, the debt ratio of the previous year and the profit of the previous year have an inverse effect on capital investment in machinery and equipment. At the same time, there is a trade-off between capital and labor. When a business's labor increases, capital investment in machinery and equipment decreases and vice versa.

Analyze the factors affecting investment in machinery and equipment of energy enterprises listed on the Vietnamese stock exchange to have reasonable measures in investing in machinery and equipment, specifically as follows:

Enterprises need to predict future revenue (output) (after 2.5 years or more) and from the elasticity of demand for investment in machinery and equipment (short term is 0.456; long term is 0.641) to plan the necessary investment capital in machinery and equipment to achieve the set output target. The purpose of this solution is to help enterprises have a roadmap for investing in machinery and equipment to achieve the planned output target.

Enterprises need to analyze and evaluate the benefits and trade-offs between investing in modern machinery and equipment and technology for production or using machinery and equipment and technology that require a lot of labor because reducing 1 worker, the enterprise has to spend about 209 million VND more to invest in machinery and equipment.

Enterprises that have been operating for a long time need to increase investment capital for machinery and equipment to replace old machinery and equipment, improve technology, and increase competitiveness.

The ability to access capital of energy enterprises is still limited, the accessible capital is mainly short-term capital that does not meet the needs of long-term investment. Therefore, energy enterprises need to improve their ability to access capital and take advantage of external capital to access large capital sources with medium or long-term periods such as the Government's lending system, international credit programs, investment funds, commercial banking systems, financial companies, etc. or implement joint ventures to contribute to the development of specialization, supplement each other's financial capacity to overcome obstacles due to lack of capital.

Equipment and technology of energy enterprises are mostly outdated, with high wear and tear coefficients, low productivity, poor efficiency, high product prices, low competitiveness, and enterprises have not made appropriate investments in research and development of new products. Therefore, enterprises need to implement new investment solutions, upgrade existing machinery and equipment.

In addition, the State and relevant agencies and sectors support and create favorable conditions for energy enterprises to invest in machinery, equipment, and renewable, green, and clean technologies; support and create conditions for enterprises to access capital; improve the capacity to innovate machinery, equipment, and technology by providing information; guide enterprises to build a roadmap for investment in innovation of technology, machinery, and equipment in the direction of green energy, clean production, and application of quality management systems; issue policies to support science, engineering, and technology.

Limitations and future researchs: This study was conducted with a sample of energy enterprises listed on the Vietnam Stock Exchange in the period 2019-2023. This will not be representative of all enterprises in Vietnam. Future studies can consider other

aspects of the multidimensionality of demand for machinery and equipment investment (legal, economic, environmental) and the relationship that affects demand for fixed assets investment and can expand other consequences.

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